FINANCIAL SYSTEM STABILITY IN THE EAST AFRICAN COMMUNITY: PROSPECTS AND CONSTRAINTS

By

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Doctoral Thesis Submitted in Fulfilment of the Requirements for the Award of Doctor of Philosophy in Financial Economics

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DECLARATION

This is my original PhD dissertation, my own work (except as shown in the references and acknowledgements) under the supervision of Prof. Kalu Ojah. This work has not been submitted to this or any other university for any other degree or examination.

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Anna Gustav Lyimo

24th August 2021

DEDICATION

To

***The Almighty God**.*

*With love to my beautiful daughter **Annisa Lameck**, 'The Joy of My Life'*
for enduring and being delightful while I was away pursuing my dream.

*To the memory of my late precious mother **Mrs. Phoebe O. Lyimo**,*
'The Iron Lady' and 'My Lucky Star' (1945 – 2010).
Without her none of my achievements would be possible.

ACKNOWLEDGEMENTS

First and foremost, I wish to express my sincere gratitude to the Almighty God for His love, care, protection, and inspiration throughout my doctoral journey. The endless blessings that I received especially during my doctoral research journey greatly contributed to the job well done. The completion of this doctoral research work is a result of several remarkable individuals who walked me through the inspirational stage, the motivational level, actualisation and indeed the unwavering support along the murky road of my doctoral degree.

I am so grateful for my mother, late Mrs. Phoebe O. Lyimo, who instilled in me the urge to seek knowledge and the meaning of a quality life. Her belief in me and my ability to pursue my doctorate was the initial seed that has now blossomed to this piece of work. *Asante sana Mama!* Until we meet again in that glorious morning...

This doctoral dissertation would also not have been completed without the effort, wisdom, devoted patience, and advice from my supervisor; Prof. Kalu Ojah. Your unwavering support and encouragement, especially when I felt lost, with no esteem; literally reconstructed my focus and renewed my commitment to the end goal. You went beyond the call of duty, placing me under your wings and letting me soar to higher heights. I will remain greatly indebted to your kindness. Your words will linger in my mind for as long as I hold these breathe. May the good Lord serve you the best of your life and your family desires and empower you to touch more lives.

I am also enormously thankful to the Central Bank of Tanzania (BoT) for granting me time to be away and to peacefully concentrate on my studies. A special mention of the leadership of the Central Bank as well as an acknowledgment of my colleagues for their undivided support and encouragement, are in my gratitude. You all saw the potential in me and believed in me when I decided to take this lonely but fulfilling journey. I will work hard and diligently in giving back my acquired expertise as a fulfilment of my promise. I am particularly grateful to the University of the Witwatersrand for their financial support through the PhD Merit Award as well as the Bradlow Scholarship. This financial support went a long way to providing me with the necessary materials to complete my studies.

Special gratitude to my precious family members: my sweetheart Annisa; my dad Mr. Gustav; my brothers: George, Daniel and Onesmo and their families; cousins: Mhawili and Neema; aunties/uncles together with their families for encouraging me to pursue this dream.

Last but not the least, many thanks to my beloved friends: Amanda, Irene, Mecky, Wema, Anna, and MMK. To my family in Joburg: Sylvester, Wendy, Niri, Oluoch, Nduga, Maurice, Michael, Dr. Rose, Dr. Marcel, Dr. Euphemia, Dr. Jones, Dr. Nana, Dr. Godfrey, Dr. Kariuki, Dr. Anita and Mrs. Ojah for the kindness and moral support in my journey. You guys made me feel at home whenever I was in Jozi.

I acknowledge that there are so many great people and friends that are worth mentioning. Though the list is undoubtedly infinite, hear this from me: You are all loved! You are all cherished! You all shall be blessed beyond measure!

To God Be the Glory!

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ABSTRACT

This thesis examines the EAC financial system stability, focusing on the system's prospects and constraints for the period 2000 - 2018. The primary agenda is divided into four objectives. The first objective is to investigate the evolution of the financial system and the kind of environment that it has been operating in. The relevant findings in respect of this objective indicate that the EAC financial systems have experienced both positive and adverse developments that have led to the initiation of several macro-economic and financial sector reforms. Credit risk is one of the major factors affecting the EAC financial system stability.

The second objective is to conduct an empirical examination of the determinants of credit risk in the EAC financial sector. The associated results show that credit risk is responsive to the dynamics of member-countries' macroeconomic and macro-financial variables. We found that prudent macroeconomic policies intended to stabilize inflation and exchange rates — which stimulate economic growth and increases the capacity to borrow – influence credit growth. And credit growth (with less prudent lending standards) increases the ratio of non-performing loans as well as raises credit risk during recessions.

The third objective is to measure and forecast financial systems' resilience in the EAC. Findings here suggest that EAC financial systems have remained relatively resilient, albeit vulnerable to shocks. Despite the differences in financial instability characteristics across the region, countries have reflected similar financial stability (or instability) patterns. The forecast results indicate that the EAC continues to experience financial system stability for the period 2018 -2020, other factors held constant.

The last part (objective) examined the potential systemic risk contribution of individual banks to national financial systems. Here, the banking industries' interconnectedness is shown to have increased significantly, especially during economic downturns, which poses a potential for spill-over of shocks (vulnerability) across the region during times of crisis. Each bank's connectedness and potential systemic risk contribution is time varying. Also, there is a significant positive correlation between bank size and systemic risk contribution.

Based on the above findings, and other findings of the study, the EAC region should monitor credit expansion to ensure it is consistent with economic and market realities; optimize benefits from linkages in the EAC financial system structure; and enhance effective policy formulation for more robust financial system regulation and supervision. There is also a need to conduct effective periodic risk assessments to identify and mitigate potential systemic risk, as to ensure regional financial system stability.

