Balance Sheet Optimisation while complying with Regulatory Mandates

Reetsang Taudi

Supervisor: Dr Blessing Mudavanhu

Student #: 1303223

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DECLARATION

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

Signature of Candidate: Date:

ABSTRACT

The 2008 global financial crisis revealed weaknesses in the banking system and existing regulations such as Basel II. The aftermath of the financial crisis resulted in fundamental review and introduction of key regulations and standards such as the Basel III and IFRS 9. Basel III which was aimed at strengthening the regulatory capital framework as well as strengthen soundness of banks by introducing liquidity standards. The IFRS 9 was introduced by accounting standards setters aimed at early recognition of impairments with forward-looking estimated lifetime expected losses.

The authors acknowledge the benefits of Basel III and IFRS 9 in reducing risk within financial institutions, however financial institutions will have to balance shareholder's demands and expectations with regulatory requirements and standards hence driving banks to find a good balance between profitability and regulatory constraints. Therefore banks have to reassess their approach and have a strategy and financial management structure to obtain the optimal balance sheet mix which maximizes shareholder value creation whilst remaining within the regulatory constraints.

The results of the study shows that the optimization model formulated by the authors can can be used by commercial banks as a key input to their decision making process in order to optimize bank's shareholder value whilst remaining in compliance with the new regulatory reforms.

This study is important as it will assist banks to understand the impact of management financial decisions to their financial position and perfomance in a simple model. Further, it will assist with balance sheet strategies that banks could adopt to maximize financial perfomance while remaining in compliance with regulatory reforms.

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ABBREVIATIONS

Abbreviation	
ASF	Available Stable Funding
EAD	Exposure at default
ECL	Expected Credit Loss
CET 1	Common Equity Tier 1 Capital
GDP	Gross Domestic Product
IFRS	International Financial Reporting Standards
IAS	International Accounting Standards
DvP	Delivery-versus-payment
PvP	Payment-versus-payment
LCR	Liquidity Coverage Ratio
LGD	Loss Given Default
NSFR	Net Stable Funding Ratio
PD	Probability of default
RSF	Required Stable Funding

1. Introduction

1.1. Background to the study

The 2008 Global Financial Crises exposed several weaknesses in the overall banking system. Abdulle and Kassim (2012) were adamant in their view that:

> Due to the crisis, even well know and established conventional banks were badly affected with the value of their assets dropping rapidly. While a few of these institutions failed, several of them had to be saved and bailed out by the government (p.9).

This financial crisis was unique with wider geographical scope even impacting economies that were never expected to be hit by a United States of America (US) financial crisis such as emerging markets. According to Khoon and Mah-Hui (2010) the Global Financial Crisis was different as it did not start from Asia but was due to weaknesses in the US finanial industry. Africa was not spared the rod with Botswana, one the region's best perfomers experiencing a GDP contraction of 20% in the first quarter of 2009 (Maswana, 2010).

Basel III was introduced as a response to the financial crisis in order to strenthen the global capital and liquidity rules with the main aim of enhancing the resilience of the banking sector (BCBS, 2010a; Pokutta & Schmaltz, 2012).

However, Giordana & Schumacher (2017) have highlighted that though Basel III has proved to be benefinical in reducing probability of default on banks, this benefit comes at a cost which is a reduction in profitability.

IFRS (2020) defines accounting standards as follows:

> Accounting standards are a set of principles companies follow when they prepare and publish their financial statements, providing a standardised way of describing the company's financial performance. Publicly accountable companies (those listed on public stock exchanges) and financial institutions are legally required to publish their financial reports in accordance with agreed accounting standards.

The financial crisis revealed weakness in the accounting standards, more especially the 'incurred loss' model in IAS 39 which only recognized credit losses when there was an evidence of a credit event (Sarah & Petitjean, 2017). This resulted in impairment allowances for credit losses being at their lowest before an economic cycle downturn and actual losses beginning to emerge during the downturn (Novotny-Farkas, 2015).

IFRS 9 was then proposed in July 2014 as a response by the International Accounting Standards Board (IASB) to calls from several high-profile groups including the G20 to develop accounting standards that will allow for a more forward-looking provisioning for loan losses (Novotny-Farkas, 2016).

The impairment model in IFRS 9 is focused on possible losses in future and therefore a lot of information must be considered by the bank in determination of loan loss provisions (Volarevic & Varovic, 2018). There was an expectation that earlier recognition would mitigate procyclicality and thereby enhance financial stability (Novotny-Farkas, 2016).

The new IFRS 9 will impact profitability of financial institutions as loan loss provision is an important accrual item in bank financial statements which has a substantial impact on profitability (Novotny-Farkas, 2015).

1.2. Problem Statement

The aftermath of the financial crisis resulted in fundamental review and introduction of key regulations and standards such as the Basel III and IFRS 9. Basel III which was aimed at strengthening the regulatory capital framework as well as strengthen soundness of banks by introducing liquidity standards whereas IFRS 9 was aimed at early recognition of impairments with forward-looking estimated lifetime expected losses (Deloitte, 2016).

These regulations and standards whilst promoting financial stability have significant effect on the bank's resources hence reducing profitability (Giordana & Schumacher, 2017; Novotny-Farkas, 2015).

Giordana & Schumacher (2017) investigated the benefits of Basel III which proved to be benefinical in reducing probability of default on banks but also have a negative impact on

profitability of banks. According to Novotny-Farkas (2016), the new IFRS 9 model will mitigate procyclicality and thereby enhance financial stability. However, it will impact profitability of financial institutions as loan loss provision is an important accrual item in bank financial statements which has a substantial impact on profitability (Novotny-Farkas, 2015). The authors acknowledge the benefits of Basel III and IFRS 9 in reducing risk within financial institutions, however financial institutions will have to balance shareholder's demands and expectations with regulatory requirements and standards hence driving banks to find a good balance between profitability and regulatory constraints. Therefore banks have to reassess their approach and have a strategy and financial management structure to obtain the optimal balance sheet mix which maximizes shareholder value creation whilst remaining within the regulatory constraints.

This study is important as it will assist banks to understand their financial position and perfomance in a simple model and the balance sheet strategies they could adopt to maximize financial perfomance while remaining in compliance with regulatory reforms.

1.3. Central Research Question

These new regulations are important for the instilling confidence in the financial system, however they are going to affect the way banks have been doing business and have a negative impact on the banks' financial perfomance and subsequently shareholders (Giordana & Schumacher, 2017).

The Central Research Question is to understand if a simple model can be developed that would assist banks' management with decision making in order to enhance financial perfomance whilst remaining in compliance with Basel III and IFRS 9.

The study also aims to answer the following questions:

- What is the impact of Basel III on bank performance?
- What is the impact of the IFRS9 Expected Credit Loss Model on bank performance?

1.4. Justification of Study

This study is undertaken to enhance my knowledge on the new regulations that affect banking being the Basel III Accord and IFRS 9 and optimization methodologies that can be used to enhance the bank's performance.

The introduction of the above regulations and standards is going to have a negative impact on the profitability of the banking industry and would most importantly affect the Net Interest Income and the Balance Sheet composition of banks. (Giordana & Schumacher, 2017; Novotny-Farkas, 2015)

It is therefore important for banks in Botswana to understand how they can restructure the composition of their balance sheets to meet demands from the shareholders whilst remaining in compliance with the regulatory reforms.

A simple model that could be used by most banks in Botswana should be derived to assist banks with maximizing their financial performance whilst remaining within the constraints introduce by the regulatory reforms.

1.5. Outline of Study

The paper will be structured in the following way. Chapter 2 will cover literature review on previous studies that have been conducted on balance sheet optimization. Chapter 3 will discuss detailed literature study of the Basel III and the potential impact it will have in banks. Chapter 4 discusses literature on the IFRS9 Expected Credit Loss model and its impact on the bank's income. Chapter 5 will describe the modelling process including formulation of the stylized balance sheet and the optimization formula. Chapter 6 will discuss the research methodology and approach undertaken. Chapter 7 will discuss and analyse the results of the study and explains how these results should be interpreted to make them useful for banks' management. This chapter also includes scenario analysis. Chapter 8 will present the conclusions of this study and suggest recommendations for future study.

2. Literature Review

There has been a vast work done on balance sheet optimization as it is not a new topic, different researches had different approaches and views on how to approach optimization of the bank's balance sheet. However, limited work has been performed on balance sheet optimization under Basel III and IFRS 9, the paper aims contribute to this part of the literature.

Guven & Persentili (1997) discussed a multiperiod linear programming model which they constructed for a commercial bank in Turkey, taking in to consideration the systemic relations in the legal, financial and institutional setup of Turkey over the period 1987 to 1990. They then ran a sensitivity analysis results which demostrated the relevance of the multiperiod linear model for informed policy choice and the use of the model as a planning tool. However, this study was then done years and does not take into consideration regulatory constraints developed over the years. Our study will close the knowledge gap by taking consideration constraints brought by Basel III and IFRS 9.

Kruger (2011) proposed a multi-objective approach to managing bank's balance sheet by maximizing returns whilst taking in to account the regulatory capital limit enforced by Basel Pillars 1 and 2. A further recommendation was made by Kruger (2011) which involves an extension of the model to apply stochastic programming approach using tree structures to denote the progression on uncertain risk drivers. The mean-variance framework was used by Kaibe (2012) to solve the optimal allocation problem in bank and observed that the simulated results of the model always remained above the stipulated minimum Basel II Capital Adequacy requirements.
Kruger (2011) and Kaibe (2012) proposed a balance sheet optimization model taking into consideration Basel II requirements as constraints, our study takes into consideration the recently introduced Basel III and IFRS 9. This study in order to assure banks that management can optimize bank balance sheets whilst remaining in compliance with these new regulations.

Koymari (2014) formulated a multi period scenario optimization to obtain recommendation for optimal balance sheet item portfolio. However, when comparing the actual realization for the recently published data, the model results showed a reduced profit with strong positive effect on balance sheet growth. This therefore, doesn't improve shareholders returns hence against the aim of our study which is to maximize profitability. Our study is important to assure that there is a simple model that can be developed for management decision making that will help with maximising profitability.

Puts (2012) presented a modelling framework for bank balance sheet optimization under Basel III and the results showed that the methodology applied can be a solution to banks on how to optimally position the bank's balance sheet. Puts (2012) further showed how a bank can achieve a higher profitability and remain Basel III compliant throughout the whole phase-in period. However, Puts (2012) did not look at the impact of IFRS9 on profitability of the bank and subsequently how the balance can be optimized to create shareholder value in such an environment. Our research is looking to close the gap by developing a simple optimization model that optimize shareholder profitability whilst taking into consideration both Basel III and IFRS 9.

3. Basel III – the Basel Regulatory Reform

3.1. Introduction

The adverse impact of the Global Financial Crisis led to significant regulatory reforms for financial institutions intended to tighten capital requirements and introduce liquidity requirements and macro-prudential tools. These reforms include the Basel III which was agreed upon by the members of the Basel Committee on Banking Supervision (BCBS) representing major advanced and emerging economies (Beck, Jones, & Knaack, 2019). Basel III was aimed at improving the banking sector's capacity to absorb shocks arising from financial and economic stress hence reducing the risk of spill over from the financial sector to the real economy (BCBS, 2010a).

The introduction of the Basel III focused on strengthening capital and liquidity rules with the aiming of promoting a resilient bank sector (BCBS, 2010a).

3.2. Strengthening the Global Capital Framework

Basel III leveraged on the three pillars of the Basel II framework to strengthen the regulatory capital framework (BCBS, 2010a). According BCBS (2010a), "The reforms raised both the quality and quantity of the regulatory capital base and enhance the risk coverage of the capital framework" (p.10).
These reforms are reinforced by the Leverage Ratio which provides and extra layer of defence against model risk and measurement error and therefore assist with constraining excess leverage in the banking system (BCBS, 2010a).

