UNIVERSITY OF KWAZULU-NATAL

FINANCIAL SECTOR DEVELOPMENT AND ECONOMIC GROWTH IN RWANDA

BY

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Declaration

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Dedication

To my father Sebuhuzu Mahindukira who, in 1945 dreamed of studying but instead, had to look after my grandfather's cattle. May he find his journey's destination in my achievement.

Acknowledgements

I would like to thank the Seventh Day Adventist Church, through the East and Central Division for sponsoring my PhD studies. This achievement is a product of such sacrifice.

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Sebuhuzu Gisanabagabo

List of Papers and Presentations

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Abbreviations, Acronyms and Explanations

AME **:** Average Marginal Effects

AMIR : Association of Microfinance Institutions in Rwanda

ATM : Automated Teller Machine

BCR : *Banque Commerciale du Rwanda*

BDF : Business Development Fund

BIS : Bank for International Settlements

BK **:** Bank of Kigali

BNR : *Banque Nationale du Rwanda*

BPR : *Banque Populaire du Rwanda*

BRD : *Banque Rwandaise de Developpement*

CEO **:** Chief Executive Officer

CMA : Capital Market Authority

DCP **:** Domestic Credit to Private Sector

DEA **:** Data Envelopment Analysis

DFA : Distribution Free Approach

DTIs **:** Deposit Taking Institutions

EAC **:** East African Community

EDPRS **:** Economic Development and Poverty Reduction Strategy

EDPRS2 **:** Economic Development and Poverty Reduction Strategy, Second Generation

EICV : *Enquête Intégrale sur les Conditions de Vie des ménages*

FDIC : Federal Deposit Insurance Corporation

FED : Federal Reserve Bank of the United States of America

FSC : Financial Stability Committee

GDP **:** Gross Domestic Product

GFCF **:** Gross Fixed Capital Formation

IFC : International Finance Corporation

LDCs **:** Less Developed Countries

Ltd : Limited Company

Km : Kilometre

M & As : Mergers and Acquisitions

MINECOFIN: Ministry of Finance and Economic Planning

MMI : Military Medical Insurance

NBFIs **:** Non-Bank Financial Institutions

NBR **:** National Bank of Rwanda

NCDs : Negotiable Certificate of Deposit

NDIs : Non-Depository Institutions

NPLs **:** Non-Performing Loans

OCC : Office of the Comptroller of the Currency

OECD : Organization for Economic Cooperation and Development

RAMA : *La Rwandaise d'Assurance Maladie*

RBS : Rwanda Bureau of Standards

RSE : Rwanda Stock Exchange

RWF **:** Rwandan Franc

SA : South Africa

SACCOs : Savings and Credit Cooperatives

SARB : South African Reserve Bank

SFA **:** Stochastic Frontier Analysis

SMEs **:** Small and Medium Enterprises

SOEs : State-Owned Enterprises

Sq.km : Square Kilometre

SVAR **:** Structural Vector Auto-Regressive

TFA : Thick Frontier Approach

UB : Unguka Bank

UK : United Kingdom

USA **:** United States of America

US$ **:** United States of America Dollar

VAR **:** Vector Auto-Regressive

WAEM **:** West African Economic Monetary Union

WB : World Bank

Abstract

There is a widespread consensus in the literature that financial sector development plays a significant role in economic growth. Several studies have also shown that economic growth is associated with an efficient banking sector with low ratios of Non-Performing Loans (NPLs). Against this background, the government of Rwanda holds the view that developing the financial sector can lead to the country's economic growth. However, there is no agreement in the literature on whether or not individuals and companies increase borrowing in response to financial sector development. In the case of Rwanda, no study that the researcher is aware of has established the directional influence between borrowing and financial sector development, and its links to economic growth. Similarly, no assessment has been made of the country's financial sector efficiency and the causes of NPLs. Therefore, the main objective of this study is to assess the mechanism that relates financial sector development to economic growth in Rwanda. The study is made of three inter-related papers corresponding to the three specific objectives that together contribute to the achievement of the general objective of understanding how finance relates to economic growth in Rwanda. The first paper sets to investigate the relationship between financial intermediation and economic growth in Rwanda. Using a Cointegrated Structural Vector Autoregressive model on quarterly data for the period 1996:1 to 2010:4, the study finds the existence of a cointegrating relationship between financial intermediation and economic growth. It also observes that domestic credit to private sector shock accounts for the largest proportion of fluctuations in real output growth, followed by potential liquidity available, supporting the supply-leading hypothesis in the intermediation link between financial sector development and economic growth in Rwanda. The second paper aims at assessing the efficiency of commercial banks in Rwanda. Using a stochastic frontier analysis for the period 2007 to 2013, the study finds that the commercial banking sector has a mean cost efficiency score of 88.56 percent, suggesting that in order to enhance their efficiency, banks can reduce their input composition by 11.44 percent. Finally, the third paper investigates the microeconomic factors that influence NPLs in the Rwandan banking sector. Applying a multivariate logistic model, the study finds a negative relationship between repayment period and NPLs, indicating that an extension of the repayment period up to four years can lead to decreases in NPLs. Thus, for Rwanda to attract businesses that can easily make use of current financial services, it should reinforce incentives regarding the legal framework to conduct business. The country should also continue to promote the adoption and use of modern technology as well as sensitizing

financial intermediaries to extend the repayment period. Combined, these measures could boost the financial sector's efficiency, hence stimulating economic growth.

Keywords: Financial Sector Development, Economic growth, Cointegration, Structural VAR, Stochastic Frontier Analysis, Cost Efficiency, Bank, Non-performing, logit, Rwanda.

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CHAPTER ONE

INTRODUCTION

1.1 Background

The interaction between financial sector development and economic growth has attracted considerable attention in the economic growth literature for decades. Many studies have reported the significant role of financial sector development in economic growth (King and Levine, 1993; Levine, 1997; Levine, Loayza and Beck, 2000). For instance, Havránek, Horváth, and Valícková' s (2013) survey of 67 empirical studies on this relationship observes that 48 percent of these studies found that the relationship between financial sector development and economic growth is positive and statistically significant while 33 percent show that it is positive but not significant.

It is argued that financial sector development leads to economic growth by easing investors' funding concerns (Schumpeter, 1934; Benhabib and Spiegel, 2000). Financial sector development can also lead to a reduction in disparities in the prices of loans in line with the implementation of more efficient business practices, improved information conduits, and the use of technology as well as increased competition among financial institutions (Lynch, 1996). In line with this perspective, financial sector development prompted the wave of industrialization in the eighteenth and nineteenth centuries in the United Kingdom (UK) (Adams, J. Andersson, L.-F. Andersson and Lindmark, 2009). The sector provided indispensable resources to the industrialists of that period, hence growing the economies of early industrialized countries (Adams *et al.*, 2009).

However, there is no agreement on whether or not individuals and companies increase borrowing in response to financial sector development. Some studies argue that financial sector development improves the availability of funds through a well-functioning financial system, which leads to an increase in borrowing (Khan and Semlali, 2000; Levine *et al.*, 2000; Almeida and Wolfenzon, 2005; Apergis, Filippidis and Economidou, 2007). Others maintain that investors' decision to borrow is a function of the health of the economy, and is not necessarily due to financial sector development (Gurley and Shaw, 1955; De Gregorio and Guidotti, 1995; Odhiambo, 2008). Secondary views, which are also worthy of

consideration, include the interdependent approach where the response is bidirectional (Arestis and Demetriades, 1997; Odhiambo, 2005) or absent (Demetriades and Law, 2004; Muchai, 2013). However, there has been very little research work carried out to assess the relationship that exist between finance-growth in the Rwandan context as well as the efficient allocation of finance to productive uses while identifying factors that limit non-performing loans. The researcher is not aware of any study that investigated the directional influence in borrowing and its links to economic growth in Rwanda, the efficiency of the country's commercial banks and the factors influencing NPLs. This study aims to fill this gap in the literature.

Rwanda's economy is still recovering from the 1994 genocide, which led to the loss of many lives and the large-scale destruction of social, economic, and physical infrastructure. The economic growth rate reached a low level of -50 percent in 1994 (Ministry of Finance and Economic Planning [MINECOFIN], 2013). However, since then, Rwanda has been putting measures in place to develop the financial sector, with the ultimate objective of achieving sustainable economic growth via private sector development. This private sector is one of the pillars of the Rwandan Economic Development and Poverty Reduction Strategy, second generation (EDPRS 2) that spans from 2013 to 2018. As a result, the Rwandan economy has been growing steadily with some notable developments in the financial sector.

In 2013, the poverty rate in the country was estimated at 44.1 percent, down from 70 percent in 1997 (MINECOFIN, 2013). Per capita Gross Domestic Product (GDP) improved from US$ 233 in 1996 to US$ 632 in 2013, with an average annual growth rate of 7.6 percent (World Bank, 2014). In the financial sector, important improvements have also been observed, as shown by several financial indicators (World Bank, 2014). The domestic savings rate as a percentage of GDP increased from -5.1 percent in 2000 to 10.25 percent in 2013. Domestic credit to the private sector as a ratio of GDP rose from 6.8 percent in 2000 to 12.1 percent in 2010. NPLs dropped from 57 percent in 2002 to 7 percent in 2013; and the ratio of broad money (M2) to GDP remained at an average rate of 16 percent for the period 2000 to 2010.

Like many developing countries, the banking sector dominates the Rwandan financial system. It includes a small microfinance sector, and some Non-Bank Financial Institutions (NBFIs). NBFIs comprise insurance companies, pension funds, and insurance intermediaries. The monetary policy and financial stability statement of February 18, 2016 reported that as at

31 December 2015, the banking sector accounted for about 67 percent of the financial sector's total assets (Banque Nationale du Rwanda [BNR], 2016). The microfinance sector, insurance sector, and pensions funds account respectively contributed 6.6 percent, 9.3 percent, and 17.1 percent (BNR, 2016).

Given the fact that banking institutions represent the largest proportion of about two third of the financial sector' assets and are hence expected to make a substantial contribution in the intermediation between savers and borrowers; this study focuses on these institutions.

In the EDPRS 2, the Government of Rwanda is committed to achieving annual economic growth rate of 11.5 percent, in order to achieve the Vision 2020 objective of making Rwanda a middle-income country, with an average per capita GDP of US$ 1,240 by 2020 (MINECOFIN, 2013). This would require that the poverty rate be reduced by at least 24 percent, and the creation of 1.8 million new off-farm jobs, a 35 percent increase in urbanisation, and a 28 percent increase in export growth with the private sector receiving the dominant share of investment between 2012 and 2020 (MINECOFIN, 2013). An important question is; how does the private sector obtain funding to undertake the desired investments? The literature identifies two channels of private sector access to financial resources, namely, direct finance from capital markets or individual non-bank lenders and indirect finance from financial intermediaries (Casu, Girardone and Molyneux, 2015).

Rwanda's banking sector is relatively less developed and is dominated by commercial banks (BNR, 2014). A large albeit declining proportion of the population (43 percent in 2008 and 28 percent in 2012) has no access to formal banking services (MINECOFIN, 2013). Savings rates are also low and were recorded at 10.25 percent of GDP in 2013, up from -5.1 percent in 2000 (World Bank, 2014). Furthermore, the ratio of domestic credit to the private sector to GDP is very low, estimated at an average of 15 percent for the period 2005 to 2010. In addition, the country has a low per capita GDP, estimated at US$ 488.1 for the same period. This compares unfavorably with many countries categorized as low-income countries that were comparable with Rwanda in the 1960s, but have managed to change their status over time. They include China, Mauritius and Thailand that are now upper middle-income countries, and Hong Kong, and Singapore, which are presently among the high-income countries. In these countries, average savings as a percentage of GDP for the period 2005 to 2010 was estimated at 51.6 percent for China, 30.6 percent for Thailand, 33.5 percent for Hong Kong, 16.8 percent for Mauritius, and 46.6 percent for Singapore (World Bank, 2014).

Their average domestic credit to the private sector as a ratio of GDP is 115.4 percent for China, 128.2 percent for Thailand, 146.0 percent for Hong Kong, 79.5 percent for Mauritius, and 92.0 percent for Singapore. Average per capita GDP is US$ 3,609.4 for China, US$ 4,494.1 for Thailand, US$ 7,745.2 for Mauritius, US$ 36,046.1 for Hong Kong, and US$ 45,508.1 for Singapore. In terms of assets quality Rwanda's average ratio of NPLs to total loans during the same period (2005 to 2010) was estimated at 17.9 percent. This is very high in comparison with Hong Kong (1.0 percent), Singapore (1.8 percent), Mauritius (2.7 percent), China (4.5 percent) and Thailand (6.6 percent).

Since Rwanda considers the private sector to be a driver of its economic growth, the questions that require further investigation are, first whether efforts to develop the financial sector will lead to sustainable economic growth? What is the mechanism that relates financial sector development to economic growth? Does the availability of finance attract investors, or does anticipated future economic growth create demand for financial services? Put differently, what kind of finance-growth relationship exists in the Rwandan context? What are the qualities of the financial sector in terms of efficiency that may lead to its sustainability? Which factors influence most NPLs and can have an impact on economic growth? This study will contribute to the literature by answering these and other questions.

The literature emphasizes that the efficiency of the financial sector is an important condition for its development and its effects on economic growth. For example, a study by Kablan 's (2010) on bank efficiency and financial development in Sub-Saharan Africa (SSA) found that banks which are less developed have problems in translating mobilised deposits into loans to the private sector. In 2003, the whole SSA region displayed an intermediation ratio of 51 percent, compared to 75 percent for Latin America and 91 percent for Asia. Not only was the financial sector in SSA found to be inefficient in transforming deposits into loans, but it also recorded a higher level of cost inefficiency due to NPLs (Kirkpatrick, Murinde and Tefula, 2008). In their study on SSA Anglophone countries, Kirkpatrick *et al*. (2008) concluded that bad loans have contributed to increasing the score of cost inefficiency by 42.8 percent.

Considering the allocation of credit, if the financial sector performs well, the economy enjoys a period of growth due to efficient allocation of credit to productive uses (Schumpeter, 1934; Benhabib and Spiegel, 2000; Freixas and Rochet, 2008). In contrast, if this sector is performing at high inefficiency levels, this suggests that with the available resources, the sector cannot ably provide the required services and make a significant contribution to

growth. Berger and DeYoung's (1997) study on problem loans and cost efficiency in United States (US) commercial banks from 1985 to 1994 reported bi-directional causation. The study, carried out at four-year intervals, found that a one standard deviation increase in NPLs leads to a 1.7 percent increase in predicted cost inefficiency. An increase in NPLs suggests an increase in cost by incurring additional costs in the process of loan recovery such as telephone calls, visiting a borrower with repayment problems and the legal costs associated with collateral foreclosure and execution.

Studies have also shown that a large number of bank failures have been associated with large proportions of NPLs prior to failure (Hughes and Mester, 1993; Berger and DeYoung, 1997). The case of bank instability in Cyprus in 2010-2012 supports the view that financial distress goes hand in hand with increases in NPLs and a slowdown in economic growth. In this three-year period, NPLs grew more than threefold from 5.6 percent to 18.6 percent. Economic growth slowed down from 1.3 percent in 2010 to -2.4 percent in 2012 (World Bank, 2014). The same trends were observed in Greece where NPLs increased from 9.1 percent in 2010 to 23.3 percent in 2012 and economic growth slowed down from -4.9 percent to -7.0 percent in 2010 and 2012, respectively. Thus, a relationship has been established between loans quality and efficiency because at the point of failure, banks have higher ratios of NPLs, and tend to be located far from the best practice efficient frontier (Berger and DeYoung, 1997; Berger and Humphrey, 1997). From the foregoing discussion, it is probable that economic growth has links with an efficient banking sector with low ratios of NPLs.

This study, therefore, comprises three inter-related papers matching to the three specific objectives that support the general objective of understanding how finance influences economic growth in Rwanda. It commences by investigating the directional relationship between finance and economic growth. Once this relationship is established, the next step is to analyze the efficiency of the banking sector. Finally, the study investigates the factors limiting financial sector development; in this case, NPLs. Non-performing loans not only adversely affect the sector's profits, but also limit the financial sector in financing the economy through financial intermediaries' capacity to grant more loans, which indirectly constrains business expansion, thereby constraining economic growth. Accordingly, this study set three specific objectives, namely,

(1) to investigate the directional influence of finance to economic growth in Rwanda;
(2) to analyse the efficiency of commercial banks in Rwanda; and

(3) to identify the factors influencing NPLs in the Rwandan banking sector.

In order to achieve these objectives, the study answers the following questions:

1) What causal relationship exists between finance and economic growth in Rwanda?
2) How efficient is the Rwandan commercial banking sector?
3) What microeconomic factors influence NPLs in the Rwandan banking sector?

The rest of this chapter is organized as follows. Section 1.2 outlines the study's objectives and significance, and the econometric model employed for the empirical analysis for each objective. Section 1.3 presents the structure of the thesis.

1.2 Objectives, Methods and Significance

The main objective of this study is to assess the mechanism that relates financial sector development to economic growth. This is achieved by exploring three specific objectives.

The first objective is to investigate the relationship between finance and economic growth in Rwanda with a special focus on financial intermediation. This is achieved by using quarterly data for the period 1996:1 to 2010:4. A Cointegrated Structural Vector Autoregressive model is employed for this analysis. The main argument is that a good understanding of the directional relationship between finance and economic growth is essential given the Government of Rwanda's belief that financial sector development can propel economic growth in the country by financing the private sector.

The second objective is to assess the efficiency of commercial banks in Rwanda. This is carried out using a stochastic frontier analysis for the period 2007 to 2013. Efficiency evaluation of banks is of interest to many players. Shareholders and potential investors seek assurance of the efficiency of this sector as this implies the potential sustainability of banks' profitability. Managers and directors benefit by understanding the extent to which they can improve their performance to limit wasted resources in order to attain the overall objective of value maximisation. Regulators gain information on the soundness of the banking sector and can formulate policy to correct inefficiencies in regulation or supervision.

The third objective is to identify the factors influencing NPLs in Rwanda. This is achieved using a logistic regression approach. The findings are expected to be useful to financial intermediaries' managers, regulators and policymakers. Individually, any financial

intermediary may work out to find solutions to reduce existing NPLs while preventing the proliferation of new ones. Collectively, financial intermediaries can engage stakeholders such as shareholders, regulators and policymakers to find solutions to the identified causes of problems that require combined efforts. To the best of the researcher's knowledge, no study has focused on these pooled together as in this study. Thus, the study's contribution is threefold. Firstly, it provides a comprehensive analysis of the financial sector and economic growth covering three issues, while other studies have focused only on one aspect. Secondly, the study proposes a solution to some internal shocks to the financial sector related to NPLs that can limit the efficiency of the sector; hence, it could assist in enhancing economic growth. Last, but not least, it uses Rwanda as a case, pioneering research in this area which could serve as a reference for decision makers as well as other researchers.

1.3 Structure of the Thesis

The study sets out to investigate the probable relationship between finance and economic growth in Rwanda placing emphasis on an efficient banking sector with low ratios of NPLs. It is organized into six chapters. Chapter Two surveys the general state of financial sector development, and provides a brief description of the situation in Rwanda. It identifies the forces that have driven changes in the sector as well as expanded opportunities across geographical markets that offer space for competition. In addition, the chapter discusses the rationale for regulation and supervision of the financial sector and the instruments used by the central bank to achieve low inflation and the stability of the financial sector.

Chapter Three answers the first research question by investigating the directional relationship between finance and economic growth in Rwanda. It sets out different hypotheses on the link between financial intermediation and economic growth. It also provides an empirical analysis of this relationship, which is very important for policymakers and investors. The chapter concludes with a short overview of the empirical findings in relation to the study's first objective.

Chapter Four assesses the efficiency of the banking sector in Rwanda to answer the second research question in relation to the study's second objective. The efficiency of the banking sector is regarded as a prerequisite for the sector to positively impact economic growth,

which is then ultimate aim of any economic policy. The chapter closes with concluding remarks and recommendations.

Chapter Five investigates the factors that influence the level of NPLs that in turn affect the efficiency of the financial sector and hence economic growth. This chapter achieves the study's third objective and answers the third research question. The chapter ends with concluding remarks and recommendations.

Finally, chapter six compiles the study's findings based on the theoretical and empirical data collected and analyzed. It also highlights the limitations of the study and areas for further research.

CHAPTER TWO

THE RWANDAN ECONOMY AND FINANCIAL SECTOR DEVELOPMENT

2.1 Introduction

The preceding chapter noted that there is no consensus in the financial intermediation literature on the linkages between finance and growth and the causality relationship between these two variables. While empirical studies have reported mixed results, none has explicitly focused on Rwanda. Since this study aims to analyse how the financial sector development relates to economic growth in Rwanda, it begins with an overview of the Rwandan economy and the development of the financial sector in general, and in Rwanda in particular. This chapter thus examines the components of the financial development and new developments in this financial sector since the 1980s. It also discusses some features used to measure the development of the financial sector and highlights the regulation of this sector to ensure its safety and soundness. Furthermore, since the scope of this study is limited to the financial development in Rwanda where businesses primarily rely on banks in their transactions, much of the focus is on the banking sector.

2.2 An Overview of the Rwandan Economy

2.2.1 Geographical features

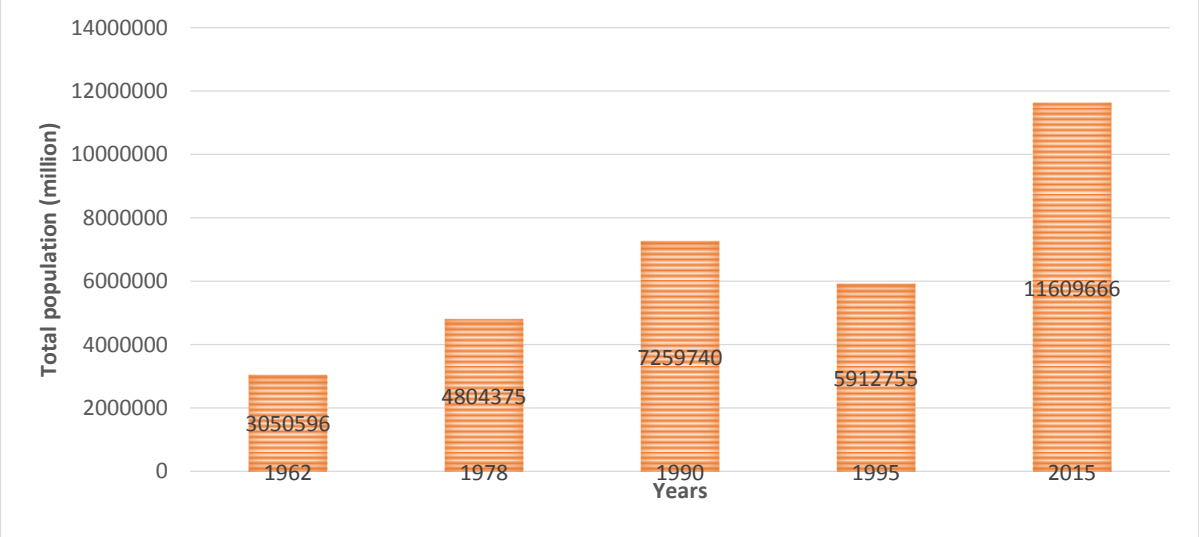
Rwanda is a small landlocked country between Uganda, Burundi, Tanzania, and Democratic Republic of Congo, respectively in the north, south, east and west. The country's capital city, Kigali is 1,740 km from Mombasa and 1,480 km from Dar es-Salaam, the two major ports used for Rwandan exports and imports. These long distances make for high transport costs. For example, Rwandan exporters pay US$ 3,245 to export a container, in comparison to those in Burundi that pay US$ 2,965 while Tanzanian exporters pay only US$ 1,040 (MINECOFIN, 2013).

Rwanda covers an area of 26,338 square kilometers (sq.km). While agriculture is the dominant economic activity, it has only 1.4 million hectares of arable land (MINECOFIN, 2000). The country is marked by irregular, hilly land with an average elevation of 1,500 m above sea level. It lies between 1^0 and 3^0 latitudes South and between 29^0 and 31^0 longitudes East.

2.2.2. Population

Rwanda is the ninetieth most densely population in the world and the second highly densely populated country in Africa with 464 inhabitants per sq.km in 2012. At 636 people per sq.km, Mauritius is the most densely populated country in Africa (World Bank, 2014). Despite the 1990-1994 war and the 1994 genocide that led to the loss of many lives, Rwanda's population increased more than 3.8 times over a period of 54 years (1962-2015) while per capita GDP almost doubled (World Bank, 2016).

Figure 2- 1: Total population of Rwanda for the period 1962 - 2015



Source: World Bank (2016)

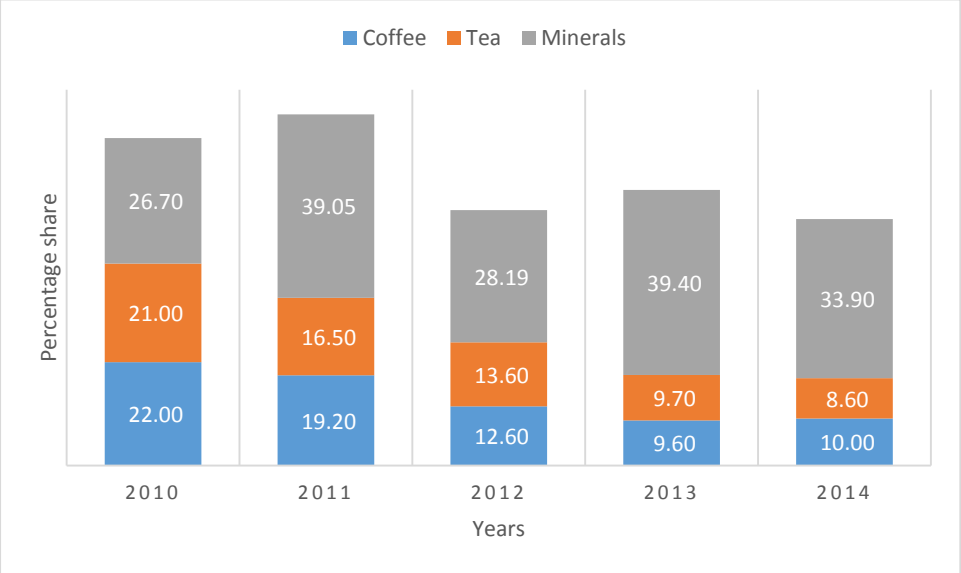
It is estimated that more than a million people were killed in the 1990-1994 war and the genocide of 1994, with many orphaned and widowed. For example, after the genocide of 1994, there were 85,000 child-headed households and 21 percent of households were headed by female widows, and the poverty rate was above 60 percent (MINECOFIN, 2002). A further challenge was maintaining internal security that was threatened between 1997 and

2000 in the Western, Central and Northern provinces of the country by the perpetrators of genocide seeking a return to power (MINECOFIN, 2002).

2.2.3 The Structure of the Rwandan Economy

The Rwandan economy is dominated by agriculture, mainly in the form of subsistence farming. Agriculture accounts for 40 percent of GDP (MINECOFIN, 2013). The industrial sector is still in its infancy and mainly consists of factories that transform imported semi-manufactured products. Coffee, tea, and minerals account for more than 50 percent of total exports (BNR, 2015). Their share of total exports was 69.7 percent in 2010; 74.75 percent in 2011; 54.35 percent in 2012; 58.7 percent in 2013 and 52.5 percent in 2014 respectively. The share of each product is shown in Figure 2-2, below.

Figure 2- 2: Share of coffee, tea and minerals in total exports of Rwanda from 2010 – 2014



Source: BNR (2015)

In addition to the limited number of products for export, a further constraint is that, their prices depend on international market prices that are themselves subject to exogenous fluctuations. For example, the mining sector's share of total exports decreased in 2012 due to a fall of about 25.9 percent in the price of tin on international markets (BNR, 2012). Furthermore, the agricultural sector's dependence on climatic conditions, demographic pressure on arable land and its low value account for the low level of per capita GDP in the

country. Prohibitive transportation costs adversely affect international trade transactions given that Rwanda is a landlocked country.

However, a positive development in the past decade has been the decreasing share of agricultural production to the benefit of the services sector and a substantial improvement in the industrial sector (see table 2-1 for the sector's share of total production from 2005 to 2014).

Table 2- 1: Sectors' contribution to GDP

Sector	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Agriculture (%)	38.4	39.3	35.1	32.7	33.9	32.6	32.3	33.4	33.4	33.1
Industry (%)	11.8	11.6	12.4	12.6	12.3	12.9	14.4	14.4	14.9	14.3
Services (%)	49.8	49.1	52.5	54.7	53.8	54.5	53.3	52.2	51.7	52.6
Per capita GDP constant 2010 US$)	425	453	474	513	530	554	582	618	632	660

Source: World Bank (2016)

Economically, Rwanda is among the poorest countries in the world. Per capita GDP nearly doubled from US$ 335.40 (constant 2010 US$) in 1962 to US$ 689.68 in 2015. In contrast, China's per capita GDP grew more than 49 times in the same period from US$ 130.14 (constant 2010 US$) in 1962 to US$ 6,416.18 in 2015 (World Bank, 2016). China is currently, counted among the lower middle-income countries. Table 2-2 compares GDP growth in Rwanda with selected countries for the period 2005-2014.

Table 2- 2: GDP growth rate of selected countries for the period 2005 – 2014

Country	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Rwanda	**6.91**	**9.23**	**7.61**	**11.16**	**6.26**	**7.31**	**7.85**	**8.78**	**4.68**	**7.00**
Burundi	0.9	5.38	4.78	5.04	3.46	3.78	4.19	4.01	4.59	4.66
Tanzania	8.71	4.66	8.46	5.56	5.38	6.35	7.90	5.14	7.26	6.96
Kenya	5.9	6.47	6.85	0.23	3.3	8.4	6.11	4.55	5.69	5.33
Uganda	6.33	10.78	8.41	8.71	7.25	5.17	9.67	4.41	3.27	4.81
Ghana	5.91	6.39	4.35	9.14	4.84	7.90	14.04	9.29	7.31	3.98
China	10.69	12.06	13.60	9.06	8.69	10.09	8.96	7.22	7.15	6.72
Mexico	3.03	4.94	3.20	1.40	- 4.7	5.11	4.04	4.01	1.34	2.25
Turkey	8.4	6.89	4.66	0.65	- 4.8	9.15	8.77	2.13	4.19	3.03

Source: World Bank (2016)

Table 2-2 shows, that, China is the fastest growing economy in this period. This is largely due to the revival of its private sector from the 1990s (Blanchard and Shleifer, 2001). Rwanda is in second position, and this is attributed to ongoing implementation of the interim

phases of Vision 2020. The poverty rate is reported to have decreased from 60 percent to 58.9 percent in 2000/2001; and 56.7 percent and 44.9 percent, respectively, in 2005/2006 and 2010/2011. The extreme poverty rate dropped from 40 percent in 2000/2001 to 35.8 percent in 2005/2006 and 24.1 percent in 2010/2011 (National Institute of Statistics of Rwanda [NISR], 2012).

2.2.4 Vision 2020 : Rwanda's Long-term Development Strategic Plan

In 2000, the government of Rwanda adopted a long-term strategic development plan called "Vision 2020". The plan serves as a roadmap for the country's economic transformation into a middle-income economy by the year 2020 (MINECOFIN, 2000). It set out phases for poverty reduction and economic development. These include the Poverty Reduction Strategy Paper (PRSP) that covered the period 2002 to 2006, the first Economic Development and Poverty Reduction Strategy (EDPRS 1) spanning 2008 to 2012, and the current ongoing EDPRS2 (2013 to 2018). While complementing one another, each phase has a major focus. The PRSP was prepared in a post conflict environment and its central emphasis was managing a smooth transition from emergency aid to restoring and rebuilding the various sectors of the country. Rural development and agricultural transformation, human development, economic infrastructure, governance, private sector development and institutional capacity building were the six priorities identified for action.

EDPRS 1 aimed to kick start development by accelerating economic growth, creating employment and generating exports. These complementary objectives were set to benefit from public investment in infrastructure, and attractive regulatory reforms in order to reduce the costs and risks of conducting business, hence creating an attractive environment for private sector investment.

On the other hand, EDPRS 2 was designed to address the lack of cross-sector coordination identified in EDPRS 1. It is organized around four thematic areas, reflecting emerging priorities. The areas are economic transformation, rural development, productivity and youth employment and accountable governance. Economic transformation envisages accelerated economic restructuring and growth in order to achieve the status of a middle-income country. Rural development aims to address the major needs of the majority of the population and enhance poverty reduction and rural living conditions.

The theme of productivity and youth employment focuses on ensuring that economic growth and rural development are supported by suitable skills and dynamic employment prospects, specifically for the growing youth population. With reference to accountable governance, the ultimate goal is to ensure that citizens are involved in in-service delivery and decision-making at a highest level in the public and private sectors, and that the population participates fully in decision-making.

Furthermore, the four thematic areas are expanded into 16 strategic sectors at national level, with each sector called upon to identify private sector partners that will commit to investment targeted at identified challenges and aligned priorities. Thus, the second generation EDPRS aims to establish a strong partnership with the private sector in order to increase investment in priority sectors and accelerate economic growth and hence create employment.

2.3 Components and development of the Financial Sector

Previous section presented an overview of the Rwandan economy and some policies aiming at establishing a vibrant partnership with private sector. This section discusses the components and development of the financial sector and highlights its regulation at national level, as well as at the international level**.** According to Fraser, Gup and Kolari (2005), the financial sector is an infrastructure framework for the transfer of funds from units in surplus (savers) to units that are in need (borrowers), mainly for investment purposes. Lynch (1996) states that financial sector development involves collecting savers' deposits at the lowest cost possible and transferring them to banks' loan applicants, with a reasonably low probability of default. For Rajan and Zingales (2003), financial sector development is a facility that provides funds to a borrower with a sound project. It also concerns investors' degree of confidence in reaping acceptable returns from their investment in this sector. Put differently, financial sector development refers to easing the borrowing-lending process and the soundness of the sector vis-à-vis its stakeholders. Development of the sector facilitates the entrance of new firms, hence increasing competition. It is argued that the more countries develop economically, the more they rely on financial markets relative to banks (Rajan and Zingales, 2003).

The institutions involved in this easing of access to funds include deposit taking financial institutions (DTIs); non-depository financial institutions (NDIs) also popularly known as non-

banking financial institutions (NBFIs); and financial markets (Cecchetti, Schoenholtz et Fackler, 2011). However, government regulatory agencies and central banks are required to ensure that these institutions operate smoothly. The financial sector thus comprises of DTIs, NDIs, financial markets, and government regulatory agencies.

Prior to 1994, there were two types of financial institutions in Rwanda: banking financial institutions and non-bank financial institutions (Coldmark, 1987). In common with other economic sectors, today, the Rwandan financial sector is being reconstituted in the wake of the devastating genocide of 1994. Alongside the young and growing capital market established in 2008, and the Central Bank, the National Bank of Rwanda, the Rwandan financial sector comprises the banking sector that dominates this sector, a small microfinance sector and a number of NBFIs. NBFIs comprise insurance companies, pension funds, and insurance intermediaries. The Monetary Policy and Financial Statement of 18 February 2016 indicates that as at 31 December 2015, the banking sector in the country comprised of 12 commercial banks, three microfinance banks, one development bank and cooperative bank, respectively (BNR, 2014). The banking sector held 67 percent of total assets in the financial sector, while pension funds and insurance companies had 17.1 percent and 9.3 percent, respectively. Even though the microfinance sector has many institutions, it has the smallest proportion of the financial sector's assets, estimated at 6.6 percent. NBFIs consist of 14 insurances companies, with 12 private and two public institutions. In terms of pension management companies, there is only one public social security fund in Rwanda managed by the Rwanda Social Security Board (RSSB), and 57 private pension schemes under the management of insurance companies. Insurance intermediaries comprise of 15 insurance brokers, 365 insurance agents, and 12 lost adjusters.

2.3.1 Deposit Taking Financial Institutions

2.3.1.1 Banking Sector

The term bank is derived from both a Greek word *trapeze* and from the Italian word *banco* meaning money changing (Freixas and Rochet, 2008). Historically, the first activity of banks was money changing. *Trapeza* designates the balance used by moneychangers to weigh coins with the objective of determining the exact quantity of precious metal the coins contained. In ancient Greece, banks performed this task. The Italian word *banco* denotes the bench on

which moneychangers placed their precious coins. However, over time, coins became heavy and difficult to handle in large transactions. This led to the use of paper money that first appeared in England in the seventeenth century. The owner of gold (silver) deposited it for safekeeping with the goldsmiths of the time, thereby reducing the risk of loss or robbery. In exchange, they received certificates of deposit that were transferrable to other people to pay for goods and services. The certificate of deposit covered the full value of the metal it represented. Initially, these deposits had a negative return because they were kept in vaults against the payment of fees, instead of investing them in productive activities. The next step was the replacement of paper money fully backed by a commodity such as gold, by notes, and later only partially covered by a commodity. The gold standard that applied in most countries up until the 1930s functioned under partial coverage of gold.

In contrast, the modern banknote has no relationship with any commodity. Its value is solely based on confidence in the government or monetary authority's ability to control the supply of notes in such a way that their purchasing power will not fall substantially. Such confidence is based on the fact, that, the law declares the notes and coins issued by the central bank as legal tender. In terms of the means of payment, cheque accounts were introduced later followed by credit and debit cards and various forms of electronic payment due to technological innovation in the financial sector.

While the term bank historically referred to a commercial bank, in the current context, it displays the behavior of all other deposit-taking institutions. This research study adopts Cecchetti *et al.*'s (2011) conception of a bank , which states that in the daily financial world the word *bank* describes what people call a financial intermediary that takes deposits and grants loans in the course of day-to-day business.

In terms of their function of safekeeping, over time banks embarked on lending activities, and other complex operations. Because the withdrawal of gold (silver) deposited for safekeeping purposes with the goldsmiths left some quantity of gold in the vaults at the end of the day, the goldsmiths devised alternative ways of conducting business with it while continuing to receive new deposits. They started lending gold (silver) for set fees. This is the origin of lending in the banking sector (Mohr and Fourie, 2004; Cecchetti *et al.*, 2011). Later, goldsmiths used gold from savers/depositors and channeled them to borrowers that were short of gold.

Today, people deposit precious assets for safekeeping with banks. However, modern banks offer services beyond safekeeping and access to payments systems. They now engage in more complex operations that take advantage of their economies of scale. The modern banking era is also known as the *universal banking* model. From the 1990s, especially in the US and other developed countries, banking activities expanded to all aspects of financial service activities, namely, securities operations, insurance, pensions, leasing and so on (Casu *et al.*, 2015). Table 2-3 below summarizes the key differences between traditional and modern banking.

Table 2- 3: Differences between traditional and modern banking

Traditional banking	Modern banking
Products and services: Limited • Deposits • Loans	Product and services: Universal • Deposits • Loans • Insurance • Securities/investment banking • Pensions • Other financial services
Income sources: Net interest income	Income sources: • Net interest income • Fee and commission income
Competitive environment: Restricted	Competitive environment: High competition
Strategic Focus: Assets size and growth	Strategic focus: • Returns to shareholders • Creating shareholder value • (generating return-on-equity, ROE, greater than the cost of capital)
Customer focus: Supply led	Customer focus: • Demand led • Creating value for customers

Source: Casu *et al.* (2015)

As noted above, traditionally banks offered consumers limited financial services. The major transactions were collecting deposits and granting loans. Income was generated from interest charged. Banks' operations were highly regulated and competition was somewhat restricted. However, the large banks that emerged offer services ranging from personal banking services to corporate banking that targets large companies. Personal banking services include current accounts with cheques facilities, credit transfers, standing orders, direct debits and plastic cards, savings, loans, mortgages, insurance, pensions and other services. Large banks target large companies and sometimes offer syndicated loans where two or more banks finance a large project that might pose too much risk to a single bank (Casu *et al.*, 2015). In such an

arrangement, the borrower is able to borrow more funds and more favorable credit terms than would be offered by many small lenders (Fraser *et al.*, 2005). From the lender's perspective, a syndicated loan can pool savings across national boundaries, hence diversifying risk and facilitating their ability to collect information on potential borrowers (Cecchetti *et al.*, 2011).

Particular types of banks in some countries include private banking, Islamic banking, and investment banking. Private banking provides services to wealthy clients, mainly individuals and their families. They focus on adapting their services to individual clients' requirements, while maintaining personal contact and long-term relationships.

Islamic banking is based on *Shariah* law that prohibits the payment of *riba* or interest while encouraging entrepreneurial activity. These banks do not charge interest but offer various profit-sharing products where depositors share the risk of the bank's lending and the return (Casu *et al.*, 2015). Depositors earn a return (instead of interest) and borrowers repay loans based on the profits generated from the project undertaken.

An investment bank is a financial institution that assists in the initial sale of securities in the primary market. It is a channel through which firms raise funds in the capital market (Cecchetti *et al.*, 2011). It does so by underwriting securities. For instance, it guarantees a price for a corporation's securities and, in turn, sells them to investors at a relatively higher price (Mishkin, 2007). The investment bank profits from the difference between the purchase price that it guarantees to the issuing corporate and the selling price of the securities on the financial market. Investment bankers also bring together investors and government that need funds and investors with surplus funds. They also offer advice on mergers and acquisitions (M&As), guaranteeing a price that the new equity or bond issue will sell for, and trading and investing in securities on behalf of different clients.

In terms of banking activities**,** banks offer customers a range of financial services, including payments, deposits and lending, investments, pension and insurance services, E-banking, financial advisory services, safekeeping facilities and foreign exchange services (Casu *et al.*, 2015). Payments services include paper-based systems using banknotes or cheques or electronic debit or credit cards. On the deposits side, banks provide their customers with cheque or current accounts that are in some instances, not interest earning while in others, they attract very low interest rates. They also offer saving and time deposit accounts that generate interest, based on the amount and time period. Turning to lending services, banks

grant loans to their customers ranging from consumer loans to investment loans for the production of goods or services.

Modern banks also engage in activities such as investment in securities, and insurance and pensions services that were initially offered by non-deposit financial institutions (Casu *et al.*, 2015). Likewise, in countries like the US, non-deposit financial institutions perform some activities that used to be exclusive to banks (MacDonald and Koch, 2006). It is argued that this is the result of advanced technology that allows banks to handle complex operations including electronic banking services through internet banking and Automated Teller Machines (ATMs). These developments have enabled banks to lower the cost of financial transactions by having customers interact with an electronic banking facility without face-to-face interaction with the banks' employees. Similarly, the availability of a 24-hour service helps to reduce queues in the banks' branches tellers and is more convenient for customers. Technological innovation has contributed to the expansion of banking activities because customers want cheap or free access to their money (MacDonald and Koch, 2006).

The main source of funding for banks is customers' deposits while their major income is interest income, which is mainly composed of interest paid by borrowers on loans. On the financing side, banks can also raise funds by issuing bonds and equity (shares) or commercial paper. They can also borrow from other financial institutions including fellow banks or as a last resort from the Central Bank, or use retained earnings from previous profits that were not distributed. Modern banks have also expanded their off-balance sheet activities for which they earn fees and commission, which make up non-interest income. Off-balance sheet activities such as credit lines, guarantees, letters of credit, standby letters of credit, and commercial letters of credit do not have any impact on balance sheet reporting but they may represent an important source of the bank's profits (MacDonald and Koch, 2006; Cecchetti *et al.*, 2011). In many countries, the Central bank regulates and supervises financial institutions and does not establish accounting and auditing procedures. These procedures are put in place by the industry itself, and financial institutions are required to adhere to internationally accepted standards of accounting and auditing in presenting their balance sheets and statement on profit/loss to facilitate monitoring and supervision (Mehran, 1998).

Bringing together the two important components of a bank's balance sheet (assets and liabilities) the bank produces a report reflecting its financial position in a report titled, "Statement of Financial position on 31/12/*Year t"* in line with the International Financial

Reporting Standards (IFRS). Table 2-4 provides a prototype Statement of the financial position of a bank following the KPMG (KPMG, 2013).