CHAPTER ONE

1. INTRODUCTION

1.1. Background to the Study

For a number of years, the incidence of global financial crises had not been pronounced, and international financial markets had remained relatively calm. It was not until 2008 when the world was reminded of the specter of financial crises, as a Global Financial Crisis (GFC, in 2007) hit, with adverse consequences for the global banking market and several other financial markets. Most importantly, the crisis rekindled interest in a better and deeper understanding of the dynamics of financial system stability, and the policy and institutional measures required to address critical gaps and deficiencies in financial institutions, markets and systems (Aloui et al., 2011). Therefore, the GFC and its consequences have demonstrably raised the importance of financial stability in most national jurisdictions.

In recent history, and in line with activity in global financial markets, the East African Community (EAC) has been one of the most active regions in Africa, particularly in terms of initiatives around regional economic and financial integration. The EAC includes six member states: Tanzania, Kenya and Uganda (as at 2000), Rwanda and Burundi (added in 2007) and South Sudan (added in 2016). Significant progress has also been achieved towards developing and harmonizing financial systems of member states within the EAC (Turner, 2013). Growing global, as well as national economic and trade interactions among these member states, have provided a basis for financial sector developments and reforms that are currently unfolding across member states. Although at nascent stages, these developments raise potential issues of financial stability.

While these regional initiatives generally recognize the benefits of economies of scale, their implementation is not necessarily devoid of potential adverse pitfalls or consequences, which may vary in form and intensity. These pitfalls are not only associated with internal forces underlying the development of financial sectors of member states, but they may also be a function of exogenous forces emanating from global developments such as asymmetric shocks that are both exogenous to the financial sector and domestic economies (Drummond and Williams, 2015). Therefore, there is a need to examine financial stability more comprehensively, in the context of the EAC region, than has hereto been the case.

1.1.1. Overview of Financial System Stability

For several decades, financial stability framework (or policy thrust) mainly consisted of two pillars: a prudential regulatory and supervisory pillar, which focused on individual financial institutions' stability (micro-prudential); and a monetary policy pillar, which focused on price stability over short to medium-term periods. The fundamental idea underlying the micro-prudential pillar is that as long as individual financial institutions are sound and stable, then the whole financial system would be sound and stable as well, regardless of their relationship with other market participants in the financial sector and the real economy as a whole (Acharya, 2009). However, studies such as Borio and Green (2011) suggest that the micro-prudential approach overlooked the impact of systemic risk on the economy.

The recent GFC has triggered a considerable discussion on how best to maintain the financial system stability and the underlying evolving paradigms in financial stability theory. One of the new paradigms goes beyond the micro-prudential and monetary policies pillars, to also focus on macro-prudential concerns when addressing financial stability issues (Arnold et al., 2012; Cerutti et al., 2015; Rubio and Carrasco-Gallego, 2016). A number of analytical works regarding foundations of the macro-prudential approach have been undertaken since the 2000s by different institutions such as Bank of International Settlement (BIS), Financial Stability Board (FSB), and International Monetary Fund (IMF), and scholars. In the same vein, a number of institutions and frameworks such as the European Systemic Risk Board in the EU, the Financial Stability Oversight Council (FSOC) in the US, *Committee of 10 (C-10)*[1] *in Africa* and Basel III Framework have been put in place to promote financial stability. These developments are aimed at mitigating systemic risks and ensuring the stability of individual institutions and the financial system as a whole.

Different scholars have defined financial stability differently, depending on the themes of their research (Allen and Wood, 2006; Schinasi and et al., 2011). Generally, financial stability can be defined as a broad concept that encompasses different finance fundamentals in the financial system that adequately fulfils the system's roles; including ensuring that the payments and settlement mechanism are functioning smoothly throughout the economy (Table 1.1). Financial stability relates not only to the absence of actual financial crises but also to the

[1] C-10 is a meeting of African Ministers of Finance and Central Bank Governors that was held in Tunisia, in November 2008, in order to monitor the impact of the GFC on Africa, assess regional and international responses and make proposals to help African economies to mitigate its effects. The meeting was under the auspices of AfDB Group, AUC and UNECA.

ability of the financial system to limit, contain, and address imbalances before they morph into a threat to the financial system or the real economy.

Table 1.1 Determinants of Financial System Stability in Developing Countries

Macroeconomic and Structural Conditions	Resilience and Robustness of the Financial System		
Macroeconomic Conditions	Financial Institutions	Financial Markets	Financial Infrastructures
❖ Economic Environment ❖ Institutional and Policy Issues ❖ Structure Conditions	❖ Banks ❖ Non-Banks ❖ Financial Institutions	❖ Capital Markets ❖ Money Markets	❖ Payment and Settlement Systems ❖ Legal Infrastructure

Source: Allen and Wood (2006) and Schinasi and others (2011)

Economic literature has identified the financial system as a confluence of complex interconnected financial institutions, markets, instruments, services, practices and transactions, which altogether facilitate economic activities in a particular context (Schinasi, et al., 2011). Simply put, it entails producing information on investment opportunities and optimizing capital allocation; savings mobilization; and flow of funds to economic activities. However, financial system is also highly associated with different kind of risks, which impede financial system stability (Figure 1.1). These risks are the key factors affecting the financial stability in a defined context with a different degree of impact. The fragility of the financial systems, which is exacerbated by their interconnected nature, is among other major reasons for financial system instability.