3.2.1. Definition of Capital

The aftermath of the global financial crisis exposed irregularity in the matter at which capital was defined and/or classified as well as the inadequate disclosures to market participants that would have otherwise assisted the market to make full assessment on quality of capital across institutions (BCBS, 2010a; Nijs, 2013). The most superior form

of Tier 1 capital under Basel III is common shares and retained earnings, hybrid capital instruments which incentives investor to redeem through features such as step-up clauses will not form part of Tier 1 capital (BCBS, 2010a). In addition, Tier 3 capital instruments were disregarded, these instruments were in past meant to only cover market risks (BCBS, 2010a; Nijs, 2013).

Basel III brought down the different types of capital from three (3) as per Basel II to two (2) being, Tier 1 Capital and Tier II Capital. The constrained capital definition assists in increasing the amount of high-quality capital that will be more loss absorbing as well as reducing ambiguity in the capital definition. Table 1 below shows the different types of capital under Basel III.

Table 1: Components of Capital

Tier 1 Capital		Tier 2 Capital
Common Equity Tier 1	Additional Tier 1	
Common shares	Preference Shares	Subordinated Debt
Share premium	Innovative Tier 1 securities	Collective Impairment Provisions
Retained Earnings		Hybrid Instruments
Non-controlling interests		Revaluation Reserves

Source: (BCBS, 2010a)

The above elements of components of capital are subject to the following limits or restrictions:

Common Equity Tier 1 (CET 1) should be at least 4.5% of risk-weighted assets whilst Tier 1 capital should be at least 6.0% of risk weighted assets and Total Capital should be at least 8.0% of risk-weighted assets (BCBS, 2010a). This implies that at a minimum Tier 1 capital must be at least 75% of Total Capital hence an increased emphasis on Tier 1 Capital.

According to BCBS (2010a), instruments that are to be classified as CET 1 capital must meet the criteria as laid out in Table 2 below

Table 2: Common Equity Tier 1 Criteria

1	Most subordinated claim in bank liquidation.
2	A claim on net asset value that is equal to the shareholding percentage that is unlimited and not capped or fixed.
3	Principal is continuous or perpetual and only repaid at the time of liquidation.
4	At issuance there should not be any expectation created that the issuance will be redeemed or cancelled.
5	Payment of dividends is not an obligation and hence not paying dividends does not result in an event of default.
6	Payment of dividends is only made after all obligations have been met including debt instruments.
7	It absorbs losses on a going concern basis
8	The paid in amount is not recognised as a liability and therefore enhances the balance sheet solvency.
9	The paid in amount is classified as equity under the relevant accounting standards.
10	It is directly issued and paid-in and the bank cannot directly or indirectly have funded the purchase of the instrument.
11	The paid in amount is unsecured and is not subject to any arrangement that could enhance the seniority of the instrument. .
12	The instruments can only be issued with approval of the bank shareholders

Adapted: (BCBS, 2010a)

Regulatory adjustments are mostly applied to CET 1 to ensure that the CET 1 is more loss absorbing, Goodwill and other intangibles are deducted from CET1 calculation (BCBS, 2010a).

For instruments to qualify as Additional Tier 1 capital must meet the criteria as laid out in Table 3 below (BCBS, 2010a)

Table 3: Additional Tier 1 Equity Criteria

1	The instrument must be issued by the bank and paid in
2	It ranks lower than depositors and general creditors of the bank.
3	The paid in amount is unsecured and is not subject to any arrangement that could enhance the seniority of the instrument.
4	The instrument does not have a maturity date and should not have any incentives to be redeemed by investors.
5	The instrument can only be called by the issuer after five (5) years: a. The bank must get approval of the Central Bank to call the instrument; and b. A bank must not raise any impression or expectation that the instrument will be certainly called; and c. The bank must only call the instrument if they replace the called instrument with capital of at least the same quality or if the bank demonstrates that it will be well capitalized above the regulatory requirements after calling the instrument.
6	Any repayment of principal must be with Central Bank approval.
7	the bank must have full discretion on payment of dividends or coupons and cancelation or reduction of such payments should not be recognized as an event default.
8	The dividends and or coupons of this instrument must be paid out of distributable items.
9	The instrument cannot contribute to liabilities that form part of the balance sheet solvency test.

Adapted: (BCBS, 2010a)

For instruments to qualify as Tier 2 capital must meet the criteria as laid out in Table 4 below (BCBS, 2010a; Nijs, 2013)

Table 4: Criteria for Inclusion in Tier 2 Capital

1	The instrument must be issued by the bank and paid in
2	It ranks lower than depositors and general creditors of the bank.
3	The instrument is unsecured and is not subject to any arrangement that could enhance the seniority of the instrument to depositors and general creditors.
4	The minimum original maturity of the instrument must be at least five years and the instrument will be discounted by 20% per annum for regulatory capital recognition over the remaining five years before maturity.
5	The instrument can only be called by the issuer after five (5) years: a. The bank must get approval of the Central Bank to call the instrument; and b. A bank must not raise any impression or expectation that the instrument will be certainly called; and c. The bank must only call the instrument if they replace the called instrument with capital of at least the same quality or if the bank demonstrates that it will be well capitalized above the regulatory requirements after calling the instrument.
6	The investors must have no right to fast track repayments except in bankruptcy of liquidation.
7	The instrument coupon should be sensitive to the bank's credit standing.
8	The bank and related parties which the bank has significant influence over cannot purchase the instrument directly or indirectly.

Adapted: (BCBS, 2010a)

Securitization exposures failed non-DVP transactions as well as investments in commercial entities used to be deducted 50% from Tier 1 and Tier 2 respectively under Basel II. These items also had an option of being deducted or risk weighted under Basel II, however, under the new regime these items will be risk weighted at 1250% (BCBS, 2010a).

3.2.2. Risk Coverage

Failure to capture major on-and off-balance sheet and derivative related exposure was one of the key contributors that to the crisis. Therefore, Basel III reforms also focused on strengthening the risk coverage of the capital framework (BCBS, 2010a).

1. Counterparty Credit Risk

Revised metric to better address counterparty credit risk, credit valuation adjustments and wrong way risk.

In order to determine the default risk capital charge for counterparty credit risk banks should use the greater of the portfolio-level capital charge based on effective EPE using current market data and the portfolio level capital charge based on Effective EPE using a stress calibration. This charge should be applied at total portfolio level and not counterparty by counterparty (BCBS, 2010a).

A bank must add a capital charge to cover the risk to mark-to-market losses on the expected counterparty risk to derivatives, in addition to the default risk capital charge determined based on standardised or internal ratings-based (IRB) approaches for credit risk (BCBS, 2010a). This additional capital charge is called Credit Value Adjustments (CVA) charge.

Basel II reforms emphasis on wrong way risk where banks are required to identify exposure that gives rise to a greater degree of wrong-way risk. Stress testing and scenario analysis must be able to identify risk factors that are positively correlated with counterparty credit worthiness (BCBS, 2010a).

Asset value correlation multiplier for large financial institutions

Basel III introduced an Asset Value Correlation multiplier for regulated financial institutions and unregulated financial institutions (BCBS, 2010a).

2. Addressing reliance on external credit ratings and minimising cliff effects

Basel III emphasis that banks should have methodologies that allow them to assess credit risk involved in exposures at both borrower level and portfolio level. These exposures should be assessed regardless of whether they are rated or unrated and determine whether risk weights applied are appropriate for their inherent risk (BCBS, 2010a). This process helps banks to reduce reliance on external credit rating agencies as experienced in the advent of the global financial crisis (Bayar, 2017).

3.2.3. Capital Conservation Buffer

Basel III introduced the Capital Conservation Buffer which according to BCBS (2010a, Pg.54) "…is designed to ensure that banks build up capital buffers outside periods of stress which can be drawn down as losses are incurred". The main reason being banks should be able to hold buffers of capital above the regulatory minimum during periods non-stress.

Basel III reforms introduced a capital conservation buffer of 2.5% above the regulatory minimum capital requirement (BCBS, 2010a). The banks will be able to operate as normal when capital levels fall into the conservation range, however, capital distribution constraints will be imposed in the form of reducing discretionary distributions of earnings such as payment of dividends and staff bonuses (BCBS, 2010a).

Table 5 below depicts the minimum capital conservation ratio under Basel III that individual banks should hold.

Table 5: Minimum Capital Conservation Standards

CET 1 ratio	Min. Capital Conservation Ratio
4.5% - 5.125%	100%
5.125% - 5.75%	80%
5.75% - 6.375%	60%
6.375% - 7.0%	40%
>7.0%	0%

Source: (BCBS, 2010a)

As depicted in Table 5 above Basel III rewards banks that holds the most CET 1 capital as banks that hold CET1 ratio above 7.0% are not required to hold capital conservation buffer.

3.2.4. Countercyclical Capital Buffer

According to BCBS (2010a, pg. 57), “Losses incurred in the banking sector can be extremely large when a downturn is preceded by a period of excess credit growth”.

The objective of introducing the countercyclical buffers was to ensure that the banking sector capital requirements also consider macro-economic environment in which banks operate in order to provide a buffer to system-wide risks.

This section of Basel III reforms place reliance on regulators to monitor credit growth and other macro indicators that may signal build up in systemic risk and put in place a countercyclical buffer requirement when the macro-environment permits (BCBS, 2010a). The buffer that is being put in place will range from 0% to 2.5% of total risk weighted assets, banks must meet this buffer with CET 1 capital (BCBS, 2010a).

3.2.5. Leverage

The leverage ratio was introduced as a Pillar 1 standard to supplement existing risk-based capital requirement in order to help contain build-up of excessive leverage in the banking system (Valinskyte, et al. 2018). It measures the size of the bank’s assets both on-and-off balance sheet and the capital held by the bank with no risk weights applied (BCBS, 2010a).

According to Valinskyte, et al. (2018), the Leverage Ratio can be computed as follows:

$$Leverage\ Ratio = \frac{Tier\ 1\ capital}{Leverage\ Ratio\ Exposure\ Measure} \quad \textbf{3.2}$$

Where Leverage Exposure Measure is comprised of the following:

1. Assets (excluding derivatives) measured at accounting value.
2. Derivatives measured at the replacement cost and an add-on for potential future exposure.
3. Add-ons for counterparty credit risk for securities financing transactions.
4. Off-balance sheet items weighted using credit conversion factors between 10% and 100%.

The table below shows the pros and cons of using Leverage Ratio over Risk-weighted capital requirements.

Table 6: Pros and Cons of Leverage Ratio versus Capital Adequacy Ratio

	Capital Adequacy Ratio	**Leverage Ratio**
Pros	• Considers risk of individual types of assets • Mitigate incentives for excessive risk-taking • Promote more effective risk management practices	• Ensure minimum level of equity • Guard against the build-up of excessive leverage • Simple and comparable across both banks and countries • Reduce model risk • Countercyclical
Cons	• Complex • Rely on known and quantifiable risks • Rely on models which are simplifications of the real world • Procyclical	• Do not consider risk of individual types of assets • Encourage banks to invest in higher-risk assets and hence does not incentivise for taking low risks • Might create incentives to move towards a high-risk or universal bank business model

Source: (Valinskyte, et al. 2018)

The table shows that the ratio can be used to validate the risk-weighted capital models which are more complex and ensure that a minimum level of equity is maintained.

3.3. Global Liquidity Standards

Before the 2007 global financial crisis asset markets were resilient and funding was readily available at low cost and the quick reversal in market conditions showed how quickly liquidity can evaporate leaving the banking system under severe stress (BCBS, 2010a). Several banks even with adequate capital levels, experienced difficulties because their liquidity risk profile was not managed prudently (BCBS, 2013). This realisation depicted that as much as stronger capital requirements could lead to banking sector stability, they are not enough as sound management of liquidity is also a key component to banking sector stability (BCBS, 2010a).

