

AN ANALYSIS OF THE EFFICIENCY OF COMMERCIAL BANKS IN
NAMIBIA

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ABSTRACT

This research analysed the level of efficiency of commercial banks operating in Namibia. The research targeted the big four banks: First National Bank, Bank Windhoek, Standard Bank and Nedbank; by market share in the economy. The research was carried out using data from the respective banks' annual reports for the period 2011 to 2015. Analysis of the data was done through the Data Envelopment Analysis (DEA) method. The inputs and outputs used were defined through the intermediation approach. The findings show that over the period under investigation only two banks achieved optimal efficiency. The two banks getting optimal score does not necessarily mean there is perfect efficiency as this optimality is benchmarked in relation to the banks being analysed. Furthermore, the overall average efficiency in the banking sector with respect to the banks investigated was around 89.4%, indicating that room for improvement exists. The presence of an efficient banking system is a clear indication of a sound intermediation process and hence the banks contribute to economic growth as well as a conduct of effective monetary policy.

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DEDICATION

First and foremost, I would like to thank God Almighty for whom nothing is impossible if you believe. I dedicate this piece of work to my beloved parents, the late Lwaga Manase Nkabila and my mother Lucy for all their hard work and sacrifice to see me through to this stage, a debt I can never ever repay in full. I would also like to thank all my Uncles and Aunts for their support during the difficult period.

DECLARATION

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Daniel Ipyana Nkabila

Date:

LIST OF ABBREVIATIONS

ATM-Automated Teller Machines

BCC- Banker, Charnes Cooper

CCR- Charnes, Cooper Rhodes

CRS-Constant Returns to Scale

DEAP-Data Envelopment Analysis Programme

DMU-Decision making Unit

DRS-Decreasing returns to scale

EQASS- External Quality Assessment Scheme

IRS-Increasing returns to scale

LTFR- Loan-to-Total-Funding Ratio

NPL- Non Performing Loans

NSX-Namibia Stock Exchange

ROA-Return on Asset

SSA- Sub-Saharan Africa

VRS- Variable returns to scale

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CHAPTER ONE: INTRODUCTION

1.1 Background to the study

The new millennium brought with it great technological progress across the board. Financial institutions experienced even more progress on the technological front in the first decade which led to reduced information costs and brought with it fierce competition between the players in the banking sector. This brought the issue of bank efficiency firmly into the lime light as these financial intermediaries looked for efficient ways to reduce costs whilst increasing customer volumes and profit margins. Competition in the banking sector and efficiency are crucial for economic development. According to Denizer, Dinc and Tarimcilar (2007), the presence of competition compels banks to pursue cost reduction measures and hence increase their cost efficiency which leads to more efficient allocation of resources. The presence of competition stimulates banks to become more efficient by reducing overhead costs, enhancement of overall bank management, improving risk management and thus provides new banking products and services.

The discourse on efficiency measurement started with Farrell (1957) who in turn drew from works by Debreu (1951) and Koopmans (1951), to define a simple measure of firm efficiency which could account for multiple inputs. In this regard, Farrell (1957) went on to propose that the efficiency of a firm be made up of two components: technical efficiency and allocative efficiency. Technical efficiency reflects on the ability of one firm to obtain maximum output from a given set of inputs whilst allocative efficiency dealt with the ability of firms to use inputs in optimal proportions. Fried, Lovell and Schmidt (1993) suggest that there are

basically two motives as to why there is interest in assessing efficiency and productivity. Firstly, these are indicators of success. Secondly, it is only by being able to measure efficiency, productivity and being able to separate their effects from those of production environment that one can explore assumptions concerning sources of efficiency productivity changes.

The Data Envelopment Analysis method has been used for numerous studies involving efficiency in various sectors but it was Shearman and Gold (1985) that first applied it to the banking sector. Furthermore, there exists numerous studies on bank efficiency but their focus has been skewed towards Europe and the USA. Lack of studies in the SSA region can be attributed to fewer banks, limited activity in markets, low levels of financial development and also the lack of quality data (Chen, 2009).

In Namibia, the only other studies carried out on efficiency were by Ikhide (2000; 2008) that used operating ratios and the cost frontier approach respectively, to assess efficiency of commercial banks in Namibia. There was no further study beyond that and thus, this study examined the efficiency of commercial banks in Namibia for the period 2010 to 2015. This is due to the fact that bank efficiency is crucial as it is generally accepted that the development of the financial sector is a key ingredient in the push for economic growth. Under the Data Envelopment Analysis method, for a DMU e.g. banks to be considered purely efficient, they must obtain a score of 1.00, which entails 100% efficiency whereas any score below 1.00 implies existence of inefficiency. Most studies show any efficiency score above 0.8 as acceptable.

1.2 Problem statement

Honohan and Beck (2007) allude to the idea that the services that are given by the financial sector in terms of mobilization of savings, facilitation of transaction services and the risk management services play a key role in economic development. Furthermore, Hussein (2000) points out that banking efficiency is crucial at both micro and macro levels and hence to allocate resources effectively, banks should be sound and efficient. Ikhide (2008) found that there was little to no substitutability between the inputs in the Namibian banking sector. This led to high operating costs for the banks. These high operating costs were then transferred to the consumers through high user and service charges, which represents inefficiency in the sector. It is within this perspective that this study drew its primary interest to establish whether or not there is an improvement on efficiency. This is critical as a country could face dire consequences with regards to its prospects of economic growth if there exist inefficiencies in its financial sector especially that of the financial intermediation sector and thus this warranted an investigation.

1.3 Objective of the study

The main objective of this paper was to assess the level of efficiency for commercial banks in Namibia.

1.4 Hypotheses

H₀: There is no efficiency among commercial banks in Namibia.

H₁: There is efficiency among commercial banks in Namibia.

1.5 Significance of study

The significance of this study is that it would help identify better strategies to improving the efficiency of banks, enabling them to play their pivotal role of financial intermediation in Namibia. Furthermore, studying the efficiency of banks is helpful in pin-pointing sources of inefficiencies so as to enable stakeholders to initiate reforms and design suitable strategic measures especially in developing economies (Chen, 2009). It is hoped that this paper would contribute to the knowledge of banking literature in the country.

1.6 Organization of the study

This thesis is organized into five chapters. Chapter 1 provides the background on the study of efficiency and why it is crucial that the efficiency of commercial banks should be investigated. This chapter introduces the problem that is to be addressed and the research objective of the thesis. Chapter 2 provides the overview of the Namibian financial system and also a review of the banking sector performance for the period between 2011 and 2016. Chapter 3 presents the review of literature on the topic matter at hand. The definition of commercial banks is also given. The theoretical background of efficiency analysis is presented including the definitions for the different types of efficiency and the approaches used in defining the inputs and outputs to be used in efficiency analysis. The empirical reviews used in the thesis are mainly from developing countries with emphasis on recent studies on efficiency of commercial banks on the African continent. Chapter 4 discusses the research methodology used in the study. The chapter discusses the research design of the study as well as the type of data used in the study. Chapter 5 houses the discussion

on the findings of the study as well as the analysis of the problem statement for this study. Chapter 6 summarizes the findings of this study and provide conclusions based on these findings. Furthermore, it makes recommendations on further study on this topic.

CHAPTER TWO: AN OVERVIEW OF THE NAMIBIAN BANKING SECTOR

2.1 Introduction

This chapter gives an overview of the banking sector in Namibia. The chapter is divided into two subsections with section 2.2 discussing an overview of the Central Bank (the Bank of Namibia) and the description of the commercial banks operating in the country. Section 2.3 provides a discussion of the banking sector performance review for the period 2011 to 2016. Section 2.4 summarizes the chapter.

2.2 The Namibian Financial System

The Namibian financial system is made up of a combination of formal and informal institutions. The formal sector comprises of the Central Bank, insurance companies, commercial banks, capital markets as well as NSX. The banking sector has eleven banking institutions, which can be grouped as follows: 5 commercial banks; a small medium enterprise bank; an E-bank; two microfinance banking institutions, a small branch of foreign banking institution and a representative office. These are the primary mobilisers of funds from the public and main sources of financing, which support business operations and economic activities in the country. The informal sector is made up of money lenders and cash loans. The system also includes developmental institutions such as SME Bank Namibia, Agriculture Bank of Namibia and Development Bank of Namibia.