In economics, stability refers to an absence of variation in the macroeconomic activities over time (Malizia and Ke, 1993). An economy with either frequent recession; a pronounced business cycle; very high or variable inflation or frequent financial crises would be considered economically unstable. For that reason, one can define economic stability as a situation whereby the financial system supports a consistently low rate of inflation and minor variations in the output growth by addressing financial imbalances via self-corrective mechanisms; and preventing adverse and unforeseeable events from disrupting the real economy or spread over to other financial systems.

Figure 1.1 Sources of Risk to Financial Stability

Source: Schinasi, et al., (2011)

The concept of financial system stability was developed in response to a series of incidents, which manifested themselves in vulnerabilities, which adversely impacted the functioning of the financial systems and the economic development and growth during the founding of the Federal Reserve in 1913 (Volcker, 1984). Later in the 1990s, a number of central banks, particularly in developed countries, introduced "financial stability" as a new independent objective in addition to the price stability objective. For instance, in 1994, the Bank of England introduced a new objective "financial stability" as an independent objective from the price stability objective (Healey, 2001; Padoa-Schioppa, 2003). Since then, there have been extensive efforts by policymakers and academia to understand the dynamics of financial stability and assign indicators for its measures (Oosterloo and de Haan, 2004; Haldane et al., 2004; Gadanecz and Jayaram, 2012).

Most scholars have explained the financial system stability as a situation in which economic performance is potentially impaired by fluctuations in the price of financial assets or by an inability of financial institutions to meet their contractual obligations (Duisenberg, 2001; Gjedrem, 2003; Oosterloo et al., 2007; Smets and others, 2013). On the one hand, in terms of analytical paradigms, scholars such as Borio et al., (2011) considered financial instability into three types of models. Such that self-fulfilling equilibria generated by exogenous shocks, models with adverse shocks, which can be idiosyncratic or systemic and an amplification mechanism, in particular, contagion shaped by information and balance sheet linkages; and model consisting of representation of the endogenous cycle view of financial system instability hypothesis. On the other hand, others have described financial stability as the absence of unsteadiness such as financial instability, financial crises or systemic risk and its sources (Mishkin, 1999; Schinasi and Teixeira, 2006; Campbell et al., 2016).

While a widely accepted definition of financial stability barely exists, a broad consensus looks at financial system stability through the smooth functioning of the key elements of the financial system. These are such as efficient allocation of capital; enabling individuals to smooth consumption across time and states of nature; and sustainable intermediation (Haldane, 2004; Schinasi et al., 2011). In contrast, financial system instability is a situation where a widespread failure of banks, financial markets and payment systems is being experienced and the public face difficulties in performing their monetary transactions locally and internationally. The key point underlying the broad consensus referred above is that stability of the financial system should be assessed in the context of the extent to which it ultimately serves the needs of a particular economy. As such, the financial system does not operate in isolation of the economic fundamentals of a particular country or context.

According to Schinasi and others (2011), a single quantitative indicator cannot fully explain the complex nature of financial stability; it is inherently difficult to forecast; its underlying principles tend to involve a trade-off between resilience and efficiency, and its policy requirements may be time-inconsistent. All of these are due to risks and vulnerabilities that are associated with financial stability. Thus, an analytical framework for monitoring, assessing, and safeguarding financial stability is required.

1.1.2. EAC Financial System stability

Financial systems in the EAC have seen both positive and adverse developments in recent history. Most economies have witnessed relatively stable economic growth, an increase in the number of licensed entities and expanding market structures (Ndirangu and Nyamongo, 2015). There have been occasional incidences of banking distress and failures of individual banking institutions across the EAC member states.[2] In some cases, market solutions towards mergers and acquisitions have been implemented in order to forestall potential risks to the system, while other solutions have come because of regulatory and supervisory interventions. Following these incidences, there have been attempts by member states to improve individual countries' regulatory and supervisory frameworks. All these underpin the policy desire to create environments supportive of increased stability of the financial system.

The East African regional banking system is characterized by a relatively large interest margin that reflects the gaps in their financial infrastructure provisioning and riskiness of lending, combined with weak property rights (inadequate credit rating agencies). Loans constitute the largest share of banks' assets and lending continues to be primarily deposit-funded, although the increased competition for deposits has led some banks to become more leveraged. A more granular balance sheet analysis of banks and other financial institutions in EAC member states points to some vulnerabilities and potential risks; in particular, the increase in non-performing loans since 2013 (Figure 1.2).

[2] Since 1999, Tanzania, Uganda and Kenya have recorded more incidences of bank failures, merger and acquisitions compared to Rwanda and Burundi. Some of these incidences are bank failures in Tanzania included Karadha Company Ltd (2000), First Adili (T) Bank Ltd (2002) and Delphis Bank (2003). Regarding merger and acquisitions included Furaha finance and Crown Finance (2002). Currently, FBME and Twiga Bancorp are under Central Bank (BoT) Supervision. In Uganda, bank failures included Uganda Cooperative Bank, Greenland Bank (1999), National Bank of Commerce (U) (2012) and Global Trust Bank (2014). Merger and acquisition: Barclays Bank (U) and Nile Bank Limited (2007). Currently, Crane Bank (third largest Bank in Uganda) is under Central Bank (BoU) Supervision. In Kenya, bank Failures included Euro Bank (2003), Charterhouse Bank (2007), Trade Bank (2007), Allied Credit Ltd (2007), International Finance Ltd (2007), Diners Finance Company Ltd (2008), Trade Finance Ltd (2008), Heritage Bank (2008), Nairobi Finance Company Ltd (2010), Central Finance Kenya Ltd (2012), Inter African Credit Finance Ltd (2012) and Daima Bank Ltd (2014), Trust Bank. Imperial Bank (2015) Dubai Bank (2015) and Chase Bank (2016). Source: Various reports from the Central Bank of Tanzania, Central Bank of Uganda and Central Bank of Kenya.