Table 2- 4: Consolidated Statement of Financial Position of the bank: bank name

	For the year ended 31 December	
In millions of (i.e. euro)	**Year t**	**Year t-1**
Assets		
Cash and cash equivalent		
Pledged trading assets		
Non-pledged trading assets		
Derivative assets held for risk management		
Loans and advances to banks		
Loans and advances to customers		
Investment securities		
Current tax assets		
Property Plant Equipment		
Intangible assets		
Deferred tax assets		
Others assets		
Total Assets		
Liabilities		
Trading liabilities		
Derivative liabilities held for risk management		
Deposits from banks		
Deposits from customers		
Debt securities issued		
Subordinated liabilities		
Provisions		
Deferred Tax liabilities		
Other liabilities		
Total Liabilities		
Equity		
Share capital		
Share premium		
Reserves		
Retained earnings		
Total equity attributable to equity holders of the bank		
Non-controlling interests		
Total Equity		
Total Liabilities and Equity		

Year $_t$: is the current year
Year $_{t-1}$: is the previous year

The balance sheet goes hand in hand with the statement of profit or loss (see Appendix 1) that provides a summary in the IFRS standards format (KPMG, 2013). More details concerning

the main components of banking income and expenses are provided in Chapter four, Subsection 4.3.3.

In Rwanda, banking financial institutions include commercial banks and specialized banks such as development banks, microfinance banks and cooperative banks (BNR, 2013). From 1963 to 1975, the Rwandan banking sector consisted of two commercial banks, the *Banque Commerciale du Rwanda* (the current I & M Bank) established in 1963 and the *Banque de Kigali* (Bank of Kigali) established in 1966. From 1975, a few financial institutions that work like cooperatives, the "*banque populaires*" were established; the first Banque Populaire was inaugurated at NKAMBA in 1975.

In 1983, the first private bank, the *Banque Continentale Africaine au Rwanda (BACAR),* thecurrent GT-Bank was registered. In 1986, all existing Banques Populaires were grouped into a federation called "*Union des Banques Populaires du Rwanda* (UBPR). In 2008, the UBPR became a commercial bank, the *Banque Populaire du Rwanda* (BPR). It signed a partnership with Rabobank in The Netherlands that bought 35 percent of BPR's shares (BNR, 2008).

Apart from these institutions, there was a type of national savings and loan institution called *Caisse d'Epargne du Rwanda* (that later went bankrupt) and other NFBIs. Non-bank financial institutions included the *Banque Rwandaise de Development* (BRD) established in 1967 and the *Caisse Hypothecaire du Rwanda* (CHR) established in 1975. These two financial institutions were owned by the government, and at their inception were not regulated by the Central Bank (Coldmark, 1987). The BRD provided loans for development purposes targeting larger agricultural and industrial projects in rural areas. The CHR was a mortgage bank. In 2004, the Central Bank provisionally granted CHR a license to operate as a housing bank "*Banque de l'Habitat du Rwanda, BHR*". In 2005, its shareholders decided to change that name to the "Housing Bank of Rwanda". However, the new structure did not last long and it was acquired by BRD in 2011 (BNR, 2012).

From 1995, the government of Rwanda launched reforms aimed at promoting a sound financial sector. Regulatory reforms included strengthening the powers of the Central Bank to regulate and supervise the sector. The second pillar of reforms involved liberalizing interest rates and the banking sector itself as well as the introduction of new financial instruments. From 1995-2000, three more privates banks emerged, the *Banque de Commerce, de Development and d'Industrie* (BCDI) established in 1995 which is the ECOBANK, the

Banque a la Confiance d'Or (BANCOR), the ACCESS BANK set up in 1995, and *Compagnie Generale des Banques* (COGEBANQUE) established in 1999.

Following the internationalization of banking in the 1990s, foreign banks started to penetrate the Rwandan financial sector from 2004. In 2004, FINA BANK, a Kenyan commercial bank acquired BACAR, which was acquired by Guaranty Trust Bank, a Nigerian financial services conglomerate in 2013 to form Guaranty Trust Bank (Rwanda) Ltd or GT-Bank Rwanda Ltd. During the same period, a takeover occurred at the *Banque Commerciale du Rwanda* (BCR) owned solely by the government of Rwanda. In 2004, Actis Capital, a private equity investment firm in the UK bought 80 percent of BCR's shares. In 2012, Actis Capital sold its shares to a consortium consisting of Kenya's I & M Bank Group, PROPARCO from France and a German investment corporation. The current brand name of the bank is I & M Bank Rwanda Ltd. Similarly, in 2007, a Pan African banking conglomerate, ECOBANK, headquartered in Lome (Togo) acquired BCDI and BANCOR was taken over by ACCESS BANK, a Nigerian multinational commercial bank owned by the Access Bank Group that acquired 75 percent of its shares (BNR, 2008).

In 2009, 2011, and 2013, the National Bank of Rwanda licensed three regional banks to operate in Rwanda, the Kenya Commercial Bank (KCB) and Equity Bank (both from Kenya) and Crane Bank Ltd from Uganda. Recently in October 2015, the Central Bank granted a license to the Bank of Africa Rwanda Ltd to operate in the country. That newly licensed bank immediately acquired AGASEKE Microfinance Bank, purchasing 90 percent of its shares. AGASEKE Microfinance Bank Ltd was an upgrade of Agaseke IMF S.A in 2011 along with Unguka IMF S.A that also upgraded to become a microfinance bank. In the same year, ZIGAMA CSS, a financial cooperative exclusively for the national army and police, also upgraded to become a cooperative bank.

Following regulation no 03/2008 on the licensing conditions of banks that appeared in the Official Gazette No 51 of 20/12/2010 (BNR, 2010), minimum capital is required for each category of bank. The minimum capital required for a commercial bank is five billion Rwandan Francs (Rwf 5,000,000,000, about US$ 6,250,000). For a development bank, the minimum capital required is three billion Rwandan Francs (Rwf 3,000,000,000, around US$ 3,750,000), and for a microfinance bank the minimum capital required is one billion five hundred thousand million Rwandan francs (Rwf 1,500,000,000 or about US$ 1,785,000).

2.3.1.2 Microfinance Sector

Microfinance institutions are a growing segment of the financial sector. The concept of microfinance can be traced back to the creation of Grameen Bank in Bangladesh by Muhammed Yunus in the 1980s with the objective of serving poor people who were classically unbanked (Ledgerwood and White, 2006). Thus, the microfinance industry is a set of financial institutions that provide a range of financial products and services to people excluded from the formal classical banking system.

However, today, many microfinance institutions have extended their services to other clients while retaining their original customer base. In some cases, they have upgraded to microfinance banks, which are financial intermediaries that offer microfinance services as well as commercial bank products and services. While microfinance institutions are historically associated with microcredit, today they offer a variety of financial products and services, including consumer loans, savings accounts, time deposits, micro insurance and international money transfers.

The microfinance industry in Rwanda comprises of 493 institutions of which 13 are limited companies and 480 are savings and credit cooperatives (SACCOs). Sixty-four of these are non-UMURENGE SACCOs and 416 are UMURENGE SACCOs. SACCOs are financial institutions that offer deposit and lending facilities, mainly to their members. The establishment of 416 UMURENGE SACCOs in 2009 extended financial services to many that were formerly excluded from the sector (BNR, 2014).

Microfinance institutions and banks not only differ in terms of licensing conditions, but target a different market. Regulation no. 02/2009 of 27/05/2009 on the Organization of Microfinance Activity (BNR, 2009) states, that an institution that seeks a license as a microfinance company, requires minimum capital of three hundred thousand million Rwandan francs (Rwf 300,000,000 or US$ 375,000). In terms of customers, banks serve customers with medium to high-level transactions including individuals, corporate or other non-government organisations, and government institutions, as well as embassies. Technological advancement and the internationalization of business have rendered their operations even more complex. Microfinance institutions are involved in far more diversified operations than their initial target of providing microcredit.

2.3.2 Non-Bank Financial Institutions

Non-Bank Financial Institutions comprise of insurance companies, pension funds, investment funds, mutual funds, finance companies, stockbrokers and dealers (Mishkin, 2007; Cecchetti *et al.*, 2011). As highlighted earlier, in Rwanda, NBFIs include only one public pension institution and insurance companies (with insurance intermediaries such as insurance brokers and agents, and lost adjusters)**.** A summary description of each is given below.

2.3.2.1 Insurance Companies

Insurance is a product that transfers risk from an individual or firm to an insurance company through prepayment of a premium in exchange for insurance policies payable when a contingency event such as death, illness, or an accident occurs (Madura, 2014). It thus manages risk for individuals and companies. Insurance companies help to stabilize business because individuals and firms no longer have to focus on ensuring the availability of contingency reserves. Instead, they concentrate on their core activities that yield returns (Oke, 2012). There are two groups of insurance companies: *life insurance* and *nonlife insurance* consisting of property and casualty insurance, health insurance, automobile insurance, and in some countries reinsurance (Fraser *et al.*, 2005; Cecchetti *et al.*, 2011).

Life insurance is a policy that pays a benefit if the insured person dies while the contract is in force. Thus, life insurance companies insure people against financial hazards following a death (Mishkin, 2007). In the banking sector, this type of insurance is called *credit life insurance*. It helps all the parties involved in the contract if the borrower dies. The bank recovers the outstanding amount from the insurance company while the borrower's family is no longer held responsible by the bank for the outstanding amount of the loan. *Nonlife insurance* such as *property insurance* provides financial protection against loss or damage to the insured's property due to fire, theft, or another type of accident described in the policy governing the contract. Insurance companies intervene in case of the occurrence of a disaster. They play an important role in the lending-borrowing contract because, when such unforeseen events occur, the insurance company steps in by indemnifying the property damaged or lost. To reduce their exposure to risk, insurance companies opt for reassurance with other insurance companies that are financially stronger and have experience in the sector (Madura, 2014).

In addition, it is worth noting that insurance companies not only offer cover for risk and indemnification, but are also investors that invest the funds they collect in premium with banks or on capital markets (Njegomir and Stojić, 2010). Adams, Andersson *et al.*'s (2009) study on the linkages between commercial banking, insurance and economic growth in Sweden between 1830 and 1998 found that there was a linkage between banking and insurance to foster economic growth. Insurance influenced both bank lending and economic growth. Generally, insurance companies offer supportive, complementary infrastructure to the banking sector due to their commitment to cover unforeseen losses due to fire or theft in relation to assets pledged as collateral for loans, or the death of a borrower.

Rwanda initially had two insurance companies, namely, *Societé Nationale d'Assurance du Rwanda* (SONORWA) that commenced operations in 1975 and *Societé Rwandaise d'Assurances* (SORAS) that was established in 1984. The private insurance sector has been growing since the year 2000, with the creation of new companies offering diverse products and services that did not previously exist. Alongside the twelve private insurance companies of which ten were established after 2000, three public medical insurance firms were created, namely, the Military Medical Insurance (MMI), *La Rwandaise d'Assurance Maladie* (RAMA) and the Community Based Health Insurance (CBHI) known as "*Mutuelle de Santé*" (BNR, 2016). RAMA and the CBHI are currently managed by the Rwandan Social Security Board (RSSB). RAMA and MMI dominate the insurance sector, accounting for more than 60 percent of total assets.

2.3.2.2 Pension Sector

State and private pension funds' income accrues from regular contributions from employees and employers that subscribe to the pension plan (Madura, 2014). Employers can deduct employees' contributions from their salaries or employees can pay them. Pension funds invest their income in long-term securities until they are withdrawn upon retirement by the employees. In the US, pension funds are vibrant investors in financial markets (Pilbeam, 2010). Demand for pension products has expanded with higher life expectancy and economic prosperity. Furthermore, in countries such as the UK, pension fund products are free from income and capital gain taxes.

In Rwanda, the pension sector is the largest component of the financial sector after the banking sector. As at 31 December 2015, it held 17.1 percent of the financial sector's total assets (BNR, 2016). It is composed of only one public social security fund, the Rwandan Social Security Board, the former *Caisse Sociale du Rwanda* established in 1962.

2.3.3 Credit Information System in Rwanda

In order to gather quality credit information, in 2011, the private Credit Reference Bureau (CRB Africa) replaced the reference bureau managed by BNR. It aims to reduce moral hazard and adverse credit guarantees. All financial institutions, banks, MFIs, and NBFIs are obliged to report to the CRB (BNR, 2015). However, some companies such as MTN and TIGO as well as the two public utility companies supplying energy (Rwanda Energy Group Ltd) and water (Water and Sanitation Corporation Ltd), and the former Energy and Water Sanitation Agency (EWSA) have voluntary integrated the credit information system. The CRB only provides information on NPLs borrowers' outstanding loans, which is an important contribution in assessing new loan applicants. However, there is a need for an independent company or body to assess customers' rating when lending institutions evaluate loan applications.

2.3.4 Financial Markets

A financial market is a platform on which investors purchase or sell assets like stocks and bonds. Participants include households and businesses as well as financial institutions and government that can sell or purchase financial assets. The financial market comprises two groups. The first is those that facilitate the trading of short-term funds with a maturity of one year or less, the "money market." The second group is those that accommodate the flow of long-term funds, also called "capital markets". The market with newly issued securities is the "primary market" whereas the "secondary market" facilitates the purchase and sale (trading) of existing securities (Madura, 2014). Financial markets can be a source of long-term funds and become more important in comparison to banks as the financial system develops (Lynch, 1996). Advanced countries rely more heavily on financial markets relative to the bank

lending principle. These countries have witnessed extensive development of equity and bonds markets as sources of nonbank finance.

For the purpose of hedging or speculation, investors make use of derivative securities traded in financial markets. Derivative securities derive from the values of underlying assets such as debt or equity securities. However, in order to function efficiently, derivatives require stable and efficient markets in their underlying assets and increase significantly as the primary markets develop to meeting the expected criteria (Lynch, 1996).

The Rwanda Stock Exchange (RSE) was established in 2008 under the coordination of the Capital Market Advisory Council (CMAC) that was replaced by the Capital Market Authority (CMA). It reports to MINECOFIN. Only seven companies trade their equities at the RSE. Some are only registered on the RSE; these companies include BRALIRWA Ltd, Bank of Kigali Ltd, Kenya Commercial Bank Ltd, and Crystal Telecom Ltd. Others such as the Nation Media Group Ltd, Ucumi Supermarket Ltd, and Equity Group Holding Ltd are primarily registered on Nairobi Stock Exchange and also on the RSE. Equity Group Holding Ltd and Crystal Telecom Ltd registered on the RSE in February 2015 and May 2015, respectively (BNR, 2016). The capital market in Rwanda still underdeveloped in terms of both registered companies and the volume of shares traded. For example in 2010, the outstanding amount of shares traded as a percentage of GDP was 0.03 percent, which is far lower than in EAC members countries at 0.26 percent for Tanzania, 0.29 percent for Uganda, and 2.4 percent for Kenya (MINECOFIN, 2013) .

With the objective of promoting the Rwandan capital market by making more marketable financial instruments available, since 2014, BNR and MINECOFIN have decided to issue Government Treasury Bonds on quarterly basis. This strategy aims to offer more savings opportunities to firms and households. The benchmark Bond is for three, five, seven, and 10 years. In addition, developments in the capital market have resulted in transactions in debt securities. The International Finance Corporation (IFC)'s Pan African Bond issued the UMUGANDA Bond worth $US 22 million over a five-year period. This bond has increased international investors' confidence in the Rwandan capital market and is an additional investment opportunity for domestic investors.

2.3.5 Regulation and Supervision of the financial sector

Any analysis of the financial sector would be incomplete if it ignored the regulatory framework in which financial institutions operate (Pilbeam, 2010). The main objective of financial sector regulation or banking regulation is creating a safe financial sector in general and banking industry in particular. Not only are regulation and supervision of financial institutions relevant to the operations of such institutions, but they facilitate adaption to the changing environment in relation to new financial instruments, technological advances and occasionally financial crises. In addition, regulation and supervision convey the confidence and stability of the financial sector to the public. This sub-section discusses the Central Bank's rationale for regulation and supervision of the financial sector to control the circulation of money and ensure the stability of the sector.

2.3.5.1 Justification for regulation and supervision of the financial sector

The nature of business in the financial sector in general, and specifically in the banking sector calls for regulation (Matthews and Thompson, 2008). The oligopolistic or monopoly structure of the banking sector could be used to exploit customers who are powerless in such a market structure. Individual consumers or customers are unable to significantly influence banks' behavior due to limited information about how they operate. In turn, banks use their informational advantage to exploit clients in the pricing of financial products and services, and in ensuring that loan contracts protect them, sometimes at the cost of borrowers. Therefore, consumers need protection against the potential unilateral influence of banks. A lack of regulation can also be damaging for banks themselves as bank panics could destroy the sector (Heffernan, 2005; Matthews and Thompson, 2008).

As a case in point, due to its decentralized regulation, until 1934, the US recorded recurrent bank runs, bank panics, and bank failures (Freixas and Rochet, 2008). Similar phenomena affected England as well as other European countries before the establishment of a Central Bank that acts as Lender of Last Resort. Without regulation, bank runs and bank panics are integral to the nature of the banking system. Bank runs are a phenomenon where depositors make large panic withdrawals from their bank fearing its bankruptcy; if excessive, they generate a liquidity shortage increasing the probability of the bank's failure. Once there is a run on an individual bank, the fear spreads to the banking industry by contagion and the

sector as a whole experiences a bank panic that can generate a financial crisis. To prevent such contagion, the Central Bank steps in by lending liquidity to the bank experiencing the problem, stabilizing the banking industry, and indirectly the economy.

However, in order to reduce the risk of large-scale failures that can affect the level of economic activity in a country, the regulator has to pay more attention to banks (Fraser *et al.*, 2005). Through regulatory institutions, the government sets specific rules that bank managers have to follow. At the same time, the regulator has general oversight using onsite and offsite inspections of financial intermediaries in order to ensure that the managers of these institutions comply fully with regulations in relation to the safety and the soundness of the banking sector. Therefore, prudential regulations are essential to banks, insurance companies, and other financial intermediaries. They aim to protect depositors from the risk of the failure of the financial institutions where they keep their assets. Specifically, they target banks because their failures generate severe negative externalities for their customers (depositors) and shareholders. The negative consequences spread at extraordinary speed to the sector and to the economy as a whole.

In many countries, the Central Bank regulates and supervises the financial sector. It sets monetary policy and rules that financial institutions have to abide by in order to promote financial stability (Pilbeam, 2010). However, in countries like the US, UK, Japan, and South Africa, other bodies also oversee the functioning of the financial sector. In the US for example, three separate and important federal agencies, alongside each state's banking department, perform this function (MacDonald and Koch, 2006). These are the Federal Reserve Bank (FED), the Office of the Comptroller of the Currency (OCC) and the Federal Deposit Insurance Corporation (FDIC). The FED, which is in charge of monetary policy, regulates and supervises banks and financial institutions in order to safeguard the safety and reliability of the financial sector while protecting consumers' rights, and overseeing the payments system in the country. The OCC is an independent bureau within the US Department of Treasury that charters, regulates, and supervises national banks and thrift institutions as well as the federal branches and agencies of foreign banks operating in the country. Insured state banks that choose not to be members of the Federal System are under the FDIC's regulation and supervision. Although the responsibilities of different regulatory agencies may overlap, they generally coordinate policies and decisions. The FDIC insures customer deposits up to $U.S.100,000 per account in both commercial banks and savings institutions (MacDonald and Koch, 2006).

Since 1997, supervision and all aspects of financial regulation in the UK have been vested in a single state regulator, the Financial Services Authority (FSA) (Heffernan, 2005). The Central Bank, the Bank of England that sets monetary policy, is still in charge of safeguarding financial sector stability as a lender of last resort. Similarly, in 2001, the Japanese Government established the Japanese Financial Services Authority (JFSA) with a mandate to formulate policies and regulate the financial sector. In South Africa, three bodies regulate the financial sector: the South African Reserve Bank (SARB) created in 1921, the Financial Services Board (FSB), established in 1993, and the National Credit Regulator (NCR), created in 2005 (Zyl, Botha and Skerritt, 2003; The Presidency of Republic of South Africa, Act No 34 of 2005). The SARB has performed all the responsibilities of a Central Bank since 1987. Previously, the Department of Finance (National Treasury) performed such functions. The FSB regulates and supervises non-banking financial institutions. These NBFIs include capital markets, collective investment schemes, financial services providers, insurers, re-insurers, and retirement funds. Finally, the NCR regulates and supervises the credit industry. Its duties include research and education, policy development, registration of credit providers and debt counselors, and investigating complaints.

In Rwanda, the financial sector is regulated and supervised by the Central Bank and the Capital Market Authority (CMA). The Central Bank regulates and supervises the banking sector, microfinance sector and NBFIs, while the CMA regulates and supervises the RSE.

National Bank of Rwanda

Established in 1964, the Central Bank of Rwanda is called "*Banque Nationale du Rwanda"*, (BNR) or National Bank of Rwanda (NBR). Historically, it was located in the capital city of Kigali, but branches have recently been established in Rwamagana (Eastern Province), Musanze (Northern Province), and Rusizi (Western Province). In order to strengthen supervision of the banking sector, it conducts offsite surveillance and onsite inspections. Furthermore, it holds regular quarterly meetings with top banks' management and some Board members. During these meetings, the Central Bank shares the outcomes of offsite surveillance and onsite inspections, which provides opportunities to discuss the problems that face a given bank and propose a way forward.

In order to promote the stability of the financial sector BNR established the Financial Stability Committee (FSC) in 2012 that analyses the financial sector. On an on-going basis,

the committee identifies the risks associated with the sector, and publishes its findings, as well as closely monitoring the sector and taking corrective measures when necessary. Equally, BNR ensures that the pension sector manages the funds at its disposal professionally, and that the insurance sector is performing well.

Capital Market Authority

In May 2014, the CMA issued guidelines for bonds issuance in Rwanda and a regulation on the book building process (BNR, 2015). In order to match the legal framework of EAC partners, it consulted the seven directives issued by the EAC Secretariat (BNR, 2015). These include the EAC Directives on Public Offers (Equity); Public Offers (Debt); Collective Investment Schemes; Public Assets Backed Securities; Corporate Governance for Securities Intermediaries; and on Listing.

While regulation promotes the safety and dependability of the banking sector, there is no consensus among economists on its relevance. Some argue that regulation is important to maintain the stability of the banking sector (Dewatripont and Tirole, 1994; Bhattacharya, Boot et Thakor, 1998) while others (Smith Vera, 1990; Benston and Kaufman, 1996; Llewellyn, 1999), advocate for "free banking". The latter group posit that free trade and free competition promote economic growth and well-being (Matthews and Thompson, 2008). Good banks would strive to conduct their business in a way that shows observable differences with bad banks. They would build their financial position to attract customers that are losing confidence in their bad banks. In so doing, they would increase their market share, and potentially their profitability. Accordingly, managers would be convinced that the success and survival of their banks hinge on their ability to retain customers' confidence and loyalty. Smith Vera (1990) claims, that, the creation of a Central Bank that regulates the banking sector is more politically motivated than business oriented. Likewise, Llewellyn (1999) states that regulation discredits and strangles innovation, thus placing a limit on the growth of the economy. For Benston and Kaufman (1996), the stability of monetary policy is more important for the smooth functioning of the banking sector than its regulation.

2.3.5.2 Instruments of banking regulation

Since the central objective of banks and other deposit taking institutions is to make profits from the lending-borrowing arrangement, they gain from interest rate differentials. As the drivers of credit, these institutions, also known as *monetary financial institutions* (MFIs) contribute to the increase in money supply in the economy (Sexton, 2008; Casu *et al.*, 2015). For example, an expansion of loans results in an increase in the stock of money circulating in an economy through the credit multiplier. To prevent banks from running short of liquidity, they are obliged to keep a fraction of total deposits with the Central Bank in the form of reserves to cope with possible withdrawals. They use the remaining proportion to grant loans to borrowers. In the past, this was one of the justifications for more stringent regulation and supervision of deposit taking institutions than non-depository institutions such as insurance companies, pension funds, investments companies, and finance houses, to name but a few.

Accordingly, the ultimate objective of banking regulation is to ensure that the interests of stakeholders in the banking sector are safeguarded and to promote sound investment policies for banks (Freixas and Rochet, 2008). In order to achieve this objective, Central Banks develop regulatory instruments. While they may vary from country to country, they have some common basic features such as capital requirements, reserves requirements, and, in some countries, deposit insurance.

Capital requirements

Since monitoring banks' assets is not an easy task, the regulator uses capital requirements to limit excessive risk taking by banks. Following the Basel Accord of 1988, many countries require minimum capital adequacy ratio of 8 percent. Central Banks can increase this minimum level depending on banks' capitalization standards and credit rating score. For instance, with effect from 1 October 2001, the minimum capital requirement for local banks in South Africa is 10 percent (Zyl *et al.*, 2003). This level is common in developed economies. A well-capitalized bank is one that has a total risk-capital asset ratio greater than or equal to 10 percent where the tier-1 capital asset ratio is greater or equal to 6 percent (Matthews and Thompson, 2008). In Rwanda, minimum capital adequacy is 15 percent of which a minimum of 10 percent represent the core capital (BNR, 2014). This is above the level in emerging and developed countries which is generally set at 10 percent (Casu *et al.*, 2015).

Reserves Requirements

In most countries, the monetary authorities require banks to hold a defined proportion of their deposits at their Central Banks. This is known as the "reserve ratio". The higher the required reserve ratio, the lower the amount of funds available to the banks to use to grant loans to borrowers and vice versa. Central banks use the reserve ratio as one of the mechanisms to control bank lending, and in this manner to control the money supply or money creation.

These reserves vary across countries and some Central Banks pay interest on them while others do not (Matthews and Thompson, 2008). In the UK, banks are compelled to maintain deposits at the Bank of England equal to 0.15 percent of eligible liabilities (roughly approximated by deposits). These reserves bear interest provided they remain within the agreed amount with the Bank of England that in turn invests them in interest bearing securities. Likewise, in the European Union, banks have to keep 2 percent of specified short-term liabilities in reserve at the European Central Bank (ECB) on average over a one-month maintenance period. They earn interest on these compulsory balances at a rate equal to the average rate of the weekly tenders over the maintenance period. In contrast, in the US, reserves with the Central Bank vary between 0 and 10 percent of deposits depending on the bank's nature and size and these balances are non-interest bearing. Similarly, in Japan and Switzerland, banks are required to keep reserves equal to between 0.05 and 1.3 percent, respectively and the balances do not bear interest. In South Africa, banks are required to keep a minimum of 5 percent of their average daily total deposits in reserve, of which 2.5 percent is kept with the SARB (Zyl *et al.*, 2003), with no interest paid.

In Rwanda, the "required reserve ratio" is fixed at 20 percent of banks' total deposits or liabilities and off-balance sheet commitments held in both Rwandan francs and foreign currencies (BNR, 2012). These reserves are held in current accounts with the Central Bank and bear no interest. The required reserves ratio in Rwanda is relatively low compared to SSA Countries (Mehran, 1998). In Angola, the reserve requirements ratio is 40 percent, while in Ghana it is 35 percent.

Along with the reserves requirements in Rwanda, through regulation no 06/2008 of 30/11/2007 on Corporate Governance of Banks, BNR has fixed the maximum level of loans that can be granted to shareholders, directors, and staff. This regulation aims to limit the misuse of a bank's funds (that mainly accrue from public deposits) (BNR, 2008). The regulation states that a bank can grant shareholders, directors and personnel a maximum of 25

percent of total core capital, while directors, executive officers and general management employees can only borrow up to a maximum of 5 percent of total capital.

Deposit insurance

In order to avoid bank panics that can have significant social and economic costs, some governments have established deposit insurance schemes. Under such schemes, a bank pays a premium to an insurance company to insure clients' deposits up to a fixed limit in the case of bank failure (Freixas and Rochet, 2008). While deposit insurance can provide a solution in the case of bank runs, it can be also a source of moral hazard behavior. Matthews and Thompson (2008) claim that moral hazard generated by deposit insurance can drive even sound and well-performing banks to decide to fund higher risk projects when faced with competition from bad banks. A case in point is the global financial crisis of 2007 – 2009. Prior to the crisis, many investors as well as government officials responsible for overseeing financial intermediaries were free riders (Cecchetti *et al.*, 2011). Rather than undertaking their own costly screening efforts, they presumed that rating agencies' assessments were truthful. Implicitly, the participants in the process acted as if the ultimate collateral value of houses would always be adequate to contain the damage from adverse selection. Had housing prices increased indefinitely, as many appeared to assume they would, the collateral would have protected investors against any damage. However, when housing prices and the value of collateral started to fall, the effects of adverse selection threatened the financial system as a whole.

Other tools used by the Central Bank to control money creation

Because the Central Bank determines a country's monetary policy, and banks are to some extent involved in money creation through issuance of credit, the Central Bank uses other conventional tools such as the discount rate and intervention in open market operations to keep money creation at the desired level (Mankiw, 2011). The discount rate allows banks to borrow money from the Central Bank when they have a shortage of liquidity to meet short-term obligations or to serve successful pending loan applications. The higher the discount rate, the lower the amount of funds those banks will decide to borrow. Put simply, banks are discouraged from borrowing. Conversely, if the discount rate is lower, banks have an opportunity to borrow more funds that they can lend to businesses.

The Central Bank can also vary the quantity of reserves in the banking system through the purchase and sale of government securities (Treasury bills and government bonds) in open-

market operations. When the Central Bank buys government securities, the sellers of these securities deposit the amount received in banks, thus, increasing bank reserves that give banks room to grant new loans. Equally, when the Central Bank sells government securities, bank reserves fall, reducing their ability to issue new loans.

The Central Bank can also apply other non-conventional market-oriented approaches such as credit ceilings and deposit rate controls as well as moral suasion to influence the quantity of money circulating within the economy (Casu *et al.,* 2015). These instruments operate through the monetary authorities' influence on the functioning of banks, and in some cases, are not in line with banks' commercial interests. The monetary authorities can exercise some control over interest on deposits, may limit the level of credit banks are able to offer or may simply direct banks to grant loans to a specific category of customers or to a given sector. With moral suasion, authorities engage bankers in a bid to establish lending priorities without imposing a limit on credit, as is the case with credit ceilings.

As in other countries, in Rwanda, BNR uses other tools such as the discount rate and open market operations (especially in the money market where Treasury bills and Treasury bonds dominate). Government issues Treasury bills to finance the government budget or to absorb surplus liquidity. Using the discount window facility, the BNR allows commercial banks to borrow its funds after assessing the real need for liquidity in the financial system. Since September 2012, the discount window is connected to the Key Repo Rate (BNR, 2015). The actual policy rate equals the Key Repo Rate (KRR) + 4 percent. To access these funds, commercial banks have to offer Treasury bills and promissory notes as collateral.

In terms of open market operations, BNR uses daily liquidity absorption repos with maturities of seven days and weekly auctions of Treasury bills with maturities of (28, 91, 182 and 364) days while Treasury bonds are issued on a quarterly basis (BNR, 2015). Repos with shorter maturities are issued at any time based on the forecast of banking sector liquidity. Repo tenders are generally publicized on the Friday after the Monetary Policy Committee's meeting. On any other working day, banks have the opportunity to bid for 1-day repo around 2:00 p.m. The minimum bid acceptable is Rwf 50 million or a multiple of this amount (BNR, 2008).

Turning to supervision, the Central Bank uses Capital adequacy, Asset quality, Management, Earnings, Liquidity, and Sensitivity to risk (CAMELS) rating criteria to assess the soundness of banks with a special focus on earnings and risk management (MacDonald and Koch, 2006;

Cecchetti *et al.*, 2011). The rating is on a scale of one to five, where a composite rating of one indicates that the bank is performing well while one of five indicates that it is in a dire situation. A bank whose rating is five is close to failure. Based on these ratings, the Central Bank advises banks on relevant action to take and, in extreme cases, can close a bank that appears to be performing poorly and displaying signs of insolvency. The capital adequacy (C) criterion indicates an institution's ability to respond to all external risks identified, measured, monitored and controlled by management. Asset quality (A) reveals the volume of prevailing credit risk in relation to loans and the investment portfolio, as well as off-balance sheet activities. The management category (M) reflects the competence of the key organs running the bank, which are the board of directors and senior management committee. It further assesses the existence and use of procedures in place to identify, measure, monitor, and control risks within the targets set by the bank in conformity with regulations. With reference to Earnings (E), regulators are more interested in the sustainability or quality of earnings. They do not limit their analysis to the magnitude of and movement in earnings, but also assess elements that may disturb the bank's earnings. Liquidity (L) reflects the sufficiency of the institution's position with regard to existing and potential sources of liquidity and funds. It also examines the institution's strategies to manage liquidity risk. Finally, sensitivity to market risk (S) reveals the extent to which the bank's earnings or economic capital are exposed to price or market risk resulting in changes in interest rates, foreign exchange rates, and commodity prices, as well as bond and equity prices.

In stabilizing and promoting the economy, the Central Bank does not only focus on the stability of financial markets and institutions. It also works towards other specific objectives, including the stability of prices, interest rates and exchange rates, and higher and stable real growth of the economy that goes hand in hand with higher employment levels (Cecchetti *et al.*, 2011; Mankiw, 2011). The stability of interest rates and exchange rates is argued to be secondary because they serve as a means to achieving low inflation, stability in real output growth and financial sector stability, which are central to achieving the ultimate goal of stability of the entire economic system. Instability in the inflation rate, interest rate, exchange rate or real economic growth poses a threat to the whole economy. Thus, the task of the Central Bank is to work towards improving each of these specific macroeconomic objectives, though some may work in diametrically opposed directions. For example, in the short run, an expansionary monetary policy that lowers interest rates raises economic growth, employment, and inflation. Understandably, the increase in economic growth and employment is at the

expense of an increase of inflation rate. When the exchange rate is stable, it is easier to predict the level of imports as well as exports, implying stability in the balance of payments. While the exchange rate is not a serious matter for the US and the European Union, it is of concern in emerging markets and LDCs because of the structure of their economies that rely on improving exports while controlling for imports. In addition, price stability, which is one of the criteria for an economy to run efficiently, boosts households and investors' confidence in their decisions as well as the efficient working of financial markets (Mankiw, 2011). Consumer decisions are stable, investors are able to distinguish successful firms from those that are performing poorly and markets can efficiently allocate resources to their best use. Furthermore, stability in real output growth boosts confidence in the future, reducing speculation in businesses activities which in turn leads to sustained economic growth, and stable employment.

2.4 New Developments in the Banking Sector

Section 2.3 discussed the components and development of the financial sector. This section discusses developments in the banking sector that brought changes in products, competition as well as regulation.

While it was historically one of the most closely regulated of all industries, the banking industry witnessed gradual deregulation in the 1980s, giving this sector an opportunity to cross even geographic boundaries. The dramatic shift in the products and services offered by this industry emanates from technological advances. Thus, the operational and regulatory environment coupled with the forces that brought about change, such as market-driven competition, product innovation and deregulation/reregulation, securitization, globalization, and technological advances have significantly altered the banking landscape (MacDonald and Koch, 2006; Casu *et al*., 2015).

2.4.1 Structural and conduct deregulation

Many analysts ascribe change in the financial service industry to deregulation (MacDonald and Koch, 2006). Financial deregulation involves removing controls and rules, which previously protected financial institutions like banks or imposed limitations such as

geographical location, branch restrictions, restrictions on products and services on offer, and credit ceilings, among others. Deregulation was a response to intense competition across deposit taking and non-deposit taking institutions. Structural deregulation refers to the opening up of new market horizons by liberalizing financial markets to allow institutions to compete more freely. If, as proponents of deregulation assume, efficiency increases, improved resource allocation will benefit the whole society due to price reduction and/or service expansion for consumers. Deregulation aims to improve the performance of the deregulated industry. For example, the widespread liberalization and harmonization processes in the European Union since the 1980s have contributed to the creation of a business environment where operational efficiency and technology play key roles in influencing banks' strategies (Casu *et al.*, 2015).

While the deregulation process appeared to be unique for each country, there is a common pattern in most developed countries from 1970s (Matthews and Thompson, 2008). In the UK, it started with the removal of strict controls on bank assets and ceilings on interest rates on deposits, and a gradual removal of credit restrictions. In the US, deregulation kicked off with the suppression of regulation Q 1982 that set a ceiling on the interest rates that banks could pay on savers' deposits. Early in the 1980s, some advanced countries eliminated credit controls as well as exchange rate control. The European Union relaxed its heavy controls on banks' balance sheets. By the end of 1980s, Western Europe and Japan had effectively eliminated capital controls (Rajan and Zingales, 2003). Following reduction of the specialization restriction in business between banks and other financial intermediaries, intense competition emerged in different markets at domestic or international level. This resulted from trade and free movement of capital at international scale, triggering the modernization of the financial sector. The influence of the state decreased and the industrial and banking sectors were privatized.

2.4.2 Financial innovation and the adoption of new technologies

Like innovation in other business sectors, financial innovation is an ongoing process where banks and financial institutions seek to develop new products and services to meet customers' needs (MacDonald and Koch, 2006; Casu *et al.*, 2015). It involves the creation of new financial instruments as well as new financial technologies, institutions and markets that fit

the preferences of customers, and at the same time generate more income for financial institutions (Cecchetti *et al.*, 2011). Innovations include new credit, deposit, insurance, leasing, hire purchase, derivatives and other financial products. These innovations have the ultimate objective of better responding to changes that align market demand in order to improve efficient regulation of the financial sector. Once achieved, this leads to gradual changes in the economy. They can also target the establishment of new types of financial intermediaries. In some circumstances, financial innovation has allowed financial institutions to circumvent the existing legal and supervisory framework (MacDonald and Koch, 2006).

Innovation has also facilitated the extensive adoption of new financial instruments such as derivative products introduced with the objective of reducing risk through hedging. Examples of derivatives include swaps, options and futures contracts. In addition, technology has allowed banks to adopt various market segmentation strategies following the profitability 80-20 rule. Following this rule, the top 20 percent slice of profitable customers who contribute about 80 percent of overall profits are given a wider range of products which move them to a more profitable position for themselves and for the bank, and the less profitable 80 percent of customers are moved towards lower-cost banking services.

With the development of the financial sector, market fragmentation is reduced, and more complex financial products flow into the market as a result of the advanced financial infrastructure in place and reduced information asymmetry that allow for a more accurate evaluation of the financial risks associated with these products (Lynch, 1996). Advanced computers and software have contributed significantly to the reduced costs of information management related to collection, storage, processing and transmission, as well as containing information asymmetries in financial transactions.

However, extensive use of technology is not risk free. Banks face the risk of investing in Information Technology (IT) infrastructure that could rapidly become obsolete or suffer theft, and legal and operational risk. Legal risk relates to uncertainty surrounding the applicable laws and regulations on a number of aspects relating to technology such as the legal status of remote banking, validity and proof of transactions, and strict respect for a customer's privacy. It also concerns the risk of loss resulting from the fact that a contract cannot be enforced simply because the borrower did not have the right to enter into it or because the terms of the contract are not in force in case of bankruptcy of the bank (Matthews and Thompson, 2008). Another important concern is operational risk that may result from the system's failure

associated with non-upgrade of the banking IT infrastructure (leading to data corruption and programming errors, among others). In addition, internal control could fail to cope with the new operational environment and employees might make unintentional or willful mistakes. It can also result from errors in instructing and processing payments or settling transactions within the bank, across banks in the country or in international transfers (Matthews and Thompson, 2008). Despite such shortcomings, rapid innovation that undeniably benefited from technological advances has contributed to the dynamic efficiency of the financial sector, with positive effects on overall economic growth (Casu *et al.*, 2015).

2.4.3 Globalization

Globalization has also impacted the development of the financial sector as geographic confines no longer restrict financial transactions (MacDonald and Koch, 2006). Many nations have removed regulatory barriers to international banking. In turn, the removal of geographic barriers intensifies interconnections and integration between financial markets and financial institutions worldwide. Investors with surplus funds are to move wherever there are new investment opportunities. Funds can freely flow between countries due to efficient money and capital markets as well as currency exchange.

In most financial centers, banks have the capacity and expertise to enable customers to access capital in any denominated currency in the form of either debt or equity (MacDonald and Koch, 2006). While there has been product innovation and the acquisition of domestic firms by foreign ones has led to substantial removal of the physical boundaries that previously separated firms internationally the process has been made a reality by technology, especially the commercialization of the Internet. Consumers and producers search beyond their local market in pursuit of price, quality and availability of goods, services and capital, despite being separated by long distances.

This growth in the international activities and trade of multinational corporations has increased demand for services from financial institutions that operate across borders (Cecchetti *et al.*, 2011). Such institutions finance trade, facilitate foreign exchange and offer wholesale (large) short-term Eurocurrency loans and deposits to both residents and non-residents. The question that needs further investigation is, what factors were at the center of expanding their businesses overseas?

Casu *et al.* (2015) concur with Fraser *et al.* (2005) that the main driving forces for banks and other multinational companies' overseas expansion include price differential and trade barriers; arbitrage and the cost of capital; ownership advantages; and efficient use of excess managerial capacity. International banking and other multinationals seek to expand their business overseas with the aim of serving their customers who are involved in export and import of goods and services, and to maximize profits by taking advantage of prices differences in the factors of production and products. Some banks or multinationals target the less developed world, where labor is cheaper, and final products are affordable to the broad market because of reduced transport costs.

These institutions also seek to overcome the barriers associated with restrictive laws in some countries. In terms of arbitrage and the cost of capital, banks in developed countries have the advantage of borrowing cheaply on the domestic market in strong currency markets and investing in overseas markets where currencies may be weak. Conversely, they can acquire domestic banks at a relatively cheap price, thus, giving them the opportunity to diversify and increase their earnings.

Owing to comparative advantages in advanced technology, marketing expertise, production efficiency, managerial expertise, and innovative products, such banks have the confidence to enter foreign markets to make profit. Furthermore, banks as well as other companies can expand their operations in new markets overseas in order to more efficiently exploit their managerial skills and comparative and competitive advantage on a larger scale in order to make more profit from investment in their human capital (Casu *et al.*, 2015).

A country's decision to allow the flow of capital across borders is determined by global conditions rather than domestic, specifically political, considerations. Openness has a significant influence on the development of the financial sector. Easy access to international capital markets offers domestic firms an opportunity to raise funds in foreign markets (Rajan and Zingales, 2003). For example, in the 1980s, reputable Japanese export firms raised finance on the Euromarkets. This served a lesson to Japanese banks to change their practices. Conversely, foreign financial firms' entry into domestic markets has made a significant contribution to financial sector development. Openness to the rest of the world makes it easier for domestic agents to invest their funds elsewhere where they expect to obtain high returns.

Depending on the laws of domestic and host countries, a bank can enter the foreign market either in the form of a **correspondent bank, representative office, branch office, agency** or a **subsidiary** (Heffernan, 2005; Casu *et al.*, 2015). The services offered via a correspondent banking relationship consist of payments and other transactions as well as various trade credit facilities performed by a bank located in the host country, where the parent bank is not initially present physically in exchange for fees paid to the local bank. A representative office cannot provide banking services that involve taking deposits and making loans. Instead, it acts as a marketing agency for the parent bank. In contrast, a branch is an integral part of the parent bank. It can legally perform all banking functions allowed by the banking regulator in the host country. An agency functions like a branch in that it is an integral part of the parent bank; but in countries like the US, it performs fewer operations than branches. A subsidiary is a separate legal entity from the parent bank. It has its own capital and is regulated by the financial regulatory agency of the host country. The parent bank only provides support when it faces difficulties.

2.4.4 Securitization

Securitization refers to the process where loans and other financial assets which are illiquid in nature such as mortgages, are combined together into financial instruments called "*mortgage-backed securities*" and sold as securities to investors (MacDonald and Koch, 2006). It transforms illiquid assets into marketable securities. The pools include, mortgage loans, credit card loans, car loans, and other different loans to business. Fannie Mae, Freddie Mac and the Federal Housing Administration were the first mortgage securities to issue mortgage-backed securities in the US (Cecchetti *et al.*, 2011). Because the bank no longer has to allocate loan-loss reserves against non-performing assets, its capital requirement declines proportionately. Securitization helps the bank to eliminate the interest rate risk associated with financing the underlying assets. In turn, borrowers enjoy lower costs of funding because lenders are in a position to sell the assets more easily.