2.2.1 The Central Bank

The Central bank was established by the Bank of Namibia Act 8 of 1990 with the primary objective of providing and maintaining a sound monetary, credit and financial system. Additionally, the Bank of Namibia (BoN) was established to promote internal and external monetary stability, serve as lender of last resort to commercial banks as well as be a banker of the government. The Bank of Namibia is also expected to coordinate and spearhead the attainment of national goals by means of appropriate monetary policy measures. (BoN, 2012)

Namibia's monetary policy regime looks towards the existing exchange rate system of the common monetary area union in which Namibia, South Africa, Lesotho and Swaziland are member states. The Bank rate is the main instrument used by the Bank of Namibia in carrying out the monetary policy. Although adjustable, at times, to be in line with that of other common monetary area member states' bank rate, the Bank of Namibia may maintain a different rate tailored to suite the domestic money supply and demand, directly, as per Bank of Namibia Act 15 of 1997. Therefore, regulation and overseeing the operations of commercial banks in the economy through monetary policy is the major role of the Bank of Namibia (BoN, 2012)

2.2.2 Commercial Banks

In specific terms, the Namibian banking industry is characterized by an oligopolistic market structure in which a few institutions dominate the industry (Andongo and Stork, 2005). Commercial banks play a vital role in Namibia's financial system, since they also allocate funds for investment projects and mobilize savings. Commercial banks in Namibia operate under the Banks Institutions Act 2 of 1998

which aims to consolidate and amend the laws relative to banking institutions. The Act aims to provide authorization of a person to conduct business as a banking institution and to control, supervise and regulate banking institution. This act also aims to make provision for the winding-up or judicial management of banking institutions and for the cancellations of authorizations, and also as provision for matters concerning banking institutions in Namibia (BoN, 2010).

The most recent amendment of this Act was made in 2010, Act 4 of 2010, when the BoN embarked on activities to strengthen the regulatory and supervisory framework to ensure banking institutions comply with international best practices. This amendment Act includes provisions for permitting the establishment of branches of foreign banking institutions in order to stimulate competition among banking institutions, as well as provisions to permit the Minister of Finance to issue regulation relating to ownership and citizenship of board of directors, officers of banks and bank controlling companies. The commercial banks offer a number of products and services tailored to meet personal financial needs and circumstances. Among the services offered by the commercial banks are provision of credit, mortgage loans, motor vehicle finance, foreign exchange services, debit or credit card accounts, internet and cell phone banking (BoN, 2012).

2.3 Banking Sector Performance (2011-2016)

The following banking sector performance review is made with reference to the Bank of Namibia's Financial Stability Reports from 2011 to 2016. The areas reviewed include the banking sector assets and liabilities, liquidity and capital requirements. This review will show the progress or lack thereof that the industry has made over the period.

2.3.1 Performance Review for 2011

The overall balance sheet in this period grew by 16.4% as compared to 8% in the previous year. The balance sheet stood at N\$60 billion at 31 December 2011 compared to N\$51.5 billion in 2010. This growth in the balance sheet was attributed to the increase in loans and advances on the asset side and non-bank funding on the liability side of the sheet. This growth came about mainly due to the huge upsurge in total loans and advances from N\$4.4 billion to N\$43.5 billion. The large part of this came from the residential and commercial real estate mortgage loans. Another large contributor came from the increase in the short term negotiable securities which climbed from N\$3.2 billion to N\$6.3 billion. The loans and advances were the largest portion of the assets, they accounted for 71.9% at the close of the year. The remainder of this was shared between the short-term negotiable securities, cash and balances with banking institutions and other assets and investments. (BoN, 2011)

With regard to the capital and liabilities side, the major driver to the balance sheet growth came from the non-bank funding, growing by 17.8% to N\$50.5 billion, stemming mainly from demand deposits. This made the maturity structure of bank deposits skewed towards short term rather than long term deposits, which indicates to the practice of using short term funding to support long term lending. On the capital adequacy front, the industry as a whole was adequately capitalized and all banking institutions reporting levels well above the minimum regulatory capital requirements. (BoN, 2011)

The growth in the capital funds was only 2.5% at the end of December 2011 due to dividend payments during the year and which was much lower than the 23.4% increase in December 2010 caused by a higher growth in tier 2 capital. In terms of credit risk, 2011 saw an improvement in quality of bank assets, seen from the reduction in non-performing loans (NPLs) and total provisions, some debts being written off during this period. The total amount of NPLs in the industry declined by 15.7% in 2011, which amounted to N\$641.2 million. The NPLs as a percentage of total loans and advances reduced to 1.5% from 2% in December 2010. The industry NPL ratio remained well below the benchmark of 4%. (BoN, 2011)

Liquid assets held exceeded the liquid assets required throughout the year under review, recording a growth of 12.9% at the end of December 2011. Liquid assets held by the banking sector stood at N\$7.4 billion, while the minimum required limit was N\$5.1 billion, resulting in a surplus of N\$2.3 billion. Liquid assets increased in tandem to total assets, causing the ratio of liquid assets held as a percentage of average total liabilities to increase from 12% in December 2010 to 14.5% in

December 2011. The banking sector's profitability continued to improve as a result of the increase in total income. (BoN, 2011)

Total income increased slightly by 5.9% from N\$4.0 billion in 2010 to settle at N\$4.1 billion in 2011. The growth in total income was mainly caused by the increase in net interest income. The lower non-performing loan ratio, which declined from 2.0% in 2010 to 1.5% in 2011, supported the banking sector's profitability results, despite the low interest-rate environment which prevailed in 2011. This period saw interest expenses fall at a faster pace than interest income, thus the net interest income grew by 10.7%. (BoN, 2011)

2.3.2 Performance Review for 2012

In 2012 balance sheet grew as well but not at the same level as the 16.8% recorded in 2011, with just 11.8% growth recorded. This 11.8% growth amounts to N\$67.1 billion. Despite the reduced growth rate, the balance sheet growth once again stemmed from the increase in total loans and advances on the asset side and non-bank funding on the liability side. On the asset front, the balance sheet grew 17.2% which was mainly due to total loans and advances. This year 2012 saw a further upsurge in the commercial and residential mortgages which increased to N\$27.2 billion. There was also an increase in the overdrafts from N\$4.8 billion to N\$6.3 billion. A systematic breakdown of the industry loans and advances showed that the loan book was still concentrated in mortgages, accounting for 54%. (BoN, 2012)

On the liability side of the balance sheet, growth was mainly due to the non-bank funding, interbank funding, capital and reserves. The deposits in this period accounted for 82.5% of the banking sector total funding. Capital adequacy in this

period saw great growth as compared to 2011. Qualifying capital grew by 15.8% as compared to the mere 2.5% reported in 2011. The capital components that led to the increase in the Tier 1 capital were general reserves, retained profits and share premium, while subordinated term debt, current unaudited profits and general provisions contributed to the growth in the Tier 2 capital. (BoN, 2012)

The quality of assets was healthy in 2012 as a result of declining non-performing loans (NPLs) ratio despite the increase in the NPLs. In the industry, the level of NPLs increased by 5.4% during the year and amounted to N\$670.6 million. However, the NPL ratio declined from 1.5% to 1.3%. This decline was as a result of a 17.2% growth in the total loans and advances compared to slower increase of 5.4% by the NPL. The main composition with regards to the NPL came from mortgages at 56.2%. The Provisions made for loan losses by the banking sector were adequate and improved by N\$16.3 million to reach N\$619.3 million in 2012. (BoN, 2012)

For the liquidity scenario, the sector as a whole was relatively liquid with assets totaling to N\$7.5 billion and a surplus of over N\$1.5 billion above the minimum required limit of N\$5.8 billion. The ratio of loans to assets increased from 71.1% to 74.5% but this was still below the 75% international benchmark. The increase of the ratio came from the higher percentage increase in net loans and advances as compared to the percentage increase in the total assets. Furthermore, the loans to deposit ratio increased to 85.6% due to the higher percentage increase in the net loans and advances as compared to the percentage increase in deposits. The banking sectors liquid assets were dominated by the Government Treasury Bills which stood

at 54%. The holding of these Government Treasury Bills increased from N\$3.8 billion to N\$4.0 billion. (BoN, 2012)

2.3.3 Performance Review for 2013

During this year, the balance sheet of the banking sector grew by 14.8% with a total of N\$76.9 billion, compared to the N\$67.1 billion in 2012. The main driver of this growth came from the increase in total loans and advances on the asset side and deposits on the liability side. The growth seen on the asset side was due to the N\$7.6 billion increase in the total loans and advances. This was brought about by the increase to N\$30.7 billion of the commercial and real estate mortgage loans. Additionally, this year also saw the increase in the installment debtors and eases to N\$9.3 billion. At the close of the year, the loans and advances were the largest constituent of the sector's total assets at N\$58.2 billion. (BoN, 2013)

On the liabilities side, growth came about due to the increase in deposits. The demand deposits grew to N\$33.7 billion and NCDs grew by N\$2.9 billion, standing at N\$15.8 billion. The deposits made about 80.8% of the total funding that the banking sector had. Equity and interbank funding only represented about 10.1%. The majority of the funding for the sector during this period came about from the short-term deposits. (BoN, 2013)