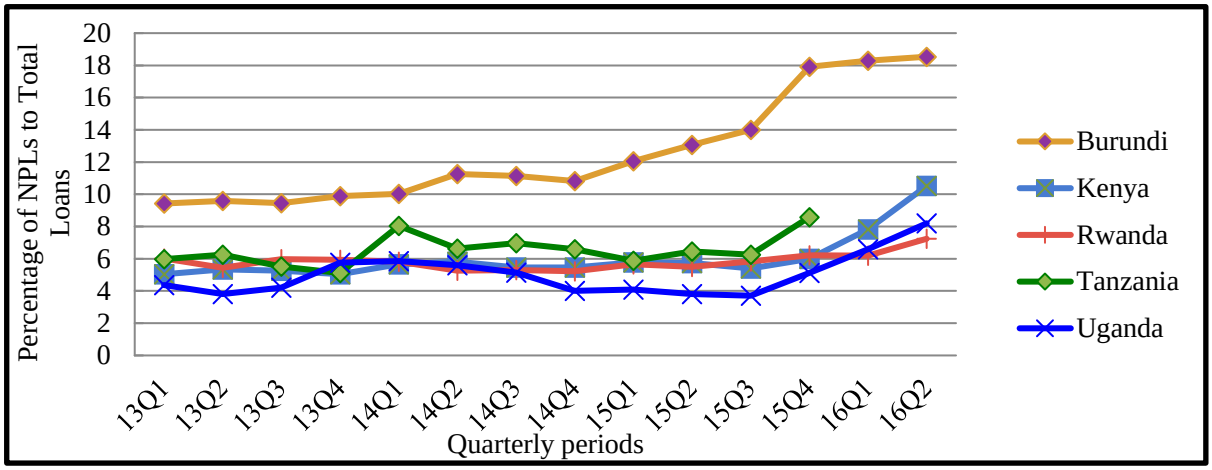

Figure 1.2 Quarterly Non-Performing Loans of the EAC (2013 – 2016)
Source: *IMF (2019)*

The increase in non-performing loans of commercial banks (both domestic and foreign banks) across the region shows that there is a risk that the more recent expansion of loans will lead to a further uptick in the level of non-performing loans (Boudriga et al., 2009; Kingu et al., 2018). This calls for an effective mechanism that will monitor credit growth (a key factor of financial development) and minimizes threats and vulnerabilities that may potentially bring about financial instability in the region.

Further, financial markets with low capitalization and liquidity, and significant government dependency for external sources of financing, also raise some other challenges to the regional financial stability. A relatively low number of listed companies which are mostly commercial banks, fragmented markets, high risks, low liquidity, and their market regulation models differ from each other. Thus, these markets are more exposed to unpredictable banking risks as well as asymmetric information and coordination problems, which lie at the heart of potential risks of financial stability (Born et al., 2014).

Furthermore, non-banking financial institutions, in particular, the evolution of mobile money within the region, have increased inter-linkages between banking activity with mobile money platforms. This underpinning improvement in access to financial services will increase the money multiplier and is likely to lead to a positive impact on efficiency and growth. However, some mobile money activities do not appear to have formal financial regulations that ensure confidence in mobile money platforms, particularly lack of clarity about mechanisms for safeguarding payment system against liquidity problems or during the financial crisis in the integrated market payments flows (Aduda and Kalunda, 2012). This may result in credit risk, liquidity risks, operational risks and cyber risks, which may be a basis for adverse challenges

to financial system stability. While these risks appear to be limited at this stage, the rapid growth in mobile money requires that these issues be addressed proactively.

In addition to domestic developments, regional financial integration has progressively taken root, creating grounds for massive economies of scale for business entities, harmonization of standards for operation and supervision. Growing economic and trade relations among member states have significantly influenced recent financial sector developments within the EAC and strengthened growth prospects. We have also witnessed some institutional measures, albeit at the domestic level, towards institutionalizing financial stability function, which led to the expansion of the financial system in terms of structural growth (McAuliffe and Saxena, 2015). Thus, there is no doubt that regional integration and harmonization initiatives have played an important part in shaping the level of financial stability in the region.

Nevertheless, growing financial integration increases the scope for cross-border leakages of macro-prudential policy (Beck, 2015; Tonzer, 2015). Financial imbalances in one country within the union can spill over to the other members, including their banking sectors. Besides, the current growing trend towards technological innovation in the banking sector may warrant policy response. The trend is likely to have a significant impact on the risk profile of most emerging market economies' banking industries as a source of instability if appropriate policy and regulatory responses are not forthcoming (Kodongo et al., 2016). Hence, it is crucial to establish structured measures that contain the resulting risks in order to intervene, resolve or restructure weak banks, avert systemic shocks, and maintain financial stability.

1.2. Problem Statement

The ongoing economic and financial sector developments, provide a laboratory for the analysis of the evolution of financial systems, with particular focus on financial stability, and its impact on financial stability within the EAC region. The growing regional market for banks and financial markets, in general, is a positive development that may raise the prospects for stability of the financial system in the region. However, some other developments that have taken place over the recent past threaten to introduce some elements that may lead to increased vulnerabilities and shocks; and potential financial instability within the region.