The Basel Committee therefore introduced global liquidity standards which will provide minimum requirements for sound management of liquidity risk (BCBS, 2010a). The standards introduced by Basel III are namely Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFR).

3.3.1. Liquidity Coverage Ratio (LCR):

The main objective of the LCR is to promote short-term resilience of banks' liquidity risk profile ensuring that banks keep a desired stock of unencumbered high-quality liquid assets (HQLA) that can be converted into cash easily to meet the bank's liquidity obligations for a 30-calendar day stress scenario (BCBS, 2013).

According to BCBS (2013) the formula for computing LCR is defined as below.

$$\text{LCR} = \frac{\text{Stock of HQLA}}{\text{Total net cash outflows over the next 30 calendar days}} \geq 100\% \qquad \textbf{3.3}$$

As per the formula above, the LCR has two (2) key components being HQLA and net cash outflows which are calculated based on risk weights approved by Basel (BCBS, 2013).

3.3.1.1. High Quality Liquid Assets (HQLA)

Assets that are easily convertible into cash are considered HQLA (BCBS, 2013). According to BCBS (2013) the following are key attributes or characteristic of HQLA:

a. Low risk: assets that less risky i.e. high credit standing, low duration, and low legal risk tend to have higher liquidity.
b. Ease and certainty of valuation: Assets which are easy to value tends to be more liquid.
c. Low correlation with risky assets: For an asset to be considered as HQLA it should have little or no correlation with financial institutions risk that is because assets issued by financial institutions would be less liquid in time of financial stress.
d. Active and sizeable market**:** HQLA should have an active outright sale or repo markets.
e. Low volatility: Assets which are relatively more stable are less prone to sharp declines in prices.
f. Flight to quality: markets tend to move into quality assets during times of systemic stress.

The table below outlines the risk weights of HQLA as depicted by (BCBS, 2013).

Table 7: Stock of HQLA

Stock of HQLA	
Level 1 Assets	
Coins and banks notes	100%
Securities from sovereign, central banks and PSEs	
Qualifying Central Bank reserves	
Level 2 Assets (maximum of 40% of HQLA)	
Level 2A Assets	
Sovereign, central banks and PSEs assets qualifying for 20% risk weighting	85%
Qualifying corporate debt securities rated AA- or higher	
Qualifying covered bonds rated AA- or higher	
Level 2B Assets(maximum of 15% of HQLA)	
Qualifying RMBS	75%
Qualifying corporate debt securities rated between A+ and BBB-	50%
Qualifying common equity shares	50%

Source: (BCBS, 2013)

Level 1 assets can be easily turned into cash and therefore attracts a higher LCR. The table shows that lending of some high-quality clients can be structured in such a way that the bank may have LCR relief through the client.

In general, for assets to accepted as high quality their liquidity generating capacity must remain intact even in periods of severe stress (BCBS, 2013).

3.3.1.2. Net Cash Outflows

According to BCBS (2013, pg.26), "The term total net cash outflows is defined as total expected cash outflows minues total expected cash inflows in the specified stress scenario for the subsequent 30 calendar days." These expected outflows are calculated by multiplying the outstanding balances per asset/liability type and counterparty type by the expected run-off rate or drawndown rate as stipulated by Basel (BCBS, 2013).

The formula for net cash outflows is defined by BCBS (2013) as below.

$$Net\ Cash\ Outflows = Cash\ outflows - Min(ash\ inflows; 75\%\ of\ cash\ outlows) \quad \textbf{2.3}$$

The table below shows the expected cash outflows risk weights as depicted by (BCBS, 2013).

Table 8: Cash Inflows Risk Weights

Cash Ouflows	
Retail Deposits	
Demand and term deposits (less than 30 days) • Stable deposits (deposit insurance sheme meets criteria) • Stable deposits • Less stable retail deposits	 3% 5% 10%
Unsecured Wholesale Funding	
Demand and term deposits (less than 30 days) by small business customers • Stable deposits • Less Stable Deposits	 5% 10%
Operational deposits generated by clearing, custody and cash management activities	25%
Corporative banks	25%
Non-Financial corporates, sovereigns, PSEs etc	40%
Financial Institutions	100%
Secured Funding	
Backed by Level 1 asset	0%

Cash Ouflows	
Backed by Level 2A asset	15%
Backed by non-Level 1 or non-Level 2A domestic PSEs	25%
Backed by Retail Mortgage-backed Securities eligible for Level 2B	25%
Backed by other Level 2B assets	50%
All other secured funding transactions	100%

Source: (BCBS, 2013)

The table above shows that the LCR has less risk weighting on retail and small business funding compared to funding from corporates and financial institutions. This translates that 90% of short-term (less than 30 days) funding raised from less stable retail funding can be used for lending whilst 10% is reserved as part of HQLA. On the other hand should short-term (less than 30 days) funding be raised from Financial Institions the whole amount will towards HQLA which is low yielding compared to lending.

The table below shows the expected cash inflows risk weights as depicted by (BCBS, 2013).

Table 9: Cash Inflows Risk Weights

Cash Inflows	
Maturing Secured Lending	
Backed by Level 1 asset	0%
Backed by Level 2A asset	15%
Backed by Retail Mortgage-backed Securities eligible for Level 2B	25%
Backed by other Level 2B assets	50%
All other assets	100%
Other Inflows by Counterparty	
Amounts to be received from Retail Counterparties	50%
Amounts to be received from non-financial wholesale counterparties	50%
Amounts to be received from financial wholesale institutions and central banks	100%
Net derivative Cash Inflows	100%

Source: (BCBS, 2013)

3.3.2. Net Stable Funding Ratio (NSFR)

The NSFR defines the minimum acceptable amount of stable funding based on the liquidity characteristics of the bank's assets and activities over a one (1) year horizon (BCBS, 2010a). "A sustainable funding structure is intended to reduce the likelihood that disruptions to a bank's regular sources of funding will erode its liquidity position in a way that would increase the risk of its failure and potentially lead to broader systemic stress" (BCBS, 2014; pg. 5).

According to (BCBS, 2010b) the NSFR is designed to act as a minimum enforcement mechanism to complement the LCR by promoting structural changes in the liquidity risk profiles of banks. Hence encouraging banks to move away from reliance on short-term wholesale during times of buoyant market liquidity consequently driving banks towards more stable, longer term funding of assets and business activities (BCBS, 2010a).

BCBS (2014) defined the formula for NSFR as follows.

$$NSFR = \frac{Available\ Stable\ Funding}{Required\ Stable\ Funding} \geq 100\% \qquad \textbf{2.4}$$

The levels of available and required stable funding detailed in the NSFR were standardized to reflect the presumed degree of stability of liabilities and liquidity of assets (BCBS, 2014).

The table below shows the factors used in computing available stable funding as described by (BCBS, 2014).

Table 10: Available Stable Funding

Balance Sheet Component	Factor
• Total regulatory capital • Other capital instruments and liabilities with effective residual maturity of one year or more	100%
• Stable non-maturity (demand) deposits and term deposits with residual maturity of less than one year provided by retail and SME customers	95%
• Less stable non-maturity deposits and term deposits with residual maturity of less than one year provided by retail and SME customers	90%
• Funding with residual maturity of less than one year provided by non-financial corporate customers • Operational deposits • Funding with residual maturity of less than one year from sovereigns, public sector entities (PSEs), and multilateral and national development banks • Other funding with residual maturity of not less than six months and less than one year not included in the above categories, including funding provided by central banks and financial institutions	50%
• All other liabilities and equity not included in above categories, including liabilities without a stated maturity • Derivatives payable net of derivatives receivable if payables are greater than receivables	0%

Source: (BCBS, 2014)

As described by BCBS (2014) and Lubinska (2020), the liabilities were standardized to capture the following key characteristics:

a) Funding Tenor: As the NSFR is intended to promote sustainable funding structure, the longer-term liabilities are assumed to be providing a more stable funding compared to short-term liabilities hence attracting a higher factor.
b) Funding Type and Counterparty: Short-term funding from Individuals and Small business customers has been factored as more stable compared to wholesale funding of the same tenor.

The table below shows the factors used in computing available stable funding as described by (BCBS, 2014).

Table 11: Required Stable Funding

Balance Sheet Component	Factor
• Coins and banknotes • All central bank reserves • Unencumbered loans to banks subject to prudential supervision with residual maturities of less than six months •	0%
• Unencumbered Level 1 assets, excluding coins, banknotes and central bank reserves	5%
• Unencumbered Level 2A assets	15%
• Unencumbered Level 2B assets • HQLA encumbered for a period of six months or more and less than one year • Loans to banks subject to prudential supervision with residual maturities six months or more and less than one year • Deposits held at other financial institutions for operational purposes • All other assets not included in the above categories with residual maturity of less than one year, including loans to non-bank financial institutions, loans to non-financial corporate clients, loans to retail and small business customers, and loans to sovereigns, central banks and PSE	50%
• Unencumbered residential mortgages with a residual maturity of one year or more and with a risk weight of less than or equal to 35% • Other unencumbered loans not included in the above categories, excluding loans to financial institutions, with a residual maturity of one year or more and with a risk weight of less than or equal to 35% under the Standardised Approach	65%
• Other unencumbered performing loans with risk weights greater than 35% under the Standardised Approach and residual maturities of one year or more, excluding loans to financial institutions • Unencumbered securities that are not in default and do not qualify as HQLA including exchange-traded equities • Physical traded commodities, including gold	85%
• All assets that are encumbered for a period of one year or more • Derivatives receivable net of derivatives payable if receivables are greater than payables	100%

• All other assets not included in the above categories, including non-performing loans, loans to financial institutions with a residual maturity of one year or more, non-exchange-traded equities, fixed assets, pension assets, intangibles, deferred tax assets, retained interest, insurance assets, subsidiary interests, and defaulted securities	

Source: (BCBS, 2014)

As described by BCBS (2014) and Lubinska (2020), the required stable funding for various assets was standardized to capture the following key characteristics:

a) Resilient Credit Creation: The ratio requires stable funding for some percentage of lending to the real economy in order to ensure the continuity of intermediation.
b) Bank Behaviour: The ratio is calibrated under the assumption that banks may seek to roll over a significant proportion of maturing loans to manage customer relationships.
c) Asset Tenor: The NSFR undertakes that some short-dated assets require a smaller proportion of stable funding because banks would be able to allow some proportion of those assets to mature instead of rolling them over;
d) Asset Quality and Liquidity Value: Unencumbered, high-quality assets that can be securitised or traded, and thus can be readily used as collateral to secure additional funding or sold in the market, do not need to be wholly financed with stable funding.

3.4. Conclusion

3.4.1. Definition of Capital

Basel III has put more emphasis on the CET1 capital ratios and Tier 1 ratios encouraging banks to keep the most loss absorbing form capital (BCBS, 2010a).

The table below shows different capital ratio under Basel III versus Basel II which depicts that Basel III has higher capital ratios compared to Basel II, the table also highlights the emphasis of Common Equity Tier 1 Capital in the new reform.

Table 12: Capital Ratios in Basel III versus Basel II

Ratio	Basel II	Basel III
CET 1 ratio	2%	4.5%
Tier 1 ratio	4%	6%
Capital Conservation Buffer	-	2.5%
Countercyclical Buffer	-	≤2.5%
Leverage Ratio	-	3%

The requirement for banks to have more Tier 1 capital means the return to shareholders which is measured through return on equity (ROE) will be under pressure during Basel III regime as shareholders are required to invest more capital compared to the previous regimes.