However, the purchasing of these securities by investors, mainly banks and insurance companies, without full appreciation of the risk was a major cause of the global financial crisis of 2007 – 2009. Investors did not fully document borrowers' income and assets and this is argued to have been the source of *subprime borrowing* in the US in the decade from 1996

to 2006, and hence the root cause of the financial crisis of 2007 – 2009 (Cecchetti *et al*., 2011). For example, from 2000 through 2006, national home prices increased by 88.7 percent, far more than incomes (Mankiw, 2011). The housing market boom, which proved unsustainable, became the trigger for the financial crisis. Nationwide, housing prices decreased by about 30 percent, followed by a series of mortgage borrowers' defaults and home foreclosures (Mankiw, 2011). The increase in homes sold prompted a price decrease and financial institutions that owned mortgage-backed securities experienced enormous losses. This lead to the collapse of the housing industry, and the bankruptcy of many financial institutions such as the Lehman Brothers Bank in the US in September 2008 and Northern Rock Bank in the UK in September 2007 (Cecchetti *et al.*, 2011). As financial institutions were weak during the crisis, the world experienced a severe economic recession. Internationally, active banks become distressed and this posed a threat to the global financial system.

2.4.5 Re-regulation

One consequence of the process of deregulation has been the increased perceived riskiness of the banking business. Sexton (2008) argues that deregulation, coupled with deposit insurance, was the driver of the moral hazard behavior of bank managers in the US prior to the 2007 – 2009 financial crisis. On the one hand, banks directed savings into loans to high-risk real estate projects and other risky schemes. On the other, depositors were careless about the health of their banks, meaning that they had little incentive to monitor how their banks were performing based on the assurance of protection by deposit insurance. In the new environment, banks took the opportunity to expand their activities outside the traditional banking regulatory framework in order to maximize their earnings (Rose, 2002). Over the years, banks have tried to move towards replacing interest income with fee income.

In the spirit of diversifying sources of income, in the 1980s, competition from financial markets created a move to more value-added products, which were better adapted to customers' needs (Freixas and Rochet, 2008). Banks expanded into nontraditional areas and products such as investment banking activities, encouraging off-balance sheet activities, such as standby letters of credit, commitments and guaranties, commitments related to interest rate swaps, currency exchange, leases, and insurance on securities, mortgage servicing, and credit

enhancement products. Under such circumstances, the big challenge to bankers was to provide services that met customers' demand, while still controlling their risk implications (Fraser *et al.*, 2005). In order to strengthen their position in providing more services to customers in the liberalized and competitive financial environment, banks increased their size through Mergers and Acquisitions (M & As) (Matthews and Thompson, 2008; Cecchetti *et al.*, 2011; Casu *et al.*, 2015).

The justification for M & As is that poorly-managed firms can do better if merged or acquired by well-managed ones or the assumption that two are more powerful that one on its own (Casu *et al.*, 2015). It is expected that the new structure will yield better results for the shareholders of the two or more institutions coming together. Other reasons for M & As are exploiting economies of scale and economies of scope, thus, reducing inefficiencies. On the one hand, economies of scale resulting from the larger structure lead to lower unit costs of providing financial services to the benefit of consumers of banking services while maximizing their financial position. On the other, benefits arise from economies of scope as a result of consolidating some departments and /or improving channels of delivery in the new structure. Put differently, cost savings result from jointly delivering services through the new organization instead of the isolated old ones. They can also accrue by making proper links between production and marketing departments or externally through joint consumption channels. It is argued that M & As, are likely to eliminate inefficiencies by exploiting previously unexplored opportunities, leading to cost cutting and increased products and services, and hence, overall earnings. Equally, M & As can enhance the new entity's bargaining power, diversify its product lines and improve marketing and distribution. All these factors promote higher margins and improved profitability, and hence, the value of the newly formed institution resulting in increased efficiency that reducing agency incentives and increases market power.

Consumers/customers might also benefit by being able to access a package of products or services at the same place, thus reducing transactions and information costs. For example, when the same institution supplies banking and insurance products, a situation called *bancassurance*, economies of scope are possible (Matthews and Thompson, 2008; Cecchetti *et al.*, 2011; Casu *et al.*, 2015). Zyl *et al.* (2003) argue that in the South African banking sector, bancassurance groups have emerged in recent years where banks also provide insurance services. Thus, banks supply both loans and insurance to depositors and borrowers. This has attracted complementary activities, and competition between banks and insurance

companies. Products like home insurance and credit insurance are complementary to loans offered by banks.

In such a context, even strongly market-oriented systems needed to strengthen supervision. This was a key element in improving the safety and soundness of the overall financial sector or reregulating the financial sector. Re-regulation is the process of implementing new rules, restrictions and controls in response to market participants' efforts to escape existing regulations (MacDonald and Koch, 2006). Alternatively, it is a way to minimising any potential adverse effects that may be associated with excessive competition brought by deregulation.

2.4.6 International Regulation of the Banking Sector

With internationalization of the banking sector alongside the increasing sophistication of financial markets, there has been support for international regulation of the firms involved. The need to regulate and supervise this development led to the adoption of the Basel Accord in 1988 by members of the Basel Committee composed of senior Central Bank officials for the G-10 countries that are Belgium, Canada, France, Germany, Italy, Japan, Netherlands, Sweden, the UK, and the US, plus Luxembourg and Switzerland (Casu *et al.*, 2015). Its mandate was to ensure the soundness and stability of the globalized banking system (Heffernan, 2005).

The Basel Accord set a minimum capital adequacy ratio of 8 percent made up of tier 1 (at least 4 percent) and tier 2 capital divided by weighted risk assets (assets plus credit risk equivalents) where assets are weighted by credit type and credit risk equivalents are weighted by counterparty type. Tier 1 or core capital comprises paid-up capital, retained earnings and disclosed reserves (which are provisions to cover unexpected risks). Tier 2 or supplementary capital consists of other elements of capital divided into upper tier 2 and lower tier 2 (Heffernan, 2005; Pilbeam, 2010). The upper tier 2 captures capital such as cumulative perpetual preferred stock, loan loss allowances, undisclosed or hidden reserves, revaluation reserves (discounted by 55 percent) such as equity or property where the value changes, general loan loss reserves, and hybrid debt instruments such as convertible bonds or cumulative preference shares. The lower tier 2 contains subordinated debts. Indeed, Tier 2 safeguards regular depositors who are major debt holders in case of bank failure (Matthews

and Thompson, 2008). While the Basel Accord of 1988 provided a foundation to regulate the international banking sector, it was criticized on the following grounds (Matthews and Thompson, 2008):

1. Differences in taxation systems and accounting rules caused the measurement of capital to vary broadly across countries.

2. The Accord only focused on credit risk and ignored other types of risk that also cause disturbances in the banking sector. These include interest rate risk, liquidity risk, currency risk and operating risk.

3. Banks that strived to reduce their risk portfolio were not rewarded because there risk diversification was not taken into account in calculating capital requirements.

4. By asking all banks to conform to the same capital-asset ratio in order to mitigate risk, the Accord ignored the fact that banks conduct different financial operations.

5. In terms of foreign exchange and interest rates contracts, the Accord did not reflect on the expected market value of banks' assets. It thus created the problem of market value lagging behind when calculating capital adequacy.

Basel II of 2004 and Basel III in 2010 aimed to address the deficiencies of the Basel Accord of 1988. The most important improvement in Basel II is to permit banks to use internally developed risk assessments as inputs for capital calculations. Basel II aimed to preserve the key principles of Basel I, while encouraging innovations in risk management, thereby firming up the stability and reliability of the financial system. Three reinforcing pillars achieve this objective.

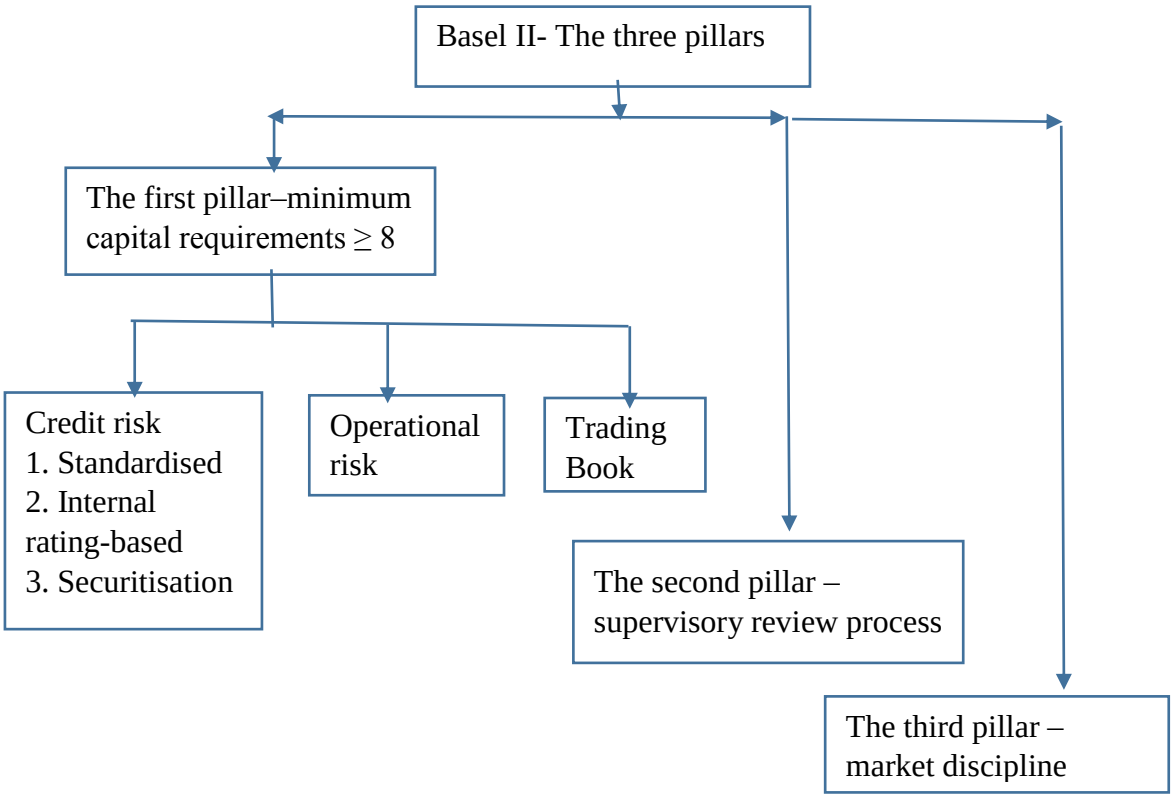
Pillar 1 includes the calculation of minimum capital requirements to cover credit risk. It includes operational risk and market risk on the banks' trading book. Subsequent to developments in banks' operations, it sets three approaches to evaluate credit risk, the standardized approach, internal rating-based approach and securitization approach framework. Firstly, the standardized approach, which is an extension of the Basel I approach, allocates risk weights to specific assets and integrates the risk weights provided by external rating agencies. Secondly, regulatory authorities allow banks that have deep, sophisticated control of risk-taking operations to apply their internal ratings standards. These internal rating models determine capital requirements, which are subject to specified, rigorous evidence and data on operational conditions. Thirdly, the securitization approach framework to assessing

credit risk ensures that banks hold regulatory capital for securitization transactions in order to limit some of the damaging effects of these operations. Banks are free to choose the standardized approach or the use of internal models.

The second pillar provides room for national regulatory authorities to modify regulatory capital levels. Depending on the targeted levels, they can impose higher capital charges than those required in pillar 1. The second pillar also requires banks to develop internal methods to assess their overall required capital adequacy ratio.

The third pillar obliges banks to make greater disclosure of their operations to financial markets as well as to the public with the ultimate objective of firming up market discipline and making their risk management practices more responsible and transparent. Figure 2-3 summarizes the structure of the Basel II process and the three pillars.

Figure 2- 3: The Basel II Approach



Source: Matthews and Thompson (2008)

During the implementation of Basel II Agreement, banks made use of sophisticated risk-modelling techniques. The new requirements appeared to be cumbersome as they were voluminous (2000 pages) and prescriptive. In addition, the capital requirements laid down in

Basel I and Basel II were inadequate to contain the credit crash that culminated in the global financial crisis of 2007 – 2009 (Rose and Hudgins, 2013). Banks found ways to circumvent the rules by holding both insufficient total capital and a fragile mix of different kinds of capital. Furthermore, they lacked sufficient financial assets to deal with the devastating problems resulting from credit growth. Moreover, while the largest international banks seemed to be functioning under fairly stable and uniform rules in Basel I and II, in many countries small domestic banks did not enjoy the same standards, unfairly benefitting some big banks and disadvantaging other small ones (Matthews and Thompson, 2008). Following the failure of Basel II to limit the credit catastrophe, banking regulators around the world met to reexamine the capital that banks need to hold in order to deal with severe financial difficulties. Basel III sets greater total capitalization (a higher percentage of capital relative to assets) and clearly designates what is or is not a component of a bank's capital. Another serious concern was the volume and mix of capital of high-risk mortgage-backed securities and derivatives that the leading banks in the world were maintaining in order to prevent potential banking and financial crises.

During its Seoul Summit in November 2010, the G20 approved Basel Accord III. It addressed new economic risks and the changing structure of the banking sector. The Basel Accord III promoted the construction of a capital buffer for periods of financial and economic difficulty. It also enforced a leverage ratio greater than the existing risk-weighted capital requirements of previous Basel Accords in order to discourage excessive credit growth (Cecchetti *et al.*, 2011). This third version of the Basel Agreement, took into consideration additional risk exposure such as business cycles and systemic risk that banks deal with on a daily basis (Rose and Hudgins, 2013). The Accord is a set of reform measures proposed in order to strengthen the regulation, supervision and risk management of the banking industry. The reforms are both micro prudential and macro prudential. The micro prudential reforms focus on the individual bank and aim to help banking firms to absorb economic and financial shocks to the sector, whether the source is internal or external. They also aim to improve banking risk management while strengthening transparency and disclosure. On the other hand, the macro prudential reforms seek to improve compliance with market discipline by addressing the problem of systemic risks leading banks to common exposure or to pro-cyclicality phenomena. Furthermore, to ensure that individual banks are well capitalized, Basel III decided that they should at all times have minimum total capital (Tier 1 capital plus

Tier 2 capital) of 8 percent of risk-weighted assets plus 2.5 percent of capital as a safeguarding buffer (Bank of Internatioan Settlements [BIS], 2010).

2.5 Measuring Financial Sector Development

While the financial sector has many components, they can be compartmentalized into financial institutions and financial markets. An important question is how to measure financial sector development. Čihák, Demirgüç-Kunt, Feyen and Levine's (2012) study on benchmarking financial systems around the world proposes a '4x2-matrix framework for financial sector development', summarized into four dimensions, namely, depth, access, efficiency and stability. Table 2-5 illustrates this classification.

Table 2- 5:The World Bank's '4x2 matrix of financial system characteristics'

	Financial institutions	**Financial markets**
Depth	▪ Private sector credit to GDP ratio ▪ Financial institutions' assets to GDP ratio ▪ M2 to GDP ratio ▪ Deposits to GDP ratio	▪ Stock market capitalisation plus outstanding private debt securities to GDP ratio ▪ Private debt securities to GDP ratio ▪ Public debt securities to GDP ratio ▪ Stock market capitalisation to GDP ratio ▪ Stocks traded to GDP ratio
Access	▪ Accounts per thousand adults (commercial banks) ▪ Branches per 100,000 adults (commercial banks) ▪ % of people with a bank account ▪ % of firms with lines of credit (all firms) ▪ % of firms with lines of credit (small firms)	▪ % of market capitalisation outside of top 10 largest companies ▪ % of value traded outside of top 10 traded companies ▪ Government bond yield (three months and 10 years) ▪ Domestic securities to total debt securities ratio ▪ Private securities to total debt securities ratio ▪ New corporate bond issuance to GDP ratio

	Financial institutions	**Financial markets**
Efficiency	▪ Net interest margin ▪ Non-interest income to total income ratio ▪ Overhead costs (% of total assets) ▪ Profitability (ROA, ROE) ▪ Concentration indicator ▪ Competition indicators (Boone Indicator, H-Statistics	▪ Turnover ratio (turnover/capitalisation) for stock market ▪ Price synchronicity ▪ Private information trading ▪ Price impact ▪ Quoted bid-ask spread for government bonds ▪ Turnover of bonds (private, public) on securities exchange ▪ Settlement efficiency
Stability	▪ Z-score (or distance to default) ▪ Capital adequacy ratio ▪ Asset quality ratios ▪ Liquidity ratio ▪ Other ratios (net foreign position to capita, etc.)	▪ Volatility (standard deviation/average) of stock price index, sovereign bond index ▪ Skewness of the index ▪ Vulnerability to earnings manipulation ▪ Price to earnings (P/E) ratio ▪ Duration ▪ Short-term bonds to total bonds (domestic, international) ratio ▪ Correlation with major bond returns (US, EU)

Source: Čihák *et al*. (2012).

2.5.1 Depth

The depth of the financial sector implies its size. The size of financial institutions and markets expresses the degree to which the financial sector is bank-based or financial market-based. For financial institutions, it is captured through proxies such as private sector credit to GDP ratio; financial institutions' assets to GDP ratio; M2 to GDP ratio; deposits to GDP ratio; and gross value added of financial sector to GDP ratio. The ratio of private sector credit to GDP relates to domestic bank lending to the private sector as a percentage of GDP. The ratio of financial institutions' assets to GDP refers to the sum of banks' assets and those of non-bank financial institutions divided by GDP. The ratio of deposits to GDP is the sum of cash mobilized from depositors as current account deposit and/or savings and term deposit accounts over GDP. This ratio expresses the total amount available within the banking system from which banks can lend, and is equivalent to M2/GDP. The ratio of gross value added of the financial sector to GDP provides information on how many financial institutions

contribute to the overall output of the economy. Section 3.3 in chapter three uses some of these variables such as private sector credit to GDP ratio and M2 to GDP ratio highlighted here as measures of financial sector development to assess the link between financial intermediation and economic growth in Rwanda.

Regarding financial markets, the most commonly used indicator is the sum of stock market capitalization and outstanding domestic debt securities to GDP ratio. In addition, the individual private debt securities to GDP ratio, public securities to GDP ratio, international debt securities to GDP ratio, stock market capitalization to GDP ratio, and stocks traded to GDP ratio serve to measures the level of financial sector development via the financial markets group.

2.5.2 Access

Access as a feature of financial sector development relates to how the adult population or companies are accessing financial services, mainly banking services within the economy. This measure records the number of adult persons out of 1,000 that have commercial bank accounts, the number of banking branches serving 100,000 customers and the percentage of people with a bank account in a country. In relation to companies, access relates to the percentage of all companies with access to a credit line in general and in particular the percentage of small firms with access to a credit line.

For the financial market, access relates to firms' access to market-based finance using market concentration measures. It records the percentage of market capitalization outside the top 10 largest corporations, the percentage of value of securities traded outside of the top 10 traded corporates, and trading in the market of government bonds yields over three months and 10 years. To assess access to finance in financial markets, one can use the ratio of bonds issued by domestic firms compared to total debt securities, the ratio of domestic bonds issued by private firms to total domestic debt securities, and the ratio of new corporate debt securities issued to GDP. A higher concentration index implies that new or small firms that aim to issue securities have problems in accessing such markets.

2.5.3 Efficiency

Efficiency as a benchmark indicator of financial sector development for financial institutions points to elements such as profitability measures including interest rate margin; the lending-deposits spread; the ratio of non-interest income to total income; total operating expenses as a percentage of total assets, and other factors. According to MacDonald and Koch (2006), the net interest margin (NIM) is a ratio of net interest return on income generating assets to average earning assets. In other words, the ratio is interest income less interest expenses divided by average earnings assets. The lending-deposits spread is the difference between the interest rates at which banks lend funds and interest rates that banks pay to depositors. A low lending-deposits spread suggests the existence of competition which is argued to be an indicator of efficiency in the banking sector (Casu *et al.*, 2015). The percentage of noninterest income to total income indicates the weight of income from other sources beyond the interest income that derives from the loans portfolio. It is argued that when the financial sector matures, there is a large set of diversified income to the bank other than interest income, so that the ratio becomes higher (Cecchetti *et al.*, 2011). The total operating expenses divided by total costs reflect the proportion of such noninterest expenses to total costs. Total overhead expenses or noninterest expenses or simply total operating expenses are compared to total assets in order to allow comparison across different sized banks (MacDonald and Koch, 2006). They indicate where banks achieve cost efficiencies or where a given bank has a comparative disadvantage.

Other profitability measures include return on assets (ROA) and return on equity (ROE); and banking-market concentration measured by the Boone indicator, Herfindahl index or H-statistic or cointegration such in Chirwa's (2003) study. However, return on assets and return on equity are not straightforward indicators of efficiency because they relate directly to other factors related to pricing and the market environment. Nevertheless, they provide information about the banking sector’s level of performance and to some extent its efficiency. The market concentration measures portray efficiency once they are closer to zero.

Furthermore, the economic literature proposes diverse frontier approaches to measure efficiency. Berger and Humphrey (1997) present a detailed summary of these. Among the non-parametric approaches are Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH). Parametric approaches include Stochastic Frontier Analysis (SFA), and the Distribution Free Approach (DFA), and Thick Frontier Approach (TFA).

In terms of the non-parametric approaches, the DEA procedure involves constructing an envelope of outputs related to inputs using a linear programing technique (Matthews and Thompson, 2008). The linear programming produces a series of points of best-practice observations, and the efficient frontier is derived as a series of a set of linear combinations of these points (Berger and Humphrey, 1997). The FDH is an improved version of the DEA that allows the free disposability of inputs and outputs to construct the frontier line which has a stepwise shape (Fried and Lovell, 1994). In this approach, efficiency is evaluated on the firm's ability to supply as many services as possible with the same resources at its disposal in a given operating environment (Fried, Knox Lovell and Eeckaut, 1993). This means, *ceteris paribus*, that firm A is more efficient than firm B if firm A provides more services using the same resources as those used by firm B. If the two firms are using one resource to produce one output, on the efficiency frontier, firm A appears on the left side west of firm B on the quadrant comprising firms A and B. If the two firms are using more than one resource to produce for example two set of outputs, on the efficiency frontier, firm A appears on the right side east of firm B in the quadrant comprising firms A and B. In that case, firm A is said to be dominant or undominated while firm B is dominated by firm A. Fried and Lovell (1994) argue that inefficiency for firm B can be related to an operating environment that is not favourable to firm B. The overall efficiency of the industry corresponds to the region constructed from the positions of undominated firms.

The DFA is a specific functional form of the objective function, but does not make any assumption about the distribution of random errors (Berger and Humphrey, 1991; Berger, Hunter and Timme, 1993; Matthews and Thompson, 2008; Ncube, 2009). It assumes that there are no random fluctuations. Consequently, all deviations from the estimated frontier signify inefficiency. Put another way, random errors are zero on average, suggesting that random errors tend to cancel each other out in the course of time. Therefore, the efficiency of each firm is stable over time. The inefficiency measure is the difference between the average residual of an individual firm and the average residual for the firm on the frontier. Some researchers use the DFA technique when panel data is available. For the TFA, a specific functional form of the major function is stated to determine the frontier based on the performance of the best firms (Matthews and Thompson, 2008). This technique assumes that deviations from the major function with the lowest average quartile of firms in a size class represent a random error, while deviations in the predicted function between the highest and the lowest quartile represent X-inefficiencies (Bauer, Berger and Humphrey, 1991; Berger

and Humphrey, 1991; Ncube, 2009). Applying the TFA requires a relatively large subclass of firms to outline the frontier (Ncube, 2009). It should be noted, that this technique only provides the efficiency score of the industry as a whole and not that of an individual firm (Berger and Humphrey, 1997). Finally, SFA is a parametric approach to evaluate efficiency that counts for a composite error term. This error term comprises of technical inefficiency resulting from factor inputs that are overused such as hiring more employees beyond the acceptable level and on other hand, allocative inefficiency arising from not efficiently allocating factor inputs due to either careless management, or other external unforeseen events (Battese and Coelli, 1992;1995; Heffernan, 2005; Matthews and Thompson, 2008).

While all these techniques are widely used, the literature reports extensive use of DEA and SFA in frontier studies. For example, Berger and Humphrey (1997), found that, of 129 frontier studies, 62 of the 69 non-parametric applications used DEA while the SFA was applied by 24 of 60 parametric applications, with the remaining techniques thus used by a total of 36 studies. Subsection 4.2.1.2 of chapter four discusses this in more detail.

Regarding financial market indicators of efficiency, the basic measure is the stock market turnover ratio, which relates to the value of securities traded as a percentage of GDP. The larger the volume of securities traded, the better the market flow and thus its efficiency. Other indicators of the level of efficiency of the sector are price synchronicity displaying co-movement, private information trading, the price impact, the ratio of liquidity to transaction costs, the quoted bid-ask spread for government bonds, the turnover of private and public bonds on securities exchange and settlement efficiency.

2.5.4 Stability

Stability is measured much by the Z-score that is the distance to default. It reflects the extent to which a bank's profitability is stable. Higher Z-scores imply greater stability of the system (Casu *et al.*, 2015). Capital adequacy ratios, asset quality ratios, and liquidity ratios as well as other measures like net foreign exchange position to capital are also used to assess the stability of the banking sector. The idea behind these measures is to assess the fragility of the sector.

On the side of financial markets, the indicator most often used to express stability is the volatility of the stock price index, which is the standard deviation of the sovereign bond index over the annual average of that index (Čihák *et al.*, 2012). The stock price index provides information on how much the value of an average stock has increased or decreased. Simply put, this index informs financial market participants how much total wealth has gone up or down, thus affecting the average return to a holder of a portfolio of a particular share of each stock (Cecchetti *et al.*, 2011). The more volatile this ratio is, the lesser stable the market, and hence the financial sector. In contrast, when stock prices are stable, reflecting fundamental values, financial markets work efficiently, and allocate resources efficiently. This suggests that investments flow to their best normally useful usage. Other measures of the financial market's stability include the proportion of price to earnings ratio, the duration, the ratio of short-term domestic and international bonds to total bonds, the correlation with major bond returns (Germany, US) and vulnerability to earnings manipulation as well as the skewness of the index of stock prices and sovereign bonds.

2.6 Concluding remarks

This chapter discussed financial sector development in general, focusing on Rwanda's financial sector. It described the important features of financial sector forces as well as some reactions to the changes that have led to the transformation of the financial sector, especially the banking sector. These include deregulation/reregulation, financial innovation, securitization, globalization and advances in technology. These changes have enabled firms to offer new products and services and opened up new geographical markets using new financial instruments that speed up transactions and offer opportunities to adjust their risk profile. They have also led to increased competition that has enabled consumers and companies to benefit from lower interest rates and capital availability.

The chapter emphasized that the Rwandan banking sector dominates the financial sector because it accounts for more than two-thirds of its total assets, which implies that the banking sector is set to contribute more to the intermediation process in the Rwandan economy. Chapter three investigates the relationship between this sector and economic growth in Rwanda. The Rwandan banking sector's efficiency is assessed in chapter four, while the

factors that influence NPLs in Rwanda that can limit the normal working of the sector forms the core of chapter five.

CHAPTER THREE

FINANCIAL INTERMEDIATION AND ECONOMIC GROWTH: EVIDENCE FROM RWANDA

3.1 Introduction

Economic theory postulates some interaction between financial sector and economic growth via investment (Benhabib and Spiegel, 2000; Mishkin, 2007; Kargbo11 and Adamu, 2009). Financial intermediaries that make an important component of the financial sector collect funds from economic agents who have a surplus and lend them to those who have prospective projects but are short on funds (Pagano, 1993). However, as highlighted in chapter one, Section 1.1, existing empirical evidence suggests that there is no consensus on the nature of the causal relationship between financial sector development and economic growth. Thus, it is not clear how people react in the presence of the development of financial sector, especially banks. This study aims to investigate the directional causality between financial sector development and economic growth in Rwanda, as no study has established this relationship despite its importance for investment purposes as well as policy decisions.

Financial intermediaries offer a wide range of financial services, namely, payment services, deposit and lending services, investments, pensions and insurance services, E-banking, internet banking, financial advisory services, safe-keeping facilities, foreign exchange services, and money transfers (Casu *et al.*, 2015). This suggests that the presence of financial intermediaries enables individuals and firms to save their liquid assets in a place considered safe, that is, the bank. Once accumulated, these institutions can lend the funds to individuals or other economic agents for different purposes. To succeed in this exercise of pooling people's savings that at the end, are transformed into loans, financial intermediaries have to attract many and important savers, which is the core of indirect finance (Cecchetti *et al.*, 2011). Therefore, they have to convince savers of the safety of keeping their assets with such institutions. Financial intermediaries make profits on interest rate differentials and different fees for the services they provide.

Indeed, financial intermediaries are in good position to reduce transaction costs, mobilize savings, screen, and monitor credit, transform liquidity, and smooth consumption as well

work in a committed and disciplined way. They contribute to the reduction of transaction costs by exploiting their economies of scale and scope because they possess superior information that is the core of all financial transactions and contracts. However, because information is not a free good, information asymmetries with customers can generate adverse selection and moral hazard problems, which can affect the banks' earnings**.** Moral hazard arises when the borrower knows if he or she is truthful, while lenders/banks do not have such information. Thus, the central pivot in conducting banking business hangs on the strategies that banks put in place to limit and manage such kinds of risk. They screen loan applicants to guarantee that they are creditworthy and monitor loan recipients to ensure that they use funds for the purpose for which they were borrowed (Cecchetti *et al.*, 2011).

Financial intermediaries also help to mobilise short-term or long-term savings and transform them into short-term or long-term loans with the aim of making profits. They collect small deposits from savers and repackage them into larger loans due to their ability to exploit economies of scale. Following the experience of the goldsmiths of the 16th century that led to the creation of the first bank, as highlighted in chapter two, depositors do not claim their deposits concomitantly. Banks are thus able to lend long, for example on a residential mortgage, that can take about 20 years or more from demand deposits which are generally for short periods and can be withdrawn without prior notice. Because banks are borrowing short and lending long, there is a 'mismatch' between their **assets** (funds lent to borrowers) and their **liabilities** (funds collected from savers) which can create problems in terms of liquidity risk. Banks deal with this risk by diversifying their investments. Due to the pooling of risk inherent in financial intermediation, the improved risk assessment that financial intermediaries are able to undertake is easy. This helps investors or households to achieve portfolio diversification due to better ways of spreading investments across different financial instruments like bonds and stocks that reduce risk without decreasing the expected return.

Besides the ancient role of safekeeping individuals' assets, banks provide accounting services to their customers and serve as channels of payments at national and international levels. In their role of accounting services providers, banks help customers to manage their finances. With the modernization of deposits, and transfer of funds and other payment procedures that are complex in nature, banks assist their customers to save time by providing a framework to carry out all these operations. These include purchasing groceries, buying fuel for cars, payment of different bills, and payment of duties and taxes as well as other transactions and

local and international transfer of funds. It is also through the banking system that most employees are paid their wages and salaries.

These institutions specialize in mobilizing savings, evaluating projects and their risks, and monitoring borrowers-cum-investors (Pagano, 1993). Therefore, they are able to contain asymmetric information, and help to reduce transaction costs, leading to efficient investments that yield a positive return to the economy (Becsi and Wang, 1997). Financial intermediaries examine the economic condition of the individuals and businesses that apply for financing to identify those that present the best prospects that can bring positive returns. Accordingly, they ease liquidity limitations on enterprises by providing them with long-term investments and reducing credit constraints on investors. They direct funds to individuals with better investment opportunities, which in turn promote economic growth. By doing so, they facilitate affordable exchanges between borrowers and lenders in a world of imperfect information (Khan and Semlali, 2000).

Since there is a likelihood that borrowers will default, monitoring credit risk is costly on the part of savers. As depositors would find it costly to undertake monitoring, they delegate responsibility to specialized agents such as financial intermediaries because these institutions have the expertise and economies of scale to collect and analyze information on risky borrowers. Financial intermediaries obtain such information upon their employees' initial contact with borrowers when filling in application for loans. They can also gather it over time through repeated dealings with the borrower. In addition, financial intermediaries such as banks can collect information related to the borrower that goes beyond that provided in the loan application or credit report through good relationships with customers (Pilbeam, 2010; Cecchetti *et al.*, 2011).

Lending institutions invest in information technology that allows them to screen applications for loans, and monitor the projects financed, thus limiting the moral hazard behavior of the borrower by making sure that he/she adheres strictly to the terms of contract. Due to such information advantage, depositors are willing to keep their funds with financial intermediaries that are able to direct them to appropriate borrowers without the former having to incur information and monitoring costs. Likewise, financial intermediaries are able to acquire information on investment opportunities available to borrowers, thus, reducing information costs and efficient channeling funds to the right projects that are likely to yield good returns.

Financial intermediaries also contribute to liquidity transformation. Deposits that are on the liabilities side of financial intermediaries' balance sheets are liquid and low risk. Loans, which are on the assets side, are relatively illiquid and high risks assets. Thus, financial intermediaries transform liquid assets that expose them to liquidity risk because the demand for withdrawal is the demand for liquidity, implying that there is a probability of default on meeting depositors' withdrawals (Aghion, Angeletos, Banerjee, and Manova, 2010). In order to avoid such risk, they keep different liquidity features on both sides of their balance sheet through diversification of their portfolios, thus lowering risk (Pilbeam, 2010).

Because financial intermediaries finance loans (illiquid assets) with demand deposits that can be withdrawn at any time and any quantity without notice, these institutions commit themselves at two levels. On the one hand, bankers or managers of financial intermediaries have to behave prudently by ensuring that they hold sufficient liquidity and capital resources to meet demand withdrawals while continuing to grant loans (Casu *et al.*, 2015). On the other hand, bankers/managers have to build strong relationships with customers that will allow them to acquire relevant information about their investments projections, stimulate borrowers to pay back their loans, and take due remedial action on time in case the borrower faces repayment problems.

Moreover, financial intermediaries mitigate the impact of shocks affecting consumption. Economic agents, specifically consumers, have uncertain preferences about their expenditure and create demand for liquid assets. In response to such demand, studies have reported that financial intermediaries, especially banks and related institutions enable economic agents to smooth their consumption. They achieve this by offering insurance against shocks to a consumer's consumption path via lending which in turn; helps smooth individuals' consumption patterns. In doing so, they perform the function of consumption smoothening (Allen and Gale, 1994; Freixas and Rochet, 2008). Merton (1993) states that in the presence of a well-developed and well-functioning financial system, the banking sector impacts on the efficient life-cycle allocation of household consumption by facilitating efficient allocation of physical capital to its most productive use.

However, a review of the literature to date shows that there is no published research on the relationship between finance and economic growth in Rwanda. In less developed countries (LDCs) evidence on the nature of this relationship is deficient, mainly at country level where very few studies have been conducted. Examples include those on Sierra Leone (Kargbo11

and Adamu, 2009), Uganda (Kilimani, 2007), and Tanzania (Odhiambo, 2005), among others. This calls for empirical research at country level, given the policy implication benefits that LDCs would derive from these findings. Rwanda is a case in point and this study is thus among pioneering research in this area in the country.

This study applies a co-integrated structural autoregressive model to investigate the plausible links between the financial sector and economic growth in Rwanda for the period 1996 to 2010. The use of this model is based on the advantages of using an autoregressive framework identified by Shan, Morris and Sun (2001). They stressed that this is the best model to apply in any multi-variate relation analysis for three reasons. Firstly, it allows for testing of causality using a Wald statistic that has an asymptotic chi-square distribution that does not influence the order of integration between variables as it is in time-series model. Secondly, the autoregressive model does not need any functional form. Finally, it reduces the probability of simultaneous bias that can take place in time-series single-equation models. Furthermore, the adoption of the co-integrated structural autoregressive model in this study relates to its power to determine the dynamic response of the variables of interest to various disturbances within the system.

A good understanding of the channels, through which the relationship between financial intermediaries and economic growth works is essential vis-à-vis the government of Rwanda's belief, that, the financial sector can boost economic growth in the country. In addition to contributing to the body of knowledge on the relationship between financial intermediaries and economic growth, the findings will also shed light on investment decisions and policymaking. The findings of the study suggest that domestic private sector credit shocks contribute the most to variations in the rate of economic growth, while the shock to potential liquidity comes second. Therefore, the findings of this study support the supply-leading hypothesis in the intermediation link between the financial sector and economic growth in Rwanda. The ratio to GDP of domestic credit to private sector and potential liquidity available that this study makes use of are among the depth measures of financial sector development discussed in chapter two, sub-section 2.5.1.

The rest of the chapter is organized as follows. Section 3.2 reviews the literature on the relationship between finance and economic growth. This section discusses the theories and empirical evidence on the relationship between financial sector development and economic growth that serve to orientate this study. Section 3.3 presents the methodology that is a

roadmap for the study. Section 3.4 presents and discusses the results by contrasting them with previous findings whilst Section 3.5 provides summary and concluding remarks.

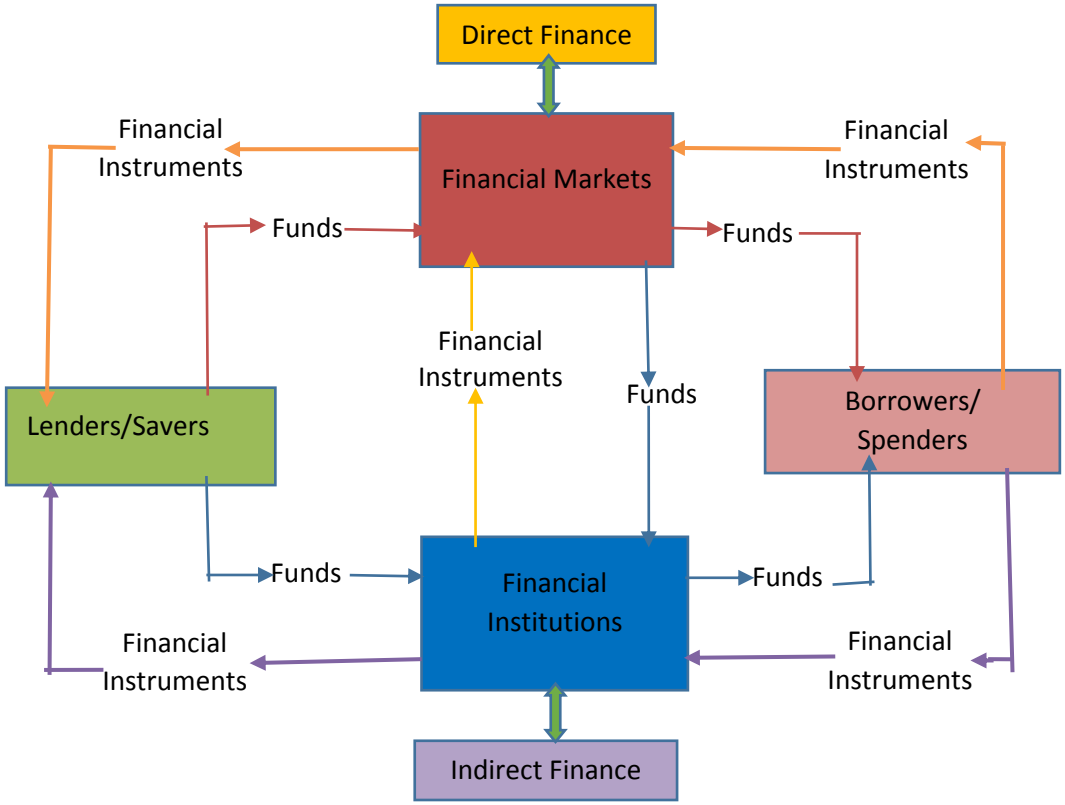
3.2 Interaction between Financial Intermediation and Economic Growth

The primary purpose of this section is to provide a theoretical understanding of how financial sector development relates to economic growth. Schumpeter (1934) argued that financial intermediaries contribute to economic growth by identifying and directing funds to more innovative projects, which otherwise would not have access to capital. However, due to imperfect information in the lending-borrowing process, savers cannot identify a trustworthy investor to whom they can lend their funds. To overcome this barrier, financial intermediaries that specialize in scrutiny and monitoring and have access to superior information, bring together lenders and borrowers-cum-investors, and the process eventually benefits all parties involved with spillover effects to the economy. The lender is to some extent confident that the funds will be directed to the right borrower while the borrower obtains funds for the project undertaken. Financial intermediaries are paid for their services and the whole economy benefits from the availability of goods and/or services produced by the investor, job creation, and purchase of inputs. The question remains however, how do investors access funds?

The literature on the theories of financial intermediation points to two channels through which the private sector can access financial resources: direct finance from capital markets through the issuance of stocks or bonds, or from private individuals or non-bank lenders; and indirect finance from financial intermediaries, in the form of loans (Casu *et al.*, 2015). Financial intermediation is the process that takes place when economic agents with surplus funds invest their funds using either financial intermediaries or financial markets. It is also a process by which economic agents that are short of funds obtain financing (Fraser *et al.*, 2005). In direct finance, savers and borrowers do not need any intermediary to perform the transactions in which they are involved. Borrowers obtain funds directly from lenders and this involves an agreement between the two parties. In contrast, in indirect finance, financial intermediaries facilitate the transfer and acquisition of funds between savers and borrowers. Savers/lenders are economic agents and include individuals, firms and government wishing to keep their funds with the ultimate objective of making returns in the future that they can use to purchase property, pay school fees, and provide for retirement, among other things

(Pilbeam, 2010). Borrowers/spenders are economic agents that include individuals, firms and government and are driven by the need for income and investment. Some economic agents also borrow to finance expenditure like buying a car or a house that they cannot afford with their present income. Figure 3-1 presents the flow of funds between savers and borrowers through the two types of financing, direct and indirect finance.

Figure 3- 1: Flow of funds through the two types of financing



Source: Adapted from Cecchetti *et al.* (2011) and Mishkin (2007)

In indirect finance, financial intermediaries like banks stand between savers and borrowers. They borrow from savers (depositors) and lend funds to borrowers. In order to raise more funds, banks along with other financial intermediaries such as insurance firms, brokers, pension funds, other companies, and government, issue financial instruments called financial securities (Zyl *et al.*, 2003). Those issued by financial intermediaries are generally known as "indirect securities" and include loan contracts, negotiable certificates of deposit (NCDs) or Central Banks' debentures. An NCD is a financial instrument issued by banks, to confirm the deposit of a given amount for a precise period of time and at a set interest rate. Bank debentures, on the other hand, are short-term transferable securities issued by Central Banks

with the objective of enabling banks to invest any surplus short-term funds. The government issues short-term securities and long-term securities such as treasury bills and treasury bonds.

Securities from the private sector include bankers' acceptances and commercial paper. Bankers' acceptances are issued by private companies seeking a commitment from the bank to serve bills drawn by that specific company. A banker's acceptance indicates that a bank accepts the responsibility to pay the amount that appears on the draft to the bearer at maturity (MacDonald and Koch, 2006; Madura, 2014). In international trade, an importer makes use of a banker's acceptance to the benefit of the exporter. For example, an exporter sending goods to an importer whose credit rating is unknown will often prefer that a bank acts as a guarantor. A letter of credit specifying the terms of agreement of all parties involved in the transaction establishes a bankers' acceptance. The drawer endorses the draft in blank and the bank stamps it with the words "accepted" across the document, which obligates the bank to pay at a specified maturity date. In turn, when the banker's acceptance matures, the importer pays the bank the amount that he/she owes the exporter along with a fee to the bank for having guaranteed the payment to the exporter. The instrument becomes payable to the bearer, which means that it can be traded on the secondary market. The maturity period for a bankers' acceptance varies from one to six months (MacDonald and Koch, 2006). Commercial paper is a debt instrument issued by a company in order to obtain finance for its accounts receivables, inventories or simply to meet short-term financial obligations.

On the side of direct finance, borrowers sell securities such as equities (shares) and debt instruments like bonds or treasury bills directly to the lender in the financial markets. These securities are "primitive securities". With the development of efficient allocation of resources in the real economy, has come the advent of "derivatives financial instruments" that are based on the behavior of the underlying primitive securities (Cecchetti *et al.*, 2011). The most prominent derivative instruments are futures and option contracts mainly used in hedging or transferring the risk from one part to another. A futures contract prescribes the price at which the transaction will take place while options contracts give the holder the right, but not the obligation to buy or purchase the underlying asset (*call option*) or to sell the underlying asset (*put option*) at a fixed price at or before the maturity period. Financial market participants consider securities including bonds and companies' shares, as well as derivatives products to be good indicators of financial sector development (Lynch, 1996). Direct finance can also involve individual borrowers and lenders outside financial market.