During 2013, the total qualifying capital grew to N\$8.3 billion. This growth was mirrored by the growth of Tier 1 capital which grew by N\$1.1 billion moving to N\$6.6 billion. This year saw a further increase in the NPLs but the quality of assets in the sector remained adequate. The NPL ratio stood static at 1.2% of total loans and advances. The stagnation was as a result of the total loans and advances growing

faster at 15.6% compared to the growth of the NPLs which was at 10.6%. The NPL levels in the banking sector stood at N\$747.9 million. Apart from the credit cards, it was the small increases in all other loan types (mortgages, personal loans, installment sales and other loan portfolios) that led to the relative static nature of NPLs during this period. The total provisions for loan losses were adequate throughout the year and increased by N\$74.9 million to N\$694.1million. This increase helped cater for the overall increase in the non-performing loans. (BoN, 2013)

This year saw the liquidity remain well above the minimum requirements of 10% and the early warning trigger ratio of 10.5%. The total liquid assets held in the sector stood at N\$8.2 billion with N\$1.2 billion in excess over the required minimum limit. The loan-to-asset ratio in 2013 increased further to 74.8% which was just short of the international benchmark of 75%. The increase in this ratio was as a result of higher percentage increase in net loans and advances as compare to the percentage increase in the total assets in addition to the low levels of liquid assets. (BoN, 2013)

The loans-to-deposits ratio also grew from 85.6% to 86.4% as a result of higher percentage increase in net loans and advances as compared to the percentage increase in deposits. The liquid assets of the sector were dominated by the Government Treasury Bills which stood at 60.6%. These increased from N\$4.0 billion to N\$4.8 billion, which pushed up the proportion of 54.2% which was held in the previous year. It was noted that for this year, the banking industry had enough scope in terms of the deposit base to support credit extension activities, as seen from the loan-to-deposits ratio, which was below the international benchmark of 100 %.(BoN, 2013)

2.3.4 Performance Review for 2014

During the 2014 financial year, a 13.2% year on year increase saw the balance sheet of the banking industry amount to N\$87.2 billion at 31 December 2014. The drivers of this growth remain the growth in deposits on the liabilities side and total loans on the asset side. The overall banking sector business model continued on the traditional front characterized by extension of credit to households and business. A 3.5% increase in total loans and advances saw it hold 78.0% share of the banking sectors total assets. Mortgages loans still made up the bulk of the composition sitting at 52.3%, which was a drop from the 52.8 % in the previous year. In total, loans and advances increased by N\$9.8 billion to N\$68.0billion during this year. (BoN, 2014)

On the capital front of the balance sheet, the growth was driven by the non-bank funding in the form of demand, fixed and notice deposits. This non-banking funding was responsible for 79.9% of the total funding in the banking sector. The largest component was that of demand deposits at 54.2% and this attributed to the maturity funding structure skewing towards short-term as compared to long term deposits. The sector as a whole remained adequately capitalized and the total qualifying capital increased to N\$9.6 billion. This growth was on the back of significant growth on the Tier 1 capital which increased by N\$1.2 billion to N\$7.8 billion. (BoN, 2014)

There was an increase in the non-performing loans ratio, but the increase was not significant enough to destabilize the sector. The NPLs moved up to N\$987.9 million compared to the N\$747.9 million in 2014. The driving factor of the NPL growth came from the N\$144 million in mortgages. There was a slight increase observed in the ratio of non-performing loans to total loans from 1.3% to 1.5%. Nonetheless, the

asset quality remained satisfactory during this year as shown from the relatively low NPL ratio. (BoN, 2014)

With regards to the adequacy of provisions, 2014 saw a decline in the cover. The specific provisions in absolute terms increased to N\$256.4 million from N\$221 million the previous year. When it was expressed as percentage of NPLs, the specific provisions fell to 26% from 29.5%. This came as a result of the majority of the new NPLs were secured by residential mortgage properties. In this year, the banking sectors holding of liquid assets amounted to N\$10.1 billion with a surplus of N\$2.1 billion. (BoN, 2014)

In 2014 the loan-to-asset ratio finally broke through the international benchmark barrier of 75% and sat at 78% at the end of the year. The increase in the ratio came about as a result of the increase in net loans and advances as compared to the percentage increase in assets in addition to relatively lower levels of liquid assets. The loans-to-deposit ratio moved to 97.6% as a result of higher percentage increase in net loans and advances in comparison to the percentage increase in deposits. As the trend over the years, the banking sectors liquid assets were largely Government Treasury Bills with a share of the total liquid assets. (BoN, 2014)

2.3.5 Performance Review for 2015

The banking sector balance sheet as of 31st December 2015 saw a year-on-year increase of 14.5% and stood at N\$99.0 billion. The movement was largely due to increases in deposits in the liabilities space and total loans on the assets side. The industry continued with conventional way of doing business. The total loans and advances saw a 15% increase and closed the year at N\$78.2 billion. However, there

was a decrease in the cash balances. The banking sectors assets were dominated by the total loans and advances which made up 78.2% of the assets. Commercial and residential, the mainstay of the asset section saw a drop in their share of the loan book moving from 53.0% to 51.3% in 2015. (BoN, 2015)

On the liabilities front, the deposits remained the dominant force in terms of growth. The deposits were responsible for 77.8% of the banking sectors total funding and increased to N\$77.8 billion compared to the N\$69.7 in 2014. The growth of deposits came as a result of the demand as well as fixed and notice deposits that grew by N\$1.2 billion and N\$1.7 billion respectively. The demand deposits, the largest component of deposits, saw a drop in the share of total deposits from 55.3% to 50.4% in 2015. This fall thus saw the maturity funding structure of the deposits continue to angle towards short-term deposits instead of long-term. (BoN, 2015)

During 2015, as with the other years before, the banking sector was adequately capitalized and maintained levels above the prudential requirements. Total qualifying capital grew to N\$11.2 billion over this year. This growth in the qualifying capital was as a result of a very significant growth in Tier 1 capital which moved by 19.1%. This growth in the Tier 1 Capital occurred as a result of increased retained profits of N\$1.2 billion and general reserves by N\$271.1 million. In 2015 a further increase in the non-performing loans was recorded but remained below the 4.0% benchmark. There was an increase of N\$222 million in the NPLs which led it to the N\$1.2 billion level. This increase is attributed to the increases in mortgages, installment sales and overdrafts. The mortgages were still the main category under the non-performing

loans, making up for 54.1%. The year also saw an increase in the non-performing loans ratio, moving from 1.5% to 1.6%. (BoN, 2015)

On the liquidity front, the banking sector continued to be relatively liquid and maintained assets that were in excess of the statutory requirements. The liquid assets amounted to N\$11.3 billion with a surplus of N\$2.7 billion above the required minimum of N\$9.1 billion. There were increases observed in both liquid assets portfolio as well as the total liabilities to the public which increased by 13% and 13.5% respectively. There was sustenance of the part of the loan-to-asset ratio as it increased and stayed above the international benchmark. The ratio moved from 77.1% to 80.8%, thus remaining above 75% international benchmark. This increase was brought about due to the lower increase in the other assets other than net loans in advance. The loans-to-deposit ratio increased from 97.6% to 100.5% in 2015 which was attributed to lower increase of total deposits as compared to increase in net loans and advances. The Government Treasury Bills continued to be the major liquid assets in the banking sector with a 58.4% share. These increased from a value of N\$5.1 billion to N\$7.1 billion in 2015 and thus leading to the increase in liquid assets holding. (BoN, 2015)

2.3.6 Performance Review for 2016

The 2016 report showed that the Banking sector remained sound, profitable and was adequately capitalized. The sector continued to provide a variety of conventional banking products with mortgage lending still dominant. The residential and commercial mortgage lending increased slightly to 51.5% of the total loan book from

51.3% in 2015. The concentration high exposure to mortgage lending is a key concern but the introduction of the Loan-to-Value ratio was expected to reduce the concentration. The cash and balances held by bank saw a slowdown of the double digit rates seen previous times and increased by 9% from N\$8 billion to N\$8.8 billion during the period under review. (BoN, 2016)

On the funding front, it continued to be spearheaded by short-term deposits on the capital and liabilities side of the balance sheet. The demand deposits made up 47.9% of the total deposits at the end of 2016, lower than the 50.4% that was recorded in 2015. The evidence above shows that demand deposits continued to be the major non-banking funding source. This led to short-term rather than long-term deposits being the preferred maturity funding structure of the bank deposits. The savings deposits represented just 4% of non-bank funding, Fixed and Notice Deposits represented 19.5% with Negotiable Certificates of Deposits accounting for 25.2%. There was a fall in the share of Foreign Funding which went from 4.3% in 2015 to 3.2% in 2016. (BoN, 2016)

With respect to the Loan-to Deposit (LTD) ratio, it was moderated but still remained high. This ratio was cited as an area of concern and needed monitoring in the last FSR moderated to 98% in December 2016 from 101% in December 2015. This lower ratio alludes to the fact that the banks have made relatively more use of deposits to fund loans and advances than their funding sources such as debt capital which normally tend to be more expensive. There is no set benchmark, however, a loan-to-deposit ratio close to or over 100% implies that some banks rely on borrowed funds to fund their loans. (BoN, 2016)