3.4.2. Global Liquidity Standards

The liquidity standards regulatory reform are going to impact the bank's profitability by increasing pressure on the Net Interest Income due to the following:

1. Limited Credit Extension: The liquidity standards such as LCR penalises banks for lending deposits that have been raised from Financial Institutions in the short-term as banks are required to have a stock of High Quality Liquid Assets (HQLA) that covers this deposits in full. HQLA are generally low-yielding compared to Loans and Advances hence increasing pressure on interest revenue.

2. Elongation of Funding Profile: Banks are generally used to borrowing on the shorter-end of the yield curve and lending at the longer of the yield curve. The introduction of the LCR and NSFR encourages banks to raise more long term deposits, hence lengthening the funding profile of the bank but increasing pressure on interest expense and subsequently the Net interest Income.

4. Accounting Standards Reforms – IFRS 9

4.1. Introduction

Accounting standards are a set of principles that publicly accountable companies and financial institutions follow when preparing and publishing financial statements, providing a standardised way of describing financial performance hence achieving an objective of transparency, accountability and efficiency to financial markets (IFRS, 2020).

Banks' balance sheets are made up of financial instruments and the standard setters has set standards that are used for recognition, measurement, impairment, derecognition and hedge accounting of such financial instruments (PWC, 2017).

As the 2008 Global Financial Crisis unravelled, these standards were blamed for the delayed recognition of the of credit losses by financial institutions and the general classifications of financial assets. The standard setters responded by introducing the IFRS 9 which is a replacement of the then IAS39 (PWC, 2017). According to the IFRS (2017), "IFRS 9 specifies how an entity should classify and measure financial assets, financial liabilities, and some contracts to buy or sell non-financial items."

IFRS 9 was proposed in July 2014 as a response by the International Accounting Standards Board (IASB) to calls from several high-profile groups including the G20 to develop accounting standards that will allow for a more forward-looking provisioning for loan losses (Novotny-Farkas, 2016).

The table below has been adapted from (Huian, 2012; Gornjak, 2017) who summarised the differences between IAS 39 and IFRS 9 standards.

Table 13: Comparison between IAS 39 and IFRS 9

	IAS 39	IFRS 9
Scope	All financial assets with some exceptions	The same
Initial recognition and Measurement.	When entity becomes party to the contractual provisions.	The same

	IAS 39	IFRS 9
	Instrument measured at fair value plus transaction costs (for financial assets not held for trading	
Subsequent measurement	Fair value, Amortised cost, Cost (for equity investments with no reliable fair value measurement)	Fair value through Profit or Loss (FVTPL) Amortised cost Fair value through Other Comprehensive Income (FVOCI)
Type of Classification	Available for sale (AFS) Held-to-maturity (HTM) Loans and receivables Fair value through profit or loss (FVTPL)	Fair value through Profit or Loss (FVTPL) Amortised cost Fair value through Other Comprehensive Income (FVOCI)
Reclassification	Reclassification is prohibited through profit or loss after initial recognition.	Allowed only if there is a change in the business model
Impairment	Several models of impairment, model of incurred losses.	A unified model of impairment for all financial instruments – the expected loss model.

Adapted: (Huian, 2012; Gornjak, 2017)

The table depicts that there is no difference between IFRS 9 and IAS 39 when it comes to scope, initial recognition and initial measurement. Change in the replacement is observed on the categories of classification from four (4) to three (3), basically the IFRS 9 simplifies classification of financial instruments (Gornjak, 2017).

The IAS 39 impairment model was blamed for enhancing the global financial crisis because of its late recognition of impairments, the IFRS 9 introduced a new impairment model which will result in earlier recognition of losses (Gornjak, 2017; PWC, 2014). The secondary objective of this study is to understand the difference between the impairment models as described by IFRS 9 and IAS39.

4.2. Impairment Model – Incurred Model

The IAS39 required entities to assess on a periodic basis where there is any impartial evidence that financial assets are impaired (CPA Australia, 2015). This means that when there is no evidence of a credit event the impairment will not be calculated.

The amount of the impairment loss is recognized in profit or loss and measured as the difference between the carrying amount of the asset and present value of estimated future cash flows. This cashflows do not include future credit losses that have not been incurred. The future cash flows are discounted the effective interest rate computed at initial recognition (CPA Australia, 2015). This impairment model is called the incurred loss model.

4.3. Impairment Model – Expected Credit Loss

The Expected Credit Loss (ECL) model replaces the incurred loss model with a forward-looking impairment mode that considers historic, current and forward-looking data to determine the financial asset impairment loss (BDO United Kingdom, 2017).

According to BDO United Kingdom (2017) the following are three stages that are used to determine both the amount of ECL and interest income that should be recognized:

Stage 1: At this stage credit risk would have not increased significantly compared to initial recognition, entities are required to recognise 12-month ECL and recognise interest income on a gross basis (BDO United Kingdom, 2017). This stage aims to alleviate some of the concerns raised around the IAS 39 model that it overstates interest revenue at origination by not adjusting for credit losses, the recognition of the 12-month ECL in IFRS 9 reflect that the initial pricing takes into consideration expected credit losses (Novotny-Farkas, 2015).

Stage 2: At this stage financial assets credit risk would have increased significantly since initial recognition but with no objective evidence of impairment. Financial assets in this stage are required to recognise lifetime ECL but interest income will continue to be

recognised on a gross basis (BDO United Kingdom, 2017). According to Novotny-Farkas (2015, pg.13),"By recognising lifetime ECLs following a significant increase in credit risk this economic loss is reflected in the financial statements".

Stage 3 This are financial assess where there is objective evidence of impairment, this is effectively the point at which there has been an incurred loss event under the IAS 39 model. For financial assets in stage 3, entities will continue to recognise lifetime ECL, but they will now recognise interest income on a net basis. This means that interest income will be calculated based on the gross carrying amount of the financial asset less ECL (BDO United Kingdom, 2017; Novotny-Farkas, 2015).

The ECL calculation should present an unbiased and probability weighted amount that will be used as impairment to book value of financial assets (Volarevic & Varovic, 2018).

There are different several methods that can be used in computing ECL, Volarevic & Varovic (2018) proposed the below.

$$ECL = EAD \times PD \times LGD \qquad \textbf{3.1}$$

Where; EAD – Exposure at Default
PD – Probability of Default
LGD – Loss Given Default

The variable that are needed to compute ECL are Exposure at Default (EAD), Loss Given Default (LGD) and Probability of Default (PD) (Volarevic & Varovic, 2018).

1. Exposure at Default (EAD): This represents the amount that the lender stands to lose should the borrow fully default on the debt (Volarevic & Varovic, 2018).

2. Loss Given Default (LGD): This variable represents the proportion of the financial assets that the borrower expects to lose when the borrower defaults (Volarevic & Varovic, 2018).

   To illustration if the lender lends BWP10,000 to a debtor, and the debtor starts to experience financial difficulties. The part of the credit that we expect the borrower to have not paid when reaching a point of default is calculated. If this figure comes

at BWP4,500 then the LGD = 45%. The recovery rate can also be used to determine the LGD, the recovery is the part of credit that we expect the borrower to have repaid before reaching the point of default. In the illustration above recovery rate will 55%, as the borrower is expected to have paid BWP5,500 (BWP10,000 – BWP4,500) of the debt before reaching a point of default (Volarevic & Varovic, 2018).

An increase in LGD will result in an increase in expected credit losses.

3. Probability of Default (PD): This variable represents the likelihood of a borrower defaulting over an observed period. The historical PD can be calculated by analysing the borrower's cash flow adequacy in servicing debt, operating margin and percentage of leverage used (Volarevic & Varovic, 2018). "The historical PD derived from a bank's internal credit rating has to be calibrated with forward-looking macroeconomic factors to determine the PD term structure" (KPMG, 2017). A deterioration in the client's credit risk or macro-economic outlook will result in an increase in PD and a resultant increase in ECL.

4.4. Conclusion

The introduction of IFRS 9 was a necessity to address some of the concerns that were raised by the G20. It is clear that the IFRS 9 improves the reporting and measurement of financial instruments and hence provides assurance to users of financial reports including investors and the financial system. The introduction of the forward looking Expected Credit Losses model means that credit losses are recognized ealier and provided for.

As depicted by (BDO United Kingdom, 2017; Novotny-Farkas, 2015) credit impairments negatively impact the profit and loss account and hence reduced profitability for financial institutions. These would increase the amount of impairment charges and also increase the sensitivity of the impairment charge to macro-economic environment.

5. The Optimisation Model

5.1. Introduction

This chapter is focused on conceptualizing the optimization, the model focuses on banks' balance sheet to perform despite the stringent regulations recently introduced through Basel III and IFRS9. A portfolio optimisation technique is applied to optimise the bank's balance sheet, as the bank's balance sheet can be viewed as a portfolio consisting of interest rate investment instruments. The assets would produce a positive return whilst the liabilities produce a negative return which is all translated into the bank's Profit and Loss Statements. There are two main difficulties in coming up with a standard model that fits any bank:

a. Banks' balance sheets are composed by a great number of types of assets, liabilities and even equity instruments
b. Each bank has its own balance sheet composition with different types of assets, liabilities and equity instruments

The model would be very complex and slow should all the instruments with their different structures be considered. The proposed model has predefined balance sheet instruments and is created in a way that could be adapted by different commercial banks and it is cheap and easy to implement.

5.2. Balance Sheet

The Balance Sheet model has a total of sixteen (16) instruments which is comprised as follows:

- Nine (9) Asset Instruments
- Six (6) Liabilities Instruments
- One (1) Equity type

According to the basic accounting equation the balance sheet is in equilibrium when the sum of all positions in the asset instruments equals the sum of all the liability and equity instruments.

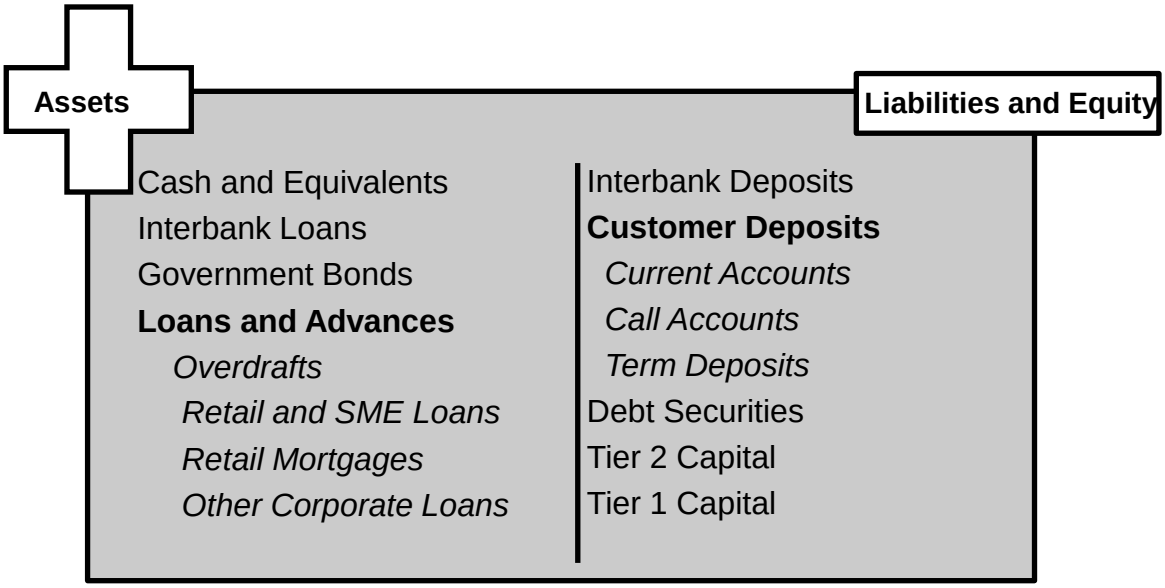


Figure 1: Model Balance Sheet

Figure 1 above highlights the stylized Balance Sheet showing breakdown of Assets as well as Liabilities and Equity. The model will be based on the products or balance sheet items shown in Figure.