The main barriers to the direct financing process involving individual borrowers and lenders outside the financial market are the difficult and expensive procedure involved in matching the complex needs and requirements of individual borrowers and lenders (Casu *et al.*, 2015). Indeed, lenders' requirements differ from those of borrowers. The lender that fears the risk of default from the borrower, willfully or otherwise, would wish to minimize the cost of transactions. Given lack of knowledge of future events, lenders prefer short-term lending to long-term lending as well as assets that are more easily convertible into cash. The borrower on the other hand, would prefer to obtain cash in the shortest period possible, at the lowest cost, preferably for long-term maturity. Therefore, financial intermediaries step in to bridge the gap between borrowers and lenders' desires and reconcile their incompatible needs and requirements. It is in bridging that gap that financial intermediaries play a central role.

The benefits of financial intermediation accrue to ultimate lenders, to ultimate borrowers and society as a whole (Casu *et al.*, 2015). The benefits to lenders with surplus funds position include lending to a financial intermediary rather than directly to an ultimate borrower. They achieve greater liquidity with less risk. The lending decision is quick, since there are fewer lending opportunities to financial intermediaries than to ultimate borrowers. This process reduces the transaction costs associated with lending, especially where straightforward deposit facilities are used. Finally, in a situation where there is a possibility of selling the certificate of deposit in a market, instead of waiting until maturity of the securities, depositors or lenders may sell these securities to regain cash. Generally, borrowers are able to obtain larger loans for a longer time-period from financial intermediaries at lower transaction costs than from ultimate lenders. The interest rate will generally be lower when borrowing from financial intermediaries. Furthermore, the possibility of obtaining loans at the required time is higher.

For the community or society as a whole using financial intermediaries improves evaluation of lending opportunities. There is also more efficient utilization of funds in the economy. Moreover, there will be a higher level of borrowing and lending due to the lower risks and costs associated with lending at a financial intermediary's level. Because financial intermediaries are able to absorb the risk of default by borrowers through interest earned on other loans and at a larger scale, their presence into the economy can lead to improved availability of funds for higher-risk ventures. Such ventures are widely considered important for creating the basis of future prosperity for the economy.

Many profitable investments require long-term commitment of capital, whereas, savers are sometimes reluctant to keep their savings for long periods. Raising funds from individual lenders is costly, and has been proven to be inefficient (Schiller, 2011). Furthermore, many LDCs like Rwanda have underdeveloped capital markets. Accordingly, most borrowers like small-scale firms and consumers that do not have access to equity or debt markets, are served by banks and other deposit taking institutions. Given the underdeveloped nature of the country's capital market (discussed in sub-section 2.3.4), and the fact that, private individuals as well as non-bank lenders, which are the channel to direct finance, do not have adequate financial resources for the envisaged investments; this study concentrates on indirect finance.

Several empirical studies have tested the relationship between financial intermediation and economic growth (see Gurley and Shaw, 1955; King and Levine, 1993; Levine, 1997; Levine *et al.*, 2000; Odhiambo, 2005; Muchai, 2013). Some have observed that finance may influence growth; the supply-leading hypothesis (see Khan and Semlali, 2000; Levine *et al.*, 2000; Habibullah and Eng, 2011). Others have found that growth drives finance; the demand following hypothesis (see Ghirmay, 2004; Zang and Kim, 2007). In addition, there is a possibility of bidirectional causality (see Akinboade, 1998; Odhiambo, 2005), unimportant influence or simply independence between finance and economic growth (Stern, 1989; Tuck, 2003; Cevik and Rahmati, 2013).

3.2.1 Supply-leading hypothesis

This approach, also known as "finance-led growth", postulates that development of the financial sector leads to economic growth. By promoting the financial sector, financial intermediaries are able to collect savings and grant loans to investors involved in establishing businesses that produce products or services and improve the conduct of existing ones. This view is in agreement with the findings of many studies (Goldsmith, 1969; King and Levine, 1993; Levine, 1997; Neusser and Kugler, 1998; Khan and Semlali, 2000; Levine *et al.*, 2000; Almeida and Wolfenzon, 2005; Jean-Claude, 2006; Apergis *et al*., 2007) on pooled countries' time series. It states that financial sector development and economic growth go hand-in-hand. Countries with better-developed financial systems tend to enjoy a sustained period of growth and studies confirm the causal link where the financial sector drives economic growth (see Schumpeter, 1934; Neusser and Kugler, 1998; Almeida and Wolfenzon, 2005). The same

conclusion was reached by studies conducted in developing countries, either pooled together (Odedokun, 1996; Ndikumana, 2000; Christopoulos and Tsionas, 2004; Ndebbio, 2004; Habibullah and Eng, 2011), or considered individually, such as Kilimani's (2007) and Kargbo11 and Adamu's (2009) research in Uganda and Sierra Leone, respectively. Similarly, Seetanah's (2008) investigation of the dynamic relationship between financial sector development and economic growth in Mauritius for the period 1952 to 2004 concluded that financial sector development drives economic growth. The German Imperial Government's decision to develop a banking system called the "German banks of affairs" or "capitalisation banks" that extended bank credit to industry in the late eighteenth century is a successful case that supports this hypothesis (Bowen, 1950). Foreign borrowing to finance industrial activity was avoided by creating a domestic source of financing. This contributed to the rapid expansion of German industry.

Levine and Zervos (1998) examined whether the banking sector and capital markets, as the main sources of indirect and direct finance, respectively, contribute more to economic growth. The study found that both the banking sector and stock market liquidity have independent positive and significant effects on economic growth. Arestis, Demetriades et al. (2001), Shan *et al.* (2001) and Abu-Bader and Abu-Qarn (2008) explored the relationship between financial sector development and economic growth, using a bank-based model and concluded that financial sector development is a catalyst for economic growth. Expressed differently, banks perform scrutiny and monitoring tasks on behalf of investors. They mitigate the underlying risks, by capitalizing on information acquired, which reduces uncertainty and enables funds to flow to the most profitable projects. In such a situation, the spillover effects of efficient investment lead to economic growth (Levine, 2005). Employing a neoclassical framework to analyze the linkage between finance and growth from a European perspective, Papaioannou (2007) found evidence that financial development promotes economic growth in developing and emerging countries by lowering the cost of capital while for advanced economies it works through raising total factor productivity. Similarly Habibullah and Eng (2011) noted that a strong network of financial institutions that provide diversified financial services impacts positively on economic growth.

3.2.2 Demand-following hypothesis: Economic growth creates demand for financial services

The demand-following hypothesis, also known as growth-led finance, states that when the economy grows, it creates additional demand for financial services in response to demand from investors and other economic agents (Shan *et al.*, 2001). This relationship stems from the understanding that when an economy experiences real growth, private businesses are most likely to plan investments that increase their demand for financial services (Robinson, 1952; Gurley and Shaw, 1955; Ghirmay, 2004; Zang and Kim, 2007). Improved firm performance implies an increase in the need for financial capital for expansion, meaning that financial sector development responds positively to higher rates of economic growth. Private investors are interested in exploiting available opportunities, and borrow more from financial intermediaries to make investments. In addition, financial intermediaries respond to the needs of the economy by availing new financial instruments such as bonds and other commercial papers.

Odhiambo's (2008) research on the link between financial development and economic growth in Kenya found a causal relationship flowing from economic growth to financial sector development. Likewise, Quartey and Prah (2008) found evidence to support the demand-following hypothesis in a study in Ghana using the growth of broad money to GDP ratio as a measure of financial sector development. Along the same lines, Hassan, Sanchez and Yu (2011) assessed the relationship between financial sector development and economic growth for selected low-and middle-income countries over the period 1980 – 2007 and concluded that the causal relationship runs from growth to finance in the SSA, East Asia & Pacific regions, hence supporting the demand-following hypothesis.

3.2.3 Reciprocal influence between finance and economic growth

The bidirectional influence between financial sector development and economic growth refers to the mutual influence of these variables. This indicates that financial sector development inluences economic growth and vice-versa. Patrick (1966) argued that the directional causality between financial sector development and economic growth changes with the stage of development. In the early stage of development, the economy needs the financial sector to provide funds for innovation and investment. Later, when the economy reaches a level of self-sustainability, many investors identify opportunities and increase their

borrowing, in order to further invest in new projects. Akinboade (1998)and Odhiambo (2005) established the existence of a bi-directional causality between financial development and economic growth in Botswana and Tanzania, respectively. Both studies found that financial sector development and economic growth are complementary**.** The same conclusion was reached by Luintel and Khan (1999) in a study of the finance-economic growth relationship in ten LDCs. Similarly, Calderón and Liu (2003) and Bangake and Eggoh (2011) found a mutual causal relationship between financial development and economic growth. This indicates that financial sector development and economic growth are in reciprocal influence. However, Bangake and Eggoh (2011) stressed that output growth had more influence on financial development than did financial development on economic growth. They added that this link appears to be more pronounced in low-income countries than in high-income countries.

3.2.4 Independence between finance and economic growth

The absence of any relationship between finance and economic growth presents an exception to the previous hypothesis. It indicates that financial sector development and growth in output in an economy do not influence each other. Furthermore, no unidirectional relationship is plausible between financial sector development and output growth on the one hand or between output growth and financial sector development on the other. Muchai (2013) and Cevik and Rahmati (2013) found no relationship between finance and economic growth in Kenya and Libya, respectively. Using VAR analysis for the period 1972 to 2008, Muchai's (2013) empirical study of the finance-growth channel in Kenya found that savings mobilized by financial institutions did not influence capital formation and hence did not lead to economic growth. Cevik and Rahmati's (2013) research on Libya for the period 1970 to 2010 found no long-run relationship between financial intermediation and non-hydrocarbon output growth. Similarly, in revisiting the long- and short-run relationships between bank lending (as a proxy for the financial sector) and economic growth in Malaysia for the period 1960 to 1998, Tuck (2003) found no relationship between the volume of bank loans and real output growth. A plausible explanation is possibly funds diversion to non-productive activities, due to microeconomic inefficiencies in the banking sector (Demetriades and Andrianova, 2004).

It is clear that studies of the same nature have reached different conclusions. While some found that, the relationship between financial sector development and economic growth resulted in financial supply leading economic growth (Goldsmith, 1969; Odedokun, 1996; Jean-Claude, 2006; Kargbo11 and Adamu, 2009), other found the reverse. This suggests that economic growth drives the development of the financial sector (Robinson, 1952; Quartey and Prah, 2008). Other studies found that relationship to be bi-directional (Patrick, 1966; Luintel and Khan, 1999), and a few established no relationship (Cevik and Rahmati, 2013; Muchai, 2013). In seeking to provide an explanation for these differences, Demetriades and Hussein (1996) show that the directional causality depends on the variables used. They argue that each country exhibits different results, depending on its individual characteristics. Lucas (1988) questioned the relationship between financial sector development and economic growth and concluded that, this relationship is "over-stressed". Levine (2002) and Tadesse (2004) suggest that the type of financial system is of secondary importance in the development path. What is important for growth is the existence of liquid and efficient financial intermediaries, irrespective of whether there are equity markets or banks.

3.3 Methodology

This section discusses the methods used to analyze the link between financial sector development and output growth using selected variables. It sets the model, the structural VAR for estimating the relationship under investigation based on previous theoretical and empirical studies. It defines the variables included in the model, and tests their stationarity and the plausible existence of a cointegrating relationship, and the determination of lag-length.

3.3.1 Definition of Variables

Previous empirical studies have used a range of variables to express financial sector development such as monetary aggregates (M1, M2, and M3 as percentages of GDP), domestic credit to private sector as a percentage of GDP and control variables such as human capital, geography and population (see King and Levine, 1993; Kilimani, 2007; Kargbo11 and Adamu, 2009). Some of these studies used panels of countries with the same or different

characteristics (Levine *et al.*, 2000; Almeida and Wolfenzon, 2005; Apergis *et al.*, 2007), whilst others focused on individual countries (Akinboade, 1998; Odhiambo, 2005; Cevik and Rahmati, 2013). In this study, this relationship is investigated using five variables, namely, potential liquidity available (PLA) (proxied by the ratio of M2 to GDP), real interest rates (INT), domestic credit to the private sector as a ratio of GDP (DCP), gross fixed capital formation as a ratio of GDP (GFCF), and the rate of economic growth (Y). Among these five variables, in this study, proxies for financial sector development are PLA and DCP.

Financial sector development expresses the degree of supply of financial assets within an economy and increases with its monetization (Muchai 2013). The ratio of M2 to GDP comprises the sum of funds held by financial intermediaries from demand deposits, and time and saving deposits as well as foreign reserves deposits (Ritter, Silber, Udell and Fan, 2004). Given that money offers opportunities of saving and payment services, the higher the available liquidity with financial intermediaries, the greater the capacity of these institutions to grant credit to more borrowers, and hence a potential increase in output (Lynch, 1996; Muchai, 2013). Ngalawa and Viegi (2011) argue that a decline in available bank credit adversely affects investment and output.

Real interest rates (INT) reflect the real cost of funds to investors and real return to savers. Lynch (1996) states that there is a positive relationship between the real interest rate spread and savings. A positive real interest rate spread attracts savings that, in the end, help increase investments. In addition, when the real interest rate is low, investors-cum-borrowers take advantage and increase their applications for loans with financial intermediaries. Once granted these funds are put to productive use that in turn lead to increases in the level of output. Domestic credit to the private sector (DCP) expresses more accurately the role of financial intermediaries in channeling funds to private businesses (see Khan and Semlali, 2000; Demetriades and Law, 2004). Khan and Semlali (2000) and Demetriades and Law (2004) consider the amount of bank credit to the private sector, to be a good indicator of the general level of interaction between the banking sector and the productive economic sector. A probable reason for such positive interaction is that private investors are in good position to identify projects that have good prospects. Failure by financial intermediaries to transform deposits at their disposal to lending to the private sector implies a loss of opportunities for the economy. It also indicates the level of development of the financial sector itself. For example, studies report that the financial sector in the SSA region is underdeveloped compared to other regions in the world. Kablan's (2010) study on SSA countries found that this region falls

behind compared to other regions in transforming deposits into loans to the private sector. The study found that between 1980 and 2002, the ratio of domestic credit to the private sector to GDP in SSA was about 14.6 percent, while it was 31.8 percent for Latin America and 29 percent for Asia.

The stock of capital, represented by gross fixed capital formation (GFCF), establishes a basis for economic activities. The standard prediction of the neoclassical growth model is that growth rates will be higher with enhanced capital accumulation (Papaioannou, 2007).

3.3.2 Analysis Tests

In order to avoid spurious results when estimating relationships between variables, one of the conditions is to have data that are stationary (Christopoulos and Tsionas, 2004). In the literature, the diagnosis of the properties of data uses tests for unit root and cointegration.

3.3.2.1 Unit Root Test

The analysis for stationarity of the variables series is usually conducted using graphical plots, descriptive statistics, and correlogram. Stationary series have to display a tendency of a reverting mean and a constant variance (Gujarati, 2003). If variables series are non-stationary, this indicates that they have unit root. If they are used as regressors, one may get spurious results that can mislead in decision making or policy formulation (Davidson and MacKinnon, 2004). Therefore, before making any kind of estimation, one has to make a test for unit root for the time series. If the time series has unit root, what follows is the transformation of that non-stationary time series into one that is stationary. One way of inducing stationarity in non-stationary series I(d), is to be differenced of order *d* before getting to I(0) or simply to say the series becomes stationary. However, even though differenced series may graphically look stationary, this is not sufficient; it requires formal unit root tests.

The many alternatives for testing for unit root include Dickey-Fuller (ADF) tests and Phillips-Perron (PP), among others. The ADF tests assume that error terms follow an autoregressive (AR) process of a known order while the PP presents advantages when time series have moving average components (Phillips and Perron, 1988). However, Davidson and

MacKinnon (2004) and Greene (2008) among others, argue that the most widely used approach to testing for unit root are the ADF tests. To this end, this study uses the ADF procedure to test for unit root to verify if variables are stationary, as the test assumes that error terms follow an autoregressive (AR) process which lines up with the *structural* VAR that is used in this study.

3.3.2.2 Cointegration Test

Once the unit root tests have been performed, the next step is to carry out the cointegration tests. A co-integration is a phenomenon related to a situation where two or more series having unit roots drift upward together (Greene, 2008). The series having a kind of co-movement are said to be integrated, meaning that they have a type of common trend. However, visual observation of this kind of movement is not sufficient to analyze these series; it requires a test for co-integration. Consequently, the purpose of a co-integration test is to confirm the existence of any long-run relationship(s) or analyze any short-run deviations from the long run between a set of non-stationary time series (Johansen, 1988; Phillips and Perron, 1988; Johansen and Juselius, 1990). The literature presents two approaches that are widely used to test for co-integration, namely, the Engle and Granger (1987) technique and Johansen and Juselius' (1988, 1990) technique. The Engle and Granger (1987) approach is essentially based on evaluating whether errors appear to be stationary in single-equation estimates of the equilibrium relationship. On the other hand, the Johansen and Juselius' (1988, 1990) technique focuses on the vector autoregressive (VAR) approach. As this study uses an SVAR, the test for cointegration is performed using Johansen and Juselius (1990). This test has two approaches: the trace statistic ($\lambda\, trace(r)$) and the maximal-eigenvalue statistic ($\lambda\, max(r, r+1)$) given by equation 3.1 and equation 3.2 respectively. r denotes the number of independent equilibrium relationships or co-integrating vectors and $\hat{\lambda}_i$ is the estimated value of the ith ordered eigenvalue of matrix A (matrix of coefficients of variables of the model).

$$\lambda\, trace(r) = -T \sum_{i=r+1}^{n} ln\left(1 - \hat{\lambda}_i\right) \quad (3.1)$$

The trace statistic tests the null hypothesis that there are r co-integrating vectors or $r = r_1$ against the alternative that $r = r_2$, for $r_1 < r_2 \leq g$ where g is the rank of the covariance matrix (Davidson and MacKinnon, 2004). On the other hand, the maximal-eigenvalue

statistic (see equation 3.2) tests the null hypothesis that there are r co-integrating vectors against the alternative that there are $r + 1$ co-integrating vectors.

$$\lambda\, max(r, r+1) = -Tln\left(1 - \hat{\lambda}_{r+1}\right) \quad (3.2)$$

The test for co-integration concludes that there is a long-run relationship if the trace statistic ($\lambda\, trace(r)$) and/or the maximal-eigenvalue statistic $\lambda\, max(r, r+1)$ are greater than the critical value from Johansen and Juselius' (1990) critical values. In this study, the test consists of assessing the existence of potential long-run relationship(s) between financial sector development and economic growth in the reduced form of an SVAR specified model in equation (3.5).

3.3.3 Lag-Length Determination

In conjunction with unit root tests, and prior to estimating the VAR, the selection of an appropriate lag-length is of great importance as inference on the VAR model is dependent on this choice (Canova, 2007). An appropriate lag-length assumes that residuals are Gaussian, meaning they do not suffer from autocorrelation, non-normality and heteroscedasticity. However, Hatemi-J and S. Hacker (2009) argue that the determination of criteria for choosing a lag order is not based on any conventional criteria. In many cases, the number of lagged values to be included in each equation, is determined by using Akaike Information Criteria (AIC), Schwarz Information Criteria (SIC), and Hannan and Quinn Criteria (HQC). The lower the value of criteria statistics, the better the model Gujarati (2003).

3.3.4 Econometric Model

According to Stock and Watson (2001), a VAR is an econometric model in which each variable is explained by its own lagged variables, current and past values of other endogenous variables and some exogenous variables**.** Hatemi-J and S. Hacker (2009) argued that even though the VAR model is atheoretical, it is dynamic and is in accord with economic theory. Stock and Watson (2001) and Lütkepohl (2011) consider VAR models to be powerful tools to describe the dynamic behavior of economic and financial data and to generate reliable multivariate benchmark forecasts, in their different variants in applied economics.

According to Stock and Watson (2001), these variants are a *reduced* form VAR, a *recursive* VAR and a *structural* VAR. In the reduced form, each variable is a linear function of its own lags and that of other variables with serial uncorrelated error terms. To estimate parameters, each equation uses ordinary least square regression. However, one of the shortcomings of this reduced form VAR is the possibility of having some variables in the model that are correlated, as it is observed for many macroeconomic variables. In such circumstances, any estimation may lead to biased estimates because error terms are correlated across equations. For the recursive VAR, the model is built in a way that error terms across equations are uncorrelated. As a result, residuals are uncorrelated across equations. While this recursive VAR overcomes the problem of correlation among error terms, it suffers from the use of an arbitrary mechanical technique based on Choleski decomposition of the variance-covariance matrix to model contemporaneous correlation among variables (Cooley and LeRoy, 1985; Keating, 1992). This indicates that any change in the order of variables in VAR equations ends up changing the parameters estimated. Criticism of the Choleski decomposition led to the development of a structural VAR that uses economic theory to identify the contemporaneous relationships between variables (Bernanke, 1986; Blanchard and Watson, 1986; Sims, 1986). This technique consists of the transformation of the reduced form VAR in a model of structural equations based on economic theory. The SVAR is thus considered as a superior alternative to the above-mentioned VAR models in the recent economic literature (Canova, 2007). Structural VAR also has the advantage of flexibility in setting restrictions on data. Berkelmans (2005) argues that the SVAR does not impose too many restrictions on the data used when capturing the endogenous relationships among variables in the system. Pagan (1987) notes that another strength of the SVAR is that, it is developed and estimated in a way that ensures the model is consistent with a coherent theoretical view of long-run relationships between variables while also taking into account the short-run dynamics. Equally, SVAR has the advantage of being carried in levels to avoid the loss of information that makes the analysis of impulse responses functions meaningful (Ramaswamy and Sloek, 1998). The authors state that the impulse response functions from the SVAR in levels enable determination of whether or not the impact of shocks is persistently permanent. Along the same lines, Phillips and Perron (1988) stressed that impulse response analysis, based on the unrestricted VAR containing unit roots, is inconsistent. This suggest that policy based on estimated impulse responses undertaken from unrestricted VARs can be misleading.

To illustrate the SVAR, assume that the structural form of the VAR is given by equation (3.3) below:

$$Ay_t = C_0 + D_1 y_{t-1} + D_2 y_{t-2} + \cdots + D_p y_{t-p} + Bu_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.3)$$

where A is an invertible matrix(kxk) of the coefficients on the i^{th}variable in the i^{th} equation. This invertible matrix describes the contemporaneous relations among variables. C_0 is a $(kx1)$vector of constants or intercepts, y_t is a $kx1$ vector of endogenous variables. D_i for all $i = 1, 2, \dots, p$ is a vector of coefficients, B is a (kxk) matrix whose non-zero off-diagonal elements allow for direct effects of some shocks on more than one endogenous variable in the system, and u_t is a $(kx1)$ vector of error terms that may be contemporaneously correlated, but are uncorrelated with their own lagged values.

The system of equations (3.3) cannot be easily estimated because the variables have contemporaneous effects on one another. This problem is solved by rewriting the VAR in a reduced form, which is obtained by pre-multiplying equation (3.3) by the inverse of A (Greene, 2003; Gujarati, 2003; Enders, 2004; Ngalawa and Viegi, 2011):

$$y_t = A^{-1}C_0 + A^{-1}D_1 y_{t-1} + A^{-1}D_2 y_{t-1} + \cdots + A^{-1}D_p y_{t-p} + A^{-1}Bu_t \dots\dots\dots\dots\dots\dots\dots (3.4)$$

Designating $A^{-1}C_0$=γ_0, $A^{-1}D_1$=γ_1, $A^{-1}D_2 = \gamma_2$ and $A^{-1}D_p$= $\gamma_i$for all $i = 1, 2, 3, \dots, p$ and $A^{-1}B\ u_t$=e_t, equation (3.4) can be rewritten as:

$$y_t = \gamma_0 + \sum_{i=1}^{p} \gamma_i\, y_{t-i} + e_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots .. (3.5)$$

The result in equation (3.5) can be easily estimated because no variable has a direct contemporaneous effect on other variables in the VAR (Greene, 2003; Ngalawa and Viegi, 2011). In this reduced form, the occurrence of one structural shock on one variable can potentially be transmitted to other variables, due to the fact that the error terms in the VAR are composites of e_t=A^{-1}Bu_t. The vector e_t holds the following properties:

E(e_té$_t$) = $\sum$ where A$\sum A'$ =BB' ………………………………………………………(3.6)

The structural economic shocks are separated from the estimated reduced form residuals by imposing restrictions on the parameters of matrices A and B as presented in equation (3.6) based on economic theory (Giannini, 1991; Berkelmans, 2005). The model requires a set of $2n^2 - \left(\frac{n(n+1)}{2}\right)$ restrictions on the matrices A and B for model identification in order to

derive practical economic structures (Giannini, Lanzarotti and Seghelini, 1995). To impose these restrictions, this study makes use of structural factorization, an approach commonly applied in the recent literature (Ngalawa and Viegi, 2011; Amisano and Giannini, 2012). The structural shocks are identified according to the following system of equations (3.7):

$$\begin{bmatrix} e_t^{pla} \\ e_t^{int} \\ e_t^{dcp} \\ e_t^{gfcf} \\ e_t^{y} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & a_{15} \\ a_{21} & 1 & a_{23} & 0 & 0 \\ a_{31} & a_{32} & 1 & a_{34} & a_{35} \\ 0 & 0 & a_{43} & 1 & 0 \\ a_{51} & 0 & a_{53} & 0 & 1 \end{bmatrix}^{-1} \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 \\ 0 & 0 & 0 & 0 & b_{55} \end{bmatrix} \begin{bmatrix} u_t^{pla} \\ u_t^{int} \\ u_t^{dcp} \\ u_t^{gfcf} \\ u_t^{y} \end{bmatrix} \dots\dots\dots (3.7)$$

where:

Matrix A = $\begin{bmatrix} 1 & 0 & 0 & 0 & a_{15} \\ a_{21} & 1 & a_{23} & 0 & 0 \\ a_{31} & a_{32} & 1 & a_{34} & a_{35} \\ 0 & 0 & a_{43} & 1 & 0 \\ a_{51} & 0 & a_{53} & 0 & 1 \end{bmatrix}$ and Matrix B = $\begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 \\ 0 & 0 & 0 & 0 & b_{55} \end{bmatrix}$

Therefore, to make the system of equations (3.7) just identified, 35 constraints have to be imposed on the two matrices A and B. Matrix B has 20 coefficients that are equal to zero, and the main diagonal of matrix A provides another five restrictions because each structural equation is normalized to a given specific endogenous variable. In addition to the five restrictions on the main diagonal, matrix A also provides 10 more restrictions and 10 free parameters to be estimated. The five structural innovations "u_s" essentially represent shocks to potential liquidity available, real interest rate, domestic credit to the private sector, gross fixed capital formation and output. They are considered as a source of fluctuations in the observable variables. The non-zero coefficients "a_{ij}" indicate that variable *j* affects variable *i* instantaneously.

In the system (3.7), equation one implies that potential liquidity available responds only contemporaneously to a shock from output (Ngalawa and Viegi, 2011). In order to adjust instantaneous potential liquidity available in response to any adverse shock in the level of output (being either a decrease or an increase above the level of potential level of output), the monetary authorities change money supply in the opposite direction of the shock (Mankiw, 2011).

Equation two suggests that only real interest rate responds contemporaneously to shock in potential liquidity available and to shock from domestic credit to the private sector (Berkelmans, 2005; Mankiw, 2011). An expansionary monetary policy increases the amount available from financial intermediaries for loans, which in this study is called potential liquidity available (*PLA*). The increase in liquidity available put downward pressure on interest rates (*i*). Following a decline in the interest rate, private investors as well as households tend to increase their borrowing as expressed in equation three. Financial intermediaries tend to raise the interest rate in response to increased demand for credit by the private sector. If the interest rate increase is far above the Central Bank's discount rate, the Central Bank can react by increasing money supply in order to correct such disturbance (Cecchetti *et al.*, 2011). In contrast, when demand for credit falls drastically below the Central Bank's discount rate, to encourage borrowings, the response of the Central Bank is in the opposite direction. In such circumstances, it can act by decreasing the discount rate that offers financial intermediaries opportunities to borrow from the Central Bank as the cost of borrowing has decreased. In turn, they have the possibility of extending more credit to the economy.

Equation three postulates that domestic credit to the private sector is contemporaneously affected by all variables in the system. The interaction of domestic credit to the private sector with other variables in that equation are in accordance with Berkelmans (2005) and Ngalawa and Viegi's (2011) argument that credit responds contemporaneously to money supply shock, interest rate shock and output shock. The response to interest rate shock is in relation to the behavior of households and investors relative to the interest rate being a cost of borrowing. The response to output shock is justified by the fact that people borrow in response to current activity, but also taking into consideration expectations about future activity. In this equation, the feedback is an opportunity that lines up with the possibility of increasing investment by businesses or consumption by households in acquiring homes or durable goods such as vehicles, refrigerators or furniture (Berkelmans, 2005; Mankiw, 2011). Conversely, if the shock leads to a fall in potential liquidity available, the interest rate increases. As the cost of funds is expensive, this discourages borrowers from increasing their borrowings, hence limiting investment or consumption that also affect the country's output.

Equation four indicates that capital formation is directly influenced only by changes in credit to private sector. Capital formation is one of the options for the use of borrowed funds for investment and consumption on durable goods. Finally, equation five indicates that output

responds instantaneously to shocks in potential liquidity available, and domestic credit to the private sector as well as to capital formation. The response of output to innovation in potential liquidity available is consistent with the effect of an expansionary monetary policy in the short-run (Mankiw, 2011).

Prior to analyzing the transmission of shocks on the VAR system, a stability test is carried out. A VAR is stable if all the eigenvalues of matrix A of coefficients of the lagged variables have modulus less than one (Hatemi-J, 2004). That means that none of the inverse roots of the characteristic autoregressive polynomial lies outside the complex unit circle**.**

The study employs impulse responses and variance decomposition to analyze the results. Introduced in VAR modeling by Sims (1980), impulse response functions provide an answer to the question of how a change in one variable, affects the system in the future. It traces the time path response of the current and future values of each variable to a one unit increase, in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero (Stock and Watson, 2001; Enders, 2004; Amisano and Giannini, 2012). It provides a quantitative measure of the reaction of each variable to shocks in the different equations of the system (Bernanke and Mihov, 1997). Variance decomposition, on the other hand, indicates the extent to which the forecast error variance of each variable can be explained by shocks to the remaining variables. It provides information on the proportion of the movements in a sequence, due to the variable's own shock and other identified shocks (Enders, 2004), separating the variation in endogenous variables into the component shocks of the VAR**.**

3.3.5 Data and variables

The VAR used in this study contains five variables, namely, financial development, proxied by PLA (potential liquidity available is measured by the ratio of M2 to GDP) and domestic credit to the private sector (DCP), real interest rates (INT), gross fixed capital formation (GFCF), and the rate of economic growth (Y). These variables are quarterly time series from World Development Indicators and span the period 1996:1 – 2010:4 (World Bank, 2014). The initial intention was to cover a period of about three decades, but because the economy of Rwanda was totally destroyed during the 1994 genocide, the starting point is moved forward to 1996 when the economy started recovering. The cut-off date is set at 2010 because

data is not available for many variables thereafter. In addition, the variables are initially available in annual frequency, but are converted to quarterly series using the Quadratic-match average approach**.** Except for real interest rate, and GDP growth rate, each series used is in natural logarithm form. While data interpolation has the advantage of increasing degrees of freedom, it has some shortfalls related to "seasonal factors" that may arise in quarterly data. However, according to Marwah (1997), this problem is not as serious in quarterly data as it might be in higher-frequency data (e.g., monthly, weekly or daily data). If the time series consists of weekly or daily data, this may require adjustment of such data to remove the seasonality aspect that can lead to unstable relations (Chow, 1984).

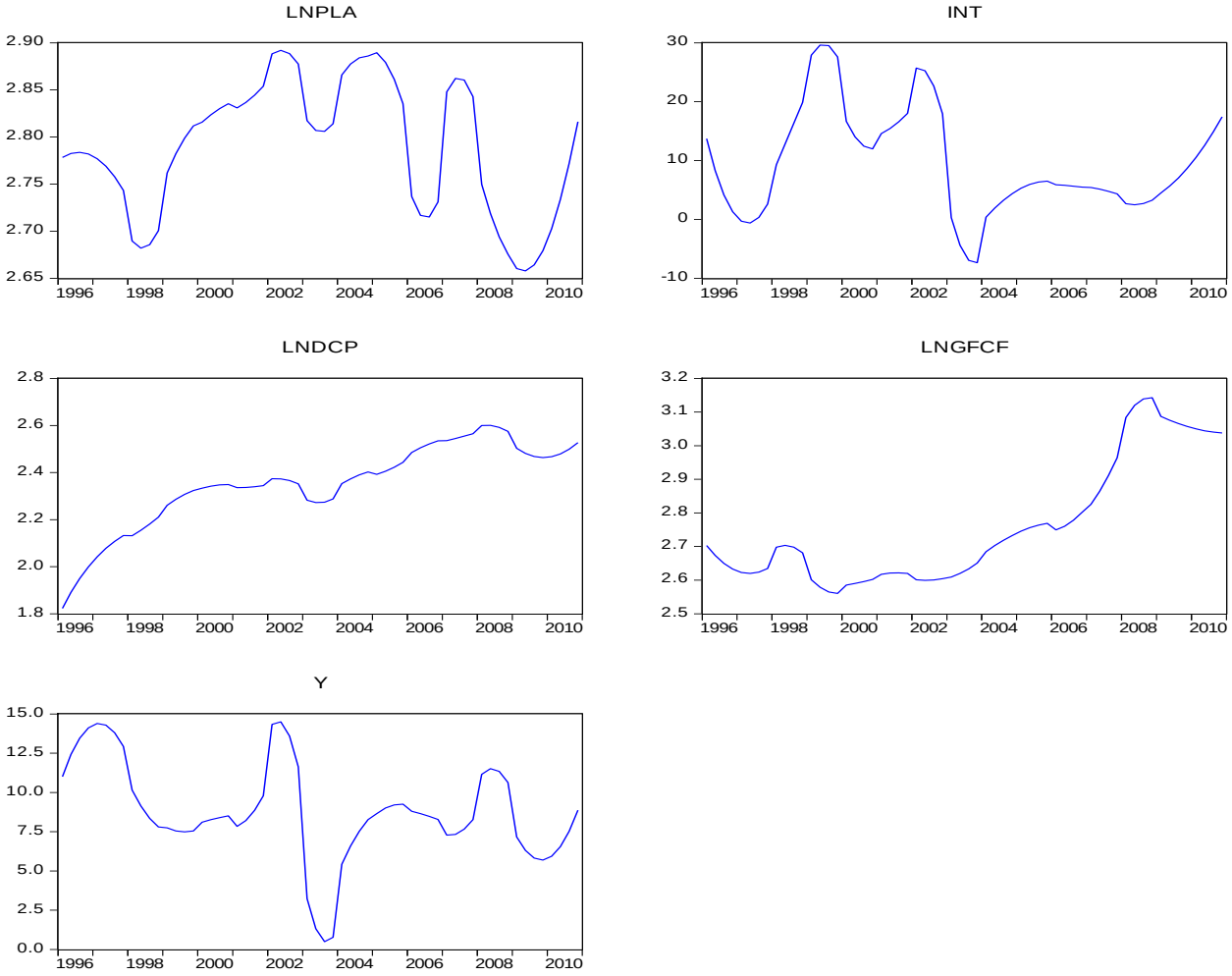
3.4 Empirical Results and Discussion

The long-run relationship between financial sector development and economic growth is estimated using the cointegration technique of Johansen and Juselius (1990), and using the computer software E-Views 7. However, prior to undertaking the estimation, the data is tested for stationarity, in order to understand its properties (Harris, 1995). While the test for stationarity is very useful, it is not sufficient. The selection of an appropriate lag-length and test for stability of the system are also very important.

3.4.1 Stationarity Tests

As pointed out earlier, stationary series have to display a reverting mean and a constant variance (Gujarati, 2003). Using graphical plots as displayed in Figure 3-2, visual examination reveals that none of the variables is stationary, as none of the graphs fluctuates around a zero mean.

Figure 3- 2: Graphical plots of variables series



***PLA**: Potential Liquidity Available, **INT**: Real Interest Rate, **DCP**: Domestic Credit to Private Sector, **GFCF**: Gross Fixed Capital Formation, **Y**: GDP growth.*

From the graphical plot, none of the variables appears to be stationary. Therefore, the study uses the ADF test to determine the order of integration of the variables in the model. The results report that all series are I(0) at first difference (see Table 3-1 for results).

Table 3- 1: ADF unit root test results for stationarity of variables

Variable	**Levels (ADF Test Statistic)**	**1st Difference (ADF Test Statistic)**	**Order of integration**
Potential liquidity available (PLA)	0.201789	- 2.198665**	I(1)
Real interest rates (INT)	- 0.604608	- 2.499218**	I(1)
Domestic credit to private sector (DCP)	0.975554	- 2.378643**	I(1)
Gross Fixed Capital Formation (GFCF)	0.788542	- 4.140875***	I(1)
GDP growth (Y)	- 0.795077	- 3.050678***	I(1)

Note: (***), (**), and (*) signify rejection of the unit root hypothesis at the 1%, 5% and 10% levels, respectively.

3.4.2 Lag length selection

As indicated previously the appropriate lag length to consider is the one associated with the lowest values of the criteria statistics given by any of Akaike Information Criteria (AIC), Schwarz Information Criteria (SIC), or Hannan and Quinn Criteria (HQC). For this study, the lag length of two in each equation as shown on Table 3-2 was determined concomitantly by AIC, SIC, and HQC, as well as the sequential modified Likelihood Ratio test statistic (LR) and final prediction error (FPE)**.**

Table 3- 2: Lag length selection

Sample: 1996Q1 2010Q4

Included observations: 57

Lag	LogL	Likelihood Ratio Test	Final Prediction Error	Akaike Information Criteria	Schwarz Information Criteria	Hannan and Quinn Criteria
0	-188.3027	NA	0.000607	6.782552	6.961767	6.852201
1	194.4109	684.8559	2.16e-09	-5.768802	-4.693512	-5.350908
2	255.2483	98.19374*	6.26e-10*	-7.026256*	-5.054890*	-6.260116*
3	268.0201	18.37352	1.01e-09	-6.597197	-3.729757	-5.482812

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)

3.4.3 Cointegration Tests

Once the unit root tests are performed and all variables are identified as I(1), the next step is to carry out cointegration tests using the Johansen and Juselius (1990) procedure. Co-integration of the variables in our model, if established, suggests that there is a long-run relationship between the variables (Gujarati, 2003). The Johansen and Juselius (1990) cointegration test has two variants: the Trace test ($\lambda\, trace(r)$) and the Maximum Eigenvalues test ($\lambda\, max(r, r+1)$). The procedure starts with the selection of the correct lag-length. All information criteria confirm the number of lagged values to include in each equation identified to be two (see Table 3-2). Thereafter an analysis of the SVAR's stability follows in order to establish the stability of the model and assurance of meaningful impulse response and variance decomposition outcomes. For the stability of the VAR, all the inverse

roots of the characteristic polynomial are less than one (see Table 3-3), meaning that they are all inside the unit circle.

Table 3- 3: Roots of characteristic polynomial

Endogenous variables: Potential Liquidity Available, Real Interest Rate, Domestic Credit to Private Sector, Gross Fixed Capital Formation, and GDP growth

Lag specification: 1 2

Root	Modulus
0.948477	0.948477
0.854568	0.854568
0.809860 - 0.242636i	0.845426
0.809860 + 0.242636i	0.845426
0.696161 - 0.401135i	0.803461
0.696161 + 0.401135i	0.803461
0.747230	0.747230
0.472239 - 0.413446i	0.627652
0.472239 + 0.413446i	0.627652
0.402696	0.402696

No root lies outside the unit circle.
VAR satisfies the stability condition.

Given the conclusiveness of the above tests, a formal test for cointegration is performed and the results are presented in Table 3-4.

Table 3- 4: Results of cointegration tests

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.422972	83.56607	69.81889	0.0027
At most 1 *	0.363729	52.22381	47.85613	0.0184
At most 2	0.247481	26.45240	29.79707	0.1158
At most 3	0.156853	10.24563	15.49471	0.2623
At most 4	0.009092	0.520626	3.841466	0.4706

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.422972	31.34226	33.87687	0.0974
At most 1	0.363729	25.77141	27.58434	0.0838
At most 2	0.247481	16.20677	21.13162	0.2130
At most 3	0.156853	9.725009	14.26460	0.2306
At most 4	0.009092	0.520626	3.841466	0.4706

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The trace test indicates the existence of two cointegrating relationships because from trace test statistic 52.22 that is greater than the critical value 47.86, the null hypothesis that there is at most one co-integrating vector is rejected in favour of two co-integrating vectors or relationships. The maximum eigenvalue test suggests no cointegrating relationship because none of the maximal-eigenvalue statistic is greater than the critical value. This study adopts the results of the trace test, as it has been established that it is superior, since it appears to be more robust to skewness and excess kurtosis in the residuals than the maximum eigenvalue test (Sjö, 2008). Following the confirmation of the existence of cointegrating relationships, and satisfaction of the necessary and sufficient condition for stability of the system, it can safely be concluded that the model's impulse response functions and forecast-error variance have meaningful interpretations. Therefore, an analysis of short-run dynamics can be carried out using impulse response functions and variance decomposition among the variables employed in the study.

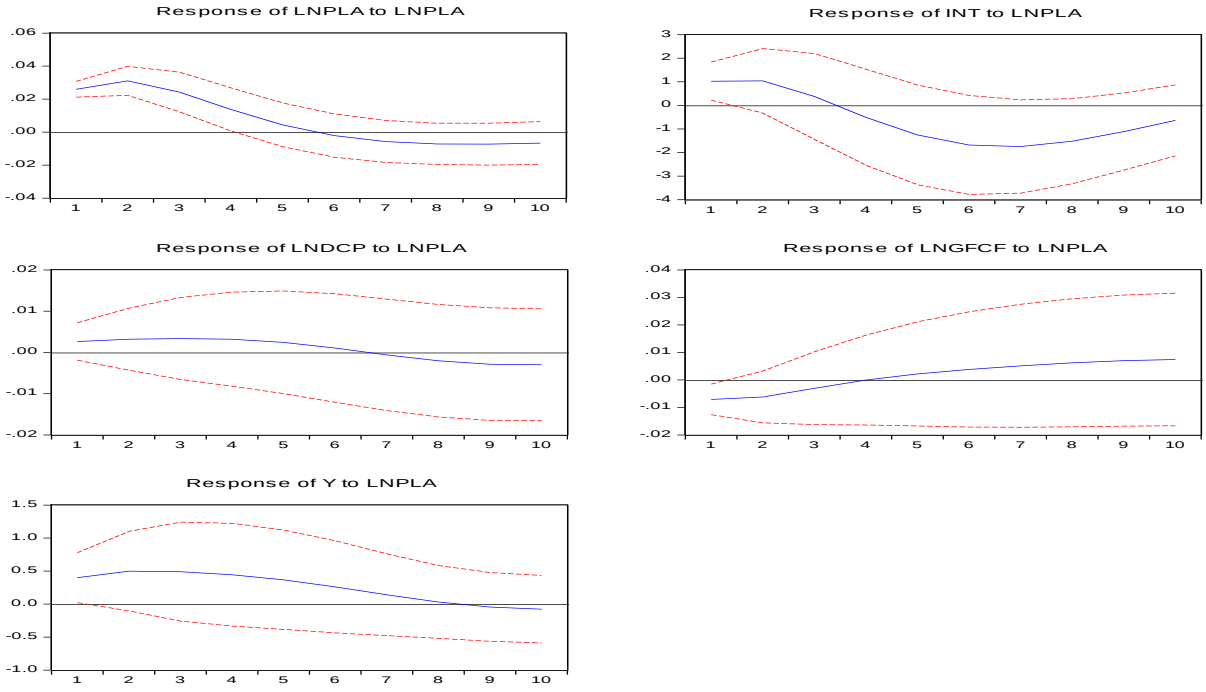
3.4.4 Impulse responses and variance decomposition analysis

3.4.4.1 Impulse Responses Analysis

Impulse response functions provide responses on how a change in one variable, affects the system in the future. In this study, impulse response functions show reaction of the five variables, namely, potential liquidity available, real interest rate, domestic credit to the private sector, gross fixed capital formation and output to a shock coming from any of these variables making up the system (3.7). Figures 3-3 to 3-7 summarize these impulse responses.