The Loan-to-Total Funding (LTFR) remained high in the banking sector. The level remained above 90% during the period reviewed, which confirmed the sustained pressure on the funding base. The ratio implies that, on average, 90% of banks funding is extended as loans and advances. The implication is that only 10% of total funding in addition to total capital and equity was available to be employed on liquid and other assets. When the LRTF is high, banks are limited with regards to expanding the loans and advances books, while maintaining sufficient liquid assets to proactively manage liquidity risks. The ratio is even of more importance given the current mismatch between assets and liabilities, experienced by all banks. (BoN, 2016)

On the Asset quality front, the non-performing loans ratio as a measure of credit risk in the banking sector saw an improvement and remained within Bank of Namibia's benchmark level of 4%. This posed no threat to the stability of the sector. The NPL as a ratio of the total loans decreased from 1.6% in 2015 to 1.5% in 2016. This fall in the NPL can be attributed to lower NPLs on banks' other loans and advances, instalment credit and leasing finance, which overtook the increase in NPLs on mortgage loans, overdrafts and credit cards. The high share that mortgage loans have in total NPLs is not surprising as residential and commercial mortgage loans accounted for more than 50% of total loan book. (BoN, 2016)

The sector remained adequately capitalized in addition to maintaining capital positions that were above the minimum prudential requirements. Despite the general deterioration of liquidity in 2016, the sector continued to hold liquid assets well above the statutory minimum liquid asset requirement. There was an improvement in

the liquidity ratio, from 12.4% in the final quarter of 2015 to 13% in 2016. (BoN, 2016)

2.4 Summary

Over the period reviewed, the movements show that the sector as a whole was stable despite some fluctuations in some years. The banking industry as a whole was heavily dependent on mortgages, residential and commercial, on the assets area and the short term deposits were the main source of funding throughout the period. It was surprising to see that the sector as a whole had operated below the international benchmark of 75% for the loan-to-asset ratio for the period before 2014 where it managed to break past the benchmark. This performance under the international benchmark could feed into efficiency of the banks as a whole. All in all, the banking sector was stable throughout the period and showed more growth than losses during this period.

CHAPTER THREE: LITERATURE REVIEW

3.1 Introduction

This chapter puts into perspective the different literature pertaining to efficiency and the role it has in commercial banking, which are seen as major contributors to a strong financial sector that is a major cog in the push for economic growth of any economy. The chapter is divided into four sections. The theoretical literature is discussed in section 3.2. Section 3.3 presents the empirical literature while the lessons learnt are presented in section 3.4.

3.2 Theoretical literature

Gitman and McDaniel (2008) define efficiency as the ability to produce results with the least amount of effort or resources. Data Envelopment Analysis calculates the efficiency of a given organization in a set in relation to the best performer in that set, (Coelli, 1996). The best performing organization is used as a benchmark. It is generally used in the measurement of efficiency of non-profit organizations or private sector firms as well as government service. The individual units analysed are known as decision-making units or DMUs in Data Envelopment Analysis. Furthermore, these decision making units for which efficiency scores are calculated can be either a whole organisation such as hospitals, banks or just units within organizations such as the different wards in a hospital or individual bank units.

Data Envelopment Analysis has four main models namely Constant Return to Scale(CRS), sometimes known as CCR; Variable Return to Scale (VRS), known as BCC; Increasing Return to Scale (IRS); and Decreasing Return Scale (DRS). Each

of these models has two approaches of input orientation and output-orientation. A brief explanation will be provided about CCR and BCC models which are the basis for other models.

The CCR model was developed by Charnes, Cooper and Rhodes (1978), where each decision-making unit (DMU) placed on efficiency border is efficient and units not placed on border are inefficient and the level of inefficiency is determined through the radial distance to the border. The CCR model can be defined as follows: consider a set of DMUs (Decision Making Units) to be evaluated, DMU_j , ($j= 1,2,3\dots n$) that consumes the amounts $X_j = \{x_{ij}\}$ of m different inputs ($i =1 ,2, \dots,m$) and produces Y_j amounts of r outputs ($r=1,\dots,s$) . The technical efficiency of a particular DMU_0 under the assumption of constant returns to scale (CRS) can be obtained from the following linear programmes:

$$\max \frac{\sum_{r=1}^s u_r y_0}{\sum_{i=1}^m v_i x_{i0}}$$

$$\text{Subject to } \frac{\sum_{r=1}^s u_r y_0}{\sum_{i=1}^m v_i x_{ij}} \leq 1, j=1, \dots, n$$

$$u_r, v_i \geq \epsilon; r=1, \dots, s; i=1, \dots, m \quad (3.1)$$

Where

u and **v** are the weights of each input and output

s is the number of output features

m is the number of input features

Hence the dual problem for the CCR is as follows:

$$\begin{aligned} \min \theta - \varepsilon (\sum_{i=1}^m s_i^- + \sum_{r=1}^s s_r^+) \\ \text{s.t. } \sum_{j=1}^n \gamma_j x_{ij} + s_i^- = \theta x_{i0} \quad i=1, \dots, m \\ \sum_{j=1}^n \gamma_j y_{rj} - s_r^+ = y_{r0} \quad r=1, \dots, s \\ \gamma_j, s_i^-, s_r^+ \geq 0 \quad j=1, \dots, n \end{aligned} \quad (3.2)$$

Banker, Charnes and Cooper (1984) developed the BCC model which unlike the CCR model assumes varying efficiency comparator scale. The BCC model basically allows for the calculation of scale efficiency. Using varying efficiency to scale leads to highly accurate analysis by using technical efficiency according to efficiency values resulted from scale as well as management-resulted efficiency.

Creating input and output oriented models in BCC model requires use of principles of CCR model. Normally, the efficiency score for each DMU under CCR does not exceed the BCC efficiency scores. In the input-oriented model, reduced inputs lead to increased efficiency but in output-oriented model, increased outputs leads to increased efficiency.

The BCC model allows a calculation of pure technical efficiency that is measured without the scale efficiency. Hence the mathematical form of this model can be represented as follows:

$$\begin{aligned}
 PTE_0 &= \max \frac{\sum_{r=1}^s u_r y_{r0} + \mu_0}{\sum_{i=1}^m v_i x_{i0}} \\
 \text{s.t. } & \sum_{r=1}^s u_r y_{rj} + \mu_0 - \sum_{i=1}^m v_i x_{ij} \leq 0, j=1, \dots, n \\
 & u_r, v_i \geq \varepsilon; r=1, \dots, s; i=1, \dots, m
 \end{aligned} \tag{3.3}$$

Therefore the dual problem for the BCC will be as follows:

$$\begin{aligned}
 \min & \theta_0^{\text{BCC}} - \varepsilon \left(\sum_{r=1}^s s_r^+ + \sum_{i=1}^m s_i^- \right) \\
 \text{s.t. } & \sum_{j=1}^n \gamma_j x_{ij} + s_i^- = \theta_0^{\text{BCC}} x_{i0}, i=1, \dots, m \\
 & \sum_{j=1}^n \gamma_j y_{rj} - s_r^+ = y_{r0}, r=1, \dots, s \\
 & \sum_{j=1}^n \gamma_j = 1 \\
 & \gamma_j, s_i^-, s_r^+ \geq 0; i=1, \dots, m; r=1, \dots, s; j=1, \dots, n
 \end{aligned} \tag{3.4}$$

3.2.1 Efficiency concepts

It is critical to understand the various concepts of efficiency, namely technical, allocative and cost efficiency. According to Usman, Wang, Mahmood and Shahid (2010), bank efficiency occurs when the best level of output is obtained without any changes with regard to the amount of input. As compared to other methods used in the comparison of service providers, the Data Envelopment Analysis method has two advantages in the benchmarking sphere. Firstly, it can be used to make simultaneous comparisons of a number of dependant performance measures and give a measure for the best practice. Secondly, the Data Envelopment Analysis method can calculate the amount of resources that can be spared, or equally the amount of additional output that could have been produced had the provider operated using methods and techniques of the best practice providers. The following are some brief descriptions of the types of efficiency.

Technical efficiency: according to Farrell (1957) this concept deals with the usage of labour, capital, and machinery as inputs to produce outputs in relation to benchmark in a given sample of DMUs. Therefore, given similar technology for all the decision making units, no wastage of inputs is considered in producing the given output quantity. An organisation operating at best practice is said to be the benchmark and in comparison to all others in the sample is said to be technically efficient. Thus,

organisations are benchmarked against the best performing organization and their technical efficiency is expressed as a percentage of best practice. Technical efficiency is determined by comparing the difference between the observed organization's output-input ratio and the ratio achieved by best practice. Producing the maximum output or consuming the minimum inputs, as compared to what is technically feasible, is an essential step for service providers to be able to meet their objectives best. Managerial practices and the scale of operations affect technical efficiency. This occurs as a result of the scale of operation and is based on engineering relationships rather than prices and costs.

