



Investigating Liquidity Risk Management in the Namibian Banking System

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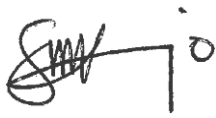
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DECLARATION

I, Albert Vetjitiraiye Kamuinho declare that this study titled, “Investigating liquidity risk management in the Namibian banking system,” is my own work carried out under the supervision of Prof. Ravinder Rena and Prof. Andrew Maredza. This thesis has not been submitted for any study or qualification in any institution of higher learning. All sources used in the study have been strictly indicated and acknowledged through references.



28 May 2021

Signed

Date

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I am greatly indebted to my wife Uaandja Kamuino, my daughters Vitjitua Zamunu and Karupingenua Kamuino, my sons Ruvao Kamuino and Mahonapara Kamuino. They were always there during difficult times towards the completion of this thesis. Secondly, my indebtedness goes to my late father Leonard Kamuino, my late grandmother Kaazapi Kandjoze and my late mother Tjimbombota Kandjoze. Finally, special thanks go to my friends for their emotional support and encouragement.

Albert Vetjitiraiye Kamuino

DEDICATION

The work is dedicated to the memory of my beloved late mother, grandmother and father:

- ❖ Albertine Tjimbombota Kandjoze (1947 – 1976)
- ❖ Theodolfine Kaazapi Katamunua (1912 -1994)
- ❖ Leonard Urihekuavi Kamuino (1937 – 2014)

ABSTRACT

Liquidity dried up in the 2007-2009 global financial crisis as banks were not able to borrow money from each other or either obtain money from the inter-market, which led to the closure and bailing out of various financial institutions. Financial regulation and liquidity risk management are critical to financial stability and to the economy as a whole. This prompted a call to revise banking regulations and risk management, which subsequently led the Basel Committee to introduce the Basel III, which encompasses liquidity measurements. The main purpose of this thesis was to analyse commercial banks' liquidity shocks in Namibia for the period 2009 to 2018 using the Structural VAR model (SVAR). The aim of the study was to be achieved by satisfying two sub-objectives, namely, conducting an audit of the liquidity data between 2009 and 2018, and exploring how banks were exposed to liquidity risk. Secondly, the study sought to determine the extent to which the Net Stable Funding Ratio (NSFR) which is part of Basel III can strengthen Uniform Financial Institution Rating system which is referred to by the acronym CAMELS indicators in identifying liquidity shocks. The sample consisted of four of the largest Namibian commercial banks representing 98% of total assets. These banks are namely Standard Bank, First National Bank, Nedbank and Bank Windhoek. The data sources were balance sheets that were derived from the Bank of Namibia. In addition, the Namibia Statistics Agency provided macroeconomic indicators. The empirical analysis covered the most recent global financial crisis (2007-2009) and the post crisis period, which was dominated by the shortage of liquidity in banks. Using SVAR, the study analysed the interactions of macroeconomic variables in identifying the structural shocks and provided some implications for policy and decision-making. In estimating the SVAR regression model, granger causality, impulse-response functions and forecast error variance decomposition were employed and evaluated. By auditing liquidity data between 2009 and 2018, empirical results showed that commercial banks liquidity risk in is caused by a combination of structural shocks. The granger causality, impulse-response functions and forecast error variance decomposition documented that credit risk (non-performing loans) and sensitivity to market risk (RSA_RSL) are key factors affecting commercial banks liquidity conditions in Namibia in the medium to long run. In addition, the empirical results showed that quality earnings (ROA) and capital adequacy (Tier 1 RWCR) have minimal impacts on liquidity conditions in

the short run. By determining the extent to which the NSFR can strengthen CAMELS indicators in identifying liquidity shocks, the findings imply that the NSFR has minimal influence in strengthening the traditional indicators based on the CAMELS approach in identifying the liquidity shocks. The findings support the financial regulations' focus on the traditional CAMELS approach in identifying the liquidity shocks. The study contributes to the empirical research by establishing the relationship between non-performing loans ratio (NPL) and two liquidity ratios, namely, Liquid assets to total assets (LA_TA) and Liquid asset to average total liabilities ratio (LA_ATL) as sources of liquidity shocks in banks. This is the first study to examine the relationship between NPL, LA_TA and LA_ATL from the present researcher's knowledge and the study helped to establish the said relationships. Additionally, this study also established a relationship between rate sensitivity to assets and liabilities (RSA_RSL) and LA_TA. Again, from the present researcher's knowledge, there is no other study that has attempted to establish the said relationships. On the other hand, the study created and used disaggregated data in the case of Net Stable Funding Ratio to demystify the relationship with other CAMELS ratios. Reforming assets quality policies, rate to sensitivity to market risk policies, earnings quality policies, capital adequacy policies, and liquidity policies such as Basel III liquidity measures can be valuable policy tools to minimise liquidity shortages and avoid insolvent banks in Namibia.

Key Words: Basel III; Liquidity Risk; CAMELS; Net Stable Funding Ratio (NSFR)

JEL Classification: G13, G32.

Table of Contents

Declaration	ii
Acknowledgements	iii
Dedication	iv
Abstract	v
List of Appendices	xii
List of Tables	xiii
List of Figures	xiv
Abbreviations	xv
CHAPTER I	1
1. Introduction	1
1.1 Background of the Study	1
1.2 Overview of banking system development in Namibia	5
1.2.1 Namibia banking system	5
1.2.2 Regulatory and Supervisory Framework	7
1.3 Statement of the Problem	8
1.4 Aim and objectives of the Thesis	9
1.5 Significance of the Study	9
1.6 Scope of the study	11
1.7 Structure of the thesis	11
1.8 Chapter Summary	12

CHAPTER II	13
2. Theoretical framework & Literature review	13
2.1 Genesis and Evolution of the Theory of Liquidity Management	13
2.3 Justification for regulation of financial institutions	18
2.3.1 To sustain system stability	20
2.3.2 To maintain safety and soundness of banks	20
2.3.3 To protect the consumer	21
2.4 CAMELS Rating System	22
2.5 Traditional CAMELS Measurement Ratios	23
2.5.1 Capital Adequacy	24
2.5.2 Asset Quality	29
2.5.3 Management Efficiency	35
2.5.4 Earning Quality	37
2.5.5 Liquidity	41
2.5.6 Sensitivity to market risk	46
2.6 Basel Accords	49
2.6.1 Basel I Accord	49
2.6.2 Basel II Accord	49
2.6.3 Basel III Accord	50
2.7 Basel III Liquidity Measurement Ratios	51
2.7.1 Liquidity Coverage Ratio	52
2.7.2 Net Stable Funding Ratio	56
2.8 A Comparison of Predicting Models	61
2.9 Theoretical Framework	62

2.10 Implication of literature to the study	64
2.11 Chapter Summary	67
CHAPTER III	68
3. Research Methodology	68
3.1 Research Philosophies	68
3.2 Research Approach	71
3.3 Research Strategies	71
3.4 Research Design	73
3.5 Population of the Study	74
3.6 Sample	75
3.7 Research Procedures	76
3.8 Data Collection Instruments	77
3.9 Methods of Data Analysis	78
3.10 Aligning the Research Objectives and Methodology	80
3.11 Model Specification	82
3.12 Estimation Technique	84
3.12.1 Granger Causality	84
3.12.2 Impulse Response Functions	85
3.12.3 Forecast Error Variance Decomposition	85
3.13 Postestimation Diagnostic	86
3.13.1 Normality Test	86
3.13.2 Autocorrelation Test	87

3.13.3 Characteristic Polynomial Test	87
3.13.4 Heteroscedasticity Test	87
3.14 Unit Root Test	88
3.15 Choice of proxy variables	89
3.16 Justification of explanatory variables	93
3.17 Ethical considerations	95
3.18 Chapter Summary	95
 CHAPTER IV	 97
4. Data Analysis	97
4.1 Descriptive Statistics	98
4.2 Unit Root Test	104
4.3 Data and estimation results	106
4.3.1 LA_ATL results	106
4.3.2 NSFR Results	110
4.3.3 LO_DEPO Results	113
4.3.4 LO_TA Results	116
4.3.5 LA_TA Results	119
4.4 Robustness Checks	122
4.5 Chapter Summary	126
 CHAPTER V	 127
5. Findings and Discussion	127

5.1 LA_ATL	128
5.2 NSFR	130
5.3 LO_DEPO	131
5.4 LO_TA	132
5.5 LA_TA	134
5.6 Chapter Summary	135
 CHAPTER VI	 137
Summary, Conclusions and Policy Recommendations	137
6.1 Answers to the research objectives	138
6.2 Policy implications	140
6.3 Areas for further research	141
References	142

List of Appendices

Appendix1: VAR Granger Causality	163
Appendix 2: Autocorrelation	166
Appendix 3: Polynomial	169
Appendix 4: Heteroskedasticity Tests	172
Appendix 5: Namibia Commercial banks, NSFR (%)	174
Appendix 6: Annual growth rate of real GDP (%)	176
Appendix 7: Unemployment total (% of total labour force)	178

List of Tables

3.1: Research Philosophies	70
3.2: List of countries where Namibian commercial banks operate	76
3.3: The Balance Sheet	77
3.4: Description of Basel III Liquidity ratios and CAMELS rating elements	90
4.1: Descriptive statistics	99
4.2 Unit root tests: LLC & IPS in levels and first differences	105
4.3: Variance Decomposition of LA_ATL	109
4.4: Variance Decomposition of NSFR	112
4.5: Variance Decomposition of LO_DEPO	115
4.6: Variance Decomposition of LO_TA	118
4.7: Variance Decomposition of LA_TA	121
4.8: LA_ATL normality test	122
4.9: NSFR normality test	123
4.10: LO_DEPO normality test	124
4.11: LO_TA normality test	125
4.12: LA_TA normality test	125

List of Figures

1.1: Liquid Assets and Liquidity Ratio & Loan-to-Deposit and Loan-to-Funding Ratio	6
2.2 Theoretical Framework for the study	63
3.1 Framework diagram	73
4.1: Response of LA_ATL to other CAMELS indicators	107
4.2: Response of NSFR to other CAMELS indicators	111
4.3: Response of LO_DEPO to other CAMELS indicators	114
4.4: Response of LO_TA to other CAMELS indicators	117
4.5: Response of LA_TA to other CAMELS indicators	120

LIST OF ABBREVIATIONS AND ACRONYMS

ALM	Asset-Liability Management
ASF	Available stable funding
AGTOTTL	Total Agricultural Loans to Total Loans
BCBS	Basel Committee on Banking Supervision
BvD	Bureau van Dijk
CAMELS	Capital adequacy, Asset quality, Management efficiency, Earnings quality Liquidity, Sensitivity to market risks
CAR	Capital adequacy ratio
NCDs	Negotiable Certificate of Deposit
CI2LN	Commercial and Industrial loans, Loans to REITs and Mortgage Bankers, Construction Loans, Commercial Real Estate Loans to Total Assets
CILNNL	Commercial and Industrial Loans to Net Loans
CILTL	Commercial and Industrial Loans to Total Loans
COSTFDC	Change in Interest and Depositors Dividends to Earning Assets
EBA	European Banking Authority
EQTA	Total Equities to Total Assets Ratio
ESTA	Earned Surplus to Total Assets
FDIC	Federal Deposit Insurance Corporation
FTC	Federal Trade Commission
GCARA	Gross Capital to Adjusted Risk Assets
GCONI	Gross Charge-offs to Net Operating Income plus Loss Provision
GDP	Gross Domestic Product
CSR	Corporate Structure Ratio
HERF	Herfindahl Index for Bank's Local Banking Market

HLBANW	Federal Home Loan Bank Advances to Net Worth
HQLA	High-Quality Liquid Assets
IFS	International Financial Statistics
IMF	International Monetary Fund
ISFTF	Interest Sensitive Funds to Total Funds
ECLLRATA	Equity Capital plus Loan Loss Revenue Allowance to Total Assets
LA	Loans to Assets
LA_ATL	Liquid Asset to Average Total Liabilities Ratio
LADEPO	Liquid Assets to Total Customer Deposits Ratio
LADPSTMD	Liquid Assets to Total Customer Deposits and Short-Term Market Funding Ratio
LA_TA	Liquid Assets to Total Assets
LCR	Liquidity Coverage Ratio
LCR	Loan to Capital Ratio
LLPII	Loan Loss Provisions to Net Interest Income
LLPTL	Total Provisions for Loan Losses to Total Loans
LMI	Liquidity Mismatch Index
LNTA	Natural Logarithm of Total Bank Assets Less Loan Loss Reserves to Total Assets
LODEPO	Total Loans to Total Customer Deposit Ratio
LODPSTMD	Total Loans to Total Customer Deposits and Short-Term Market Funding Ratio
LO_TA	Total Loans to Total Assets Ratio
LPDR	Loans Past-due 90 days or More, Still Accruing Interest to Total Assets
LRTR	Loan Revenue to Total Revenue

NALR	Non-accrual Loans to Total Assets
NAMFISA	Namibia Financial Institutions Supervision Authority
Net NPA	Net Nonperforming Assets to Net Advances
NFSS	Namibia Financial Sector Strategy
NLTA	Net Loans to Total Assets
NOIGOI	Net Operating Income to Gross Operating Income
NPA	Net Nonperforming Assets to Total Assets
NPERFV	Noncurrent Assets plus Other Real Estate Owned to Assets
NPL	Non-Performing Loans
NSA	Namibia Statistics Agency
NSFR	Net Stable Finding Ratio
NWTA	Net Worth to Total Assets
OCC	Office of the Comptroller of Currency
CIR	Cost to Income Ratio
OETR	Other Expenses to Total Revenue
OGINR82	County-Level Oil and Gas Sector Earnings to Total County Earnings
PSE	Public Sector Entity
PKTAHAT	Regulator-Recognized Capital to Assets
RETA	Real Estate Owned to Total Assets
ROA	Return on Assets
ROE	Return on Equity
RSA_RSL	Rate Sensitivity to Assets and Liabilities
RSF	Required Stable Funding
SENSDTD	Sensitive Deposits to Total Deposits
SIBR_CDR	Spread of the One-Month Interbank Rate & the Central Bank Policy Rate

SLRTR	Local Obligations to Total Revenue
SVAR	Structural Vector Autoregressive Model
TLTA	Total Loans to Total Assets
TLTS	Total Loans to Total Savings
YLDEAC	Change in Interest and Fee Income to Earning Assets

CHAPTER I

INTRODUCTION

1.1 Background of the Study

“Liquidity always comes first; without it a bank doesn’t open its doors; with it, a bank may have time to solve its basic problems” (Cates, 1990 cited in Sinkey, 1998).

One of the lessons learnt in the 2007 to 2009 global financial crisis is the shortage of liquidity in the market and its serious effects on the real economy. An analysis of liquidity creation and liquidity risk has a long history, dating back to the work of John Law in 1707 which focused on the real bills doctrine. The real bills doctrine or theory refers to the banks that were lending out money to businesses on a short-term basis in order to avoid the shortage of liquidity and this process was known as self-liquidating loans according to Laidler (cited by Reissl, 2016:3). In banking, liquidity refers to the ability of a bank to meet obligations and unanticipated withdrawals from depositors (Le, 2017:7; Vousinas, 2018:9). Financial analysts consider the provision of liquidity as a central function of banks and also as an essential element of the functioning of the economy as a whole. Karri, Meghani and Mishra (2015:29) point out that liquidity is essential for any institutions working with money.

Liquidity creation refers to a situation where banks obtain liquid deposits on a short-term basis, and offer it to borrowers on a long-term period (Angora and Roulett, 2011). Banks are intermediaries between those aiming to save their money and those aiming to borrow from the banks. The rationale of intermediation between savers and borrowers is necessitated by different needs in terms of liquidity, maturity and yield. In playing the intermediary role, banks are exposed to maturity transformation risks such as bank run arising from the maturity mismatch of assets and liabilities from a balance sheet as discussed by Bonfim and Kim (2017). The maturity transformation risk refers to a situation in which banks are unable to meet the obligations and anticipated withdrawals from depositors (Angora et al. 2011:9). “The fundamental role of banks

in the maturity transformation of short-term deposits into long-term loans makes banks inherently vulnerable to liquidity risk both of an institution-specific nature and those which affect markets in general” (BCBS, 2008, p.1). Gobat, Yanase and Maloney (2014) stress that banks are exposed to maturity transformation risks because they are taking deposits from savers on short-term requirements and lend this liquidity on long term requirements such as residential mortgages. As a result, banks are inherently exposed to maturity transformation risks which derive from a maturity mismatch of assets and liabilities from a balance sheet. The risk of liquidity could affect the image of a bank, consumers and the public at large (Gowri and Ramya, 2013:14; Gautam, Singh and Kumar, 2014:8). The maturity transformation risk could lead to higher bank distress.

Traditionally, there are three ways a bank can source funds in difficult times in order to meet depositors’ withdrawal demands and prevent the shortage of liquidity. Firstly, banks can source funds by selling or securitising assets and this process is also known as asset liquidity (Angora et al. 2011:8). Allen and Gale (2017:1) point out that during the 2007-09 global financial crisis, banks were selling their assets at fire-sale prices in order to raise funds to address liquidity shortages. In this process, banks can source funds in order to minimise liquidity shortages and meet depositors’ demands. Saunders and Cornett (2017:358) define fire-sale prices as a price that is offered to an asset that has been sold. Accordingly, when an asset is sold at low fire-sale prices, this could increase the likelihood of bank distress (Saunders et al. 2017:358). Secondly, banks can also obtain external funds from the interbank market. The interbank market plays an active role by providing the required funds from those having surplus funds. Under the interbank market, banks can issue commercial papers and covered bonds in order to raise funds. Angora et al. (2011:10) argue that banks take more moral hazards due to the availability of the interbank market. Consequently, banks with surplus funds take advantage against those required funds during difficult times. For example, banks with surplus funds always have better information in terms of transactions and market power to buy assets at low fire sale prices from those banks with the required funds (Acharya, Gromb and Yorulmazer, 2012:184). Finally, the central bank acts as a lender of last resort in assisting liquidity shortages to those banks that require funds. In response to the interbank market inefficiency, the central bank can mitigate losses against the banks that need funds to address liquidity shortages by borrowing them the required funds (Acharya et al. 2012:186). The lender of last resort doctrine was influenced by the

work of Bagehot in 1873 and this was used in 19th to 20th century by the central banks as interventions to address liquidity shortages. According to Bagehot (cited by Allen et al., 2017:12), central banks should, (1) lend to solvent banks at a high interest rate; (2) any assets should be of a value between panic and pre-panic prices, (3) not lend to any banks that have no collateral and any banks without collateral should be allowed to collapse. In modern times, most central banks follow the Bagehot principles in lending to needy banks (Allen et al. 2017:12). Under the Bagehot principles, banks that do not provide collateral have a higher probability of failure, hence, the central bank's role is to provide the required funds so that the needy banks can meet withdrawal from depositors.

Moreover, in 1934 law makers in the US adopted a system of deposit insurance that aimed to minimise bank run and bank distress. The doctrine of the deposit insurance system was introduced in response to the stock market crash of 1929. Afterwards, it has become a universal system of minimising bank run and bank distress. Chenrnykh and Cole (2010:7) define the deposit insurance system by linking it to three goals, (i) the protection of savers' funds, (ii) maintain confidence amongst depositors in the banking system, and (iii) maintain and attract savings from depositors. According to Chenrnykh et al. (2010:6), the deposit insurance system has been recommended by the International Monetary Fund (IMF), World Bank and European Union as the "best-international practice". Although deposit insurance is purportedly for the protection of depositors and prevents bank distress, on the other hand, it has unintended concerns, for example, persuading banks to take extreme risk. Following earlier studies, the deposit insurance system has massively protected depositors and banks against the likely bank distress (Calomiris and Jaremski, 2016:3; Calomiris, Heider and Hoerova, 2015:24). According to literature, there are two schools of thought about the deposit insurance system. Although the deposit insurance system increases safety and soundness among banks, on the other hand, it also persuades banks to take excessive risk. Calomiris et al. (2016) argue that the deposit insurance system influences the moral hazard among banks. According to Demirgüç-Kunt and Detragiache (2000), banks take a risk by financing high risk projects and high return projects. Consequently, there are concerns that are associated with the deposit insurance system as a result of the moral hazard effect. Thus, the deposit insurance system is associated with bank distress. All the aforementioned efforts are not adequate, and this includes the selling of securitised assets,

interbank, lender of last resort and deposit insurance system in preventing a repeat of the 2007-09 global financial crisis.

The 2007-09 global financial crisis was characterised by a lack of liquidity from the interbank market, needy banks selling assets at low fire sale prices and central banks providing funds to needy financial institutions (Allen et al. 2017:1; Sironi, 2018:8). In this context, the aforementioned quotation (Cates, 1990) is pertinent to explain the crisis that emanated from the US housing market and this led to bailouts and closures of large multinational financial institutions such as the Lehman Brothers and Merrill Lynch in the US and Northern Rock in the United Kingdom. The financial crisis exposed inadequate supervision, lack of sufficient capital reserves and insufficient liquidity buffers which appeared to have led to systemic risks to the banking systems in other parts of the world. Varotto (2011:11) and Giustiniani and Thornton (2011:3) cite the above-mentioned factors as the root causes of the crisis. Consequently, this prompted a call to revise banking regulations and risk management, which subsequently led the Basel Committee to introduce the Basel III Accord in 2011, which involves a pillar focusing on liquidity measurements. Prior to the 2007-09 global financial crisis, there were no quantitative measures that were used as an assessment tool in managing and controlling liquidity risk, and liquidity risk was not recognised as crucial by supervisory and regulatory bodies.

Before Basel III was introduced, the first accord known as Basel I was introduced in 1988, which focused only on credit risks thereby ignoring other types of risks associated with banks. In 2004, the Basel Committee introduced a second accord known as Basel II, with the aim of providing a buffer against bank failures and addressing the inadequacy of the first accord. However, Basel II failed to detect and prevent the 2007-09 global financial crisis. This necessitated the revision of financial regulations and subsequently led to the introduction of Basel III. In the current decade, regulators and supervisors place attention on liquidity risk management due to bank run and the distress associated and or caused by liquidity risk. On the other hand, financial regulators are interested in safety and soundness of banking institutions in maintaining confidence among players and thus economic growth.

1.2 Overview of Banking System Development in Namibia

1.2.1 Namibia Banking System

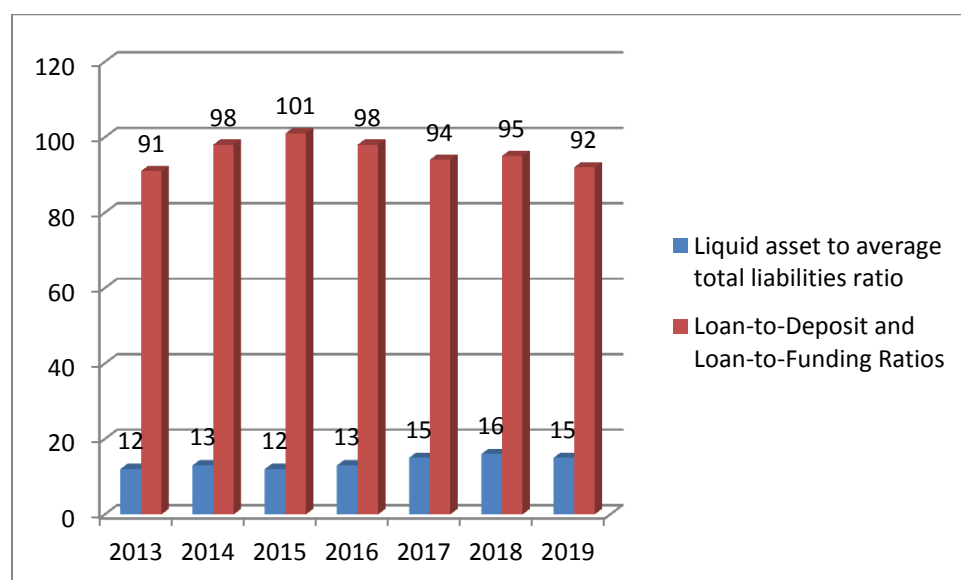
The Namibia banking system consists of two pillars: private sector banks and state-owned financial institutions. They are distinguished in terms of ownership, goals and operations. Private sector banks are owned by private institutions and some are subsidiaries of foreign banks with South African historical links. The private sector banks comprise of commercial banks, E-Bank, representative offices of foreign banks and foreign banks' branches. The private sector consists of nine (9) commercial banks that are as follows:

- Standard Bank of Namibia (Ltd.)
- First National Bank of Namibia (Ltd.)
- Nedbank Namibia (Ltd.)
- Bank Windhoek (Ltd.)
- Absa (Ltd.)
- Trustco Bank of Namibia (Ltd.)
- Bank BIC Namibia Limited of Angola (Ltd.)
- Letshego Bank of Namibia (Ltd.)
- Banco Privado Atlantico Europa (Ltd.)

State-owned financial institutions consist of saving banks such as Nampost Savings Bank, Agricultural Bank of Namibia and the Development Bank of Namibia. Nampost Savings bank provides savings, postal services and loans to the government and individual pensioners. Agricultural Bank of Namibia provides loans and guarantees to all related farming activities. The Development Bank of Namibia provides loans to businesses and finances infrastructural development. State-owned financial institutions operate in all 14 regions of Namibia by supporting government efforts that are aimed towards development and financial inclusion.

At present, the commercial banks have automated cash machines throughout the country and they also offer online banking and cell phone banking. In addition, they provide a range of services such as saving accounts, unsecured and secured loans, mortgage bonds, overdraft facilities, foreign currency transactions and general financial advice. They also provide services to corporate customers such as payroll services, leasing and hire purchase, export and import facilities and international financial transfers. In contrast to most emerging economies, the Namibian banking system is dominated by four largest banks, namely, Standard Bank, First National Bank, NedBank and Bank Windhoek. This has led to a tremendously oligopolistic banking system. These four largest banks account for 98% of all total bank assets (IMF, 2018:10).

Figure 1.1: Liquid assets and liquidity ratio and loan-to-deposit and loan-to-funding ratio



Source: Own construction from Bank of Namibia database

With regards to liquidity positions, the two key liquidity indicators show mixed results. Liquidity assets to average total liabilities ratio refers to the bank's ability to meet unexpected cash demand from depositors and also the ability to convert the liquid assets into cash (Bank of Namibia, 2019:41). The banking sector kept liquid assets over the last years above the level that is required by the regulatory institution (Figure 1.1). Accordingly, banks are required to hold 10 percent of their liquid assets (Bank of Namibia, 2019:10). Considering the loan-to-deposit and

loan-to-funding ratio, if the banking sector is close to 100 percent or over, this displays the fact that those banks borrowed funds to supply loans to borrowers. Figure 1.1's results imply that banks borrowed funds in order to supply loans. The results call for Basel III liquidity measures in order to manage their liquidity positions effectively including diversifying their sources of funds. Further to this, the parliament also approved the Namibia Deposit Guarantee Act of 2018 to enable the establishment of a Deposit Guarantee Scheme in Namibia. The rationale for the Deposit Guarantee Scheme is to provide funds to banks in the event that they face liquidity shortages and maintain stability in the banking system.

1.2.2 Regulatory and Supervisory Framework

The Bank of Namibia's Banking Supervision Department is responsible for regulating and supervising all commercial banks in Namibia. It is responsible for both prudential regulation and the business conduct perspective. The central bank is tasked to maintain safety and soundness monetary, credit and liquidity functions as well as to prevent the insolvency of financial institutions. Considering risk management, the Bank of Namibia derives its supervisory and regulatory powers from the Namibia Banking Institutions Act of 1998 along with the Basel II accord. The Act covers minimum capital funds, minimum liquid assets, minimum local assets, minimum credit extension, and disclosure of bank charges, fees and commission, among the other areas. Basel II covers credit risk, market risk and operational risk, thereby ignoring liquidity risk. In addition, Basel II emphasises capital requirements, and supervisory and market discipline through disclosure of information as part of the accord. However, the Namibia Financial Institutions Supervision Authority (NAMFISA) supervises all non-banking financial institutions, and it is responsible for both a prudential regulation and a business conduct perspective. These include pension and retirement funds, long-term insurance, short-term insurance, medical aid schemes, friendly societies, unit trust management schemes, the Namibian Stock Exchange, asset managers, participation bond schemes, public accountants and auditors, micro lenders, and hire purchase outlets.

1.3 Statement of the Problem

One of the root causes of the most recent global financial crisis (which started 2007-09) was the shortage of liquidity amongst global financial institutions and this had serious effects on the real economy (Casu, Pietro and Trujillo-Ponce, 2017:2; Kapan and Minoiu, 2017:2; Allen et al., 2017:1; Sironi, 2018:8). This led to bailouts and failures of several financial institutions globally. “The fundamental role of banks in the maturity transformation of short-term deposits into long-term loans makes banks inherently vulnerable to liquidity risk both of an institution-specific nature and those which affect markets in general” (BCBS, 2008:1). In doing this, banks are accepting deposits from savers that are liquid assets, then they turn these liquid assets into illiquid assets, for example, by using savers’ funds to finance long-term loans such as mortgages and so on (Casu et al. 2017:2). By doing so, banks are exposed to liquidity risk in the event that depositors demand their funds in large volumes. However, higher capital (capital adequacy) and non-performing loans (credit risk) have shown to be key factors affecting liquidity conditions in banks. For example, higher capital ratios have been found to be reducing liquidity creation and this leads to illiquidity amongst banks (Distinguin, Roulet and Tarazi, 2013:20; Horvath, Seidler and Weill, 2014:17; and Kapan et al., 2017:15). With regards to non-performing loans (credit risk), higher non-performing loans are found to be caused by lower liquidity and consequently liquidity risk in banks (Berrios, 2013:15; Hajja and Hussain, 2015:255; Nabilar and Khushiri, 2018:17). Namibia’s banking system is not an exception to the financial distress links to liquidity shortages. From 2012 to 2013, the Bank of Namibia (2014) reported a maturity mismatch of assets and liabilities which led to liquidity risks in their Financial Stability Reports. From 2011 to 2015, commercial banks recorded increases of loan-to-deposit ratio, which is one of the key indicators of liquidity, which increased from 85 percent to 101 percent (Bank of Namibia, 2016:34). This implies that banks borrowed funds to supply loans to borrowers, meaning that banks could not have sufficient liquid assets (Bank of Namibia, 2017:23). According to Bank of Namibia (2016:32), a percentage of loan-to-deposit ratio close to or over 100 percent means that commercial banks rely on borrowed funds to finance loans to those who want to borrow. The International Monetary Fund (2018:7) conducted Namibia’s financial system stability assessment and arrived at similar sentiments that commercial banks faced liquidity shortages over the time and they obtained funds from wholesale funding in order to provide loans to the needy borrowers. Based on the available literature, there are limited studies that have attempted to

identify the sources of liquidity shocks in Namibia. Therefore, the knowledge gap has been persisting in this area of study which thus necessitated the present study to uncover the sources of liquidity shocks in the Namibian context. It is against this background that the present study sought to contribute to the liquidity management body of knowledge by identifying and establishing the sources of liquidity shocks in Namibia. This study is vital for banking institutions, regulatory bodies and the economy as a whole since it focuses on liquidity risks which affect banking performances that could lead to bank failure. Besides contributing to the body of knowledge, the research offers insights to bank managers in preventing liquidity risks. Thus, the main question is identifying the source of the liquidity shocks which are bringing about the liquidity risk problem in Namibia over time. The research questions related to this point are: What would an audit of the liquidity data between 2009 and 2018 reveal about banks' exposure to liquidity risk? To what extent may NSFRs strengthen CAMELS indicators in identifying liquidity shocks?

1.4 Aim and Objectives of the Study

The aim of this thesis was to identify and establish the sources of liquidity shocks in Namibia for the period from 2009 to 2018.

To achieve the aim, the following sub-objectives were addressed:

- To conduct an audit of the liquidity data between 2009 and 2018 and explore how banks were exposed to liquidity risk; and
- To determine the extent to which NSFRs can strengthen CAMELS indicators in identifying liquidity shocks.

1.5 Significance of the Study

The thesis is in response to the ten years Namibia Financial Sector Strategy: 2011 - 2021 (NFSS), initiated by the Namibian Ministry of Finance towards achieving Vision 2030 which is

aimed at making Namibia become an industrialised nation. With regards to the financial sector, the strategy calls for the financial sector to address inadequate financial regulations and customer protection. According to the NFSS, the financial system must be guided by robust regulations and supervision, including a strong management and measurement of liquidity risk, credit risk, capital adequacy and market risk among others.

This study aimed to reveal the sources of liquidity shocks in Namibia and the study provides some valuable policy tools to address liquidity shortages in banks. Beneficiaries for this study include banks, liquidity risk managers, regulatory bodies, academics, bank customers, investors, shareholders and the whole financial system in Namibia. The findings of the study are useful to financial planning, risk management and measurements. The study is relevant to Namibia and particularly to the regulatory bodies since they are in the process to improve their financial policies in order to comply with international standards and practices. With regards to banks, the study may benefit them by understanding the sources of liquidity shocks in Namibia. Risk managers may benefit from this research and be able to understand the factors that caused the liquidity risk and the consequences of the shortage of liquidity in banks to the whole economy. In relation to the regulatory bodies such as the Bank of Namibia, this study may help them to understand the causes of liquidity shocks and thereby enable them to implement sound financial policies to tackle liquidity risks.

In addition, academics may benefit from the generated new knowledge so that they can advance it in the literature and conferences. The results could be useful to customers with regards to their investments and this can enable them to make informed decisions with regards to their savings and borrowings. The results can also benefit investors in terms of their investments' safety as well as allowing them to make informed decisions with regards to investments. Shareholders are interested in their investments and returns; therefore, this study may benefit them in revealing the sources of liquidity shocks which can affect their investments. Lastly, the survival of banks and a whole financial system is important for economic growth. The relationship between financial development and particularly the performance of financial institutions and economic growth has been documented from the works of Joseph Schumpeter in the 19th century and Ronald McKinnon and Edward Shaw in the 20th century. Levine, Lin and

Xie (2017:8) also established the relationship between financial development and economic growth.

1.6 Scope of the Study

The study sought to identify and establish the sources of liquidity shocks in Namibia for the period from 2009 to 2018. As such, the scope of the study falls within the field of finance and management. The research examined four commercial banks in Windhoek which account for 98 percent of the total bank assets (IMF, 2018:10). Three of the four commercial banks are subsidiaries of main parents that are based in South Africa. However, the study was limited to their operations in Namibia.

1.7 Structure of the Thesis

The thesis was necessitated by the adverse consequences of liquidity shortages on bank financial distress, and potential job losses on the realm of the economy. The literature on banking conditions implies that liquidity risk is caused by several factors that are from micro-macroeconomic indicators. Thus, it is essential to link liquidity conditions with other micro-macroeconomic indicators.

As a point of departure, in Chapter 2, the thesis describes the evolution and theory of liquidity management and the rationale of liquidity regulation. The chapter also highlights the methods and measures that are used to assess risks in banks including the CAMELS approach and Basel accords. Furthermore, Chapter 2 reviewed empirical literature that used the CAMELS approach and Basel III liquidity measures in identifying liquidity shocks and predicting bank distress. In Chapter 3, the thesis outlines the methodology including the research approach and strategies, target population and sample, procedures, data collection methods, model specification, data estimation techniques, proxies and variables among others.

In Chapter 4, the thesis examines the sources of liquidity shocks in Namibia for the period from 2009 to 2018 using a liquidity ratio introduced by Basel III, namely, NSFR and traditional CAMELS ratios, namely, LA_ATL, LO_DEPO, LO_TA and LA_TA. The links between macroeconomic indicators and bank liquidity conditions were explored. In addition, robustness analysis was made to confirm the validity and reliability of the model and the results. In Chapter 5, the comparisons and benchmarks are made between prior empirical results and the current study in order to confirm the significance of the results. Chapter 6 provides conclusions that are related to the study objectives, areas for further research and policy implications.

1.8 Chapter Summary

This chapter gave an overview of the disciplines of liquidity management and the challenges facing banking institutions. It commenced with a section that highlighted the evolution of liquidity management, followed by a section that provided a concise overview of the liquidity concept. Further to this, the chapter highlighted the introduction of the study, statement of the problem, aim and objectives of the study, significance of the study, scope of the study, and the structure of the thesis. The subsequent chapter focuses on literature review in order to identify the sources of liquidity shocks and to reveal the methodologies that were utilised in prior studies.

CHAPTER II

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 Introduction

Following the past studies, liquidity has been a focus in the literature in the last three decades and it has been emphasised as a key component in banks and particularly for the stability of the financial system and for economic growth (Bonfim et al. 2017:26; Allen et al. 2017:1; Sironi, 2018:5). In relation to the problem statement as presented in Chapter 1, the aim of this thesis was to identify and establish the sources of liquidity shocks in Namibia for the period from 2009 to 2018. In doing these, the study reviewed prior studies in order to identify the sources of liquidity shocks in various countries and economies, and also revealed the methodologies that were utilised in prior studies. As a point of departure, the structure of this chapter is therefore as follows: Section 2.2 contains a brief analysis of the origins of liquidity management. Section 2.3 provides a justification for regulating financial institutions. Section 2.4 highlights the CAMELS rating system. Section 2.5 reviews the traditional liquidity ratios measurements. Section 2.6 highlights the Basel Accords. Section 2.7 analyses the new proposed liquidity ratio measures under Basel III. Section 2.8 discusses bank failure models. Furthermore, Section 2.9 provides the theoretical framework. Section 2.10 highlights the implications of the literature to the study. Finally, Section 2.11 provides a summary of the literature review.

2.2 Genesis and Evolution of the Theory of Liquidity Management

The liquidity management theory has been at the heart of debates from the 19th century through the 20th century. From the liquidity management perspective, short-term loans and financial crises have played a central role in liquidity management. The liquidity risk management theory can be traced as far as the 19th century and it has evolved to the current

asset-liability management and securitisation theory. For many years, the liquidity risk management theory has dominated the monetary policy and liquidity risk management in general. The issue of the liquidity risk management theory has grown in importance in response to financial crises. There are five theories that have attempted to explain liquidity risk measurement and management perspectives within the banking sector from the financial regulation perspective and they are as follows: (1) Commercial loan theory or real bills doctrine during the 1920s and earlier as from the work of John Law (1707), (2) Asset-conversion or shiftability approach in the 1940s, (3) Anticipated-income theory during the 1950s, and (4) Liability management in the 1960s to 1970s, and (5) subsequently the current asset-liability management and securitisation theory from the 1970s to the present day.