Figure 3-3 summarizes the responses to a structural shock on PLA. It shows that an increase of 1 percent in PLA in the first quarter, leads to a decrease in real interest rate by 0.9 percent, a slight increase in gross fixed capital formation of about 0.1percent below the baseline and a small increase in economic growth of 0.4 percent (see Figure 3-3). The small increase in capital formation following a shock in PLA for loans is probably in relation to the high level of consumption observed in the Rwandan context that represents a larger proportion of GDP. From 1996 to 2013, the ratio of final consumption expenditure to GDP in Rwanda is almost above 90 percent (World Bank, 2016). All three responses quickly become insignificant by the second quarter. The significant output response to a potential liquidity shock, nonetheless, supports the supply-leading hypothesis on the relationship between financial sector development and GDP growth. Domestic credit to the private sector, however, does not respond significantly to the PLA shock. Thus, PLA appears to have little impact on real output. This finding is not surprising due to the imperfect structure of the financial sector in Rwanda and the level of use of banking services by its citizens. For example, the number of borrowers from commercial banks (per 1,000 adults) increased from 0.38 in 2004 to 10 in 2013 while those making deposits with commercial banks (per 1,000 adults) changed from 7.5 in 2004 to 234 in 2013 (World Bank, 2016).

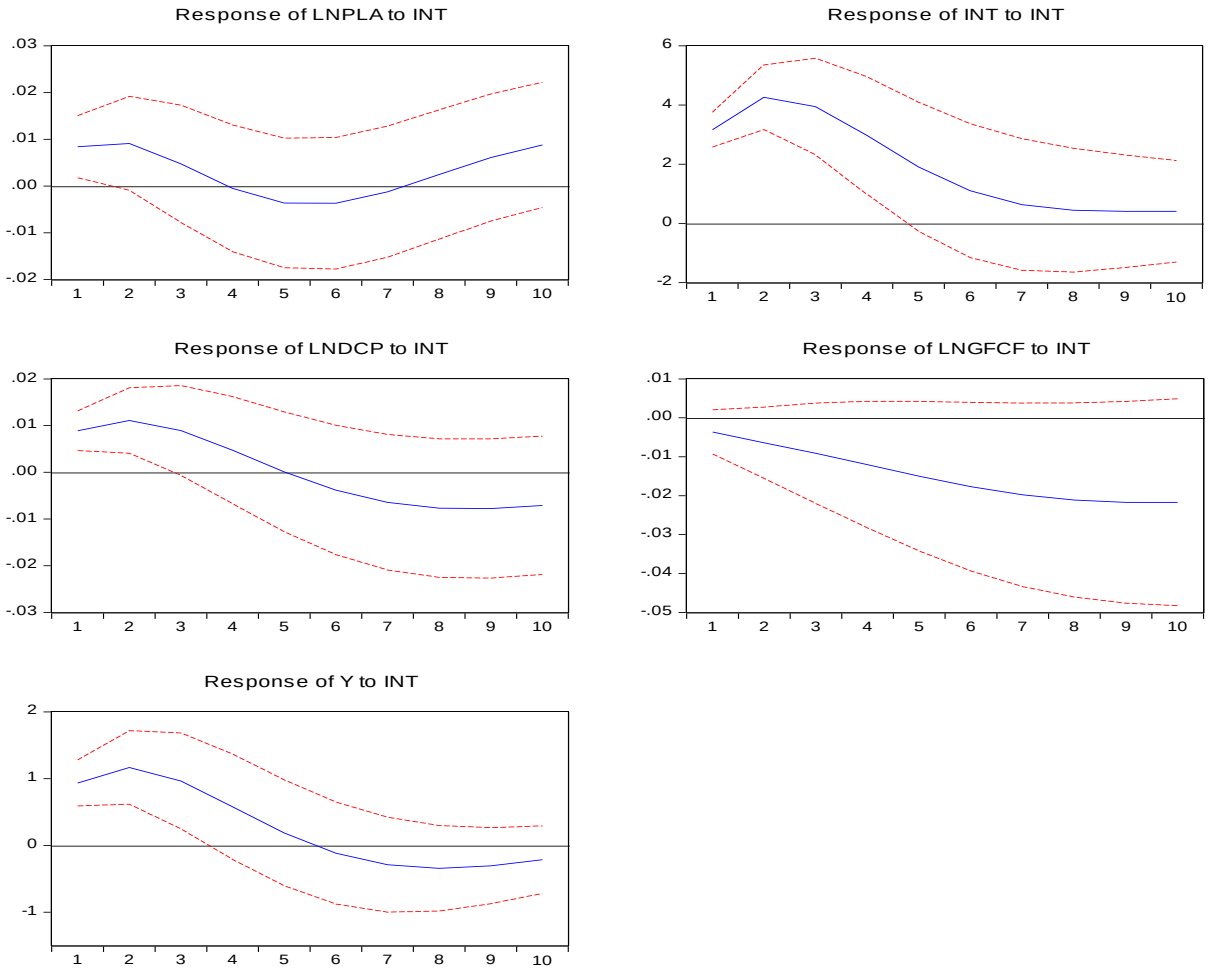
Figure 3- 3: Impulse Responses to a potential liquidity available (PLA) Shock



***PLA**: Potential Liquidity Available; **INT**: Real Interest Rate; **DCP**: Domestic Credit to Private Sector; **GFCF**: Gross Fixed Capital Formation; **Y**: GDP growth.*

Figure 3-4 presents the impulse responses of the selected variables to an interest rate shock. It shows that following the shock, domestic credit to the private sector increases, reaching a maximum of 1.1 percent in the second quarter before returning to equilibrium by the end of the third quarter. Real GDP growth increases up to a maximum of 12 percent in the second quarter. This response becomes insignificant by the fourth quarter. The increase in domestic credit to the private sector following a positive interest rate shock may appear inconsistent with the conventional theory. However, it reveals that in Rwanda, domestic private borrowers may not be primarily constrained by how high interest rates are, but rather by the availability of domestic credit. An increase in interest rates makes lending more profitable for financial intermediaries. Thus, financial intermediaries may reshuffle their asset portfolio in the wake of increasing interest rates, in the process increasing the share of loans and advances in total assets.

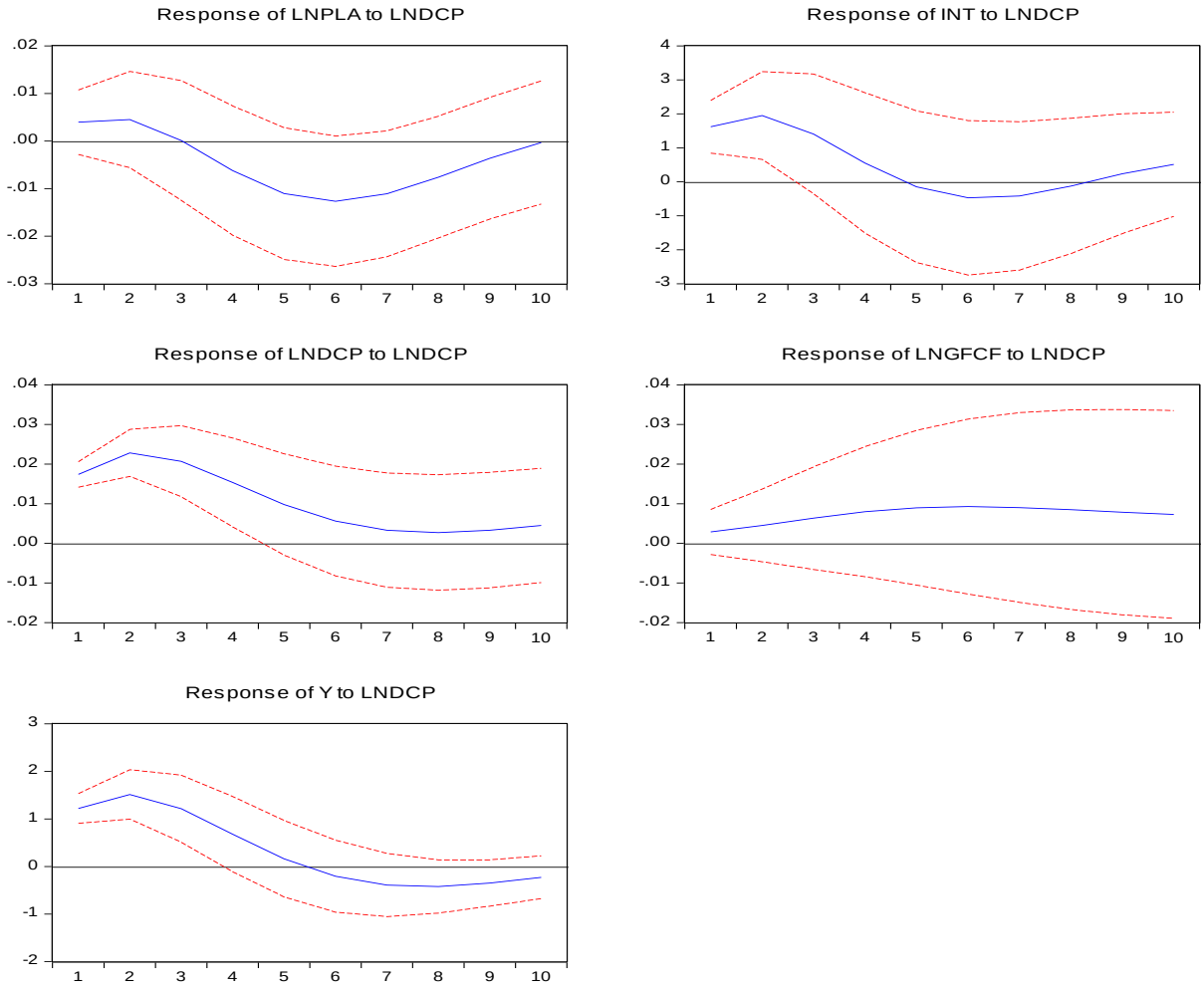
Figure 3- 4: Impulse Responses to an interest rate Shock



***PLA**: Potential Liquidity Available; **INT**: Real Interest Rate; **DCP**: Domestic Credit to Private Sector; **GFCF**: Gross Fixed Capital Formation; **Y**: GDP growth.*

Figure 3-5 presents the impulse responses of the selected variables to a shock on domestic credit to the private sector. It shows that following the shock, real output growth increases significantly reaching a maximum of 15 percent in the second quarter, and thereafter declining to equilibrium in the fourth quarter. Interest rates also respond to the shock with an initial increase of 1.5 percent and 2 percent in the second quarter before declining to equilibrium. This shows that an increase in domestic credit to the private sector raises interest rates, probably due to financial intermediaries' declining ability to convert other assets into loans and advances. This was pointed out by Kablan (2010) as among the features characterizing the level of intermediation in LDCs where the financial sector is less developed.

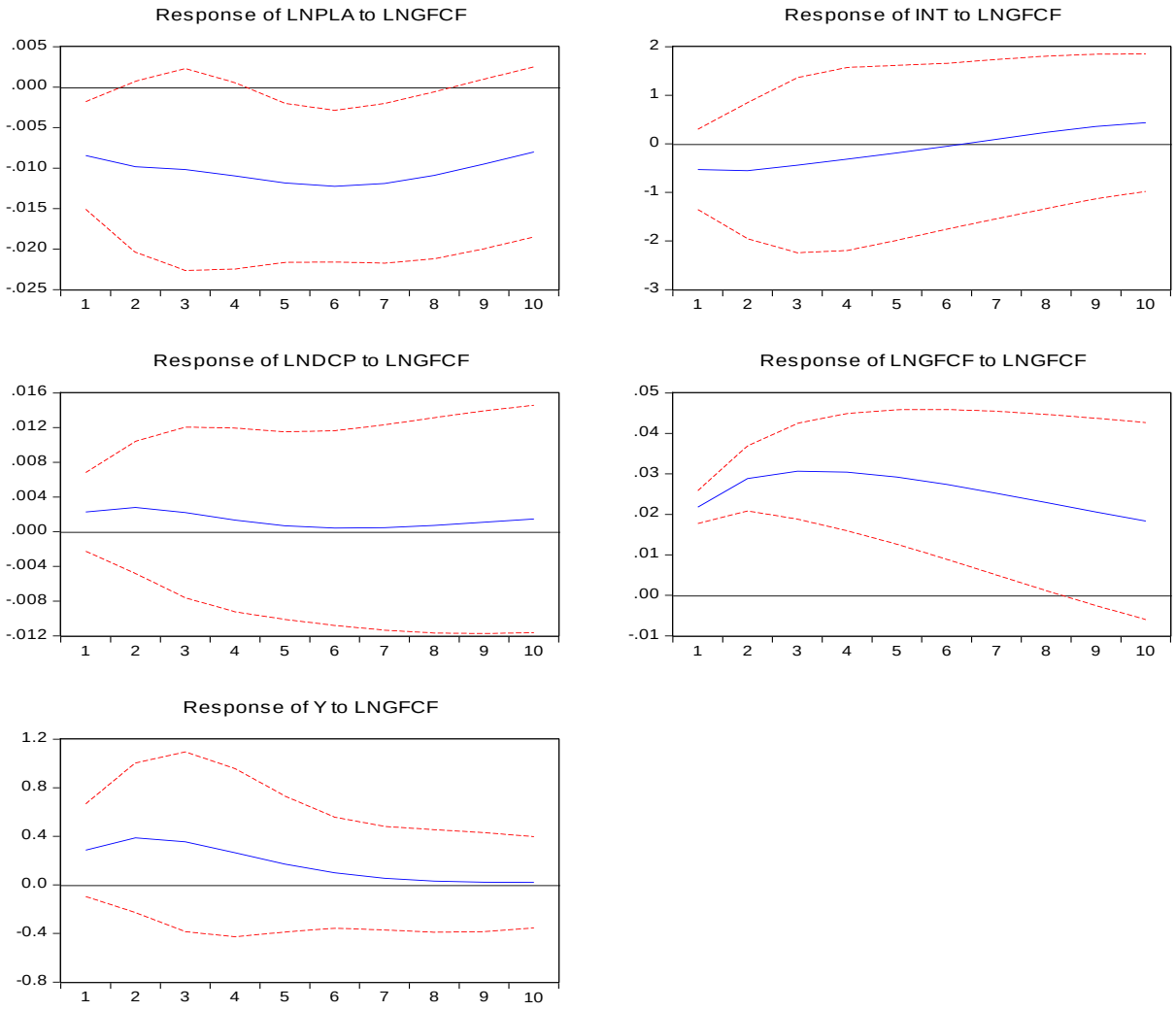
Figure 3- 5: Impulse Responses to a DCP Shock



***PLA**: Potential Liquidity Available; **INT**: Real Interest Rate; **DCP**: Domestic Credit to Private Sector; **GFCF**: Gross Fixed Capital Formation; **Y**: GDP growth.*

Figure 3-6 presents the impulse responses of selected variables to a capital formation shock. It shows that following the shock, PLA reacts to the shock by decreasing slightly below the baseline in the first quarter and quickly becoming insignificant.

Figure 3- 6: Impulse Response to a GFCF Shock

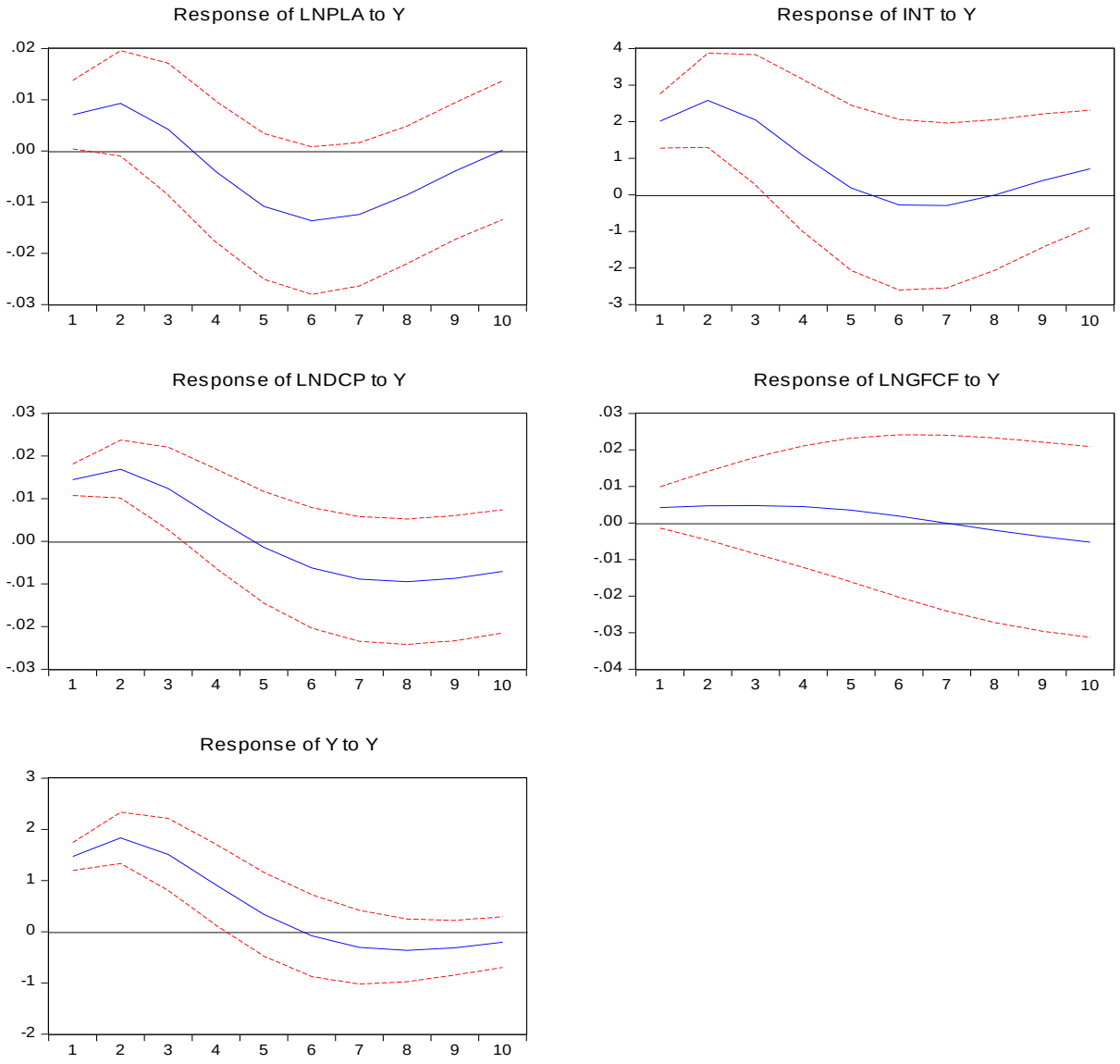


***PLA**: Potential Liquidity Available; **INT**: Real Interest Rate; **DCP**: Domestic Credit to Private Sector; **GFCF**: Gross Fixed Capital Formation; **Y**: GDP growth.*

The impulse responses of a real output growth shock are presented in Figure 3-7. Potential liquidity available increases instantaneously following the output growth shock, probably to accommodate the increase in economic activity arising from the shock. The increase in potential liquidity is, however, marginally significant and it becomes clearly insignificant by the beginning of the second quarter. Interest rates respond to the shock by increasing initially, peaking at about 3.5 percent after two quarters before taking a downturn and reverting to equilibrium. Domestic credit to the private sector also records an immediate increase

following the shock, peaking after about two quarters. The instantaneous rise in domestic credit and interest rates in the first period is a direct consequence of the real output growth shock. The higher output growth in the first period requires an increase in investment and hence financial resources, consequently putting upward pressure on domestic credit to the private sector and interest rates.

Figure 3- 7: Impulse Responses to Y shock



***PLA**: Potential Liquidity Available; **INT**: Real Interest Rate; **DCP**: Domestic Credit to Private Sector; **GFCF**: Gross Fixed Capital Formation; **Y**: GDP growth.*

3.4.4.2 Variance Decomposition

The proportion of fluctuations in a given variable due to different innovations to each variable is provided in the variance decomposition for every variable in the model**.** Specifically, the relationship between the innovations of financial expansion through potential liquidity available (PLA), the domestic credit to the private sector (DCP), gross fixed capital formation (GFCF), and real interest rate (INT) vis-à-vis economic growth (Y) is analyzed. The results from the decomposition method clarify how the forecast error variance of the variables under examination can be broken into components, which in turn can be in relation to each of the variables in the SVAR. The forecast variance decomposition of our SVAR uses estimates over a sixty quarters period and Table 3-5 provides details of the first 20 quarters**.**

Table 3- 5: Variance Decomposition

Variance decomposition of Potential Liquidity Available

Period	Standard Error	Potential Liquidity Available	Real Interest Rate	Domestic Credit to Private Sector	Gross Fixed Capital Formation	GDP Growth
1	0.102904	98.16707	0.811298	1.001603	0.010016	0.010016
4	0.208081	86.75151	0.426327	10.80246	1.894881	0.124819
8	0.241641	70.42638	0.922944	13.13260	15.38921	0.128870
12	0.278422	65.70520	1.389530	12.40430	20.37316	0.127814
16	0.300620	59.78121	1.575537	18.94573	19.47881	0.218716
20	0.321929	52.50907	1.595011	28.13855	17.41929	0.338078

Variance decomposition of Real Interest Rates

Period	Standard Error	Potential Liquidity Available	Real Interest Rate	Domestic Credit to Private Sector	Gross Fixed Capital Formation	GDP Growth
1	0.101446	1.010097	98.97939	0.010306	0.000103	0.000103
4	11.06761	36.77586	2.028087	58.20867	2.417382	0.570005
8	22.47933	58.91776	2.099122	37.86261	0.750057	0.370450
12	24.09669	59.35421	2.051549	37.27811	0.915345	0.400787
16	25.51548	57.16956	1.843743	38.29669	2.258709	0.431300
20	26.16567	56.23184	1.756277	39.02292	2.549611	0.439347

Variance decomposition of Domestic Credit to Private Sector

Period	Standard Error	Potential Liquidity Available	Real Interest Rate	Domestic Credit to Private Sector	Gross Fixed Capital Formation	GDP Growth
1	0.103725	0.816358	0.630925	96.62031	0.966203	0.966203
4	0.358962	0.204617	0.885275	97.60482	0.192745	1.112545
8	0.559954	0.225447	1.041497	97.34989	0.188986	1.194181
12	0.686182	0.152823	1.029952	97.47244	0.137686	1.207097
16	0.761438	0.176633	1.056490	97.41222	0.148837	1.205818
20	0.803503	0.262408	1.085794	97.26335	0.183203	1.205240

Variance decomposition of Gross Fixed Capital Formation

Period	Standard Error	Potential Liquidity Available	Real Interest Rate	Domestic Credit to Private Sector	Gross Fixed Capital Formation	GDP Growth
1	0.101999	0.036802	0.825754	1.019449	98.10780	0.010194
4	0.305433	5.416843	2.068113	13.82021	78.52100	0.173843
8	0.556188	9.058138	2.494076	44.48185	43.42561	0.540329
12	0.782913	9.014226	2.403478	61.02456	26.80723	0.750507
16	0.958580	7.608585	2.234900	70.01186	19.27519	0.869462
20	1.088503	6.325636	2.086295	75.26516	15.38466	0.938253

Variance decomposition of GDP Growth

Period	Standard Error	Potential Liquidity Available	Real Interest Rate	Domestic Credit to Private Sector	Gross Fixed Capital Formation	GDP Growth
1	0.100000	0.000000	0.000000	0.000000	0.000000	100.0000
4	2.275768	33.45622	0.252584	36.27915	28.29763	1.714417
8	6.139682	27.72303	0.082826	54.46856	16.95636	0.769218
12	6.548727	24.99927	0.130086	58.72731	15.35340	0.789938
16	6.567449	24.95289	0.135523	58.80016	15.31874	0.792693
20	6.583714	24.88875	0.134865	58.82772	15.35624	0.792421

Table 3-5 shows that variations in domestic credit to the private sector and gross fixed capital formation better explain the fluctuations in potential liquidity available. The contribution of domestic credit to the private sector (DCP) to variations in potential liquidity available (PLA), increases from 10.80 percent after four quarters to 12.40 percent after 12 quarters, and 28.14 percent after 20 quarters. The contribution of gross fixed capital formation to fluctuations in potential liquidity available also increases from 1.89 percent after four quarters to 20.37 percent after 12 quarters, but drops to 17.42 percent after 20 quarters. The

contribution of real output growth to fluctuations in potential liquidity available is very small, and remains less than 0.5 percent each quarter over 20 quarters.

It is further observed in Table 3-5 that domestic credit to the private sector accounts for the largest proportion of fluctuations in real output growth, followed by potential liquidity available, indicating that the relationship between financial intermediation and economic growth in Rwanda may be supply leading. Domestic credit to the private sector accounts for 36.28 percent of the fluctuations in real output growth in the first four quarters, and increases to 54.47 percent after eight quarters and 58.83 percent after 20 quarters. The contribution of potential liquidity available to variations in real output growth is somewhat smaller albeit still large relative to other variables. Potential liquidity available accounts for 33.46 percent of the variations in real output growth after four quarters, but drops to 27.72 percent after eight quarters and 24.89 percent after 20 quarters. This corroborates the earlier observation from the impulse response functions connoting that financial sector development leads economic growth (supply-leading hypothesis).

Gross fixed capital formation also accounts for a relatively large proportion of the fluctuations in GDP growth. Table 3-5 further shows that gross fixed capital formation explains about 28.29 percent of the fluctuations in GDP growth after four quarters. The contribution of gross fixed capital formation in GDP growth variations declines to 15.35 percent after 12 quarters and remains more or less the same at 15.36 percent after 20 quarters.

The largest proportion of the fluctuations in domestic credit to the private sector is explained by domestic credit to the private sector itself (96.62 percent in the first quarter, 97.47 percent after 12 quarters and 97.26 percent after 20 quarters). This is probably explained by the imitating behavior inherent in Rwanda, in conducting business with limited entrepreneurial spirit and less diversification. In addition, it reconfirms that domestic credit to the private sector does not necessarily line up with interest rates in Rwanda. Rather, with more credit, additional productive capacity take place through increased gross fixed capital formation and GDP growth, which again requires more domestic credit to the private sector. This explains why besides its own contribution; GDP growth contributes the most to fluctuations in domestic credit to the private sector. GDP growth accounts for 1 percent of the variations in domestic credit to the private sector after the first quarter, increases to 1.2 percent after 12 quarters and remains unchanged until after 20 quarters.

3.5 Concluding Remarks

This chapter investigated the link between financial intermediation and economic growth in Rwanda for the period 1996:1 to 2010:4. The study applied a cointegration procedure and a Structural VAR with potential liquidity available and domestic credit to private sector as measures of financial sector development. It finds that GDP growth makes a very small contribution to fluctuations in potential liquidity available (used as a measure of financial development). This indicates that a GDP growth shock leads to a very small increase in potential liquidity available, which is marginally significant. On this basis, the study concludes that there is no evidence that economic growth leads financial development in Rwanda.

The findings also show that potential liquidity available accounts for a third of the fluctuations in GDP in the first four quarters, and drops to about a quarter at the end of five years. This suggests that GDP growth increases instantaneously and significantly following a shock to potential liquidity available. Likewise, the domestic credit to private sector accounts for large proportion of fluctuation in the real output growth ranging from 36.28 percent in the first four quarters to 58.83 percent after five years. This provides evidence that the relationship between financial sector development and economic growth in Rwanda is in line with the supply-leading hypothesis, indicating that development of the financial sector leads to economic growth in the country and not vice versa.

Thus, the financial sector may be acting as a driver of economic growth in Rwanda. These findings are in agreement with similar studies on developing countries (Odedokun, 1996; Ndikumana, 2000; Christopoulos and Tsionas, 2004; Ndebbio, 2004), Kilimani (2007) and Kargbo11 and Adamu (2009). The question of how efficient the Rwandan financial sector is in order to contribute effectively to economic growth is thoroughly explored in the following chapter.

CHAPTER FOUR

MEASURING COMMERCIAL BANKS' EFFICIENCY IN RWANDA: A STOCHASTIC FRONTIER ANALYSIS

4.1 Introduction

Chapter Three reviewed the relationship between financial intermediation and economic growth in Rwanda. The directional causality between financial sector development and economic growth was established to be supply-leading meaning that financial sector development drives economic growth. The chapter emphasized that Rwanda should strengthen incentives to attract businesses to effectively use financial institutions' services, underscoring that domestic credit to the private sector is the main reason for fluctuations in real output growth followed by potential liquidity available. However, the literature highlights that financial institutions can only have a positive impact on the economy if they are efficient (see Berger and DeYoung, 1997; El and Gamal and Inanoglu, 2005; Freixas and Rochet, 2008; Chen, 2009). Consequently, this chapter examines how efficient the Rwandan financial sector is, based on an analysis of commercial banks which account for the largest proportion of total financial assets in Rwanda, i.e., 78.6 percent in 2013 (BNR, 2014). If the banking sector is performing at high efficiency levels with existing resources, the sector can provide better services and make a larger contribution to economic growth (Freixas and Rochet, 2008). In contrast, if the sector performs at a low level of efficiency, any worthwhile contribution would be either be greatly diminished or absent. Kablan's (2010) study on bank efficiency and financial development in SSA found that SSA banks are less developed and have problems in transforming deposits collected into loans to the private sector. According to this study, in 2003, the SSA region displayed an intermediation ratio of 51 percent, compared to 75 percent for Latin America and 91 percent for Asia.

Many studies have been conducted on bank efficiency in developed economies at regional or country level (see Edward Chang, Hasan and Hunter, 1998; Altunbaş, Gardener, Molyneux and Moore, 2001; Sathye, 2001; Drake and Hall, 2003; Fang, Hasan and Marton, 2011; Aiello and Bonanno, 2013). A comprehensive compilation by Berger and Humphrey (1997) indicates that of 116 single countries covered by the survey, 81 are on developed countries,

including 66 on the US**,** 14 on Europe, and 1 on Canada. Other studies have focused on Asian countries (Bhattacharyya, Knox Lovell and Sahay, 1997; Chen, 2001; Hardy and Bonaccorsi di Patti, 2001; Xiaoqing Maggie and Heffernan, 2007)**,** and Latin America (Taylor, Thompson, Thrall and Dharmapala, 1997; Carvallo and Kasman, 2005).

A limited number of studies have covered some African countries (Chaffai, 1997; Agu, 2004; Kablan, 2007; Chen, 2009; Ncube, 2009; Muvingi, 2015). Furthermore, very few studies have focused on low-income SSA countries (Agu, 2004; Aikaeli, 2006; Onour and Abdalla, 2010; Lelissa, 2014; Miencha, Murugesan, Vasanth, Lingaraja and Raja, 2015) and very few of these have applied a stochastic frontier approach. In addition, only one of the few studies conducted on some SSA countries mentioned efficiency in the Rwandan banking sector with only 23 observations in a sample of 152 countries (Hasan, Koetter, Lensink and Meesters, 2009). Despite this small number of observations (23 over a period of eight years), the study also aggregated the banking sector at country level which leads to very generalized results. To the best knowledge of the author, there is no published study on the efficiency of commercial banks operating in Rwanda. This chapter, therefore, contributes to the literature by investigating the efficiency of commercial banks operating in Rwanda from 2007 to 2013. The efficiency of the banking sector can attract investors to the country either by establishing new businesses, or engaging in joint ventures or simply lending funds to banks directly or through the purchase of established companies' bonds. This analysis will assist bank management to improve the possibility of their institution's survival in a globalized and integrated, competitive financial market (Isik and Hassan, 2002).

The analysis in this chapter differs from Hasan *et al.* (2009) in that it spans a recent period, 2007 – 2013, counts more observations, 49 compared to 23, and does not generalize the financial sector but focuses on commercial banking, which dominates the banking sector in Rwanda (BNR, 2014). The study also utilizes a more contemporary approach in analyzing efficiency, which is the stochastic frontier approach that yields more consistent estimates than other approaches to measure efficiency including accounting, non-parametric or other parametric ones.

The findings of the study confirm a mean cost efficiency of 88.56 percent, implying that commercial banks in Rwanda jointly wasted about 11.44 percent of available resources to produce the level of output they achieved during the period 2007 – 2013. This suggests that

in order to enhance their efficiency, banks could reduce their input composition by 11.44 percent. Furthermore, inefficiencies are statistically significant, decreasing over time with the penetration of foreign-owned banks in the Rwandan banking sector, and increasing with the rapid replacement of Chief Executive Officers (CEOs) in office.

The rest of this chapter is organized in the following sections. Section 4.2 reviews the theoretical and empirical analysis of cost efficiency; Section 4.3 outlines the methodology; Section 4.4 reports on the results of the assessment carried out with reference to the efficiency of the commercial banking sector in Rwanda; and Section 4.5 presents a summary and concluding remarks.

4.2 Banking Cost Efficiency Measurement

Neoclassical theory postulates that firms are rational in maximising profitability. From this perspective, firms produce at the frontier. However, there is still inefficiency in the process of production either at firm or industry level, limiting the level of profitability. Therefore, an analysis that establishes the magnitude of efficiency of a firm as well as at industry level is of great significance for different stakeholders. This section presents the theoretical foundations of efficiency measurement and its application to the banking sector.

4.2.1 Theoretical Foundations of Efficiency Measurement

In the efficiency measurement literature, two broad approaches have been used, accounting-based ratios approach and the frontier approach that includes both non-parametric and parametric approaches.

4.2.1.1 Accounting-based Ratios

The efficiency ratio is an accounting-based ratio that measures efficiency (MacDonald and Koch, 2006). It measures a bank's ability to control noninterest expenses relative to net (adjusted) operating incomes.

$$Efficiency\ ratio\ (EFF) = \frac{Noninterest\ expense}{Net\ intest\ income\ (NII) + Noninterest\ income} \ldots\ldots\ldots\ldots\ldots\ldots (4.1)$$

Bank managers use this ratio to measure the success of their efforts to contain noninterest expenses while adding earnings from increasing fees. It indicates precisely how much a bank pays in noninterest expenses for one monetary unit of operating income. For good practice, bank analysts advise banks to maintain this ratio below 55 percent per monetary unit of net operating income. The smaller the ratio the more profitable the bank, *ceteris paribus*. Accounting-based measures of efficiency are, however, limited due to different accounting conventions and differences in the regulatory and risk environments across countries which can make international comparison less valid (Matthews and Thompson, 2008). However, they can be effective for similar kinds of banks operating in the same geographical, regulatory and supervisory conditions.

4.2.1.2 Frontier Approaches

Section 2.5.3 in chapter two discussed a number of non-parametric and parametric techniques used to measure financial sector development through efficiency. It underlined that DEA and SFA are the frontiers approaches most often used to measure efficiency.

Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) was developed by Charnes, Cooper, and Rhodes in 1978 (Charnes, Cooper and Rhodes, 1978). It is based on a concept of efficiency that is extensively used in engineering and the natural sciences (Yue, 1992). The model corresponds to a mathematical programming applied to measure the efficiency of a variety of institutions. In engineering, the measure of efficiency of a given machine is the ratio of output produced by that machine to the amount of energy that the machine consumed in the process of production. Therefore, based on this definition of efficiency, a firm is efficient in comparison to another one if it produces the same level of output with fewer inputs or more output using the same or lesser inputs. In relation to inefficiency, the DEA assumes that there are no random fluctuations in the process of production and attributes all deviations from the frontier to inefficiency (Ferrier and Lovell, 1990; Yue, 1992)**.**

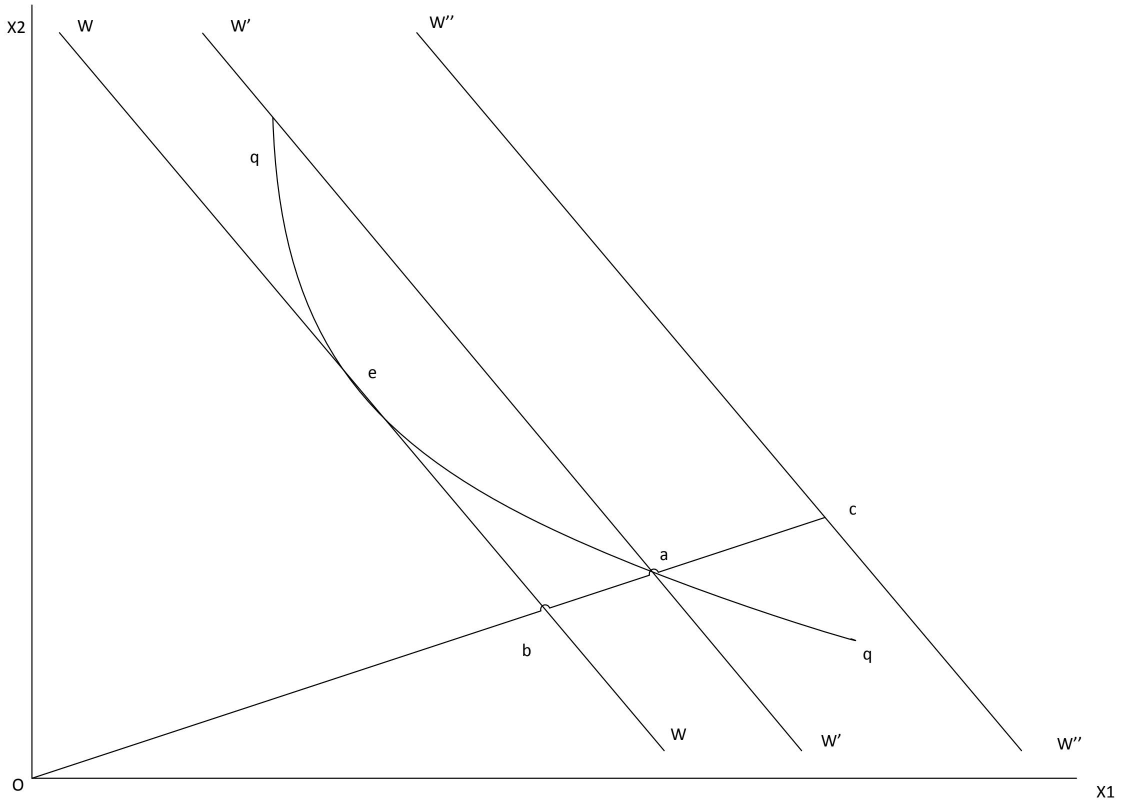
The extensive application of DEA could be due to the fact that, it does not require information on prices or an explicit functional form of the production function to be specified prior to estimating efficiency scores. It only requires data inputs and output quantities and their selection has fewer limitations than other alternatives such as econometric approaches. With regard to the functional relation to be estimated, the DEA is a mathematical programming algorithm related to a multi-objective optimisation problem in which all inputs are minimised and all outputs are maximised all together (Yue, 1992). In addition, DEA efficiency scores do not depend on the units in which inputs and output are measured, as long as these units are the same for all firms in the sample**.** However, the major limitation of the DEA approach is related to its assumption of the absence of a random error (Berger and Humphrey, 1997; Battese, Coelli, Rao and O'Donnell, 2005). This denotes that the application of DEA assumes that there is no measurement error when defining the frontier, and no eventuality of giving a certain firm a higher or a lower performance. Furthermore, the inaccuracies in accounting rules make the measured outputs and inputs deviate from economic measures of outputs and inputs.

Stochastic Frontier Analysis (SFA)

Stochastic Frontier Analysis is a parametric approach to measure efficiency. Generally it assumes that the inefficiency component of the error term follows a truncated normal distribution and that the random error term follows a symmetric normal distribution (Ferrier and Lovell, 1990; Battese *et al.*, 2005). This approach dates back to Farrell (1957) who made use of the work of Debreu (1951) and Koopmans (1951) to design a straightforward measure of a firm that could account for many inputs. Debreu (1951) introduced a measure of output-oriented technical efficiency, which he called a "coefficient of resource utilisation". Farrell (1957) built on this work by demonstrating how to measure input-oriented technical efficiency, input allocative efficiency, and cost efficiency (Kumbhakar and Lovell, 2000). Farrell (1957) suggested that the efficiency of a firm consists of a composite of *technical efficiency* and *allocative efficiency* which is consistent with the neoclassical theory of production (Kumbhakar and Lovell, 2000; Matthews and Thompson, 2008). Using this theory, an application can be drawn from a firm producing a single output (Q) with two inputs (x_1 and x_2). Figure 4-1 displays technical efficiency and allocative efficiency, and hence economic efficiency or cost efficiency. Technical efficiency refers to the aptitude of a firm to achieve maximum output from a given set of inputs while allocative efficiency

denotes the aptitude of a firm to use available inputs in an optimal combination, given their respective prices and production technology (Kumbhakar and Lovell, 2000).

Figure 4- 1: Technical Efficiency and Allocative Efficiency



Source: Matthews and Thompson (2008)

Suppose that a firm uses inputs x_1 and x_2 to produce a given level of output Q (see equation 4.2). The total cost of production is C (see equation 4.3) where $w_1$and w_2 are respectively prices of inputs x_1 and x_2. The isocost *ww* is given by the ratio of input prices.

$$Q = f\ (x_1, x_2) \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (4.2)$$

$$C = w_1 x_1 + w_2 x_2 \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . (4.3)$$

If the firm produces a level of output at point *c*, which is to the right of isoquant *qq*, then the firm is technically inefficient because it employs more inputs x_1 and x_2 than needed to produce the level of output *q* on the isoquant. In contrast, if the firm produces a level of output given by point *a*, it is 100 percent technically efficient. Formally, the measure of technical efficiency (*TE*) is given by the ratio of expenditure at point *a*, to the expenditure at point *c* or the ratio *Oa/Oc*. In this case, the firm produces the level of output *q* using the correct combination of factors of production or inputs, yet still using more inputs than is

optimal. Thus, the firm is technically efficient, but not cost efficient because of a misallocation of factors of production in line with their relative prices.

On the other hand, the ratio of cost efficiency to input-technical efficiency (*Ob/Oa*) measures allocative efficiency (*AE*)**.** As the firm moves along the isoquant curve from point *a,* towards point *e* (the minimum cost possible), the gap *ab* decreases up to zero and allocative efficiency *AE*=100 percent. As a result, this decomposition leads to the relation giving the allocative efficiency as *AE = CE/TE*.

Combined, the measures of technical efficiency and allocative efficiency provide a measure of "economic efficiency" or "cost efficiency". The concept of economic efficiency is related to a state where firms find a mixture that enables them to produce the desired level of output at minimum cost (Yue, 1992). The efficient cost-minimising position corresponds to point *e*, where the isocost *ww* is tangent to the isoquant *qq*. The ratio of minimum cost represented by isocost *ww* to actual cost represented by isocost $w''w''$(which passes by *c* and is parallel to *ww)* measures the cost efficiency. Thus, the cost efficiency (*CE*) is measured by the ratio of expenditure at point *e* (which is indeed equal to expenditure at point *b*) to expenditure at point *c* or simply by *Ob/Oc*. Part of cost inefficiency results in no optimal combination of inputs which is represented by the distance *ba*. Figure 4-1 shows that generally, cost inefficiency is different to technical inefficiency as long as the distance *ba* is different from zero.

As the SFA relates to this type of frontier analysis, its history comprises of two major phases. The first can be traced to work of Farrell (1957), Aigner, Lovell Knox and Schmidt (1977) and Meeusen and Van den Broeck (1977) while the second culminates in Battese and Coelli's (1995) paper. In the first phase, there were attempts to improve the model by capturing all components of the stochastic frontier model vis-à-vis inclusion of all disturbing factors that hinder firms from being on the frontier. These disturbing factors enter the model through the error term having two components, one of which captures technical inefficiency while the other captures exogenous factors outside the control of producers or managers, while having an effect on output (Aigner and Chu, 1968; Timmer, 1971; Schmidt, 1976). In the second phase, attempts were made to incorporate the firm's specific effects that were initially invariant, to vary across firms and over time (Kalirajan, 1981; Pitt and Lee, 1981; Kumbhakar, Ghosh and McGuckin, 1991; Reifschneider and Stevenson, 1991; Battese and Coelli, 1992; Huang and Liu, 1994).