Allocative efficiency: according Farrell (1957), this concept deals with the minimization of cost of production with proper choice of inputs for a given level of output and set of input prices, assuming that the organization being examined has already achieved full technical efficiency. It is expressed as a percentage score, with a score of 100% indicating that the organization is using its inputs in the proportions which would minimize costs. An organization that is operating at best practice in engineering terms could still be allocatively inefficient if it is not using inputs in the proportions, which minimize its costs, given relative input prices.

Cost efficiency: according to Adongo, Stork and Hasheela (2005), cost efficiency measures the change in a bank's variable cost adjusted for random error, relative to the estimate cost needed to produce an output bundle as efficiently as the best practice bank in the sample facing the same exogenous variable, which include variable input prices, variable output quantities and fixed net put (inputs and outputs). It comes about as a result of technical inefficiency, which leads to the use

of an excess or sub-optimal mix of inputs given input prices and output quantities. This concept deals with a combination of technical and allocative efficiency. An organization will only be cost efficient if it is both technically and allocatively efficient. Therefore, the only way an organization can achieve a 100% score in cost efficiency is if it has achieved 100% in both technical and allocative efficiency.

3.2.2 Methods of efficiency measurement

Efficiency analysis can either be parametric involving the Stochastic Frontier analysis or non-parametric methods involving Data Envelopment method. The parametric methods include production, cost as well as revenue functions as alternatives that may be used in estimating production technology and the estimation of technology. The non-parametric methods involve using mainly the linear programming techniques.

The Stochastic Frontier analysis is based on a regression instead mathematical programming used in the Data Envelopment analysis. This method takes into account an estimated production function to specify a technical, cost or profit frontier against which the units of the analysis are compared and their degree of efficiency measured. According to Greene (2005), under the Stochastic Frontier method, it is necessary to assume that the bank specific characteristic drivers of inefficiency enter the model in the form of effects and are uncorrelated with the input levels. The fundamental assumption underlying Stochastic Frontier analysis model is that, the inefficiency component and the random component of the residual will be distributed differently. The Stochastic Frontier analysis is used mainly as it addresses two shortcomings of Data Envelopment Analysis which are the presence of random noise, measurement

error and outliers on one side and the relationship between the inputs and outputs on the other. The main advantage with regards to this method of analysis is that it allows the calculation of technical, allocative and economic efficiency. Furthermore, this approach helps to circumvent the shortcomings from the assumption that bank specific deviations are time invariant. However, Greene (2005) argues that to assume that bank specific deviations are time invariant is to a certain extent unrealistic.

The Data Envelopment Analysis method is widely used to analyse technical efficiency in firms. These measures allow the ranking of firms according their performance. It is non-parametric in nature as it does not have any assumptions of a particular functional form. The advantageous feature of Data Envelopment Analysis is that it does not need the specification of a particular functional form for the technology. However, the main disadvantage with this method is that it is not possible to estimate parameters for the model which then hence makes it impossible to test hypothesis concerning the performance of the model. Furthermore, the programming approach is not stochastic and hence infers noise as inefficiency; the econometric approach imposes a parametric structure on both technology and the distribution of inefficiency, thereby vulnerable to specification error.

According to Bauer et al. (1998), DEA suffers from a self-identifiers and near-self identifiers problem. When imposing constraints like quality control and control variables in the model, some firms may be self-identified as 100% efficient simply because no other firms or linear combination of firms are comparable in some dimensions. When there are a small number of observations relative to the number of

inputs, outputs and other constraints, it is difficult for a large proportion of the observations to match in all dimensions.

3.2.3 Approaches used for identification of input-output variables

There remains much contention on how inputs and outputs are measured and defined when it comes to the banking environment (Nigmonov, 2010). The choice of variables to be used in efficiency studies has the ability to greatly affect the results. Furthermore, the problem is compounded further by the fact that the selection of the variables (inputs and outputs) greatly depends on the availability of the relevant data. The joint production and pricing assigned to usually bundled services make the measurement of the inputs and outputs cumbersome. There exist several approaches used to measure and define outputs-inputs and these include: production, profit, operating and intermediation approach. There is still no consensus reached by researchers on which of the approaches is best.

Under the production approach, there is the definition of the traditional inputs in the form of land, labour and capital which then produce outputs. This approach assumes that the banks look to produce liabilities (deposits) in addition to loans (assets) and other services. Benston (1965) was one of the first to use this approach in a study with the aim of investigating which bank can produce services at lowest cost.

Sathye (2003) observed that these traditional inputs are used to produce outputs such as deposits and that this was one of the major differences between this approach and

intermediation. D'Souza and Lai (2004) point to the failure of this approach being unable to account for mitigation of financial risk that commercial banks incur during loan transactions.

The profit approach can be attributed to the works of Berger and Mester (1997). This approach takes into account unmeasured changes in the quality of banking services by including higher revenues paid for the improved quality, and may also capture the profit maximizing goal by including both the costs and revenues. Drake, Hall and Simper (2006) used net interest income, net commission income, and other incomes as outputs whilst employee expenses, other non-interest incomes, and ratio of income to expenses from allocations to release of loan provisions as inputs.

The operating approach which is also known as the income based approach, looks at financial institutions as individual business units whose objectives are solely to generate revenue given total costs incurred in running the business (Leightner and Lovell, 1998). Under this approach, institution inputs are defined as total expenses (paid expenses and operating expenses) and the outputs defined as total revenues (interest and non-interest).

Sealey and Lindley (1977) introduced the intermediation approach which assumes that the bank's main aim is to transform liabilities (deposits) into loans (assets). Under this approach, the exact number of inputs and outputs depend on the data availability. Banks are seen as fund collectors that in turn use these funds to for intermediation of and loans and other assets. The intermediation approach considers a bank's production process to be financial intermediation behaviour related to

borrowing funds from depositors and subsequently lending them to others. Each output here is measured not in the number of transactions but in the value. Under this approach, outputs are measured by monetary values of varied earning assets such as loans and investments, whilst inputs include labour, capital, operating costs and interest expenses. Holod and Lewis (2011) came to the conclusion that there is no correct set of input and outputs defined for the intermediation approach.

Brissimis, Delis and Tsionas (2010) and Van Heerden and Van der Westhuizen (2008) support the intermediation approach and believe it is more superior as compared to the production approach. Three points are put forward in defence of the position they took. First and foremost, the intermediation includes the interest expenses, which could account for more than half of the banks total cost. Secondly, in terms of cost minimization it is total costs that are minimized and not just the production costs. Third and final point was that the data availability was unmatched. This paper will follow the intermediation approach to define the inputs and outputs used in the analysis. This approach was chosen so as to investigate the economic role of commercial banks played through their role as main financial intermediaries in the country.

3.3 Empirical literature

There exist various empirical studies that have looked at issues of efficiency in banking across developing countries. Among these are Ikhide (2000) who analysed the efficiency of commercial banks in Namibia using operating ratios and cost frontier approach. The data analysed for this study was for the five commercial banks of that time, namely First National Bank, Standard Bank, Commercial Bank of

Namibia, Bank Windhoek and City Savings & Investment Bank, for the period 1993 to 1998. Using a one input- three output trans-log cost function, the study used total cost, bank loans and input prices of land labour and capital to determine efficiency of the commercial banks. Results from the operation ratios established that profit ratios were high in the banking industry during that period. The trans-log cost function showed the existence of economies of scale in the Namibian industry. These Economies of Scope could be exploited by banks expanding their scale of operation. Another finding from the paper was that during this period, more banks could join the industry without there being any compromise on the profitability of the industry. All in all, the study showed that there was little substitutability between inputs in the industry, the ability for substitutability would have added significantly to the observed high costs of producing output in the industry.

The standard econometric frontier approach was used by Ikhide (2008) to examine the efficiency of commercial banks in Namibia. The major aspect of efficiency investigated was that of scope efficiency. Scope efficiency looks to whether a firm produces as efficiently as it possibly can relative to its size. The results showed the existence of substantial economies of scale in the Namibian banking industry. This suggests that during this period, the commercial banks could increase their efficiency by their existing scale of operations. With regards to the economies of scope, results showed that the level of input combination the banks used during that period did not make for efficiency maximization due to the existence of substantial scope for more efficient combination of inputs. The author further suggested that with the existence of these scopes there was room to reduce operating costs in the Namibian banking industry and stimulate efficiency.

Aikaeli (2008) used the Data Envelopment approach to estimate the technical and scale efficiency for the banking sector in Tanzania. The period investigated was 1998 to 2004 using monthly data sourced from the Bank of Tanzania's annual and quarterly reports. The findings from this research showed that for the period under investigation, commercial banks operated on the decreasing part of their average cost curves and this gave them a room to expand with increasing returns to scale. On the technical efficiency front, it was found that foreign banks ranked the highest, followed by small banks and then large domestic banks; while for the scale efficiency, the small banks ranked the highest followed by international banks and then large domestic banks.