5.2.1. Asset Instruments

The model includes nine (9) different asset instruments and are referenced by the letter *i*, which is given by

$$i = \begin{cases} Notes\ and\ Coins, & 1 \\ Statutory\ Reserves & 2 \\ Interbank\ Placements, & 3 \\ Overdrafts, & 4 \\ Government\ Bonds, & 5 \\ Retail\ Unsecured\ Loans, & 6 \\ Retail\ Mortgages, & 7 \\ Corporate\ Debt/Loans, & 8 \\ Property\ and\ Equipment, & 9 \end{cases}$$

Furthermore, an asset instrument could be divided into a sub class. Two different sub classes are taken into consideration.

Each property is a matrix with dimension $nx1$, and they are defined below:

1. Maturity Property: $Mi = \{1,2,3\}$

$$M = \begin{Bmatrix} 1\ Day - 6\ Months \\ 6\ Months - 1\ Year \\ > 1\ Year \end{Bmatrix}$$

2. Credit Rating Property: $Ci = \{1,2,3,4,5\}$

$$C = \begin{Bmatrix} AAA\ to\ AA- \\ A+\ to\ A- \\ BBB+\ to\ B- \\ Below\ B- \\ Unrated \end{Bmatrix}$$

The total exposure of assets equals the sum of the individual exposures of the nine (9) different assets that have been identified above.

$$X_{Assets} = X_1 + X_2 + X_3 + X_4 + X_{5(Mi)} + X_6 + X_{7+} X_{8(Ci)} + X_9 \qquad \textbf{4.1}$$

The key input to the balance sheet management is the bank's strategy is management desired balance sheet structure based on the bank's strategy. This is mostly informed by the strategy and budgeting process. Henceforth banks should be able to specify or define the minimum and maximum exposure of a balance sheet line. This minimum and maximum exposure per asset class is defined by the boundaries below. These boundaries will be used in all balance sheet items going forward.

The boundaries for the asset side of the balance sheet are defined as follows in the model:

$$X_1^{Min} \leq X_1 \leq X_1^{Max}$$

$$X_2^{Min} \leq X_2 \leq X_2^{Max}$$

$$X_3^{Min} \leq X_3 \leq X_3^{Max}$$

$$X_4^{Min} \leq X_4 \leq X_4^{Max}$$

$$X_5^{Min} \leq X_5 \leq X_5^{Max}$$

$$X_6^{Min} \leq X_6 \leq X_6^{Max}$$

$$X_7^{Min} \leq X_7 \leq X_7^{Max}$$

$$X_8^{Min} \leq X_8 \leq X_8^{Max}$$

$$X_9^{Min} \leq X_9 \leq X_9^{Max}$$

5.2.2. Liability Instruments

The model includes six (6) different liability instruments and these instruments are referenced by the letter i, which is given by:

$$i = \begin{cases} Interbank\ Borrowings, & 10 \\ Current\ Accounts, & 11 \\ Call\ Accounts, & 12 \\ Term\ Deposits, & 13 \\ Debt\ Securities, & 14 \\ Tier\ 2, & 15 \end{cases}$$

As with assets, liability instruments are also divided into sub classes. Three different sub classes are considered, namely a set of maturities, a set of depositor holder type, set of wholesale funding and set of deposit type. Where, each property is a matrix with dimension $nx1$, and they are defined below:

1. Maturity Property: $Mi = \{1,2,3,4\}$

$$M = \begin{Bmatrix} < 1\ Month \\ 1\ Month - 6\ Months \\ 6\ Months - 1\ Year \\ > 1\ Year \end{Bmatrix}$$

2. Deposit Type: $Di = \{1,2,3\}$

$$D = \begin{Bmatrix} Retail \\ Corporate \\ Financial\ Institution \end{Bmatrix}$$

We would therefore expect the Liability exposure to be equal to sum of individual liability exposures above, as depicted in the equation below:

$$X_{Liabilities} = X_{10} + X_{11(Di)} + X_{12(Di)} + X_{13(Mi,Di)} + X_{14} + X_{15} \quad \textbf{4.2}$$

The boundaries for the liability side of the balance sheet are defined as follows in the model:

$$X_{10}^{Min} \leq X_{10} \leq X_{10}^{Max}$$

$$X_{11}^{Min} \leq X_{11} \leq X_{11}^{Max}$$

$$X_{12}^{Min} \leq X_{12} \leq X_{12}^{Max}$$

$$X_{13}^{Min} \leq X_{13} \leq X_{13}^{Max}$$

$$X_{14}^{Min} \leq X_{14} \leq X_{14}^{Max}$$

$$X_{15}^{Min} \leq X_{15} \leq X_{15}^{Max}$$

5.2.3. Equity Instruments

The capital is composed of one instrument which is also referenced by the letter i, which is given by:

$$i = \{Common\ Equity\ Tier\ 1\ Capital, \qquad if\ i = 16$$

$$X_{Equity} = X_{16} \tag{4.3}$$

This basically represents the net asset value of the bank (NAV).

The boundaries for equity in the balance sheet as defined as follows in the model:

$$X_{16}^{Min} \leq X_{16} \leq X_{16}^{Max}$$

The basic accounting equation is followed where:

$$X_{Assets} = X_{Liabilities} + X_{Equity} \tag{4.4}$$

The basic accounting equation is used to validate the construct of the balance sheet.

5.3. Income Statement

5.3.1. Net Interest Income

The largest source of income in most banks is the Net Interest Income which is defined as Interest Income less Interest Expenses. Interest-bearing assets such as Loans and Advances generate Interest Income whilst Interest Expense is generated by Interest-bearing liabilities such as deposits. Therefore, some part of the Profit and Loss Statement can be generated from the balance sheet items defined above. However, there are other variables that contribute to the bank's Profit and Loss that cannot be directly deduced

from the stylised balance sheet defined above. The section below defines how income and expenses will be deduced.

5.3.1.1. Interest Income

The interest income is produced by interest bearing assets which includes all the nine (9) asset items identified in the stylised balance sheet above. A rate of return is estimated on each of the interest-bearing assets which would in turn generate the Interest Income on the model.

The rate of return of is defined by y_i and thus below is the interest income formula:

$$Y_{income} = \sum_{1}^{9} X_i \times y_i \qquad \textbf{4.5}$$

The variable y_i represents the average annual rate of return in which the bank expects from the product. This variable is multiplied by the asset balances X_i to give interest income Y_{income}. An increase in variable y_i would result in an increase in interest income, the same is true with a variable X_i.

5.3.1.2. Interest Expense

The interest expense is produced by interest-bearing liabilities, a negative rate of return $(-y_i)$ is estimated on each of the interest-bearing liabilities which would in turn generate the Interest Expense in the model. The formula below shows the interest expense formula:

$$Y_{expense} = \sum_{10}^{15} X_i \times (-y_i)$$

Therefore,

$$Y_{expense} = -\sum_{10}^{15} X_i \times y_i \quad \textbf{4.6}$$

The variable y_i represents the average annual interest rate in which the bank is expected to pay for the liability. This variable is multiplied by the liability's balances X_i to give interest expense $Y_{expense}$. An increase in variable y_i would result in an increase in interest expense, the same is true with a variable X_i.

The Net Interest Income is defined as the difference between the Interest Income and Interest Expense.

$$Net\ Interest\ Income\ (NII) = Interest\ Income - Interest\ Expense$$

Therefore,

$$NII = \sum_{1}^{9} X_i \times y_i - \sum_{10}^{15} X_i \times y_i \quad \textbf{4.7}$$

An increase in interest expense would result in a decline in Net Interest Income, the inverse is true with interest income as it will in the net interest income. This therefore means variable y_i in both assets and liabilities can negatively or positively influence in the increase or decline in Net Interest Income.

5.3.2. Provisions and Impairments

Banks provide credit to debtors and therefore when they expect a certain asset to suffer a loss, they set aside provisions which will be used to cover write-down or write-off of those assets. Chapter 3 of the study has deliberated in detail on the ECL model which is the new model introduced by IFRS 9 to compute impairment loss.

All asset instruments are eligible for the credit-loss charge except cash and the statutory reserves. The credit loss charge is calculated as per the model introduced in Chapter 3 which was adopted from (Volarevic & Varovic, 2018).

$$Expected\ Credit\ Loss = EAD \times PD \times LGD \quad \textbf{3.1}$$

All the variables are positively correlated to the expected credit loss, an increase in PD would result in an increase in ECL and the same applies for LGD.

5.3.3. Net Income (NI)

The study is focused on Net Interest Income which is where banks are mostly impacted by the Basel III and IFRS9 regulations. Therefore, Net Income will be computed as:

$$NI = (NII - Expected\ Credit\ Loss - \beta) \times (1 - T_x) \quad \textbf{4.8}$$

Where, $\boldsymbol{\beta}$ – constant that represent operational expenses.
T_x – Tax rate

This study is looking at a single period optimization and therefore the concerned about value created by the bank within a single period. Therefore, the study will not investigate the bank's dividend policy and the retained earnings as those will be pivotal in a multi-period scenario.

5.4. Return on Equity

For this model the Return on Equity (ROE) will be computed as net interest income and credit impairments over the available equity. ROE is a critical performance measurement metric to shareholders and therefore being able to maximize this formula will result increased shareholder value and high performance by management.

$$ROE = \frac{NI}{Equity} \quad 4.9$$

An increase in net income would result in an increase in return on equity, however the inverse is true with an increase in equity. Therefore, this implies that for banks to satisfy their shareholders they must minimal capital to maximise net income.

5.5. Risk Weighted Assets

The model assumes that the bank being studied is a typical African Commercial Bank with minimal Market Risk activities which is then considered negligible for this study's case. However, credit risk and operational risk capital requirements are considered in the study. The computation of risk weighted assets will be based on the risk weights recommended by BCBS (2005).

5.5.1. Credit Risk Assets

Credit risk assets can be calculated based on two different approaches namely; Standardized Approach, Internal Ratings Based (IRB) Approach. (BCBS, 2005) The standardized approach "measure credit risk in a standardized manner, supported by external credit assessments." (BCBS, 2005)

The Internal Ratings Based Approaches allow banks to use internal credit ratings models to measure credit risk, this is subject to approvals by the Central Banks. (BCBS, 2005)

In this model the authors chose to use the Standardized Approach to compute the credit risk weighted assets (RWA). In obtaining the Credit RWA all asset positions are multiplied by respective risk weights as shown below, these risk weights have been adopted from. BCBS (2005)

$$\begin{pmatrix} RW_1 \\ RW_2 \\ RW_3 \\ RW_4 \\ RW_{5,1} \\ RW_{5,2} \\ RW_{5,3} \\ RW_6 \\ RW_7 \\ RW_{8,1} \\ RW_{8,2} \\ RW_{8,3} \\ RW_{8,4} \\ RW_{8,5} \\ RW_9 \end{pmatrix} = \begin{pmatrix} 0\% \\ 0\% \\ 20\% \\ 100\% \\ 0\% \\ 0\% \\ 0\% \\ 75\% \\ 35\% \\ 20\% \\ 50\% \\ 100\% \\ 150\% \\ 100\% \\ 100\% \end{pmatrix}$$

The below equation denotes how Credit RWA will be computed.

$$CRWA = \sum_{i=1}^{9} RW_i \times X_i \qquad \textbf{4.10}$$

The Credit Risk Weighted Assets are positively correlated to capital required, therefore an increase in credit risk weighted assets will result in an increase in capital required for credit activities.