The earliest work on the frontier production function that followed Farrell's (1957) contribution assumed a deterministic production frontier function of the form of equation (4.4). In this function, it is assumed that a certain maximum level of output y_i is to be attained using a set of inputs, x_i.

$$y_i = f(x_i, \beta) \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots .. (4.4)$$

Aigner and Chu (1968) applied the techniques of mathematical programming to a cross-section of N firms within the industry to estimate the unknown vector of parameters, β, of a production function expressing the maximum output attainable from the inputs combination at the existing state of technology. One of the problems of such deterministic models was their high sensitivity to outliers, which led to the development of 'probabilistic' production frontiers by Timmer (1971). In this alternative approach, a deterministic frontier is computed using mathematical programming techniques with a sequence of solutions until the computed frontier becomes stable. However, the computed deterministic frontier makes hypotheses testing impossible, meaning that the mathematical programming techniques lacked known statistical properties. In an attempt to provide such frontier models with a statistical basis, Schmidt (1976) added a one-side disturbance term to (4.4), which led to the model expressed in equation (4.5).

$$y_i = f(x_i, \beta) + \varepsilon_i \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots .. (4.5)$$

with$i = 1, \dots, N$ (which is the number of firms concerned in the model).

Schmidt (1976) pointed out that the goal of programming models has a statistical interpretation if a distributional assumption is imposed on the disturbance term, ε_i. By adding the distribution assumption for the error term, ε_i, the model can be estimated by maximum likelihood techniques. This model specification has solved the problem of noise which previous frontier models were unable to account for. In addition, it facilitated hypotheses testing. However, such specification ignores the fact that random shocks such as the effects of weather, luck, strikes, and damaged material, among others that are not under the control of a producer affect output. In this case, there was no room for the possible influence of measurement error and other statistical noise on the estimated frontier production function. It was assumed that all deviations from the frontier arose from technical inefficiency, and not from other exogenous factors. In order to address the problems associated with both the deterministic and probabilistic frontier Aigner *et al.* (1977) and Meeusen and Van den Broeck (1977) concurrently introduced the stochastic production frontier models. These models

allow for the presence of technical inefficiency while acknowledging the fact that exogenous factors outside the control of producers can have an effect on output. Consequently, to estimate the stochastic frontier production function, one has to keep a mind a separation between the impacts on output of shocks due to exogenous factors' "noise" and the contribution of change to inefficiency. The statistical noise is accounted for by adding a symmetric error term **(**v_i**)** to a non-negative error term accounting for inefficiency **(**u_i**).** From this stochastic frontier approach, the estimation of technical efficiency involves two conditions. The first consists of the specification of the functional form of the production function and the second is specification of the distributional assumption of the composed error term. Then, the error term is defined following equation (4.6).

$$\varepsilon_i = v_i + u_i \quad \ldots\ldots (4.6)$$

$$i = 1, \ldots, N$$

Equation (4.6) shows that the composite error term, ε_i has two components: a symmetric error component (v_i) capturing the effect of measurement error and other random shocks outside the firm's control. The error term v_i are assumed to be independently and identically distributed i.e, $v_i \sim N(0, \sigma^2)$. The one-sided error component (u_i) captures the level of technical inefficiency from firm specific effects, which are under the firm's control such as carelessness of employees in the production process. The disturbance component (u_i) is derived from a normal distribution truncated above at zero and has to be distributed independently of v_i. However, even though there was improvement in modelling this error term, in general, studies that followed that of Aigner *et al.* (1977) and Meeusen and Van den Broeck (1977) did not incorporate the environment effects as explanatory variables in their models to predict technical efficiency.

Authors like Pitt and Lee (1981) and Kalirajan (1981) investigated the relationship between environmental variables and predicted technical inefficiencies using a two-stage approach (Battese and Coelli, 1995)**.** Firstly, to estimate the main frontier model, they used environmental variables previously omitted. Secondly, they regressed the predicted technical inefficiencies on the environmental variables. Omission of environmental variables in the frontier function at the first stage generally leads to biased estimators of the parameters of the deterministic part of the frontier function, as well as biased predictors of technical inefficiency (Battese *et al.*, 2005). To solve this imperfection, they allowed environmental

variables to directly influence the stochastic component of the stochastic frontier function by assuming that inefficiency effects in the frontier model have distributions that vary with environmental variables.

Kumbhakar *et al.* (1991), Reifschneider and Stevenson (1991) and Huang and Liu (1994) proposed models in which the parameters of the stochastic frontier production function and the inefficiency model are estimated simultaneously based on appropriate distributional assumptions with cross-sectional data of firms in the sample**.** On the other hand, as an improvement, Battese and Coelli (1995) presented an extension of Kumbhakar *et al.* (1991), Reifschneider and Stevenson (1991) and Huang and Liu (1994) by introducing estimation of technical inefficiency effects in a stochastic frontier production function by applying a panel data set**.** Using panel data provides an alternative way of avoiding either the strong distribution assumptions of the data, or equally a strong independence assumption made in the cross-sectional production frontier literature (Kumbhakar and Lovell, 2000)**.** A process of repeated observations in a sample of producers can serve as a stand-in for strong distributional assumptions in cross-sectional data. Equally, not all estimations on panel data require the independence of the technical inefficiency error component from the explanatory variables**.** In the Battese and Coelli (1995) model, the inefficiency effects are stochastic and follow a truncated distribution, and the model allows the estimation of both technical change in the stochastic frontier and time-varying technical inefficiencies. In addition, the parameters of the model are estimated by applying the method of maximum likelihood which permits the separation of the effects of inefficiency and those of technical change (Battese *et al.*, 2005). Moreover, in hypotheses testing, to test an individual coefficient, one can use a Z test or a likelihood ratio test (LR test). However, if the hypothesis testing concerns more than one coefficient, the appropriate test is the LR.

While the SFA has been extensively applied as a measure of efficiency and has recorded success, the approach has its drawbacks. Firstly, the stochastic frontier model fails to decompose individual residuals into their two components, thus making it impossible to estimate technical inefficiency by observation (Førsund, Knox Lovell and Schmidt, 1980). Secondly, the derived level of efficiency is susceptible to the functional form of the frontier and also to the specification of the component of the error term (Berger *et al.*, 1993). Nevertheless, despite these shortcomings, in comparison to other frontiers models, it produces higher scores estimates of efficiency (Heffernan, 2005).

4.2.2 Empirical Measurement of Efficiency in the banking sector

As noted earlier, the assessment of efficiency in this chapter focuses on cost efficiency in the banking sector. Efficiency in the banking sector has been the subject of a number of studies (see DeYoung, 1997; Resti, 1997; Sathye, 2003; Semih Yildirim and Philippatos, 2007; Hughes and Mester, 2008; Hays, De Lurgio and Gilbert, 2009; Tahir, Bakar and Harons, 2010). Some have focused on cost efficiency (Bonin, Hasan and Wachtel, 2005; Xiaoqing Maggie and Heffernan, 2007; Lelissa, 2014) while others dwelt on cost-profit analysis (Isik and Hassan, 2002; Ncube, 2009). Given that this study applies a stochastic cost frontier analysis to measure commercial banks' efficiency in Rwanda, the review focuses on cost frontier related studies.

Cost efficiency models are based on expenditure to acquire total inputs (total cost) and data on their prices, as well as the output quantity produced using acquired inputs (Kumbhakar and Lovell, 2000). They do not utilise input quantity data in their estimation because researchers presume that banks take present input prices and output quantities as given, and then attempt to minimise costs by employing the optimal level of inputs (Isik and Hassan, 2002). Consequently, cost efficiency is considered as a measure of how far a bank's cost is from best practice bank's cost setting; if both have to produce the same bundle of output under the same environmental conditions. Thus, the cost function specifies the minimum cost of producing the output vector, *y*, given the cost drivers, such as price vector p (labour, Pl; capital, Pk and funds, Pf), and some exogenous factors beyond the managers' control. Estimation of cost frontier can be accomplished in situations where producers produce a single output or multiple outputs (Kumbhakar and Lovell, 2000).

The measure of cost efficiency is normally between zero and unity, and attains its upper bound if, and only if, a producer uses a cost-minimizing input vector. Cost inefficiency can arise depending whether one is employing an excess amount of inputs (technical inefficiency), or has a sub-optimal mix of inputs (allocative inefficiency). Xiaoqing Maggie and Heffernan (2007) argue that firms become more X-efficient (numerical efficiency measure) by lowering costs, through for example, improved management and/or greater employee productivity, which brings them closer to a more efficient way of exploiting available resources.

Empirical studies on the banking sector have been carried out using translog cost functions or Cobb-Douglass cost functions, and very few studies have been conducted applying effects cost frontier models (Greene, 2005a; 2005b). Many of these studies have found that banks are cost efficient. In a study on the level of efficiency of Ethiopian Banks in the period 2008 – 2012, using a DEA approach, Lelissa (2014) found that the sector was at the average level of cost efficiency of 86.7 percent. Along similar lines, Ncube (2009) applied a translog cost frontier model to assess the efficiency of South Africa's commercial banking sector. He found improvements in cost efficiency at eight commercial banks in the country, from an average mean of 40.4 percent in 2000 to 66.2 percent in 2005. Using a translog cost frontier function to assess bank efficiency in the West African Economic Monetary Union (WAEMU) for the period 1993 – 1996, Kablan (2007) found an average cost efficiency of 67 percent. In conducting the test of bank efficiency using a translog cost frontier model on a sample of 152 countries, Hasan, Koetter et al. (2009) found that, except for Ethiopia and Honduras that exhibit relatively higher efficiency of 90.6 percent, the mean cost efficiency was between 28 and 91 percent. Adopting a DEA approach, Hauner and Peiris (2005) also found average bank cost efficiency of 92.6 percent in Uganda for the period 1999 – 2004, just after the privatisation of the largest state-owned Uganda Commercial Bank. Similarly, Aikaeli (2006) found an estimated 8.56 percent X-inefficiency of commercial banks in Tanzania for the period 1998 – 2004, using a translog cost frontier function. Using a translog cost frontier on data from private Korean banks for the period 1985 – 1995, Hao, Hunter et al. (2001) reported an average cost efficiency of 88.97 percent. This indicates that 11.03 percent of cost was wasted because banks did not operate at the efficient frontier.

Integrating the bank-specific and industry-specific characteristics as well as macroeconomic determinants in the analysis of the efficiency of the banking sector in Tanzania for the period 2005 – 2008 using the DEA approach, Raphael (2013) found that the level of technical inefficiency in the banking sector in the country was 13 percent. This presents a slightly worse situation than the 8.56 percent reported by Aikaeli (2006). Banks' inefficiency may have increased as a direct result of the international global financial crisis of 2007–2009.

Some studies have reported weak cost efficiency estimates or even the inverse, denoting an overall decrease in cost efficiency and therefore implying an increase in total cost. Applying a translog cost frontier model to estimate X-efficiency and scale-efficiencies of the banking sector in Croatia for the period 1994 – 1995, just after the liberalisation policy of 1990, Kraft

and Tırtıroğlu (1998) found that new banks were more X-inefficient and more scale-inefficient while being highly profitable, although the relationship was weak. They reported X-efficiency estimates in the range of 54.7 percent to 87.9 percent. The authors argued that the performance of older banks relative to new ones might be due to the experience that older banks have as well as better levels of managerial efficiency. A relative increase in cost inefficiency was also observed by Kiyota (2009) in a study of 29 SSA countries for the period 2000 – 2007. Applying a translog cost frontier to estimate the efficiency of banks in these countries, he found that they had experienced cost inefficiency of 1.05 and 1.06 percent. Xiaoqing Maggie and Heffernan (2007) fitted a translog cost frontier to examine the cost X-efficiency in China's banking sector for the period 1985–2002. Their findings do not differ substantially from the two previously highlighted studies. They show that banks were operating at 40 – 60 percent below the X-efficient frontier. Using data from 1988 – 1997, and employing a Data Development Analysis (DEA) approach to assess the cost efficiency of Taiwanese banks following financial liberalisation in the 1980s, Chen (2001), found that banks' X-efficiency had substantially increased in Taiwan's deregulated banking market; on average, X-inefficiency decreased from 3.9 percent in 1988 to 2.0 percent in 1997.

Other studies have explored the relationship between X-efficiency and the type of bank ownership, for example domestic versus foreign, and public versus private. Once more, the empirical findings are mixed. In a study analysing the efficiency of Kenyan private banks versus public banks, applying a DEA approach, Miencha *et al.* (2015) report that public banks were performing relatively better than their private counterparts. Their public banks' average efficiency score was 0.995492 against 0.995188 for the private ones. In a study on the impact of new financial reforms in the banking sector adopted by Hungary in 1998 to privatise banks, Hasan and Marton (2003) concluded that bank reform improved X-efficiency scores between 1993 and 1998. Banks with higher levels of foreign ownership were associated with lower inefficiency, estimated at 20.96 percent compared to 24.84 percent for those with no form of foreign involvement. Equally, a study conducted by Kirkpatrick *et al.* (2008) on anglophone SSA, fitting a translog cost and profit function, using DFA and SFA found that the penetration of foreign banks in SSA anglophone countries had contributed to reducing cost inefficiency by about 39.1 percent. However, these studies contrast with that of Tahir *et al.* (2010) on the efficiency levels of domestic versus foreign banks in Malaysia for the period 2000 – 2006. They found that domestic banks were more cost efficient than their

foreign counterparts. Domestic banks had a ratio cost efficiency of 88.2 percent while foreign ones stood at 75.5 percent.

Many of these empirical studies on efficiency in the banking sector have been carried out either in a cross-sectional cost frontier model or in panel data cost frontier models using non-parametric DEA specification or parametric translog- stochastic frontier specification (Kraft and Tırtıroğlu, 1998; Hasan *et al.*, 2009). Only Greene's (2005) study is based on effects cost frontier analysis. This study aims to fill this gap in the literature while at the same time contributing to the body of knowledge on Rwanda where research is at an early stage of development.

4.3 Methodology

Section 4.2 discussed a variety of techniques related to accounting-based ratios and the frontier approach in its different forms as well as the advantages and disadvantages associated with each. This section discusses the modern efficiency measurement adopted in this chapter, stochastic frontier analysis. It describes the data used, and provides an empirical formulation to estimate the cost efficiency frontier based on existing theoretical and empirical literature.

The analysis of the efficiency of the commercial banking sector in Rwanda uses an effect cost stochastic frontier analysis (SFA) and the sample period is 2007 to 2013. As noted earlier, SFA is classified among the more contemporary and widely used techniques in measuring efficiency among parametric approaches (Ferrier and Lovell, 1990; Fu and Heffernan, 2007; George Assaf, Matousek and Tsionas, 2013), and non-parametric methods such as DEA (Jackson and Fethi, 2000; Mostafa, 2007; Paradi, Yang and Zhu, 2011). The study adopts the SFA approach because among the contemporary frontier techniques in measuring efficiency, SFA is the best that fits an institution's assessment of efficiency, as it accounts for statistical noise (Eisenbeis, Ferrier and Kwan, 1999; Maudos, Pastor, Perez and Quesada, 2002; Battese, Coelli *et al.*, 2005; Carvallo and Kasman, 2005; Fiorentino, Karmann and Koetter, 2006; Kao and Liu, 2009). In addition, empirical evidence confirms that efficiency scores calculated from a non-parametric technique such as a DEA model provide low estimators of the true inefficiencies (Heffernan, 2005). Berger and Humphrey (1997) have emphasized that studies that have applied parametric approaches have an average cost mean inefficiency level

of 15 percent, lower than the 28 percent for studies that have applied non-parametric approaches (Heffernan, 2005). Furthermore, the accounting-based ratio approach is difficult to apply in a rapidly changing banking industry (Yue, 1992; Berger *et al*., 1993; DeYoung, 1997). DeYoung (1997) argues that the accounting efficiency ratio is not a perfect measure of bank cost efficiency because in its equation net revenue is a denominator, suggesting that it is sensitive to the structure of interest rates. He further stresses that this efficiency ratio can be misleading in comparing the performance of an individual bank to the performance of its peers that have the same characteristics (Rose and Hudgins, 2013). A comparison of the cost ratios of two banks can be only meaningful if both are nearly the same in terms of product mix, size, market conditions, and other characteristics that can affect banks' expenses. As the empirical analysis in this chapter covers more than two banks, it follows that the accounting-based ratio approach is irrelevant for this study.

Furthermore, the investigation in this study adopts the intermediation approach because it has fewer data problems than the production approach (Ncube, 2009; Kablan, 2010; Aiello and Bonanno, 2013; Maredza and Ikhide, 2013). The production approach suffers from a basic problem related to the determination of output volumes (Freixas and Rochet, 2008). It uses the number of accounts opened in a given bank, the number of operations performed on these accounts, or the value of amounts transacted on these accounts. In terms of profit efficiency analysis and cost efficiency analysis, some studies give preference to cost efficiency because managers make an effort to minimize costs (Isik and Hassan, 2002; Maudos *et al.*, 2002; Ncube, 2009). They argue that by minimizing the cost, indirectly, the profit is positively affected. Ncube (2009) found that South African banks improved their cost efficiency between 2000 and 2006 while efficiency gains on their profitability over the stated period were not significant. Similarly, Maudos *et al*.'s (2002) study of European banks reported a lower level of profit efficiency relative to cost efficiency. Isik and Hassan (2002) found similar results for Turkish banks. The mean profit efficiency was lower than the mean cost efficiency.

The intermediation approach considers interest income and non-interest operating income as outputs and operating costs (price of labor, price of physical and intangible assets and price of interest-bearing deposits) as inputs. In addition, this approach captures real interconnections in the banking sector as the bank is an intermediary between savers and lenders, with funds primarily being raw materials in the process of banks' profit maximization objective (Berger

and Humphrey, 1997). Moreover, the cost frontier analysis is perceived as a solution to the peer group problem because a given individual bank is compared to a hypothetical best performing bank that corresponds exactly to the bank's individual characteristics and serves as a benchmark (DeYoung, 1997).

The cost gives the minimum expenditure required to produce a given level of output given input prices. A bank is inefficient if its costs exceed the theoretical minimum of the most efficient bank using the same input-output combination (Heffernan, 2005; Greene, 2008). This signifies that the bank produces less than the maximum expected from the inputs used by that bank at the given level of technology. The major concern is in relation to the reaction of bank managers. Do bank management respond correctly to relative input prices in choosing inputs and outputs, aiming at minimising technical inefficiencies and hence raising economic efficiency? Ideally, it is expected that an efficient bank remains efficient from period to period, and inefficient ones improve their level of efficiency over time (Battese *et al.*, 2005). It is important to note that technical inefficiency or cost inefficiency is the consequence of ineptness or failure to effectively utilise the inputs by the producer or employ a sub-optimal combination of these inputs to produce a given quantity of output (Isik and Hassan, 2002).

Cost efficiency (see Figure 4-1) can be expressed as the ratio between the minimum threshold of cost of a potentially efficient bank and the cost level of an actual observed bank (Aiello and Bonanno, 2013). Any bank's efficient cost must lie on or below the frontier. Deviations from the frontier reflect both technical inefficiency (u_i) and allocative inefficiency (v_i). Technical inefficiency refers, for example, to the over-use of inputs like expansion of staff; and for allocative inefficiency, to resources not allocated efficiently like a bank's failure to react optimally to a vector of input prices. The higher the u_i observed at a definite time, the more costs bank i wastes at time t to produce a given output vector (y_{jit}), and the more inefficient the bank (Hassan *et al.*, 2011).

4.3.1 Model specification

In the stochastic frontier model, it is necessary to assume that the bank-specific drivers of inefficiency enter the model in the form of "effects", and are uncorrelated with the inputs

levels (Battese and Coelli, 1995; Greene, 2005). In these studies, effects vary across cross-sectional units and exhibit variations over time. This approach circumvents the shortcomings of the assumption that inefficiency is time invariant. In reality, to assume that bank specific deviations are time invariant is to some extent unrealistic (Greene, 2005). There is no persuasive reason to suppose that bank specific deviations are time invariant, because ideally, it is expected that an efficient bank remains constantly efficient from period to period, and inefficient ones improve their level of efficiency over time (Battese *et al.*, 2005). Bank specific inefficiency is thus, measured relative to the best performing bank in the sample.

To estimate the cost efficient frontier, this study adopts the stochastic frontier model following (Battese, 1992; Battese and Coelli, 1995; Greene, 2005) which is given by the following equation (4.7):

$$TC_{it} = (X_{it}, Z_{it}) + v_{it} - u_{it} \quad \ldots\ldots (4.7)$$

where:

TC_{it} is the total cost of a given bank *i* at period *t*.

X_{it} is the vector of explanatory variables which comprise output produced by bank *i* at period *t*, (Y_{it}). These outputs include interest income (y_{1it}) and non-interest income (y_{2it}), and input prices of a given bank *i* at period *t* (P_{it}) which are price of labor (*PL*), price of capital (*PF*), and price of funds (*PF*). The time trend (T) variable is incorporated in the model to account for Hicksian neutral technological change (Battese and Coelli, 1995).

Z_{it} is a vector of the banks' specific characteristics. In this study, these relate to the type of ownership (*foreign*), government intervention either in management or in majority shareholding (*gov*), and instability in top leadership position (*mgt*).

$i = 1, \ldots, N$ (N is the number of banks involved in the study).

$t = 1, \ldots, T$ (T is the number of years covered by the study).

$$v_{it} - u_{it} = \varepsilon_{it} \quad \ldots\ldots (4.8)$$

where:

u_{it} is a non-negative random variable associated with technical inefficiency and v_{it} accounts for statistical noise, meaning that it may take any value. u_{it} denotes a rise in the cost of production due to the inefficiency factor that may result from management's mistakes in

running the bank (Isik and Hassan, 2002). In other words, management has a certain level of control of such costs leading to inefficiency. v_{it} represents a temporary rise or fall in the banks' cost due to unexpected or uncontrolled random shocks that may halt the smooth production process. Such factors include an unusually high number of equipment failures, power shortages, bad weather, labor strikes, war, floods, and drought that are beyond management's control. This suggests that deviations from the frontier may not be entirely under the full control of bank management.

We take logarithms of the variables on both sides to allow for the function to be estimated using linear regression techniques (Battese *et al.*, 2005). Therefore, equation (4.7) becomes:

$$LnTC_{it} = Ln(Y_{it}, P_{it}, Z_{it}) + v_{it} - u_{it} \dots\dots\dots\dots (4.9)$$

In accordance with the assumed constraint of linear homogeneity in input prices, cost (TC), price of labor (PL), price of capital (PK) and price of funds (PF) are to be normalized. In this case, they are normalized by PL. Replacing Z_{it} by the bank's form of ownership (foreign), government (*gov*), and management (*mgt*) leads to the following equation (4.10):

$$Ln\left(\frac{TC_{it}}{PL_{it}}\right) = \beta_0 + \sum_{j=1}^{2}\beta_j lny_{jit} + \sum_{n=1}^{2}\alpha_n \ln\left(\frac{P_{nit}}{PL_{it}}\right) + \Omega_t T_{it} + \delta_1 foreign_{it} + \delta_2 gov_{it} + \delta_3 mgt_{it} + v_{it} - u_{it} \dots\dots\dots\dots (4.10)$$

Defining $\frac{TC_{it}}{PL_{it}}$ as tc_{it}, $\frac{P_{nit}}{PL_{it}}$ as p_{nit}, equation (4.10) becomes:

$$ln\, tc_{it} = \beta_0 + \beta_1 lny_{1it} + \beta_2 lny_{2it} + \alpha_1 lnp_{1it} + \alpha_2 xlnp_{2it} + \Omega_t T + \delta_1 foreign + \delta_2 gov + \delta_3 mgt + \varepsilon_{it} \dots\dots\dots\dots (4.11)$$

where β, α, Ω, and δ, are vectors of unknown parameters to be estimated

ln denotes the natural logarithm,

ε_{it} is the composite error term that means $\varepsilon_{it} = v_{it} - u_{it}$

In the stochastic frontier model, it is suggested that if bank *i* in the sample is assessed as being fully efficient, indicating that u_i=0, other banks are compared to it and not compared to a fixed absolute standard (Greene, 2008). The study uses the method of maximum likelihood to estimate parameters with assumptions of a normal truncated distribution for the inefficiency term. Individual values of X-inefficiencies are calculated using the following formula of Jondrow, Knox Lovell, Materov and Schmidt (1982), given by equation (4.12).

$$E(u_i|\varepsilon_i) = \sigma_* \left[\frac{\phi\left(\frac{\varepsilon_i\lambda}{\sigma}\right)}{1-\Phi\left(\frac{\varepsilon_i\lambda}{\sigma}\right)} - \left(\frac{\varepsilon_i\lambda}{\sigma}\right)\right] \quad (4.12)$$

where:

ϕ (.) is a standard normal density function.

Φ (.) is a standard normal cumulative density function.

$\varepsilon_{it} = v_{it} - u_{it}$

$\lambda = \frac{\sigma_u}{\sigma_v},\ \sigma^2 = \sigma_v^2 + \sigma_u^2,\ \sigma_*^2 = \frac{\sigma_u^2\sigma_v^2}{\sigma^2}$ and $u_* = \frac{\sigma_u^2\varepsilon_i}{\sigma^2}$

Suppose $\frac{\varepsilon_{it}\lambda}{\sigma} = a_{it}$. Greene (2005) suggests rewriting equation (4.13), as follows:

$$E(u_{it}|\varepsilon_{it}) = \sigma_* \left[\frac{\emptyset(a_{it})}{1-\Phi(a_{it})} - (a_{it})\right] \quad (4.13)$$

where $a_{it} = \pm\frac{\varepsilon_{it}\lambda}{\sigma}$. The sign (+) is associated with the production frontier function and (-) to cost frontier function.

4.3.1.1. Deriving Technical Efficiency and Cost Efficiency

The main or fundamental obstacle to estimating technical efficiency resides in the fact that the inefficient component of the model, u_{it} is not directly observable. Data and estimates provide only $\varepsilon_{it} = v_{it} - u_{it}$, through equation (4.8) while the ultimate objective is to estimate u_{it} that contains the bank specific heterogeneity effects. Instead, u_{it} is derived from equation (4.13)**.**

Technical *efficiency* for bank *i* at period *t* is defined by the equation (4.14)

$$TE_{it} = Exp\ (-U_{it}) \quad (4.14)$$

If λ ($\frac{\sigma_u}{\sigma_v}$) which is under management control, attains large values, meaning λ→∞, then the inefficiency factor dominates the random factor (v_{it}) which is beyond management control (Aigner, Lovell *et al.*, 1977). In other words, if λ > 0.5, the inefficiency factor (u_{it}) exceeds the random factor (v_{it}). Similarly, deviations from the frontier can be due to technical inefficiency when the value of gamma (γ) that is generated from estimation of equation (4.11) becomes higher, meaning when it is closer to one (Battese and Corra, 1977). In such a case,

much of the variation in the composite error term is associated with the inefficiency component.

Under any of the two cases where deviations from the frontier are due to the inefficiency factor, Battese *et al.* (2005) argue that technical efficiency is closer to cost efficiency. So, a measure of cost efficiency for bank *i* at period *t* is derived following equation (4.15).

$$CE_{it} = Exp\ (-U_{it}) \qquad (4.15)$$

4.3.1.2. Prediction of Inefficiencies

Following Battese and Coelli (1995), inefficiencies are defined using the equation (4.15):

$$U_{it} = Z_{it}\delta + w_{it} \qquad (4.16)$$

where the random variable w_{it}, is defined by truncation of the normal distribution with zero mean and variance, σ^2, such that the point of truncation is $-Z_{it}\delta$, i.e., $w_{it} \geq -Z_{it}\delta$. These assumptions are said to be consistent with being a non-negative truncation of the N ($Z_{it}\delta$,σ^2)-distribution.

The inefficiency effects for bank *i* at period *t* are defined by the equation (4.17)

$$U_{it} = \delta_0 + \delta_1 foreigin + \delta_2 gov + \delta_3 mgt + e_{it} \qquad (4.17)$$

4.3.2 Data Description

To measure commercial banks' efficiency in Rwanda, this study uses data from audited financial statements of seven commercial banks that were operating in Rwanda during the period 2007 to 2013. These are Bank of Kigali Ltd (BK), I&BM Bank (*the former Banque Commerciale du Rwanda Ltd, BCR)*, Banque Populaire du Rwanda Ltd(BPR), ECOBANK Ltd (former *Banque du Commerce de Developpement et d'Industrie,* BCDI), G-T Bank (formerFINABANK Ltd, and BACAR), *Compagnie Générale des Banques* Ltd (COGEBANQUE) and Access Bank Ltd (former *Banque en la Confiance d'Or,* BANCOR). The sample includes 49 observations with seven observations per bank.

As noted in Section 4.1, the study adopts an intermediation approach, which considers operating income as outputs and operating costs as inputs. Table 4-1 presents the summary statistics of the variables that are in panel settings, where:

TC_{it}, in Rwandan francs (000 Rwf) is the total cost of a given bank *i* at time period *t*. The total cost is the amount of interest paid on deposits and borrowed funds plus non-interest operating costs.

y_{1t}, in Rwandan francs (000 Rwf), represents the total amount of interest income produced by a given bank *i* at time period *t*. Generally, interest income comprises interest earned on loans and that earned on security investments (Rose and Hudgins, 2013).

y_{2t}, in Rwandan francs (000 Rwf), represents the total amount of noninterest income produced by a given bank *i* at time period *t*. Noninterest income is the income that the bank obtains from sources other than interest income (Matthews and Thompson, 2008; Rose and Hudgins, 2013). These include, for example, fees earned from fiduciary activities (such as managing and protecting a customer's property, managing individual and organizational pension and retirement plans, recordkeeping for company security transactions and dispensing interest and dividend payments). It also includes fees charged on deposit accounts, commission earned from money transfers or exchange, fees earned on loan applications, fees for insurance services, and fees earned from security brokerage when banks help firms to issue securities directly from the capital market. Equally, they incorporate net servicing fees from servicing real estate mortgages, credit cards, and fees from execution of bank acceptances letters of credit, and cheque books. MacDonald and Koch (2006) note that deposit service fees are the most important noninterest income and represent a stable source of income for the bank.

p_{1t}, is a ratio of price of capital (*PK)* over the price of labor (*PL*). The PK is the total amount recorded as depreciation of equipment and intangible assets of bank *i* at period *t*, divided by the amount of its total assets (physical and intangible). It is the cost of maintaining banks' properties (Rose and Hudgins, 2013). The PL is the total expenses to compensate employees (wages and salaries as well as other fringe benefits) of bank *i* at period *t*, divided by the total number of employees.

p_{2t}, is the ratio of price of funds (*PF)* over the *PL*. The PF is the total amount spent as interest on deposits and borrowed funds of bank *i* at period *t*, divided by the total amount of those funds.

T: stands for the year of observation, taking values 1, 2, 3, 4, 5, 6 and 7.

Foreign, *gov* and *mgt* together represent a vector of observable heterogeneity effects of banks that are not in direct relation in the cost function structure, but that capture the banks' specific characteristics. In this study, these relate to the type of ownership (*foreign*), government intervention either in management or in the form of majority shareholding (*gov*), and instability in top leadership positions (*mgt*).

$foreign_{it}$ is a dummy variable that takes a value of 1 if the majority shareholders in bank *i* at period *t* are foreigners, and 0 otherwise.

gov_{it} is a dummy variable that takes a value of 1 if government is a major shareholder of bank *i* at period *t*, or a major government intervention occurred to prevent bankruptcy, or in the course of the period under study the bank was supervised directly by the Central Bank, or the bank has enjoyed government goodwill, and 0 otherwise.

mgt_{it} is a dummy variable that takes a value of 1 if bank *i* had a maximum of two Chief Executive Officers (CEOs) in office in the period covered by the study, 2007 – 2013, and 0 otherwise.

Table 4- 1: Summary statistics of the key variables used in the cost efficiency analysis of commercial banks in Rwanda, 2007 – 2013

Variable	N	Mean	Std. Dev.	Minimum	Maximum
lntc	49	2.967045	.3046886	2.457156	3.607053
lny1	49	6.87033	3032221	6.342412	7.655242
lny2	49	6.579901	.2913888	5.791659	7.26854
lnp1	49	-4.831504	.2981107	-5.287939	-4.116624-
lnp2	49	-5.570065	.2484852	-5.287939	5.096942
t	49	4	2.020726	1	7
foreign	49	.5520204	5025445	0	1
gov	49	.1632653	.3734378	0	1
mgt	49	.7142857	.4564355	0	1

4.3.3 Interpretation of results

Parameters of cost frontier as well as efficiency scores were estimated applying the method of maximum likelihood with panel data using the computer software Stata 13. The results are interpreted using cost efficiency scores which vary between 0 and 1 (Battese *et al.*, 2005). The lower this ratio is, the more inefficient is the bank and the higher the ratio, the more

efficient is the bank. Therefore, 1 refers to the best performing bank, which is at the frontier, while 0 refers to the worst performing bank observed in the sample.

4.4 Empirical Results and Discussion

This section presents and discusses the efficiency results obtained from the frontier cost function estimates, the estimates ratios of cost efficiencies as well as estimates parameters of factors influencing cost inefficiencies of commercial banks in Rwanda, 2007- 2013 as reported respectively in Tables 4-2, 4-3 and 4-4. The parameter estimates of *PL* do not appear in the table because the cost and other input prices were normalised at labor price. Efficiency as well as inefficiency is a comparative to the best practice bank among the seven in our sample operating under the same conditions, not relative to best practice elsewhere, beyond the limits of the sample of this study.

4.4.1 Cost frontier's estimates of commercial banks in Rwanda, 2007 – 2013

Table 4-2 presents the estimated parameters of the cost frontier of commercial banks in Rwanda, 2007 – 2013. It shows that interest income is associated with the highest cost share of 76 percent of the total cost compared to noninterest income which is about 10 percent. The reasons are related to the structure of the Rwandan banking system in which interest income from loans is a very important component of total income. This is common among banking systems in developing countries where the development of off-balance sheet operations generating noninterest income is still at a lower level (Rose and Hudgins, 2013).

Input prices show that the most expensive factor of production is capital. This is in accordance with the theory that states that higher prices of capital lead to higher costs (Kablan, 2010). It is also a typical characteristic of developing countries that are constantly improving the working of financial institutions (Isik and Hassan, 2002). It suggests that in addition to the routine costs of investment in branches' expansion, banks increase their spending to acquire core-banking software that is able to handle modern sophisticated banking operations, and equipment for automated teller machines (ATMs). Banks also spend money to acquire computers, material for communications, equipment and material for new branches, security insfrastucture at the banks' premises as well material and equipment for

funds transportation. The installation of machines and other modern equipment, as well as training personnel to adopt such technology requires funds. The more the bank embarks on acquiring new technology, the more likely it is that the total cost will rise.

Foreign owned banks' penetration of the Rwandan banking market has a negative significant influence on total costs. The total cost decreased by 28 percent. This could be related to the fact that foreign investors may have access to low cost funds, and may also bring know-how in technology and modern financial management techniques as well as new tools to analyse banking operations, hence causing total costs to decrease (Claessens, Demirgüç-Kunt and Huizinga, 2001).

Government involvement in banking activities (gov) contributes to a decrease in total cost of about 17 percent. This suggests that to some extent, government grants a monopoly to some banks to collect important demand deposits that may not even be interest bearing. In doing so, these banks gain room to manoeuver to increase their loans, as the ratio of total loans to deposits will be relaxed. The cost that the bank could have used to pay customers for remunerated deposits is thus reduced, leading to a decrease in the level of total costs.

Top management instability (mgt) was found to be a contributing factor in increasing total cost, though not significant. Rapid turnaround in CEOs causes total cost to increase. This could be due to the fact that the new CEO needs time to master the working environment of the bank in order to give it direction. The replacement of a CEO may also involve payment of fees as a *final liquidation account* to the outgoing CEO. In addition, the new CEO may require additional benefits, all of which can increase the total costs of the bank.

Table 4- 2: Estimated Parameters of Cost Frontier of Commercial Banks in Rwanda, 2007 – 2013

Log likelihood = 53.79017				Wald chi2 (8) = 150.66 Prob > chi2 = 0.0000	
lntc	Coefficient	Std. Err.	z	p > | z |	[95% Conf. Interval]
lny1	.76199576***	.1086444	7.04	0.000	.5490186 .9748966
lny2	.0990042	.1130092	0.88	0.381	-.1224898 .3204983
lnp1	.2912824***	.0850946	3.42	0.001	.1245 .4580647
lnp2	.1389979**	.0687227	2.02	0.043	.0043039 .2736918
t	.0001211	.0137132	0.01	0.993	-.0267564 .0269985
foreign	-.2812087***	.0530318	-5.30	0.000	-.3851491 -.1772683
gov	-.1689279*	.0923362	-1.83	0.067	-.3499036 .0120478
mgt	.0229311	.1643863	0.14	0.889	-.2992601 .3451223
-Cons	-.8570171	.7555291	-1.13	0.257	-2.337827 .6237928

/mu	.2268117	.1172354	1.93	0.053	-.0029655	.4565889
/eta	.0644396	.0365197	1.76	0.078	-.0071377	.136017
/lnsigma2	-4.090433	.7052076	-5.80	0.000	-5.472615	-2.708252
/iltgamma	1.15945	.9980731	1.16	0.245	-.7967376	3.115637
sigma2	016732	0117995			.0042002	.0666532
gamma	.7612327	.1814072			.3107238	.9575332
sigma_u2	.0127369	.0119161			-.0106181	.036092
sigma_v2	.003995	.0008994			.0022323	.0057578

****, ** and * indicate that the estimated coefficient is significantly different from zero at 1%, 5% and 10% level of significance.*

Following the estimates from Table 4-2, the important step that follows is to derive the cost efficiency of the banks in our sample. The value of gamma (γ) equal to 0.76 (see Table 4-2), which is high, as well as λ = 1.78, denote that most of the variations in the composite error term are attributed to the inefficiency component. Equally, the test on whether there is no inefficiency ($Ho: \gamma = 0 \; against \; H1: \gamma > 0$) given by $Z = \frac{\tilde{\gamma}}{Se\,(\tilde{\gamma})} \sim N(0,1)$.

(Aigner, Lovell *et al.*, 1977; Battese, Coelli *et al.*, 2005) support the above conclusion that the inefficiency component is the dominant source of random variation in the model. The t-statistic (from $Z = \frac{\tilde{\gamma}}{Se\,(\tilde{\gamma})}$) is equals 4.20 whereas the critical value is 1.96 (from the critical values at 95 percent confidence level of significance in the standard normal distribution). Accordingly, we reject the null hypothesis that there are no inefficiency effects at 5 percent level of significance. Thus, the cost efficiency can be estimated using equation (4.14) in accordance with Battese *et al.* (2005).

4.4.2 Ratios of cost efficiency of commercial banks in Rwanda, 2007 – 2013

Table 4-3 presents estimation results on the cost efficiency scores of commercial banks in Rwanda over the period 2007 – 2013. It shows that the mean cost efficiency over the period covered by this study is 88.56 percent. This implies that throughout the period, banks jointly would have needed only 88.56 percent of resources to produce the level of output that they produced. Consequently, about 11.44 percent of total costs were wasted relative to the bank on the frontier having the same inputs. Equally, cost efficiency improved from 85.43 in 2007 to 92.32 in 2013. This is in line with the positive sign of *eta*, as argued by Battese *et al.* (2005). When eta (η) has a positive sign (0.06 as displayed in Table 4-2), this suggests improvement in cost efficiency over time. With reference to Hasan, Koetter et al. (2009), the

mean efficiency has improved from 57.6 percent from that study to 88.56 percent in the current study.

The banks' cost efficiency scores range between 83.10 percent and 96.03 percent. For the bank operating at lower mean efficiency level 83.10 percent, this suggests that it wastes about 16.90 percent of its resources relative to the best performing bank in the sample. Of the seven banks investigated where three are domestic owned and four are foreign owned, only three operate above the mean cost efficiency. Furthermore, of the top three performing banks with a cost efficiency score greater than the mean cost efficiency, two are foreign owned, suggesting that foreign owned banks are more cost efficient than domestic banks. This could be due to the fact that, foreign investors bring more advanced technology, have access to lower cost funds, and are more well-equipped with best practices in bank management. According to Arena (2008), foreign owned banks have better risk-management practices, well-balanced capitalisation, and easy access to funding from their parent banks. Even during times of financial distress, they have the option of relocating their deposits without involving capital outflows, suggesting that they are less vulnerable to crises. Likewise, Claessens *et al.* (2001) argue that the entry of foreign banks in emerging markets and less developed economies is associated with greater efficiency in the banking system because they influence domestic banks to adopt superior banking techniques and best practices.

Table 4- 3: Estimates ratios of cost efficiencies of commercial banks in Rwanda, 2007 – 2013 (in percentages)

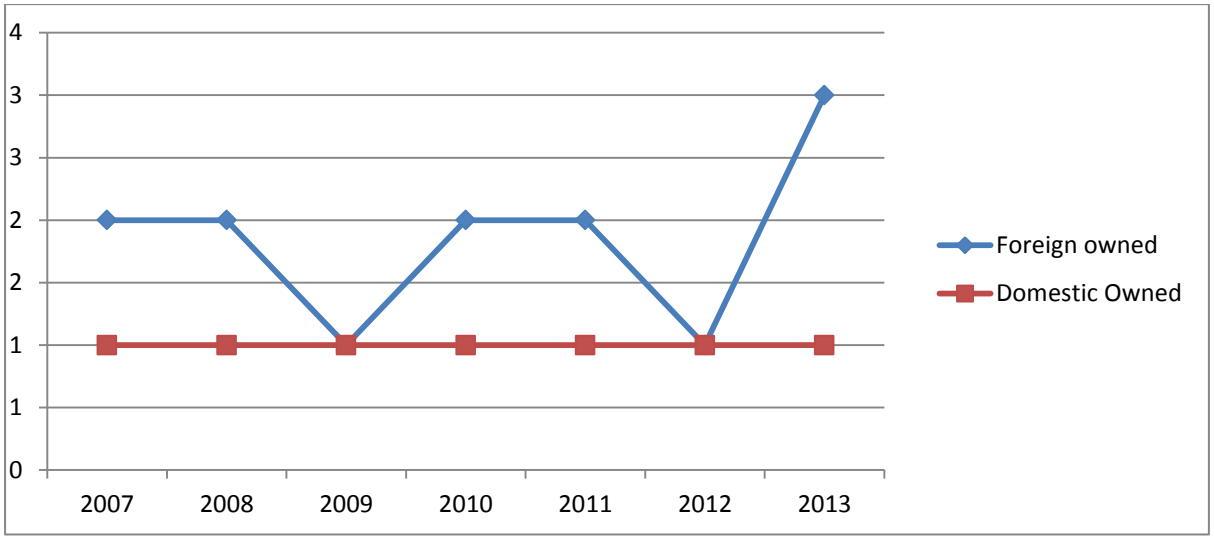
Bank	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**Mean Efficiency**
Bank 1	81.50	82.30	85.06	86.66	89.12	89.87	88.07	**86.08**
Bank 2	98.52	95.96	96.12	94.40	95.13	95.34	96.03	**96.03**
Bank 3	88.61	87.48	81.98	91.91	94.13	95.93	96.93	**91.00**
Bank 4	84.33	84.14	82.41	80.47	86.26	87.75	90.12	**85.07**
Bank 5	82.64	81.59	83.25	83.62	87.19	88.76	88.91	**85.14**
Bank 6	76.43	75.66	81.97	83.15	85.92	85.77	92.83	**83.10**
Bank 7	85.96	94.15	95.99	97.96	97.57	90.42	92.66	**93.53**
Mean Efficiency	**85.43**	**85.9**	**86.68**	**88.31**	**90.76**	**90.55**	**92.32**	**88.56**

Source: Summarized from cost frontier estimates

Taking the annual mean cost efficiency, Figure 4-2 again shows that for five of the seven years covered by the study, three out the four foreign owned banks were functioning above

the mean cost efficiency of domestic owned banks, further emphasising that foreign owned banks are more cost efficient than domestic owned banks.