Moffat and Valadkhani (2009) used the Data Envelopment Approach to assess the efficiency of financial institutions in Botswana. The period under investigation was 2001 to 2006 where ten major institutions were selected as the DMUs and the data was sourced from the financial reports of the institutions. The researchers used three approaches in specifying the input-output mix so as to provide for robust results. The findings showed that in all three approaches, Bank of Baroda and First National Bank, both foreign banks, and Botswana Savings Bank were among the most efficient banks for all the years observed. In contrast, Botswana Development Corporation, African Bank Corporation and National Development Bank were the least efficient. The findings also indicated that it was the small or large institutions in terms of asset size that were most efficient. Furthermore, one interesting finding was

that it contradicted the findings of Das and Ghosh (2006) who found that operating many branches made banks more susceptible to reduced efficiency levels. In their findings, Botswana Savings Bank had many rural branches and still enjoyed high efficiency levels and this was consistent with the findings of Favero and Papi (1995) in India.

Using the Data Envelopment Analysis method, Nigmonov (2010) assessed bank performance and efficiency in Uzbekistan. This paper focused on twenty three banks operating in the Uzbek economy for the period between 2004 and 2006. Using the intermediation approach to define variables: operational expenses, fixed assets and total deposits were the inputs whilst total non-interest income and other non-interest income were outputs used. The findings showed that for the period under investigation the efficiency dropped each year and the average efficiency score was 84%. Furthermore, findings showed that a majority of the banks operated under the decreasing returns to scale.

Haque and Tariq (2012) analysed the efficiency of banks in Pakistan using the Data Analysis Envelopment approach. The banks included both the conventional and Islamic banking. The study covered a sample of 22 banks of which 16 were conventional banks and 6 Islamic banks. The period under investigation was between 2006 and 2010. This study followed the intermediation approach of defining inputs and outputs used in the analysis. The outputs used were investment and financing, total income and liquid assets whilst the input variables were administrative costs, operating fixed assets and total deposits. The results from this analysis found that there the banking sector in the country was not efficient in 2009. Additionally, the

study found that the Islamic banks were more efficient during the period under investigation as compared to the Conventional banks.

With the help of the input oriented Data Envelopment Analysis, Ally (2013) investigated the efficiency of commercial banks in Tanzania with particular interest on the regional and small banks. The study used the following inputs and outputs: total deposits, number of employees, total expense, total loans and total interest income. This paper followed the non-parametric approach and used data for the period 2006-2012 to analyse the efficiency of the banks. Out of the 14 banks that operate in the regions, only seven were picked due to data availability for the selected period of 2006 to 2012. Data used in this research was taken directly from the annual reports of the individual banks. The results found that the overall mean efficiency of the banks was 90.4%, which entails that during the period under investigation, the banks could have reduced their inputs by 9.6% without there being any effect on the output. The study further found that four banks were most efficient during the period under investigation.

Micajkova and Poposka (2013) used the Data Envelopment Analysis to determine the level of efficiency of Macedonian banks. The paper covered the period from 2008 to 2011 and looked at the efficiency of fifteen banks in the country. The researchers used the intermediation approach to define their inputs and output variables. The inputs used were internal costs, commission costs, labour costs, amortization, other administrative costs, fixed assets and total deposits received. The outputs used were interest revenues, non-interest revenues, investments and loans. The findings from this research showed that average efficiency increased from 2008

to 2010 and it dropped in 2011. The efficiency level was at 77.9% and the major cause was found to be scale inefficiencies and it was mainly detected from the large banks. These large banks were found to be operating at decreasing returns to scale.

Ally and Patel (2014) evaluated the efficiency of commercial banks in Tanzania and looked to identify the drivers of efficiency. The paper looked at commercial banks for the period 2006 to 2013. The study adopted the intermediation approach in defining the inputs and outputs used. The inputs included total deposits, number of employees and total expenses; outputs used were total loans and total interest income. The results from the Data Envelopment Analysis model found that the overall technical efficiency for the banks in Tanzania was at 95.9%. Additionally, results also indicated that on average the large banks were more efficiency than small banks who in turn were more efficient than medium sized banks. With regards to sources of inefficiency in the Tanzanian banking sector, it was found to come from poor utilization of inputs which points to managerial inefficiency.

Abdalla (2014) used the Data Envelopment Approach to analyse the efficiency of commercial banks in Sudan. This study sampled 29 commercial banks operating in the country and analysed efficiency for the period between 2009 and 2010. The outputs in the model used where loans, assets and profits whilst the puts were administrative expenses, deposits and assets. The results from the analysis found that of the 29 banks in the sample, only 4 banks were technically efficient and 4 banks were purely technically efficient but were lacking in scale efficiency. The overall industry technical efficiency stood at 84% for the period under investigation.

Alrafadi, Kamaruddin and Yusuf (2014) carried out an investigation on efficiency and its determinants in the Libyan banking industry. This paper used a combination of the Data Envelopment Analysis and the Tobit model to carry out the assessment of the efficiency of 17 Libyan banks in for the period 2004 to 2010. The Tobit model via the Eviews7 software, was used to examine the determinants of efficiency for the Libyan banking sector. The variables used in this study include ROA, risk, total assets, total deposits, EQASS, government link of bank and efficiency, mergers and ownership structures. The results showed that the specialized banks showed higher average technical efficiency in comparison to the commercial and private banks. It was also found that the pure technical inefficiency outweighed the scale efficiency in the Libyan banking sector during the period under investigation. The findings from the determinants of efficiency found a positive relation between the bank's efficiency and ROA, size of operation, capital adequacy and government ownership.

Using the standard and the alternative approaches to Data Envelopment Analysis, Erasmus and Makina (2014) carried out a study on bank efficiency in South Africa. The study used data for the period 2006 to 2012 to estimate efficiency scores of Standard Bank, ABSA Bank, First Rand Bank, Nedbank and Capitec Bank. The study used the following inputs and outputs; deposits, other liabilities, shareholder's equity, staff costs, non- interest expense, fixed assets, loans and overdrafts and non-interest incomes. The results from both approaches showed that most of the major South African banks were efficient. Furthermore, the results suggested that the 2008 global crisis did not affect the efficiency of many of the banks. The authors suggested that since the banks were already efficient before the financial crisis, it is

arguable that their efficiency could be a reason for their resilience during the financial crisis of 2008.

Akeem and Moses (2014) carried out an empirical analysis of allocative efficiency of Nigerian commercial banks. The researchers chose to use 10 out of the 15 commercial banks operating in Nigeria and data for the period between 2002 and 2011 was used to assess efficiency scores via the Data Envelopment Analysis approach. The researchers used three inputs namely; deposits, operating expenses and assets, and used four outputs variables consisting of loan and advances, investments, interest income and non-interest income. The findings from the assessment found that the average allocative efficiency was at 89.6% for the period under investigation. This entails that during this period under investigation, the banks could reduce their inputs by 11.4% without having any impact on the output. The researchers concluded that there was a need for Nigerian banking sector to seek managerial attention beyond the banking reforms.

Ayadi (2014) used the Data Envelopment Analysis method to measure the technical efficiency of Tunisian banks. The data used for the research was for the period 2001 to 2011 and the variables were defined using the intermediation approach. The inputs used were labour, physical capital and financial capital whilst the outputs were total consumer loans and portfolio investments. The results from this paper showed that the overall efficiency score was at 57.1% despite scale and pure technical efficiency scoring 86.9% and 64.7 respectively. The researcher explained that the low score was a result of 2011 being the year of the Arab revolution in the country. This was

characterized by insufficient capital and saw the banks unable to increase their loan volumes therefore failing to improve efficiency.

Using the input oriented Data Envelopment Analysis; Alber (2015) investigated the determinants of efficiency in the Egyptian banking sector. The author applied the Wilcoxon rank test on 10 banks for the period 1984 to 2013. Efficiency, size, age and ownership of the bank were used as variables in this study. The results from the paper showed that efficiency scores varied significantly according to size, age and ownership of the bank. The Egyptian banks that were small, old, and private were found to be more efficient as compared to the bigger, younger and public banks. In the case of bank ownership, it only attributed to 21.1% of the efficiency scores.

Muvingi and Hotera (2015) used the Data Envelopment Analysis Malmquist approach to assess the efficiency of ten commercial banks in Zimbabwe. Out of the ten banks assessed three were foreign owned banks, six were private domestic owned and only one was state owned. The period of study was from 2002 to 2012. The researchers used the intermediation approach in the selection of the variables to use as inputs and outputs. Deposits and operating costs were used as the inputs whilst the outputs used were loans and advances. Results found that for the efficiency scores for CRS was 70.95% whilst those for the VRS were 81.5%. Furthermore, the Malmquist Productivity index showed that the average total factor productivity for commercial banks in Zimbabwe for the period 2003 to 2012 had increased by 13.8%. Additionally, the totally productivity reached its highest level in 2009 at 121.1% and reached the lowest level of -52% in 2005.