Financial stability is paramount for economic growth, as most transactions in the real economy are made through the financial system. However, financial systems are highly associated with several risks that contribute to financial (and by extension) economic crises. One of the leading causes of most financial crises is the various ways through which banks

have transferred credit (or other) risks in the financial system and poses a more significant threat that can lead to bank runs, hyperinflation, or a stock market crash (Schularick and Taylor, 2012). Consequently, it can severely shake confidence in the financial and economic systems and pose a threat of systemic risk. Thus, to assessing the impacts of the ongoing regional and global economic and financial development initiatives on the EAC financial system, which is becoming more integrated.

A vast majority of the studies have been conducted to address financial systemic risk management. In the same vein, institutions and frameworks such as the FSOC in the US and Basel III Framework have been put in place to promote financial stability. These developments are aimed at mitigating systemic risks and ensuring the stability of individual institutions and the financial system as a whole. One of the recent surveys on the analysis of the systemic financial risk literature conducted by Silva et al., (2017) revealed gaps and opportunities for future studies about systemic risk, in particular in emerging market regions such as the EAC.

Hitherto, lack of clarity and/or knowledge of how best to manage systemic risk contribution to the EAC financial system stability highlights the need to have a clear understanding of potential effects of financial system instability on the real economy of the EAC. For this reason, prominence in this research is given to the analysis of the factors underlying the level of financial system stability in the EAC, focusing on systemic risks over the period since the rebirth of the EAC, and expected strengths and weaknesses of financial system regionalization on EAC financial stability. It also focuses on efforts to develop an effective framework and design of models, which can be used as effective mechanisms for early warning of potential financial crises in the EAC region.

1.3. Research Questions

Flowing from the problem statement are key questions, if effectively answered, would serve as a systematic guide to resolving the problems identified in this work:

i. Does the EAC financial system development ascertain financial system stability following macro-economic and financial reforms?
ii. What are the key factors determining one of the significant financial risks (i.e., credit risk) that hinders financial system stability in the EAC?
iii. What are the critical stability indicators driving the EAC financial system's resilience over the past two decades?
iv. Do bank size and other identifiable financial institutions or market factors pose systemic risk threats to the EAC financial system stability?

1.4. Research Aim and Objectives

As has now become apparent, the main objective of this research is to conduct an analytical assessment of prospects for and constraints on financial stability within the EAC region, in view of ongoing national, regional and global financial and economic reforms and developments. This objective entails the examination of financial system development and its impact in respect of financial stability in the EAC. In the process, we interrogate a number of policies, institutional and operational variables that are key to achieving financial stability and, thus, develop a better understanding of their dynamics. In this regard, the objective includes recommendations on an effective framework and design of models that have an effective early warning system of potential financial crises. The results of this work appropriately inform policymaking processes that foster financial stability within the EAC region.

The examination implicit in this study's key objective takes quantitative research approaches that focus on the following specifics:

i. Assessing the background of the financial sector developments in the EAC prior to its inception from 2000 to 2018, considering the effect of the implementation of several the macro-economic and financial reforms. This background maps the architecture of the current financial sector.
ii. Assessing determinants of the major risks, in particular credit risk, that hamper the financial system stability for the period 2000 – 2018. This analysis provides the empirical evidence on factors that may dynamically need to be considered in analysing and explaining prospects for and constraints on the regional financial stability.
iii. Assessing systemic stability of member states' financial systems for July 2000 – June 2018, by developing an Aggregate Financial System Stability Index (AFSSI) for EAC financial system, which is used as a metric for measuring the stability of the financial system, the stress-testing method as well as an early warning system. This analysis provides a detailed picture of the performance of the EAC regional financial system and ascertains the EAC financial system stability and the major risks that hamper it. Following the analysis of the financial system resilience, the study also forecasts the regional financial system resilience for the period 2018 - 2020.
iv. Assessing systemic risks by quantifying the systemic impact of financial distress on the EAC financial system, considering their interconnectedness and conditional dependence over the period 2012 - 2018. This analysis focuses on the size of financial institutions and their systemic influence about the regional financial system stability.

1.5. Literature Review and Conceptual Framework

This part provides a snapshot of the economic background of the effective mechanisms for attaining a stable and more robust financial system that would contribute to economic growth. This part is in two sections. The first section provides a brief overview of the existing theoretical and empirical sets of factors underpinning the importance of ensuring financial system stability in the economy. The second section provides a conceptual framework that underpins much of this study, especially the empirical analyses carried out.

1.5.1. Literature Review

The economic literature has explained the economic theories of financial system stability in three main strands. The first strand underlines the importance of ensuring financial system stability, considering the complex nature and dynamics of the financial systems. The second strand indicates risks that hamper financial system stability. These risks are of the major concern as if not manageable, their impact on financial stability may impede economic growth. The last strand presents the efforts that have been taken in ensuring financial system stability and contribute to economic growth. This study applies all the three strands by analysing the prospects for and constraints on the financial system stability in the EAC region.

The empirical literature regarding financial system stability is vast and dynamic. We have gathered empirical evidence underpinning the importance of analysing the financial system stability in the EAC into four aspects. First, an overview of the EAC financial sector developments. Second, aspect relates to the extant evidence of the risks that hamper financial system stability. Third, evidence that emphasise on ensuring financial system stability and the measures used to measure financial system stability. Lastly, the potential systemic risk, which can potentially disrupt the real economy. Detailed literature review of each objective with a way forward in analysing the context of the EAC financial system stability is provided in the related chapter of the study.

In a nutshell, theoretical and empirical literature has highlighted that there is a strong positive link between financial system growth and economic growth. There are evidence of the existing cycle where economic growth influences the quality of financial services and financial system structure, which contributes to long-run economic growth (Levine, 1997; Çelik and Citak, 2016; Cojocaru et al., 2016). Interestingly, studies have indicated that the link between financial system development and economic growth has two different effects: positive and negative effects. The positive effect reflects when risks to the financial system are mitigated and support economic growth. The adverse effects reflect when the risks to the financial system

are not mitigated and mature to financial system distress and financial crisis, comes the worst-case scenario.