1) Commercial loan theory or real bills doctrine

The origins of the commercial loan theory or real bills doctrine can be traced as far as from the work of John Law in 1707. Humphrey (1974:3) defines the real bills doctrine as “a rule purporting to gear money to production via the short-term commercial bill of exchange, thereby ensuring that the output generates its own means of purchase and money adapts passively to the legitimate needs of trade”. According to Laidler (cited by Reissl, 2016:3), banks lend out money to businesses on a short-term basis to finance production and distribution and they were recognised as self-liquidating loans. In this view, the producers took their products to retail outlets and then sold them to customers in order to gain income and repay their loans to banks. According to this theory, this process ensures the availability of liquidity in a bank. In the worst case scenario, commercial banks had an option to borrow from the central bank in order to meet their short-term requirements.

However, the real bills doctrine monetary policy was blamed for several financial crises such as the Great Depression in the US lasting from 1929 to 1939, the Weimar hyperinflation in Germany in 1923 and during the Napoleonic Wars lasting from 1803 to 1815 when Bank of England suspended the conversion of notes (Reissl, 2016). Based on these financial crises, Goodhart and Jensen (2015:11) state that the real bills doctrine was not a failure but it was

unsuccessful to prevent financial crises. From these criticisms, in 1940 the real bills doctrine was substituted by the asset-conversion or shiftability approach and the next section presents the review of this theory.

2) Asset-conversion or shiftability approach

The asset-conversion or shiftability theory is the second major of the bank liquidity management theory. This theory was formulated by Harold G. Moulton in 1918, an economist from the University of Chicago. Harold Moulton (cited by Summers, 2012:19) proposed that banks could buffer themselves against deposit withdrawals by keeping vast liquidity reserves, for example, money market instruments such as commercial paper, prime bankers' acceptance and most essential treasury bills (Summers, 2012:19). Prochanow (1949:302) in his studies on Bank Liquidity and the New Doctrine of Anticipated Income pointed out that under the shiftability theory, the liquidity of a bank was measured by the degree to which a bank shifted its assets to another bank for cash or obtained funds from another bank at reasonable prices. In this view, in a case when the bank required liquidity, it obtained it from another bank or from the money market. In the worst-case scenario, if all banks required liquidity, then an individual bank was supposed to approach a central bank as a lender of last resort.

The first theory of liquidity management focused on the short period and self-liquidating was no longer considered as banks could rely on money market instruments as a source of liquidity. Prochnow (1949:303) argues that one of the shortcomings of this theory is that banks and money markets may be reluctant to give loans to unsecured banks and this creates a liquidity crisis. In the 1940s, Herbert Victor Prochanow extended Moulton's analysis by formulating the theory of anticipated-income.

3) Anticipated-income theory

In 1949, Prochanow put forward an attempt to move away from short term loans to long-term loans. From the 1940s, commercial banks were offered long term loans over one to five years such as consumer loans, mortgage debts and businesses loans. Henceforth, a longer-term loan was used as a source of liquidity for commercial banks (Alshatti, 2015:63). The characteristics of the anticipated income theory can be summarised as follows:

- The loans are issued for a period of more than a year
- The borrowers paid in a series of instalments
- Future earnings through repayments guaranteed liquidity in a bank
- Agreements between a lender and borrowers were made to secure repayment
- Loans were offered by commercial banks, saving banks, insurance companies and governments' agencies rather than investment companies.

Abubakar, Ezeji, Shaba and Ahmad (2016:62) argue that the anticipated-income theory was not denying the fact that the focus of short-term loans leads to self-liquidating. However, in the 1960s, the world shifted to liability management theory and the next section presents the review of this theory.

4) Liability management

The foundation of the liability management theory was established in the 1960s, with the expansion of money market and various instruments. The money market consists of the domestic and international market for short-term borrowing and lending. The liability management strategy was also known as the purchased liquidity (Rose and Hudgins, 2008:352). The instruments include federal funds, negotiable certificate of deposit (NCDs), Eurodollars, repurchase agreements, brokered deposits, notes and debentures. The commercial banks began to pay attention on liabilities to acquire liquidity as well as managing their balance sheets. Sinkey

(1998:268) argues that the uniqueness of liability management was that commercial banks could acquire funds from the money market in order to meet the liquidity requirements. Sinkey (1998) further states that the unique features of liability management are interest rate, maturity and services of these instruments compared to other sources of funds.

The strategy of liability management allowed banks to free funds to investors and investment opportunities in order to make more profit while relying on the money market for short-term borrowing in the case of liquidity demands. Rose *et al.* (2008:352) point out that the advantage of liability management is that banks moved away from ideas of storing liquidity in assets, which was lower in terms of their returns. Saunders *et al.* (2017:559) point out that the shortcomings of the liability management strategy is that, for example, if a bank obtains excessive short-term borrowing from the money market, this could lead to a liquidity crisis if investors lose confidence in a bank and refuse to offer borrowing. From the 1970s up to today, the world has moved to asset-liability management and securitisation theory and the next section presents the review of this theory.

5) Asset-liability management and securitization theory

In the 1970s, financial institutions put forward an attempt to strengthen the liability management strategy by introducing the asset-liability and securitization strategy (ALM) in response to volatile interest rates and insolvencies among savings and loan institutions from 1980 to 1982 (Sakovich, 2012:5). According to Sakovich (2012:4), ALM is a strategic management tool to control all risks caused by mismatches between the assets and liabilities of a bank. Rose *et al.* (2008:245) point out that interest rate volatility caused by mismatches between short-term liabilities such as deposits and long-term assets, for instance, loans and securities, have affected banks in terms of liquidity.

The ALM was developed to hedge financial institutions against all risks such as interest rate, credit risk and exchange rate, and contingency risk, and to maximise profit on the other

hand (Dash, Venkatesh and Bhargav, 2011:1; Dash, 2013:230). The asset-liability management tool intended to manage the volumes, maturity, rate sensitivity, and mismatches in order to achieve the risk and reward ratio (Charumathi, 2008:1; and Dash et al. 2011:1). In addition, ALM's main focus is summarised as follows:

- Profit maximisation
- Management of interest rate risk and other risks
- Managing mismatches between assets and liabilities
- Reducing costs of services for customers

2.3 Justification for the Regulation of Financial Institutions

The financial systems in many parts of the world are vulnerable to instability and failure. Several financial crises such as Great Depression 1932, the International Debt Crisis 1982, the East Asian Economic Crisis 1997-2001; the Russian Economic Crisis 1992-97 and the recent global financial crisis 2007-2009 have been characterized by various financial institutions failures due to deficiency of financial regulation among others. For example, CAMELS approach and Basel II accord were not adequate to prevent financial crises (Varotto 2011:11 and Giustiniani and Thornton, 2011:3). This has prompted the need for safety and soundness of banking systems in order to prosper economic growth. In that respect, financial regulation remains an essential and topic issue for regulatory bodies, investors, banks, policy makers, academics and banks' stakeholders at large. In this view of the importance of financial regulation, it necessary to establish issues that justify economic or financial regulation and particularly CAMELS approach and Basel accords which are main financial regulations designed for banks and key elements of this study.

The theory of economic regulation was advocated by Stigler (1971) in his classic article "The Theory of Economic Regulation". According to Stigler (1971), regulation is a product like any product in the marketplace. The difference is that regulation is designed and imposed by politicians or the government. Stigler (1979:3) went further by arguing that "regulation is

acquired by the industry and is designed and operated primarily for its benefits”. Stigler (1971:3) pointed out that there are two alternative beliefs; firstly, regulation is aimed for the protection and benefits of public interest. Stigler’s (1971) view is that regulation is considered, for example, when the cost of products or petroleum increases and hurts the US, which necessitates the regulation. Secondly, the regulation was driven by politics because of the government’s coercive power. Stigler (1971:4) argues that the state has the machinery, power and basic resources which are a threat to any industry. The government’s power could help or hurt some institutions or industries. In order for some institutions or industries to survive under the government’s coercive power, they seek entry barriers, control price-fixing, and subsidies from the government. In addition, for some institutions to grow and survive, they offer votes and financial support to the government or to the ruling party. In doing this, the regulation will be in their favour at the expense of the public at large. Thus, Stigler (1971:3) stresses that a regulation is designed to benefit a few individuals or the subordinated class. In the last two decades, literature offered justifications for regulations based on risks that are posed to financial institutions and the next paragraph presents the review.

The current discussion tracks earlier presentations, whereby Simpson (1996:16) maintains that the ultimate rationale of regulation is to protect the consumer’s interests and correct market failures. Benston (1998:18) argues that regulation is imposed to protect the interests of the government, legislators, and financial institutions in general. According to Benston (1998:18), this is the main reason for regulating financial institutions although it generally hurts mostly consumers. As discussed by Bonfim and Kim (2017:2), the risks taken by banks are in relation to the mismatch of assets and liabilities which could lead to bank run and funding liquidity risk. According to Bonfim et al. (2017:1), this is the main argument for liquidity measures and regulations. Llewellyn (1999:9) in an article titled, *The Economic Rationale for Financial Regulation*, put forward an attempt to strengthen the rationale for financial regulations by linking it to economic benefits. According Llewellyn (1999:9), the ultimate economic rationale for regulation is to sustain system stability, correction of market imperfections and failures, monitoring financial institutions, consumer confidence in the system, adverse selection, moral hazard problems, and consumer demand for regulation. As discussed in the Occasional Paper Series title “*The Economic Rational for Financial Regulation*” by Llewellyn (1999:9), financial regulation is justified for three core reasons as discussed below:

2.3.1 To Sustain System Stability

The fundamental role of financial intermediaries is obtaining short-term deposits from savers and making long-term borrowings which affect the balance sheet and exposes banks to liquidity risk. Due to this mismatch of the balance sheet of a bank, a bank run can occur from one institution to another solvent institution due to the lack of confidence among consumers (Lo, 2009:3). In the event of consumers panicking and having a lack of confidence in a bank, they run to a bank to withdraw their money and the consumers' beliefs or domino effect can affect all banks and this leads to banks' failure. As a result, consumers or depositors cannot differentiate between insolvent and solvent banks and that could affect all banks. In that regard, depositors could withdraw all their money from both insolvent and solvent banks due to asymmetric information. A systemic risk that runs from one institution to another leads to losses and failure of banking institutions and can affect the economic as a whole, and the past financial crises have demonstrated that (Huang, Zhou and Zhu, 2009:1; Pedersen and Richardson, 2010:2). The Basel Committee on bank supervision has been stepped up by introducing regulations to cater for capital adequacy and liquidity shortages in order to maintain stability in the banking system.

2.3.2 To Maintain Safety and the Soundness of Banks

The safety and soundness of banks originated from banking laws in the 1880s in the United States of America that were aimed to protect depositors and holders of investments. Menand (2019:153) refers to safety and soundness bank as a bank that maintains confidence in the banking system by managing monetary instruments such as notes and deposits in a safe manner that convinces holders and depositors to continue to save and expect returns that derive from the value of these instruments. Accordingly, an unsafe and unsound bank is when it is unable to make returns and or meet obligations when they fall due from depositors (Menand, 2019:154). Pan (2009:9) went on to stress that the financial regulation is aimed to maintain the safety and soundness of the financial system by focusing on three areas: prudential regulation,

business conduct regulation and the stability of the market. Prudential regulation refers to rules and policies (e.g. Basel Accords) that are aimed to ensure that banks are safe and sound. Prudent regulations consist of capital adequacy rules, liquidity management, internal control and overall risk management. Llewellyn (1999:10) argues that consumers are not in a position to see the safety and soundness of financial institutions and that justifies the rationale of financial regulation. Business conduct regulation refers to the manner in which a bank does business with its customers. This involves the need for financial firms to disclose all information, show honesty, fairness and integrity in terms of business conduct. Pan (2009:10) highlights that the business conducts regulations that are aimed to protect customers from unfair products and services charges and the terms and conditions of agreement. Lastly, the stability of the market requires regulators to maintain safety and soundness in the operation of the market. This involves managing the payment system, money market, and overnight lending among others. Pan (2009) stresses that regulators are required to assist banks as a lender of last resort, by provide liquidity as required and intervene in any difficult situation in order to maintain confidence in the financial system.

2.3.3 To Protect the Consumer

The case for consumer protection arises from two reasons. According to Llewellyn (1999:10), a bank might fail where consumers hold or have deposited their funds, or the bank fails to manage the resources in an appropriate manner. Banks play an important intermediary role between savers and borrowers. When banks fail or become insolvent, the consumers might lose their savings and investments. Thus, the need for consumers' protection is crucial for broader economic stability. Koopman and Mitchell (2015:5) argue that the rationale for protecting consumers derives from insufficient competition, price overcharging, asymmetric information, and inequality among other factors. For example, the United States Federal Trade Commission (FTC), in protecting consumers is promoting competition by preventing anticompetitive practices and preventing fraud, as well as unfair and dishonesty practices (Waller, Brady, Acosta, Fair and Morse, 2011:3). The consumers have limited information and

some are financially illiterate in order to monitor their savings and investments. These circumstances make it difficult for consumers to control and monitor their investments and so on. Thus, the business' conduct should be monitored closely by the regulator in order to protect consumers' interests and maintain stability within the banking system and the economy as a whole.

2.4 CAMELS Rating System

The Uniform Financial Institution Rating system which is referred to by the acronym CAMEL represents five components in evaluating the banks' conditions and these are as follows:

- C – Capital adequacy
- A – Asset quality
- M – Management efficiency
- E – Earning quality
- L – Liquidity
- S – Sensitivity to market risk

The CAMELS rating system was created in 1979 in the US by three federal banking supervisors, and principally proffers that the Federal Reserve regulates bank holding companies and state banks, Federal Deposit Insurance Corporation (FDIC) which regulates other state banks that are members of the FDIC, and the Office of the Comptroller of Currency (OCC) regulates nationally chartered banks (Papanikolaou and Wolff, 2015:7). After a decade, the Federal Deposit Insurance Corporation Improvement Act of 1991 was implemented and mandated with an annual on-site examination for banks and the CAMEL approach came into enforcement (Cole and Gunther, 1998:103; Hirtle and Lopez 1999:1). The CAMEL rating system is used as an on-site examination on banking institutions by regulatory and supervisory bodies. Further to this, it is an internal supervisory tool for evaluating the banking institutions' conditions.

In 1996, the CAMEL rating system was revised and ‘S’ was added and today it is known as the CAMELS rating system. The added ‘S’ refers to sensitivity to market risks. The rating ranges from a 1 to 5 score, and a bank that receives 1 means strong performance, 2 means satisfactory performance, 3 means performance that is unsound, 4 means performance below average, and 5 means unsatisfactory performance which is a cause for concern to supervisory bodies (Cole, Cornyn and Gunther, 1995:32; Datta, 2012:1). The CAMELS rating system is used by regulatory bodies such as the Bank of Namibia to examine the financial conditions of commercial banks in order to uncover regulatory violations and the problems at hand. The regulatory bodies use quarterly data derived from the balance sheet and income statements. The next section presents the review of empirical literature related to the use CAMELS approach.

2.5 Traditional CAMELS Measurement Ratios

The banking performance is measured by traditional accounting and financial ratios. The Bank of Namibia uses the CAMELS rating system which consists of several financial ratios as a measurement tool of banking performance. The CAMELS rating system is utilised for measuring capital adequacy, asset quality, management efficiency, earning quality, liquidity management and sensitivity to the market risks of banks. The use of financial ratios in identifying financial shocks can be traced back as from 1970s from the works of Sinkey (1975:27), Altman (1977:465), Martin (1977:265), Barth, Brumbaugh, Sauerhaft and Wang (1985:198), and Demirguc-Kunt (1989:10). Consequently, the CAMEL rating system came into effect, and financial ratios that were used by these researchers were consistent with the CAMEL rating (Angora et al., 2011:9). In the 1970s, 1980s and 1990s, numerous early warning indicator studies on bank performance were conducted to study the accuracy of various models and the CAMELS rating system in identifying shocks and banks distress. This trend has grown and has also become common and relevant to the current decade by comparing various models and financial ratios in identifying shocks and predicting bank distress. The rest of this section is organised as follows: it discusses the CAMELS rating components which include capital adequacy, asset quality, management efficiency, earnings quality, liquidity capability and sensitivity to market risks.

2.5.1 Capital Adequacy

Capital is one of the vital factors that determine banking operations and stability in terms of the available capital in the banks. Capital adequacy refers to the availability of capital from a bank to cover unexpected losses and to avoid reductions in asset value which could cause a banking institution's failure, and the banks' ability to satisfy depositors and debt holders in the event that they require their investments (Venkatesh *et al.*, 2014:6). Posner (2015:2) argues that a bank is only solvent when its assets exceed its liabilities, and it is therefore a measure of the capability of the bank to survive unexpected losses. Isanzu (2016:72) stresses that capital adequacy measures the financial strength of a bank, for example, the ability of a bank to meet its obligations in an event that they come due as well as an ability to operate even under abnormal losses. Capital adequacy ratios are used to assess the overall financial condition of banking institutions and whether banks can absorb any losses from either internal or external influences (Le, 2017:5). The capital adequacy is critical because it maintains confidence among stakeholders and prevents bank distress and insolvency (Gowri *et al.*, 2013:12 and Gupta, 2014:95). A large body of literature has applied several financial ratios to determine their usefulness in identifying the financial shocks of banks.

The seminal studies on analysing banks' conditions started in the 1970s and 1980s through the works of several authors (Sinkey, 1975:27, Altman, 1977:465, Martin, 1977:265, Barth, Brumbaugh, Sauerhaft and Wang, 1985:198, Demirguc-Kunt, 1989:10). These works were in response to the 1930s and 1980s financial crises that led to the closure of 1,500 banks in the 1930s and 800 banks in the 1980s (Demirguc-Kunt, 1989:2). These studies applied several financial ratios consistent with the CAMELS rating and models in the determinant of the likelihood of financial constraints that use balance sheets and income statements data. The use of financial ratios was related to financial crises when most banks' distress was common, in order to assess the performance between failed and non-failed banks.

In earlier studies, capital adequacy was analysed based upon the following set of variables. The variables are loan to capital ratio (LCR), net worth to total assets (NWTa), Federal Home Loan Bank advances to net worth (HLBANW), Earned surplus to total assets

(ESTA), Gross capital to adjusted risk assets (GCARA), Equity capital plus loan loss revenue allowance to total assets (KTA), natural logarithm of total bank assets less loan loss reserves to total assets (LNTA), and regulator-recognised capital to assets (PKTAHAT) as proxies to measure capital adequacy. Typically, these studies used these financial ratios that are consistent with the CAMELS rating to evaluate the conditions of commercial banks.

LCR numerator consists of total loans and discounts and the denominator consists of total capital accounts plus reserves for bad debt losses on loans (Sinkey, 1975:28). The NWTAR ratio equals total assets minus total liabilities of a bank. HLBANW represents the advances to net worth that are granted to the banks. ESTA represents the profit generated for a specific period to the total assets of a bank. The GCARA ratio measures the basic capital to assets, with or without debts (Martin, 1977:274). KTA comprises of equity capital and loan loss revenue allowance to total assets. LNTA consists of a natural logarithm of the total bank assets less loan loss reserves to total assets. PKTAHAT refers to regulator-recognised capital (e.g., minimum capital) to the assets of a bank.

Sinkey (1975:26) undertook an empirical study of the financial performance of the banking sector of the US using financial ratios to determine bank distress. The study comprised of problem banks and non-problem banks for the financial year 1969 to 1972 and focused on the accuracy of financial ratios and developing an early warning system. Sinkey (1975) used the LCR ratio in measuring the capital adequacy of banks and it was also used by the Office of the Comptroller of the Currency (OCC) as a preliminary indicator of the bank's capital adequacy. Sinkey (1975:28) found that the capital position of banks was inadequate and worsening for the period from 1969 to 1972 in the US and the ratio was significant in identifying financial shocks. Altman (1977:450) improved on Sinkey's (1975) work by utilising the quadratic structure and evaluating 212 savings and loan associations from the US during the period 1966 and 1973. The study examined no-problem, temporary problem and serious problem banks. Altman (1977) focused on the accuracy of financial ratios and developing an early warning system as well. Altman (1977) utilised the NWTAR ratio to measure capital adequacy. The NWTAR ratio was found as an important and accurate variable in determining the likelihood of the bank's financial

shocks in terms of capital adequacy. The result is also demonstrated in the study of Barth et al. (1985:199) and Benston, (cited by Demirguc-Kunt, 1989:11). Barth et al. (1985:190) analysed 318 closed and 588 non-closed savings and loan institutions between 1981 and 1983 using semi-annual data. Benston (1985:1) analysed 178 closed and 712 non-closed savings and loans institutions between 1981 and 1985. Altman (1977:457) also used the HLBANW ratio as a measure of capital adequacy and found them to be accurate variables in identifying financial shocks.

Martin (1977:262) undertook a study covering over 5,700 US commercial banks for the financial year 1970 and 1976. The study also focused on failed and non-failed commercial banks, the accuracy of financial ratios and developing an early warning system. Martin (1977) used the GCARA ratio as a measure of capital adequacy and found it to be an important and accurate variable in identifying financial shocks. Avery and Hanweck (1984:2) undertook a study involving 100 closed banks and 1,190 non-closed banks between 1978 and 1983 using semi-annual data. The study focused on closed and non-closed commercial banks. Avery et al. (cited by Demirguc-Kunt, 1989:10) utilised KTA and LNTA ratios as a measure of capital adequacy and both proved significant in identifying financial shocks. Gajewski (cited by Demirguc-Kunt, 1989:10) conducted a study involving 134 closed and 2,747 non-closed banking institutions in 1986 using cross-sectional data. It was a first study to use two-step logit to determine an early warning system and closure process. Gajewski (cited by Demirguc-Kunt, 1989:11) applied the PKTAHAT ratio to measure capital adequacy and to prove its significance in the determinant of the likelihood of bank financial shocks. Thus, the results suggest that all ratios have proven significant in detecting the likelihood of bank financial constraints. Contrarily, the analyses suggest that although several financial ratios consistent, with the CAMEL rating were used and it was found to be significant in determining the probability of bank financial constraints. But there were no widely support of such ratios, except the net worth of total assets (NWTa) that have been confirmed by Altman (1977:457), Barth et al. (1985:197), and Benston (cited by Demirguc-Kunt, 1989:11). Further to this, none of these ratios have been utilised by current studies in measuring capital adequacy.

The next major changes took place in 1988 when global regulators especially from G10 countries met in Basel, Switzerland where they introduced standard capital ratios that were applicable to all countries. Consequently, the Basel I Accord was agreed upon and it came into effect to all member countries. The Basel I Accord introduced Capital adequacy ratio (CAR), and consists of Tier 1 and Tier 2 capital ratio as proxy to measure capital adequacy. In addition, total equities to total assets ratio (EQTA) also feature in the current studies as standard indicators of capital adequacy. CAR measures banks to see if they have enough capital in order to absorb unanticipated losses with enough margins to enable them to continue as a going concern (Vousinas, 2018:7). Tier 1 refers to core capital which comprises of common stock and surplus, undivided profits (retained earnings), qualifying non-cumulative perpetual preferred stock, minority interest in the equity accounts of consolidated subsidiaries, and selected identifiable intangible assets less goodwill and other intangible assets (Rose et al., 2008:484). Tier 2 refers to supplementary capital which involves the allowance (reserves) for loan and lease losses, subordinated debt capital instruments, mandatory convertible debt, intermediate-term preferred stock, cumulative perpetual preferred stock with unpaid dividends, and equity notes and other long-term capital instruments that combine both debt and equity features (Rose et al., 2008:484). The lower the CAR ratio is an indication of a weaker bank which correlates with the bank's financial constraints (Kumar and Murty, 2017:100).

Venkatesh and Suresh (2014:12) define total equities to total assets as a measure of the amount of equity a bank holds against total assets. Le (2017) stated that EQTA represents the percentage of total assets that are funded by shareholders' equities. Typically, a total equity to total assets is part of the CAMELS rating unlike CAR which is derived from the Basel accords. The higher the total equities to total assets ratio indicates lower performance which is associated with bank financial constraints (Le, 2017:6).

Kowanda, Pasaribu and Firdaus (2014:367) conducted a study on Indonesian banks over the 2009 – 2012 period covering 27 banks. The study found a negative relationship between CAR and bank financial distress. Similarly, Sjahril, Priharto and Parewangi (2014:20) found that CAR has no effect on the bank's distress. Sjahril et al. (2014:13) examined Indonesian banks over the 2002 to 2013 period. In contrast, Gupta (2014:95) undertook a study on Indian banks

over the 2009 to 2013 period using CAR to measure capital adequacy. The study revealed the significance of CAR in detecting the bank's financial shocks because of the United Bank of India's poor performance among others. The result was also demonstrated in the study of Nurazi and Usman (2016:139) over the 2002 to 2011 period on Indonesian banks; Majumder and Rahman (2016:239) over the 2009 to 2013 period on Bangladesh banks; Kumar and Murty (2017:100) over the 2012 to 2016 period on Indian banks; Vousinas (2018:10) over the 2007 to 2016 period on Greek banks and Hossain, Khan and Sadique (2018:6) over the 2007 to 2014 period who examined BRICS economies (e.g. Brazil, Russia, India, China and South Africa) and they all covered subprime crisis periods and afterwards. Thus, the results suggest that CAR proved significant in detecting the likelihood of a bank's financial distress.

Other studies used Tier 1 capital ratio on its own, for example, Baek, Balasubramanian and Lee (2015:101) scrutinised US commercial banks for the period of 2000 to 2013 covering the subprime crisis using quarterly data between failed and non-failed banks. The study revealed that Tier 1 risk-based capital ratio is a useful indicator and it is significant to detect the bank's financial distress. Venkatesh et al. (2014:5) undertook a study on Bahrain banks for the period spanning from 2006 to 2012 comprising of four banks. The study revealed that Tier1 capital ratio was low, which is associated with a bank's financial distress. This result was also demonstrated in the study of Kandrak (2014:4296), who found that it would be better to enter the crisis with higher Tier 1 capital ratio in order to absorb unanticipated losses with enough margins to enable the bank to continue as a going concern. Thus, the results suggest the significance of CAR and Tier 1 on detecting the likelihood of a bank's financial distress. Consequently, higher capital ratios (Tier 1) and lower liquidity creation lead to illiquidity amongst banks. This was supported by the works of Hossain et al. (2018:9), Casu et al. (2017:19), Distinguin et al. (2013:20), Horvath et al. (2014:17), and Kapan et al. (2017:15) who studied the influence of Tier 1 on the liquidity conditions of banks. In this view, the findings established the influence of capital adequacy on the liquidity conditions of a bank, which leads to liquidity shocks and financial distress in the long run.

The EQTA was used to measure capital adequacy during pre- and post-crisis periods of the 2007 – 2009 global financial crisis. Isanzu (2016:72) studied Tanzanian banks for the period

of 2006 – 2011 using EQTA ratio as a measure of capital adequacy. The study found that EQTA is significant in determining the probability of bank distress. Le (2017) conducted a study on the Vietnamese bank system over the 2008 – 2013 period, using EQTA to measure capital adequacy. The study found that private banks outperformed public banks and revealed the significance of EQTA in determining the likelihood of a bank's financial distress. Oliveira, Martins and Brandao (2015:10) studied US banks for the period from 2000 – 2014 and covered the subprime crisis. The study revealed the significance EQTA in detecting the likelihood of a bank's financial distress. The results are also consistent with the findings of Tatom and Houston (2011:13) for the period spanning between 1988 and 1994 of US banks; Papanikolaou et al. (2015:12) for the period spanning between 2002 and 2015 of US banks; Flori, Giansante and Pammolli (2016:34) for the period spanning between 2005 and 2014 for 180 countries; Affes and Hentati-Kaffel, (2017:5) for the period spanning between 2008 and 2013 of US banks; Papanikolaou (2017:6) for the period spanning between 2003 and 2009 of US banks. Thus, the findings suggest the positive significance of EQTA in detecting the likelihood of a bank's financial distress.

Thus, capital adequacy was included in the present study as part of the CAMEL rating system, because it has an influence on the liquidity of a bank. For example, Casu et al. (2017:19) found a strong relationship between capital adequacy (e.g. equity to total assets ratio and Tier 1 capital ratio) and liquidity capability by examining 1,367 banks in 17 European countries over the 1999 to 2013 period. Casu et al. (2017:19) argued that banks may opt to reduce liquidity creation when capital increases on the other hand. The result is consistent with the findings of Hossain et al. (2018:12) with regards to the relationship between capital ratios and liquidity ratios by examining BRICS economies. Thus, Tier 1 and 2 capital ratios were considered for the current study as a proxy of capital adequacy because it is also part of the new Basel III Accord.

2.5.2 Asset Quality

Asset quality is used to assess the repayment of loans and advances which are the main sources of bank incomes (Gowri et al. 2013:13 and Vousinas, 2018:8). Mazreku and Morina

(2016:12) stress that the performance of loans is important because it represents around 50 percent of assets of a bank. Venkatesh et al. (2014:9) pointed out that the major risk of banks originates from credit risk due to non-performing loans. The asset quality of a bank determines the safety and soundness of a bank against the loss of value of assets that lead to major risk and bankruptcy (Gupta, 2014:96). Assets quality refers to the risk associated with different assets such as loans and advances, investments, securities, off-balance sheets items, land, fixed assets and properties (Ishag, Karim, Zaheer and Ahmed, 2015:27). A large of body of literature has applied several financial ratios as proxies to measure banks' asset quality and determine their usefulness in identifying financial shocks and predicting bank distress.

Earlier studies employed the ratio of loan revenue to total revenue (LRTR), loans to assets (LA), real estate owned to total assets (RETA), real estate owned (Scheduled Items) to total assets (SRETA), total loans to total savings (TLTS), commercial and industrial loans, loans to REITs and mortgage bankers, construction loans, commercial real estate loans against total assets (CI2LN), gross charge-offs to net operating income plus loss provision (GCONI), net loans to total assets (NLTA), commercial and industrial loans to net loans (CILNNL), non-accrual loans to total assets (NALR) and loans past-due 90 days or more, still accruing interest to total assets (LPDR) as proxies to measure the asset quality of banking institutions. Typically, these studies used these financial ratios that are consistent with the CAMELS rating to evaluate the performance of loans and advances in banks.

LRTR measures the percentages generated from loan payments to the total revenue generated by a bank. LA is used to assess the total loans remaining as a percentage of the total assets of a bank. RETA measures the real estate owned as a percentage of the total assets of a bank. SRETA refers to those loans which are outstanding or default (Altman, 1977:453). TLTS is used to assess the percentages of total loans to the total deposits of a bank. CI2LN refers to all types of loans to the total assets of a bank. GCONI refers to the total of loans written off to the total income and loss provision. NLTA is defined as a percentage of the assets of a bank that represent loans (Venkatesh and Suresh, 2014:9). CILNNL refers to the percentage of commercial and industrial loans to the net loans of a bank. NALR refers to the percentage of non-performing

loans to the total assets of a bank. LPDR refers to outstanding loans that still increase the interest rate to the total assets of a bank. Accordingly, the higher these ratios are, the more risk the bank is facing (Isanzu, 2016:72).

Sinkey (1975:28) used LRTR and LA to measure the asset quality of banks and both proved significant in detecting the likelihood of banks' financial shocks, however, LRTR proved to be a good discriminator in identifying the banks' financial shocks. Alman (1977:454) used RETA, SRETA and TLTS to measure the asset quality of banks and found that all three are important variables and that they are accurate in identifying banks' financial shocks. Martin (1977:266) used CI2LN and GCONI to measure the asset quality of banks and found both variables as significant and accurate in identifying banks' financial shocks. Avery et al. (as cited by Demirguc-Kunt, 1989:10) used NLTA and CILNNL to measure asset quality and both proved significant in their study in identifying banks' financial shocks. Gajewski (cited by Demirguc-Kunt, 1989:11) applied NALR and LPDR to measure asset quality and both proved significant in detecting the likelihood of banks financial shocks. Thus, the findings suggest that all financial ratios proved significant in detecting the likelihood of banks financial shocks in the 1970-80s, but there was no sufficient evidence to support the said ratios.

Previous studies, a few financial ratios were introduced and tested to determine the likelihood of bank financial shocks in terms of asset quality. The performance of loans and advances in a large body of literature are analysed based upon the following set of variables. The variables are total provisions for loan losses to total loans (LLPTL), Net nonperforming assets to total assets (NPA), loan loss provisions to net interest income (LLPII), total loans to total assets (TLTA), Noncurrent assets plus other real estate owned to assets (NPERFV), Non-performing loans (NPL) to measure asset quality of banks, and net nonperforming assets to net advances (Net NPA) as proxies to measure asset quality. Henceforth, these studies used these financial ratios that are consistent with the CAMELS rating to evaluate the performance of loans within banks.

LLPTL refers to losses because of bad loans and defaults of a bank. The higher the LLPTL is, the worse the asset quality of a bank is (Le, 2017). NPA ratio is used as a measure of the risk associated with all loans that are overdue. The higher the NPA is an indication of lower performance which is associated with banks' financial shocks (Vousinas, 2018). LLPII means by creating a bank of reserve funds that help to offset accumulated bad debt (Venkatesh et al. 2014:9). The higher value of this ratio is associated with a higher level of banks' financial shocks (Le, 2017). TLTA is used to measure the value of total loans against the total assets of a bank. Accordingly, the higher the ratio is, the more risk the bank is facing (Isanzu, 2016:72). NPERFV refers to "assets that are past due 90 days or more plus assets placed in nonaccrual status" (Oliveira et al. 2015:12). The higher the NPERFV ratio is, the more risk facing a bank (Kandrac, 2014:4295). NPL refers to the percentage of loans that are overdue for a particular year observed (Nurazi and Usman, 2016:140). The higher the NPL ratio is, the more risk facing a bank (Kowanda et al. 2014:365). Net NPA shows the level of non-performing loans to advances (Srinivasan and Saminathan, 2016:48). The higher the Net NPA ratio is, the worse it is for the bank (Gautam, Joshi, Singh and Kumar, 2014:7).

Angora et al., (2011:5) undertook a study comprising of US and European commercial banks over the 2005 – 2009 period, using LLPTL to measure the asset quality of banks. The study found that LLPTL were significant, which is associated with higher levels of bank financial shocks and subsequently financial distress. Venkatesh et al. (2014:9) used LLPTL to measure the asset quality of Bahrain banks over the 2006 to 2012 period, and the study found that performance was average which means that it was not satisfactory or worse in that case. Le (2017:10) found that LLPTL was significantly positive between 2008 and 2013 for some Vietnamese banks which required government intervention. The significance of the LLPTL ratio in detecting the likelihood of bank financial shocks is also demonstrated in the study of Jabeen (2011:4) on Pakistan banks over the 2006 to 2010 period. Thus, the results suggest that LLPTL proved significant in detecting the likelihood of banks' financial shocks.

Affes and Hentati-Kaffel (2017:3) evaluated US banks over the 2008 to 2013 period using NPA to measure asset quality. The study indicated that NPA was low, which means a significant income to these banks. In contrast, Vousinas (2018:8) undertook a study that used

NPA to measure the asset quality of Greek banks between the 2007 and 2016 period. The study discovered that NPA was significantly positive with the deterioration of financial shocks which affected the credit supply for the Greek banking system. Kumar et al. (2017:101) analysed Indian banks over the 2012 to 2016 period using NPA to measure asset quality. The results stressed that NPA is significant to determine the likelihood of bank financial shocks. Makinen and Solanko (2017:16) analysed Russian banks over the 2013 to 2017 period using NPA to measure the asset quality of banks. The results indicated that NPA is significantly correlated with bank financial shocks. Thus, the results suggest that NPA proved significant in detecting the likelihood of bank financial shocks.

Venkatesh et al. (2014:5) scrutinised Bahrain banks over the 2006 to 2012 period, using LLPII to measure capital asset. The study indicated that LLPII were average, which means that it was not either satisfactory or worse to Bahrain banks. This result is also demonstrated in the study of Le (2017:10), which also indicated that LLPII were average for Vietnamese banks over the 2008 to 2018 period. Baek et al. (2015:101) also applied loss allowance to loans similar to LLPII in measuring asset quality and proved significant in increasing the likelihood of financial shocks. Thus, LLPII ratio obtained average results in detecting the likelihood of bank financial shocks.

The TLTA that is appearing in the contemporary studies corresponds with the ratio of loan to assets (LA) as in Sinkey's study (1975:28); commercial and industrial loans, loans to REITs and mortgage bankers, construction loans, commercial real estate loans against total assets (CI2LN) as in Martin's study (1977:263); and net loans to total assets (NLTA) as in Avery et al. (cited by Demirguc-Kunt, 1989:10). Isanzu (2016:72) applied TLTA to measure the asset quality of Tanzanian commercial banks between the 2006 and 2011 period and revealed that this ratio was higher for 8 out of 9 banks which are associated with more risk to banks. Le (2017:10) indicated that TLTA were average for the Vietnamese banking system for the 2008 to 2018 period. Mujumder et al. (2016:244) analysed Bangladesh banks over the 2009 to 2013 period, using TLTA to measure the asset quality of banks. The results revealed the significance of TLTA

in correlating with bank financial shocks. Thus, the results suggest that TLTA proved significant in detecting the likelihood of bank financial shocks.

Baek et al. (2015:97) evaluated US banks over the 2000 to 2013 period, using NPERFV to measure asset quality which corresponds to the ratio of loans past due 90 days or more that were still accruing interest to total assets (LPDR) as in Gajewski (cited by Demirguc-Kunt, 1989:11). The study indicated that NPERFV was low, which is associated with bank financial shocks and subsequently financial distress. This result is also demonstrated in the study of Tatom et al. (2011) that analysed US banks over the 2006 to 2010 period; Oliveira et al. (2015:23) that analysed US banks over the 2000 to 2014 period; and also in the study of Kandrak (2014:4297) that evaluated US banks over the 2008 to 2009 period. Thus, the results suggest that NPERFV proved significant in detecting the likelihood of bank financial shocks.

Srinivasan et al. (2016:48) examined Indian banks over the 2012 to 2014 period, using Net NPA ratio to measure asset quality. The results indicated that Net NPA ratio is a significant ratio to assess the asset quality of banks. The result is also demonstrated in the study of Kumar et al. (2017:101) which covered the 2012 to 2016 period of Indian banks, and Gautam et al. (2014:7) who covered the 1996 to 2009 period of Indian banks. Thus, the results suggest that Net NPA proved significant in detecting the likelihood of bank financial shocks. Overall, findings suggest that all ratios are reliable in determining the likelihood of bank financial shocks.