Using the Data Envelopment Analysis approach, Miencha, Murugesan, Vasanth, Lingaraja and Raja (2015) measured the efficiency of Kenyan commercial banks. The study covered the period between January 2010 and December 2013. The researchers chose a sample of 22 banks which included five public sector and seventeen private sector banks. These 22 banks were chosen out of a pool of 45 banks operating in 2012 and selection was based on their market capitalization. The findings from the paper found that most banks were efficient throughout the period under investigation and the mean efficiency scores indicated that the public sector banks were more efficient than private sector banks.

Emrouznejad, Barros and Wanke (2015) using the integrated Fuzzy Data Envelopment Analysis and bootstrapping, assessed the efficiency of banks in Mozambique. The data used was obtained from KPMG and it covered 13 banks for the period 2011 to 2013. The following inputs and outputs were used: Total cost, employee costs, total deposits, income before tax and total credit, and all were denominated in United States dollars. The findings from the paper showed that fuzziness was predominant over randomness in the interpretation of the results. Additionally, this fuzziness can be used by decision-makers to identify missing variables to help in results interpretation. Results showed that the cost structure played a huge role in efficiency of banks in the country. The high costs were a major factor in the low efficiency scores found in the banks investigated. The authors advised that in order to increase their efficiency, banks in the country should look to downsize their staff and capital leveraging initiatives while simultaneously expanding their operations.

Using the Data envelopment analysis method, Lera and Rao (2016) assessed the efficiency of banks in Ethiopia pre and post the reform period. The pre reform part of the study was the time when the Central bank of Ethiopia was monopoly and the post reform part included all the private owned banks. The study analysed fourteen of the nineteen commercial banks in the country for the period 1990 to 2013. This study used the intermediation approach to define the variables analysed; inputs included loans and advances, interest and non-interest income and the outputs were total deposits, interest expense, fixed assets and interest expense. Results from this study found that during the period investigated, the banks in Ethiopia were moderately efficient with an average of 78.3%. Furthermore, the findings showed that the improvements in the industry technical efficiency post reform were as a result of increased scale of operation but there was weaker managerial efficiency.

Using the Data Envelopment Analysis method, Hacini and Dahou (2016) assessed the Algerian banks post liberalization period. The research investigated the technical efficiency of fifteen banks for the period 2000 to 2012. Using the intermediation approach to define variables, the researchers used two inputs; total deposits and interest expenses, and three outputs; total loans, interest income and non-interest income. The findings from the paper indicated that the banking reforms had helped in the enhancement of banking efficiency. The Algerian banks achieved an average high technical efficiency of 95%. Scale efficiency was captured at 80%. The researchers noted that the entrance of foreign banks increased competition and forced the Algerian banks to increase operations by way of more branches. This led to the banks operating at an unsuitable scale and this was identified to be the major cause of scale inefficiency in the Algerian banking sector.

Tesfay (2016) used the Data Envelopment Analysis and Tobit model to assess the determinants of commercial banks efficiency for selected Ethiopian banks. The study used data for the period 2003 to 2013 to assess efficiency of 8 selected banks and its determinants in the Ethiopian banking industry. The data was obtained from the financial statements of the various banks and was collected from the National Bank of Ethiopia. For the variables, the researcher used capital strength as a proxy of capitalization, expenses as proxy of management capability, deposits as a proxy of market share, profitability as a proxy of earning strength, asset size as proxy of bank size and liquidity and diversification as a proxy of banks diversification strategy. Results showed that the main variables increasing bank efficiency are deposits and liquidity whilst loan quantity, expenses, profitability, bank size and diversification were statistically insignificant. This insignificance means that they are not determinants of banking efficiency. Hence, the recommendation made was that banks should look to collect more deposits through strategies such as convenience of location.

3.4 Summary

From the above discussion, it can be concluded that efficiency in commercial banks has had mixed outcomes in the different countries studied. Some results showed that it was as a result of being efficient prior to the 2008 crisis that cushioned some banks from the effects. Other results have shown that it was the privately owned banks, the bigger banks or those with more capital that were more efficient. For the Namibian context, the previous studies pointed out to the existence of economies of scope and little substitutability in terms of inputs in the industry. With this rigidity comes high costs to the banks as the inputs used in the intermediation process are for a particular

purpose and cannot be easily tuned for another process. The papers showed that profits were high for banks in both Ikhide's (2000 and 2008) studies, showing that bank charges were high so as to cover the high costs incurred on inputs.

CHAPTER FOUR: METHODOLOGY

4.1 Introduction

This chapter provides a discussion on the research methodology used in this study. The chapter is divided into five sections. The sections discuss the analytical framework with regards to data sources, software and procedures, the models adopted and the variables used in the research.

4.2 Software and Procedure

The study used Microsoft Excel for capturing and presenting of the data. The main analysis of the study was done using DEAP 2.1 as the main software to run the efficiency tests.

4.3 Model

There exists a plethora of Data Envelopment Analysis models which are mainly determined by the assumptions that the researcher makes. According to Cooper, Seiford and Tone (2007) the model can be either output or input oriented. For input oriented models, the focus is on the extent that a firm can minimize inputs without there being a change in the quantity of output. As for the output oriented models, the focus is on how firms can maximize their output without making changes or altering their input quantities. Ozcan (2008) points out that there is also the issue of a non-oriented model which basically assumes that managers have control over both outputs and inputs. Thus in the quest to measure bank efficiency, the input oriented

Data Envelopment Analysis model has been seen to be useful. The reason behind this is that banks basically have more control on their inputs as compared to their outputs.

CCR-Model was introduced by Charnes, Cooper and Rhodes (1978). This model measures the efficiency of each DMU which obtained as a maximum of a ratio of total sum of weighted outputs to total sum of weighted inputs. Thus, the efficiency can be defined as:

$$\text{Efficiency of bank } i = \frac{\text{(Weighted sum of Bank } i \text{ outputs)}}{\text{(Weighted sum of Bank } i \text{ inputs)}}$$

(4.1)

The weights for the ratio are determined by the restriction that similar ratios for every DMU have to be less than or equal to unity, thus reducing multiple inputs and outputs to a single virtual output without requiring pre-assigned weights. Therefore, the efficiency score is a function of the weights of the virtual input-output combination. The relative efficiency score of a given DMU_o is obtained by solving the following linear programming model

$$\max h_o(a,b) = \frac{\sum_r^s = 1 a_r y_r}{\sum_i^m = 1 b_r x_i} \quad (4.2)$$

Where:

X_{ij} = The amount of input i utilized by the j^{th} DMU

Y_{rj} = The amount of output utilized by the j^{th} DMU

$b_i =$ The weight given to input i

Thus, the model shown above is run n times so as to identify the efficiency score of all the DMUs. Input weights that maximize the efficiency score are then selected for each of the DMUs.

4.4 Variables

The selection of the sample size, both the quantity of inputs and outputs is usually but not strictly informed by the rule of thumb as proposed by Banker and Morey (1989). In this rule of thumb: $n \geq 3(m + s)$, where: n is the number of DMUs to be included in the sample; m represents the number of inputs; and s represents the number of outputs to be included in the analysis. However, this paper did not adopt this rule of thumb as the commercial banking sector in Namibia is dominated by four big banks that have a combined market share of nearly 90%. Thus the DMUs are only 4 as compared to the 3 inputs and 3 outputs selected. The inputs to be used are; deposits, staff costs and fixed assets. The outputs will be non-interest income and loans, and overdraft.

Table 4.1 outlines the variables to be used as bank inputs and outputs for the proposed study.

Table 4.1 Inputs and Outputs

INPUTS	OUTPUTS
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<ul style="list-style-type: none"> • Deposits • Staff costs(including benefits) • Fixed-assets(property& Equipment) 	<ul style="list-style-type: none"> • Non-interest income • Loans
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4.5 Definition of Variables

Deposits: for uniformity, all the deposits are taken as the amount of money paid into bank account by that institution’s customers and did not take into account those that came from other sources such as other banks.

Staff Costs: the staff or employees of any institution play a vital role in the service delivery industry and thus this was chosen as one of the inputs. They play a major role in how well or efficient the institution functions. Hence, to look at efficiency, the cost incurred on the staff is investigated. Will those with a larger wage bill be more efficient or will smaller staff and more technology see higher efficiency scores? The staff costs figures include benefits offered to employees so as to see how well the workers are taken care off and if it translates to higher efficiency levels.

Fixed Assets: these are assets bought with the view of long term usage and cannot be easily and quickly converted into cash. These fixed assets include land, buildings and equipment. The equipment here includes the Automated Teller Machines (ATMs) which allows customers to access their funds without entering the branches and some ATMs allow for deposits by customers into their accounts. Fixed assets are used as an input variable so as to capture the firm’s property value and whether investment in its infrastructure has a bearing on the efficiency scores of the institutions.

Non-Interest Income: these are incomes that the bank receives from fees including deposit and transaction fees, monthly account service charges, and inactivity fees and so on. This was chosen as an output variable so as to capture the funds raised from non-interest bearing activities of the banks. These funds are raised from the activities of customers as they use the various services being offered by the institutions. Thus figures will enable to measure efficiency by checking how much money banks are making from the services other than deposits. Do those with higher figures entail better efficiency or is it just high bank charges leading to inefficiency.