Figure 4- 2: Banks with mean cost efficiency above the average mean cost efficiency by ownership status



These findings are in line with previous findings in the literature, such as those of Bonin *et al.*'s (2005) study on the impact of the privatization of banks in transition economies. Their findings show that foreign banks were most efficient and government-owned banks were least efficient. Similarly, Hasan and Marton (2003) concluded that bank reform in Hungary improved X-efficiency scores between 1993 and 1998. Banks with higher foreign ownership involvement were associated with lower inefficiency. However, the results depart from those of Tahir *et al.* (2010) that found that Malaysian domestic banks had higher cost efficiency of 88.2 percent, compared to foreign banks at 75.5 for the period 2000 – 2006.

The results of the inter-temporal comparison across banks are mixed. Nevertheless, for the sector, cost efficiency is at lower levels, in 2007 – 2009 and 2012. For the period 2007 – 2009, there is a slight increase in the level of cost efficiency of about 1.25 percent in three years (85.43 percent to 86.68 percent). In 2012, the mean cost efficiency is 90.55 percent, dropping from 90.76 percent in 2011, but recovering to 92.32 percent in 2013. These findings are not surprising because the period covered by the study is a period where on the one hand, the global financial crisis occurred (2007–2009) that might have also affected the Rwandan banking sector. On the other hand, it coincides with the unexpected suspension or delay in budget support to Rwanda by development partners in 2012. These events might have affected the banks' operational efficiency. The global financial crisis was not conducive for

financial institutions and the sudden withdrawal of budget support to Rwanda by some donors, created a shortage of foreign reserves inflows to the banking sector.

In relation to the effects of the 2007–2009 global financial crisis while low income countries are not well integrated in global financial markets, there were still affected in one way or another. The effects of the international global financial crisis of 2007–2009 in decreasing efficiency were also highlighted by Raphael's (2013) analysis of the bank-specific, industry-specific, and macroeconomic determinants of bank efficiency in Tanzania for the period 2005 – 2008.

4.4.3 Factors influencing cost inefficiency of commercial banks in Rwanda, 2007- 2013

In light of the observed cost efficiency, the study further investigated the factors contributing to cost inefficiencies in the banking sector within the seven-year period covered by the analysis. As highlighted earlier, the sources of cost inefficiencies are related to banks' characteristics such as the type of ownership (*foreign*), government intervention in either in management or by means of majority shareholding (*gov*), and instability in top leadership (*mgt*).

Table 4-4 below presents the descriptive statistics of these variables. The dependent variable related to inefficiencies effects (u_{it}) was measured as a continuous variable. Variables such *foreign, gov*, and *mgt* were included as dummy variables. They were coded one respectively when at bank *i* at period *t* the majority of the total shareholding was foreign owned; bank *i* had major government intervention to prevent its bankruptcy at period *t* or major shareholding/supervised directly by the Central Bank/enjoyed government good-will; or during the seven-year period bank *i* had two or more CEOs in office. These variables were coded zero otherwise.

Table 4- 4: Descriptive statistics for estimated inefficiencies

Variable	N	Mean	Std.Dev.	Minimum	Maximum
T	49	.1237505	.0679098	.014938	.27888621
foreign	49	.5510204	.5025445	0	1
gov	49	.1632653	.3734378	0	1
mgt	49	.7142857	.4564355	0	1

Table 4-5 presents estimated parameters of factors influencing the cost inefficiency of commercial banks in Rwanda over the period 2007 – 2013. The inefficiency effects for bank *i* at period *t* are estimated using equation (4.17). The table shows two variables *foreign* and *mgt* that are significantely related to changes in cost inefficiency. The negative coefficient for (*foreign*) indicates that banks where the majority of shareholding was foreign owned were most likely to be less inefficient. These findings are consistent with those of (Gopalakrishnan, Wischnevsky and Damanpour, 2003; Qayyum and Khan, 2007). A possible explanation for these results is that customers want to use modern technology that is often readily provided by foreign owned banks. These banks also introduce modern management practices to day-to-day operations. Such technology may include the use of ATMs, cellphone banking, telephone banking, internet banking, and point of sale services, among others, that have reduced some operating costs of banks. Using modern banking technology decreases queues in branches which in turn enhances bank tellers' service delivery amd hence decreases inefficiency.

The positive estimate for *mgt* implies that instability in top management positions such as the CEO position, contributes to an increase in banks' cost inefficiency, indicating a plausible positive link between management stability in a bank and efficiency. The *gov* variable has a negative effect on cost inefficiency, albeit statistically insignificant.

Table 4- 5: Estimates parameters of factors influencing cost inefficiencies of commercial banks in Rwanda, 2007- 2013

Stoc. Frontier normal/truncated-normal model						
					Wald chi2 (3) = 45.25	
Log likelihood = 78.792591					Prob > chi2 = 0.0000	
lntc	Coefficient	Std. Err.	z	p > | z |	[95% Conf.	Interval]
foreign	-.035481**	.0167569	-2.12	0.034	-.068324	-.002638
gov	-.0420705	.0275328	-1.53	0.127	-.0960338	.0118928
mgt	.0803343***	.0196863	4.08	0.000	.0417498	.1189187
-Cons	.0933508**	.0450847	2.07	0.038	.005057	.1816446
/mu	-.058419	4.60034	-0.01	0.990	-9.074919	8.958081
/lnsigma2	-6.039607	1.441631	-4.19	0.000	-8.865153	-3.214062
/iltgamma	-4.229544	100.3142	-0.04	0.966	-200.8417	192.3827
sigma2	.0023825	.0034347			.0001412	.040193
gamma	.0143501	1.418862			5.96e-88	1.000000
sigma_u2	.0000342	.0034292			-.006687	.0067554
sigma_v2	.0023483	.0004763			.0014147	.0032819

****, ** and * indicate that the estimated coefficient is significantly different from zero at 1%, 5% and 10% level of significance.*

Even though the variable *gov* is not statistically significant, the joint effects of the three variables on inefficiencies in cost setting is statistically significant. The study tested the hypothesis that coefficients of the three regressors are all zero, implying that there are no interaction effects ($\delta_1 = \delta_2 = \delta_3 = 0$). The test statistic, which is 45.25, has a *p*-value = 0.0000 < 0.05. Accordingly, the null hypothesis is strongly rejected at all levels of significance, suggesting that the joint effect of the three explanatory variables is statistically significant even though the individual effects of one variable may be statistically insignificant.

4.5 Concluding Remarks

This chapter assessed the efficiency of commercial banks in Rwanda for the period 2007–2013. The measure of banks' efficiency provides information on the financial robustness of such institutions to use limited inputs efficiently to produce financial services and products. This assessment will be useful to different stakeholders in Rwanda's commercial banking sector. The highlighted efficiency measures can help commercial bank managers and shareholders to make rational decisions. Depositors will also be more convinced of the soundness of the institutions where they keep their financial assets (cash, term deposits) if they are aware of the extent, to which these institutions are efficient. Shareholders expect dividends and business continuity, while regulators can use the results to inform policy formulation (Berger and Humphrey, 1997). Managers can improve their way of handling business by adopting the good practices of a highly efficient bank.

The study's findings reveal that the banking sector in Rwanda displays a mean cost efficiency of 88.56 percent, suggesting that banks would jointly have utilized only 88.56 percent of resources to produce the level of output achieved. This implies that about 11.44 percent of total costs were wasted relative to the bank on the frontier with the same inputs. The study also finds inefficiencies to be statistically and significantly decreasing over time with the entry of foreign banks in the Rwandan banking sector. Furthermore, it finds further inefficiencies relating to the turnover of CEOs to be statistically and significantly increasing.

Based on these findings, it is recommended that banks' shareholders should always work to reduce the turnover of top management officials. Since the entry of foreign banks in the Rwandan banking sector contributes significantly to cost reduction, and declining

inefficiency, the Rwandan government should continue to adopt incentives to attract more foreign banks.

However, the results displayed in this chapter should be treated with caution because the bank that appears to be closer to the frontier may not necessarily be better than other banks in the sample. It might have achieved such performance at the cost of an increase in non-performing assets. Further research could target UMURENGE SACCOs that are present in all 416 administrative sectors of the country. Assessing their efficiency is of great importance, as they are closer to the population, and it can be assumed that their efficiency may positively influence the living conditions of beneficiaries of their services.

CHAPTER FIVE

MICROECONOMIC FACTORS INFLUENCING NON-PERFORMING LOANS IN RWANDA

5. 1 Introduction

Chapter one noted that achieving sustainable economic growth via financing the private sector requires a safe and sound financial sector that efficiently allocates scare resources to productive projects. The finding in Chapter three, that the relationship between financial sector development and output growth is supply-leading in Rwanda suggests that, by developing the financial sector, more finance could be expected to go to the private sector that is involved in productive activities, thus promoting output growth. In chapter four, the efficiency of Rwanda's banking sector was estimated at 88.54 percent. Thus, while this sector is not fully efficient, it displays a good indicator of cost efficiency. However, the factors that threaten the performance of the financial sector in general, and of the banking sector in particular, such as NPLs have not yet been explored, which is the *raison d'être* of this chapter.

A loan is said to be nonperforming if at least one of the following two elements applies: First, there is non-payment of the principal or interest for a period of 90 days or more. Second, the loan or the borrower exhibit weaknesses such as the borrower's business suffering economic or financial deterioration (MacDonald and Koch, 2006; Barisitz, 2011). The loan amount recorded as nonperforming is the gross value recorded on the bank's balance sheet, and not the overdue amount comprising of the instalment on the principal and the interest. The ratio of NPLs is the proportion of the total value of a loan portfolio (before the deduction of loss-loan provisions) to the total loan portfolio of the bank.

While the level of NPLs in Rwanda has been decreasing over time (from 74.1 percent in 2001 to 7 percent in 2013), it is still relatively high compared to its peers in the EAC and at international level. From international standards, a bank is considered healthy if it records a maximum rate of NPLs ranging between 1 percent and 3 percent (Heffernan, 2005). Except for Burundi, Rwanda still records higher levels of NPLs than its EAC peers. For example, for the period 2007 – 2013, the average level of NPLs in Rwanda was 6.57 percent while the

figures for other EAC members were 4.25 percent for Uganda; 4.87 percent for Kenya; 5.85 percent for Tanzania; and 9.08 percent for Burundi (World Bank, 2014). Thus, determining the factors that explain the variation in the level of NPLs in Rwanda's banking sector is crucial.

A number of factors have been identified that contribute to the level of NPLs. Some studies have pointed to macroeconomic factors (Festić, Kavkler and Repina, 2011; Vogiazas and Nikolaidou, 2011; Saba, Kouser and Azeem, 2012; Badar, Javid and Zulfiquar, 2013; Beck, Jakubik and Piloiu, 2013). Others have reported macroeconomic factors and bank specific characteristics (Männasoo and Mayes, 2009; Dash and Kabra, 2010), while yet other studies have focused solely on specific banks' characteristics (Olokoyo, 2011; Biabani, Gilaninia and Mohaba, 2012; Ali, 2013). A limited number of studies have integrated borrowers, business type and loan characteristics in relation to NPLs (Roslan and Karim, 2009; Mokhtar, Nartea and Gan, 2012). However, while there is a growing literature on NPLs, their causes, and the effects on the economy, little attention has been paid to the borrower and some other features of loans such as type of business and loan conditions. The borrower is a key player in the borrowing-lending process. He/she can either divert the loan due to moral hazard behavior or may willfully refuse to repay. Business sectors and loan conditions also matter in this process. Some sectors may be riskier than others and some loan terms can also be a source of default.

These factors relating to borrower, loan type and conditions influencing NPLs have not been extensively discussed in the banking literature, especially in emerging and less developed countries, although the banking sector is an important component of the financial sector in these countries. A few studies such as those by Mokhtar *et al.* (2012) and Roslan and Karim (2009) have examined micro-lending in Malaysia, but ignored the banking sector.

In view of the foregoing discussion, this chapter investigates the influence of borrowers' characteristics, business characteristics and loan characteristics on the level of NPLs in the banking sector in Rwanda. The study contributes to the literature as these factors were neglected in previous studies despite the fact that the banking sector represents the largest component of the financial sector. On the other hand, the study uses the banking sector in Rwanda as a case, where economic research is in its early stages. It will thus serve as a reference point for other studies.

The findings indicate that across institutions, the relationship between repayment period and NPLs is negative, suggesting that the longer the repayment period, the more likely that the level of NPLs will be lower. Put differently, an extension of the loan repayment period can reduce the level of NPLs given that it decreases the stress of the borrower in meeting loan repayment obligations.

The rest of the chapter is structured as follows: Section 5.2 presents the effects of NPLs to the economy; Section 5.3 discusses Factors influencing NPLs in Banking, Section 5.4 describes the methodology used in this chapter, Section 5.5 presents and discusses the results; and Section 5.6 provides concluding remarks.

5.2 Effects of Non-Performing Loans on the economy

There has been renewed interest in the issue of NPLs among researchers due to its influence on banks' lending and profitability as well as the performance of the economy. NPLs give rise to loss-loan provisions that decrease banks' profits and hence their dividends to shareholders (Fofack, 2005). They also disturb the flow of credit to borrowers, as funds loaned out are not paid back, either in full or in part. Consequently, NPLs contribute to a decrease in investment and/or consumption (Demirgüç-Kunt and Detragiache, 1998). NPLs are also among the signals of banks' failure and can affect macroeconomic performance (Freixas and Rochet, 2008; Waweru and Kalani, 2009). It is argued that banking crises can also drive firms, including viable banks, into bankruptcy because borrowers are unable to service their debt. Therefore, banks' assets drop in value leading to insolvency that ends in banking crises.

The literature has argued that deposit insurance should prevent banking crises as it protects depositors in the advent of bank runs or bank failure (MacDonald and Koch, 2006). Depositors that are fully covered by deposit insurance will not care about the selection of a bank when making regular deposits because they are assured of getting their money back should the bank fail or become insolvent. However, empirical evidence has shown the opposite; instead of preventing the failure of banks, deposit insurance has been a source of moral hazard in the banking industry that leads to banking instability (see Chang and Velasco, 2001; Green and Lin, 2003; Ngalawa, Tchana and Viegi, 2016). The presence of deposit insurance gives bank managers room to maneuver to take excessive risk by lending to

borrowers with high-risk projects, as they are assured cover for depositors in the advent of bank failure (Kane, 1989; Demirgüç-Kunt and Detragiache, 1998; Mankiw, 2011; Casu *et al.*, 2015). This free riding behavior led to an accumulation of NPLs.

In addition, the evidence indicates that NPLs have served as warning sign of several banking and financial crises (Yang, 2003; Ahmad and Bashir, 2013). The banking distress in France and Scandinavian countries in the early 1990s, the Asian crisis of 1997 which began in Thailand, first as currency crisis where the Thailand's currency, the Thai baht underwent massive devaluations, and later escalated into financial crisis, and the global financial crisis of 2007–2009, are among recent examples.

Matthews and Thompson (2008) report that NPLs were among key drivers of banking distress in France and Scandinavian countries. In 1994, France recorded a level of 8.9 percent of total loans as NPLs. The French government decided on a rescue package for Credit Lyonnais amounting to US$ 27 billion. Equally, following a liquidity crisis in 1991, the Scandinavian bank crisis of 1991– 1992 cost about US$ 16 billion. In Finland, NPLs reached 13 percent of total bank loans in 1992. Substantial losses and insolvency in Norway led to a banking crisis in 1991 in which 6 percent of commercial bank loans were non-performing. In Sweden, 18 percent of total bank loans were reported lost between 1990 and 1993, and the Swedish government assisted the main banks to avert their failure.

Yang's (2003) study on the connection between the Asian financial crisis and the level of NPLs in Taiwan, found that the rates of NPLs steadily increased from 1996, as a precursor of the 1997 crisis. The ratio of NPLs was reported to be above 6 percent, which is relatively high by international standards (1 to 3 percent). The same trend was observed in other countries in the region, and worsened during the crisis (Heffernan, 2005). From 1996 to 1999, the rates of NPLs varied from 3.9 percent to 9 percent in Malaysia; 4.1 percent to 6.2 percent in South Korea; 8.8 percent to 37 percent in Indonesia, and 7.7 percent to 38.6 percent in Thailand. Similarly, Arena (2008) shows that banks' asset quality contributed significantly to the probability of bank failure in the 1997 East Asian financial crisis and that of Latin America from 1994 to 1995. In East Asia, 69.74 percent of failed financial institutions had a problem of NPLs while the figure stood at 55.46 percent in Latin America. This indicates that generally, banks with lower asset quality had a higher likelihood of failure than those that were stronger; with a lower level of NPLs. The majority of banks that failed were those with a higher level of NPLs prior to the crises.

Subsequent to the increase in the level of NPLs in Thailand, the intermediation role of banks declined, implying that businesses shifted to other non-bank financing sources such as corporate bond issues or simply their retained earnings (Disyatat and Vongsinsirikul, 2003). During this time of financial troubles, the systemic macroeconomic and liquidity shocks that were additional factors that triggered the crises, not only destabilized the weak banks, but by contagion even the well capitalized and strong banks were affected in one way or another (Arena, 2008).

It was also reported that the global financial crisis which started in the US was prompted by borrowers defaulting on sub-prime mortgages loans (Adebola, Sulaiman and Dalahan, 2011). The persistent effects of such bad loans and uncertainty about the health of financial institutions prolonged the crisis and depressed economic growth in many countries. The economic fallout of 2007–2009 highlights how a financial crisis can increase damage to the global economy (Stojković, 2013). Many business owners closed their companies, and retired people's savings plummeted. Millions of families lost their homes and their wealth. Around the world, about 30 million workers lost their jobs (Claessens, Kose, Laeven and Valencia, 2014).

In the US, the problems relating to the global financial crisis of 2007–2009 can be compared with those of the Great Depression of 1929. During the Great Depression, real output fell by an estimated 27 percent while unemployment rose from 3 percent in 1929 to 25 percent by 1933. There were approximately 30,000 banks in 1920 but this declined to 15,000 in 1933, and more than 9,000 banks closed between 1930 and 1933 causing huge losses to depositors and shareholders estimated at about US$ 2.5 billion (Sexton, 2008; Mankiw, 2011). Banks in rural areas closed due to large levels of NPLs among farmers, who were not able to pay on time due to low prices on farm's products.

In addition, NPLs affect banks and other deposit-taking institutions by reducing profits due to loan loss provisions, thus affecting the payment of dividends to shareholders. They also reduce institutions' lending capacity, hence placing a limit on the expansion of credit, that indirectly affects economic growth (Berger and DeYoung, 1997). An increase in NPLs leads to additional costs among all financial intermediaries in the process of loan recovery. These include telephone calls, visiting borrowers who encounter repayment problems, and the legal costs associated with the process of foreclosure of the collateral pledged by borrowers when contracting the loan and selling it in bank auctions (Kirkpatrick *et al.*, 2008). Thus, banks

spend additional funds in trying to recover bad loans. While the factors contributing to increased NPLs are both exogenous and endogenous to the bank, this chapter focuses on endogenous factors that make a greater contribution to the change in the level of NPLs in the Rwandan banking sector, and which are under the control of the management of banks, suggesting that they can be reduced or eliminated.

5.3 Factors influencing Non-Performing Loans in the Banking Sector

Previous studies have attributed the proliferation of NPLs to macroeconomic fundamentals separately or in conjunction with bank specific characteristics (Frye, 2000; Louzis, Vouldis and Metaxas, 2012; Orenge, 2013), poor management of financial intermediaries (Rottke and Gentgen, 2008; Adeyemi, 2011; Louzis *et al.*, 2012), and poor supervision (Boudriga, Boulila and Jellouli, 2009; Beck, Levine and Levkov, 2010; Levine, 2012). Very few studies relate NPLs to specific borrowers' as well as loan characteristics (Bhatt and Tang, 2002; Chaudhary and Ishfaq, 2003; Brehanu and Fufa, 2008).

Loan quality and macroeconomic variables are closely connected to the phases of expansion and contraction of the business cycle. During economic booms, investors are optimistic regarding potential returns on new projects, and they apply for more credit to invest in targeted projects. The level of NPLs is lower because the high and regular revenue of borrowers provide them with assured means to meet their credit obligations. Conversely, banks and other deposit taking institutions grant loans even to low quality borrowers. In contrast, during an ongoing period of contraction, investors are hesitant to invest in new projects. Households postpone some consumption decisions. Consequently, banks hold back on lending decisions because borrowers are experiencing a shortage of revenue. Banks are cautious to raise the amount of loans as they fear they will not be repaid (Sexton, 2008). They tend to be selective in granting new loans. In such circumstances, bad loans are likely to have soared during the boom period because banks significantly increased the amount of loans. Some of these loans become non-performing during the recession period, therefore increasing the level of NPLs.

Investigating the explanatory power of macroeconomic variables as determinants of NPLs using Pakistan banking data, Ahmad and Bashir (2013) found that GDP growth, interest rates, inflation, the Consumer Price Index (CPI), exports and industrial production, are significant in explaining the level of NPLs in the country during the period 1999 – 2000. The study

concluded that factors such as unemployment, real effective exchange rate and foreign direct investment did not contribute to the level of NPLs in Pakistan. Gerlach, Peng and Shu (2005) fitted a regression analysis using Hong Kong data for the period 1995–2002 to examine the relationship between a set of variables that included economic growth, interest rates, inflation, the change in property prices, asset size and sector concentration in lending and NPLs. Their findings suggest that an increase in interest rates led to an increase in NPLs ratio, whereas increases in economic growth, inflation, and change in property prices, negatively affected the level of NPLs.

Although most studies do not necessarily adopt the same variables, many have concluded that a relationship exists between a combined set of macroeconomic variables and bank specific characteristics and the level of NPLs. Salas and Saurina (2002) combined macroeconomic and microeconomic variables to explain aggregate the NPLs of Spanish commercial and savings banks for the period 1985–1987. They found that bank-specific determinants such as bank size, market power, and capital structure could serve as precursor indicators for increases in NPLs. Variables such as real GDP growth, bank size, market power, and rapid credit expansion and capital ratio explain fluctuations in NPLs.

Louzis *et al.* (2012) employed a dynamic panel data method on data from banks in Greece for the period 2003 – 2009 to test the validity of seven bank specific hypotheses on NPLs. The study found that variables such as GDP, interest rates, and unemployment have a significant impact in explaining variations in NPLs. However, using a regression analysis to investigate the determinants of NPLs in Indian commercial banks for the period 1999 – 2009, Dash and Kabra's (2010) findings suggest that only the real exchange rate has a significant impact on NPLs. The remaining variables (GDP growth rate, real interest rate, inflation, loans to total assets ratio, bank size and growth in loans) were found to be insignificantly associated with NPLs. Sinkey Jr and Greenawalt (1991) applied a log-linear regression to assess the factors underlying loan-losses in US large commercial banks for the period 1984 – 1987. The study concluded that risks that ended up in loan-losses occurred as a result of external factors related to the economic environment, or to internal factors such as poor managerial decisions in granting loans or both. Their results suggest that loan-loss rates in 1987 were positively correlated with loan rates, volatile funds, and the amount of outstanding loans granted in the three preceding years.

Some studies have also targeted a panel of countries. Babihuga (2007) used a pooled regression on 96 countries for the period 1998–2005 to investigate the linkages between financial stability indicators and macroeconomic variables. The study regressed NPLs against the quality of banking sector regulations and supervision, business cycle components of GDP, terms of trade, lending rates, unemployment, inflation and real effective exchange rates. The results indicate that terms of trade, quality of regulatory supervision, and a boom in the business cycle led to reduced NPLs. Other factors such as high inflation, lending rates, the unemployment rate, and depreciation of the real exchange rate did not influence changes in the level of NPLs.

Empirical findings also postulate that there is interaction among NPLs and attributes such as borrower characteristics and loans terms. Keeton (1999) investigated the influence of loan delinquencies and credit growth on NPLs, using data from US banks over the period 1982 – 1996. Applying a VAR model for analysis, the findings show a highly significant relationship between loan losses and credit growth. Further, he argued that in few states in the US, high loan losses are primarily associated with weak credit terms and the standards of the banks. Berger and DeYoung (1997) focused on the links between bank-specific characteristics, efficiency indicators, and the problem of non-performing loans. They formulated possible channels through which certain factors, namely, 'bad luck', 'bad management', 'skimping', and 'moral hazard', relate to banking efficiency and capital adequacy. They tested the derived hypotheses for a sample of US commercial banks spanning the period 1985 to 1994 and concluded that the level of NPLs was generally associated with measured cost efficiency. Low cost efficiency was positively related with increases in future NPLs.

'Bad management' refers to mismanagement that may involve weak assessment of the loan application, undervaluation of the pledged collateral, and poor monitoring of the allocation of borrowed funds, as well as the borrower's ongoing business. Podpiera and Weill (2008) provided strong support for the bad management hypothesis in a study investigating the influence of bad luck or bad management on NPLs using data from a panel of Czech Republic banks for the period 1994 – 2005. They argued that bad managers do not pay attention to monitoring loan portfolios, leading to an increase in NPLs. Louzis *et al.*'s (2012) study examined mortgage and consumer loans that became nonperforming and provided further evidence of the bad management hypothesis. This suggests that the effect of management quality is mainly reflected in the efficiency of credit granting procedures, where to some extent the evaluation of collateral is not properly done due to a lack of relevant skills

or simply because of a corrupt environment. Bad managers do not adequately monitor loan portfolios (Podpiera and Weill, 2008). The authors add that bad loans incur additional costs related to monitoring the defaulting borrower such as telephone calls, visits to the borrower, and seizing and disposing of the pledged collateral. Imprudent management is argued to have been the major driver of banks' failure in the US between 1920 and 1933 (Sexton, 2008).

Moral hazard, on the other hand, is explained by deliberate decisions of managers to finance high-risk, high-return projects when their banks are delicately capitalised. This moral hazard behaviour causes an increase in NPLs because in high-risk projects, the rate of pay back of borrowed money is very low. With regard to the bad luck hypothesis, unpredictable external factors are blamed for NPLs. These include factors such as floods and drought or economic recession that could lead to borrowers' inability to fulfil their payment obligations. The skimping hypothesis refers to a trade-off between short operating costs and future loan performance. Under this hypothesis, bank managers devote less effort to ensuring higher loan quality in the short-run, aiming to minimise resources, albeit at the expense of a higher level of NPLs in the long-run (Hughes and Mester, 1993). It suggests that bank managers allocate less resources in initial credit assessment and continual monitoring.

Turning to bank size, Salas and Saurina (2002) agree with HU, Li and Chiu (2004), among others, that bank size is likely to contribute to the reduction of NPLs. Salas and Saurina (2002) report a negative relationship between bank size and NPLs. They argued that a bigger size allows for more diversification opportunities, hence reducing NPLs. Similarly, HU *et al.* (2004) argue that large-sized banks have enhanced capabilities for loan evaluation and processing due to their ability to devote more resources to the whole process prior to granting the loan and subsequently in monitoring. In the same vein, Arena (2008) found that total assets which are a proxy for the size of a bank are relevant in allowing a diversified portfolio and consequently reducing countries' asset risks during financial crises as was the case in East Asia in 1997 and Latin America in 1994 –1995. Similarly, Sexton (2008) found that the small size of banks in the US was among the factors that triggered their failure between 1930 and 1933. However, Louzis *et al.*'s (2012) findings rejected the diversification hypothesis related to bank size affecting the level of NPLs. They argue that the size variable may not fully capture diversification even if non-interest income is used as a proxy for diversification. The coefficients estimates, even if they are of expected signs, are not statistically significant.

With regard to the relationship between macroeconomic and bank specific characteristics and NPLs, a number of studies have focused on the influence of borrowers' attributes and loan terms on NPLs. Louzis *et al.*'s (2012) empirical results suggest that the quantitative effects of the various determinants of NPLs depend on the type of loans. A consumer loan was the most sensitive to a change in lending interest rates while mortgage loans were not significantly affected by macroeconomic fundamentals.

With respect to macroeconomic fundamentals, the ratio of business loans to GDP growth as well as unemployment had a significant effect on NPLs.

A number of studies have been conducted on the relationship between microcredit and NPLs. Mokhtar *et al.*'s (2012) study on the determinants of microcredit loans repayment among microfinance borrowers in Malaysia focused on two important microfinance institutions involved in microcredit programmes, namely, Yasasan Usaha Maju (YUM) and an Economic Fund for National Entrepreneurs Group called TEKUN. They applied a logistic regression model. The findings reveal that age, gender, type of business, mode of repayment, and repayment amount contribute to loan repayment problems among TEKUN and YUM borrowers. Along the same lines Brehanu and Fufa's (2008) study on the determinants of repayment performance among small-scale farmers in Ethiopia using probit and logit regressions found that borrowers who own large farms, are located in high rainfall regions, and have a considerable number of livestock were most likely to be able to repay back their loans. Loans to this group of borrowers are most likely to increase the farmers' productivity and income. They also found that additional business income earned by a farmer was a good predictor of repayment performance. In addition, they found that gender matters, with male borrowers have a higher probability of default (Roslan and Karim, 2009; Mokhtar *et al.*, 2012).

The study also established that repayment period matters. An investigation of microcredit loan repayment behaviour in AgoBank Malaysia by Roslan and Karim (2009) found that male borrowers and borrowers with a long repayment period had a higher probability of defaulting. Furthermore, borrowers involved in non-production business activities such as the services or support sectors that had undergone training in their particular business, and had borrowed higher amounts had lower probabilities of defaulting. These findings suggest that the more a borrower is equipped with managerial skills relating to the activities that he/she

wants to undertake, the higher the probability of success, and if he/she contracts a loan, the probability of default is lower.

To limit moral hazard behaviour, some financial institutions grant loans in inputs instead of providing funds. Okorie (1986) studied repayment behaviour in an agricultural corporation in Nigeria. He found that borrowers who received a loan in kind (seed, fertilisers and equipment) had a lower probability of default relative to those who received a cash loan. The explanation lies in the fact that some borrowers misused the cash received, diverting it to their own consumption instead of allocating it to the real motive for borrowing, that is, a productive project.

Several studies also suggest a significant relationship between repayment rates and educational level. Chaudhary and Ishfaq (2003) examined the credit worthiness of 224 rural borrowers in Pakistan. Applying a logistic regression model, they found that borrowers with higher educational levels, that were involved in a non-farm business activity, were using the loan for investment, and were female, had a higher probability of repaying their loans. Similarly, Bhatt and Tang's (2002) study on the determinants of loan repayments in microcredit programmes in the US found that higher educational level was significantly and positively related to better repayment performance. Unlike the previous studies, they found that female borrowers, level of household income, type of business and borrower's experience had no significant effect on repayment behaviour.

Beyond the financial sector, researchers have also studied the underlying factors responsible for the defaulting behaviour of households. Their findings add value to this research as they investigate the common problem of defaulting. Canner and Luckett (1990) fitted a logistic regression to assess the determinants of households' loan repayment performance. Their results suggest that the marital status of the household head is significantly related to a household's repayment performance. Households with married and single heads had a higher probability of not missing a payment or making a late repayment than separated or divorced adults, all other things remaining constant. Lawrence's (1995) investigation of how a default option changes the standard implications of the life model concluded that low-income borrowers have a higher average probability of default, which probably explains why they pay higher interest rates than high-income borrowers do. Canner, Luckett, Cook and Middleton (1991) reported that US households' difficulty in making loan repayments was strongly related to the borrower's level of income. The marital status of the borrower as well

as whether or not the borrower owns a home were also influencing factors. The study, which covered a sample of 1 534 families, was commissioned by the Federal Reserve Board in the US to obtain information on consumer debt in the 1980s with a view to ascertaining how a default option alters the standard implications of the lifetime model.

5.4 Methodology

This section discusses the model specification and methods used to investigate microeconomic factors that influence non-performing loans in the Rwandan banking sector. It sets the model, the logistic model that is appropriate with the categorical nature of the dependent variable used in this study, the non-performing loan. It defines the variables included in the model, the estimation technique that the study applies and highlights the way that results are interpreted.

5.4.1 Model Specification

Due to the categorical nature of our dependent variable, that is the probability that a given loan is non-performing, this study uses the logistic regression model (Wooldridge, 2006). Estimated parameters will be obtained by applying the maximum likelihood technique following (Taktak, Shabou and Dumontier, 2010; Khieu, Mullineaux and Yi, 2012).

The binary response model lies primarily in the response probability as given by:

$$P\{Y_i = 1|X_i\} = G\ (X_i, \beta) \qquad (5.1)$$

where:

Y_i: stands for a non-performing loan that is the amount overdue not paid in full or in part for a period equal to 90 days and above.

X_i: is a $kx1$ vector of explanatory variables that include borrowers' characteristics, business characteristics and loan characteristics. These characteristics are Gender, Age, Marital status, Business type, Number of dependents of the borrower, and Repayment period.

β: is a vector of unknown parameters that have to be estimated.

Equation (5.1) states that the probability of having a non-performing loan depends on the vector X_i containing individual characteristics.

G (.) is a specified parametric function of $X_i'\beta$ which is usually a cumulative distribution function taking on values strictly between zero and one (Cameron and Trivedi, 2010).

Thus, the logistic function G (.) is of the form:

$$G(X_i, \beta) = \frac{e^{X_i'\beta}}{1 + e^{X_i'\beta}} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots .. (5.2)$$

Due to data unavailability, this study uses only six explanatory variables.

X_1 stands for gender,
X_2 stands for age,
X_3 stands for marital status,
X_4 stands for business type,
X_5 stands for repayment period,
X_6 stands for number of dependents of the borrower.

In the interpretation of estimation results, one does not think in terms of the measures of the dependent variable and explanatory variables, but rather in terms of the association between the variables. Coefficients from a Logit model are interpreted like OLS coefficients except that a logit model refers to probabilities. Coefficients represent a change in the logit for each unit change in the predictor. The direction of the effect of the predictor variable, say signs and significance, is more important because the sign of the effect is the same as the coefficient of the predictor (Verbeek, 2008; Cameron and Trivedi, 2010). In this chapter, the interpretation of the parameter estimates β_k is done through marginal effects.

It is postulated that the marginal effect measures how the dependent variable responds to a change in one of the regressors, X_k, after controlling for other variables in the model (Cameron and Trivedi, 2010). The effect of a change in X_k on $P(Y_i = 1)$ depends on the values of all X variables. This study adopts the average of marginal effect (AME) because it has been proven to be more realistic than other marginal effect measures, namely, marginal effect at mean (ME $X = \overline{X}$) or marginal effect at a representative value (ME at X=X^*) as argued by Cameron and Trivedi (2010). The reality is that, no person who can actually have mean values on all Xs. For example, nobody can be 23.18 years old, and be 2.5 percent black or white, and 12.5 percent female or male.

The AME is computed as a sample-weighted average of the marginal effect for each individual case ($X = X_i$). In other words, a marginal effect is computed for each case, and then all computed effects are averaged.

For continuous independent variables, the marginal effect measures the change in $P(Y_i = 1)$ as X_k increases by one, keeping all other variables fixed (Verbeek, 2008). The impact of a marginal change in X_k on the expected value of Y_i, other things remaining equal, is given by equation (5.3).

$$\frac{\partial E\{Y_i|X_i\}}{\partial X_{ik}} = exp\{X_i'\beta\}\beta_k \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . (5.3)$$

Marginal effects for categorical variables illustrate how $P(Y_i = 1)$ is predicted to change following a change in X_k from 0 to 1, holding other Xs constant, as expressed in equation (5.4).

$$Marginal\ \ Effect\, X_k = \Pr(Y_i = 1|X, X_k = 1) - \Pr(Y_i = 1|X, X_k = 0) \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . (5.4)$$

Alongside the marginal effect approach, the parameter estimates β_k can also be interpreted as additive effects on the *log* of the odds for a unit change in the k^{th} explanatory variable. For a unit change in X_k, the odds are expected to change by a factor $\exp(\hat{\beta}_k)$, holding the remaining variables constant (Alonso-Rodríguez, 2001). The quantity representing the percentage change in the odds, for a unit change in X_k, is given by $100\,(e^{\widehat{\beta}_k} - 1)$. In this study, however, this approach is not used.

To measure the accuracy with which the estimated model for the Bank of Kigali Limited and Unguka Bank Limited approximate their data, this study uses the percentage of correctly predicted. The rationale for the adoption of this measure is that it is widely used to measure the goodness-of-fit for binary dependent variables (Wooldridge, 2006; Verbeek, 2008; Cameron and Trivedi, 2010). This measure consists of comparing the predicted outcomes with actual outcomes based on the fitted probability of loans being non-performing ($\widehat{NPLs}$ =1) or not $\widehat{NPLs}$ =0. It is associated with a symmetric loss function where $\widehat{NPLs}$ =1 if F($x'\beta$)> 0.5 and $\widehat{NPLs}$ =0 if F($x'\beta$) $\leq$ 0.5. Therefore, observations of correctly classified NPLs correspond to a percentage greater than 50 percent.

5.4.2 Data and Variables

Empirical analysis in this chapter covers two consecutive years, 2012 and 2013, for the two banks in the sample and one more year, 2014 for Unguka Bank Ltd, for purposes of a robustness check. Among the data used is defaulting borrowers' information, which is sensitive in nature due to the privacy rule on customer information in the banking sector. In conducting this research, the idea was to cover the whole banking sector in Rwanda. However, due to the reluctance of most banks to share their customer information even for research purposes, only two banks that responded positively are covered. These are the Bank of Kigali Limited (a commercial bank) and Unguka Bank Limited (a microfinance bank). Fortunately, these two banks are the largest in the subsets of commercial banks and microfinance banks. The two set of banks (commercial banks and microfinance banks) represent more than 83.62 percent of banking services in Rwanda (Banque of Kigali [BK], 2013; BNR, 2013).

In 2013, the Bank of Kigali Limited had about 33.8 percent of the market share in the Rwandan banking sector, where 81 percent of the players are commercial banks. The nine remaining banks shared 47.2 percent. On the other hand, Unguka Bank Limited had 1.01 percent of the market share out of 2.62 percent combined market share of the three microfinance banks in the Rwandan banking sector. The two remaining microfinance banks, Urwego Opportunity Bank Limited and Agaseke Bank Limited shared 1.61 percent market share, respectively in the proportion of 0.98 percent and 0.63 percent.

Besides the impressive market share of the two banks vis-à-vis their peers, a recent survey conducted by the Association of Microfinance Institutions in Rwanda (AMIR) showed that these two banks are among the financial institutions that are well known to the public as saving institutions of choice (Association of Microfinance Institutions in Rwanda [AMIR], 2015). The survey revealed that Bank of Kigali Limited and Unguka Bank Limited were among the top four banks that are known to customers as saving institutions for their deposits. Seventeen percent of the participants' stated that the Bank of Kigali Limited was their bank of choice, placing it in second position after BPR Limited at 20 percent. Equity Bank Limited was third with 10 percent of respondents. On the other hands, Unguka Bank Limited was affirmed by 7 percent of the respondents as their bank of choice, ahead of the other two microfinance banks, Urwego Opportunity Bank Limited and Agaseke Bank Limited, at 4 percent and 3 percent, respectively.

Therefore, based on the foregoing discussion, while there were constraints to accessing data for many institutions, by accessing data from the two biggest banks covering the two categories of banks that are profit oriented, it can safely be argued that the two financial intermediaries fairly represent their peer institutions. Thus, the factors that will be found to influence NPLs in the two banks can be reasonably generalized to the whole banking sector in Rwanda.

Based on the available data, the study uses a set of variables such as borrowers' characteristics (Gender, Age, and Marital status, the number of dependents of the borrower), business characteristics (type of loan), and some loan characteristics (repayment period). The dependent variable, NPLs is a dichotomous variable. It takes a value of "1" if the borrower delays payment of the principal or interest for a period of 90 days or more (Barisitz, 2011), and "0" otherwise (meaning the borrower delays payment of the principal or interest for a period between one day and 89 days). The independent variables are gender (*gender*), age (*age*), marital status (*maritast*), business type with different variants that include consumer loan (*consl*), mortgage loan (*mortgl*), overdraft, treasury loan (*tresl*), equipment loan (*equipl*), agricultural loan (*agriculture*), commercial loan (*commerce*), construction loan (*construction*), transport loan (*transport*), repayment period (*repperiod*), and the number of dependents of the borrower (*depend*). Some variables like age, marital status, and business type were measured as dichotomous. In case where several categories were attached to a variable like marital status, age and business type, a set of dummy variables was necessary, but taking one variable as a reference category for the group, in order to avoid the dummy variable trap (Greene, 2008).

For example, in estimating the influence of selected variables on the level of NPLs in the Bank of Kigali Limited, the marital status variable is represented by three major categories: *married*, *single*, and *widow*, taking *married* as a reference category. The age variable is represented by four categories: aged between 18 and 30 years (*age 18 – 30*), between 31 and 45 years (*age 31 – 45*), between 46 and 65 years (*age 46 – 65*), and aged above 65 (*age > 65*), taking the group *age 18 – 30* as a reference category. The business type variable is represented by five major categories: consumer loans (*consl*), equipment loans (*equipl*), mortgage loans (*mortgl*), overdraft (*overdraft*), and treasury loans (*treasl*), taking consumer loans (*consl*) as a reference category. For Unguka Bank Limited, the business type variable is represented by four major categories: commerce (*commerce*), agriculture (*agriculture*),

construction (*construction*), and transport (*transport*), taking commerce (*commerce*) as a reference category.

Before proceeding to the presentation and analysis of estimation results, it is important to briefly describe the two financial institutions in the sample.

5.4.2.1 Bank of Kigali Limited

The Bank of Kigali Limited is a company limited by shares. It was established in the Republic of Rwanda on December 22, 1966. Initially, it was a joint venture between the Government of Rwanda and Belgolaise (a Belgian bank), each owning 50 percent of the ordinary share capital. In 2007, the bank was fully acquired by the Government of Rwanda. In 2011, it was registered with the Rwanda Stock Exchange (RSE), and new shareholders have since joined the bank. In 2013, it was the leading bank in Rwanda with 33.8 percent market share in total assets of the financial sector, 31.8 percent in net loans, and 29.4 percent in customers' deposits (BK, 2013). It managed to decrease its level of NPLs from 19.4 percent in 2007 to 6.7 percent in 2013.

A brief summary of some financial highlights of the Bank of Kigali Limited for the five years from 2009 to 2013 is presented in Table 5-1. The table shows that from the time Bank of Kigali Limited was registered on the RSE in 2011, it recorded tremendous increases in all highlighted financial indicators compared to 2010. In three years, 2011 to 2013, the total number of clients increased by 167 percent, its total deposits increased by 81.43 percent, and its loan portfolio rose by 96.27 percent. With these improvements, the bank has managed to increase profits by a significant 140 percent, and consequently, its total assets have increased by 113.66 percent. The bank's market share has increased by 5.3 percent while NPLs decreased by 1.6 percent over the same period.

Table 5- 1: Financial highlights of Bank of Kigali Limited, 2009 to 2013

	Year/Subject	**2009**	**2010**	**2011**	**2012**	**2013**
1	Number of clients	41,900	72,182	156,597	236,055	264,946
2	Deposits by customers (Rwf'000)	124,586,791	154,598,382	200,109,714	226,843,505	280,489,463
3	Outstanding loans (Rwf'000)	77,094,866	101,402,652	123,130,687	185,066,752	199,025,241

	Year/Subject	2009	2010	2011	2012	2013
4	Net profits/loss (Rwf'000)	5,286,963	6,178,582	8,688,765	11,781,336	14,830,235
5	Total assets (Rwf'000)	151,871,003	197,676,646	287,899,874	322,794,214	422,360,073
6	Rate of NPLs	8.4	8.5	8.3	6.5	6.9
7	Bank market share (%)	26.4	27.4	32.3	31.7	33.8

Source: Bank of Kigali's Financial Reports, 2009 – 2013.