Kowanda et al. (2014:365) utilised NPL to total assets ratio to measure asset quality on Indonesian banks and found it to be significantly positive in detecting bank financial shocks. Similarly, financial shocks probabilities were also revealed in the analysis presented in Majumder et al. (2016:244) for the period spanning between 2009 and 2013 of Bangladesh banks; Affes et al., (2017:5) for the period spanning between 2008 and 2013 of US banks, and Vousinas (2018:19) for the period spanning between 2007 and 2016 of Greek banks. In contrast, Sjahril et al. (2014:20) found that NPL has no effect on the bank's financial distress. Sjahril et al.'s (2014) study examined Indonesian banks over the 2002 to 2013 period. Thus, the results overall suggest that NPL proved significant in detecting the likelihood of bank financial shocks. On the other hand, Hajja and Hussain (2013:15) revealed the relationship between credit risk and liquidity risk. Hajja et al.'s (2013) study found that higher non-performing loans lower liquidity

and consequently liquidity risk. Similarly, Berrios (2013:15) and Nibilar et al. (2018:17) arrived at the same sentiment that credit risk that is measured by NPL also causes liquidity risk and subsequently financial distress. Based on the literature and discussions with regulatory personnel, the NPL was considered for this study as a proxy of asset quality

2.5.3 Management Efficiency

Management efficiency refers to the ability of the bank's management to manage the resources in a profitable manner, by maximising profit on one hand and reducing the costs on the other hand (Isanzu, 2016:72; Le, 2017:6; and Vousinas, 2018:8). The management efficiency ratios are used to measure the growth and survival of a bank based on management competencies (Tripathi, Meghani, and Mahajan, 2014:120). Venkatech et al. (2014:11) stress that management efficiency refers to adherence to bank norms, knack to plan and being proactive in managing a changing environment, leadership and administration competencies. The management efficiency refers to abilities and competencies of the management in managing the resources and facilities of a bank. Based on the literature review, several financial ratios were used to measure the bank's operation efficiency.

Earlier studies employed cost to income ratio (CIR), other expenses to total revenue (OETR), net loans to total assets (NLTA), sensitive deposits to total deposits (SENSDTD), total agricultural loans to total loans (AGTOTTL), and commercial and industrial loans to total loans (CILTL) as proxies to measure the management efficiency of banks. Typically, these studies used these financial ratios that are consistent with the CAMELS rating to evaluate the bank's operational efficiency. The CIR comprises of expenses compared to the income of a bank. The higher costs are associated with a higher level of bank financial shocks (Angora et al. 2011:9). The OETR includes other expenses against the total revenue of a bank. Again, the higher costs are likely to contribute to bank financial shocks (Angora et al. 2011:9). NLTA is defined as a percentage of the assets of a bank that represent loans (Venkatesh et al. 2014:16). The higher the NLTA ratio is, the more risk facing a bank (Gaweski, 1988). SENSDTD is used to assess the

difference between loans and deposits in a particular period. The higher the SENSDTD ratio is means the liquidity risk facing a bank (Gaweski cited by Demirguc-Kunt, 1989:14). AGTOTTL refers to agricultural loans compared to the total assets of a bank, while CILTL refers to commercial and industrial loans to total loans. Again, the higher both ratios are, the higher the risk facing a bank (Gaweski cited by Demirguc-Kunt, 1989:14).

Sinkey (1975:25) conducted a study on US banks over the 1969 to 1972 period, using CIR and OETR to measure commercial bank's operating efficiency. The study indicated that the problem is that the banks experienced higher costs which are associated with bank financial shocks and consequently bank failure. The study also indicated that both ratios proved significant to determine the likelihood of bank financial shocks. Late in the 1980s, Gajewski (cited by Demirguc-Kunt, 1989:12) applied four ratios, namely, (1) NLTA, (2), SENSDTD, (3) AGTOTTL, and (4) CILTL to measure management efficiency and all four proved significant as determinants of the likelihood of bank financial shocks. The results indicated that all four ratios were high for problem banks. Contrarily, all four variables analysed by Gajewski (cited by Demirguc-Kunt, 1989:14) as measures of management efficiency all belong to asset quality not management efficiency as demonstrated by the majority of researchers (for example, see Sinkey, 1975:28; Altman, 1977:465; and Martin, 1977:263). Thus, the findings, although all are financial ratios, proved significant in detecting bank financial shocks, but there is no wide support from other studies.

Previous studies, financial ratios were introduced and tested to determine the likelihood of bank financial shocks in terms of operating efficiency. The banks operating efficiency are analysed based upon cost to income ratio (CIR) as a proxy to measure management efficiency, which is a variable that is appearing voluminously in most studies. CIR ratio refers to the ability of a bank to manage its operating costs against operating income (Venkatesh et al. 2014:14; Bonfim et al. 2017:12). The CIR ratio is the same as the ratio of total operating expenses to operating income that was used in the studies of Sinkey (1975:27). The higher ratio is likely to contribute to bank financial shocks (Angora et al. 2011:9; and Kowanda et al. 2014:365).

Angora et al. (2011:5) undertook a study consisting of US and European banks that were heavily affected by the 2007 to 2009 global financial crisis due to the collapse of major banks. The study covered the 2005 to 2008 period using CIR to measure the bank's operating efficiency. The study indicated that CIR is significantly positive and had meaningful signals prior to bank financial shocks. This result is also demonstrated in the study of Kandrac (2014:4298) over the 2008 to 2009 period of US banks concerning overhead costs that are associated with bank financial shocks. Kowanda et al. (2014:365) evaluated Indonesian banks and applied CIR to measure management efficiency. The study showed that the coefficient of CIR is significantly positive and is a good indicator of bank financial shocks. This result was also demonstrated in the study of Flori et al. (2016:38) who analysed 180 banks over the world between 2005 and 2014. The significance of CIR in detecting meaningful signals prior to bank financial shocks as evidence of US and European banks as a result of the 2007 - 2009 global financial crisis. Vousinas (2018:8) evaluated the Greek banking system over the 2007 to 2016 periods, using CIR to measure the bank's operating efficiency. The study concluded that the CIR ratio was satisfactory for Greek banks. On the other hand, Sjahril et al. (2014:19) found that CIR has an effect on the bank financial shocks. Sjahril et al., (2014:13) examined Indonesian banks over the 2002 to 2013 period. Thus, overall CIR proved significant in detecting the probability of bank financial shocks. Based on literature and discussions with regulatory personnel, the cost to income ratio (CIR) was considered for this study as a proxy of management efficiency.

2.5.4 Earning Quality

Earning quality is the ability of a bank to generate profit compared to the expenses it incurred (Venkatesh et al., 2014:13). Earning quality ratios are used to measure the profit of a bank and also the ability of a bank to maintain consistent earnings (Tripathi et al. 2014:123 and Gupta, 2014:98). From a profitability viewpoint, strong earnings from a bank side reflect a bank's ability to sustain itself in the present and future operations (Vousinas, 2018:8). With regards to earnings, it measures earnings over a specific period such as quarterly or annual bases. Karri et al. (2015:25) point out that bank income influences share prices as a result of the profit generated by a bank. The financial statements such as balance sheet and income statement are the

primary indicators of revenues, expenses and net income after tax deductions. Based on the literature review, several financial ratios were used to measure bank earnings and profitability.

In earlier studies, earnings and profitability were measured by revenue from state and local obligations to total revenue (SLRTR), net operating income to gross operating income (NOIGOI), Net income to total assets (ROA), Herfindahl index for the bank's local banking market (HERF), Semi-annual percentage change in total deposits within each bank's local banking market (PTD), Interest sensitive funds to total funds (ISFTF), Change in interest and fee income to earning assets (YLDEAC), Change in interest and depositors' dividends to earning assets (COSTFDC), and county-level oil and gas sector earnings to total county earnings (OGINR82) ratios as proxies to measure earnings quality. Typically, these studies used these financial ratios that are consistent with the CAMELS rating to evaluate the bank's earnings and profitability.

SLRTR refers to bonds issued by the state and the local government to commercial banks thereby compares bonds to total revenue. NOIGOI refers to net operating income compared to gross operating income. ROA is used to assess the ability of banks to generate income from asset management (Kowanda et al. 2014:366). Herfindahl index is the sum of quadrangles of market shares for commercial banks (Demirguc-Kunt, 1989:13). Barth et al. (1985:195) define PTD as a percentage change in total deposits within an SMSA or non-SMSA or non-SMSA county of the bank's home office. ISFTF refers to short-term deposits compared to the total funds the bank holds. YLDEAC refers to income and interest variation compared to the earnings of banks. COSTFDC refers to the interest generated and depositors' dividends paid compared to the earning assets of a bank. OGINR82 refers to county-level oil and gas sector earnings to total county earnings. Typically, a lower ratio indicates lower earnings of the financial institutions.

Sinkey (1975:25) evaluated US banks for the period from 1969 to 1972, using SLRTR to measure earning quality. The study indicated that the SLRTR ratio is significant in determining the likelihood of bank financial constraints as problem banks were worsening. Altman (1977) improved on Sinkey's work by utilising NOIGOI as a measure of bank earnings and found a

positive effect, and it showed that it is useful in identifying bank financial shocks. Martin (1977:249) improved on Altman's work by utilising ROA as a measure of bank earning and found it to be an important and accurate variable in identifying bank financial shocks. The ROA proved to be a best discriminator in determining the likelihood of bank financial shocks (see also Barth et al. 1985:195; Benston cited by Demirguc-Kunt, 1989:11). On the other hand, Avery et al. (cited by Demirguc-Kunt, 1989:10) also used Herfindahl index for the bank's local banking market (HERF) and PTD, and both were found to be positive and significant variables in identifying bank financial shocks. Barth et al. (1985:195) also applied ISFTF in their study to measure earning quality and proved positive and statistically significant in determining the likelihood of bank financial constraints. Benston (cited by Demirguc-Kunt, 1989:11) applied YLDEAC and COSTFDC to measure earning quality in banks and both proved positive and statistically significant in identifying bank financial constraints. Finally, Gajewski (cited by Demirguc-Kunt, 1989:11) also used OGINR82 to measure the earning quality of banks. The study found that OGINR82 is significant in detecting bank financial shocks. Based on the literature review, all financial ratios used to measure bank earnings proved significant in detecting meaningful signals prior to bank financial constraints but there is no wide support from other researchers, except ROA ratio that received overwhelming support.

Previous studies, few financial ratios were tested to determine the likelihood of bank financial shocks in terms of earnings and profitability. The bank's earnings and profitability are analysed based upon 2 (two) variables that appear in most studies. These variables are Return on Assets (ROA) and Return on Equity (ROE) and both are consistent with the CAMELS rating as proxies to measure earning quality. ROA refers to the ability of a bank to generate income from asset management (Kowanda et al. 2014:366). ROA corresponds to the ratio of net income to total assets as in Martin (1977:263), and Barth et al. (1985:195). ROE refers to the ability of a bank to generate income in relation to equity (Nurazi et al. 2016:140). Accordingly, the lower value of ROA and ROE ratio is the meaningful signals of bank financial shocks (Le, 2017:6).

Angora et al. (2011:5) analysed US and European banks over the 2005 to 2009 period, using ROA to measure earnings and profitability. The results indicated that the coefficient of ROA was significantly lower and contributed to bank financial shocks. Oliveira et al. (2015:10)

scrutinised US banks over the 2000 to 2014 period, using ROA to measure earnings and profitability. The results also revealed that ROA was significantly lower and contributed to bank financial shocks. Kandrac (2014:4297) found that ROA is a potential indicator of bank financial shocks, demonstrating lower income of US banks during the 2007 - 2009 global financial crisis. This result is also demonstrated in the analysis presented by Tatom et al. (2011:13) who analysed US banks over the 2006 to 2010 period; Kowanda et al. (2014:366) for a study period of 2009 to 2012 on Indonesian banks; Kumar et al. (2017:104) for a study period of 2012 to 2016 on Indian banks; and Affes et al. (2017:5) for a study period of 2008 to 2013 on US banks. In contrast, Isanzu (2016:72) undertook a study on Tanzanian banks over the 2006 to 2011 period using ROA to measure earnings and profitability. The study indicated that all banks have significantly higher income. The result is also demonstrated in the study of Vousinas (2018:8) over the 2007 to 2016 period for the Greek banking system. Overall, the results suggested that poor earnings and profitability during the 2007 to 2009 global financial crisis contributed to the bank financial shocks especially to US and European banks. In addition, the results suggest that ROA proved significant in determining the likelihood of bank financial shocks. Further to this, the works of Panigrahi (2014); Ghurtskaia and Lemonjava (2016); Pradhan and Shrestha (2016) documented the relationship between ROA and banks' liquidity conditions. Panigrahi and Shrestha (2016) argued that focussing on profit maximisation lowers liquidity on one hand, while focusing on liquidity lowers the profit on another hand. Thus, Panigrahi and Shrestha's (2016) study established a correlation between ROA and the liquidity conditions of banks. Ghurtskaia et al. (2016:1611) scrutinised the relationship between bank earnings and the liquidity conditions of the Georgian banks sector over the period from 1998 to 2017. Ghurtskaia et al. (2016) found a positive correlation between ROA as a measure of bank earnings and liquidity conditions measured by liquid assets to total assets (LA_TA). Pradhan et al. (2016:7) found a positive relationship between bank profit and the liquidity conditions of banks. Pradhan et al. (2016) examined the impact of liquidity on the Nepalese sector performance by utilising liquid assets and total assets as a liquidity indicator and ROA as an earnings indicator. Pradhan et al. (2016) found that an increase of bank liquidity reduces the profit of a bank and leads to bank financial shocks.

Vousinas (2018:11) utilised ROE to measure earnings and profitability over the same period on Greek banks. The study revealed a positive sign which refers to marginal profits and a stable banking system. Kumar et al. (2017:104) analysed Indian banks over the 2012 to 2016 period using ROE to measure management competence rather than earnings. The study found that ROE is positive and significant in predicting bank financial shocks. On the other hand, Flori et al. (2016:8) scrutinised 180 banks over the world between the 2005 and 2014 period. The study discovered that ROE was significant which is associated with stable banking. The same result was also demonstrated in the study of Majumder et al. (2016:249) on the significance of ROE on bank earnings and identifying bank financial shocks. Majumder et al. (2016) examined as management competence ratio was examined by other researchers as earnings variables. Thus, the results suggest that ROE proved significant in determining the likelihood of bank financial shocks. Based on the reviewed literature and discussions with regulatory personnel, the return on assets ratio (ROA) is considered for this study as a proxy of earning quality.

2.5.5 Liquidity

Liquidity management refers to the ability of a bank to satisfy depositors' withdrawal and maintain adequate capital (Isanzu, 2016:72). Liquidity ratios are used to measure the ability of a bank to meet its commitments whenever they come due, for example, the depositors' withdrawals demand (Gupta, 2014:99 and Le, 2017:7). Venkatesh et al. (2014:15) argue that the inability to satisfy these commitments will affect performance and lead to bank financial constraints. Ishag et al. (2015:45) clarified the importance of liquidity in terms of avoiding liquidity shortfalls, which can prompt bank financial shocks. In order to avoid the liquidity shortfall, the bank is required to hold high liquid assets that can be easily changed into cash, forecast future cash inflow and outflow, and be able to obtain loans from the inter-bank market (Ishag et al. 2015:43). Gowri et al. (2013:14) pointed out that liquidity risk should be taken into account by protecting the image of the banks and also to investing a high percentage in high return undertakings, whilst generating income that is available to meet depositors' demands.

Based on the literature review, several financial ratios were used to measure the liquidity position of the banks.

In earlier studies, there were two traditional ratios which received attention, namely, liquid assets to total assets (LATA) and natural logarithm of total assets (LNTA) as proxies to measure liquidity capability. Barth et al. (1985:195) define LATA as “liquid assets include total cash plus investment securities including accrued interest less valuation allowance to total assets”. The higher ratio is indicating the high liquid assets a bank holds (Angora et al. 2011:10). Barth et al. (1985:196) define natural logarithm of total assets as an indicator of greater liquidity, because they argued that larger financial institutions have a greater ability to borrow than small institutions in order to avoid unanticipated liquidity demands.

Barth et al. (1985:186) examined US saving and loan associations, consisting of 318 failed and 588 non-failed saving and loan associations over the 1980 to 1984 period. The study applied LATA and LNTA to measure liquidity capability of saving and loan associations. The results indicated that both ratios were statistically significant as determinants of the position of liquidity within saving and loan associations. Thus, the results revealed the significance of both ratios in detecting bank financial shocks and subsequently financial distress based on failed and non-failed saving and loan associations. In the 1980s, not much attention was paid to liquidity capability in banks, because there were no other researchers to support the significance of these ratios in determining the liquidity position of banks.

Previous studies, several financial ratios were introduced and tested to determine the likelihood of bank financial shocks in terms of liquidity capability. These include liquid assets to total assets ratio (LATA), liquid assets to total customer deposits ratio (LADEPO), liquid assets to total customer deposits and short-term market funding ratio (LADPSTMD), loans to total assets ratio (LOTA), total loans to total customer deposit ratio (LODEPO), and total loans to total customer deposits and short-term market funding ratio (LODPSTMD) as proxies to measure liquidity capability within banks. LATA is defined as “liquid assets include total cash plus investment securities including accrued interest less valuation allowance to total assets” (Barth et

al., 1985:196). The lower the ratio indicates fewer liquid assets a bank holds (Angora et al., 2011:10). LADEPO ratio is used to measure the ability of banks to meet the obligations from customers when they become due (Mishra and Aspal, 2013:49; Srinivasan et al. 2016:48). The lower the ratio means that the bank faces the risk of unexpected withdrawals from savers (Angora et al. 2011:10). LADPSTMD ratio indicates the percentage of short-term obligations that can be reclaimed at short notice from bank assets in the event of unanticipated withdrawals (Venkatesh et al. 2014:17). The lower the ratio means that the bank will not be in a position to repay its short liabilities (Le, 2017:7). LOTA ratio is used to measure the asset risk related to mismatches in terms of the maturity of loans (Arena, 2005:8). The higher the ratio means the less liquid the bank has and that has higher a failure probability (Venkatesh et al. 2014:16). LODEPO ratio refers to the ability of a bank to transform deposits into loans that are offered to borrowers (Murthy, 2003:17). If banks are lending more money to customers, then it becomes difficult to repay their current liabilities (Tatom et al. 2011:11). Accordingly, the higher the ratio, the higher the risk facing the bank in the case of unexpected deposit withdrawals by savers (Angora et al. 2011:10). LODPSTMD ratio shows the degree of a bank in terms of illiquid loans while it is expected to meet deposit withdrawals. The higher the ratio means that the bank faces the risk of unexpected withdrawals from savers (Le, 2017:7).

Angora et al. (2011:5) conducted a study on US and European banks, consisting of 574 from the US and 207 European banks over the 2005 to 2009 period which covered subprime crisis. The study utilised LATA ratio which was also used by Barth et al. (1985:195) to measure the liquidity capability of banks. The results indicated that LATA is not significant. Thus, the results suggest that liquid assets to total assets ratio (LATA) is not statistically significant in detecting bank financial shocks. Majumder et al. (2016:239) scrutinised Bangladesh banks over the 2009 to 2013 period, using LATA to measure liquidity capability. The study found that LATA was significantly positive and is good in detecting the probability of bank financial shocks. Vousinas (2018:7) analysed Greek banks over the 2007 to 2016 period using LATA to measure the liquidity capability of banks. The results indicated that liquidity was improving in the last years of the reviewed period. Makinen et al. (2017:9) analysed Russian banks over the 2013 to 2017 period using LATA to measure the asset quality of banks. The results indicated that LATA is significantly correlated with bank financial shocks. Thus, the results demonstrated the

significance of LATA in measuring liquidity. Based on literature, non-performing loans (NPL) have some effects on liquidity conditions in banks. The works of Berrios (2013:15), Hajja and Hussain (2015:255), and Nabilar and Khushiri (2018:17) documented the influence of NPL on liquidity conditions in banks.

Majumder et al. (2016:239) scrutinised Bangladesh banks over the 2009 to 2013 period using LADEPO to measure liquidity capability. The study found that LADEPO is significant in detecting the probability of bank financial shocks. Kumar et al. (2017:100) scrutinised Indian banks over the 2012 to 2016 period using LADEPO to measure liquidity capability. The results revealed the significance of LADEPO ratio in identifying bank financial shocks. The result is also demonstrated in the study of Affes et al. (2017:5) over the 2008 to 2013 period of US banks, and Lallour and Mio (2016:12) examined US and European banks over the 2010 to 2014 period. Overall, the results suggest the significance of LADEPO in determining the likelihood of bank financial shocks.

Kumar et al. (2017:100) examined Indian banks over the 2012 to 2016 period using LADPSTMD to measure liquidity capability. The results discovered the significance of the LADPSTMD ratio in foreseeing bank financial shocks. Flori et al. (2016:7) analysed 180 banks over the world between the 2005 and 2014 period. The study utilised LADPSTMD to measure liquidity capability. The study revealed that LADPSTMD was significant and associated with bank financial shocks. The findings suggest that LADPSTMD is significant to explain the bank probability of financial constraints.

Oliveira et al. (2015) analysed US banks over the period from 2000 to 2014, using LOTA to measure liquidity capability. The study found that LOTA is not a significant determinant of the likelihood of bank financial shocks. In contrast, Angora et al. (2011:5) scrutinised US and European banks over the 2005 to 2009 period. The study revealed that LOTA is significantly positive and reliable in identifying bank financial shocks. The findings suggest that LOTA is significant to explain the bank's probability of financial shocks based on both US and European banks which experienced difficulties in the recent global financial crisis. Berrios (2013:15) found that credit risk and particularly the loans to deposits ratio have an effect on LOTA which could

worsen the liquidity conditions in banks. Berrios study's examined US banks over the 2005-2009 period by exploring the relationship between credit risk and bank financial performance.

Tatom et al. (2011:9) scrutinised US banks over the 2006 to 2010 period. The study used LODEPO to measure the liquidity capability of banks. The study revealed that LODEPO were significantly negative, which is not associated with bank financial shocks. The result is also demonstrated in Angora et al.'s (2011:5) study that analysed US and European banks over the 2005 to 2009 period and in the study by Sjahril et al. (2014:13) study that examined Indonesian banks over the period from 2002 to 2013. In contrast, Affes et al. (2017:3) utilised LODEPO to measure the liquidity position of US banks between 2008 and 2013. The study found that LODEPO were too high, which means that banks had enough liquidity to meet obligations. Similarly, Desta (2016:13) found that LODEPO were less satisfactory and banks had enough liquidity to meet their obligations. Desta's study covered seven (7) banks from Africa over the 2012 to 2014 period as rated by the Global Finance Magazine. Similarly, Oliveira et al. (2015:23) found that LODEPO is significant in identifying bank financial shocks in their study of US banks over the 2000 to 2014 period. The result is also demonstrated in the study of Gautan et al. (2014:8), which examined Indian banks over the 1996 to 2009 period. Thus, results suggest that LODEPO is significant in determining the likelihood of bank financial shocks.

Flori et al. (2016:10) applied LODPSTMD to measure the liquidity conditions of banks over the 2006 to 2010 period. The study consisted of 180 banks across the world. The result indicates that LODPSTMD was significantly positive which is associated with bank financial shocks. The result is also demonstrated in the study of Angora et al. (2011:5) that examined US and European banks over the 2005 to 2009 period. Thus, results suggest the significance of LODPSTMD in detecting the likelihood of bank financial shocks. This study considered all the liquidity ratios used in the literature as proxies of liquidity capability. Consequently, the current study employed the same liquidity ratios as previous studies by comparing them with Basel III liquidity ratios.

2.5.6 Sensitivity to Market Risk

Sensitivity to market risk refers to the ability of a bank to identify, monitor, manage and control market risks that may impact the income (Tripathi et al. 2014:134 and Karri et al. 2015:31). It is used to measure the market risks that are associated with the movement of prices such as interest rates, foreign exchange rates, commodity prices and equity prices on how they impact the income of a bank (Le, 2017:7). Venkatesh et al. (2014:18) stress that sensitivity to market risk looks at how the banks react to risks that adversely affect earnings and are derived from the movement of prices in terms of interest rate, commodity prices, equity prices, and currency rates. Based on the literature review, several financial ratios were used to measure the risks that adversely affect earnings, which could lead to bank financial shocks and subsequently financial distress.

Earlier studies used corporate structure ratio (CSR) as a proxy to measure sensitivity to market risk as part of the CAMELS rating framework. CSR is defined as “corporate structure variable equals zero if the bank is independent or a one-bank holding company, it equals the number of banks in the multibank holding company if a subsidiary” (Demirguc-Kunt, 1989:11). Gajewski (cited by Demirguc-Kunt, 1989:11) undertook a study on US banks over the 1984 to 1986 period, using CSR to measure sensitivity to market risk. The study focused on failed and non-failed banking institutions. The study indicated that the CSR ratio was significantly positive and it could detect the probability of bank financial shocks. Thus, the findings suggested the significance of CSR in determining the likelihood of bank financial shocks. But this was only one study in that time to rely on its findings.

In previous studies, a few financial ratios were introduced to measure the risks that adversely affect the earnings of financial institutions. These are rate-sensitive assets, volatile liabilities ratio, total securities over the total assets, interest spread ratio and 10 years and 3-month T-bill rate. The rate-sensitivity asset refers to assets or a liability which is “repriced at or near the current market interest rates within a maturity bucket” (Saunders et al., 2017:205). Accordingly, changes in the currency value and cumulative gaps adversely affect the bank’s

income (Saunders et al. 2017:205 and Le, 2017:7). Volatile liabilities ratio refers to deposits and borrowed funds, for example, Federal funds which are very interest sensitive which the bank expects withdrawals during a certain period (Rose et al., 2008:358). Accordingly, a change in interest rates adversely affects bank income and lowers the ratio which means the better the bank (Rose et al., 2008:358; Vousinas, 2018:9). The total securities over the total assets refer to total securities divided by the total asset of a bank (Baek et al., 2015:100). Accordingly, income from securities is volatile from time to time and that affects the income for a bank's performance (Flori et al., 2016). The interest spread ratio refers to the difference between the interest generated and the interest paid (Tripathi et al. 2014:134). The higher the ratio is, the better it is for banks in terms of increases in profits (Tripathi et al. 2014:134). The T-bill rate refers to a "change in the slope of the yield curve, given by the change in the quarterly difference between the 10-year US T-bill rate and the 3-month US T-bill rate divided by total earning assets" (Papanikolaou et al., 2015:19). Accordingly, the larger spread provides optimism to investors about the economy because of the predicted future earnings (Tatom et al., 2011:11).

Le (2017:4) undertook a study on Vietnamese banks over the 2008 to 2013 period, using the rate-sensitive assets to measure their sensitivity to market risks. The results revealed that rate-sensitive assets are significant in detecting the likelihood of bank financial shocks by differentiating between best and worst-performing banks. Thus, the result suggests the significance of rate-sensitive assets to measure sensitivity to market risks. The works of Casu et al., (2017:20), and Banti and Phylaktis (2019:86) also documented the effects of interest rate on the liquidity conditions of banks. Casu et al., (2017:20) found that an increase of interest rate can affect bank income and liquidity creation. Banti et al., (2019:86) found that any changes to repo rates leads to tightened liquidity conditions in banks and that contributes to the increase in houses prices.

Vousinas (2018:7) examined Greek banks between the 2007 and 2016 period using volatile liabilities ratio to measure sensitivity to market risks. The study revealed that the volatile liabilities ratio was low and were significant in identifying bank financial shocks. Thus, the result suggests the significance of volatile liabilities ratio to measure sensitivity to market risk, but there is no wide support from the available literature. Flori et al., (2016:7) undertook a study

consisting of 180 countries over the 2005 to 2014 period. The study utilised total securities over the total assets to measure sensitivity to market risk. The results indicated that total securities over the total assets were positive and significant in explaining bank financial shocks. Baek et al. (2015:96) analysed US banks over the 2000 to 2013 period, and used total securities over total assets to measure sensitivity to market risk. The result showed that total securities over total assets were deteriorating and is significant in identifying bank financial shocks. Thus, the result suggests that total securities over the total assets proved reliable in detecting the likelihood of bank financial shocks, though the literature is limited to support the findings.

Tripathi et al., (2014:111) conducted a study on Indian banks covering the 2004 to 2013 period. The study applied interest spread ratio to measure sensitivity to market risks. The results revealed that interest spread ratio is significant in identifying bank financial shocks as a result of interest gained and interest paid by banks. The result was also demonstrated in the analysis of Karri et al., (2015) over the 2010 to 2014 period on Indian banks. Distinguin et al., (2013:21) found that an increase in the spread between the one-month interbank rate and the policy rate of the regulatory bodies leads to illiquid in the banking system. Thus, the result suggests the significance of interest spread ratio to measure sensitivity to market risk and it has some effects on liquidity conditions in the banks.

Tatom et al., (2011:9) undertook a study of US banks in which the sample spanned the period from 2006 to 2010. The study utilised 10-year and 3-month T-bill rate to measure the sensitivity to market risk of banks. The results indicated that 10 year and 3-month T-bill rate have positive effects on bank financial shocks. The results were also demonstrated in the analysis of Papanikolaou et al. (2015:13) which examined US banks over the 2002 to 2015 period. Thus, results suggest the significance of 10-year and 3-month T-bill rate to measure sensitivity to market risks.

2.6 Basel Accords

2.6.1 Basel I Accord

The first accord was introduced in 1998 and it is known as Basel I. Basel I focused on two main sections, (1) the definition of capital and (2) the structure of credit risk weights. The definition of capital for supervisory purposes consists of two components: Core capital (Tier 1) and Supplement capital (Tier 2). The structure of credit risk weighs the denominator of the Basel formula whereby the sum of risk-adjusted assets plus off-balance sheet items are adjusted to risk.

Tier 1 consists of (1) Paid-up share capital/common stock, and (2) Disclosed reserves. Tier 2 consists of (1) Undisclosed reserves, (2) Asset revaluation reserves, (3) General provisions/general loan-loss reserves, (4) Hybrid (debt/equity) capital instruments, and (5) Subordinated debt. Concerning credit risk weights, there are four (4) credit risk weights: 0%, 20%, 50% and 100%. The 0% is for cash or central bank claims; 20% is for the interbank claim; 50 is for residential mortgages; and is 100% allocated to all commercial and consumer loans.

2.6.2 Basel II Accord

In June 2004, the Basel Committee on Banking Supervision (BCBS) introduced a new capital adequacy framework, commonly known as the Basel II accord, with the aim of providing a buffer against bank failures. The Basel Committee introduced Basel II to respond to the inadequacy of the 1988 first Capital Accord (Basel I), which focused only on credit risks thereby ignoring other types of risk associated with banks. It would be useful to mention briefly the main elements of Basel II. The capital adequacy framework (Basel II) consists of three pillars which aim to contribute to the safety and soundness of the financial system's stability. These pillars are minimum capital requirements, supervisory review process, and market discipline.

The first pillar focuses on minimum capital requirements for three major risk exposures associated with banks; credit risk, operational risk and market risk by forcing banks to have enough capital in place to cover them against unexpected losses. Pillar 2 is concerned with supervisory reviews that aim to ensure that banks have enough capital in place to cover the risks they were taking as well as to use better risk management techniques in monitoring and managing the risks that banks face (BCBS, 2004:204). The third pillar which is about market discipline aimed to strengthen the first two pillars' minimum capital requirements and the supervisory review process in order to fulfil its purposes through increased information disclosure. In this respect, market discipline requires firms to conduct their business in a safe and sound manner.

2.6.3 Basel III Accord

Recently, after the 2007-09 global financial crisis, it became clear that Basel II was not adequate to prevent the crisis. Subsequently, Basel III was introduced in 2010 with the aim to strengthen global capital and liquidity regulations with the goal of promoting a more resilient banking sector (BCBS, 2010). Furthermore, the new accord aims to prevent future financial crisis and seeks to address the perceived insufficiencies of the Basel II accord. Basel III builds on the Basel II deficiencies, for example, strengthened capital requirements, risk management and supervision, and market discipline. In addition, liquidity regulation was introduced for the first time. Basel III consists of three pillars and liquidity regulations.

The first pillar consists of capital requirements, risk coverage and containing leverage. With regards to capital requirements, it focuses on the minimum level of capital; the non-viability of a bank; the capital conservation buffer, and the countercyclical buffer. With regards to risk coverage, the covered risk is associated with credit risk or default. Concerning the containing of leverage, the focus is on non-risk-based leverage ratio that includes off-balance sheet items.

The second pillar enhanced risk management and supervision by strengthening firm-wide governance and risk management in all areas of a bank. The third pillar revised market discipline by strengthening disclosure requirements, for instance, securitisation exposures, sponsorship of off-balance sheet vehicles, enhanced regulatory capital and disclosure of calculation of capital ratios. With regards to the liquidity regulation, two standard ratios have been introduced, namely, LCR and NSFR. In addition, principles for sound liquidity risk management and supervision and supervisory monitoring have been strengthened. The next section presents the review of empirical literature related to the use Basel III accord.

2.7 Basel III Liquidity Measurement Ratios

Basel III liquidity ratios are measures that are aimed to address maturity mismatches within banks in both the short-term and long-term. On the aftermath of the 2007 – 2009 global financial crisis, the Basel Committee of Banking Supervision (BCBS) introduced the Basel III accord consisting of liquidity ratios in 2010. The Basel Committee's comprehensive aim is to strengthen global capital and liquidity regulations with the goal of promoting a more resilient banking sector (BCBS, 2010). Furthermore, the new accord aims to prevent future financial crises and address the perceived insufficiencies of the Basel II accord highlighted in the literature.

Under Basel III, the Committee introduced the Principles for Sound Liquidity Risk Management and Supervision, “Sound Principles”, as guidelines for managing liquidity risk at banks and enhancing supervision from a regulatory institution's perspective. In order to complement this, the Basel Committee also announced the two minimum standards to determine asset liquidity and funding liquidity. These standards are Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR). The newly proposed LCR ratios build on traditional liquidity ratios such as those based upon the CAMELS ratings that are used by banks to evaluate the risk associated with liquidity events (BCBS, 2013:1). The NSFR is aimed to complement LCR and supervisory efforts in measuring liquidity risk in terms of long-term funding mismatches (BCBS, 2013). At the aftermath of the 2007-09 global financial crisis, few empirical

studies have been carried out internationally, specifically in the developed countries such as the US and European countries about the effectiveness of LCR and NSFR ratios in identifying banks liquidity shocks. Thus, these studies assisted in this analysis of literature. The rest of this study is organised as follows: it discusses LCR and NSFR by reviewing empirical studies that have been conducted and determines the accuracy of these liquidity ratios in identifying the liquidity shocks in banks.

2.7.1 Liquidity Coverage Ratio (LCR)

Hong, Huang and Wu (2013) define LCR as “the ratio of the stock of high-quality liquid assets to the total net cash outflows over the 30 calendar days”. In this regard, banks are required to hold enough liquid assets that can be converted into cash within 30 calendar days as specified by the LCR rules (BCBS, 2013:4). The denominator is the net cash outflow that is subject to 30 days, which differentiates between incoming cash flows and outgoing cash flows (Duijm and Wierst, 2016:387). Accordingly, the lower the LCR is, the higher the maturity mismatch of banks which is associated with bank financial shocks (Van den End and Kruidhof, 2012:5; Cucinelli, 2013:44). According to the LCR definition, the stress scenario encompasses idiosyncratic and market-wide shocks which have three notches; the run-off of a proportion of retail deposits, wholesale funding capacity, and short-term financing with collateral and counterparties.

Under the LCR, the stock of high-quality liquid assets is divided by the total net cash outflows over the next 30 calendar days, and it is required to be above 100% (Wu and Hong, 2012:6). This is expressed as follows:

$$LCR = \frac{\text{High – quality liquid assets}}{\text{Total net cash outflows over 30 days}} \geq 100$$

The LCR has two elements as mentioned above. The stock of high-quality liquid assets (HQLA) encompasses assets with the following fundamental characteristics; low risk, ease and

certainty of valuation, low correlation with risky assets, and listed on a developed and recognised exchange market. In addition, market-related characteristics encompass assets that have an active outright sale in a sizeable market, have low volatility and flight to quality (BCBS, 2013:7). With regards to the minimum level of liquidity, “Level 1” assets can be included without limit, while “Level 2” assets can only comprise of up to 40% of the Stock (BCBS, 2013:11).

Under the HQLA calculation, Level 1 assets encompass coins and bank notes, qualifying marketable securities from the sovereign Public Sector Entity (PSE) and multinational development banks, qualifying central bank reserves, and domestic sovereign or central bank debts. These are assigned a 100% risk-weight. Level 2 assets comprise Level 2A assets and Level 2B assets. Level 2A assets are sovereign, central bank, multilateral development banks, and PSE assets, qualifying for 20% risk weighting; qualifying corporate debt securities rated AA- or higher; and qualifying covered bonds rated AA- or higher, and all are assigned an 85% risk-weight. Level 2B assets are qualifying RMBS that is assigned a 75% risk-weight; qualifying corporate debt securities rated between A+ and BBB- assigned 50% risk-weight and qualifying common equity shares assigned a 50% risk-weight. Under the LCR, the term total net cash outflows mean the total expected cash outflows minus the total expected cash inflows within 30 calendar days as specified under the stress scenario (BCBS, 2013:6). These include various types of liabilities and off-balance sheet activities in calculations. The total net cash outflows comprise of retail deposits and unsecured whole funding, secured funding, and other additional requirements.

From regulatory perspectives, BCBS and the European Banking Authority (EBA) have also conducted monitoring studies, but they have used non-public bank data. The study by BCBS covered Group 1 and 102 Group 2 banks across 26 nations from Europe, the US, Asia, South America, and South Africa. Group 1 consists of international active banks under Tier 1 capital, while Group 2 consists of all other banks.

Recently, after the 2007-09 global financial crisis, BCBS (2011) undertook a monitoring exercise of group 1 and 2 banks. The monitoring results revealed that LCR for Group 1 banks

were 90% and below the 100% required by LCR, while Group 2 banks were 83%, again below the 100% required by LCR. Similarly, EBA's (2011:1) monitoring results revealed that LCR for Group 1 banks were 71% and below the 100% required by LCR, while Group 2 banks were 70%, again below the 100% required by LCR. This suggests that there was a shortfall in terms of the total assets to meet the minimum requirements during the 2007-09 global financial crisis.

In 2014, both BCBS and EBA also carried out a liquidity monitoring exercise. BCBS (2014) found that LCR for Group 1 banks were 125.3% which is above the 100% required by LCR, while Group 2 banks were 143.7%, again above the 100% required by LCR. Accordingly, 85% reported banks met and exceeded the required 100% by LCR (BCBS, 2014:3). On the other hand, EBA (2014:8) revealed that Group 1 banks were 123.7% which is above the 100% required by LCR, while Group 2 banks were 149.6%, again above the 100% required by LCR. Accordingly, 72% of the banks met the minimum requirements (EBA, 2014:8). This suggests that banks made some improvements subsequently from the first monitoring exercise in 2011 and met the minimum requirements.

In the last monitoring exercise in 2017, BCBS (2018:8) found that LCR for Group 1 banks were 131.0% which is above the 100% required by LCR, while Group 2 banks were 163.8%, again above the 100% required by LCR. Accordingly, 80% of the reported banks met and exceeded the required 100% by LCR (BCBS, 2018:8). Similarly, EBA (2018:8) monitoring results revealed that for Group 1, banks were 137.6% which is above the 100% required by LCR, while Group 2 banks were 178.5%, again above the 100% required by LCR. Accordingly, 100% banks met the minimum requirements (EBA, 2018:8). Thus, results suggest that banks made improvements, subsequently from 2011 and 2014 monitoring exercises in meeting the minimum requirements.