Loans and advances: these represent assets to the banks as it is the money they lend customers who are obligated to pay back with interest. Loans vary from motor vehicle loans to purchase vehicles, all the way through to mortgage, used to purchase houses. Thus this was chosen as a variable so as to see the volumes of loans being made and how much money the banks are raising. The most ideal situation is having customers honour their obligation to service the loan. This is not always the case and any deviation from customers servicing their debt indicates inefficiency within the system.

4.6 Data Type and Source

This study makes use of annual secondary data for the period 2011 to 2015 collected from the annual reports of the four banks and the Bank of Namibia databases. This period has been selected due to the unavailability of data from some of the banks.

CHAPTER FIVE: RESULTS AND DISCUSSION

5.1 Introduction

This chapter gives the information and interprets the data collected. Furthermore, this chapter provides understanding on the efficiency levels of the four commercial banks as they progressed from the first decade of the new millennium with advances in technology in the banking sector into the first half of the second decade. The chapter is divided into two sections. Section 5.2 contains the descriptive statistics and Section 5.3 contains the results of the Data Envelopment Analysis

5.2 Descriptive Statistics

This section of the paper reports the descriptive and correlation analysis of the variables used in determining banking efficiency in Namibia for the period 2011 to 2015.

Variables	Fixed Assets	Deposits	Loans	Non-interest income	Staff Costs
Mean	263529.7	14033805	13769528	594950.0	401866.5
Median	213933.0	14342297	13547255	575791.0	416091.5

Maximum	849171.0	23951813	23621871	1260061.	644427.0
Minimum	123611.0	4843791.	5476323.	211219.0	154128.0
Std. Dev.	177682.7	5921846.	5105135.	291925.7	147288.8

Table 5.1 Descriptive Statistics

Table 5.1 shows a large variation across the banks as seen by the difference between their maximum and minimum across all the variables under investigation in the time period between 2011 and 2015. Additionally, the dispersion of the variables, as seen through the standard deviation, is seen to be high.

The level of correlation between the inputs and outputs is a key aspect which has great impact on how robust the Data Envelopment Analysis model is. Hence, it was vital that a correlation analysis be carried out first so as to determine the appropriate inputs and outputs. Thus, if very high correlations were detected between input and other input variables or outputs and other outputs, this input/output relationship is seen to be a proxy of other variables. However, if an input (output) variable is found to have very low correlation with all other inputs (outputs) it may show that this variable does not fit in the model. A correlation analysis was carried for each pair of variables and the results are presented below.

Table 5.2 Correlation Coefficients

CORRELATION	ASSETS	DEPOSITS	LOANS	NON_INTEREST	STAFF
ASSETS	1.000000				
DEPOSITS	0.613184	1.000000			

LOANS	0.535599	0.913693	1.000000		
NON_INTEREST	0.827651	0.911539	0.835758	1.000000	
STAFF	0.629113	0.964212	0.924594	0.913586	1.000000

Table 5.2 shows that there is no evidence of high correlation between any single (input) output variable and any n other (input) output variable. Additionally, there is no evidence of very low correlation between any of the input and output with other input/output variables. This validates the DEA model used.

5.3 Data Envelopment Analysis Results

Table 5.3 Data Envelopment Model Output

BANKS	EFFICIENCY SCORES					Mean Bank Efficiency
	2011	2012	2013	2014	2015	
FNB	0.829	0.790	0.83	0.849	0.842	0.828
NEDBANK	1.00	1.00	1.00	1.00	1.00	1.00
BANK WINDHOEK	1.00	1.00	1.00	1.00	1.00	1.00
STANDARD BANK	0.795	0.781	0.657	0.744	0.757	0.747
Mean Annual Efficiency	0.906	0.893	0.872	0.898	0.900	

With reference to table 5.3 results from the Data Envelopment Analysis model show that the mean annual efficiency of the banks was stable and hovered between 89-90%

efficiency over the period 2011 to 2015. Nedbank Namibia Holdings and Bank Windhoek Holdings achieved the highest efficiency score possible with a score of 1.0 which is 100% for the whole period under investigation. First National Bank Namibia Holdings achieved an average efficiency score of 0.828, which is 82.8% for the whole period being investigated. This means that the bank could have reduced inputs by 17.2% without having any effect on output levels. Standard Bank Namibia Ltd achieved an average efficiency of 0.747, which is 74.7% for period under investigation. Like First National Bank Namibia, Standard Bank could have reduced their inputs by 25.3% during the period under investigation with no effect on their output.

First National Bank is the biggest bank in the country by market share and one would associate this with high efficiency but the results do not indicate that. However, the results are consistent with results reported by Isik and Hassan (2002) as well as Staub, da Silva e Souza and Tabak (2010) who found insignificant influence of bank size to efficiency in their respective studies. Furthermore, the findings above share similar conclusions with Ariff and Can (2008) who found a negative and weak relationship between bank size and efficiency for large banks but significantly positive association in the case of medium sized banks. In addition, the findings from this research relate to the findings of Jeremic (2002) who found that in Croatia, banks that recently entered the market were more efficient than those operating for a long time and that smaller banks were more efficient than large ones.

Under Data Envelopment Analysis, efficiency comparisons are made according to the sample given and benchmarks one which it uses as the measure to which the rest

in the set are compared to. In this regard, it is Nedbank and Bank Windhoek that are the benchmarks as they each scored 100% efficiency. The results from table 5.3 show that being the largest bank does not necessarily translate to having efficiency in terms of service provision. These average efficiency scores of 84% and 74% scored by First National Bank and Standard Bank Namibia respectively shows that there remains a huge room for improvements to these banks' operations. Additionally, the 100% efficiency scores achieved by Nedbank and Bank Windhoek do not mean that there is no room for improvement as they are only benchmarks for the group that is being assessed.

The trend with regards to efficiency in the Namibian commercial banking sector showed some decline from 2011 to 2013 as seen by the mean efficiency score moving from 0.906 to 0.872 in that period. Table 5.2 shows the mean efficiency score increased post 2013 to a level of 0.900 in 2015. This shows that the sector as whole saw gradual improvement in the efficiency in the second half of the period of investigation. The sector mean efficiency score of 0.900 for 2015 shows that there does exist room for improvement in the sector. This also shows that the sector as a whole can reduce inputs by 10% without there being an effect on the output. We can therefore reject the null hypothesis that states there is no efficiency in the Namibian commercial banking sector 89.4% is a good level of efficiency.

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter is separated into two parts, conclusion and recommendations. Section 6.2 summarises the findings and makes the concluding statement with regard to the topic at hand. Section 6.3 provides recommendations of possible areas of further study with respect to the study at hand.

6.2 Conclusion

The main contribution from this research is that to the best of the researcher's knowledge, the Data Envelopment Analysis method has been applied on the Namibian banking data for the first time. Results from this would not only benefit the banking sector but also the economy as a whole via the detection of inefficiencies. The study, however, cannot be used to make generalisations of the Namibian banking sector as only 4 banks operating in the economy were assessed. Furthermore, there does lay some possible limitations in the form of there being inaccurate data reported in the various banks financial statements. This inaccuracy might have led to misleading results which could in turn lead to misleading interpretations.

The objective of this research was to assess the level of efficiency of commercial banks in Namibia using the 4 biggest banks by market share as the Decision Making Units (DMUs). The decision to use the Data Envelopment Analysis method was borne out of literature search. The objective set has been achieved. The literature review in the paper was centred mainly on developing countries so as to find what those countries in the same bracket as Namibia found on efficiency in their banking sectors. Results varied based on whether it was input or output orientated, how the inputs-outputs were defined, the number of inputs-outputs and the time periods chosen as some had data from before the global financial crisis and could plot whether banks had recovered in that regard and were operating efficiently. Some studies looked at what were the determinants of banking efficiency for their particular markets. This study strictly looked into the efficiency of the banks for the period between 2011 and 2015. This time period is short due to the unavailability of data for some of the banks. In this paper, the intermediation approach was used to define the inputs and outputs used as banks play an intermediary role in the economy.

The results from the analysis found that in the time period investigated, only 2 of the 4 banks managed to score an efficiency score of 100%. The average commercial banking efficiency score for the entire period stood at 89.4% meaning there was room for improvement within the sector.

6.3 Recommendations

The data results uncovered that the largest bank by market share was not the most efficient and this makes for a curious conversation on what would these scores be if all

the commercial banks in the country where analysed. Furthermore, by only focusing on merely the efficiency scores of the banks, there is room for further study on the determinants of banking efficiency in Namibia as large market share has been seen not to translate to better efficiency. The productivity of the banking sector is another angle that can be viewed in light of the efficiency results. Thus a Malmquist DEA application can be used to probe this and see whether efficiency and productivity align for the Namibian banking sphere.

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