1.5.2. Conceptual Framework for Financial System Stability

Figure 1.3 provides a snapshot of how financial system is complex and interconnected in nature, which is associated with a number of risks. These risks are emanating from within and outside the financial system (endogenous and exogenous risks). If these risks are not contained, they will trigger financial system distress or a worst-case scenario: financial crises that, in turn, impede the economic growth.

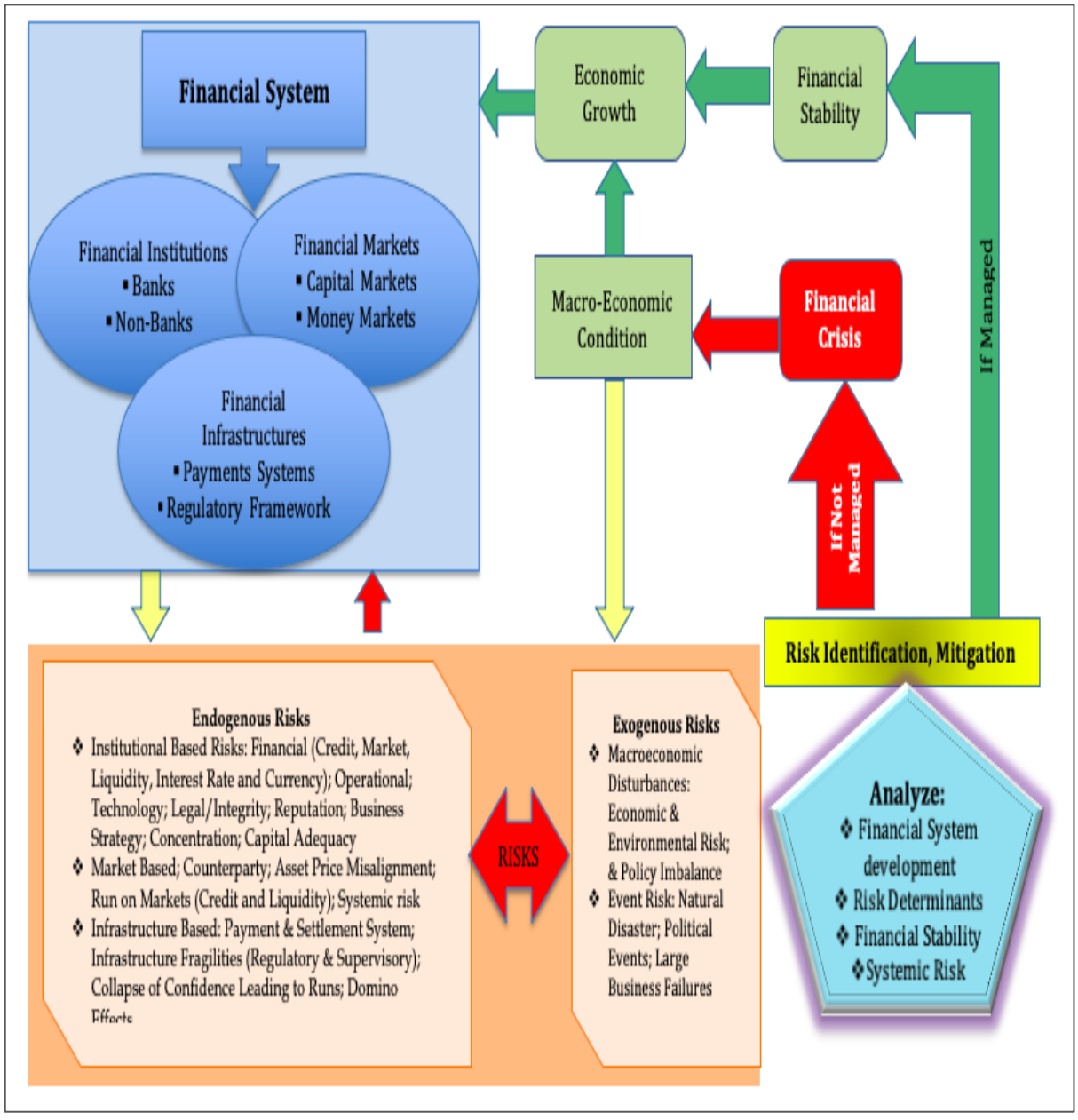

Figure.1.3 The Financial System Stability Conceptual Framework
Source: Author's Construction

Therefore, theories and international evidence point to procyclical nature of the financial system, which might lead to a financial crisis if not managed. In respect of that, clarity of how best to manage build-up of risk threatening the financial system stability is required in order to ensure financial system stability. It is against this backdrop that this research seeks to examine the impact of the ongoing economic and financial developments on financial system stability and assess the level of the financial system stability and its determinants. The EAC is increasingly becoming more interconnected economically as well as in terms of trade. Creating a framework, which supports financial system stability within the EAC, is a necessity at this point in time. The figure below presents the conceptual framework of financial system stability. It indicated how the financial system is highly connected with the risks that if not managed, these risks might hinder economic growth.

1.6. Research Methodology

This section links the research questions and theoretical background to the set of methodologies used to investigate the research problems and objectives (more specifically questions) of the study. First, the section explains research paradigms, design and relevant population of the study. Further, research-sampling methods used for the study are explained, along with the source of data and the relevant empirical models used to ascertain the relationships between the research variables per relevant objectives of the study.