From academic perspectives, several studies examined LCR to determine the likelihood of bank financial shocks. Wu et al. (2012:7) conducted a study on the US banking system by assessing the newly proposed LCR on identifying banks financial shocks using the call report data over the 2001 and 2011 period. The results indicated that LCRs were 99% on average,

which had been in a downward trend from 2001 to 2007. Furthermore, the study found that the newly proposed LCR is not a better predictor of bank financial shocks compared to traditional liquidity risk measures based upon the macroeconomic indicators namely net short-term asset ratio, current ratio, and government securities ratio. De Haan and Van Den End (2012:13) conducted a similar study on Dutch banks containing 62 banks, accounting for 99% of the total assets of the Dutch banking sector. The sample periods were 2004 to 2010, representing a period before and during the global financial crisis which started in 2007 to 2009. The study used monthly data containing both the cash inflows and outflows. The result revealed that most banks hold adequate liquidity assets such as bonds to buffer against the stock of liquid liabilities. Hlatshwayo, Petersen, Mukuddem-Petersen and Gideon (2013:8) examined 391 banks across 36 countries over the 2002 to 2012 period. The study evaluated LCR against traditional ratios based upon macroeconomic indicators such as London Interbank offered Rate-Overnight Indexed Swap Spread (LIBOR-OISS), Basel II Tier 1 capital ratio, government securities ratio and brokered deposit ratio in predicting bank distress. The study finds that LCR have low predicting power on bank financial shocks compared to traditional liquidity ratios. Cucinelli (2013:44) undertook a study of 575 Eurozone banks over the 2006 to 2010 period. The study utilised LCR to measure the probability of bank financial shocks. The results revealed that there is a relationship between LCR and bank financial shocks. Kochanski (2014) examined Polish banks over the 1996 to 2012 period by calculating LCR in measuring liquidity capability. The study found that Polish banks deteriorated before and worsened during the recent financial crisis. Kochanski's (2014:1) study argued that on average Polish banks can meet the LCR requirement. Kutum and Hussainey (2014:162) conducted a study based on 5 major Canadian banks which accounted for more than 90% of the total banking assets. The study covered data for the period from 2009 to 2013. Due to lack of data, the study utilised quick ratio in exception of LCR in order to determine Canadian banks' readiness in complying with LCR. The results indicated that Canadian banks will be able to meet the LCR requirements upon implementation.

Furthermore, Duijm et al. (2016:390) undertook a study of 59 Dutch banks over the 2003 to 2013 period, using monthly data to measure LCR. The study used DLCR similar to LCR, but this differs on the regulatory weights. The shortcomings of this study in terms of the results is that the formula used did not distinguish whether the LCR were above or below the minimum

requirement. Accordingly, the DLCR proved significant in maintaining minimum requirements (Duijm et al. 2016:397). Hossain et al. (2018:6) examined 57 banks from BRICS economies which consist of India, Russia, China, Brazil and South Africa over the 2007 to 2014 period. The study utilised LCR to measure bank financial shocks. The results suggest that the higher value of LCR is likely to increase the resilience of banks if it is implemented correctly. Komaromi, Hadzi-Vaskov and Wezel (2016:11) analysed 47 Panamanian banks as of the end of October 2015. The study used LCR to measure the liquidity position of banks. The results revealed that half of the banks did not meet the minimum requirements. Accordingly, many countries rely on safety nets and interbank market to increase the resilience of banks against liquidity shocks (Komaromi et al. 2016:4). Bai, Krishnamurthy and Weymuller (2016:3) undertook a study on 2882 bank holdings companies over the 2002 to 2014 period. The study compared the Liquidity Mismatch Index (LMI) measure of liquidity with LCR in measuring liquidity capability. LMI refers to asset-side liquidity by subtracting the liability-side liquidity of a bank (Bai et al. 2016:5). The results suggest that LMI outperformed LCR in measuring the likelihood of banks financial shocks. Bai et al.'s (2016:7) study applied only Tier 1 and 2 capital ratio and ROA to measure liquidity capability which differentiated it from other studies. Moreover, Du (2017:5) undertook a study of US bank holding companies over the 2002 to 2015 period. The study applied LCR to measure individual banks' systemic risk and also whether it can predict *ex ante* which banks are exposed to risk and financial shocks. In considering the 2007-09 global financial crisis and especially the US banking sector, the results revealed that LCR has positive effects on individual banks' systemic risk. Furthermore, LCR is significant in predicting *ex ante* which banks are exposed to risk and financial shocks.

2.7.2 Net Stable Funding Ratio (NSFR)

De Young, Distinguin and Tarazi (2017:15) define Net Stable Funding ratio (NSFR) as the ratio of 'available stable funding' to 'required stable funding'. The NSFR is aimed to promote long-term funding within banking lending activities. Available stable funding (ASF) is defined as the total amount of bank capital, preferred stock with maturity of equal to or greater than one year, liabilities with effective maturities of one year or greater, the portion of non-

maturity deposits and/or term deposits with maturities of less than one year, and the portion of wholesale funding with maturities of less than a year (BCBS, 2014:3). Under the NSFR, the available amount of stable funding divided by the required amount of stable funding is required to be greater than 100% (Wu and Hong, 2012:6). As discussed by Bonfim et al. (2017:9), the higher the ratio is an indication that a bank liquidity position is good for the stability of banks. Under the NSFR, “stable funding” refers to the amounts and types of equity and liability financing that can be sources of funds available over a one-year period under conditions of extended stress (BCBS, 2013:3). Under the NSFR, the required amount of stable funding includes the amount of the value of the assets held and financed by the institution and then multiplied by a specific required stable funding (RSF) factor assigned to each particular asset type, added to the amount of off-balance sheet (OBS) activity (or potential liquidity exposure), multiplied by its associated RSF factor (BCBS, 2014:6).

Accordingly, the higher the NSFR shows less liquidity risk and more liquid of a bank (De Young et al. 2017:16). The formula for the calculation of the available amount of stable funding divided by the required amount of stable funding is outlined below:

$$NSFR = \frac{\text{Available Stable Funding}}{\text{Required Stable Funding}} \geq 100$$

The NSFR is aimed to complement LCR and supervisory efforts in measuring liquidity risk in terms of short-term funding mismatches (BCBS, 2013). The newly proposed NSFR builds on the traditional “net liquid asset” and “cash capital” methodologies used widely by internationally active banking institutions, bank analysts and rating agencies (BCBS, 2013:1). As discussed by Bonfim et al. (2017:9), NSFR is aimed to address liquidity mismatch and to promote medium to long-term finance.

From regulatory perspectives, BCBS and the European Banking Authority (EBA) have also included NSFR in their monitoring studies. BCBS (2011:3) undertook a monitoring exercise of group 1 and 2 banks. The monitoring results revealed that NSFR for Group 1 banks were 94%

and below the 100% required by NSFR, while Group 2 banks were 94%, again below the 100% required by NSFR. Similarly, EBA (2011:1) monitoring results revealed that NSFR for Group 1 banks were 89% and below the 100% required by NSFR, while Group 2 banks were 90%, again below the 100% required by NSFR. Thus, the results suggest that there was a shortfall in terms of the total assets to meet the minimum requirements during the 2007-09 global financial crisis.

In 2014, both BCBS and EBA also carried out liquidity monitoring exercises. BCBS (2014:4) found that LCR for Group 1 banks were 111.2% which is above the 100% required by NSFR, while Group 2 banks were 113.8%, again above the 100% required by NSFR. Accordingly, 75% of Group 1 and 85% of Group 2 reported that banks met and exceeded the required 100% by NSFR (BCBS, 2014:4). On the other hand, EBA (2014:35) revealed that Group 1 banks were 102% which is above the 100% required by NSFR, while Group 2 banks were 109%, again above the 100% required by NSFR. Accordingly, 75% of Group 1 and 85% of Group banks met or exceeded the minimum requirements (EBA, 2014:35). Thus, the result suggests that banks made improvements subsequently from 2011's first monitoring exercises in meeting or exceeding the minimum requirements.

In the last monitoring exercise in 2017, BCBS (2018:8) found that NSFR for Group 1 banks was 115.8%, which is above the 100% required by NSFE, while Group 2 banks were 114.1%, again above the 100% required by NSFR. Accordingly, 93.1% of Group 1 and 93.8% of Group 2 reported banks met and exceeded the required 100% by NSFR (BCBS, 2018:8). Similarly, EBA (2018:8) monitoring results revealed that Group 1 banks were 111.1% which is above the 100% required by NSFR, while Group 2 banks were 117.5%, which again is above the 100% required by NSFR. Accordingly, 89.1% majority of banks met the minimum requirements (EBA, 2018:8). This suggests that banks made improvements from the 2011 and 2014 monitoring exercises in meeting the minimum requirements.

From an academic perspective, recently after the introduction of NSFR by the Basel Committee in 2010, several empirical studies have been conducted to determine its predicting power of bank financial shocks. Wu et al. (2012:7) conducted a study on the US banking system

by assessing the newly proposed NSFR in identifying banking financial shocks. The results indicated that NSFR have a low prediction power compared to traditional risk measures based on macroeconomic indicators, for example, core deposit ratio, non-core funding ratio and brokered deposits ratio. King (2013:2) analysed banks in 15 countries for the year-ending 2009 after the financial crisis. The study assessed whether banks were having enough liquidity during the crisis. The results showed that banks in 10 countries were below the NSFR minimum requirement. Hlatshwayo et al. (2013:2) undertook a study which examined 391 banks across 36 countries over the 2002 to 2012 period. The study made comparisons between NSFR and traditional ratios in predicting bank financial shocks. The results revealed that NSFR have low predicting power compared to traditional ratios based upon macroeconomic indicators such as ROA, LIBOR-OISS, Basel II Tier 1 capital ratio, government securities ratio and brokered deposit ratio in predicting bank financial shocks. Cucinelli (2013:44) undertook a study of 575 Eurozone banks over the 2006 to 2010 period. The study utilised NSFR to measure the probability of bank financial shocks. The results revealed that there is no relationship between NSFR and bank financial shocks or either financial distress. Kochanski (2014:2) examined Polish banks over the 1996 to 2012 period by calculating NSFR in measuring liquidity capability. The study found that Polish banks deteriorated before and worsened during the recent financial crisis. Kochanski (2014:3) study stressed that due to lack of data, their study was based on assumptions.

Gobat et al. (2014:1) extended the work of previous researchers by analysing over 2000 banks consisting of 128 countries including Namibian banks for the year-end 2012. The study compared NSFR against traditional measures such as loan to deposit ratio and core funding ratio based upon the CAMELS rating to measure liquidity predicting capability. The result showed that NSFR is capable to predict bank financial shocks compared to other traditional measures. Again, the results revealed that Namibian and South African banks obtained approximately 106.0% which is above the 100% required under NSFR. The result is also demonstrated in the study of De Young and Jang (2016:31) that only one-in-seven US banks failed to meet NSFR targets over the 1992 to 2012 period. Their empirical findings are similar to those released by De Young et al. (2017:16) who found that US banks met or exceeded with 118.71% of NSFR minimum requirement over the 1998 to 2012 period. But their study employed interpolation and extrapolation techniques due lack of data to calculate NSFR over that period. Shen and Chen

(2014:11) improved on Gobat et al.'s work by extending the period of study from 2005 to 2009. The study covered US and European banks by comparing NSFR with traditional measures namely liquid assets to total asset (LATA) based upon the CAMELS rating in terms of the capability to predict bank financial shocks. The result indicates that NSFR outperformed LATA as a bank financial shocks indicator.

Further to this, Boulifa and Khouaja (2016:64) undertook a study of US banks over the 2008 to 2010 period. The study examined the combination of NSFR, Leverage ratio and Tier 1 capital in measuring the likelihood of bank financial shocks. The result revealed that NSFR is more appealing to small banks because they face more risks than large banks. Boulifa et al. (2016:69) argued that large banks have advantages such as the fact that they are 'too big to fail' and 'too big to discipline', so they are not affected by liquidity ratio measures. In this view, large banks engage in diversified income compared to small banks. Lallour et al. (2016:8) examined US and European banks over the 2010 to 2014 period. The study compared NSFR against traditional measures namely liquid assets to total customer deposits ratio (LADEPO), Core funding ratio (CFR) and Loans to deposits ratio (LODEPO), all based upon the CAMELS rating in terms of qualities in predicting bank financial shocks. The results revealed that NSFR is significant and it could have assisted regulators in predicting bank financial shocks or distress before the 2007-09 global financial crisis. The result is consistent with the findings of Hossain et al. (2018:9), who revealed the statistical significance of NSFR as an early warning indicator. Furthermore, LADEPO outperformed CFR and LODEPO in predicting bank financial shocks. Angora et al. (2011:5) examined US and European banks using the data as from 2012 to 2014 period. The study examined the NSFR with regards to whether it adds predictive value to the CAMELS rating in detecting early warning signals to explain the probability of bank default. The results indicated that NSFR adds predictive values to other ratios based on the CAMELS rating system. Distinguin et al. (2013:20) found that when a bank faces liquidity shortages, the bank may reduce Tier 1 capital ratio in order to stabilise liquidity conditions. Horvath et al. (2014:17) found that higher capital ratio such as Tier 1 leads to deterioration of liquidity conditions of banks. Kapan et al. (2017:15) also repeat and stressed that an increase in capital leads to illiquidity in banks. Thus, the relationship between capital and liquidity conditions has

been documented and confirmed especially using the recent NSFR proposed by the Basel Committee.

2.8 A Comparison of Predicting Models

After the 2007-09 global financial crisis, there have been several empirical studies that have attempted to evaluate most accurately bank financial shocks and the distress model. Angora et al. (2011:5) examined US and European banks over the 2005 to 2009 period. The study utilised the logit model to examine whether NSFR complements the CAMELS rating ratios in order to explain the bank's probability of default. The advantage of this model and application is that it compares the CAMELS rating ratios with Basel III liquidity ratios which are the main focus of the present study. Hong et al. (2013) analysed US banks between the 2005 and 2011 period, using the discrete-time hazard model to evaluate its accuracy to predict bank financial shocks. The study found that the discrete-time hazard model outperformed other model bank financial shocks and distress models. Kowanda et al. (2014:364) analysed Indonesian banks between the 2009 and 2012 period, using the logit model to evaluate financial shocks in banks. The results revealed that the logit model is adequately good to determine the probability of financial shocks. Boulifa et al. (2016:65) stressed that the logit model distinguishes failed banks from non-failed banks. Gautam et al. (2014:6) analysed Indian banks between the 1996 and 2009 period, using discriminant analysis to detect bank failure. The result revealed that the discriminant analysis is reliable in detecting bank distress over a one (1) year period. Cole and Wu (2014:10) used a data set of US banks over the 1985 to 1993 period to compare the static probit and hazard model in terms of the accuracy of bank financial distress. The results revealed that static probit outperformed the hazard model because they claimed that hazard is good for timely financial data while the static model is good for non-financial data.

Affes et al. (2017:8) used a data set of US banks over the 2008 to 2013 period to compare the Canonical Discriminant Analysis and Logit in terms of the accuracy of predict bank financial shocks. The results indicated that Logit can predict bank financial shocks compared to the Canonical Discriminant Analysis. Papanikolaou (2017:10) analysed US banks between the 2003

and 2009 period, using the hazard model to distinguish stable and distressed banks. The result indicates that the hazard model is capable of detecting the likelihood of bank distress. This result is consistent with the findings of Cole et al. (2011:17) who found that the hazard model is good in classifying bank distress status. Shen et al. (2014:7) examined US and European Union banks between the 2005 and 2009 period. The study compared traditional liquidity ratio and Basel III Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFR). The study adopted the Multinomial Logit Model and found it to be capable in terms of predicting bank financial shocks and subsequently bank failure. Based on literature, the current study opted to use the logit model for two reasons. Quint and Tristani (2017:4) examined the Euro area by identifying the liquidity shocks derived in the interbank market. The study employed the Structural VAR model in identifying the liquidity shocks rooted in the interbank market. The study found that when financial challenges become tight then liquidity shocks can be identified. Goldberg (2017) examined the US Treasury market by identifying liquidity supply shocks based on macroeconomic and asset prices. The study utilised Structural VAR and used a combination of impulse responses and forecast error variance decomposition to complement each other in identifying liquidity shocks and the study found it to be reliable. Firstly, the Namibian banking system has not experienced a banking crisis that has led to bank failure in order for this study to consider a model that can distinguish between bank failure and non-failure. Based on that, the present study considered Structural VAR which consists of granger causality, impulse response and forecast error variance decomposition in order to complement each other in the analysis in order to identify the liquidity shocks that pose a threat to the banking sector in Namibia. Furthermore, this model allowed this study to involve the CAMELS rating ratios and the Basel III liquidity ratios in identifying liquidity shocks.

2.9 Theoretical Framework

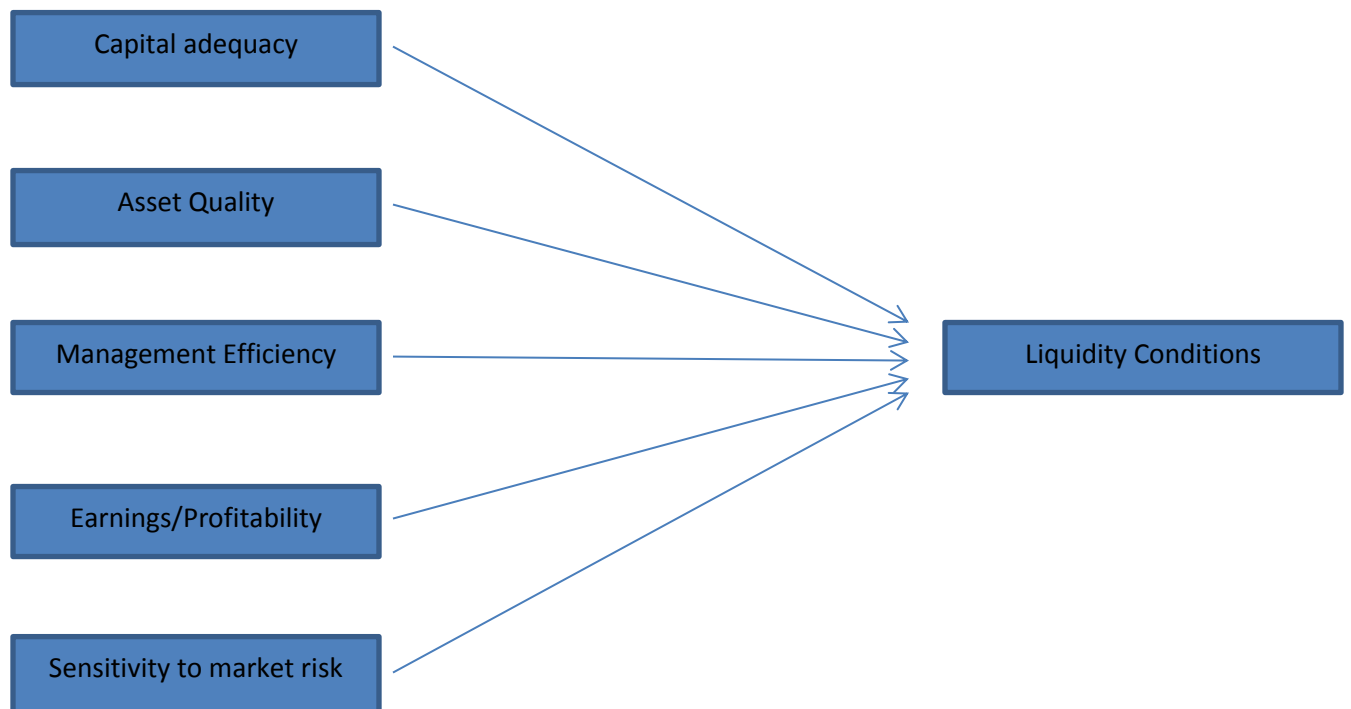
A theoretical framework was established in order to guide the empirical research for data collection. A theoretical framework was established after scrutinising the literature and as a guide to identify and establish the sources of liquidity shocks in Namibia. Figure 3.2 illustrates the relationships between capital adequacy, asset quality, management efficiency, earning quality and sensitivity to market risk against the liquidity conditions of banks. A theoretical framework

was established in order to assist in establishing the relationships among the said components of the CAMELS approach.

Based on literature, the theoretical framework in Figure 3.2 illustrates the relationships as follows:

- Capital adequacy (measured by Tier 1 capital) has some influence on banking liquidity conditions.
- Asset quality (measured by NPL) has some influence on banking liquidity conditions.
- Management efficiency (measured by OEOI) has some influence on banking liquidity conditions.
- Earnings quality (measured by ROA) has an influence on banking liquidity conditions.
- Sensitivity to market risk (measured by RSA_RSL) has some influence on banking liquidity conditions.

Figure 2.2: Theoretical Framework for the study



The study intended to correlate the above mentioned financial ratios against liquidity ratios, namely LA_ATL, NSFR, LO_DEPO, LO_TA and LA_TA in order to identify and establish the sources of liquidity shocks in Namibia. The liquidity conditions of banks (e.g., measured by LA_ATL, NSFR, LO_DEPO, LO_TA and LA_TA are dependent variables, whilst capital adequacy (Tier 1 capital), asset quality (NPL), earnings quality (ROA) and sensitivity to market risk (RSA_RSL) are independent variables.

2.10 Implication of Literature to the Study

The related literature focused on areas encompassing capital adequacy, asset quality, management efficiency, earning or profitability quality, liquidity and sensitivity to market risk in measuring banking conditions and performance. In addition, related literature used CAMELS framework consisting of financial ratios in measuring banking conditions and performance. Alternatively, several studies used financial ratios which are part of the CAMELS framework, and it was necessary to use the CAMELS framework in measuring banking conditions and performance. The related literature only focused on advanced economies such as the U.S financial sector, the European financial sectors and other emerging financial sectors such as from Asia and Latin America which experienced banking failure and economic recession. Only a few studies focused on various African countries hence one of the major knowledge gaps. There are no specific studies that attempted to investigate the Namibian banking sector in terms of liquidity conditions and performance comprising all components of the CAMELS approach. Thus, this study aimed to fulfil this gap in knowledge.

A large body of literature indicates that capital adequacy is very critical as it maintains confidence among stakeholders and prevents bank distress and insolvency (Gowri and Ramya, 2013:12 and Gupta, 2014:95). Isanzu (2016:72) point out that capital adequacy measures the ability of a bank to meet obligation in any event they encounter as well as an ability to operate even under abnormal losses. However, the literature documented the relationship between capital adequacy and liquidity management. The works of Hossain et al. (2018:9), Casu et al. (2017:19), Distinguin et al. (2013:20); Horvath et al. (2014:17) and Kapan et al. (2017:15) reveal that higher

capital ratios (Tier 1 capital) lower liquidity creation and lead to illiquidity amongst banks. This could be one of the sources of liquidity shocks in Namibia. Additionally, past studies are in line with this study in identifying the sources of liquidity shocks in Namibia.

Literature shows that asset quality and particularly loans and advances, are vital as they represent the assets of banks (Mazreku et al. 2016:12). The major risk associated with financial institutions is derived from credit risk due to defaults from the borrowers' side (Venkatesh et al. 2014:9). Literature indicates that credit risk has an influence on liquidity conditions of banks (Hajja et al., 2013:15; Berrios, 2013:15 and Nibilar et al., 2018:17). study Hajja et al. (2014) finds that higher non-performing loans lower liquidity and consequently liquidity risk. This could be another source of liquidity shock in Namibia. Thus, previous studies are consistent with this study in identifying the sources of liquidity shocks in Namibia. Prior studies frequently applied loans to deposits ratio, liquid assets divided by customer deposits and short-term funding to estimate liquidity conditions in banks. Existing studies claim that the non-performing loan ratio (NPL) is not used, which is a core ratio under the CAMELS framework in studying its influence on liquidity conditions and particularly on LA_ATL, NSFR, LO_DEPO, LO_TA and LA_TA ratios. In that regard, this study intended to close the gap in knowledge and contribute to the body of knowledge by using NPL in measuring banks liquidity conditions.

Literature indicates that management efficiency is vital in managing the resources in profitable manner, by maximising profits on one hand and reducing the costs on other hand (Isanzu, 2016:72; Le, 2017:6; and Vousinas, 2018:8). Several studies (Tripathi, Meghani and Mahajan, 2014:120; Venkatech et al. 2014:11; Kandrach, 2014:4298) agree that management efficiency plays an important role in managing the resources and facilities of a bank. Based on literature, management efficiency is a critical element in minimising the risk exposed by financial institutions demonstrated by their abilities in managing institutions affairs. Thus, past studies are in line with this study in identifying the sources of liquidity shocks in Namibia.

Literature indicated that strong earnings from a bank side reflect a bank's ability to sustain itself in the present and future operations (Vousinas, 2018:8). Previous studies show that financial institutions should generate profit compared to the expenses they incur in order to survive and remain sustainable (Venkatesh et al. 2014:13; Tripathi et al. 2014:123 and Gupta, 2014:98). Further to this, the works of Panigrahi (2014:319); Ghurtskaia and Lemonjava

(2016:1611); and Pradhan and Shrestha (2016:7) document the relationship between ROA and banks liquidity conditions. Panigrahi's study (2014) concluded that focusing on profit maximisation lowers liquidity on one hand, while focus on liquidity lowers the profit on another hand. This could be one of the sources of liquidity shocks in Namibia. Additionally, past studies are in line with this study in identifying the sources of liquidity shocks in Namibia. Current studies have not explored the relationship between ROA and LA_ATL ratio. Thus, this study aimed at closing the gap in knowledge and contributing to the body of knowledge.

Literature indicated that the inability of a bank to satisfy commitments in relation to liquidity could affect the performance of a bank and leads to bank financial constraints (Venkatesh et al. 2014; Isanzu, 2016:72; Gupta, 2014:99; Le, 2017:7). Gowri et al. (2013:14) point out that liquidity risk should be taken into account, by protecting the image of the banks and also to invest high percentage in high return undertaking, whilst generating income that is available to meet depositors' demand. The works of Berrios (2013:15); Hajja et al. (2015:255); Nabilar et al. (2018:17) document the influence of credit risk on liquidity conditions in banks. This could be one of the sources of liquidity shocks in Namibia. Additionally, previous studies are in line with this study in identifying the sources of liquidity shocks in Namibia. Based on literature, studies scarcely investigated the relationship between LA_ATL, LO_TA and LA_TA against other CAMELS approach ratios. Thus, this study intends to contribute to the body of knowledge by closing the knowledge gap.

Literature indicates that the ability of a bank to identify, monitor, manage and control market risks in relation to sensitivity to market risk is vital in maintaining income for financial institutions (Tripathi et al. 2014:134 and Karri et al. 2015:31). Venkatesh et al. (2014:18) stressed that sensitivity to market risk looks on how the banks react to risks that adversely affect earnings and derived from movement of prices in terms of interest rate, commodity prices, equity prices, currency rates. Literature documents the effects of interest rate on liquidity conditions of banks (Banti et al. 2019:86; Casu et al. (2017:20). Accordingly, the fluctuations of interest rate could affect bank income and liquidity creation. This could be one the sources of liquidity shocks in Namibia. Additionally, previous studies are in line with this study in identifying the sources of liquidity shocks in Namibia. Prior studies are uncommon that investigated the influence of RSA_RSL on liquidity conditions and particularly LA_ATL, NSFR, LO_DEPO, LO_TA and

LA_TA ratios. Thus, this study intends to close the gap in knowledge and contribute to the body of knowledge.

2.11 Chapter Summary

The first objective of this thesis was to conduct an audit of the liquidity data between 2009 and 2018 and explore how banks exposed liquidity risk. Before commencing with empirical analysis, the study reviewed other previous studies. Following the literature, the chapter examined two regulatory and supervisory tools namely, the CAMELS system and Basel accords and particularly that ratios are used to measure the performance of banking institutions over time. Further to this, these ratios are currently used by regulatory bodies globally to assess the performance of banking institutions. The study found that capital adequacy, particularly Tier 1 and 2 capital ratio and equity to total assets ratio have influence on banks liquidity conditions as proposed by Casu et al. (2017) and Hossain et al. (2018), and are significant in predicting bank financial shocks. The study also found that asset quality ratio such as (loan loss provisions to net interest income and non-performing loans), management efficiency ratio such as cost to income ratio, earning quality ratio such as Return on Assets, and all ratios of liquidity capability are statistically significant in predicting bank financial shocks and subsequently financial distress. The study also found that the new proposed Basel III liquidity ratios, namely, LCR and NSFR have influence in predicting bank financial shocks. The findings revealed that NSFR can contribute to the CAMELS ratios in predicting bank financial shocks as proposed by Angora et al. (2011) and Lallour et al. (2016). The said financial ratios have been indicated by literature as statistically significant in identifying financial shocks and these were considered for methods of data collection and analyses. The preceding chapter focuses on the research methodology for the study.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Introduction

The analysis of the previous studies in Chapter II, provided guidance for this research in terms of choosing the appropriate methods for studying the proposed Basel III liquidity ratios and traditional liquidity ratios based upon the CAMELS rating system. Therefore, this chapter outlines the methodological aspects of the research, as well as offer justification of the approaches taken. This chapter is divided into the following sections: Section 3.1 research philosophies; Section 3.2 research approach; Section 3.3 research strategies; Section 3.4 research design; Section 3.5 the target population; Section 3.6 sample techniques; Section 3.7 research procedures; Section 3.8 data collections instruments; Section 3.9 methods of data analysis; Section 3.10 the alignment of research objectives and methodology; Section 3.11 model specification; Section 3.12 estimation techniques; Section 3.13 post estimation diagnostic; Section 3.14 stationarity test; Section 3.15 choice of proxy variables; Section 3.16 explanatory variables; Section 3.17 ethical considerations; lastly Section 3.18 provided a chapter summary.

3.2 Research Philosophies

There are four major research philosophies (also called worldviews) that have been identified by researchers and discussed in literature. The worldviews relate to research designs such as quantitative, qualitative and mixed-methods approach. This means research can adopt either quantitative, qualitative or mixed-methods approach. When it is quantitative, it excludes the researcher from adopting qualitative approach, and when it is qualitative, again it excludes the researcher from adopting quantitative approach. But when it is mixed-methods approach, it allows the researcher to adopt both quantitative and qualitative approach. Thus, the research design is determined by the research philosophy.

The first worldview refers to positivism also known as post-positivism, which is associated with quantitative approach. According to Creswell and Creswell (2018), post-positivism refers to post thinking after positivism. Positivists believe in determinism, reductionism, empirical observation and measurement, and theory verification philosophy. Researchers believe in that (1) causes determine the effects or outcomes; (2) reductionism means to reduce the focus into a small set of variables; (3) observe and establish measurements; (4) test and verify the theory (Creswell, 2014:5 and Neuman, 2014:97; Creswell et al., 2018:6). In a positivism view of the world, the positivists use deductive reasoning in gathering theories in order to test the particular issue understudy (Sekaran and Bougie, 2013:29). Positivists are looking for evidence that is valid and reliable which relate to the problems investigated rather than generalisation (Creswell et al. 2016:59). In this view of the world, positivists seek to observe people behaviour, examine the extent to which variables are related, investigate changes of the study objects over time, and question a group of respondents with the goal of identifying differences in their responses. This is done in order to understand the world well in which they live and inform researchers and policy makers.

The second worldview refers to constructivism which is associated with qualitative approach. Constructivists emphasize on subjectivity in terms of research. Constructionism focuses on the process by which meanings are created, negotiated, sustained and modified (Du Plooy-Cilliers, Davis and Bezuidenhout, 2014:232). Constructivists focus on people's perceptions and interpretation of the study undertaken, including people behaviours, group process and cultural practices (Leedy and Ormrod, 2015:106). In this view of the world, constructivists seek to understand people's perceptions, perspectives, and particular situations in order to understand the world well in which they live and inform researchers and policy makers.

The third worldview refers to participatory philosophy which is associated with qualitative approach. Participatory philosophy is influenced by political agenda. Concerns such as empowerment, disadvantaged ethnic and marginalised groups must be addressed (Creswell and Clark, 2011:41). Under this philosophy, the researchers collaborate with individual people's experiences about understudy issues in order to investigate or research on. In order to solve these issues, collective action between key stakeholders must be conducted in order to improve the situation and change for the better (Neuman, 2014:93). In conducting participatory research, the

researcher conducts interviews with participants from various cultural groups in order to investigate issues that they are facing as an ethnic group (Saunders, Lewis and Thornhill, 2016:399). In this view of the world, challenges facing ethnic groups could be investigated by interviewing participants in order to inform the world and particularly the government in order to improve the situation.

The final worldview refers to pragmatism which combines both quantitative and qualitative approaches and is also known as mixed-methods approach. Du Plooy-Cilliers et al. (2014:19) describe pragmatism research as a research that aims to find solutions to problems posed by applying both qualitative and quantitative approaches. In mixed-method approaches, the study combines qualitative and quantitative from research questions formulation, research designs, sample, and data analysis stage. Pragmatists believe in practice since the theory is developed from practice and then employed back to practice in order provides solution to the problem under investigation (Sekaran et al. 2013:30). In this view of the world, the usefulness of the research lies within practice relevance.

Table 3.1: Research Philosophies (as proposed by Burrell and Morgan, 1979)

Sociology of Regulation			
OBJECTIVE	Positivism ❖ Determination ❖ Reductionism ❖ Establish measurements ❖ Test theory	Constructivism ❖ Understanding ❖ Seeking meaning ❖ Theory development	SUBJECTIVE
	Participatory ❖ Political agenda ❖ Collective action ❖ Engage participants	Pragmatism ❖ Practical relevance ❖ Support action ❖ Focus on problem ❖ Multiple realities	
Sociology of Radical Change			

Based on the four philosophies, this study fits into positivism, which seeks to observe and establish measurements such as the CAMELS rating and Basel III liquidity measurements in

identifying liquidity shocks. Furthermore, the present study aimed at measuring dependent variables at different points of time (2009 to 2018) in identifying liquidity shocks. In measuring and predicting research, positivists believe that people will be able to inform policy makers and understand the world well (Sekaran et al. 2013:29).

3.3 Research Approach

Research approach refers to the overall approach to the research process, from the theoretical point of view to data analysis. There are three types of research reasoning namely: inductive, deductive and abductive reasoning. In this instance, the researchers should decide whether to adopt inductive, deductive or abductive reasoning to the problem under study. In inductive reasoning, the study commences with observing phenomena under study before arriving at conclusions of the subject (Leedy et al., 2015). For example, if a study commences with data collection and then builds a theory, it is known as inductive reasoning (Saunders et al., 2016:145). On the other hand, deductive reasoning commences with gathering a theory which will then guide the study (Sekaran et al. 2013:26). The deductive reasoning involves identifying “problem statement, hypothesizing, determining measures, data collection, data analysis and interpretation of the results” (Sekaran et al. 2013:26). The final form of reasoning is called abductive reasoning in which a researcher develops a conceptual model guided by interviews conducted, and then develops hypotheses to test (Saunders et al. 2016:150). Based on results, the researcher would be able to improve the conceptual model. Thus, this study adopted the deductive reasoning since it has formulated a problem statement, hypothesis, measures, data collection and analysis. In that regard, the current study was guided by the theory from the formulation of the problem statement, the review of literature, data collection and analysis.

3.4 Research Strategies

The proposed Basel III and liquidity ratios under study are part of financial regulations or policy of banking sector enforced by central banks all over the world on commercial banks. The financial regulation has certain rules and regulations aimed to provide a buffer against bank

financial shocks. Ideally, this research evaluated the effectiveness of the proposed liquidity measurements against the traditional CAMELS liquidity ratios measures in terms of identifying liquidity shocks which may lead to bank financial distress. Thus, this study is an impact assessment study also referred to evaluation research. The evaluation research aims to evaluate intervention initiatives such as programme, policy or strategy are effective (Neuma, 2014:28).

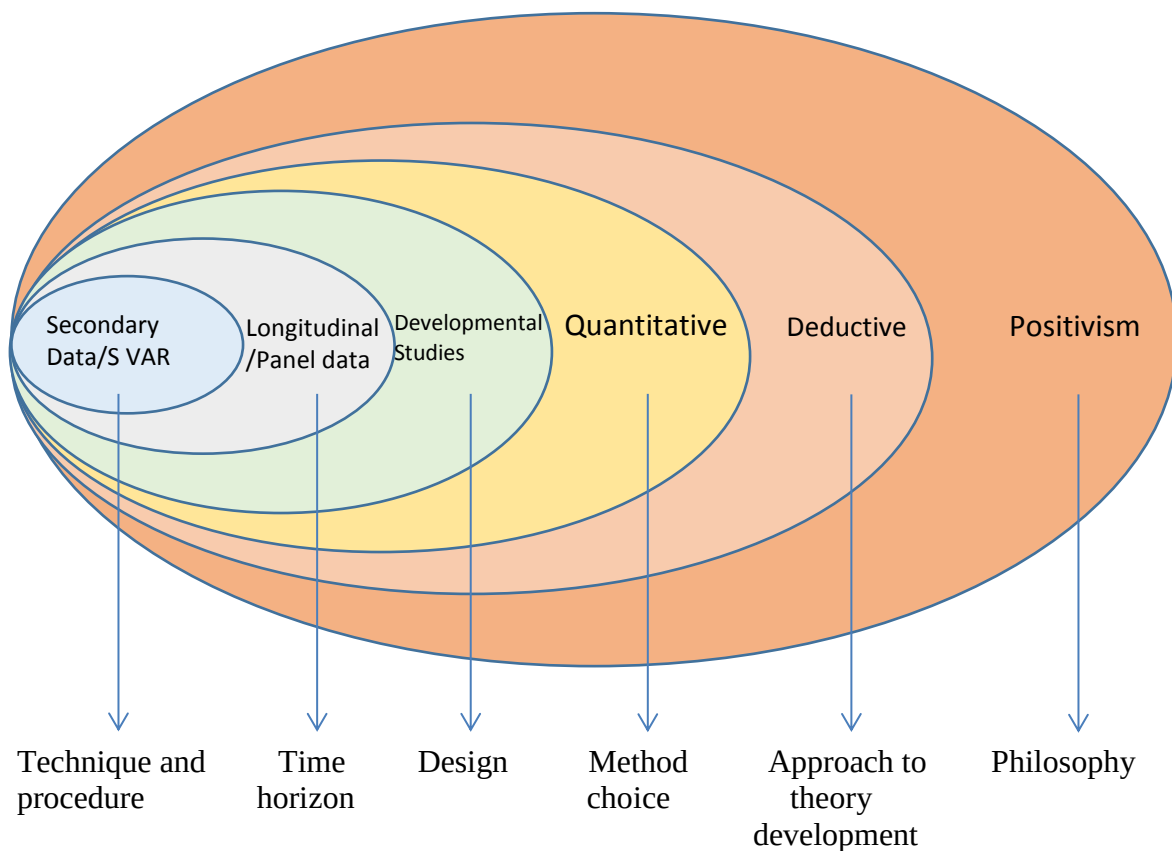
The research strategies refer to instruments that are used to collect data for the phenomenon under scrutiny. Under quantitative approach, this includes survey research, correlation study, developmental studies and observation studies (Leedy et al. 2015:158). Thus, the researcher chooses an appropriate research strategy that would address and achieve the phenomenon under scrutiny. For the purpose of this study, the researcher opted for developmental studies where developmental studies investigate changes of the study objects over time using either cross-sectional or longitudinal study (Leedy et al. 2015:158). Cross-sectional studies refer to studies that gather data once a time such as a few days, weeks or months in order to address the problem under scrutiny (Sekaran et al., 2013:106). Moreover, cross-sectional studies often apply the survey strategy to collect the data. On the other hand, a longitudinal study refers to a study that looks at issue over a certain period of months or years and data are collected at two or more points (Leedy et al. 2015:158).