5.5.2. Operational Risk Assets

According to BCBS (2005), there are three approaches that are used to compute operational risk capital charges namely; Basic Indicator Approach, the Standardised Approach and the Advanced Measurement Approach. BCBS (2005) prescribes that,

> Internationally active banks and banks with significant operational risk exposures (for example, specialised processing banks) are expected to use an approach that is more sophisticated than the Basic Indicator Approach and that is appropriate for the risk profile of the institution (pg.140).

The study is aimed at assisting less sophisticated African banks with decision making therefore Basic Indicator Approach is ideal as it caters for the less sophisticated banks. The Basic Indicator Approach is used to compute the required operational risk capital, this approach requires the bank's three (3) year average gross income which is then multiplied by a rate of 15% (BCBS, 2005).

The model being formulated is a single period model, therefore will on look at the gross income generated on the year being modelled. Further, since the study focus on Net Interest Income, it will be assumed that the Interest Income will be the Gross Revenue. Therefore, Operational Risk Weighted Assets (ORWA) will be given by the formula below.

$$ORWA = 0.15 \times Gross\ Income$$

Which can be also formulated as:

$$ORWA = 0.15 \sum_{1}^{9} X_i \times y_i \qquad \textbf{4.11}$$

In this model our gross income is equivalent to interest income as the authors are only focusing on the resultant effect of Basel III on interest income. The equation 4.11 above, depicts that an increase in interest income would result in an increase in operational risk weighted assets.

5.6. Basel 3 Constraints

The model looks to optimize return to shareholders given the Basel III regulations. These regulations are modelled as constraints in the model. The table below summarises the required ratio for the bank to be regarded as Basel III compliant.

Table 14: Basel III Constraints

Ratio	Limit
CET 1 Ratio	≥4.5%
Capital Adequacy Ratio	≥10.5%
Capital Conservation Ratio	≤2.5%
Leverage Ratio	≥3%
LCR	≥100%
NSFR	≥100%

For a bank to be Basel III compliant it will have to meet the ratios in the table above, these ratios have been discussed at length in Chapter 2 of the study. The limits are defined in detail in the next sections.

5.6.1. Capital Ratios

The capital ratios as prescribed by Basel III, controls the amount risk weighted assets that a bank can hold against capital. The model will focus on Capital Adequacy Ratio which is the Total Capital Ratio.

The Capital Conservation Ratio which one of the key additions from Basel III will be factored into the model through CET1. As introduced in Chapter 1, Basel III imposes that banks should hold Capital Conservation Buffers depending in the CET1 Ratio they hold. If a bank holds a CET1 Ratio of above 7% it is not expected to hold additional buffer as Capital Conservation Buffer.

In the model it is assumed that the bank would not have access to Additional Tier 1 Capital resulting in Tier 1 Capital being equal to Common Equity Tier 1 (CET1). These terms are therefore used interchangeably within the document.

The capital ratios are modelled as below:

$$CET1 = \frac{Common\ Equity\ Tier\ 1}{Operational\ Risk\ RWA + Credit\ RWA} \geq 7.0\%$$

$$CET1 = \frac{X_{16}}{ORWA + CRWA} \geq 7.0\% \quad \textbf{4.12}$$

The CET1 Ratio denotes the amount of high-quality common equity capital that should support the risk weighted assets. The higher the CET1 Ratio the more stable the bank, as it is deemed to be higher loss-absorbing qualities compared to other tiers of capital.

$$\text{Capital Adequacy Ratio (CAR)} = \frac{Common\ Equity\ Tier\ 1 + Tier\ 2\ Capital}{Operational\ Risk\ RWA + Credit\ RWA} \geq 10.5\%$$

$$\text{CAR} = \frac{X_{16} + X_{15}}{ORWA + CRWA} \geq 10.5\% \quad \textbf{4.13}$$

The higher the CAR the better the position of the bank. However, CAR introduces a bit of gearing to the capital definition as Tier 2 capital is some form debt instrument even though it is subordinated to deposits and senior debt. Tier 2 capital can reduce the Weighted Average Cost of Capital (WACC), hence increasing ROE for the bank with a risk trade-off. It is therefore important to look at both CAR and CET1 ratio. Though CET1 ratio is costly it ensures the stability of the bank as it also takes care of the leverage problem.

5.6.2. Leverage Ratio

The leverage ratio is another constraint that was introduced to contain build-up of excessive leverage in the banking system. It measures the size of the bank's assets and the capital held by the bank with no risk weights applied.

$$Leverage\ Ratio\ (LR) = \frac{Common\ Equity\ Tier\ 1}{Total\ Assets} \geq 3\%$$

$$LR = \frac{X_{16}}{X_{Assets}} \geq 3\% \quad \textbf{4.14}$$

5.6.3. Liquidity Coverage Ratio (LCR)

Another constraint that has been introduced by Basel III is the Liquidity Coverage Ratio (LCR) which forms part of the newly introduced Liquidity standards which were meant to improve the resilience of the bank's balance sheet. The LCR is aimed at ensuring that the bank has enough high-quality liquid assets to cover withdrawals when there is a 30-day liquidity stress. The LCR is modelled as follows:

$$LCR = \frac{HQLA}{Net\ Cashoutflows\ over\ a\ 30\ day\ period} \geq 100\%$$

Where HQLA is modelled as per Table 15 below.

Table 15: High Quality Liquid Assets (HQLA) Factors

Balance Sheet Item	Description	Factor (LW_i)
X_1	Notes and Coins	100%
X_2	Statutory Reserves	100%
$X_{4,1}$	Government Bonds	100%
$X_{4,2}$	Government Bonds	100%
$X_{4,3}$	Government Bonds	100%
	Level 1 Assets	
$X_{8,1}$	Corporate Debt rated AA- or better	85%
	Level 2A Assets	
$X_{8,2}$	Corporate Debt rated AA- or lower	50%
	Level 2B Assets	
HQLA		

For High Quality Liquid Assets, Government bonds are comparable to cash, this is mostly because in all markets when there is a market liquidity strain the Central Bank will be able to buy-back the bonds either through a Repo or by facilitating sale of bonds to create liquidity. Further, the HQLA is less stringent on asset side compared to Liquid Asset Ratio (LAR) as it allows for Corporate Debt to introduced if it meets the set criteria whilst LAR only takes into consideration the government bonds.

The formula below denotes how HQLA is computed which is basically a sum product of the balances and the risk factors proposed in Table 15 above.

$$HQLA = \sum_{i=1}^{8} X_i \times LW_i$$

Where,

$$X_{8,1} \leq 0.4HQLA$$

$$X_{8,2} \leq 0.15HQLA$$

There is a limit provided by the regulations that Level 2A assets should not exceed 40% of total HQLA and Level 2B assets should not exceed 15% of the total HQLA stack.
Net Cash Outflows is described as below:

$$Net\ Cash\ Outflows = Outflows - Inflows$$

The Expected Net Cash Outflows are modelled as per Table 16 below.

Table 16: Expected Cash Outflows

Balance Sheet Item	Description	Factor (LW_i)
X_{10}	Interbank Borrowing	100%
$X_{11,1}$	Retail Current Accounts	5%
$X_{11,2}$	Corporate Current Accounts	25%
$X_{11,3}$	Financial Institutions Current Accounts	25%
$X_{12,1}$	Retail Call Accounts	10%
$X_{12,2}$	Corporate Call Accounts	40%
$X_{12,3}$	Financial Institutions Call Accounts	100%
$X_{13,1,1}$	Retail Term Deposits, with maturity less than 30 Days	10%
$X_{13,2,1}$	Corporate Term Deposits, with maturity less than 30 Days	40%
$X_{13,3,1}$	Financial Institutions Term Deposits, with maturity less than 30 Days	100%
Total Outflows		

The risk factors in Table 6 above highlights that the LCR discourages funding loan book with short-dated wholesale liabilities. This is by financial institution short-term investments

and interbank borrowing attracting a risk factor of 100% which imply that these liabilities must only Level 1 high quality liquid assets. Hence a bank that is not able to diversify its funding away from short-dated wholesale deposits will not be able to grow its loan book and as such profitability will be impacted.

$$Outflows = \sum_{i=10}^{13} X_i \times LW_i$$

Table 17: Expected Cash Inflows

Balance Sheet Item	Description	Factor (LW_i)
X_3	Interbank Placements	100%
X_5	Overdrafts	50%
Total Inflows		

The expected cash inflow is modelled through interbank placements and overdrafts. These assets are short-term in nature and hence would qualify for the LCR window. Basel III only considers the net effect of cash inflows up to a maximum of 75% cash outflows.

$$Inflows = \sum_{i=3}^{4} X_i \times LW_i$$

Where,

$$Inflows \leq 0.75 Outflows$$

Therefore,

$$Net\ Cash\ Outflows = \sum_{i=10}^{13} X_i \times LW_i - 0.75 \sum_{i=3}^{4} X_i \times LW_i \quad \textbf{4.15}$$

The LCR formula in the model is expressed as below:

$$LCR = \frac{\sum_{i=1}^{8} X_i \times LW_i}{\sum_{i=10}^{13} X_i \times LW_i - 0.75 \sum_{i=3}^{4} X_i \times LW_i} \quad \textbf{4.17}$$

Where,

$$X_{8,1} \leq 0.4HQLA$$

$$X_{8,2} \leq 0.15HQLA$$

5.6.4. Net Stable Funding Ratio (NSFR)

The NSFR is additional metric that has been introduced as part of the Basel III Liquidity Standards and it is meant to provide a minimum acceptable amount of stable funding based on the liquidity characteristics of the bank's assets and activities over a one (1) year horizon.

$$NSFR = \frac{Available\ amount\ of\ stable\ funding\ (ASF)}{Required\ amount\ of\ stable\ funding\ (RSF)} \geq 100\%$$

The table below shows the required stable funding weights as stipulated in Basel III for calculation of the NSFR.

Table 18: NSFR Required Stable Funding Weights

Balance Sheet Item	Description	Factor (rsf_i)
X_1	Notes and Coins	0%
X_2	Statutory Reserves	0%
X_3	Interbank Placements	50%
X_4	Overdrafts	50%
$X_{5,1}$	Government Bonds	5%
$X_{5,2}$	Government Bonds	5%
$X_{5,3}$	Government Bonds	5%
X_6	Retail Unsecured Loans	85%
X_7	Retail Mortgages	65%
$X_{8,1}$	Corporate Debt/Advances	15%
$X_{8,2}$	Corporate Debt/Advances	50%
$X_{8,3}$	Corporate Debt/Advances	85%
$X_{8,4}$	Corporate Debt/Advances	85%
$X_{8,5}$	Corporate Debt/Advances	85%
X_9	Property and Equipment	100%

The table above highlights that NSFR is light on Notes and Statutory Reserves following by Government Bonds. The risk factors reflected in the Required Stable Funding weights

shows the percentage of the asset that needs to be funded by funding with a term of more than one (1) year. As this ratio is meant to reduce the structural liquidity mismatch and hence limit the amount of assets that banks can raise with volatile liabilities.

$$RSF = \sum_{i=1}^{9} X_i \times rsf_i$$

The table below shows the available stable funding weights as stipulated in Basel III for calculation of the NSFR.