1.6.1. Research Paradigm

A research paradigm is a viewpoint of science in a set of assumptions that are linked together to provide a philosophical framework for a research study. There are different practices and procedures applied in the course of the research, such as positivism, interpretivism/social constructionism, critical theory, constructivism and realism (Comte et al., 1865; Healy and Perry, 2000). The quantitative method used in the objective viewpoint of research normally follows the positivism approach to investigate the subject matter. The data and findings of the research used in this viewpoint are independent of the researcher. Therefore, based on that background this study intends to positivism (statistical methods) in order to analyses, discover and document possible rules that could generally be applied to quantify regional systemic stability, systemic risk and integration of the EAC financial systems.

1.6.2. Research Design

This study uses quantitative research methods because the study involves the positivism paradigm. (Gadanecz and Jayaram, 2012) provides a review of financial stability measures,

and they indicated that financial stability assessment should not be conducted in isolation; rather, it should combine both quantitative and qualitative methods. Although some central banks have experimented with computing single aggregated measures of financial stability, no such measures can be used without knowledge and use of other quantitative or qualitative instruments. Consequently, each objective uses its own appropriate methodology depending on the population size, unit of analysis, data and measures used.

1.6.3. Population and Sample Size

The population of this study includes the financial and market data from the EAC financial system. This includes 5 countries in the EAC, namely: Burundi, Kenya, Rwanda, Tanzania and Uganda. South Sudan is excluded from the study because its financial system is at a very infant stage and has no meaningful data series. The study uses a data sample period of 18 years; that is, since the inception of the EAC from 2000 to 2018. This is due to the fact that the EAC financial sector is at different levels of development in each member state such that some of the institutions might not have sufficient data required for the analysis. A case in point is financial markets data from Burundi.

1.6.4. Unit of Analysis

The principal unit of analysis in this research is the financial system (comprising banks, capital markets, money markets and payment systems in the EAC member states), though other markets, which are integrated with the EAC financial system and be used in the analysis to examine the integration and causal links among the equity markets. Sub-units include a set of individual countries' financial system in the EAC and global markets; for instance, EAC member states (for whom data is available): Kenya, Rwanda, Tanzania and Uganda.

1.6.5. Validity and Reliability

The process of data collection, editing, verification, capturing and interpretation were carried out in accordance to ensure data accuracy. The study used secondary data collected from reputable institutions such as the World Bank (WB), International Monetary Funds (IMF) and Thomson Reuters databases. The study used panel data econometric analysis due to its advantages. Panel data analysis takes into consideration both cross-sectional and time-series effects, which construct better detection (dynamic changes due to repeated cross-sectional observations) and measurement of effects that could not be observed in pure cross-sectional or time series analysis alone. It also reduces the noise coming from the individual time series, implying that heteroscedasticity is not an issue when using panel data analysis (Nerlove, 2002;

Hsiao, 2007; Hayakawa, 2009). In addition, it allows us to control for variables which cannot be observed or measured (individual heterogeneity) or omitted variable problems and provide a more accurate inference of model parameters, which gives more information with variability and generate accurate predictions.

Moreover, in order to avoid spurious regression results, the study conducted a number test such as unit root test, autocorrelation and multicollinearity tests. For instance, linear regressions require all data to be stationary. Thus, we performed three different unit root tests namely Im, Pesaran & Shin W-stat; ADF-Fisher; and PP-Fisher Chi-square tests in order to ensure our data series is stationarity (Im et al., 2003; Maddala and Wu 1999). These tests allow for individual unit root to process so that may pi vary across cross-section. The null hypothesis of all these tests assumes that all panels' data series have unit root (non-stationary).

For the case of multicollinearity problem, we performed a correlation matrix to analyse the level of correlation between the variables. Multicollinearity problem occurs when a linear relationship exists between one or more variables (Greene, 2007). We performed the correlation analysis after knowing the stationarity results of the data set. The correlation coefficient is between 0 and 1, indicating weak and strong multicollinearity problem, respectively. In addition, we performed cointegration analysis in order to estimate the statistical significance of the long-run coefficients as well as the joint significance of the level equation of the non-stationarity variables. We test if our data sets have long-run relationships in all the 4 proposed models. We use panel Engle-granger cointegration tests of (Kao, 1999; and Pedroni, 1999, 2004). The null hypothesis assumes that there is no cointegration in the model.

1.6.6. Test of Hypothesis

The following hypotheses (stated in the alternative form) are tested to address the research objectives (and the associated problems), per the introduction section:

H1: Implementation of the recent financial sector reforms contributed to the EAC financial stability.

H2: The EAC financial system stability is prone to credit risk and sensitive to cyclical, macro-financial and/or macroeconomic factors.

H3: The EAC financial system has remained resilient for the past 2 decades.

H4: There is a direct relationship between bank size, bank interconnectedness, market risk and systemic risk contribution of institution to the financial system.

The empirical analysis for testing each of the above hypotheses hence addressing the four objectives of the study uses its own methodology, depending on the population (sample) size,

unit of analysis, data and measures or proxies adopted. Detailed methodological approaches for each objective of the study is presented in the respective chapter for answering identifiable research questions (hence meeting specific individual objectives) of the study.

In a nutshell, we deployed descriptive analysis in examining the evolution of the financial system; and ARDL and GMM methods in examining determinants of the financial system. The aggregated index (AFSSI) was used in analysing the level of financial system stability; GLS and GMM econometric methods were used in assessing robustness of the AFSSI results, while HW models were used to forecast the financial system stability. Further, we used granger causality and CoVaR methods to analyse potential systemic risk in the EAC financial system stability. The rationale for using multiple sources of evidence is based on the ideas of replication and convergence (i.e., ensuring of results' robustness). Data collection techniques and variable measurements were also detailed in the respective chapters of the study.