The current study sampled 4 commercial banks in Namibia by examining their performance over the course of 10 years. Therefore, the study adopted panel study which is also known as the longitudinal study that allows one or more dependent variables being measured at different points of time (Welman, Kruger and Mitchel, 2005:96). Kumar (2014:112) stressed that trend or panel study allows studying what happened in the past and present to enable to predict the future trends. The data of this study was derived from banks' balance-sheets to determine the sources of liquidity shocks and subsequently bank financial distress. The data were retrieved from Bank of Namibia and Namibia Statistics Agency. Financial data being used were particularly balance sheets data derived from Bank of Namibia. On the other hand, economic data indicators were particularly the annual growth rate of real Gross Domestic Product (GDP) derived from Namibia Statistics Agency. The current study covered the period from 2009 to 2018 using quarterly data.

3.5 Research Design

According to Sekeran et al. (2013:95), research design refers to a blueprint followed in collecting the data, measurement, analysis and interpreting the data in response to the research questions under scrutiny. Saunders et al. (2016:163) define research design as a plan or framework followed in answering the research questions and achieving the objectives of the study. Following Saunders et al. (2016:164), the figure below (Figure 3.1) illustrates the research onion. The plan or framework shows the outer layer to inner layers of the research onion. Meanwhile, Leedy et al. (2015) categorized research designs into eight different research designs namely, case study, phenomenological study, grounded theory, content analysis, correlation studies, developmental studies, observation studies and survey research.

Figure 3.1 Framework diagram used by Saunders et al. as research onion adapted for this study



Following Leedy et al. (2015:158), the current study opted for developmental studies design. According to Leedy et al. (2015:158), developmental studies investigate changes of the study objects over time using either cross-sectional or longitudinal study. As illustrated in Figure 3.1, the current study adopted the longitudinal study also known as the panel data. The rationale of the longitudinal study (panel data) permits observing an issue over a certain period of months or years and data may be collected at two or more points which fit the current study in answering the core questions related to the sources of liquidity shocks in banks over time.

The current study is quantitative in nature. Basel III and liquidity ratios measurements are centred on numbers (e.g. percentages). Consequently, quantitative research is centred on numbers or numerical values (Bryman, 1988:11). In economics and finance, the financial data is one the sources of data on which many researchers rely. In quantitative research, from research objectives, data collection methods and data analysis are all structured and predetermined methodology (Kumar, 2005:12). According to Leedy et al. (2015:182), the quantitative research tends to determine cause-and-effect relationships between variables used in a study. Quantitative research tends to examine the relationship between variables by quantifying the extent of variations and numbering the data analysed (Kumar, 2005:12; Creswell, 2014:155). The advantage of quantitative research when statistical analyses are applied is that it removes the guesswork in terms of data interpretation (Du Plooy-Cilliers et al. 2014:125).

3.6 Population of the Study

The target population were 9 commercial banks in Namibia under the regulatory and supervisory of Bank of Namibia. These were Standard Bank, First National Bank, Nedbank, Bank Windhoek, Absa, Trustco Bank Namibia, Bank BIC Namibia Limited of Angola, Letshego Bank Namibia, Banco Privado Atlantico Europa, and SME Bank. Absa was the fifth bank that was granted a provisional banking licence in 2008 by the Bank of Namibia to set up a bank in the country. The Trustco Bank was established in 2014 after being granted approval of its acquisition of Fides Bank Namibia by Bank of Namibia. In addition, Bank BIC Namibia Limited of Angola, Letshego Bank Namibia, Banco Privado Atlantico Europa was all granted provisional

banking licences in 2014 by Bank of Namibia to operate in Namibia. Currently, the SME bank is going through liquidation.

3.7 Sample

A sample of the four largest commercial banks in Namibia was taken for the current study. The sample comprised of Standard Bank, First National Bank, Nedbank and Bank Windhoek. These four are the largest commercial banks and they account for 98 percent of the total bank assets (IMF, 2018:10). Purposive sampling was used to sample the commercial banks taken for study. Purposive sampling is divided into two major sampling techniques namely, judgement sampling and quota sampling. Judgement sampling focuses on target participants who are in good position to provide the data required for the study (Sekaran et al. 2013:252). Whilst quota sampling focuses on target participants, it ensures that diverse participants are well represented using the quota sampling technique (Sekaran et al. 2013:253). Consequently, judgement sampling was used in this study as a result of the required data's availability. The choice of the above-mentioned commercial banks using judgement sampling was that: (a) they have been in operation for a long time, (b) they are internationally active as recommended by (EBA, 2012:7), (c) they have been fully complying with Basel II, CAMELS indicators, (d) they have made submissions to Bank of Namibia such as balance sheets and income statements on regular basis in order to ensure the comparability of variables over the time. The sample period spans from 2009 to 2018, using quarterly data from the Namibian commercial banks. The study period covered the most recent financial crisis which took place in 2007-09 that was caused by shortage of liquidity among other root causes. Although the Namibian banking system was not affected by the crisis, the central bank is in the process of planning to implement the new measurements under Basel III in 2021.

Table 3.2 List of countries where Namibian commercial banks operate

Standard Bank	FNB	Nedbank	Bank Windhoek
Angola Botswana DRC Ghana Kenya Lesotho Malawi Mauritius Mozambique Namibia South Africa Swaziland Tanzania Uganda Zambia Zimbabwe United Kingdom (UK) Argentina Isle of Man (UK Island) Jersey (UK Island) Turkey Russia	Zambia Tanzania Mozambique Botswana Lesotho Swaziland Namibia South Africa	South Africa Lesotho Malawi Namibia Zimbabwe	Namibia Botswana

Source: Bank Annual Reports, 2017

3.8 Research Procedures

The Bank of Namibia was sensitised about the purpose of the research. The permission to conduct the study was discussed with the bank supervision department under auspices of Bank of Namibia. The data sources were existing banks' balance-sheets to identify the sources of liquidity shocks in Namibia. The data was sourced from Bank of Namibia and Namibia Statistics Agency (NSA).

3.9 Data Collection Instruments

The data were derived from the balance sheets of four largest commercial banks understudy. A balance sheet is divided into two parts, namely, assets and liabilities. A balance sheet lists the assets, liabilities and equity capital owned by the bank or invested in other financial institutions.

Table 3.3: The Balance Sheet (Report of condition)

Assets - Uses of funds (includes financial outputs)	Liabilities & equity -Sources of funds (includes financial outputs)
Reserves Cash and deposits in other institutions (primary reserves) Securities Securities for liquidity (secondary reserves) Loans Commercial and industrial Real Estate Consumer Interbank Other Other assets Buildings Equipment Total	Deposits Noninterest-bearing demand deposits Saving deposits NOW accounts Money market deposit accounts time deposits Non-deposit borrowings Equity capital from shareholders (Stock, surplus, and retained earnings)

Source: Own construction

The assets items consist of cash assets (e.g., cash available for meeting liquidity needs and deposits kept at other depository institutions), security holdings (e.g., loans and lease available from open market and government), and miscellaneous assets (e.g., buildings and equipment), (Rose, *et al.*, 2008). Liabilities are divided into two categories: deposits made by and owed to various customers (e.g., main source of funding for a bank, and non-deposit

borrowings of funds in the money and capital markets). Lastly, equity capital refers to long-term investment made by owners.

3.10 Methods of Data Analysis

Based on empirical literature, to analyse the data, there are three options which were followed to estimate the models, namely the Vector Autoregression (VAR) model, Structural Vector Autoregression (SVAR) model and Simultaneous Equation Model (SEM). VAR model was introduced by Sims (1980) for analysis of the interactions between sets of macroeconomic indicators by interpreting business cycle fluctuations. Sunde and Akanbi (2016 p. 127) point out that VAR model was criticised by economists as it was not adequate in the analysis of economic issues based on theory. Thus, SVAR model is advanced of the traditional VAR model which limits analysis on economic theory. SVARs were introduced after economists in the 1980s failed to agree on the usage of VAR model. In addition, the usage of SVAR and particularly the interactions between macroeconomic variables must be guided by economic theories and lead to forecast and policy implications of the phenomenon under study (Amisano and Giannini, 1997). On the other hand, SEM comprises of linear simultaneous equations which show combined endogenous variables (Hernández-Sanjaime, González and López-Espín, 2020:2). This model involves endogeneity and hierarchically structured data. Hernández-Sanjaime et al. (2020) argue that in some circumstances, data that are hierarchically structured could be unacceptable. Based on these analyses, the SVAR modelling approach was chosen among the three, in relation to achieving the objective of this thesis which was to establish the sources of liquidity shocks in Namibia for the period 2009 to 2018. It is important to mention here that the shocks implied here are mostly resulting from business cycle, a fluctuation which is exactly what popularised the SVAR modelling approach (Blanchard and Quah, 1998:660). The other reason is that SVAR can be applied to panel data, hence its appropriateness for this study. Furthermore, the study used SVAR since it concentrates on the effects of macroeconomic shocks on liquidity conditions in Namibia. Since the Namibian banking financial sector in the past did not experience financial crisis in order to differentiate between failure and survival institutions, it would not be possible to use any other prediction models. This is the rationale of using the SVAR as a result of its

appropriateness to show interactions between macroeconomic variables and identifying structural shocks, and subsequently financial distress (Amisano et al., 1997:1).

Under SVAR model, all variables are treated as an endogenous. Following Amisano et al. (1997), SVAR allows a small number of macroeconomic variables to be evaluated in terms of fluctuations over years and able to identify their structural shocks. Ideally, SVAR allows analysing interaction between variables in order to identify shocks based on theoretical restrictions (Amisano et al., 1997:15; Quint et al., 2017:1). Accordingly, shocks are sources of a variation of variables which treat all variables as endogenous and in order to observe the performance of variables, the shocks should be orthogonal (Amisano et al. 1997:15).

In estimating the SVAR regression model, Granger causality, impulse-response functions and forecast error variance, decomposition was employed and evaluated. The Granger causality provides causation links between variables in determining which variables are truly exogenous that can be used for data analysis (Amisano et al. 1997:13; Gottschalk, 2001:24). The impulse response functions are a tool which displays the response of each variable to structural shocks derived from economic data (Barnichon et al., 2018:2). The impulse response functions were proposed by Sims (1980); they show the patterns of movement of variables over time. Brownless (2018) stated that impulse response analysis is an important technique to analyse the effects of shocks on economic performance. Subsequently, forecast error variance decomposition provides complementary analysis by identifying which variable contributed mostly in causing the shocks (Lanzarotti cited by Amisano, 1997:67). Based on these three tools of data analysis, the results derived from ratios performance have established the sources of liquidity risk by displaying the causation between variables, structural shocks and mostly contributed factors to liquidity risk. Data analysis also entails coding and performing descriptive statistics using the E-views statistics software. The E-views statistics have estimated the parameter of the model. E-views enable to specify restrictions in different ways, with support for restrictions using two different short-run representations, and restrictions on the long-run impulse responses which is central to this study. Furthermore, E-views support linear restrictions across the elements of matrices and restrictions are specified via pattern matrices.

3.11 Aligning the Research Objectives and Methodology

The research objectives under analysis are discussed in detail and this involves describing the variables used to explore the objectives. Considering the data from the Bank of Namibia and Namibia Statistics Agency, the first objective focused on liquidity data between 2009 and 2018 and explored how banks expose liquidity risk. Since the study focuses on liquidity conditions, five liquidity ratios were measured against other CAMELS approach measures based on structural shocks. Considering liquidity measures, the data consists of liquid assets to average total liabilities ratio (LA_ATL), net stable funding ratio (NSFR), total loans to total deposits ratio (LO_DEPO), total loans to total assets ratio (LO_TA), and liquid assets to total assets (LA_TA). Considering other CAMELS indicators, the data consists of capital adequacy (Tier 1 RWCR), bank assets quality (non-performing loans ratio), bank earnings or profitability quality (return on assets) and rate sensitivity to market risk (rate sensitivity assets and liabilities).

The CAMELS ratings encompass six components used by regulator (e.g. Bank of Namibia) to assess commercial banks in terms soundness and safety and are expressed as following:

- C – capitalisation
- A – asset quality
- M – management efficiency
- E – earnings
- L – liquidity
- S – sensitivity to market risk

In the CAMELS ratings, all listed components are used as the bank early warning indicators in assessing banks' conditions. However, this study employed all components excluding M-management efficiency due to limited variables that can be estimated by SVAR model. Bank capital adequacy is proxy by Tier 1 RWCR, assets quality measured by non-performing loans ratio (NPL), earnings or profitability quality is proxy by return on assets (ROA), and rate sensitivity to market risk measured by rate sensitivity to assets and liabilities (RSA_RSL). The causation between macroeconomic variables was guided by prior empirical literature. By employing long-run identifying restrictions derived from economic theory, four

structural shocks (capital adequacy, asset quality, earnings quality and rate sensitivity to market risk) on liquidity conditions were assessed.

The second objective of the study was to determine the extent to which NSFRs can strengthen CAMELS indicators in identifying liquidity shocks. Under Basel III, the minimum standard measure to determine the asset liquidity and funding liquidity is the Net Stable Funding Ratio (NSFR). Under the NSFR, “stable funding” refers to the amounts and types of equity and liability financing that can be sources of funds available over a one-year period under conditions of extended stress (BCBS 2013:8). The NSFR is aimed to complement Liquidity Coverage Ratio (LCR) and supervisory efforts in measuring liquidity risk in terms of short-term funding mismatches (BCBS 2013:8). The newly proposed NSFR builds on the traditional “net liquid asset” and “cash capital” methodologies used widely by internationally active banking institutions, bank analysts and rating agencies (BCBS 2013:8). The formula for the calculation of the available amount of stable funding divided by the required amount of stable funding is outlined below:

$$NSFR = \frac{\text{Available Stable Funding}}{\text{Required Stable Funding}} \geq 100$$

Available Stable Funding (ASF) is defined as the total amount of bank capital, preferred stock with maturity of equal to or greater than one year, liabilities with effective maturities of one year or greater, the portion of non-maturity deposits and/or term deposits with maturities of less than one year, and the portion of wholesale funding with maturities of less than a year (BCBS 2013:8). In addition to a bank’s total amount of available stable funding, ASF has various categories that are determined by various factors as well. The total amount of capital, preferred stock, secured and unsecured borrowings and liabilities are assigned a 100% risk-weight. “Stable” and “Less Stable” as defined in the LCR have a 90% and 80% risk-weight respectively. Furthermore, unsecured wholesale funding, non-maturity deposits and term deposits are assigned a 50% risk-weight.

Under the NSFR, the required amount of stable funding includes the amount of the value of the assets held and financed by the institution and then multiplied by a specific required stable funding (RSF) factor assigned to each particular asset type, added to the amount of off-balance sheet (OBS) activity (or potential liquidity exposure), multiplied by its associated RSF factor (BCBS, 2010). Under the RSF, cash, unencumbered short-term unsecured instruments and transactions, unencumbered securities and loans are assigned a 0% risk-weight. Unencumbered marketable securities with residual maturities of one year or greater by sovereigns, central bank, Bank for International Settlements, International Monetary Fund, European Commission and non-central government PSEs are assigned a 5% risk-weight. Unencumbered corporate bonds or covered bonds and marketable securities by sovereigns, central banks, non-central government PSEs are assigned a 20% risk-weight. In addition, unencumbered gold, equity securities, corporate bonds and covered bonds, loans to non-financial corporate clients, sovereigns, central banks and PSEs are assigned a 50% risk-weight. Unencumbered residential mortgages and loans excluding loans to financial institutions are assigned a 65% risk-weight. Unencumbered loans to retail customers and small business customers are assigned an 85% risk-weight.

The OBS exposures or activities are calculated against the RSF factor. Under the NSFR, conditionally revocable and irrevocable credit and liquidity facilities to any client is assigned a 5% of the currently undrawn portion. Other contingent funding obligations as defined in the NSFR, including various products and instruments such as unconditionally revocable "uncommitted" credit and liquidity facilities, guarantees, letters of credit, other trade finance instruments, non-contractual obligations are determined or specified by supervisors in terms of the RSF factor.

3.12 Model Specification

Based on empirical literature and the nature of the data, the study adopted the SVAR to identify and establish sources of liquidity shocks in Namibia. A large body of empirical literature considered SVAR as a result of its appropriateness to display the interactions between sets of macroeconomic variables using panel data. The SVAR modelling approach is an appropriate tool

to analyse the dynamics of the model by subjecting it to unexpected shocks. It is a multivariate system of equations just as the simultaneous equation model. The SVAR model is used to study economic and finance theory in identifying the role of shocks in the dynamic model. The standard or general VAR cannot achieve that as it is not adequate in the analysis of economic and finance issues based on theory (Sunde et al., 2016:127). On the other hand, the simultaneous equation modelling cannot achieve this identification as a result of the absence of suitable instrument for identification in the traditional dynamic simultaneous equation approach (Sim, 1980). Thus, it is argued that this approach is best suited for policy simulations based on various scenarios (see Gottschalk, 2001:3). This study is not looking at policy simulations and thus, that rules out the use of simultaneous equation modelling approach. With the help of granger causality, impulse response functions and variance decompositions part of SVAR, the structural shocks to liquidity conditions were identified and established. The study used data for 4 major banks which for the specified period 2009-2018. These data were pooled (stacked up) to make a balanced panel. So, it is a combination of time series and cross-sectional, and pooling the two makes the panel data. The focal area was liquidity conditions of banks caused by other macroeconomic variables.

The SVAR model used is as following:

$$L_{it} + a_T T_t = B_L + B_{LT1} T_{it-1} + B_{LT2} T_{it-2} + B_{LL1} L_{it-1} + B_{LL2} L_{it-2} + C_L GDP_{it} + e_L$$

$$a_L L_{it} + T_{it} = B_T + B_{TT1} T_{it-1} + B_{TT2} T_{it-2} + B_{TL1} L_{it-1} + B_{TL2} L_{it-2} + C_T GDP_{it} + e_{T...3.1}$$

L_{it} = Current level of Liquidity conditions

T_{it} = Current level of T

T_{it-1} = T lagged once

T_{it-2} = T lagged twice

L_{it-1} = L lagged once

L_{it-2} = L lagged twice

GDP_{it} = current level of GDP

e_T = white noise error term with zero mean and constant variance.

B_L = slope parameter for equation [1] variance intercept

B_T = vertical intercept for equation [2]

3.13 Estimation Technique

The seminal studies on predicting bank distress and the interactions of macroeconomic variables started in the 1970s and 1980s, by the works of (Sinkey, 1975:27, Altman, 1977:465, Martin, 1977:265, Barth, Brumbaugh, Sauerhaft and Wang, 1985:198, Demirguc-Kunt, 1989:10). The drawbacks of this study, liquidity shocks and particularly financial distress have been predicated based on forecast rather than actual results due to the nature of the data. Considering SVAR model, the model has been used widely in economic analysis. Areas of application include, for instance, sources of unemployment based structural shocks (Sunde et al., 2016), The Supply of Liquidity and Real Economic Activity (Goldberg, 2017), Liquidity provision as a monetary policy tool: the ECB's non-standard measures after the financial crisis (Quint and Tristani, 2017). The thesis employed three techniques for data analysis, namely, Granger causation, impulse response functions and forecast error variance decomposition.

3.13.1 Granger Causality

The Granger causality provides causation links between variables in determining which variables are truly exogenous that can be used for data analysis (Amisano et al. 1997:13; Gottschalk, 2001:24). The Granger causality tool is a hypothesis that evaluates the usefulness of one variable on forecasting another variable (Wei, 2013:73). The Granger causality test has been

used to establish causality between bank capital adequacy (Tier 1 RWCR), asset quality (NPL), earnings quality (ROA), and rate sensitivity to market risk (RSA_RSL) against liquidity conditions in Namibia. A time series of CAMELS approach (e.g. Tier 1 RWCR) is expected to granger causing the liquidity conditions in Namibia. In doing this, the values of Tier 1 RWCR and liquidity conditions in Namibia provide statistical data for the future value of liquidity conditions in Namibia. This provides insights for policy implications.

3.13.2 Impulse Response Functions

The impulse response functions are a tool that displays the response of each variable to structural shocks derived from economic time series (Barnichon et al., 2018:2). The impulse response functions were proposed by Sims (1980), they show the patterns of movement of variables over time. Yu, Ju'e and Youmin (2008:59) point out that impulse response function is a useful tool in showing the direction of an endogenous variable in identifying the shocks. The impulse function has been used to trace the response of liquidity conditions against bank capital adequacy (Tier 1 RWCR), asset quality (NPL), earnings quality (ROA), and rate sensitivity to market risk (RSA_RSL). A panel data of liquidity conditions (e.g. LA_ATL) is expected to be influenced by CAMELS approach in Namibia. In this event, patterns of movement of variables over time provide either positive or negative significance of the effects of one variable to another variable (e.g. Tier 1 RWCR on LA_ATL). Again, these offer insights for policy implications.

3.13.3 Forecast Error Variance Decomposition

In relation to impulse response function, forecast error variance decomposition provides complementary analysis by identifying which variable contributes mostly in causing the shocks (Lanzarottias cited by Amisano, 1997:67). The variance decomposition displays the disparity of an endogenous variable in causing the shocks. For example, which of these bank capital adequacy (Tier 1 RWCR), asset quality (NPL), earnings quality (ROA), and rate sensitivity to market risk (RSA_RSL) is contributing most shocks to the liquidity conditions in Namibia. In doing this, variance decomposition provides most contributing factor affecting liquidity

conditions in Namibia. Higher values demonstrate most contribution in causing the shocks and subsequently liquidity shortage. This can supplement analysis of granger causation and impulse response functions and can provide insights for policy implications.

3.14 Post-estimation Diagnostic

With regards to robustness checks, the current thesis adopted the normality test (Jarque-Bera), auto correlation test, characteristic polynomial test and Standard Deviation (SE) in order to test for validity and reliability of SVAR model results.

3.14.1 Normality Test (Jarque-Bera)

Focusing on the normality test (Jarque-Bera), it determined whether the residuals derived from model are normally distributed (Berliana, 2015:6). Normality, tests show the difference between Skewness and Kurtosis whether the results were with values of -1 to +1 (Hoe, Dastane & Selvaraj, 2018:66). Normality tests were conducted by usage of the Jarque-Bera, Skewness and Kurtosis tests. The Jarque-Bera test is evaluating whether the panel data were normally distributed (Kalu, 2008:14). Skewness differentiates between positive long right tail and negative long left tail distributions (Kalu, 2008:14). On the other hand, Kurtosis differentiates between highest and flatness of time series distributions (Kalu, 2008:14).

With the null hypothesis, the study intended to find out whether the residuals are normally distributed. In contrast, with alternative hypothesis, the study aimed to find out whether the residuals are not normally distributed. If the probability values are greater than 5%, then concludes that the residuals from the model are normally distributed (Ghozali, 2015:6 as cited in Berliana). This implies that the results reject alternative hypothesis, and the residuals are normally distributed. The test results are assumed to be normally distributed.

3.14.2 Autocorrelation Test

Rahman and Hossain (2007:15) stated that autocorrelation test “measures the association between two sets of observations of a series separated by some lags”. It tests whether the residuals from the SVAR model are free from autocorrelation or not. The correlation coefficient is to establish the adequacy of the SVAR model and whether the results are not suffering from autocorrelation. With null hypothesis, the study aimed to find out whether the residuals from the SVAR model are free from autocorrelation. While with alternative hypothesis, the study aimed to find out whether the residuals from the model are not free from autocorrelation. Hamid, Suleman, Shah and Akash (2017:125) stress that a negative coefficient implies that autocorrelation approved null hypothesis, while positive means unapproved null hypothesis. If the probability values at different lag lengths are greater than 5%, then based on the results the autocorrelation failed to reject the null hypothesis (Vincent, 2013:153). The tests are assumed to not be suffering from autocorrelation.

3.14.3 Characteristic Polynomial Test

Characteristic polynomial test parameter is also evaluated for the stability of the SVAR model. Amat, Busquier and Candela (2004:6) stress that the characteristic polynomial test parameter displays the stability of a model. For the period understudy, if the characteristics roots lie within the circle, it implies that the SVAR model is stable. The characteristic polynomial test parameter is assumed to be stable over the study period.

3.14.4 Heteroscedasticity test

The heteroscedasticity test is also conducted to confirm the presence of heteroscedasticity or homoscedasticity. The heteroscedasticity test finds whether there is an inequity in the regressed model from one outcome to another outcome (Berliana, 2015:6). With null hypothesis, the study aimed to find out whether the residuals in the SVAR model are homoscedasticity. Contrary, with alternative hypothesis, the study aims to find out whether the residuals from the SVAR model are heteroscedasticity. Over the study period, if the probability values of the test

are greater than 5%, it implies that results failed to reject the null hypothesis (Herawaty and Astuti, 2016:42). This means that the residuals in the SVAR model are homoscedasticity. If it is homoscedasticity, it implies that the results are not biased in determining the outcomes. The results are assumed to be homoscedasticity.

3.15 Unit Root Test

Given the nature of the data, the study used two first-generation unit root tests for panel, the Levin Lin and Chu (LLC) (2002) and Im, Pesaran and Shin (IPS) (2003) unit root tests. The idea behind using two different tests was to validate the results and ensure consistency for the results reported. The variables were tested at levels and at first difference. This was done in the intercept and then in the intercept and trend. The hypothesis for the LLC unit root test is set below;

H_0 : Individual time series contains unit root (Non-stationary)

H_1 : Individual time series does not contain unit root (Stationary)

If the p-values show reasonable significance levels, then the null hypothesis is rejected in favour of the alternative hypothesis.

The IPS test has a slightly different hypothesis. The hypothesis for the IPS to be tested is set below;

H_0 : Cross-section contains unit root (Non-stationary)

H_1 : Cross-section does not contain unit root (Stationary)

If the p-values show significance, then the null hypothesis is rejected in favour of the alternative hypothesis.

3.16 Choice of proxy variables

Based on the empirical literature and availability of data from Bank of Namibia, the identified variables are: under Basel III is Net Stable Funding Ratio (NSFR). Under CAMEL indicators are: Tier 1 RWCR, non-performing loans ratio (NPLs), return on assets ratio (ROA), liquid assets to average total liabilities (LA_ATL), total loans to total deposits ratio (LO_DEPO), total loans to total assets ratio (LO_TA), liquid assets to total assets (LA_TA), and rate sensitivity to assets and liabilities (RSA_RSL). In data analysis, all variables have been converted into natural logs with the exception of GPD and SIB_CDR due to their lower values against the other ratios. As regards to NSFR, this is a new liquidity ratio part of Basel III accord, which was proposed in response to the recent 2007-09 global financial crisis to prevent future financial crisis. The second objective of this study was to determine the extent to which NSFRs can strengthen CAMELS indicators in identifying liquidity shocks. NSFR is aimed to promote long-term funding within banking lending activities. Under the NSFR, “stable funding” refers to the amounts and types of equity and liability financing that can be sources of funds available over one year-period under conditions of extended stress (BCBS 2014:3). Under this NSFR, the available amount of stable funding divided by the required amount of stable funding is required to be greater than 100% (BCBS 2014:3). Hence, a higher value above 100 percent shows that banks have enough liquid and are unlikely to fail (De Young et al., 2017:16). This implies that banks with more liquid and better risk management are more resilient to financial distress (Boulifa et al., 2016:68). Prior works by Casu et al., (2017:19), Distinguin et al. (2013:20); Horvath et al. (2014:17) and Kapan et al. (2017:15) find a sturdy relationship between Tier 1 RWCR and liquidity conditions. The study assumes that liquidity conditions of banks measured by NSFR could be affected by capitalisation, asset quality, earnings quality of banks and sensitivity to market risks. The influence of other CAMELS ratios on NSFR and particularly liquidity conditions of banks could lead to liquidity shocks and subsequently bank distress.

With regards to bank capitalisation, the study proxy Tier 1 capital ratio (*Tier 1 RWCR*), this measures the total equity to total assets (Hossain et al. 2018:7). Tier 1 capital ratio is a key indicator of capital adequacy within banks which is used by regulatory bodies in many parts of the world and recommended by Basel Committee on Banking Supervision.

Table 3.4 Description of Basel III Liquidity ratios and CAMELS rating elements

Category	Ratios	Formula	Significance	Evaluation Criteria
Basel III Liquidity	Net Stable Funding Ratio (NSFR)	Available stable funding/Required stable funding	It measures the available stable funding against the required stable funding	Lower the worst
Capital Adequacy	Tier 1 RWCR capital	Tier-I Capital/aggregate of risk weighted assets (RWA)	It measures the ability of a bank in absorbing unanticipated losses with enough margins to enable to continue as a going concern	Lower the worst
Asset Quality	Non-performing loan ratio (NPL)	Non-performing loans/total loans	It measures percentage of NPL per each year observed	Higher the worst
Earning Quality	Return on assets ratio (ROA)	Net income/total assets	It measures the ability of a banks to generate income from asset management	Lower the worst
Liquidity	Liquid assets to average total liabilities (LA_ATL)	Liquid assets/average total liabilities	It measures the ability of a bank to meet minimum liquid assets requirements arising from funding obligations	Lower the worst
	Total loans to total deposits ratio (LO_DEPO)	Total loans/total deposits ratio	It measures the ability of a bank to transform deposits into loans that are offered to borrowers	Higher the worst
	Total loans to total assets ratio (LO_TA)	Total loans/total assets ratio	It measures the asset risk related to mismatches in terms of maturity of loans	Higher the worst
	Liquid assets to total assets (LA_TA)	Liquid assets/total asset ratio	It measures the maturity structure	Lower the worst
Sensitivity	Rate-sensitive assets and rate-sensitive liabilities to total assets	Rate-sensitive assets and rate-sensitive liabilities/total assets	It measures the impact of market prices on bank's earnings	Lower the worst

Source: Srinivasan and Saminathan, (2016) & Own constructions

According to Basel's definition of capital, Core capital (Tier 1) consists of core elements comprising of equity capital and published reserves from post-tax retained earnings minus goodwill. Under Basel II, banks are subject to hold capital not less than 8 percent as a requirement (BCBS, 2004:12). Accordingly, banks with higher capital adequacy and profitability are likely to survive (Cole et al., 2014:18, Papanikolaou, 2017:9). Prior works by Casu et al. (2017:19), Distinguin et al. (2013:20); Horvath et al. (2014) and Kapan et al. (2017:15) find a strong relationship between Tier 1 RWCR and liquidity conditions. Thus, we can expect a strong relationship between capital adequacy (Tier 1 RWCR) and liquidity conditions. In addition, we assume the effect of capital adequacy on liquidity conditions in Namibia, which could be one of the sources of liquidity shocks in banks.

Regarding quality of bank assets, the non-performing loans (NPL) is considered as a proxy and as an early warning indicator. NPL refers to the percentage of loans overdue for a particular year observed (Nurazi et al. 2016:140). The higher the NPL ratio is, the more risk a bank is facing (Kowanda et al. 2014:365). Credit risk measured by NPL is an essential factor of bank liquidity conditions due to non-repayment of loans by borrowers as it increases liquidity risk that could lead to bank distress (Hajja et al. 2015:256). Prior works by Berrios (2013:15); Hajja and Hussain (2015:255); Nabilar et al. (2018:17) find a significant positive relationship between credit risk and liquidity risk. Subsequently, it can be expected that a positive relationship and the influence of credit risk (NPL) on liquidity conditions in Namibia could be some of the sources of liquidity shocks in banks.

As for the bank earnings, the study considered the return of assets (ROA) as a proxy in measuring the influence of profitability against liquidity conditions of banks. ROA shows the returns received on assets employed by a bank (Karri et al. 2015:25; Srinivasan et al. 2016:48). Higher return on assets means higher profit generated by a bank (Karri et al. 2015). Angola et al. (2011:9) argue that the deterioration in bank profit is suggestive of the bank facing probability of bad loans. Banking institutions with low levels of earnings also have a higher insolvency probability (Papanikolaou, 2017:9). Prior works find a positive correlation between ROA and liquidity conditions in banks (Panigrahi, 2014:319; Ghurtskaia et al., 2016:1611; Pradhan and Shrestha, 2016:7. Consequently, a correlation between ROA and liquidity conditions is expected, and the influence of ROA on liquidity conditions could be one of the sources of liquidity shocks

in Namibia. The ROA is an important ratio in measuring bank profitability and it is used by several regulatory bodies including Bank of Namibia, which is a regulatory body in Namibia.

Concerning liquidity ratios, these ratios determined the ability of the bank to meet its commitments resulting from depositors and investors. In the case of banking liquidity conditions, the study proxies' four liquidity ratio in measuring with other non-liquidity ratios, but all are part of CAMELS framework. The first liquidity ratio is Liquid assets to average total liabilities (LA_ATL). It measures the ability of a bank to meet minimum liquid assets requirements arising from funding obligations. The lower the ratio, the bank faces the risk of unexpected withdrawals from savers (Srinivasan et al. 2016:48). Prior studies find that LA_ATL could be affected by non-performing loans and sensitivity to market risk (Hajja et al., 2015:255; Nabilar et al., 2018:17; Distinguin et al., 2013:21; Casu et al., 2017:20; and Banti et al., 2019:86). The results assumed the LA_ATL to be affected by non-performing loans (NPL) and rate sensitivity to assets and that could be one of the sources of liquidity shocks in banks.

The second liquidity ratio is the total loans to total customer deposit ratio (LO_DEPO). It indicates ability of the bank to transform deposits into loans in order to supply loans to borrowers (Venkatesh et al. 2014:17). According to Venkatesh et al. (2014:17) banks are lending more money to customers then it becomes difficult to repay their current liabilities. Affes et al. (2017:5) point out that the higher the ratio, the higher the risk facing the bank in a case of unexpected deposit withdrawals from savers. Prior studies find that LO-DEPO could be affected by bank capital adequacy and rate sensitivity to market risk (Casu et al., 2017:19; Distinguin et al., 2013:20). The results are assumed that LO_DEPO could be affected by bank capital adequacy ratio and rate sensitivity to assets and that could be one of the sources of liquidity shocks in banks.

The third liquidity ratio is the total loans to total assets ratio (LO_TA). It measures the percentages of assets of a bank in relation to total loans (Venkatesh et al. 2014:16). The higher ratio means more liquid assets of a bank and that has higher probability of financial distress (Majumder et al., 2016:246). Prior studies find that LO_TA could also be affected by non-performing loans and bank earnings or profitability (Berrios, 2013:15; Hajja et al., 2015:255; Ghurtskaia et al., 2016:1611; Pradhan et al., 2016:7). The results assumed that LO_TA could be

affected by non-performing loans and earnings or profitability and that could be one of the sources of liquidity shocks in banks.

The fourth liquidity ratio is liquid assets to total assets ratio (LA_TA). This ratio is imposed by the central bank (e.g. Bank of Namibia) on commercial banks (Saunders and Cornett, 2008:498). It measures the maturity transformation risk arising from maturity mismatch of assets and liabilities from a balance sheet (Srinivasan, 2016:48). An increase of liquid assets to total assets ratio means a bank has a higher liquidity and is unlikely to face a bank run (Shen and Chen, 2014:1). Prior studies find that LA_TA could be affected by non-performing loans ratio and capital adequacy (Berrios, 2013:15; Hajja et al., 2015:255; Nabilar et al., 2018:17; Casu et al., 2017:19; Distinguin et al., 2013:20). The results are assumed that LA_TA could be affected by non-performing loans and capital and that could be one of the sources of liquidity shocks in banks.

Regarding the sensitivity to market risk, the study proxies the rate-sensitive assets and rate-sensitive liabilities to total assets. The rate-sensitivity asset refers to assets or liability which is “repriced at or near the current market interest rates within a maturity bucket” (Saunders et al., 2017:205). Accordingly, change in currency value and cumulative gaps adversely affect bank income (Saunders et al., 2017:205 and Le, 2017:7). Prior studies find a positive correlation between bank income and liquidity conditions (Ghurtkaia et al., 2016:1611; Pradhan et al., 2016). The results are assumed to be affected by interest rates, foreign exchange rates and prices and that could be one of the sources of liquidity shocks in banks.

3.17 Justification of Explanatory Variables

This section introduced other explanatory variables as part of the control variables. As discussed by Tirole (2011:3), liquidity risk cannot be measured by single financial ratio since liquidity risk or bank runs are caused by many factors. It is against the factors that necessitated this study to consider other ratios that could expose banks to liquidity risk. From a literature perspective, bank size came into consideration as a result of the argument that is too-big-to-fail (e.g. refer to a bank). As discussed by Bonfim et al. (2017:12), larger banks are always seen as

they are too-big-to-fail, but they are having fewer incentives to have sound liquidity measurements. Boulifa et al. (2016:68) stress that bank size is a vital factor in determining bank probability of default. According to Angora et al. (2011:12), the complexities of products, services and transactions offered and conducted by large bank could affect its stability. The natural logarithm of total bank assets less loan loss reserve (LNTA) is a proxy of the bank size and capital adequacy. A positive signal is the indication of bank probability of default (Angora et al. 2011:12). In an earlier section, the study documented the relationship between capital adequacy and liquidity positions of banks (see Casu et al., 2017:19; Distinguin et al., 2013:20; Horvath et al., 2014:17; and Kapan et al., (2017:15). In that regard, the bank size is an important factor in determining the stability of banking institutions and that could assist in revealing the sources of liquidity shocks in banks.

In addition, numerous researchers argued that economic downturn is also an important factor when studying bank liquidity shortages and financial distress. For example, when a country is experiencing economic downturn, that subsequently leads to deterioration of banks' loans and losses (Angora et al. 2011:13). In a more recent impact assessment study, Gobat et al. (2014:5) found that when a country's macroeconomic conditions deteriorate, banks can be vulnerable to bank financial distress. The annual growth rate of real Gross Domestic Product (GDP) is a proxy of macroeconomic conditions of a country which determines bank liquidity shortages and financial distress. A negative signal determines the bank liquidity risk and financial distress. In that regard, GDP has influence of banking performance and that could assist in revealing the sources of liquidity shocks in banks.