Table 19: NSFR - Available Stable Funding Weights

Balance Sheet Item	Description	Factor (asf_i)
X_{10}	Interbank Borrowing	0%
$X_{11,1}$	Retail Current Accounts	95%
$X_{11,2}$	Corporate Current Accounts	50%
$X_{11,3}$	Financial Institutions Current Accounts	50%
$X_{12,1}$	Retail Call Accounts	90%
$X_{12,2}$	Corporate Call Accounts	50%
$X_{12,3}$	Financial Institutions Call Accounts	0%
$X_{13,1,1}$	Retail Term Deposits	90%
$X_{13,1,2}$	Retail Term Deposits	90%
$X_{13,1,3}$	Retail Term Deposits	90%
$X_{13,1,4}$	Retail Term Deposits	100%
$X_{13,2,1}$	Corporate Term Deposits	50%
$X_{13,2,2}$	Corporate Term Deposits	50%
$X_{13,2,3}$	Corporate Term Deposits	50%
$X_{13,2,4}$	Corporate Term Deposits	100%
$X_{13,3,1}$	Financial Institutions Term Deposits	0%
$X_{13,3,2}$	Financial Institutions Term Deposits	0%
$X_{13,3,3}$	Financial Institutions Term Deposits	50%
$X_{13,3,4}$	Financial Institutions Term Deposits	100%
X_{14}	Debt Securities	100%
X_{15}	Tier 2 Capital	100%
X_{16}	Equity (Tier 1 Equity)	100%

The Available Stable Funding ranks funding based on stability, funding with a tenor of more than one (1) year ranks higher. Meaning all the funds of funding above 1 year can be used to support loan book growth. When it comes to operational deposits Retail current accounts rank higher compared to other corporates. Short-term (0 – 1 month) investment deposits for Financial Institutions are not recognized at all as part of Available Stable Funding Ratio. The ratio discourages this kind of funding to be used to fund growth on assets including yielding high-quality liquid assets.

$$ASF = \sum_{i=10}^{16} X_i \times asf_i$$

Therefore,

$$NSFR = \frac{\sum_{i=10}^{16} X_i \times asf_i}{\sum_{i=1}^{9} X_i \times rsf_i} \geq 100\% \qquad \textbf{4.18}$$

5.7. Optimisation Formulation

The focus of this study is to optimize returns to shareholders in an environment that is highly regulated with new regulations more especially Basel 3 and IFRS9. The aim is to have a simple optimization model that can be easily used by organization with minimal costs to computation.

Taking into consideration the Basel III constraints defined in the model and considering the Risk Profile of an institution, we are now able to formulate a simplistic version of the optimisation problem constructed in the model.

$$max \qquad ROE$$

$$Subject\ to$$

$$LR \geq 3\%$$
$$CET1 \geq 7\%$$
$$CAR \geq 10.5\%$$
$$LCR \geq 100\%$$
$$NSFR \geq 100\%$$
$$X_{Assets} = X_{Liabilities} + X_{Equity}$$
$$X_1^{Min} \leq X_1 \leq X_1^{Max}$$
$$X_2^{Min} \leq X_2 \leq X_2^{Max}$$
$$X_3^{Min} \leq X_3 \leq X_3^{Max}$$
$$X_4^{Min} \leq X_4 \leq X_4^{Max}$$
$$X_5^{Min} \leq X_5 \leq X_5^{Max}$$
$$X_6^{Min} \leq X_6 \leq X_6^{Max}$$
$$X_7^{Min} \leq X_7 \leq X_7^{Max}$$
$$X_8^{Min} \leq X_8 \leq X_8^{Max}$$
$$X_9^{Min} \leq X_9 \leq X_9^{Max}$$
$$X_{10}^{Min} \leq X_{10} \leq X_{10}^{Max}$$
$$X_{11}^{Min} \leq X_{11} \leq X_{11}^{Max}$$
$$X_{12}^{Min} \leq X_{12} \leq X_{12}^{Max}$$
$$X_{13}^{Min} \leq X_{13} \leq X_{13}^{Max}$$
$$X_{14}^{Min} \leq X_{14} \leq X_{14}^{Max}$$
$$X_{15}^{Min} \leq X_{15} \leq X_{15}^{Max}$$
$$X_{16}^{Min} \leq X_{16} \leq X_{16}^{Max}$$

5.8. Conclusion

The main research question is to propose a simple model that can be used by banks to optimise shareholder returns whilst remaining in compliance with Basel III and IFRS9.

In order to answer this question a simple model that can be used by banks optimize shareholder returns whilst remaining in compliance with Basel III and IFRS 9. The stylized model has been conceptualized in this chapter, which will capture stylized bank balance sheet and income statement. The model captures Basel III constraints and uses the ECL impairment model proposed by IFRS 9 to compute impairment charges.

6. Research Methodology

6.1. Introduction

In this chapter we discuss the methodology used in coming up with stylized bank balance sheet used to mimic the banks in Botswana and assess the validity of the proposed optimization formula.

6.2. Data Sources

The model was tested on a stylized balance sheet based on the financial statements of one of Botswana's largest banks as at 30 June 2019 and the financial statements were modified to fit model. The financial statement was obtained from the Botswana Stock Exchange website (www.bse.co.bw). It is assumed that the bank in the model is also based in the Botswana.

All balance sheet items in return have a percentage yield which was based on the average rates as surveyed through different bank managers in Botswana.

6.3. Scenario Analysis

In order to test the validity and reliability of the model, a scenario test was conducted based on management risk appetite.

The following metrics were identified as buffers or limits for managers with different risk profile appetite. The risk seeking is aggressive whose aim is just to meet set regulatory requirements and maximise profits. Whilst risk averse management is not aggressive and conservative with buffers on regulatory requirements and strict concentration limits on the portfolio.

Table 20: Risk Profile Scenarios

Risk Profile	Risk Seeking	Risk Neutral	Risk Averse
Unsecured Lending	90%	60.00%	50.00%
Retail Lending	90%	80.00%	50.00%
Overdraft	90%	30.00%	30.00%
Interbank Ratio	90%	10.00%	5.00%
CET1	7%	7.50%	8.00%
LCR	100%	110.00%	115.00%
NSFR	100%	110.00%	115.00%
CAR	11%	11.00%	11.50%
Leverage Ratio	3%	3.50%	4.50%

The table above shows the assumed limits and buffers for scenario testing. If the model works efficiently the risk seeking clients should be able to have high optimized ROE compared to Risk Neutral and Risk Averse profiles compensating for the additional risk taken by management.

6.4. Software

The Solver Engine in Microsoft Excel was used to model the stylised balance sheet and also to compute the optimal solution given the Basel III constraints.

6.5. Conclusion

The risk profile scenarios will act as a validation rule to test if the model is functional and captures the expected behaviour. The most risk averse profile is expected to return the lowest ROE compared to others.

7. Results and Analysis

7.1. Introduction

In this chapter we discuss the results of the optimization model that has been constructed and discussed in Chapter 4. The model was utilized to simulate the balance sheet position that would optimize return on equity for the bank given Basel III constraints. To test the model management risk profiles are used for scenario analysis.

7.2. Optimization Results

The table below shows the optimized ROEs per risk profile as well as attained Basel III ratios per risk profile.

Table 21: Impact of Balance Sheet Optimization per Risk Profile

Metrics	Original BS	Optimized - with Risk Seeking Profile	Optimized - with Risk Neutral Profile	Optimized - with Risk Averse Profile
ROE	12.01%	62.85%	51.04%	36.22%
CAR	9.02%	10.50%	11.00%	11.50%
CET1	7.64%	8.76%	7.94%	8.00%
Leverage Ratio	4.92%	4.92%	4.92%	4.92%
LCR	55.03%	100.00%	110.00%	115.00%
NSFR	137.49%	103.66%	110.21%	115.00%
Unsecured Lending to Advances	26.46%	90.00%	60.00%	50.00%
Retail Lending to Advances	55.45%	90.00%	80.00%	50.00%
Overdraft to Advances	8.20%	4.13%	0.00%	0.00%
Interbank Ratio	3.73%	7.73%	0.00%	5.00%
Basel III Compliant	No	Yes	Yes	Yes

The table above shows the summary results of the optimization model and shows that the model was able to transform a Basel III non-compliant bank to be compliant and almost tripled the resultant return on equity for the shareholders. The detailed outline of the balance sheet changes is the detailed in the below sub-chapters.

7.3. Risk Seeking

The graph below shows the stylized balance sheet composition of the sample bank with risk seeking profile.

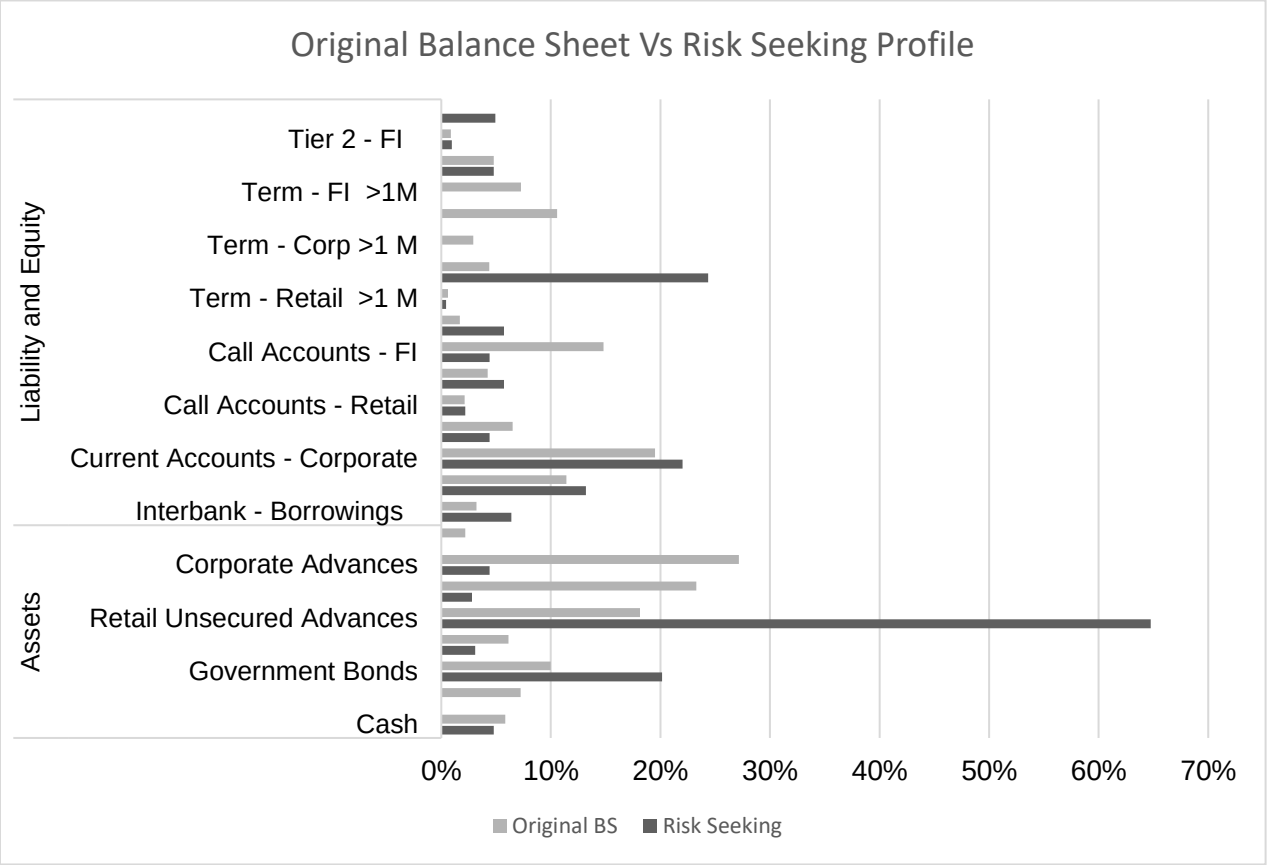


Figure 2: Optimized Risk Seeking Balance Sheet

The results from the graph shows that the Risk Seeking Profile has more than 60% of the bank's assets being deployed towards Unsecured Retail Advances this is an increased risk compared to the original balance sheet which had the highest concentration split between Mortgages and Unsecured Retail Advances at 18% and 23% respectively. This change in balance sheet composition also shows the high-risk profile intended by management on the asset deployment leg of the balance sheet. To reduce LCR weighted outflows the optimized model was underweight Financial Institutions Term Funding with less than 1-month maturity and increased Corporate Term Funding with less than 1-

month maturity. The rest of the classes were left unchanged as per the set management boundaries.