5.4.2.2 Unguka Bank Limited

Unguka Bank Limited is a microfinance bank created in 2005 as a microfinance institution limited by shares on the initiative of young graduates from three universities in Rwanda. It started with a capital of Rwf 321,200,000 (US$ 609,568.63) owned by 214 shareholders (Unguka Bank [UB], 2013). In 2008, it raised its capital to Rwf 1,766,600,000 (US$ 3,209,432.45), that allowed Unguka Microfinance Company limited by shares to qualify to upgrade to a microfinance bank in 2011, as the minimum capital requirement for that intermediate bank category is Rwf 1,500,000,000 (US$ 2,725,092.65). In 2012, it was joined by a new strategic shareholder, Rural Impulse Fund II from Netherlands, that brought in a capital share of 1 billion Rwandan francs and 0.5 billion as share premium, raising the bank's capital to 2.8 billion Rwandan francs (US$ 4,517,288.95). From its establishment in 2005, it managed to control the level of NPLs to less than or equal to 5 percent. Table 5-2 presents some financial highlights of Unguka Bank Limited for the five years, 2009 to 2013. The figures in this table show that an unprecedented change in total deposits, loan portfolio, and total assets followed the licensing of Unguka as a microfinance bank limited in 2011. Only net profits did not follow this trend due to important investments in assets related to the new structure (status) of the bank and a 50 percent expansion in new branches. In 2013, the number of staff decreased due to a restructuring process aimed at providing new skills to drive its new microfinance status.

Table 5- 2: Financial highlights of Unguka Bank Limited, 2009 to 2013

	Year/Subject	2009	2010	2011	2012	2013
1	Number of clients	13,011	16,838	26,545	27,371	28,228
2	Deposits from customers (Rwf'000)	1,135,390	1,722,906	2,937,245	4,857,839	10,365,285
3	Outstanding loans (Rwf'000)	2,045,158	2,874,463	4,111,349	5,181,486	8,907,623

4	Net profits/loss (Rwf'000)	146,140	210,481	169,102	173,379	189,774
5	Total assets (Rwf'000)	2,751,765	3,731,955	5,577,368	8,906,924	15,371,912
6	Rate of NPLs	4.08	2.3	4.0	3.9	4.0
7	Number of staff	87	107	210	230	223

Source: Unguka Bank's Financial Reports, 2009 – 2013.

5.5 Empirical Results and Discussion

A multivariate logistic regression was used (equation 5.2) to investigate the effect of the micro-factors, borrowers' characteristics, business type, and loan characteristics on NPLs, using the computer software Stata 13. Data were collected from the Bank of Kigali Limited and Unguka Bank Limited's financial reports for the years 2012 and 2013. As observations are valid for only one year, this study opted for the past two years in order to check for variability that may contribute to the level of NPLs across, and within institutions over these two years. In addition, for purposes of a robustness check, a further investigation was conducted on Unguka Bank Limited for the year 2014. A summary of descriptive statistics of the variables used at bank level are presented per bank per year (see Tables 5-3 and 5-8 for Bank of Kigali Limited for 2012 and 2013, respectively and Tables 5-5, 5-10 and 5-13 for Unguka Bank Limited for 2012, 2013 and 2014, respectively). In these tables, the statistics are in relation to the problem of loan repayment where the borrower has delays repayment for at least one day (PAR 1) and above. It should be noted that a loan is called non-performing if the borrower delays repayment for a period of 90 days and above. This indicates that not every loan with repayment problems is a NPL, while the reverse holds.

The estimation results for each bank are presented separately per bank per year (see Tables 5-4 and 5-9 for Bank of Kigali Limited and Tables 5-6, 5-11 and 5-14 for Unguka Bank Limited). A summary capturing the estimation results for the two banks is also provided (see Table 5-7 for 2012 and Table 5-12 for 2013).

5.5.1 Estimates of factors influencing NPLs for 2012

5.5.1.1 Estimates of factors influencing NPLs for 2012 for Bank of Kigali Limited

Table 5-3 presents descriptive statistics for the Bank of Kigali Limited in 2012. As discussed previously, *mortgl*, *overdraft*, *treasl*, *equipl* are business type variables. *mortgl* stands for mortgage loan, *overdraft* for overdraft loan, *treasl* for treasury loan, *equipl* for equipment loan, *repperiod* for repayment period, *age* for the age of the borrower, *gender* for the gender of the borrower, and *single* and *widow* for marital status of the borrower. Consumer loan *(consl)* serves as a reference category for business type variables, age group 18 to 30 (*age 18 – 30*) as a reference category for the age group variable, and married (*married*) as a reference category for the marital status variable. Table 5-3 indicates that 89.1 percent of the total observations under analysis represent NPLs. A large proportion of borrowers with NPLs problems fall into the category of overdraft loans (63.2 percent) followed by the reference category, consumer loans (36.7 percent). More than half are aged between 31 and 45 and 27 percent are young borrowers aged between 18 and 30. Of the borrowers with NPLs problems, 38.1 percent were single, a small proportion (1.36 percent) were widows and the largest proportion of 69.3 percent represents male borrowers. On average, the repayment period is 10.97 months, that is, less than a year.

Table 5- 3: Summary statistics of the key variables for Bank of Kigali Limited for 2012

Variable	N	Mean	Std.Dev.	Minimum	Maximum
NPLs	3 150	.8911111	.3115492	0	1
single	3 150	.3812698	.4857757	0	1
widow	3 150	.0136508	.1160548	0	1
gender	3 150	.6930159	.4613160	0	1
age 31 – 45	3 150	.5660317	.4956993	0	1
age 46 – 65	3 150	.1638095	.3701614	0	1
age> 65	3 150	.0092063	.0955222	0	1
repperiod	3 150	10.9711100	15.9869200	1	180
equip	3 150	.0146032	.1199770	0	1
mortgl	3 150	.0079365	.0887469	0	1
overdraft	3150	.6320635	.4823205	0	1
treasl	3150	.0276190	.1639047	0	1

Table 5-4 presents estimation results on the contribution of selected variables to the change in the level of NPLs in the Bank of Kigali Limited for 2012. The results in this table suggest that the probability of experiencing a NPL decreases significantly with repayment period and

age. A one-month increase in the loan maturity period leads to a 4.8 percent decrease in NPLs, *ceteris paribus*. These findings are in line with those of (Kung, Wu, Hsu, Lee and Yang, 2010; Mokhtar *et al.*, 2012). For example, Mokhtar, Nartea *et al.* (2012) found that the longer the period of loan repayment, the lower the probability of delayed or non-repayment of loans in TEKUN. Borrowers whose repayment period was more than a year had a decreased probability of having loan repayment problems of 15.61 percentage points. Similarly, Kung *et al.* (2010) concluded that the longer the mortgage maturity period, the lower the probability of default. However, they differ from Roslan and Karim (2009) who concluded that a long repayment period was a significant contributing factor to defaulting in Malaysia.

With regard to age, the probability of one's loan being non-performing decreases as people get older, compared to the reference category 18 – 30 years. This means that, borrowers aged above 31 are more likely to have a lower probability of contributing to NPLs relative to young borrowers aged between 18 and 30. The estimation results reveal that borrowers aged between 31 and 45 and between 46 and 65 had a 3.19 percentage points and 5.17 percentage points lower probability, respectively, of contributing to an increase in NPLs than borrowers aged between 18 and 30, *ceteris paribus*. These findings are consistent with Canner *et al.* (1991) who established that households headed by people under the age of 35 were nearly four times more likely to report payment problems than those headed by an individual aged at least 55. However, they contradict Mokhtar *et al.*'s (2012) finding that borrowers aged between 46 and 55 had problems repaying their debt in TEKUN. Along similar lines, Kung *et al.* (2010) stated that young borrowers are less likely to default.

The reason why young borrowers are more prone to defaulting could be that they are likely to have lower paying jobs. In this study, the explanation probably hinges on their lack of experience in business or lack of accumulated assets to complement the income expected from business to pay back the loan when business is not promising. However, while it is not significant, borrowers aged 65 years and above had 3.88 percentage points lower probability of contributing to an increase in the level of NPLs than young borrowers aged between 18 and 30. This age group (above 65 years) normally corresponds with retirement, when people tend to have limited sources of quasi-permanent income and are less involved in business activities.

Taking consumer loans as a reference category, mortgage loans, overdrafts and treasury loans are found to be significantly contributing to the level of NPLs in the Bank of Kigali Limited. *Ceteris paribus*, mortgage loans have 32.61 percentage points higher probability of increasing NPLs than consumer loans while treasury loans and overdrafts have 20.78 percentage points and 17.11 percentage points lower probability, respectively, of contributing to the level of NPLs than consumer loans. While equipment loans were reported to have 4.92 percentage points higher probability of contributing to the level of NPLs than consumer loans, they were not found to be significant. The variables related to gender and marital status were also not statistically significant contributors to the level of NPLs. It is worth pointing out at this stage that the overall prediction accuracy of the model is acceptable, as the percentage of correctly predicted NPLs is 89.08 percent.

Table 5- 4: Estimates of factors influencing NPLs in the Bank of Kigali Limited for 2012

Variable	Estimates Coefficients	Marginal Effects
gender	-.1341	-.0126
marital status		
single	.0276	.0026
widow	.0150	.0014
age		
age 31 – 45	-.3384**	-.0319
age 46 – 65	-.5470**	-.0517
age> 65	-.4105	-.0388
business type		
equip	.5211	.0492
mortgl	3.4500**	.3261
overdraft	-1.8109***	-.1711
treasl	-2.1984***	-.2078
repperiod	-.0483***	-.0045
-Constant	4.2658***	
Number of observations	*3 150*	
Log likelihood	*-1 047.19*	
LR chi2 (11)	*73.98*	
Prob. > chi2	*0.0000*	
Percent of correctly predicted	*89.08*	

****, ** and *, indicate that the coefficient is significant at 1%, 5% and 10% level*

5.5.1.2 Estimates of factors influencing NPLs for 2012 for Unguka Bank Ltd

Table 5-5 presents descriptive statistics for Unguka Bank Limited in 2012. *agriculture, commerce, construction and transport* are business type variables. *agriculture* stands for loans to borrowers involved in agricultural activities, *commerce* for loans to borrowers involved in commerce activities, *construction* for loans to borrowers involved in construction activities, and *transport* for loans in the transport sector, *repperiod* for repayment period, and *gender* for the gender variable. Commercial loan *(commerce)* serves as a reference category for the business type variables. Table 5-5 shows, that, 71.42 percent of the total observations under analysis represent NPLs. The average repayment period is about 17.8 months, and 78.32 percent of borrowers with NPLs problems are male. The sector with the largest proportion of borrowers with NPLs is commerce (57.65 percent).

Table 5- 5: Summary statistics of the key variables used in Unguka Bank Limited for 2012

Variable	N	Mean	Std.Dev.	Minimum	Maximum
NPLs	203	.7142857	.4528708	0	1
gender	203	.7832512	.4130486	0	1
agriculture	203	.1330049	.3404196	0	1
construction	203	.0541872	.2269464	0	1
transport	203	.2906404	.4551804	0	1
repperiod	203	17.8226600	8.3694450	3	48

Table 5-6 presents estimation results on the contribution of selected variables to the change in the level of NPLs in Unguka Bank Limited for 2012. The table shows, that, business type variables and repayment period are negatively associated with the level of NPLs. Taking commerce as a reference category, in 2012, borrowers whose main activities were transport, construction and agriculture had a significantly lower probability of increasing NPLs than those undertaking commercial activities. They were respectively lower by 24.5 percentage points, 24.6 percentage points, and 27.9 percentage points compared to commercial activities. In addition, the overall predictive accuracy of the model appears satisfactory, as the percentage of correctly predicted NPLs is 71.42 percent.

Table 5- 6: Estimates for factors influencing NPLs in Unguka Bank Limited in 2012

Variable	Estimates Coefficients	Marginal Effects
gender	.2955	.0548
business type		
agriculture	-1.5030***	-.2792
construction	-1.3242*	-.2460
transport	-1.3236***	-.2458
repperiod	-.0171	-.0031
-Constant	1.7516	
Number of observations	*203*	
Log likelihood	*-112.1377*	
LR chi2 (5)	*18.62*	
Prob. > chi2	*0.0023*	
Percent of correctly predicted	*71.42*	

****, ** and *, indicate that the coefficient is significant at 1%, 5% and 10% level*

Besides the interpretation of coefficients for each individual financial institution, a cross-sectional comparison of the two banks is presented in order to identify the attributes that influence most NPLs in the Rwandan banking sector. Table 5-7 presents the summary of the parameter estimates across these institutions in order to draw conclusions on the existence of pattern of the influence of borrowers' characteristics, business characteristics, and loan characteristics on NPLs.

Table 5-7 presents estimation results on the contribution of selected variables to the change in the level of NPLs in the Bank of Kigali Limited and Unguka Bank Limited for 2012. The table shows, that, only two variables of the explanatory variables are common to both these banks in 2012. These are gender and repayment period. However, only the repayment period (*repperiod*) is negatively associated with NPLs. Furthermore, it is only significant for the Bank of Kigali Limited. This suggests that the more the repayment period increases, the lower the probability of a loan being non-performing in the Bank of Kigali Limited. Following these findings, an investigation was conducted to assess the factors that influenced the level of NPLs for the two banks in 2013, in order to draw a conclusion based on two years, although the defaulting behavior is valid for analysis for one year. Generally, a loan that is non-performing for a period of 360 days is written-off.

Table 5- 7: Factors influencing NPLs across the Bank of Kigali Limited and Unguka Bank Limited for 2012

Variable	Bank of Kigali Limited		Unguka Bank Limited	
	Estimates Coefficients	Marginal Effects	Estimates Coefficients	Marginal Effects
gender	-.1341	-.0126	.2955	.0548
marital status				
single	.0276	.0026	-	-
widow	.0150	.0014	-	-
age				
age 31 – 45	-.3384**	-.0319	-	-
age 46 – 65	-.5470**	-.0517	-	-
age> 65	-.4105	-.0388	-	-
business type				
equip	.5211	.0492	-	-
mortgl	3.4500**	.3261	-	-
overdraft	-1.8109***	-.1711	-	-
treasl	-2.1984***	-.2078	-	-
agriculture	-	-	-1.5030***	-.2792
construction	-	-	-1.3242*	-.2460
transport	-	-	-1.3236***	-.2458
repperiod	-.0483***	-.0045	-.0171	-.0031
-Constant	4.2658***		1.7516	
Number of observations	*3 150*		*203*	
Log likelihood	*-1 047.19*		*-112.1377*	
LR chi2	*73.98*		*18.62*	
Prob. > chi2	*0.0000*		*0.0023*	
Percent of correctly predicted	*89.08*		*71.42*	

****, ** and *, indicate that the coefficient is significant at 1%, 5% and 10% level*

5.5.2 Estimates of factors influencing NPLs for 2013

5.5.2.1 Estimates of factors influencing NPLs for 2013 for Bank of Kigali Limited

Table 5-8 presents descriptive statistics for the Bank of Kigali Limited in 2013. *age* stands for the age group of the borrower, *gender* for the gender of the borrower, and *single* and *widow* for the borrower's marital status. Age group 18 to 30 (*age 18 – 30*) serves as reference category for the age group variable, and married (*married*) as a reference category for the marital status variable. The table shows that 84.79 percent of the total observations under analysis represent NPLs. Married borrowers, who are the reference category for the marital status variable represent 59.7 percent of borrowers with NPLs problems. Similar to the 2012 figures, the age group of borrowers with minimal NPLs problems is the group aged 31 to 45 years. It accounts for 57.9 percent of the set of borrowers with NPLs problems. Young people

aged between 18 and 30 represent 27.29 percent of borrowers with NPLs problems. About 69.7 percent of borrowers with NPLs problems are male. On average, the repayment period is 3.38 months, that is, about a quarter of a year. Compared to 2012 where the average repayment period was 10.97 months, the average repayment period decreased by 7.58 months.

Table 5- 8: Summary statistics of the key variables used in the Bank of Kigali Limited for 2013

Variable	N	Mean	Std.Dev.	Minimum	Maximum
NPLs	3 638	.8479934	.3590766	0	1
single	3 638	.3936229	.4886200	0	1
widow	3 638	.0104453	.1016811	0	1
gender	3 638	.6979109	.4592268	0	1
age 31 – 45	3 638	.5794393	.4937169	0	1
age 46 – 65	3 638	.1489830	.3561206	0	1
age> 65	3 638	.0057724	.0757671	0	1
repperiod	3 638	3.3886750	8.6457230	1	120

Table 5-9 presents estimation results on the contribution of selected variables to the change in the level of NPLs in the Bank of Kigali Limited for 2013**.** The table shows that in 2013, only age and repayment period made a significant contribution to the level of NPLs in this bank, all other things remaining equal. Borrowers aged between 46 and 65 had 8.12 percentage points lower probability of increasing NPLs than borrowers aged between 18 and 30. The age group of 46 to 65 years made the lowest contribution to the increase in NPLs in the Bank of Kigali Ltd. These estimation results are consistent with Canner *et al.*'s (1991) findings, but contradict those of Mokhtar *et al.* (2012) that stated that borrowers aged between 46 and 55 had problems repaying their debt. Again, the overall prediction accuracy of the model is satisfactory, as the percentage of correctly predicted NPLs is 84.74 percent.

Table 5- 9: Estimates of factors influencing NPLs in the Bank of Kigali Limited for 2013

Variable	Estimates Coefficients	Marginal Effects
gender	.0873	.0109
marital status		
single	.1120	.0140
widow	.3474	.0437
age		
age 31 – 45	-.1297	-.0163
age 46 – 65	-.6461***	-.0812
age> 65	-.3839	-.0483
repperiod	-.0272***	-.0034

-Constant	1.9147***	
Number of observations	*3 638*	
Log likelihood	*-1 514.99*	
LR chi2 (7)	*70.85 (7)*	
Prob. > chi2	*0.0000*	
Percent of correctly predicted	*84.74*	

****, ** and *, indicate that the coefficient is significant at 1%, 5% and 10% level*

5.5.2.2 Estimates of factors influencing NPLs for 2013 for Unguka Bank Limited

Table 5-10 presents descriptive statistics for Unguka Bank Limited in 2013. As highlighted in Table 5-5, *agriculture*, *commerce*, *construction and transport* are business type variables. *agriculture* stands for loans to borrowers involved in agricultural activities, *commerce* stands for loans to borrowers involved in commerce activities, *construction* stands for loans to borrowers involved in construction activities, and *transport* stands for loans in the transport sector. *repperiod* stands for the repayment period variable, and *gender* for the gender variable. Commerce loan *(commerce)* serves as a reference category for the business type variables. Table 5-10 shows that 36 percent of the total observations under analysis represent NPLs. The average repayment period is about 23.63 months and 81.77 percent of borrowers with NPLs problems are male. As was displayed in the 2012 outcomes, the sector with the most borrowers with loan problems is commerce (the reference category). For 2013, it represents 44.72 percent. The table also shows that significantly fewer borrowers whose main activity is construction and agriculture contributed to an increase in NPLs than those in commerce. They respectively represent 11.2 percent and 16.5 percent.

Table 5- 10: Summary statistics of the key variables used in Unguka Bank Limitedfor 2013

Variable	N	Mean	Std.Dev.	Minimum	Maximum
NPLs	472	.3601695	.4805587	0	1
gender	472	.8177966	.3864216	0	1
agriculture	472	.1652542	.3718039	0	1
construction	472	.1122881	.3160556	0	1
transport	472	.2754237	.4472015	0	1
repperiod	472	23.6313600	20.1042900	1	104

Table 5-11 presents estimation results on the contribution of selected variables to the change in the level of NPLs in Unguka Bank Limited for 2013. Although the transport sector was not found to significantly contribute to an increase NPLs in 2013, controlling for commercial activities, the sector appeared to be the highest contributor to the increase in NPLs with 7.7

percentage points lower than commerce. This is followed by construction and agriculture at 20.57 percentage points and 22.33 percentage points, respectively lower than commercial activities. Therefore, managers of Unguka Bank Limited should pay attention to the commercial and transport sectors when assessing loan applications from new borrowers.

The study results in Table 5-11 also reveal that, *ceteris paribus,* a one-month increase in the loan maturity period leads to a 2.27 percent decrease in the level of NPLs, and is statistically significant. As observed in the Bank of Kigali Limited, the gender variable was not a statistically significant contributor to the level of NPLs. Furthermore, the overall prediction accuracy of the model looks fair, as the percentage of correctly predicted NPLs is 62.92 percent.

Table 5- 11: Estimates for factors influencing NPLs in Unguka Bank Limited for 2013

Variable	Estimates Coefficients	Marginal Effects
gender	-.3376	-.0712
business type		
agriculture	-1.0588***	-.2233
construction	-.9754**	-.2057
transport	-.3652	-.0770
repperiod	-.0227***	-.0048
-Constant	.5526	
Number of observations	*472*	
Log likelihood	*-287.3601*	
LR chi2 (5)	*42.20*	
Prob. > chi2	*0.0000*	
Percent of correctly predicted	*62.92*	

****, ** and *, indicate that the coefficient is significant at 1%, 5% and 10% level*

As performed for 2012, a cross-sectional comparison of the two banks for 2013 is made in order to identify the attributes that most influenced NPLs in the Rwandan banking sector for that specific year. Table 5-12 below presents a summary of estimation results on the contribution of selected variables to the change in the level of NPLs in the Bank of Kigali Limited and Unguka Bank Limited for 2013. As noted for 2012, the table shows that only two variables, gender and repayment period are explanatory variables that are common to the Bank of Kigali Limited and Unguka Bank Limited. However, contrary to the findings in Table 5-7 for 2012, the repayment period (*repperiod*) is statistically significant and negatively associated with the level of NPLs for the two banks.

Table 5- 12: Factors influencing NPLs across Bank of Kigali Limited and Unguka Bank Limited for 2013

Variable	Bank of Kigali Limited		Unguka Bank Limited	
	Estimates Coefficients	Marginal Effects	Estimates Coefficients	Marginal Effects
Gender	.0873	.0109	-.3376	-.0712
marital status				
single	.1120	.0140	-	-
widow	.3474	.0437	-	-
age				
age 31 – 45	-.1297	-.0163	-	-
age 46 – 65	-.6461***	-.0812	-	-
age> 65	-.3839	-.0483	-	-
business type				
agriculture	-	-	-1.0588***	-.2233
construction	-	-	-.9754**	-.2057
transport	-	-	-.3652	-.0770
repperiod	-.0272***	-.0034	-.0227***	-.0048
-Constant	1.9147***		.5526	
Number of observations	*3 638*		*472*	
Log likelihood	*-1 514.99*		*-287.3601*	
LR chi2	*70.85 (7)*		*42.20*	
Prob. > chi2	*0.0000*		*0.0000*	
Percent of correctly predicted	*84.74*		*62.92*	

****, ** and *, indicate that the coefficient is significant at 1%, 5% and 10% level*

Given that the repayment period was significant for the two banks in 2013, while in 2012 it was only significant for the Bank of Kigali Limited, we carry out a further investigation on Unguka Bank Limited for 2014. We used data collected from borrowers' files in its six large branches who were at risk of at least a one-day delay (PAR 1). These branches are Nyarugenge, Remera, Nyabugogo, Musanze, Rubavu and Muhanga. They held an estimated 58.4 percent of the total Portfolio at Risk (PAR1). The findings are reported in Table 5-14.

5.5.3 Estimates for factors influencing NPLs for 2014

Table 5-13 presents descriptive statistics for Unguka Bank Limited in 2014. *agriculture, commerce, construction and transport* are business type variables. *agriculture* stands for loans to borrowers involved in agricultural activities, *commerce* stands for loans to borrowers involved in commerce activities, *construction* stands for loans to borrowers involved in construction activities, and *transport* stands for transport loan. *repperiod* stands for the repayment period variable, *age* stands for the age group of the borrower variable, *gender* for

the gender of the borrower variable, *maristat* for the marital status of the borrower variable, and *depend* stands for the number of people dependent on the borrower variable. Commerce loan *(commerce)* serves as a reference category for the business type variables. This table shows that 50.96 percent of the total observations under analysis represent NPLs. The average repayment period is about 25.10 months. Male borrowers with NPLs problems represent 86.53 percent. Most borrowers with NPLs problems (61.5 percent) fall into the age group 31 and 45. This is followed by young people aged between 18 and 30 (the reference category) at 22 percent. As was the case in 2012 and 2013, the economic sector that accounts for most NPLs is commerce (the reference category) at 56.22 percent. The variable *depend* which stands for the number of people dependent on the borrower is unchanged; on average 1.81 persons (approximately 2 persons) are dependent on the borrower.

Table 5- 13: Summary statistics of the key variables used in Unguka Bank Limited in 2014

Variable	N	Mean	Std.Dev.	Minimum	Maximum
NPLs	208	.5096154	.5011136	0	1
gender	208	.8653846	.3421357	0	1
age 31 – 45	208	.6153846	.4876780	0	1
age 46 – 65	208	.1682692	.3750077	0	1
maristat	208	.7788462	.4160251	0	1
agriculture	208	.0432692	.2039534	0	1
construction	208	.1442308	.3521712	0	1
transport	208	.2932692	.4563591	0	1
repperiod	208	25.1057700	13.8413500	1	60
depend	208	1.8173080	2.4247690	0	9

Table 5-14 presents estimation results on the contribution of selected variables to the level of NPLs in Unguka Bank Limited for 2014. The table indicates that in 2014, male borrowers had a 17.10 percentage points higher chance of contributing to the increase in the level of NPLs than female borrowers, *ceteris paribus.* Controlling for commerce, borrowers involved in transport were most likely to default, suggesting that transport activities make a larger contribution to the level of NPLs than other activities, *ceteris paribus*. The transport sector had a 21.55 percentage points higher contribution to the increase in NPLs relative to commerce. Consequently, managers of Unguka Bank Limited should pay attention to the transport and commercial sectors when assessing loan applications.

The repayment period is reported to negatively affect the level of NPLs and is statistically significant. A one-month increase in the repayment period leads to a 2.56 percent decrease in the level of NPLs, *ceteris paribus*. The variables relating to the number of dependents under

the borrower's care (*depend*) and the age groups of the borrower were not statistically significant factors contributing to the level of NPLs. As for 2013, the overall predictive accuracy of the model appears to be fair, as the percentage of correctly predicted NPLs is 65.57 percent.

Table 5- 14: Estimates for factors influencing NPLs in Unguka Bank Limited for 2014

Variable	Estimates Coefficients	Marginal Effects
Gender	.7803*	.1710
maristat	-.0810	-.0177
age		
age 31 – 45	-.0200	-.0043
age 46 – 65	-.4146	-.0908
business type		
agriculture	.7240	.1586
construction	-.4254	-.0932
transport	.9833***	.2155
repperiod	-.0256**	-.005
depend	.1050	.0230
-Constant	.2920	
Number of observations	*208*	
Log likelihood	*-130.7580*	
LR chi2 (9)	*26.76*	
Prob. > chi2	*0.0016*	
Percent of correctly predicted	*65.57*	

****, ** and *, indicate that the coefficient is significant at 1%, 5% and 10% level*

From the findings exhibited on Tables 5-7, 5-12 and 5-14, it is established that an extension of the repayment period significantly and negatively affects the level of NPLs. It is probable that the extension of the repayment period helps the borrower to be less financially distressed by the burden of servicing the loan. Accordingly, the probability of paying back the borrowed funds increases, which leads to a lower level of NPLs. Gender was found to be associated with mixed outcomes. The question remains, what is a reasonable repayment period that could minimize the level of NPLs?

Table 5-15 presents a summary of available options for a minimum repayment period that could lead to a significant reduction of NPLs towards zero. The period varies between 21 months and 37 months for the Bank of Kigali Limited for 2012 and 2013, respectively suggesting that the level of NPLs could decrease toward the lowest level if the repayment period of a loan is about three years. For Unguka Bank Limited, the period varies from 59

months, to 43 months and 39 months respectively for 2012, 2013 and 2014. Therefore, one can conclude that an average repayment period of about four years could significantly reduce the level of NPLs.

This is not surprising as the institutions targeted customers and activities as well as products, and credit terms and conditions might differ. On the one hand, the largest commercial bank in the country, Bank of Kigali Limited, serves a range of customers such as large corporations, small and medium enterprises (SMEs), public entities, embassies and other international organizations. On the other hand, Unguka Bank Limited is a microfinance bank competing in the same market segment served by commercial banks while serving low-income customers who are the target of microfinance institutions.

Table 5- 15: Summary of available options for repayment period

Repayment Period	**Bank of Kigali Ltd**		**Unguka Bank Ltd**		
	2012	2013	2012	2013	2014
Minimum repayment period	1	1	3	1	1
Average repayment period	11	3	18	24	25
% decrease in NPLs due to one month increase in the maturity of the loan	4.8	2.7	1.7	2.3	2.5
Theoretical period required to eliminate NPLs towards zero percent	21	37	59	43	39

Source: Authors' calculation

To sum up, a repayment period varying between three to four years could contribute to a significantly lower level of NPLs in the Rwandan banking sector.

The overall predictive accuracy of the model appears satisfactory, as the percentage of correctly predicted NPLs varies between 62.92 percent and 89.08 percent, which is greater than 50 percent in all cases. However, it is not straightforward to conclude whether these findings can help predict repayment problems in Rwanda in the future due to the uniqueness observed in each institution with respect to the data available, the targeted market, and the loan filing system in relation to borrowers' characteristics, and loans aspects. However, the study's findings shed light on some isolated behavioral problems with respect to borrowers' age, economic activity undertaken, and the maturity of the loan that bankers can use in assessing and making decisions on any loan application.

5. 6 Concluding Remarks

The primary objective of this chapter was to investigate the influence of borrowers' characteristics, business characteristics and loan characteristics on the level of NPLs in Rwanda, using a sample of a commercial bank, the Bank of Kigali Limited and a microfinance bank, Unguka Bank Limited. The ultimate objective was to gain a comprehensive understanding of the micro-factors contributing to NPLs. However, mitigating this problem lies in the hands of managers.

The study's results on the factors influencing NPLs in Rwanda reveal that borrowers' characteristics such as age, business type, and repayment period are among the factors that influence NPLs in the country's banking sector. In 2012 and 2013, the repayment period (*repperiod*) had a negative effect on the level of NPLs. With respect to age, at the Bank of Kigali Ltd, the probability of loan default decreased with age. *All things remaining equal*, borrowers aged between 31 and 45, and those between the ages of 46 and 65 and above are most likely to make a lower contribution to the level of NPLs than young borrowers aged between 18 and 30. Younger borrowers might have less experience in business or earn low wages. Taking into consideration business type, mortgage loans, overdraft and treasury loans were found to be significantly contributing to the level of NPLs in the Bank of Kigali Ltd relative to consumer loans, c*eteris paribus*. The repayment period was found to be negatively related to NPLs and was statistically significant.

With regard to Unguka Bank Ltd, controlling for commerce, the transport sector had the highest probability of increasing NPLs, *ceteris paribus*. The repayment period was found to have a negative effect on the level of NPLs for 2013 and 2014, and this was statistically significant.

The cross-institutions comparison revealed that, only the repayment period variable (*repperiod*) was significantly and negatively associated with NPLs. This suggests that the more the repayment period increases, the higher the probability of paying back the borrowed funds, given that the borrower is somehow less financially distressed by the burden of loan servicing. On average for a given loan, a repayment period of about four years could significantly lower the level of NPLs towards zero in the banking sector in Rwanda.

As highlighted earlier in Section 5.3.2, a limitation of this chapter is that it was not possible to compile data for all financial institutions operating in Rwanda's banking sector due to

sensitivity issue related to the data in relation with the privacy of the customer. In addition, variables such as borrowers' educational level, credit history, and number of dependents, could not be readily obtained from all banks. The study thus relied on data (without names of customers in complying with the privacy principle) from the two largest banks in their sub-set (commercial banks and microfinance banks) and focused only on two years, 2012 and 2013 with a check for robustness in 2014 for Unguka Bank Limited. While there is independent behaviour among banks over time, an investigation covering an interval of at least five years could shed more light on this subject. Thus, our results are to be treated with caution in predicting a borrower's behavior vis-à-vis business type and loan characteristics in influencing NPLs due to the uniqueness of each institution with respect to the data available, the targeted market, and the reporting system.

It is therefore recommended that the Central Bank put regulations in place to sensitize financial institutions to extend the loan repayment period and oblige them to record the borrower's characteristics in their loan assessment records. These include gender, age, marital status, educational level, employment status, income, number of dependents, outstanding loans with other financial institutions, and credit history. This could be useful in future research of this kind where comparisons of findings can be made over a medium to long period and contribute to policy formulation by lending institutions.

In addition, the Central Bank should conduct a comprehensive survey on the factors that most influence defaulting behavior that could be used in different policy-oriented studies. This type of survey could be conducted every five years as with the Integrated Household Living Conditions Survey, EICV (*Enquête Intégrale sur les Conditions de Vie des ménages*). Likewise, the Central Bank should reinforce measures to sensitize borrowers to pay off their loans as failure to do so adversely affects the sector and the economy as a whole. Finally, the Central Bank should initiate or sensitize private businesses to create a body to assess the overall rating of customers applying for loans. This rating body could help lending institutions when assessing new applications for loans.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The literature on financial intermediation and economic growth posits a link between economic growth and an efficient banking sector with low ratios of NPLs. Based on this notion, through its Vision 2020 the Government of Rwanda aspires to transform the country's economy into a middle-income one driven by the private sector financed by a developed financial sector. However, there is a paucity of research on the directional relationship between financial sector development and economic growth in Rwanda. The main objective of this study was therefore, to assess the mechanism that relates financial sector development to economic growth. In doing so, several interrogations needed to be carried out. What causal relationship exists between financial sector development and economic growth in Rwanda? How efficient is the Rwandan banking sector? And what are the microeconomic factors influencing NPLs in Rwanda? The answers to these three questions were provided in chapters three, four and five respectively. They are in line with the three specific objectives under which the main objective of this study is achieved and making three inter-related papers found respectively in chapters three, four and five.

Chapter Three investigated the directional relationship between finance and economic growth in Rwanda using a Cointegrated Structural Vector Autoregressive model on quarterly data for the period 1996:1 to 2010:4. The central argument was that identifying the mechanics through which financial intermediaries relate to economic growth in Rwanda is essential vis-à-vis the Government of Rwanda's belief that the financial sector can serve as a catalyst for economic growth in the country by providing finance to the private sector.

The second objective was to assess the efficiency of commercial banks in Rwanda. This was achieved using a stochastic frontier analysis approach on a set of banking data for the period 2007 to 2013 in line with Battese (1992), Battese and Coelli (1995) and Greene (2005). Efficiency evaluation of banks is of interest to many stakeholders, and this was the core of chapter four. Owners and potential investors seek assurance of sustainable profitability of the banks vis-à-vis their level of assessed efficiency. Managers and directors benefit by

understanding the extent to which they can contain resources that were wasted due to identified inefficiencies, thus improving their performance for the attainment of the bank's overall objective, which is wealth maximisation. Regulators can make use of the findings to formulate policy in relation to reducing inefficiencies, improving the soundness of the banking sector.

The third objective was to determine the factors influencing NPLs in Rwanda. This was achieved using a logistic regression approach following (Wooldridge, 2006) on data from a sample of two different types of banks for at least two consecutive years, 2012 and 2013. The findings of this study will be useful to financial intermediaries' managers, shareholders and regulators. Individual financial intermediaries that seek solutions to existing NPLs while preventing the proliferation of new ones could make use of these findings. Collectively, financial intermediaries could engage stakeholders such as shareholders, regulators and policymakers to find solutions to the factors that cause NPLs identified in this study. Based on the highlighted factors, it is recommended that regulators adopt measures to reduce NPLs that impede the banking sector's performance.

6.2 Summary of findings

The first objective was to investigate the relationship between financial intermediation and economic growth in Rwanda applying a cointegration procedure and a structural VAR. The findings indicate that domestic credit to the private sector and potential liquidity available, which are proxies for financial development in this study, account for the largest proportion of fluctuations in real output growth. Domestic credit to the private sector accounts for 36.28 percent of the fluctuations in real output growth in the first four quarters, which increases to 54.47 percent after eight quarters and 58.83 percent after 20 quarters. Potential liquidity available accounts for 33.46 percent of the variations in real output growth after four quarters, and drops to 27.72 percent after eight quarters and 24.89 percent after 20 quarters. These findings support the supply-leading hypothesis that indicates that financial sector development causes growth in output.

The second objective was to assess the efficiency of commercial banks in Rwanda using stochastic frontier analysis on a set of banking data for the period 2007 to 2013. The findings reveal that the banks' cost efficiency score ranges between 83.10 percent and 96.03 percent.

The bank operating at the lower mean efficiency level of 83.10 percent wastes about 16.90 percent of its resources relative to the best performing bank in the sample. Overall, the findings show a mean cost efficiency of 88.56 percent, implying that about 11.44 percent of total costs were wasted relative to the bank on the frontier having the same inputs. This suggests that banks jointly would have utilized only 88.56 percent of resources to produce the level of output that they produced. Moreover, inefficiencies were found to be statistically significant in decreasing over time with foreign banks' involvement in the Rwandan banking market and increasing with the rapid replacement of CEOs.

The third objective was to identify the factors influencing NPLs in the Rwandan banking sector. The results show that borrower characteristics such as age, business type, and repayment period, among other factors, contributed to the variation of the level of NPLs in Rwanda. Combined, the findings reveal that repayment period is negatively associated with NPLs. On average, a repayment period of about four years could significantly lower the level of NPLs in the Rwandan banking sector.

6.3 Conclusions and Recommendations

The relationship between financial sector development and economic growth in Rwanda is in line with the supply-leading hypothesis, where the financial sector drives economic growth. The study observes that the largest proportion of variations in economic growth are explained by changes in domestic credit to the private sector and potential liquidity available, which are the proxies for financial development. This provides evidence that development of the financial sector leads to economic growth in the country. Thus, the financial sector could be a driver of economic growth in Rwanda. Accordingly, the country should reinforce incentives that lead to the further development of its financial sector, and attract businesses that could easily make use of available financial services.

The study also investigated the efficiency of commercial banks in Rwanda and the results showed that the sector performed at a mean cost efficiency of 88.56 percent vis-à-vis the bank on the frontier with the same inputs. It is imperative to understand the efficiency of the commercial banking sector in Rwanda because it provides information on the financial health of these deposit-taking and lending institutions in efficiently transforming inputs into financial services and products. Inefficiencies in the Rwandan banking sector were

statistically significant, decreasing over time with foreign owned bank setting up in the country, and increasing with the rapid turnover of CEOs of commercial banks in the sample. This calls for banks' shareholders to reduce the turnover of top management officials, especially CEOs because their short term in office is associated with increased inefficiencies. Government needs to put incentives in place to attract foreign banks to Rwanda, as it was found that they contribute to the efficiency of the banking sector. Further research could assess the efficiency of UMURENGE SACCOs that are spread throughout the 416 administrative sectors of the country. As they are closer to the population, their efficiency could contribute to changes in living conditions, especially in rural areas.

The study further examined the factors influencing NPLs in the Rwandan banking sector. Its findings indicate that across institutions, the repayment period is negatively associated with NPLs, suggesting that if lending institutions could extend the repayment period, NPLs in Rwanda will decline. In addition, the study findings show that borrower's characteristics such as age and business type are among the factors that impact on NPLs in one way or another. The probability of default among young borrowers aged 18 to 30 is relatively high, compared to the probability of default among older people, c*eteris paribus*.

All else remaining equal, the study observed that mortgage loans, overdrafts and treasury loans make a significant contribution to the level of NPLs relative to consumer loans in the Bank of Kigali Limited. In Unguka Bank Limited, the transport sector contributed more to the increase in NPLs relative to the commercial sector. It is thus recommended that bank managers pay attention to these sectors when assessing applications for new loans.

To solve the problem of data availability, this study recommends, firstly, that the Central Bank of Rwanda sensitizes or obliges banks to keep complete and updated information on borrowers' characteristics. These include gender, age, marital status, educational level, employment status, income, number of dependents, outstanding loans with other financial institutions, credit history; and sectors financed as well as credit characteristics such as amount borrowed, interest rate charged, repayment period, repayment mode, business revenue, repayment amount, and type of collateral. Secondly, to supplement this data from banks, the Central Bank should conduct a regular, comprehensive survey on the relationship between defaulting behavior and the highlighted borrowers' characteristics, business type and

loans' characteristics. These two suggested data collection channels could add value to other research of this kind.

6.4 Limitations

The major limitation of this study was the availability of adequate data for the empirical analyses from which conclusions were drawn. Firstly, in chapter three, the initial intention was to cover a period of about three decades. However, because the economy of Rwanda was destroyed during the 1994 genocide, the starting point was 1996 when the economy started recovering, up to 2010, after which data for many variables was not available. Moreover, these variables were initially available in annual frequency for the period 1996 – 2010. To fit our analysis, data were interpolated to quarterly series using the Quadratic-match average approach.

Secondly, in chapter four, the efficiency of a given bank refers to the best performing bank among the seven in the sample operating under the same conditions, not relative to best practice somewhere else, that was beyond the scope of the sample for this study. It is also possible that the bank that appears to be closer to the frontier might not be convincingly better than others because it might achieve such performance at the cost of an increase in its NPLs.

Thirdly, in chapter five, data onthe borrowers' characteristics did not cover all borrower characteristics. For example, data on educational level, employment status, income, outstanding loans with other financial institutions, and credit history was not available. Data on business type as well as loans' characteristics were only partially available for all banks in the sample. In addition, due to sensitivity issue related to the privacy on details of a bank's customer, especially concerning defaulting borrowers, it was not possible to compile data for all financial institutions operating in Rwanda's banking sector.

Despite these shortcomings, the overall objectives of this study were achieved. The study established the directional link between financial intermediation and economic growth in Rwanda that is supply-leading; found that the commercial bank sector is efficient in cost management, and that, if the repayment period is extended, this could make a significant

contribution to reducing NPLs in the Rwandan banking sector. It can therefore be concluded that it is possible that financial sector development contributes to economic growth in Rwanda, which is the view taken by the Government of Rwanda.

Appendix 1: Consolidated Statement of profit or loss and other comprehensive income: bank name

	For the year ended 31 December	
In millions of (i.e. euro)	**Year t**	**Year t-1**
Interest income		
Interest expense		
Net Interest Income		
Fee and commission income		
Fee and commission expense		
Net fee and commission income		
Net trading income		
Net income from other financial instruments at fair value through profit or loss		
Other revenue		
Revenue		
Other income		
Net impaired loss on financial assets		
Personnel expenses		
Depreciation and amortization		
Others expenses		
Profit before tax		
Income tax expense		
Other comprehensive income		
Items that will never be reclassified to profit or loss		
Remeasurements of defined benefits liability (asset)		
Related tax		
Items that are or may be reclassified to profit or loss		
Foreign currency translation difference for foreign operations		
Net gain (loss) on hedges of net investment in foreign operations		
Cash flow hedges:		
Effective portion of change in fair value		
Net amount transferred to profit or loss		
Fair value reserve (available for sale financial assets):		
Net change in fair value		
Net amount transferred to profit or loss		
Related tax		
Other comprehensive income, net of tax		
Total comprehensive income		
Profit attributable to:		
Equity holders of the bank		
Non-controlling interest		
Profit		
Total comprehensive income attributable to:		
Equity holders of the bank		
Non-controlling interests		
Total comprehensive income		
Earnings per share		

	For the year ended 31 December	
In millions of (i.e. euro)	**Year t**	**Year t-1**
Basic earnings per share (i.e. euro)		
Diluted earnings per share (i.e. euro)		

Year $_t$: is the current year
Year $_{t-1}$: is the previous year

Appendix 2: Language Editing and Proofreading Certificate

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1 February 2017

This is to confirm that I have edited the thesis, "Financial Sector Development and Economic Growth in Rwanda", by Sebuhuzu Gisanabagabo, student number 213574110, excluding the List of References.

DISCLAIMER: The editor cannot be held responsible for any errors introduced due to changes being made to the document after the editing is complete.

Yours sincerely,

(Ms) Deanne Collins (MA)

Professional Editor

Appendix 3: Ethical Clearance

09 February 2016

Mr Sebuhuzu **Gisanabagabo**
(213574110) School of Accounting,
Economics &Finance Westville
Campus

Dear Mr Gisanabagabo,

Protocol reference number: HSS/0124/016D
Project title: Financial Sector Development and Economic Growth in Rwanda

Full Approval - No Risk/ Exempt

Application In response to your application received on 23 September 2015 the Humanities &Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted FULL APPROVAL.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....

Dr Shenuka Singh (Chair)

/ms

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Cc Academic Leader Research: Professor JA Fairburn
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