Lastly, the higher demand of liquidity from the interbank market is also taken into consideration for liquidity shortages and subsequently financial distress. For example, the shortage of liquidity from the interbank is likely to affect banking daily operations (Angora et al. 2011:13; Bonfim et al. 2017:10). Bonfim et al. (2017:10) define interbank rates as the ratio that differentiates interbank assets (e.g. loans given to other banks) and interbank liabilities (e.g. loans obtain from other banks and the central bank). The spread of the one-month interbank rate and the central bank policy rate (SIB_CDR) is a proxy of demand of liquidity from the interbank market. The higher value of the spread of the one-month interbank rate and the central bank policy rate is likely to affect the bank in terms of accessing the liquidity from the interbank. A

positive signal determines the bank's financial distress. In this regard, SIB_CDR is vital in determining liquidity shortages from interbank market which could affect banking operations and that could assist in revealing the sources of liquidity shocks in banks.

3.18 Ethical Considerations

Sekaran et al. (2013:13) refer to ethics as the code of conduct when conducting a research, for example, during data collection, data analyses, reporting and dissemination of results. In an attempt to adhere to the description of the above, this research followed academic rules and regulations which involve, as part of its process, to avoid any form of falsification, deceit, misrepresentation or dishonesty. The participant banks remain anonymous during the analysis of the data, reporting and dissemination of results and have been identified as Bank A, B, C and D and so on. The data derived from balance sheets, income statements and off-balance sheet activities have been kept confidential.

3.19 Chapter Summary

The purpose of this study was identifying and establishing the sources of liquidity shocks in Namibia for the period 2009 to 2018 using a liquidity ratio introduced by Basel III and traditional CAMELS ratios. Consequently, the study required appropriate methods and model in order to measure the ability of the said ratios in identifying liquidity shocks. The thesis followed the quantitative approach for data collection, data analysis and discussion. As observed from the methodology justification, the research philosophy is of positivism, the approach is deductive reasoning, and the strategies involve longitudinal studies and particularly the panel data. The target population comprised of (9) nine commercial banks, but only four were sampled for this study. These are Standard Bank, First National Bank, NedBank and Bank Windhoek. The sample technique is judgement sampling. The data has been sourced from Bank of Namibia and Namibia

Statistics Agency. Data was derived from the balance sheets of the stated commercial banks and annual growth rate of real Gross Domestic Product (GDP) from Namibia Statistics Agency. The thesis adopted SVAR model in order to explore the interactions between macroeconomic variables. This enables to identify structural shocks, and subsequently liquidity risk. In SVAR, three techniques, namely: granger causation, impulse response and variance decomposition functions have been employed for data analysis. In addition, robustness checks have evaluated using normality test (Jargue-Bera), auto correlation test, characteristic polynomial test and standard deviation (SE) in order to maintain the reliability and stability of the SVAR model. The subsequent chapter focuses on the research findings for the study.

CHAPTER IV

DATA ANALYSIS

4.1 Introduction

The main purpose of this thesis was to analyse commercial banks' liquidity shocks in Namibia for the period between 2009 to 2018 using the Structural VAR model (SVAR). Before conducting data analysis, the study started with descriptive statistics in order to describe and summarise the data. In addition, before data analysis and interpretation, unit root tests are reviewed and presented. As already stated in Chapter III, the study used the Structural Vector Autoregression (SVAR) in order to analyse macroeconomics variables and sources of the banks' cycle fluctuations in terms of liquidity shocks. In estimating the SVAR regression model, granger causality, impulse-response functions and forecast error variance decomposition was employed and evaluated. As already discussed in Chapter III, granger causality provides causation links between variables in determining which variables are truly exogenous that can be used for data analysis (Amisano et al., 1997:13; Gottschalk, 2001:24). The impulse response functions are a tool that displays the response of each variable to structural shocks derived from economic time series (Barnichon et al., 2018). The impulse response functions were proposed by Sims (1980); they show the patterns of movement of variables over time. In relation to impulse response function, forecast error variance decomposition provides complementary analysis by identifying which variable contributed mostly in causing the shocks (Lanzarotti as cited by Amisano, 1997:67).

To test for validity and reliability of SVAR model results, normality test (Jargue-Bera), auto correlation test, characteristic polynomial test and standard Deviation (SE) were evaluated in terms of carrying out hypothesis tests. The normality test displays whether the residuals were normally distributed. If the probability values are greater than 5%, it concludes that the residuals from the model are normally distributed. The normality test is assumed to be normally distributed.

Rahman and Hossain. (2007:15) state that autocorrelation test “measures the association between two sets of observations of a series separated by some lags”. It tests whether the residuals from the SVAR model are free from autocorrelation or not. The correlation coefficient is to establish the adequacy of the SVAR model and the results do not suffer from autocorrelation. Characteristic polynomial test parameter is also evaluated for stability of the SVAR model. For the period understudy, if the characteristics roots lie within the circle, it implies that the SVAR model is stable. The characteristic polynomial test parameter is assumed to be stable over the study period. The heteroscedasticity test is also conducted to confirm the presence of heteroscedasticity or homoscedasticity. Over the study period, if the probability values of the test are greater than 5%, it implies that results fail to reject the null hypothesis. This means that the residuals in the SVAR model are homoscedasticity. If it is homoscedasticity, it implies that the results are not biased in determining the outcomes. As mentioned above, normality test (Jargue-Bera), auto correlation test, characteristic polynomial test and heteroscedasticity tests can be used to measure the stability, adequacy and the efficiency SVAR model. This chapter is divided into the following sections: Section 4.1 provides and discusses the descriptive statistics. Section 4.2 presents the unit root tests results, while Section 4.3 is on the correlation analysis between variables understudy. Finally, Section 4.4 discusses and evaluates robustness results.

4.2 Descriptive Statistics

Table 4.1 shows descriptive statistics of the variables understudy. Descriptive statistics attempt to describe and summarise gathered data. The descriptive statistics were measured as mean, median, maximum, minimum and standard deviation. Mean values refer to average values of variables understudy. Median is a measure of middle point of centrality of variables understudy. Whilst, maximum and minimum refers to highest and least values respectively of the variables understudy. Lastly, standard deviation measures the dispersion of the variables understudy.

Table 4.1: Descriptive statistics of the variables understudy, for Namibian commercial banks, on average, from 2009 to 2018

Variables	Mean	Median	Max	Min	Std Dev	Obs
TIER1RWCR	12	12	16	8	2	185
NPL	2	2	5	1	1	188
ROA	2	2	4	1	1	181
LA_TA	11	10	25	7	3	186
LA_ATL	12	12	20	10	2	188
LO_TA	74	74	87	17	9	188
LO_DEPO	90	89	158	66	12	188
NSFR	115	114	139	62	12	156
RSA_RSL	98	97	184	74	17	188
GDP	3.6	4.3	15.34	-6.09	4.97	156
LNTA	16.66	16.67	17.5	15.57	0.48	144
SIBR_CDR	0	0	0	-1	1	124

Source: Own construction from dataset of Bank of Namibia and Namibia Statistics Agency

The results in Table 4.1 indicate proxies' variables used to measure banks conditions over the period from 2009 to 2018. The banks' conditions were evaluated by looking at the adequacy of capital, asset quality, earning quality, liquidity positions, and sensitivity to market risks of sampled banks on average. In addition, the exogenous variables namely, annual growth rate of real Gross Domestic Product (GDP), natural logarithm of assets (LNTA) and spread of the one-month interbank rate and the central bank policy rate (SIBR_CDR) was evaluated to demonstrate the macroeconomic environments over the time.

Concerning adequacy capital, it was measured by Tier I capital (TIER1RWCR) over the period from 2009 to 2018 of sampled banks. The banking sector reports high capital ratios, from Table 4.1, the Tier 1 capital has a mean value of 12 with a standard deviation of 2 and a minimum and maximum value at 8 and 16 respectively. According to Basel II requirements, banks are required to meet minimum statutory capital requirement of 8%. The results suggest that banks are profitable and adequately capitalised by scoring higher percentages over 8% required. However, the standard deviation of 2% highlights that there is a small dispersion of capital. Analysing the minimum value of 8 and maximum value of 16, this implies banks are within and above the required percentages of capital adequacy. The high capital ratio and well-capitalised in sampled banks can be attributed to general reserves and retained earnings according to (Bank of Namibia, 2019:27).

Non-performing loans to total loans (NPL) were used to measure asset quality and riskiness to the banking sector. The variable has an average value of 2 with a standard deviation of 1 value. This means that sampled banks NPL ratio remained below the statutory maximum of 4% target or benchmark. The results suggest that the sampled banks have a low performing loan which means that they are stable and sound. Low non-performing loans amongst sampled banks reflect low interest rate environments decided by the central bank which allows borrowers to repay their loans. However, minimum and maximum recorded 1 and 5 respectively. The high maximum level of NPL ratio can be attributed to weak domestic economic activities over the last 5 years, which leads to high level of NPL ratio (Bank of Namibia, 2019:30). The 1 recorded standard deviation values highlights that there is a little dispersion in terms of capital set aside to cover the non-performing loans.

The sampled banks' profitability and earnings were measured by return on assets (ROA). ROA refers to the ability of banks to generate income. Over the 2009 to 2018 period, ROA on average the mean stood at 2 values while standard deviation stood at 1 value. The minimum and maximum stood at 1 and 4 respectively. According to Bank of Namibia, the statutory minimum requirements for ROA are 2 percent, which means that a bank is sound and profitable. Angora et al. (2011:90) point out that higher ROA is associated with taking high risks which could lead to bank failure. The results suggest that sampled banks have solid profits. This can be attributed by

efficient banking operations and high capital ratio. The standard deviation for ROA was 1% indicating the variation in terms of profit over the sampled period of time. On the other hand, the minimum and maximum values show that some banks generated less profit at some point in time while others generated above targeted requirements. Overall, the ROA means that banks are safe and sound.

With regards to liquidity capability, the study used Liquid assets to total assets (La_Ta) as one of the core indicators to measure liquidity position of sampled commercial banks. The variable shows an average value of 11% for the period from 2009 to 2018. However, standard deviation value is 3 and minimum and maximum values stood at 7 and 25 respectively. This suggests that Namibian commercial banks invested 11% on average in liquid assets between 2009 to 2018 period. This again the results reveal that Namibian commercial banks are closed to 12 percent of statutory requirements. Again, the results suggest that banks are liquid. The standard deviation of 3% highlights that there is a small dispersion. In relation to minimum and maximum values, the results imply that there was liquidity shortfall at some point of time demonstrated by 7% minimum values while maximum values show highly liquidity among sampled banks. The IMF (2018:7) report that three of the banks experienced liquidity shortfall over the sampled period. Lower values of this ratio reflect lower bank liquidity as a result of poor maturity management from a bank side (Angora et al. 2011:10).

Liquid asset to average total liabilities (LA_ATL) was also used to measure liquidity position of banks. The average mean for LA_ATL reported for sample banks over the period from 2009 to 2018 is 12 while standard deviation stood at 2 values. In addition, minimum and maximum stood at 10 and 20 respectively. The results suggest that banks above the 10% statutory requirements. This means that banks are safe and sound. The standard deviation of 2% implies that there is a small dispersion in term of liquidity in banks. With regard to minimum and maximum values indicating that some of the sampled banks were below the 11 percent statutory requirement over the time, demonstrating liquidity shortfall among banks, while maximum value highlighting highly liquidity in banks. Lower values of this ratio reflect lower liquidity meaning liquidity shortfall among banks.

Total loans to total assets ratio (LO_TA) were also used to measure liquidity position of sampled banks over the period from 2009 to 2018. The variable indicates an average value of 74 which is close to 75 percent statutory minimum requirement. The standard deviation stood at 9 while minimum and maximum are 17 and 87 respectively. Higher values of 85% of this variable indicate illiquidity amongst banks. The results suggest that banks are liquid and sound. The reported standard deviation of 9% implies that there is a small dispersion. On the other hand, minimum values suggest that there were lower loans to total assets at some point over the study period, while maximum values indicating illiquidity among banks in some point over the study period. The results imply that banks are liquid although there were times over the study period when banks were illiquid. The higher values of this variable attribute to lack of liquidity in a bank.

Total loans to total deposits (LO_DEPO) were another variable employed to assess the liquidity position of sampled banks over the period of 2009 to 2018. The average LO_DEPO reported for sampled banks is 90, while standard deviation stood at 12 values. On the other hand, minimum and maximum values are 66 and 158 respectively. A lower ratio than the 100 percent of statutory requirements means that the banking sector has sufficient capital to fund loans as opposed to search for expensive source funding such as borrowed funds. The results suggest that banks have sufficient funds to provide loans rather than borrow elsewhere. The reported standard deviation of 12% highlights that there is a small dispersion. With regards to minimum values of 66%, this suggests that banks were having sufficient capital to provide loans, but the maximum values of 158% highlight that in some point of time over the study period banks were not having sufficient capital to fund loans to borrowers. Overall, the results imply that banks have sufficient funds to provide loans rather than borrow elsewhere, but there were difficult times banks could not have enough capital to provide loans to borrowers, highlighting liquidity shortfall.

The study also used Net Stable Funding Ratio (NSFR) which is part of the new Basel III liquidity measurements to measure liquidity positions over the period from 2009 to 2018 for the sampled banks. The variable has an average value of 115 with standard deviation of 12. This demonstrates that on average, banks are above 100 percent required to cater for liquidity shortfall. The standard deviation of 12% highlights a medium dispersion of cash set aside to

cover the liquidity shortfall. Analysing the minimum value of 62 and maximum value of 139, this implies in terms of minimum value there was liquidity shortfall of 38% in some point of sample period. Overall, the results suggest that sampled banks met NSFR statutory requirements, which means that banks were safe and sound over the sample period. Higher values of this ratio imply that banks maintained maturity management of assets and liabilities, meaning that they hold high liquidity (Cucinelly, 2013:2; and Bonner et al. 2015:24).

The study used rate sensitive rendering assets to rate sensitive liability as a proxy to measure sensitivity to market risks which might reduce the income of the sampled banks over the period from 2009 to 2018. The variable shows an average value of 98 with a standard deviation of 17. On the other hand, the minimum and maximum values are 74 and 184 respectively. The mean value of 98% demonstrates that the market risk exposed by sampled banks is within the statutory requirements of below 120 targets. The standard deviation value of 17% implies a medium dispersion. However, minimum and maximum values are 74 and 184 respectively. Concerning the maximum values of 184, it implies that there was time when market risks posed serious challenges to the sampled banks. Overall, the results suggest that market risks are within the range of 80 to 120 values, as required by the central bank. Higher values of this variable reflect inability of a bank to identify, monitor, manage and control market risks that may reduce the income (Tripathi et al. 2014:134 and Karri et al. 2015:31).

The study also used annual growth rate of real gross domestic product (GDP) as proxy for macroeconomic environment and exogenous variable in the determining banks stability. From Table 4.1, the GPD has a mean value of 3.6 with standard deviation standing at 4.97, whilst minimum and maximum values of -6.09 and 15.34 respectively. The reported GDP over the sample period is positive, which demonstrates economic growth over the time. The results imply that GDP dispersion is relatively high (4.97), suggesting that economic growth for sample period is widely dispersed. On the other hand, the minimum value of -6.09 demonstrates that the banking sector and the country experience negative economic growth at some point over the sample period. Real GDP contraction has influence on banking capital, assets, profitability, liquidity and market risks.

The bank size was measured by the natural logarithm of assets (LNTA) of the sample banks on average. On average, the mean value stands at 16.66 while standard deviation at 0.48 values. However, the reported minimum and maximum are 15.57 and 17.5 respectively. Considering standard deviation values, this implies that bank size dispersion is relatively small. The results suggest the sample banks in terms of size and assets quality, there is no much difference. This is also supported by the reported difference between minimum and maximum values of 15.57 and 17.5 respectively. Again, the results demonstrate the homogeneity of the sample banks under study. According to IMF (2018:10), Namibian banking sector has four large banks in term of assets and they are concentrated. These four large banks are controlling and dominating the market. For example, this result is consistent with IMF's (2018:10) finding that these four large banks hold about 98 percent of total bank assets in Namibia.

Lastly, the spread of the one-month interbank rate and the central bank policy rate (SIBR_CDR) was used to measure liquidity pressures from interbank market of sampled banks. The variable has an average value of 0 during the sample period. The results suggest that interbank rates are relatively low, which could encourage participant banks in terms of borrowing and lending. The minimum and maximum values are -1 and 0 respectively. The reported standard deviation value is 1%, which implies that there is small dispersion in terms of interbank rates over the sample period. Contrary wise, during the 2007-09 global financial crisis, the interest rate spread was widening and increased prices, which made difficult for financial institutions to borrow and lending in the interbank markets (Schwarz, 2018:26). In that respect, asset prices or cost were volatile and this threatened liquidity shortfall and subsequently banks' failure.

4.3 Unit Root Test

Before the analysis and interpretation of the results, the stationarity of data was evaluated using unit root test in order to confirm the variables understudy and ensure that they are fit for the intended purpose. Due to the nature of the data, the data were converted into natural logs with the exception of GDP and SIB_CDR as they contain negative values.

Table 4.2 Unit root tests: LLC & IPS in levels and first differences

Variable	Model Specification	LLC	IPS	LLC	IPS	Order of Integration
		Levels	Levels	First Difference	First Difference	
NSFR	Intercept	-1.16	-1.73**	-5.03**	-5.82**	I(0)
	Intercept and trend	-0.06	-0.12	-4.18**	-5.00**	I(1)
TIER1RWCR	Intercept	-2.55**	-2.55**	-12.11**	-11.39**	I(0)
	Intercept and trend	-3.82**	-2.73**	-11.35**	-11.00**	I(0)
NPL	Intercept	0.83	1.19	-5.81**	-5.24**	I(1)
	Intercept and trend	-1.25	3.79	-8.24**	-7.88**	I(1)
ROA	Intercept	-3.57**	-3.23**	-8.26**	-11.03**	I(0)
	Intercept and trend	-3.67**	-3.18**	-7.01**	-10.40*	I(0)
LA_ALTL	Intercept	-1.57	-2.24**	-9.71**	-11.35**	I(0)
	Intercept and trend	-1.99**	-1.71**	-8.36**	-10.58**	I(0)
LO_DEPO	Intercept	-2.84**	-2.24**	-9.25**	-11.14**	I(0)
	Intercept and trend	-4.06**	-3.68**	-7.96**	-10.30**	I(0)
LO_TA	Intercept	-3.71**	-2.93**	-10.02**	-10.46**	I(0)
	Intercept and trend	-4.53**	-2.22**	-8.86**	-9.70**	I(0)
LA_TA	Intercept	-0.50	-1.03	-5.49**	-10.45**	I(1)
	Intercept and trend	-0.30	-0.86	-3.46**	-9.63**	I(1)
RSA_RSL	Intercept	-0.18	-0.76	-8.27**	-9.21**	I(1)
	Intercept and trend	-0.99	-0.73	-7.27**	-8.49**	I(1)
GDP	Intercept	-2.47**	-4.40**	-8.40**	-11.26**	I(0)
	Intercept and trend	-3.63**	-5.26**	-6.87**	-10.76**	I(0)
LNTA	Intercept	-0.75	2.44	-8.94**	-9.39**	I(1)
	Intercept and trend	-1.88**	-1.20	-8.23**	-8.50**	I(0)
SIB_CDR	Intercept	-0.99	1.35	-9.34**	-8.12**	I(1)
	Intercept and trend	-5.16**	-3.33**	-7.92**	-6.85**	I(0)

*Note: ** means the rejection of the null hypothesis at 5%.*

According to the results in the Table 4.2, variables Tier1 RWRC, ROA, LA_TA, LO_DEPO and GDP are all stationary. This means that they are integrated of order zero. On the

other hand, the variables RSA_RSL and LA_TA are stationary in the first difference or order 1. The rest of the variables have a combination of order zero and one.

4.4 Data and Estimation Results

4.4.1 LA_ATL results

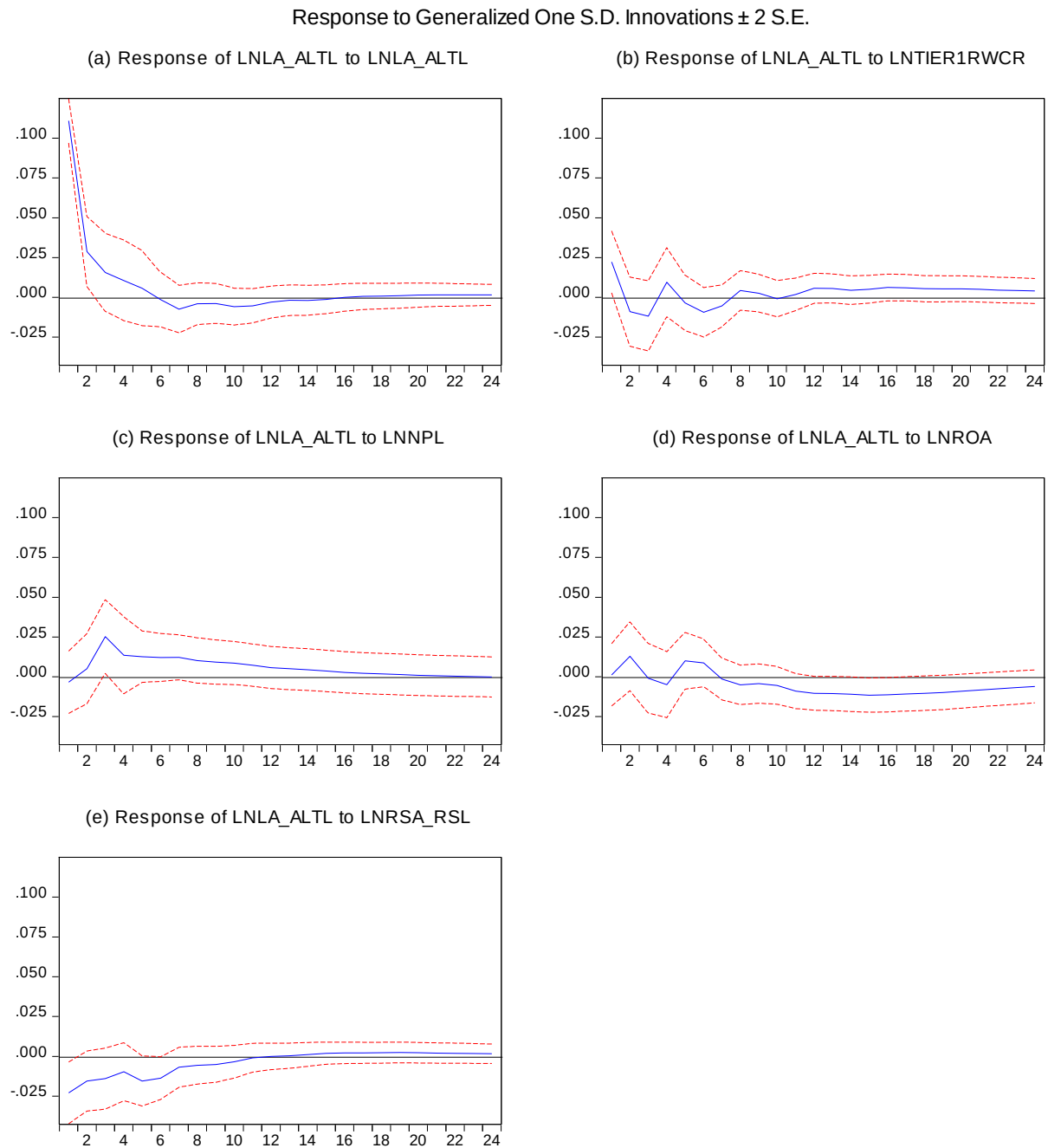
The impulse response analysis revealed the reaction of liquidity indicators to specific shocks. Capital adequacy, asset quality, profitability, and sensitivity to market risks are assumed to influence the liquidity conditions of banks. Liquidity shocks or changes are linked to shocks over the time or long run trends of the variables understudy.

Considering the Granger causality between capital adequacy and liquidity, Tier 1 RWCR is granger causing the liquidity conditions to stand at 18% level of significance (see Appendix 1). This means that there is no causality between Tier1RWCR and LA_ATL. The relation between NPL and LA_ATL shows that it is the strongest. NPL is Granger causing the LA_ATL at 1% level of statistical significance. This means that liquidity conditions in banks are influenced by NPL from borrowers' side. Furthermore, ROA and LA_ATL show that there is also strong causality at 9% level of significance. This means that there is Granger causality between income and liquidity positions in banks. On the contrary, RSA_RSL show that there is no causality with LA_ATL at 22% level of significance. These results imply that it is only NPL and ROA ratios that have Granger causality with LA_ATL ratio. The results conclude that credit risk (non-performing loans) and poor earning could affect liquidity conditions in banks.

Figure 4.1 shows the impulse response of the Liquid assets to average total liabilities (LA_ATL) to a shock of Tier 1 capital, non-performing loans, return on assets, and rate sensitivity assets and liabilities. According to Panel (a) in Figure 4.1, it shows that LA_ATL positively responds to a positive availability of liquidity shocks. Thus, availability of liquidity shock has an effect on the liquidity conditions of banks. Panel (b) indicates both negative and

positive effects of Tier 1RWCR during 2009 to 2012 period then afterwards it has been at borderline significant. In 2009-10 was when most world economies experienced financial crisis and subsequently led to bank failures across the world.

Figure 4.1: Response of LA_ATL to other CAMELS indicators



Panel (c) in Figure 4.1 shows that liquidity conditions respond to positive non-performing loan shocks in banks. Liquidity increases in the first two years then slightly remain constant. Thus, non-performing loans shocks have effect on liquidity conditions in banks in the long run. From lending perspectives, NPL ratio is determined by lack of repayments of loans from borrowers' side. Panel (d) displays the impulse response functions of the LA_ATL to a shock of return on assets. The results show that liquidity conditions in banks were both increases and decreases in the first four years before it gradually decreased in the remaining years understudy. Again, the effect is borderline significant in the long run. This means that profitability shocks measured by return on assets responded positively than negatively and have a favourable effect on liquidity positions in banks in the short run.

A negative profitability shock may be caused by declined economic performance by referring to Namibia performance over the last 4 years. For example, in Namibia, GDP recorded 4.8% in 2015, 0.6% in 2016, -2.0% in 2017, and -1.7% in 2018 (Namibia Statistics Agency, 2019). Finally, as revealed in Panel (e), it shows that a negative rate sensitivity assets and liability shock leads to decreases of liquidity condition in Namibia. Thus, rate sensitivity assets and liability could affect liquidity conditions of banks. With regard to rate sensitivity assets and liability influence on liquidity, sensitivity to market risks could affect liquidity conditions in banks. Overall, all ratios have influence on liquidity conditions in Namibia.

Apart from impulse response, Table 4.3 presents the forecast error variance decomposition of the variables understudy derived from Structural VAR. The forecast error variance decomposition of the liquidity conditions in banks is vital as it shows various structural shocks that lead to liquidity conditions. Table 4.3 displays that Tier 1 capital, non-performing loans, return on assets and rate sensitivity assets and liabilities shocks are influencing liquidity conditions within banks. Additionally, Table 4.3 demonstrates that NPL shocks have the most important impact on the forecast error variance of the liquidity conditions. It shows that it has increased over the time from 5% to 10%. The ROA shocks are another important dynamic for the forecast error variance of the liquidity conditions. They increased from 1% to 8% over time. In the long run, ROA is the second important factor of the forecast error variability of the liquidity conditions.

Table 4.3: Variance decomposition of LA_ATL

Period	S.E.	LNLA_ATL	LNTIER1R WCR	LNNPL	LNROA	LNRSA_RSL
1	0.110939	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.116721	96.40850	1.664359	0.422066	1.234705	0.270369
3	0.122336	89.39358	3.066186	5.433861	1.197484	0.908884
4	0.124231	87.40831	3.336166	6.381398	1.176012	1.698114
5	0.126611	84.35517	3.351424	7.257487	2.130428	2.905494
6	0.128738	81.60288	3.766408	8.046500	2.773933	3.810274
7	0.129925	80.44017	3.789956	8.816950	2.728646	4.224274
8	0.130794	79.46795	3.899125	9.237911	2.729502	4.665517
9	0.131459	78.75200	3.927735	9.596119	2.726021	4.998128
10	0.132054	78.24332	3.892968	9.918876	2.778180	5.166654
11	0.132644	77.70960	3.909312	10.09597	3.065149	5.219972
12	0.133273	77.02938	4.104464	10.14159	3.483545	5.241016
13	0.133841	76.39589	4.276304	10.16104	3.928399	5.238371
14	0.134374	75.81131	4.372148	10.16668	4.439520	5.210351
15	0.134943	75.18153	4.497773	10.13267	5.018787	5.169240
16	0.135518	74.54450	4.679383	10.07088	5.578951	5.126290
17	0.136039	73.97677	4.840061	10.00802	6.087983	5.087168
18	0.136506	73.47489	4.961168	9.949193	6.561782	5.052963
19	0.136937	73.01839	5.075972	9.890984	6.991715	5.022940
20	0.137322	72.61907	5.191282	9.836594	7.356265	4.996793
21	0.137649	72.28746	5.289196	9.790104	7.658006	4.975235
22	0.137922	72.01361	5.366986	9.751366	7.909981	4.958053
23	0.138152	71.78620	5.433908	9.719269	8.116493	4.944130
24	0.138341	71.60181	5.492585	9.693789	8.279101	4.932717

Source: Own calculation from Eviews 8

The importance of RSA_RSL and Tier 1 capital are also imminent of the forecast error variability of the liquidity conditions. RSA_RSL account for about 0 to 5% over time, while Tier 1 capital account for about 0% to 5% as well over time. The results demonstrated that the SVAR Model is efficient and results can be reliable. Table 4.3 shows that these numbers were derived from various factors as critical in influencing liquidity conditions over time, the CAMELS indicators were an important source of liquidity fluctuations. Thus, liquidity shocks were present over time.

4.4.2 NSFR Results

With regard to Granger causality between NSFR against Tier1 capital requirements, NPL, ROA and RSA_RSL are not strong. For example, Tier1 RWCR account for 96%, NPL account for 68%, ROA account for 41%, and RSA_RSL account for 39% of level of significance. Thus, there is no Granger causality with all variables against NSFR (see Appendix 1).

The impulse response functions of the various CAMELS indicators against NSFR are presented in Figure 4.2. According to Panel (a) in Figure 4.2, the NSFR negatively responds to positive availability of liquidity shock. Thus, availability liquidity has an effect on liquidity conditions in banks. Panel (b) indicates that NSFR responds both positively and negatively to Tier1 RWCR impulse in banks. Liquidity increases and then decreases in the early stage then slightly remains constant in the remaining years understudy. Thus, Tier1 RWCR impulse has an effect on liquidity conditions in banks. The effect is determined by capital adequacy in banks in satisfying liquidity demands.

Similarly, as shown in Panel (c), NSFR responds negatively to non-performing loans impulse. The results show a decrease in early stage then the effects were borderline significant. Accordingly, NPL ratio performance may be influence by repayments of loans by borrowers. Panel (d) demonstrated that the relationship between NSFR and ROA is weak. NSFR responds positively to ROA in the first three years, but for the remaining years the effects are borderline significant. This implies that the relationship is not strong. Lastly, Panel (e) showed that NSFR responds both positive and negatively to the RSA_RSL impulse. Thus, again the sensitivity to market risk remains closed to zero of borderline, which means that relationship is not strong. Overall, all ratios have an influence on liquidity conditions in Namibia.

Figure 4.2: Response of NSFR to Other CAMELS Indicators

Response to Generalized One S.D. Innovations ± 2 S.E.

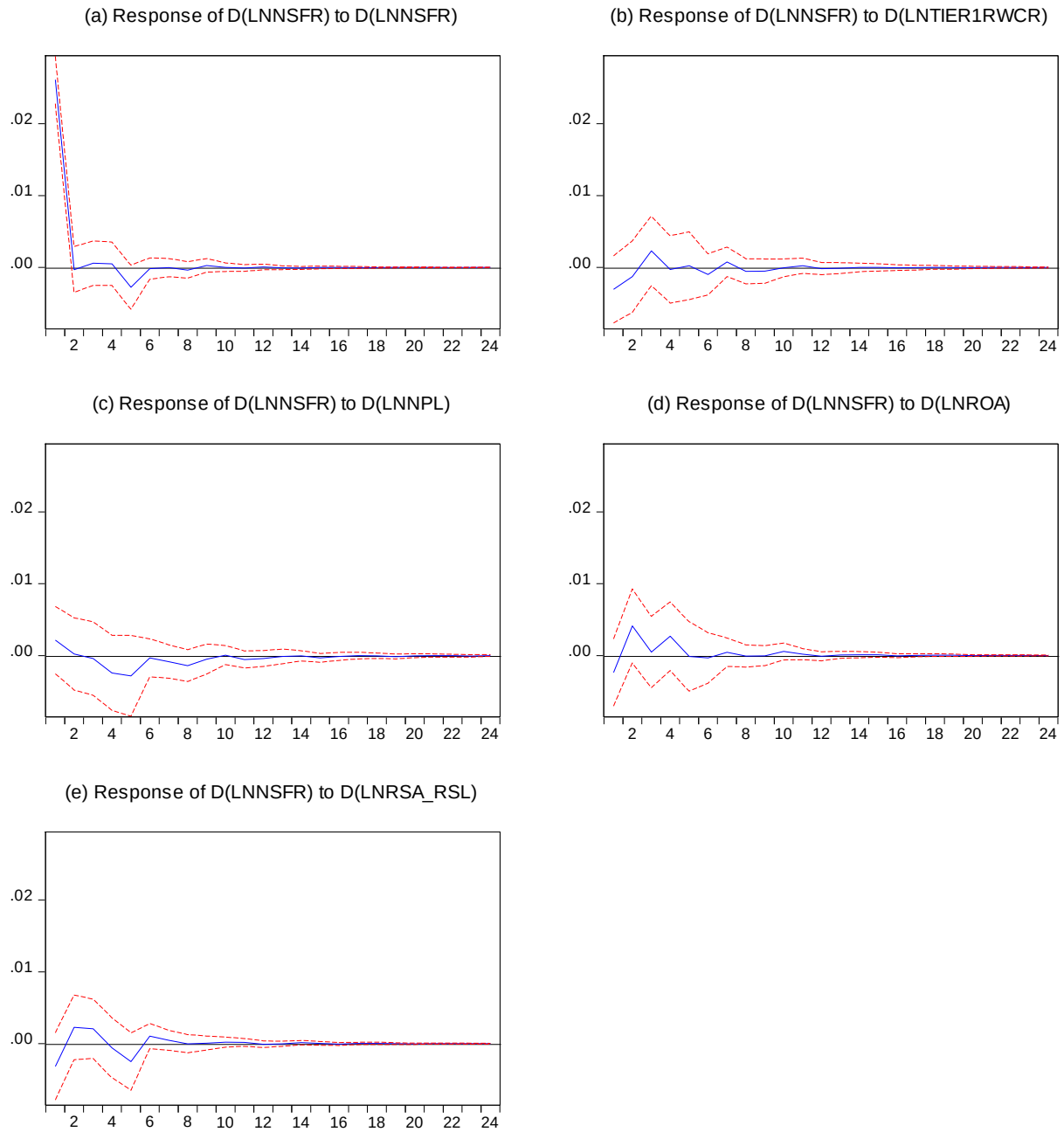


Table 4.4 presents forecast error variance decompositions of the NSFR and other CAMELS variables. Table 4.4 shows that Tier1 capital, non-performing loans, return on assets and sensitivity to market risk all have a minimal influence on liquidity conditions, particularly the NSFR. In the long run, the ROA plays an important part in defining the forecast error variability of liquidity variable. The ROA increases from 0% to 3% over the study period. NPL and RSA_RSL both increased from 0% to 2% and are second most important factors for the forecast error variance of liquidity conditions in banks. Lastly, Tier 1 capital play little part in describing the forecast error variability of liquidity variable. Tier 1 capital increased from 0% to 1% over the study period.

Table 4.4: Variance decomposition of NSFR

Period	S.E.	DLNNSFR	DLNTIER1R WCR	DLNNPL	DLNROA	DLNRSA_RSL
1	0.026102	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.026587	96.40062	0.242825	0.015211	2.450042	0.891299
3	0.026811	94.84268	1.030831	0.073834	2.462608	1.590048
4	0.027032	93.33743	1.020588	0.902155	3.163002	1.576829
5	0.027462	91.43991	0.989701	1.787998	3.168565	2.613821
6	0.027504	91.16331	1.118444	1.790721	3.191339	2.736185
7	0.027537	90.94345	1.194210	1.896574	3.198699	2.767072
8	0.027581	90.66714	1.235309	2.130141	3.208726	2.758684
9	0.027592	90.60863	1.264541	2.160309	3.208593	2.757928
10	0.027600	90.55903	1.264313	2.159616	3.251271	2.765771
11	0.027608	90.50744	1.270425	2.202816	3.250355	2.768963
12	0.027612	90.47947	1.273541	2.223767	3.254110	2.769109
13	0.027612	90.47601	1.275073	2.225569	3.254336	2.769016
14	0.027613	90.47239	1.275013	2.225683	3.255459	2.771453
15	0.027615	90.45944	1.274831	2.239064	3.255231	2.771438
16	0.027616	90.45683	1.274985	2.240789	3.255689	2.771707
17	0.027616	90.45648	1.275128	2.240824	3.255732	2.771840
18	0.027616	90.45579	1.275126	2.240956	3.255946	2.772177
19	0.027616	90.45321	1.275209	2.243614	3.255861	2.772108
20	0.027616	90.45301	1.275211	2.243754	3.255905	2.772124
21	0.027616	90.45293	1.275210	2.243752	3.255940	2.772164
22	0.027616	90.45282	1.275208	2.243830	3.255948	2.772192
23	0.027616	90.45239	1.275266	2.244228	3.255933	2.772179
24	0.027616	90.45238	1.275266	2.244240	3.255933	2.772178

Source: Own calculation from Eviews 8

4.4.3 LO_DEPO results

Considering the Granger causality between LO_DEPO and other CAMELS variables, Tier1 RWCR is Granger causing the liquidity variable at 6% level of significance. This implies that the causality between Tier1 RWCR and LO_DEPO is weak. In addition, NPL accounts for about 21% of granger causality towards liquidity variable. This means that there is no causality between NPL and LO_DEPO. The ROA is Granger causing the liquidity variable at 73% level of significance. This means that there is no causality between income and liquidity. Finally, RSA_RSL accounts for about 11% level of significance of Granger causality. This means that there is no causality between RSA_RSL and LO_DEPO. This further indicates that it is only Tier 1 RWCR that has minimal Granger causality with LO_DEPO (see Appendix 1).