As per Table 18 above the ROE for the Risk Seeking Profile increased to 63% compared to 12% of the Original Balance Sheet. The model has been able to optimize the bank's balance sheet with an increase in ROE and structured the balance sheet to be Basel III compliant.

7.4. Risk Neutral

The graph below shows the stylized balance sheet composition of the sample bank with risk neutral profile.

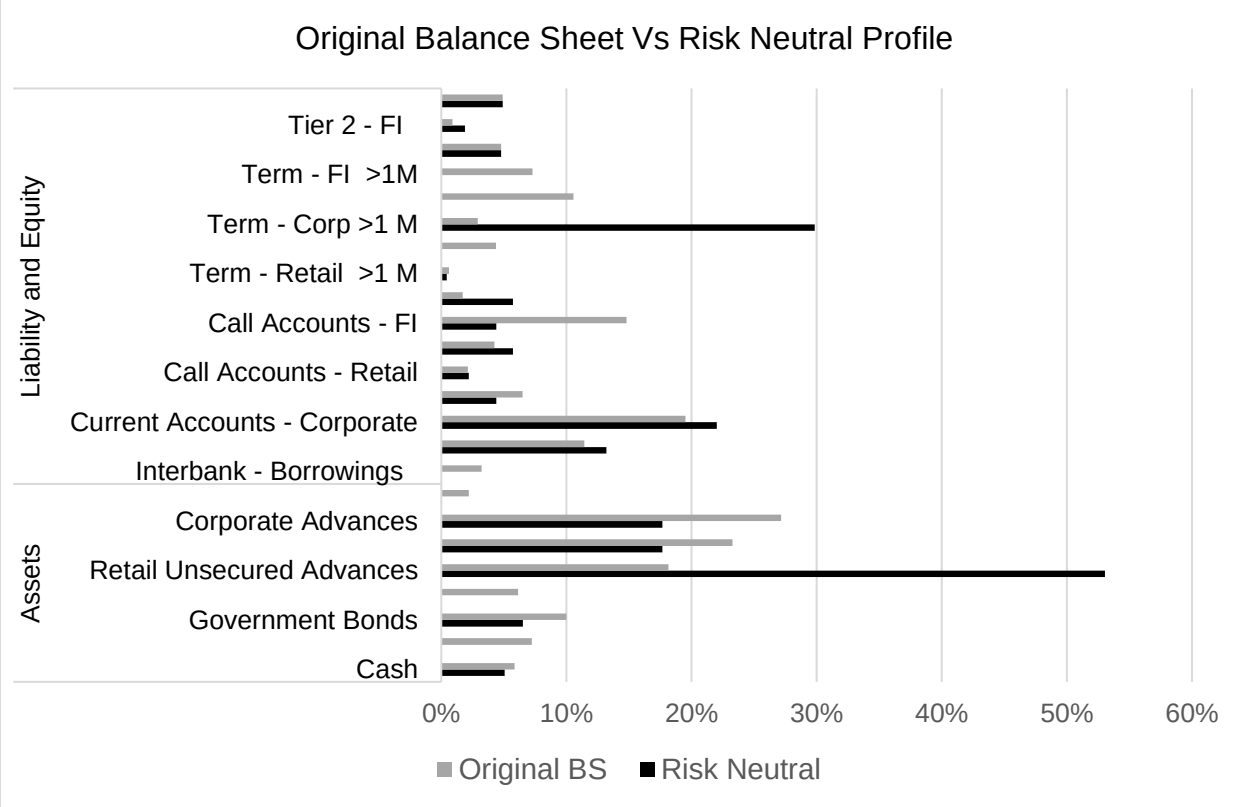


Figure 3: Optimized Risk Neutral Balance Sheet

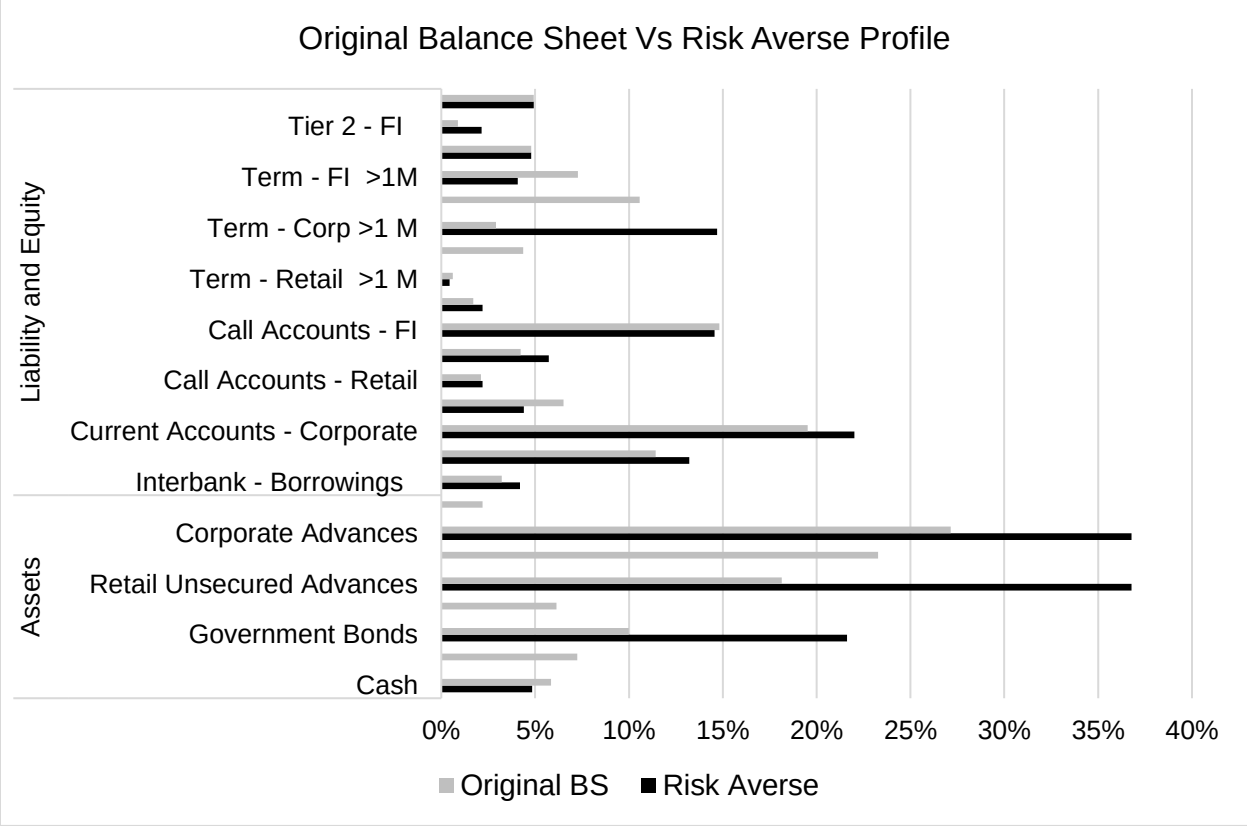
The graph above depicts that the Risk Neutral Profile has less concentration on Unsecured Retail Advances compared to the Risk Seeking Profile, however the concentration remains higher than from the Original Balance Sheet. The weighting of

Bonds which form part of HQLA has been reduced significantly, this is possible because of increased term deposits with maturity between one (1) and six (6) months which do not form part of LCR outflows. This then allows the bank to release HQLA and be invested in other higher yielding assets such as corporate loans.

The optimized ROE of a Risk Neutral Profile is at 51% which is a significant improvement compared to the original ROE of 12%. The reduction in ROE compared to the risk seeking profile is in line with risk-reward principle as the risk neutral profile is less risky compared to risk seeking profile.

7.5. Risk Averse

The graph below shows the stylized balance sheet composition of the sample bank with risk averse profile.



The Risk Averse Profile is more evenly distributed compared to Risk Seeking and Risk Neutral Profiles reflecting a reduced concentration risk. Although, the ROE of the Risk

Averse Profile has reduced it remains higher than that of the original balance sheet which was not Basel III compliant. The Risk Averse Profile maintains the highest degree of Basel III compliance compared to other profiles with LCR at 115% compared to 110% and 100% for Risk Neutral and Risk Seeking profiles respectively.

7.6. Conclusion

The formulated model has been able to optimize the bank's balance sheet as shown by an increase in return on equity whilst the sample bank complied with Basel III regulation. The model was stressed through scenario analysis to validate that it can react to different conditions as set by management as expected risk aggressive profiles resulted in higher optimised return on equity compared low risk profiles.

8. Conclusion and Recommendations

8.1. Introduction

This chapter presents the summary and conclusion of the study of which the main objective was to formulate a simple mode that can be used by banks to optimize shareholder returns whilst remaining in compliance with Basel III and IFRS9. The main objective is complemented by secondary objectives which are; (1) to understand the Basel III regulations and their importance to commercial banks, (2) To understand the impact of Basel III on bank performance, (3) to understand how the impairment model introduced by IFRS9 differ from IAS39 and lastly to understand the impact of this model on bank performance.

8.2. Findings

The findings of this research contribute towards understanding the Basel III regulatory regime as well as the new impairment model introduce by IFRS9. The impact of these two regulatory reforms on the bank's perfomance then lastly introduce a simple model that can be used by banks in Botswana to optimize their return to shareholders whilst remain in compliance with the introduced reforms.

The study shows that regulatory reforms were meant increase stability of the financial system and therefore are good for the economy and for protecting depositors funds. However, these new regulations which are good for the financial system come at a cost to the banks. Introduction of Basel III will mean banks will have to hold more expensive capital which has an impact on Return on Equity as the denominator (Equity holding) will increase to cover risk weighted assets. Further the introdution of global liquidity standards under Basel III encourages banks to raise longer dated liabilities to reduce the mismatch, further banks are expected to hold more low yielding high quality liquid assets if they raise funding from financial institutions. This means that banks wont be able to extend credit using short-term financial institutions deposits.

The Expected Credit Loss Model which was introduced through the IFRS9 standards which is meant to enhance financial stability was through the literature reviews found to be more punitive to the bank's income statement as it is more forward-looking.

The success of the study comes on the proposed optimization model being able to maximize the banks return on equity will being in compliance with this regulatory reforms as they are a necessity to the stability of our financial system. In the study we were able to model the simplified balance sheet of a sample Botswana bank, the model is simple and can be operated and interpretated by anyone with finance knowledge. The parameters of the model are customizable which makes the model application ready for any banking environment.

The results of the study shows that the simple model which was formulated by the authors can be used to optimize shareholder returns and at the same time ensuring that banks comply with regulatory reforms. The model was tested through data of a sample bank based in Botswana and the results were expected showing the admist regulatory reforms bank's shareholders returns can be optimized. The model was further tested through scenario analysis by including additional parameters in the form of management risk appetite and found that the model output allows risky strategies to achieve higher return on equity compared to less risky strategy. This is consistent with the theory that says high risk, high return.

8.3. Conclusion

A simplified model can be formulated that can be used for decision making by management banks in order to optimize return to shareholders whilst remaining in compliance with the new regulatory reforms. This model can be applied in banking institutions which do not have trading books. The model has been built to allow management to customise.

The outcome of this study is aligned to results obtained by Puts (2012) where an optimization model was developed to optimize shareholder profitability under Basel III constraints.

This study contributes to the literature on balance sheet optimization, Basel III and IFRS9 as the two (2) regulatory mandates are integrated into one simple model to assist bank management with decision making.

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