Considering impulse responses, Panel (a) in Figure 4.3, displays that LO_DEPOs positively respond to the availability liquidity impulses. Thus, availability liquidity shocks have an effect on the liquidity conditions in Namibia. Panel (b) indicates that LO_DEPOs positively respond to capital requirements impulses at an early stage then afterwards it responds negatively for the remainder of study period. The results suggest that Tier 1 RWCR significantly lowers liquidity in banks in the long run. Similarly, Panel (c) indicates that LO_DEPOs negatively respond to NPL impulses. Thus, this demonstrates that NPL shocks have a favourable effect of decreasing liquidity in banks in the long run. Panel (d) displays that ROA decreases slightly in the first year and then it responds positively for the remainder of the study period. Finally, Panel (e) displays that LO_DEPOs respond positively to rate sensitivity assets and liabilities in the first 3 years then remained closed to zero of borderline. The performance demonstrated that the relationship is weak. Overall, all ratios have effects on liquidity conditions in Namibia.

Figure 4.3: Response of LO_DEPO to other CAMELS indicators

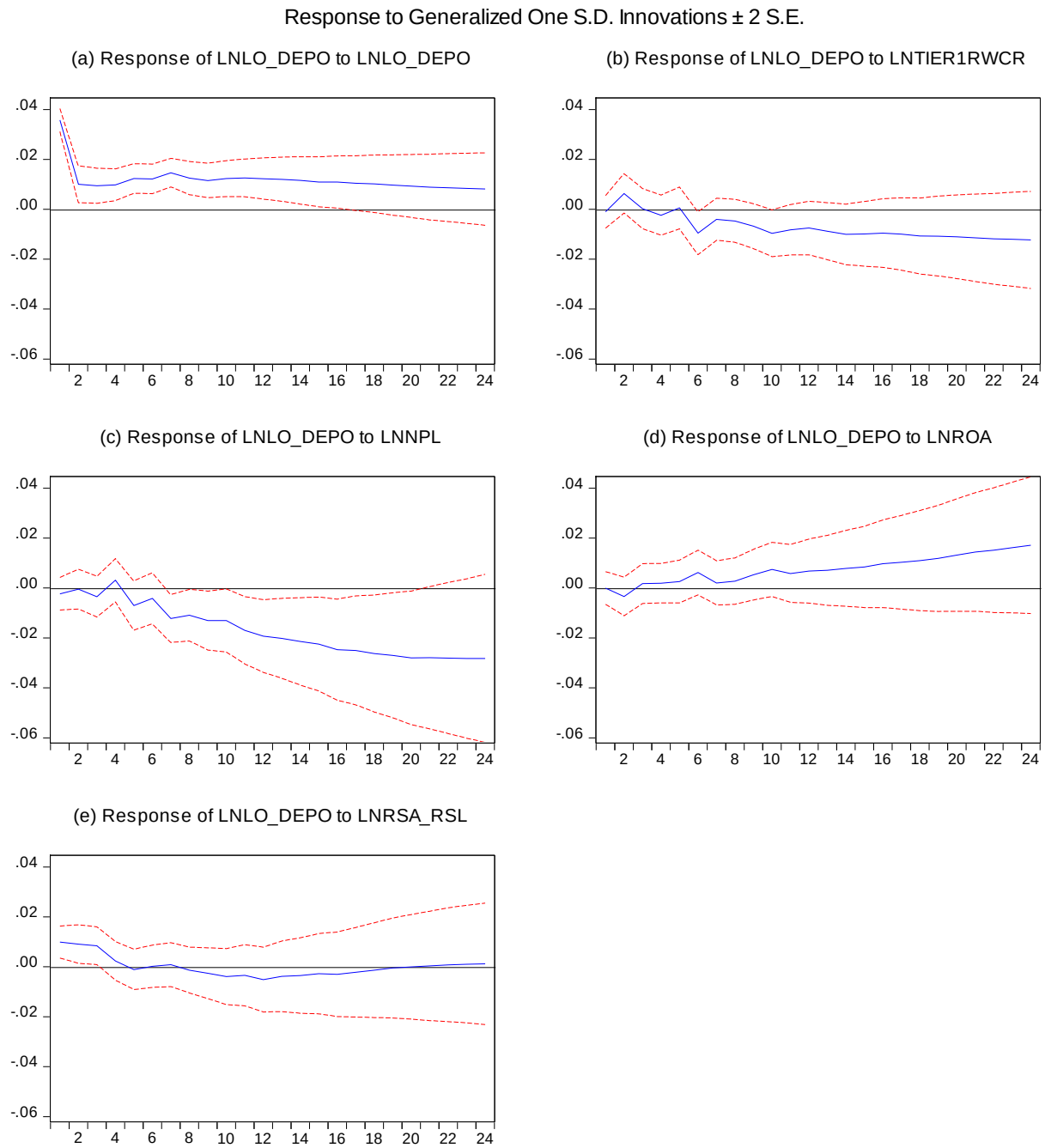


Table 4.5 displays the importance of Tier1 RWCR, NPL, ROA and RSA_RSL on the forecast error variance of liquidity conditions. Accordingly, NPL shocks play an important part on the forecast error variance of liquidity conditions. NPL increases from 0% in third year to

54% over the period. Tier 1 RWCR shocks are the most second important factor on the forecast error variance of liquidity conditions. Tier 1 RWCR shocks increases from 0% to 11% over the period. In contrast, ROA and RSA_RSL shocks have the least important impact on the forecast error variance of liquidity conditions. Thus, NPL and Tier 1 RWCR shocks have the most important impact on the forecast error variance of liquidity conditions. Again, SVAR Model is efficient and results can be reliable.

Table 4.5: Variance decomposition of LO_DEPO

Period	S.E.	LNLO_DEPO	LNTIER1R WCR	LNNPL	LNROA	LNRSA_RSL
1	0.035789	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.038340	93.93917	3.011774	0.051659	0.407674	2.589726
3	0.040131	91.24699	2.764608	0.607110	0.468848	4.912446
4	0.041656	90.22019	2.825410	1.563296	0.812671	4.578429
5	0.044129	88.16727	2.560885	3.529628	0.817997	4.924219
6	0.046992	84.47720	6.106959	3.267385	1.552469	4.595984
7	0.050591	81.27836	5.773490	7.431148	1.387508	4.129495
8	0.053281	78.77999	5.863125	9.883292	1.252061	4.221530
9	0.056263	74.83727	6.572736	12.99087	1.206265	4.392866
10	0.059720	70.66541	8.240098	14.85526	1.395580	4.843653
11	0.063576	66.26800	8.813684	18.74318	1.254734	4.920396
12	0.067814	61.52817	8.861746	23.18815	1.159827	5.262102
13	0.071955	57.44767	9.256505	27.06592	1.071726	5.158175
14	0.076177	53.55874	9.892820	30.61384	1.013038	4.921565
15	0.080318	50.04169	10.31680	34.07033	0.980867	4.590314
16	0.084841	46.50335	10.43395	37.79795	1.005896	4.258862
17	0.089173	43.47391	10.60811	40.94099	1.061100	3.915893
18	0.093647	40.60691	10.86186	43.84516	1.122578	3.563490
19	0.098077	38.00032	11.04102	46.47641	1.233221	3.249024
20	0.102621	35.53066	11.17941	48.89352	1.421885	2.974523
21	0.107034	33.35097	11.36447	50.81983	1.712578	2.752158
22	0.111377	31.40756	11.58581	52.39399	2.036818	2.575827
23	0.115658	29.65189	11.77492	53.71127	2.428304	2.433618
24	0.119864	28.06435	11.97188	54.75831	2.888173	2.317295

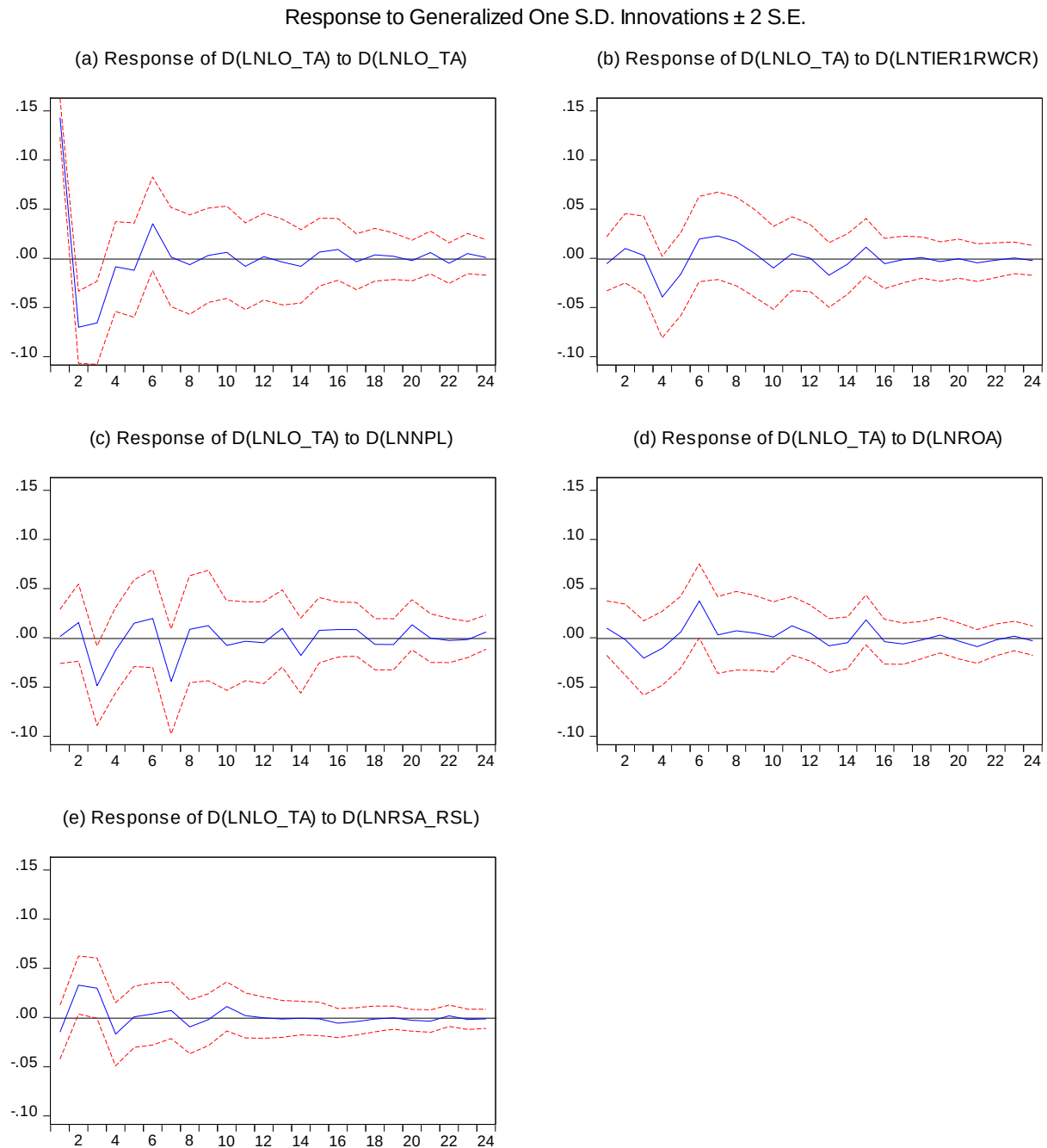
Source: Own calculation from Eviews 8

4.4.4 LO_TA Results

Concerning the level of significance and Granger causality between variables, Tier 1 RWCR is Granger causing the liquidity variable at 62% level of significance (see Appendix 1). This means that there is no causality between Tier 1 RWCR and LO_TA. NPL is granger causing the LO_TA at 6% level of statistical significance. This implies that the causality between NPL and LO_TA is weak. ROA is Granger causing the liquidity variable at 26% level of significance. Again, this implies that there is no causality between ROA and LO_TA. Lastly, RSA_RSL is Granger causing the liquidity variable at 2% level of significance. This implies that there is a strong causality between RSA_RSL and LO_TA. Overall, the results suggest that it is only RSA_RSL that has strong causality with LO_TA.

Figure 4.4 presents impulse responses derived from the CAMELS variables and particularly SVAR. According to Panel (a), it shows that LO_TA responds both positively and negatively to availability liquidity within banks. This implies that availability of liquidity and LO_TA have strong relationship. Panel (b) indicates that LO_TA responds both negatively and positively to Tier1 RWCR impulse over the long run and its effect is borderline significantly. Overall, this means that Tier 1RWCR has a negative effect on decreasing liquidity in banks. Panel (c) indicated that LO_TA have increases and decreases over the period. Thus, NPL displays positive and negative effects meaning that it has potent influence on liquidity conditions in banks. From lending perspectives, negative effects of NPL ratio are driven by lack of repayments of loans by borrowers and that could lead to liquidity risk in banks. Panel (d) presents the impulse response functions of the LO_TA to a shock of ROA. The results display that ROA shocks increase and decrease as well over the period. This means that LO_TA respond positively and negatively to ROA impulse although its effects were borderline significant for the remainder of the period. Accordingly, ROA shocks to liquidity conditions are driven by poor generated income by banks over the period. Lastly, Panel (d) displays that rate sensitivity assets and liability shocks increase slightly in the first two years and then it decreased before returning to constant for the remaining years, whereas the effects are borderline significant. This demonstrated that LO_TA responds positively to sensitivity to market in Namibia. Overall, all ratios have significant effects on liquidity conditions measured by LO_TA ratio in Namibia.

Figure 4.4: Response of LO_TA to other CAMELS indicators



As demonstrated below, the forecast error variance of the liquidity conditions is determined by Tier1 RWCR shocks, NPL shocks, ROA shocks and RSA_RSL shocks. NPL shocks have the most important influence on the forecast error variance of liquidity conditions. NPL shocks increase from 0% to 14% over the period. Tier 1 RWCR shocks are the second most important factor influencing on the forecast error variance of liquidity conditions. Tier 1 RWCR

shocks increase from 0% to 8% over the period. The ROA shocks are the third most important factor influencing on the forecast error variance of liquidity conditions. The ROA increases from 0% to 5% over the period. Finally, RSA_RSL shocks contribute the minimal impact on the forecast error variance of liquidity conditions. RSA_RSL shocks account for about 4% over the time.

Table 4.6: Variance decomposition of LO_TA

Period	S.E.	DLNLO_TA	DLNTIER1R WCR	DLNNPL	DLNROA	DLNRSA_RSL
1	0.143182	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.162780	95.97559	0.205202	0.914673	0.037753	2.866783
3	0.184394	87.49815	0.160258	7.564016	0.823630	3.953947
4	0.190350	82.30886	4.526760	7.309527	1.031506	4.823345
5	0.192320	81.02928	5.177398	7.906688	1.145589	4.741041
6	0.200513	77.59451	5.859732	8.032191	4.137884	4.375687
7	0.207242	72.64097	6.711851	12.58968	3.885208	4.172288
8	0.208550	71.83217	7.275347	12.55292	3.968240	4.371319
9	0.209044	71.51390	7.295832	12.82825	4.003094	4.358921
10	0.209746	71.11835	7.455157	12.85002	3.976844	4.599626
11	0.210382	70.84360	7.453080	12.80623	4.319473	4.577620
12	0.210504	70.76774	7.444487	12.84786	4.362738	4.577184
13	0.211684	70.01381	8.025847	12.99459	4.437883	4.527869
14	0.212706	69.49351	8.033932	13.53638	4.440243	4.495933
15	0.213981	68.75418	8.231847	13.47035	5.075490	4.468128
16	0.214490	68.60456	8.249411	13.57467	5.093959	4.477407
17	0.214795	68.43677	8.230712	13.70044	5.150990	4.481087
18	0.214949	68.36591	8.220621	13.77846	5.158356	4.476661
19	0.215101	68.27809	8.232513	13.84879	5.166230	4.474381
20	0.215557	68.00144	8.198139	14.17716	5.162119	4.461143
21	0.215883	67.86991	8.213594	14.13436	5.329775	4.452364
22	0.215979	67.86382	8.216335	14.13489	5.332160	4.452798
23	0.216054	67.86566	8.211271	14.13240	5.333371	4.457299
24	0.216174	67.79156	8.212974	14.19702	5.345729	4.452717

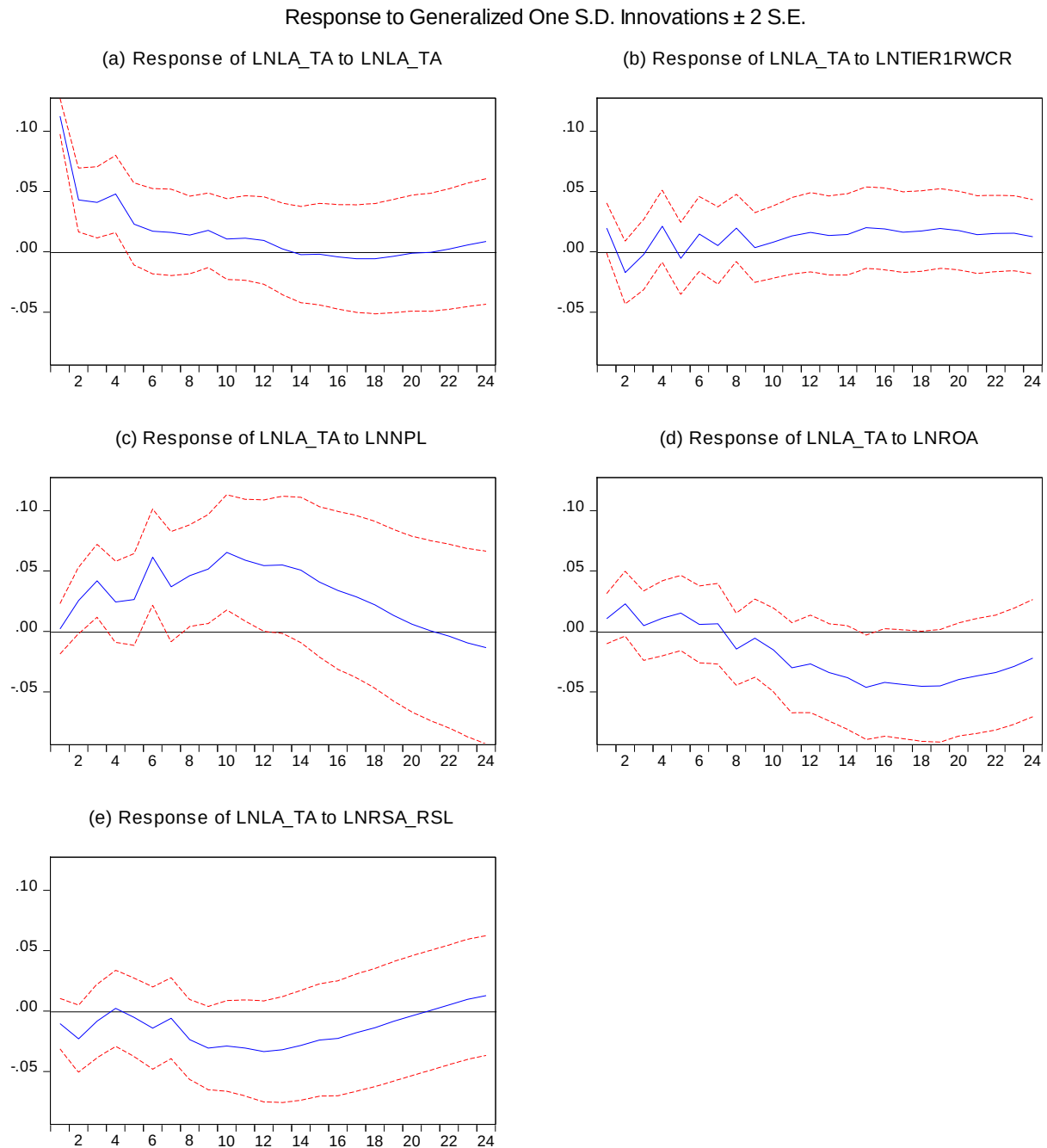
Source: Own calculation from Eviews 8

4.3.5 LA_TA Results

With regard to Granger causality, Tier1 RWCR is Granger causing the LA_TA at 14% level of significance. This implies that causality between Tier1 RWCR and LA_TA is weak. NPL is granger causing the LA_TA at 0% level of significance. This means that the causality between NPL and liquidity conditions is very strong. Furthermore, ROA is Granger causing the LA_TA at 9%. This implies that, the causality between ROA and LA_TA is weak. Lastly, RSA_RSL is Granger causing the LA_TA at 23%. This displays that there is no relationship between RSA_RSL and LA_TA (see Appendix 1).

As demonstrated in Figure 4.5, Panel (a) that LA_TA positively responds to availability liquidity impulses. This means that availability liquidity has an effect on the LA_TA and specifically liquidity conditions in Namibia. Panel (b) shows LA_TA responds both negatively and positively to Tier1RWCR impulse over the period under study. This implies that the relationship between LA_TA and Tier1 RWCR is strong and has influence of liquidity shocks. Panel (c) displays that LA_TA shocks respond positively to NPL ratio impulse. The results show that NPL shocks increase before decreasing for the remainder of the period. Thus, NPL impulses have an effect on LA_TA and particularly the liquidity conditions in banks. Panel (d) displays that LA_TA responds positively to ROA impulses in the first 4 years. Then it responds negatively ROA impulses for the remaining 6 years understudy. This means that, earnings within banks have an influence on LA_TA and particularly liquidity in banks. Contrary, Panel (e) shows that LA_TA shocks respond negatively to RSA_RSL over the time. Again, this demonstrated that sensitivity to market risk has a significant influence on liquidity conditions in Namibia. Overall, all ratios have an influence on liquidity conditions in Namibia.

Figure 4.5: Response of LA_TA to other CAMELS indicators



As demonstrated below, NPL ratio shocks have most impact on liquidity conditions and stand at 40%, which increases from 4% from the beginning. ROA shocks are the second largest part accounting for about 19%, which increase from 2% from the beginning. The RSA_RSL

shocks are the third most influential on liquidity, which stands at 8% and increase from 2% from the beginning. Lastly, Tier 1 RWCR shocks have minimal impact on liquidity conditions in Namibia, which stood at 6% after increasing from 3% from the beginning.

Table 4.7: Variance Decomposition of LA_TA

Period	S.E.	LNLA_TA	LNTIER1RW CR	LNNPL	LNROA	LNRSA_RSL
1	0.112351	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.128883	87.08697	3.795898	4.686406	2.170941	2.259790
3	0.142291	79.74774	3.565095	12.79579	1.970138	1.921242
4	0.153028	78.77596	3.803892	13.15429	2.439808	1.826052
5	0.158274	75.73597	3.918824	15.26291	3.327466	1.754824
6	0.171887	65.19726	3.798857	25.19507	3.811083	1.997731
7	0.176942	62.34574	3.602104	28.07356	4.033943	1.944652
8	0.185003	57.59244	4.194595	31.36560	3.775778	3.071589
9	0.194899	52.72838	3.779790	35.26661	3.405900	4.819313
10	0.207468	46.79205	3.429382	40.89681	3.056338	5.825422
11	0.218535	42.44392	3.359149	43.82799	3.611025	6.757916
12	0.228177	39.10282	3.498826	45.57976	3.854486	7.964107
13	0.237771	36.02109	3.536011	47.09890	4.535766	8.808239
14	0.246277	33.58484	3.668449	47.92880	5.525831	9.292076
15	0.253761	31.63937	4.120873	47.47953	7.334765	9.425467
16	0.259575	30.26417	4.534425	46.88250	8.717892	9.601019
17	0.264632	29.16506	4.802372	46.13993	10.31972	9.572915
18	0.269237	28.22170	5.112955	45.12970	12.11671	9.418942
19	0.273309	27.40440	5.508329	43.95659	13.94275	9.187926
20	0.276417	26.79342	5.810424	42.99290	15.41808	8.985181
21	0.279073	26.28610	5.971483	42.18025	16.73617	8.826001
22	0.281649	25.81371	6.146322	41.45452	17.85014	8.735299
23	0.284097	25.41024	6.304623	40.90489	18.61825	8.761999
24	0.286254	25.11921	6.360658	40.56758	19.04972	8.902838

Source: Own calculation from Eviews 8

4.5 Robustness Checks

In this section, the study reveals the robustness checks in relation to SVAR model and liquidity shocks. The summarised statistics are derived from five liquidity ratios namely: LA_ATL, NSFR, LO_DEPO, LO_TA and LA_TA. Considering the LA_ATL, with null hypothesis, the study would like to find out whether the residuals are normally distributed. In contrast, with alternative hypothesis, the study aims to find out whether the residuals are not normally distributed. According to Table 4.8, if the probability values are greater than 5%, that concludes that the residuals from the SVAR model are normally distributed. The results imply that the estimated SVAR model was normally distributed.

Table 4.8: LA_ATL normality test

Normality test results			
<i>Component</i>	<i>Jarque-Bera</i>	<i>df</i>	<i>Prob.</i>
1	102.2671	2	0
2	1.657384	2	0.4366
3	0.996068	2	0.6077
4	0.473858	2	0.789
5	3733.912	2	0

Source: Own calculation from E-views 8

Focusing on autocorrelation with null hypothesis, the study aimed at finding out whether the residuals from the SVAR model are free from autocorrelation. While with alternative hypothesis, the study focused on finding out whether the residuals from the model are not free from autocorrelation. If the probability values at different lag lengths are greater than 5%, then based on the results, they failed to reject the null hypothesis. According to the results (Appendix 2), the majority probability values are greater than 5%; this means that the models are free from autocorrelation and reject the null hypothesis. In addition, if the characteristics roots lie within

the circle (see Appendix 3), conclude that parameter used in the SVAR model are stable. Considering the heteroscedasticity test, with the null hypothesis, the study aimed at finding out whether the residuals in the SVAR model are homoscedasticity. In contrast, with alternative hypothesis the study aimed at finding out whether the residuals from the SVAR model are heteroscedasticity. According to the results test (see Appendix 4), the probability values of both F-test and chi-square test are greater than 5%, meaning that the results failed to reject the null hypothesis. The results imply that the residuals from the model are homoscedastic.

Considering residual normality test of NSFR results, Table 4.9 indicates that probability values are greater than 5%, which implies that the residuals from the SVAR model are normally distributed or asymptotically normally distributed. With regard to autocorrelation, the majority probability values are greater than 5%, meaning that the results failed to reject the null hypothesis (see Appendix 2). These results imply that NSFR is free from autocorrelation.

Table 4.9: NSFR normality test

Normality test results			
<i>Component</i>	<i>Jarque-Bera</i>	<i>df</i>	<i>Prob.</i>
1	142.633	2	0
2	3.387037	2	0.1839
3	1.543081	2	0.4623
4	0.684129	2	0.7103
5	3591.963	2	0

Source: Own calculation from Eviews 8

On the other hand, the inverse roots of AR characteristics polynomial for showing stability indicate that characteristics roots lie within the circle and conclude that the parameters used in the SVAR model are stable (see Appendix 3). Focusing on heteroscedasticity test, the probability values of both F-test and chi-square test is greater than 5%, meaning that the results failed to reject the null hypothesis (see Appendix 4). The results imply that the residuals from the model are homoscedastic.

Considering residual normality test of LO_DEPO results, Table 4.10 shows that probability values are greater than 5% which suggest that the residuals from the SVAR model are normally distributed or asymptotically normally distributed. Focusing on autocorrelation, the majority probability values are greater than 5%, which concludes that the results failed to reject the null hypothesis (see Appendix 2). These results indicate that LO_DEPO is free from autocorrelation.

Table 4.10: LO_DEPO normality test

Normality test results			
<i>Component</i>	<i>Jarque-Bera</i>	<i>df</i>	<i>Prob.</i>
1	4.124284	2	0.1272
2	2.151541	2	0.341
3	0.776663	2	0.6782
4	0.322413	2	0.8511
5	6384.244	2	0

Source: Own calculation from E-views 8

The inverse roots of AR characteristics polynomial lie within the circle and that concludes that the parameter used in the SVAR model is stable (see Appendix 3). Concentrating on heteroscedasticity test, the probability values of both F-test and chi-square test are greater than 5%, meaning that the results failed to reject the null hypothesis (see Appendix 4). The results imply that the residuals from the model are homoscedastic.

Concentrating on residual normality test of LO_TA results, Table 4.11 displays that probability values are greater than 5%, which implies that the residuals from the SVAR model are normally distributed or asymptotically normally distributed. Focusing on autocorrelation, the majority probability values are greater than 5%, concluding that the results failed to reject the null hypothesis (see Appendix 2). These results indicate that the LO_TA is free from autocorrelation. The inverse roots of AR characteristics polynomial lie within the circle, which concludes that the parameter used in the SVAR model is stable (see Appendix 3). Focusing on

heteroscedasticity test, the probability values of both F-test and chi-square test is greater than 5%, meaning that the results failed to reject the null hypothesis (see Appendix 4). The results imply that the residuals from the model are homoscedastic.

Table 4.11: LO_TA normality test

Normality test results			
<i>Component</i>	<i>Jarque-Bera</i>	<i>df</i>	<i>Prob.</i>
1	721.3787	2	0
2	2.820746	2	0.2441
3	1.696334	2	0.4282
4	0.844069	2	0.6557
5	3805.11	2	0

Source: Own calculation from E-views 8

Considering the residual normality test of LA_TA results, Table 4.12 displays that probability values are greater than 5%, which imply that the r Concentrating on the autocorrelation, the majority probability values are greater than 5%, which concludes the failure to reject the null hypothesis (see Appendix 2). These results indicate that LA_TA are free from autocorrelation. Residuals from the SVAR model are normally distributed or asymptotically normally distributed.

Table 4.12: LA_TA normality test

Normality test results			
<i>Component</i>	<i>Jarque-Bera</i>	<i>df</i>	<i>Prob.</i>
1	57.09221	2	0
2	2.374059	2	0.3051
3	1.339835	2	0.5118
4	0.317627	2	0.8532
5	3055.604	2	0

Source: Own calculation from E-views 8

The inverse roots of AR characteristics polynomial lie within the circle and this concludes that the parameter used in the SVAR model is stable (see Appendix 3). Considering heteroscedasticity test, the probability values of both F-test and chi-square test are greater than 5%, meaning that the results failed to reject the null hypothesis (see Appendix 6). The results imply that the residuals from the model are homoscedastic. The diagnostic tests from the SVAR model show that the errors from the model are normally distributed. Furthermore, the tests show that the results do not suffer from autocorrelation. In addition, the tests are not suffering from heteroscedasticity and there is also no parameter instability. Overall, the results obtained are reliable and valid for this study.

4.5 Chapter summary

In summary, the impulse response functions in relation to liquidity conditions are consistent with economic literature. Based on analysis, shocks derived from capital adequacy, asset quality, earning quality and sensitivity to market risks are key critical factors affecting liquidity conditions in both short and long-run in banks. Empirical results reveal that liquidity conditions are caused by multiple shocks.

With regard to structural shocks that have been analysed, non-performing loans (NPL) and sensitivity to market risk (RSA_RSL) shocks are key factors influencing liquidity conditions in the long run. However, earning quality (ROA) and Tier 1 capital (Tier 1 RWCR) shows that they have minimal impact on liquidity conditions in Namibia. The empirical results call for economic policy since liquidity conditions are affected by interactions of various structural shocks. Thus, structural shocks derived from NPL and RSA_RSL offer important insight for financial regulation designs. With regard to robustness, results conclude that SVAR are normally distributed, and do not suffer from autocorrelation. In addition, the diagnostic tests are not suffering from heteroscedasticity and also that there is no parameter instability. Thus, the results are reliable and valid for the study. The following chapter will provide the discussion of research findings presented in this chapter.

CHAPTER V

FINDINGS AND DISCUSSION

5.1 Introduction

The aim of this study was to establish the sources of liquidity shocks in Namibia for the period 2009 to 2018 using a liquidity ratio introduced by Basel III and the traditional CAMELS ratios. Firstly, the study conducted an audit of the liquidity data between 2009 and 2018 and explored how banks exposed liquidity. Secondly, the study questions whether the new liquidity ratio under Basel III adds predictive value to the CAMELS indicators in identifying bank liquidity shocks. By utilising Structural VAR model, the aim was to test whether liquidity ratios both of Basel III and the CAMELS approach can contribute to improving in identifying liquidity shocks and subsequently bank distress. The sample consisted of the four largest Namibian commercial banks over the period from 2009 to 2018. These are Standard Bank, First National Bank, NedBank and Bank Windhoek. The study contributed to the empirical studies in identifying the sources of liquidity shocks, as this issue is essential in establishing early warning signals and maintains stability in the banking system. In estimating the SVAR regression model, granger causality, impulse-response functions and forecast error variance decomposition were employed to establish the sources of liquidity shocks in Namibia. As already discussed in the data analysis chapter, granger causality provides causation links between variables, impulse response as a tool displays the response of each variable to structural shocks derived from economic panel data, and variance decomposition identify which variables contributed mostly in causing the shocks. The discussion section is guided by appropriate variables as suggested by the appropriate theory. Furthermore, the discussions have been related to other empirical literature in order to support the current study and offer contribution made to the literature. In using SVAR model, the findings can be important policy instruments for banks and regulatory institutions in confronting liquidity shocks in Namibia.

The aim of this chapter is to discuss the results by comparing them with other results from literature. This chapter is divided into the following sections. Section 5.1 is on Liquid asset

to average total liabilities ratio findings. Section 5.2 discusses Net Stable Funding Ratio findings. Section 5.3 is about the Total loans to total deposits ratio findings. Section 5.4 discusses Total loans to total assets ratio findings. Lastly, Section 5.5 is on Liquid assets to total assets findings.

5.2 LA_ATL

The findings emphasize the relevance of the CAMELS liquidity ratios including the Basel III net stable funding ratio in identifying liquidity shocks that could lead to bank financial distress. Considering the Granger causality between liquid asset to average total liabilities ratio (LA_ATL) and other CAMELS indicators, only the causality of the non-performing loans ratio (NPL) ratio are strong. In addition, ROA has weak causation with LA_ATL (see Appendix 1). This means that it is only NPL ratio and ROA that have influence on liquidity conditions and particularly LA_ATL in Namibia. In contrast, there is no Granger causality between LA_ATL against Tier 1 RWCR as a measure of capital adequacy and RSA_RSL as a measure of market risk. Considering the impulse responses, the findings imply that it is only the NPL ratio that is significantly positive. In contrast, the ROA is significantly positive in the short run and negative in the long run. Again, this means that it is only NPL ratio and ROA that have impacted the liquidity conditions and particularly LA_ATL in Namibia over the study period. This means again that NPL and ROA have a significant influence on liquidity conditions in banks that could lead to bank financial distress. Considering forecast error variance decomposition, NPL and ROA shocks have the most important impact on the forecast error variance of the liquidity conditions. Overall, the findings confirmed that NPL and ROA have effect on liquidity conditions and particularly LA_ATL on Namibian commercial banks over 2009-2018. Subsequently, the annual growth rate of real Gross Domestic Product (GDP) also contracted on several occasions since 2009 and particularly in 2016, 2017 and 2018 (see Appendix 6), which is a signal of poor performance of various economic sectors in Namibia and coupled with the effects of NPL and ROA on liquidity conditions in Namibia. In addition to this, Namibia also experienced high unemployment over the last decade (see Appendix 7), which has effects on NPL ratio and liquidity conditions in Namibia. Louzis, Vouldis and Metaxas (2010:22) found that GDP, high unemployment rates and floating interest rates affect NPL ratio and subsequently

liquidity conditions of banks. The works of Farahin and Khodori (2018:12); Skenderi, Islami and Mulolli (2016:326) also document the effects of GDP, fluctuation interest rate, rises inflation rate and high unemployment rate on NPL ratio and liquidity conditions of banks.

On the other hand, the findings are consistent with other empirical studies that attempted to correlate non-performing loans (NPL) and liquidity ratios by Berrios (2013:15); Hajja and Hussain (2015:255); Nabilar and Khushiri (2018:17). For example, Berrios (2013:15) found that higher loan amounts offered to borrowers and fewer deposits from savers create lower liquidity and consequently liquidity risk. Berrios (2013:15) utilised loans to deposits ratio in measuring the relationship between credit risk and liquidity risk. Hajja et al. (2015:255) find that there is a significant positive relationship between credit risk and liquidity risk of the Malaysian banks. Hijja et al. (2015) imply that higher non-performing loans lower liquidity and consequently liquidity risk in banks. Hijja et al. (2015) correlated non-performing loan ratio and bank liquid assets divided by customer deposits and short-term funding in measuring liquidity conditions in banks. Nabilar et al. (2018:17) also find a significant positive relationship between credit risk and liquidity risk. Nabilar et al. (2018) stress that higher non-performing loans lead to liquidity risk in banks. Nabilar et al. (2018) also employed non-performing loans and liquid assets divided by customer deposits and short-term funding in measuring liquidity conditions in banks.

Prior work frequently applied loans to deposits ratio, liquid assets divided by customer deposits and short-term funding to estimate liquidity conditions in banks. Considering the confidentiality of LA_ATL data from banks and regulatory bodies, the study's main contribution to the empirical literature has established the relationship between non-performing loans ratio (NPL) and liquid asset to average total liabilities ratio (LA_ATL). From the researcher's knowledge, no study attempted to correlate NPL and LA_ATL rather than other liquidity ratios. LA_ATL is one of the core ratios used by regulatory bodies in identifying liquidity shocks and also an early warning indicator within the banking system. The findings offer insight to credit risk managers and regulatory institutions in confronting the credit risk that affects liquidity conditions.

Considering the correlation between ROA and liquidity conditions, the results were also confirmed by works of Panigrahi (2014:319); Ghurtskaia & Lemonjava (2016:11); Pradhan & Shrestha (2016:7). Panigrahi's study established a relationship between profitability (ROA) and

liquidity condition of a company. Panigrahi's study found that focusing on maximising profit could lower liquidity conditions of banks, while focusing on liquidity may also lower the profit of a firm. Panigrahi's study used current assets to total assets ratio as a liquidity indicator and ROA as a profitability indicator. Ghurtskaia et al. (2016:1611) found a positive correlation between ROA and liquidity conditions of Georgian banking sector. Ghurtskaia et al. (2016) used ROA as a measure of profit and liquid assets to total assets (LA_TA) as a measure of liquidity conditions. Pradhan et al. (2016:7) found a positive correlation between liquidity ratio and return on assets. Again, Pradhan et al. (2016) utilised the LA_TA as a liquidity indicator and the ROA as an earnings indicator. From the current studies, there are no studies that attempted to study the influence of ROA on LA_ATL rather than LA_TA as a liquidity indicator. The findings offer insight to bank managers and regulatory institutions in managing and balancing profit and liquidity conditions of banks.

5.3 NSFR

Considering the Granger causality between Net Stable Funding Ratio (NSFR) and other CAMELS indicators, there is no granger causation between NSFR and CAMELS indicators (see Appendix 1). Considering the impulse responses, all the CAMELS ratios show both positive and negative significant in the early stages of the study period and then remain close borderline. The findings imply that the CAMELS indicators have an effect on liquidity conditions in Namibia in the short run. On the other hand, the results confirm that lack of capital amongst commercial banks, non-performing loans, poor earnings and sensitivity to market risk could cause liquidity risk and subsequently bank financial distress. This highlights the importance of the new proposed liquidity indicator under Basel III to explain the bank financial distress. Considering the forecast error variance decomposition, the ROA shocks have the most influences on the forecast error variance of the liquidity conditions.

Considering other previous works conducted by Hossain, Khan and Sadique (2018); Casu, Pietro and Trujillo-Ponce (2017:19); Distinguin, Roulet and Tarazi (2013:20); Horvath, Seidler, and Weill (2014:17) and Kapan and Minoiu (2017:15); Hossain et al. (2018:10), it was found that higher capital and strong liquidity improve the stability of banks, which subsequently

minimises bank distress. Casu et al. (2017: 19) find that when a bank decreases liquidity as capital increases on the other hand, that leads to liquidity risk. Distinguin et al. (2013:20) found that when a bank faces liquidity shortages, the bank may reduce Tier 1 capital ratio in order to stabilise liquidity conditions. Horvath et al. (2014:17) found that higher capital ratio such as Tier 1 leads to deterioration of liquidity conditions of banks. Kapan et al. (2017:15) also repeat and stress that an increase in capital leads to illiquidity in banks. Thus, the relationship between capital and liquidity conditions has been documented and confirmed especially using the recent NSFR proposed by the Basel Committee.

Considering the influence of NPL on liquidity conditions, the works of Berrios (2013:15); Hajja and Hussain (2015:255); Nabilar and Khushiri (2018:17) also document the influence of non-performing loans on liquidity conditions. Similarly, Panigrahi (2014:319); Ghurtskaia and Lemonjava (2016:1611); Pradhan and Shrestha (2016:7) also established the influence of ROA on liquidity conditions. Further to this, Distinguin, Roulet and Tarazi (2013:21); Casu, Pietro and Trujillo-Ponce (2017:20); and Banti and Phylaktis (2019:86), detected the influence of market risk on liquidity conditions. From the macroeconomic interactions perspective, the NSFR is not significant in strengthening traditional indicators particularly those based on the CAMELS approach in identifying liquidity shocks in banks.

5.3 LO_DEPO

With regards to total loans to total deposits ratio (LO_DEPO), the causality between Tier 1 RWCR and RSA_RSL against liquidity conditions is weak (see Appendix 1). This means that Tier 1 RWCR and RSA_RSL have minimal influence on liquidity conditions in Namibia. On the other hand, there is no granger causality between NPL and ROA ratios against liquidity conditions. Considering impulse responses, the findings imply that the Tier 1 RWCR ratio has a significant and negative impact on liquidity conditions of banks in the long run. This means that Tier 1 RWCR shocks significantly lowers liquidity in banks over the study period. Again, the findings demonstrated the influence of Tier 1 RWCR on liquidity conditions in Namibia which may cause financial distress in banks. Regarding the RSA_RSL ratio, the findings indicate that RSA_RSL has both positive and negative effects on liquidity. This highlights that RSA_RSL

ratio decreases liquidity in the short run. With regards to forecast error variance decomposition, only NPL and Tier 1 RWCR shocks have the most significant impact on the forecast error variance of the liquidity conditions, while RSA_RSL have third most impact on liquidity conditions. On the other hand, macroeconomic conditions including the GDP and high unemployment rates also contributed to liquidity conditions in Namibia (see Appendix 6).

Once more, the results corroborate with those previously obtained for the NSFR in relation to capital ratio. Accordingly, higher capital ratios lower liquidity creation and lead to illiquidity amongst banks. This is supported by the works of Hossain et al. (2018:9), Casu et al. (2017:19) Distinguin et al. (2013:20); Horvath et al. (2014:17) and Kapan et al. (2017:15). In contrast, the results are also in line with the works of Affes et al. (2017:3); Desta (2016:13); Oliveira et al. (2015:23) and Gautan et al. (2014:8), who demonstrate the significant of LO_DEPO in measuring liquidity conditions and consequently bank distress. In this view, the findings reveal the correlation of bank capital (Tier 1 RWCR) and liquidity (LO_DEPO) which may lead to liquidity risk and consequently bank distress. Again, the findings have important implications for capital and liquidity management practices and are relevant to bank managers and regulatory bodies.

Considering the influence of RSA_RSL on liquidity conditions, the results are consistent with those obtained earlier for the liquid asset to average total liabilities ratio (LA_ATL). For example, Distinguin et al. (2013:21); Casu et al. (2017:20); and Banti et al. (2019:86) found that the rise of interest rates and fluctuation of prices lead to the tightening of the liquidity of banks. Prior works by Le (2017:4) also established the relationship of interest rates, exchanges rates and prices against liquidity conditions of banks. Nonetheless, the findings established the correlation of rate sensitivity assets and liability against liquidity conditions in banks, which could lead to financial distress. The findings offer insight to the market risk exposed by banks and that are relevant to liquidity analysts and regulatory institutions.

5.4 LO_TA

Considering total loans to total assets ratio (LO_TA), the Granger causality between RSA_RSL and LO_TA is strong, while NPL against LOTA are weak (see Appendix 1). In

contrast, there are no causation between Tier 1 RWCR and ROA against the LO_TA. This demonstrated that RSA_RSL and NPL have influence on liquidity conditions. Focusing on impulse responses, RSA_RSL ratio has both positive and negative influence on liquidity conditions in Namibia in the short run. In contrast, NPL ratio is both positive and negative significant in the long run. This means that NPL shock significantly lowers liquidity in the long run. Similarly, Tier 1 capital and ROA are both positive and negative significant in the long run. The findings confirm the influence of RSA_RSL, NPL, Tier 1 RWCR and ROA on liquidity conditions in Namibia. However, RSA_RSL and NPL could lower liquidity in the long run in Namibia, which may lead to bank financial distress. Concerning forecast error variance decomposition, only NPL and Tier 1 capital shocks have the most important impact on the forecast error variance of the liquidity conditions followed by ROA and then RSA_RSL ratio. Subsequently, the decline of GDP and high unemployment rates in recent past years also have effects on liquidity conditions in Namibia (see Appendixes 6 and 7).

Considering the influence of RSA_RSL ratio on liquidity conditions of banks, the results were also detected by Distinguin, Roulet and Tarazi (2013:21); Casu, Pietro and Trujillo-Ponce (2017:20); and Banti and Phylaktis (2019:86). Distinguin et al. (2013:21) found that an increase in the spread between the one-month interbank rate and the policy rate of the regulatory bodies lead to illiquid in the banking system. Casu et al. (2017:20) discovered that an increase of interest rate can affect bank income and liquidity creation. Banti et al. (2019:86) revealed that any changes to repo rates leads to tightened liquidity conditions in banks and that contributes to the increase in houses prices. In this view, the correlation of interest rate, foreign exchange rates, prices and particularly rate sensitivity assets and liabilities and liquidity conditions of banks are negative significant. From the researcher's knowledge, no study attempted to correlate RSA_RSL and LO_TA rather than other liquidity ratios. RSA_RSL is one of the core ratios used by regulatory bodies in identifying financial shocks and also an early warning indicator within the banking system. From macro prudential policies perspective, these results have important implications for liquidity management practices in banks, including liquidity analysts and regulatory bodies.

Again, the results are consistent with those previously obtained for the NPL in relation to liquidity conditions. These were supported by the works of Berrios (2013:15); Hajja et al.

(2015:255); Nabilar et al. (2018:17). Contrary to the ratios used, for example, Berrios's study (2013) utilised loans to deposits ratio while Hajja et al. (2015) and Nabilar et al. (2018) employed liquid assets divided by customer deposits and short term funding in measuring liquidity conditions in banks. The study's main contribution to the empirical literature has established the relationship between non-performing loans ratio (NPL) and total loans to total assets ratio (LO_TA). From my knowledge, no study attempted to correlate NPL and LO_TA rather than other liquidity ratios. In this view, the study established the correlation of NPL and LO_TA as a source of liquidity shocks and consequently financial distress. The findings offer credit risk and liquidity risk response and actions from bank managers and regulatory institutions. Again, these required a response from bank managers and regulatory institutions.

5.5 LA_TA

Considering liquid assets to total assets (LA_TA), the Granger causality of NPL and against LA_TA are strong, while against ROA are weak (see Appendix 1). In contrast, there is no Granger causality between Tier 1 capital and RSA_RSL against LA_TA. This implies that it is only NPL and ROA that have Granger causality with LA_TA. Focusing on impulse responses, NPL ratio is significantly positive. Whereas ROA is positive in the short and significant negative in the long run. About forecast error variance decomposition, only NPL and ROA shocks have the most important impact on the forecast error variance of the liquidity conditions. The results imply that NPL and ROA have an impact on liquidity conditions that could cause bank financial distress. In addition, macroeconomic indicators such as the GDP and high unemployment rates due to their relationships with financial performances as demonstrated in literature, also contributed to liquidity conditions in Namibia (see Appendixes 6 and 7).

The results are consistent with works of Berrios (2013:15); Hajja et al. (2015:255); Nabilar et al. (2018:17). Again, this study made a contribution to the literature as it established the relationship between non-performing loans (NPL) and liquid assets to total assets (LA_TA). From the researcher's knowledge, there is no study that attempted to establish these relationships other than LA_TA against non-performing loans (NPL). Further to this, the findings support

previous results which revealed responses and actions from bank managers and regulatory institutions in tackling liquidity shocks and subsequently financial distress. The impact of Tier 1 capital on liquidity conditions was detected in prior works in the literature. Again, a response and improvement efforts are required from both bank managers and regulatory institutions in minimising liquidity shocks and financial distress. The impact of ROA on liquidity conditions were demonstrated and confirmed in the works of Panigrahi (2014:319); Ghurtskaia and Lemonjava (2016:1611); Pradhan and Shrestha (2016:7). In that respect, prior studies have established the relationship between profitability measured by ROA and liquidity conditions as a source of liquidity risk, which could lead to financial distress in Namibia.

Overall, the ratios are interrelated and have demonstrated their impact on liquidity conditions in banks. The impact of non-performing loans (NPL), capital adequacy (Tier 1 RWCR), sensitivity to market risk (RSA_RSL and earnings (ROA), all have established correlation with liquidity conditions and are sources of liquidity shocks in Namibia. The findings call for improvements in regulation and supervisory efforts from regulatory institutions in order to minimise the liquidity shocks exposed by banks, which may lead to financial distress. In doing this, the regulatory institutions could maintain safety and soundness of the bank system. In addition, this will maintain confidence and protect depositors, investors, bank employees, shareholders' wealth, protect job losses and all stakeholders including the economic as a whole.

5.6 Chapter Summary

To sum up, the findings established the sources of liquidity shocks and subsequently liquidity risk over the 2009 – 2018 period in Namibia. The Granger causality, impulse response functions and variance decomposition function established that liquidity shocks are caused by combination of structural shocks consisting of the Tier 1 RWCR, NPL, ROA and RSA_RSL ratios. However, asset quality (NPLs) and sensitivity to market risk (RSA_RSL) seem to be key factors affecting liquidity conditions in Namibia. Further to this, the findings revealed that capital adequacy (Tier 1 RWCR) and earnings (ROA) contribute to liquidity conditions as well in short run. Contrary wise, by using macroeconomic interactions the findings revealed that net

stable funding ratio (NSFR) have minimal influence in strengthening the traditional indicators those based on the CAMELS approach in identifying the liquidity shocks. The findings are consistent with theory and other empirical literature in terms of already established correlations between variables and ratios. Financial regulations and supervisory efforts in monitoring credit risk, capital adequacy, market risks, and earnings quality can be important policy instruments in minimising liquidity shocks and consequently financial distress in Namibia. The subsequent chapter concludes the study and provides policy recommendations in relation to the study.

CHAPTER VI

SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

6.1 Introduction

The traditional functions of intermediary and liquidity provision, banks are exposed to maturity transformation risk, which could lead to financial distress arising from maturity mismatch of assets and liabilities from a balance sheet. One of the lessons learned in the 2007-09 global financial crisis is the shortage of liquidity in the market which led to the financial crisis. These have led to global debate on liquidity conditions including the absence of quantitative measurements of liquidity in banks. This prompted a call to revise banking regulations and risk management, which subsequently led the Basel Committee to introduce the Basel III. Part of the rules and regulation, Basel III accord include liquidity ratios, namely, Liquidity Coverage Ratio and Net Stable Funding Ratio in order to strengthen and stabilise liquidity conditions of banks. The rationale of Basel Committee is to strengthen and equip banks and regulatory institutions with necessary skills and knowledge in order to ensure the safety and soundness of banking systems and economic progression. However, besides the new proposed liquidity ratios, liquidity risk is caused by several factors as demonstrated in the literature. Currently, there are traditional measurements namely, the CAMELS approach used to assess the banks conditions and performances. The CAMELS approach is used to assess some key areas of the balance sheet and the income statement. The CAMELS approach focuses on capital adequacy, asset quality, management efficiency, earnings quality, liquidity and market sensitivity. Using SVAR model, a number of indicators were evaluated using macroeconomic panel data over 2009-2018. This allowed identifying liquidity shocks by studying the interactions of various variables and their impact on liquidity conditions. Thus, the purpose of this thesis was to establish the sources of liquidity shocks in Namibia for the period 2009 to 2018. To achieve this, the objectives of the thesis were to conduct an audit of the liquidity data between 2009 and 2018 and explore how banks exposed liquidity risk on one hand, and to determine the extent to which NSFRs can

strengthen the CAMELS indicators in identifying liquidity shocks on the other. The study focused on two objectives and tested them empirically.

To sum up, the aim of the research has been successfully met through answering the research objectives, taking into account of the scope and limitations of the data. Section 6.1 details the main conclusions. Section 6.2 highlights suggestions for areas for further research. Section 6.3 offer potential policy implications derived from the findings.

6.1 Answers to the Research Objectives

The first objective focused on liquidity data between 2009 and 2018 and explored how banks exposed liquidity risk. However, the thesis employed five liquidity ratios to measure commercial banks performance over the time. These were liquid assets to average total liabilities ratio (LA_ATL), net stable funding ratio (NSFR), total loans to total deposits ratio (LO_DEPO), total loans to total assets ratio (LO_TA), and liquid assets to total assets (LA_TA). Contrary to these, the study employed four independent variables, namely, Tier 1 RWCR, non-performing loans ratio (NPLs), return on assets (ROA) and rate sensitivity to assets and liabilities (RSA_RSL). Empirical results show that liquidity shocks are caused by combination of shocks. The results show that non-performing loans (NPLs) shocks are dominant sources of liquidity risk in the long run. The NPL shows a significant relationship with LA_ATL, LO_TA and LA_TA, which caused liquidity shocks. According to the empirical literature, higher non-performing loans cause lower liquidity and consequently liquidity risk in banks (Berrios 2013:15; Hajja et al. 2015:255; Nabilar et al., 2018:17). These findings raise concerns for regulatory institutions on one hand, while also suggesting improvement for bank managers to minimise the shocks and risk on other hand. The results show that sensitivity to market risk (RSA_RSL) is the second most source of liquidity shocks. The RSA_RSL demonstrated a strong relationship with LO_TA, which caused liquidity shocks. Empirical literature revealed that an increase in the spread between the one-month interbank rate and the policy rate of the regulatory bodies leads to illiquid in the banking system (Distinguin, Roulet and Tarazi, 2013:21; Casu, Pietro and Trujillo-Ponce, 2017:20; and Banti and Phylaktis, 2019:86). The market risks are associated with fluctuation of interest rate, foreign exchange rates and prices. These results raised concerns for

bank managers and regulatory institutions to monitor movement of interest rates and ensure that banks are coping with set interest rates.

With regards to profitability shocks under study, the results show that return on assets (ROA) is the third most sources of liquidity shocks. The ROA demonstrated the relationship with LA_ATL and LA_TA ratios. According to empirical literature, focusing on maximising profit may lower liquidity condition on one hand, while focusing on liquidity may also lower the profit of a firm on the other (Panigrahi 2014:319; Ghurtskaia et al. 2016:1611; Pradhan et al. 2016:7). Again, the results raise concerns with bank managers and regulatory institutions in managing and balancing profit and liquidity conditions of banks.

The results show that capital adequacy (Tier 1 RWCR) is a least source of liquidity shocks. The Tier 1 RWCR demonstrated a relationship with LO_DEPO, which could cause liquidity shocks. Empirical literature revealed that higher capital ratios lower liquidity creation and leads to illiquidity amongst banks (Hossain et al. 2018:9; Casu et al. 2017:19; Distinguin et al. 2013:20; Horvath et al. 2014:17; and Kapan et al. 2017:15). These results raised concerns for bank managers and regulatory institutions to monitor capital adequacy and ensure that banks are within the required capital on their books.

The second research objective investigated the extent to which NSFRs can strengthen the CAMELS indicators in identifying liquidity shocks. During 2007-09 global financial crisis, several large financial institutions became insolvent and some were bailouts by governments due to lack of liquidity in the market. This led to the introduction of NSFR by the Basel Committee, in order to strengthen the current traditional indicator based on the CAMELS approach. The rationale of the NSFR is to measure the mismatching of assets and liabilities sides of balance sheet. From this perspective, this allows the regulator to assess banks' ability to meet anticipated withdrawals from depositors. The CAMELS approaches including the NSFR are used by regulatory institutions and empirical literatures as an early warning signals or prediction of bank distress or failure (Sinkey, 1975; Altman, 1977; Martin, 1977; Barth, Brumbaugh et al. 1985; Demircuc-Kunt, 1989, Angora et al., 2011). Based on this goal, the study attempted to investigate the strengths of the NSFR in adding value to the current traditional indicators in predicting liquidity shocks and subsequent bank distress. From macroeconomic time series point of view, the results show that the NSFR is not strengthening the CAMELS approach in

identifying liquidity shocks and overall bank distress. The results emphasize that there are no significant relationships between NSFR and against capital adequacy (Tier 1 RWCR), asset quality (NPLs), quality earnings (ROA) and sensitivity to market risk (RSA_RSL). However, the performance measurements using the NSFR show that commercial banks were greater than 100% as recommended by the Basel Committee (see Appendix 5). Again, the results show that the NSFR is not influenced by other macroeconomic indicators in identifying liquidity shocks and subsequently the bank distress.

6.2 Policy Implications

The empirical results reveal robust implication for financial policy since liquidity risk is caused by interactions of numerous structural shocks derived from granger causality, impulse response and variance decomposition. The effects of credit risk (non-performing loans) and sensitivity to market risk (RSA_RSL) on liquidity shocks in Namibia calls for macroeconomic policy designs. Again, considerable efforts should be placed on current financial regulation derived from the Basel II and the Banking Institution Act of 1998. The findings shed light on the importance to investigate and clarify why commercial banks exposed to credit risk and market risk, which led to liquidity shocks in the long run. Concerning credit risk (non-performing loans shocks), the findings provide strong evidence of relationship (granger causality) with liquidity conditions and long run shocks (impulse response). The findings are in line with empirical literature that credit risk (non-performing loans) lower liquidity and consequently liquidity risk in banks (Berrios 2013:15; Hajja et al. 2015:255; Nabilar et al. 2018:17). Sensitivity to market risk (RSA_RSL) also plays a role in influencing shocks in the medium to long run. The findings provide strong policy implications for sensitivity to market risk such as fluctuation of interest rate, currency and prices and so on. The findings are in line with empirical literature, which demonstrated, for example, that fluctuation of interest rate, currency and prices leads to illiquid in the banking system (Distinguin et al. 2013:21; Casu et al., 2017:20; and Banti et al. 2019:86). The findings call for strong policy implications from both the banks and regulatory institutions, which may protect banks against unfavourable conditions and market risks. In addition, the findings also offer a strong policy implication for the goal of profit maximisation by financial institutions. The empirical literature revealed that focusing on profit maximisation only on one

hand, may also lead to deterioration of liquidity conditions of a firm on the other (Panigrahi 2014:319; Ghurtskaia et al. 2016:1611; Pradhan et al. 2016:7). Again, considerable efforts should be placed to match and balance both profitability and liquidity conditions of banks. Lastly, capital adequacy (Tier 1 RWCR) also plays a role in influencing shocks in the short run. The findings provide strong evidence of relationship with liquidity conditions of banks in the short run. The findings are consistent with empirical literature which revealed that higher capital ratios lower liquidity creation and leads to illiquidity amongst banks (Hossain et al. 2018:9; Casu et al. 2017:19; Distinguin et al. 2013:20; Horvath et al. 2014:17; and Kapan et al. 2017:15). The proposed liquidity measures as part of the Basel III may strengthen liquidity conditions of banks by matching with capital adequacy requirements. Thus, credit risk (non-performing loans), capital adequacy (Tier 1 RWCR), sensitivity to market risk (RSA_RSL) and earnings (ROA) policies should be top of agendas in confronting liquidity risk in Namibia.

6.3 Areas for Further Research

The current study focused only on the Namibian banking system. This suggests that the generalisation of the results is limited to the Namibian banking system only, but there are other regional banking systems. It is worth mentioning that future studies should include more banking sectors, for example, representing regional economies, emerging economies and so on. There are many other banking sectors in Africa and other parts of the world that were not considered in this research as part of the targeted population. Further research could improve by including more banking sectors within Africa or other parts of the world. By including many banking sectors, this may offer more insights and comprehensive outcomes for financial regulation and challenges faced by various banking sectors. A comparative study that involves more countries and banking sectors is vital for improvements in research. The findings call for more research on this topic in relation to the fast changing financial sector and financial regulations. It is worth mentioning that more research in this area of study may contribute to the safety and soundness of financial system.

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Appendix 1: VAR Granger Causality

Table I: Dependent variable: LA_ATL

VAR Granger Causality/Block Exogeneity Wald Tests			
Sample: 2009Q1 2018Q3			
Included observations: 128			
Dependent variable: LNLA_ALTL			
Excluded	Chi-sq	df	Prob.
LNTIER1RWCR	6.242228	4	0.1818
LNNPL	13.66681	4	0.0084
LNROA	7.844070	4	0.0975
LNRSA_RSL	5.716319	4	0.2214
All	23.79471	16	0.0941

Table II: Depended variable: NSFR

VAR Granger Causality/Block Exogeneity Wald Tests			
Sample: 2009Q1 2018Q3			
Included observations: 124			
Dependent variable: D(LNNSFR)			
Excluded	Chi-sq	df	Prob.
D(LNTIER1RWCR)	0.624944	4	0.9603
D(LNNPL)	2.303390	4	0.6802
D(LNROA)	3.967166	4	0.4105
D(LNRSA_RSL)	4.119669	4	0.3901
All	11.89876	16	0.7509

Table: III: Depended variable: LO_DEPO

VAR Granger Causality/Block Exogeneity Wald Tests			
Sample: 2009Q1 2018Q3			
Included observations: 120			
Dependent variable: LNLO_DEPO			
Excluded	Chi-sq	df	Prob.
LNTIER1RWCR	11.72844	6	0.0683
LNNPL	8.298996	6	0.2170
LNROA	3.572932	6	0.7342
LNRSA_RSL	10.34406	6	0.1109
All	45.88996	24	0.0046

Table: IV: Depended variable: LO_TA

VAR Granger Causality/Block Exogeneity Wald Tests			
Sample: 2009Q1 2018Q3			
Included observations: 108			
Dependent variable: D(LNLO_TA)			
Excluded	Chi-sq	df	Prob.
D(LNTIER1RWCR)	6.242541	8	0.6201
D(LNNPL)	14.73268	8	0.0646
D(LNROA)	9.934967	8	0.2696
D(LNRSA_RSL)	17.55064	8	0.0249
All	49.86702	32	0.0230

Table: V: Depended variable: LA_TA

VAR Granger Causality/Block Exogeneity Wald Tests			
Sample: 2009Q1 2018Q3			
Included observations: 116			
Dependent variable: LNLA_TA			
Excluded	Chi-sq	df	Prob.
LNTIER1RWCR	10.86979	7	0.1444
LNNPL	26.14262	7	0.0005
LNROA	12.31972	7	0.0905
LNRSA_RSL	9.289951	7	0.2325
All	53.01680	28	0.0029

Appendix 2: Autocorrelation

Table I: LA_ATL autocorrelation

VAR Residual Serial Correlation LM Tests						
Sample: 2009Q1 2018Q3						
Included observations: 128						
Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	43.42285	25	0.0126	1.785712	(25, 358.1)	0.0126
2	25.82792	25	0.4168	1.036775	(25, 358.1)	0.4173
3	25.08742	25	0.4575	1.006030	(25, 358.1)	0.4580
4	16.08131	25	0.9124	0.636996	(25, 358.1)	0.9125
5	30.04274	25	0.2227	1.212947	(25, 358.1)	0.2231

Table II: NSFR autocorrelation

VAR Residual Serial Correlation LM Tests						
Sample: 2009Q1 2018Q3						
Included observations: 124						
Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	34.05933	25	0.1066	1.383563	(25, 343.3)	0.1070
2	24.69365	25	0.4796	0.989775	(25, 343.3)	0.4802
3	30.72158	25	0.1984	1.242030	(25, 343.3)	0.1989
4	52.48254	25	0.0010	2.189189	(25, 343.3)	0.0011
5	31.49856	25	0.1730	1.274858	(25, 343.3)	0.1735

Table III: LO_DEPO autocorrelation

VAR Residual Serial Correlation LM Tests						
Sample: 2009Q1 2018Q3						
Included observations: 120						
Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	20.00602	25	0.7465	0.795849	(25, 291.3)	0.7470
2	21.42263	25	0.6688	0.854222	(25, 291.3)	0.6694
3	30.29914	25	0.2133	1.226268	(25, 291.3)	0.2139
4	32.97919	25	0.1316	1.340758	(25, 291.3)	0.1321
5	27.40050	25	0.3362	1.103574	(25, 291.3)	0.3369
6	21.92509	25	0.6401	0.874992	(25, 291.3)	0.6407
7	26.70662	25	0.3707	1.074377	(25, 291.3)	0.3715

Table IV: LO_TA autocorrelation

VAR Residual Serial Correlation LM Tests						
Sample: 2009Q1 2018Q3						
Included observations: 108						
Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	21.17548	25	0.6828	0.842671	(25, 209.5)	0.6839
2	27.54485	25	0.3292	1.112340	(25, 209.5)	0.3306
3	16.40961	25	0.9021	0.645914	(25, 209.5)	0.9025
4	40.06743	25	0.0287	1.665729	(25, 209.5)	0.0291
5	37.33317	25	0.0537	1.542209	(25, 209.5)	0.0542
6	19.08837	25	0.7929	0.755983	(25, 209.5)	0.7937
7	19.92142	25	0.7509	0.790485	(25, 209.5)	0.7519
8	21.49972	25	0.6644	0.856212	(25, 209.5)	0.6656
9	26.07054	25	0.4038	1.049226	(25, 209.5)	0.4053

Table V: LA_TA autocorrelation

VAR Residual Serial Correlation LM Tests						
Sample: 2009Q1 2018Q3						
Included observations: 116						
Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	27.94517	25	0.3104	1.127564	(25, 257.8)	0.3113
2	38.22563	25	0.0440	1.572705	(25, 257.8)	0.0443
3	28.03068	25	0.3064	1.131197	(25, 257.8)	0.3074
4	26.43870	25	0.3845	1.063749	(25, 257.8)	0.3855
5	12.57372	25	0.9813	0.492889	(25, 257.8)	0.9814
6	24.94836	25	0.4653	1.000969	(25, 257.8)	0.4662
7	46.73706	25	0.0053	1.954325	(25, 257.8)	0.0053
8	22.53832	25	0.6045	0.900178	(25, 257.8)	0.6054

Appendix 3: Polynomial

Figure I: LA_ATL Polynomial

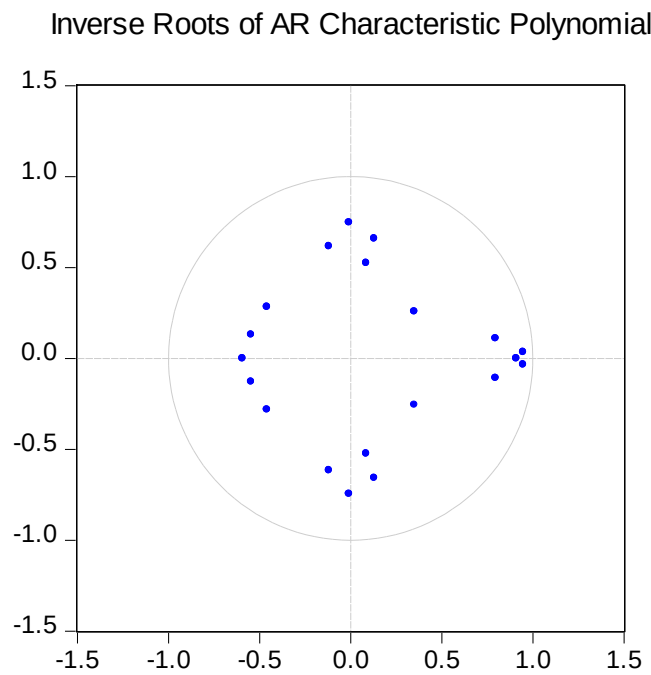


Figure II: NSFR Polynomial

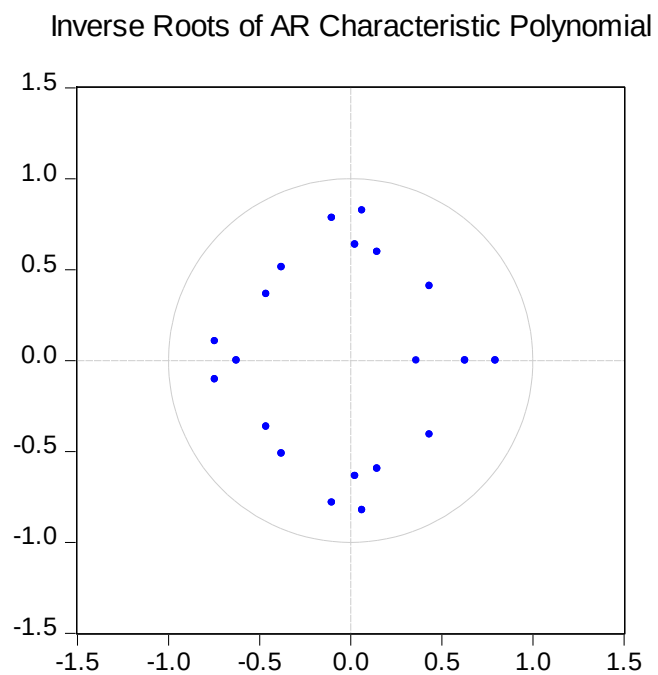


Figure III: LO_DEPO Polynomial

Inverse Roots of AR Characteristic Polynomial

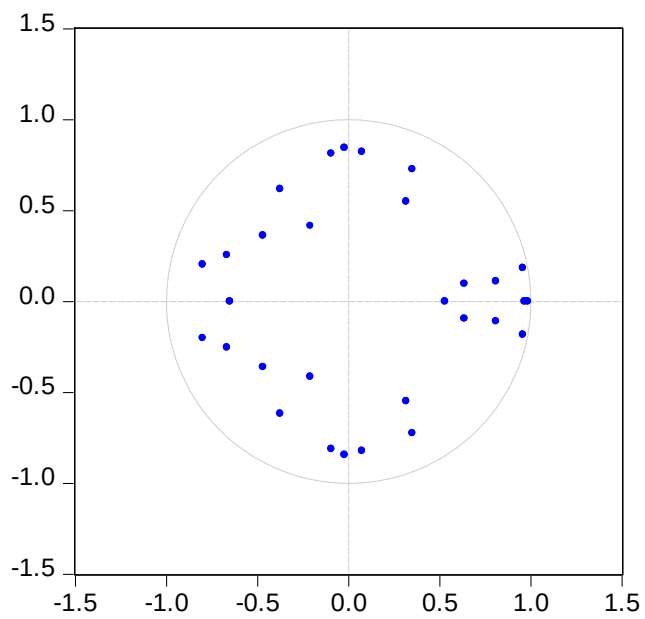


Figure IV: LO_TA Polynomial

Inverse Roots of AR Characteristic Polynomial

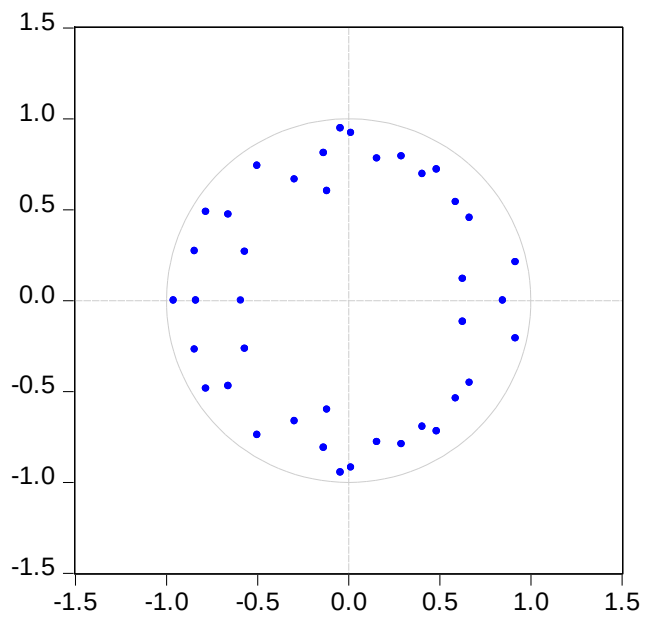
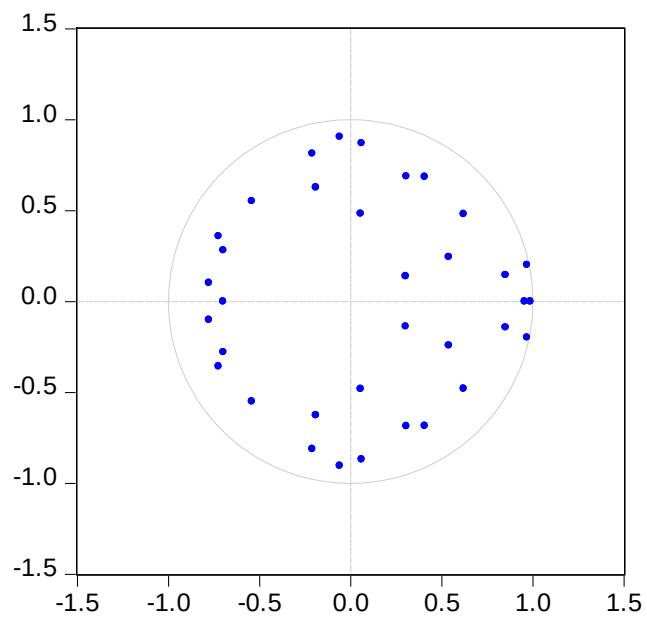


Figure V: LA_TA Polynomial

Inverse Roots of AR Characteristic Polynomial



Appendix 4: Heteroskedasticity Tests

Table I: LA_ATL Heteroskedasticity Tests

VAR Residual Heteroskedasticity Tests (Levels and Squares)					
Sample: 2009Q1 2018Q3					
Included observations: 128					
Joint test:					
Chi-sq	df	Prob.			
703.4260	660	0.1174			

Table II: NSFR Heteroskedasticity Tests

VAR Residual Heteroskedasticity Tests (Levels and Squares)					
Sample: 2009Q1 2018Q3					
Included observations: 124					
Joint test:					
Chi-sq	df	Prob.			
711.3645	660	0.0812			

Table III: LO_DEPO Heteroskedasticity Tests

VAR Residual Heteroskedasticity Tests (Levels and Squares)					
Sample: 2009Q1 2018Q3					
Included observations: 120					
Joint test:					
Chi-sq	df	Prob.			
1003.721	960	0.1591			

Table IV: LO_TA Heteroskedasticity Tests

VAR Residual Heteroskedasticity Tests (Levels and Squares)					
Sample: 2009Q1 2018Q3					
Included observations: 108					
Joint test:					
Chi-sq	df	Prob.			
1263.877	1260	0.4640			

Table V: LA_TA Heteroskedasticity Tests

VAR Residual Heteroskedasticity Tests (Levels and Squares)					
Sample: 2009Q1 2018Q3					
Included observations: 116					
Joint test:					
Chi-sq	df	Prob.			
1165.857	1110	0.1189			

Appendix 5: Namibia Commercial banks, NSFR (%)

Bank	Year	Ratio (%)
Bank A	2009	118
Bank A	2010	126
Bank A	2011	135
Bank A	2012	127
Bank A	2013	125
Bank A	2014	119
Bank A	2015	110
Bank A	2016	111
Bank A	2017	115
Bank A	2018	123
Bank B	2009	62
Bank B	2010	105
Bank B	2011	108
Bank B	2012	110
Bank B	2013	106
Bank B	2014	105
Bank B	2015	109
Bank B	2016	106
Bank B	2017	109
Bank B	2018	106

Bank	Year	Ratio (%)
Bank C	2009	114
Bank C	2010	106
Bank C	2011	124
Bank C	2012	115
Bank C	2013	111
Bank C	2014	109
Bank C	2015	106
Bank C	2016	109
Bank C	2017	114
Bank C	2018	126
Bank D	2009	114
Bank D	2010	139
Bank D	2011	130
Bank D	2012	130
Bank D	2013	123
Bank D	2014	117
Bank D	2015	121
Bank D	2016	118
Bank D	2017	129
Bank D	2018	138

Source: Own construction from Bank of Namibia

Appendix 6: Annual growth rate of real GDP (%)

Year	Quarter	GDP at market prices
2009	1	-6.1
	2	-4.4
	3	0.9
	4	10.9
2010	1	6.6
	2	12.4
	3	6.3
	4	-0.1
2011	1	7.9
	2	2.9
	3	9.3
	4	0.4
2012	1	11.3
	2	6.3
	3	-4.3
	4	7.7
2013	1	-2.8
	2	5.4
	3	15.3
	4	5.3
2014	1	7.5
	2	4.9
	3	2.9
	4	10.1
2015	1	6.5
	2	7.3
	3	6.0
	4	4.8
2016	1	4.3
	2	-0.5
	3	0.0
	4	0.6

2017	1	-0.1
	2	-0.2
	3	-1.1
	4	-2.0
2018	1	0.4
	2	1.1
	3	-0.1
	4	-1.7

Source: Own Construction from Namibia Statistics Agency dataset

Appendix 7: Unemployment, total (% of total labour force)

Year	Rates (%)
2009	21.953
2010	22.1
2011	19.335
2012	16.771
2013	19.028
2014	18.521
2015	20.882
2016	23.352
2017	21.574
2018	19.877
2019	20.273

Source: Own Construction from dataset of International Labour Organization, World Bank.