1.7. Significance of the Study

Different scholars and research institutions have conducted several diagnostic studies regarding EAC financial stability, in particular EAC Central Banks, World Bank, and BIS; most of which examined challenges encountered around the building of the EAC Monetary Union. However, very few empirical studies have investigated the impact of the EAC financial sector developments on the financial system stability of the region (McAuliffe et al., 2012; Yabara, 2012). In support of addressing that oversight, this research goes extra miles to cover an important knowledge gap regarding the evolution of EAC financial system in the context of financial stability. The study used quantitative data to understand the dynamics of financial system stability and maps key elements of the alert system that assists the safeguarding of the EAC financial system stability.

Despite the paucity of existing research on financial stability, this study contributes towards:

i. Supporting and enriching theories/models of financial system stability in developing countries, particularly within monetary union contexts.
ii. Optimizing benefits from the effective relationship of the EAC financial system structure, by evaluating ways to minimize potential risks and suggesting effective regulation and supervision mechanisms that support growing competitive banking sectors, deepening financial markets, and effective and efficient financial infrastructures provisioning. All of these foster a stable and more robust regional financial system.

iii. Formulating a regulatory and supervisory framework for financial system integration in the region by analysing the key factors which contribute towards a stable financial system with better resilience to systemic risks and shocks, by designing an effective alert system for early warning about potential financial crises.

iv. Supporting economic growth and development of the region by promoting an efficient contribution towards safe and robust financial system stability in the EAC.

1.8. Salient Findings of the Study

This study is among the first of its kind in the contexts of both monetary union and the emerging market economies' space, has expectedly contributed to the literature in various important ways. In respect of the evolution of the EAC financial system, (i) we found that the EAC financial system is becoming increasingly diversified and appears to be relatively stable, albeit vulnerable to shocks. In particular, deterioration of the banking sector's assets quality, which manifested itself in the worsening of the NPL position, which is one of the critical factors of bank failure, highlights the need to identify potential risks to the financial system stability.

Findings from the determinants of financial stability support the economic theory that suggests that credit risks are responsive to the dynamics of countries' macroeconomic and macro-financial variables. Credit risks are legacy effects of economic and credit growths and previous NPLs management both in the short- and long-run. (ii) We found that macro-prudential and micro-prudential policies help to lower credit risks. As is theoretically expected, improvements in banks' profitability, cost efficiency, liquidity, interest margin, terms of trade, money supply and economic growth lower credit risks in the EAC banking system. However, (iii) increases in credit growth, exchange rate, interest rates and required capital to risk-weighted assets (with less prudent lending standards) increase the ratio of NPLs and, consequently, raises credit risks during the recession.

From the EAC financial system resilience analysis, (i), we found that the EAC financial systems have remained relatively stable, albeit vulnerable to shocks. In the first half of the sample period, regional financial systems were less developed compared to the second (current) period; operating in a weak macroeconomic environment with fairly inadequate regulatory frameworks, made the financial systems more vulnerable to shocks. However, since 2010 there is a notable development in terms of access and usage of financial services, which improves the stability of the EAC financial systems.

Moreover, (ii) Risks to financial system stability relate mainly to tighter financial conditions and weaker economic growth, which have led to elevated credit risk, liquidity risk

and declining profitability across the region. (iii) Robust regression analyses confirm the significance of the AFSSI. Moreover, it indicates that variables that populate the sub-indices are useful leading indicators to be relied upon as early warning indicators of potential risks to the stability of the financial systems. Lastly, (iv), we were able to forecast the EAC financial system stability for the following 3 years out. The four methods deployed were able to predict the AFSSI for within and out-of-sample. We found a positive trend of the AFSSI for the period of 2018 – 2020.

Upon investigating sources of contribution to systemic risk of the EAC financial system stability, we found that (i) there is a significant increased bidirectional causal effect between EAC banks. Most of the banks from Kenya and Uganda appeared to have more connectedness, implying that they may be of greater concern in terms of potential spill-over effects. (ii) Higher interconnectedness appeared mostly during economic downturns or financial crisis episodes. (iii) Moreover, we found that banks' systemic risk contributions are time-varying, with about 92 percent of the total number of banks found to be significantly causative to systemic risk. That notwithstanding, 8 percent of total banks significantly contribute to the financial system stability. This implies that the degree of systemic risk contribution is higher when banks are in distress condition. Most importantly, (iv) in line with other studies, we found a significant positive correlation between bank size and contribution to systemic risk. However, banks' level of connectedness does not increase systemic risk; this suggests there is a potential contagion effect in the EAC banking sector, which pose a potential threat to the financial system stability during times of crisis.

1.9. Organization of the Study

The remainder of the research report is organized as follows: Chapter Two reviews the evolution of the EAC financial system. Determinants of financial system stability are empirically examined in Chapter Three, while the resilience of the EAC financial system stability is examined in Chapter Four. Analysis of the systemic risk contribution by banks is discussed in Chapter Five. Finally, the conclusion to the study, in relation to the research questions, with a particular focus on what had been resolved and what requires further research intervention, are then discussed in Chapter Six.

CHAPTER TWO

2. EVOLUTION OF THE EAC FINANCIAL SYSTEM: A DESCRIPTIVE OVERVIEW

In this chapter, we are largely concerned with the presentation and interpretation of the background of the EAC financial system developments for the period 2000 – 2018. In particular, this chapter is answering the research question 1 as per the introduction chapter, hence meeting the first objective of the study that intends to map the architecture of the current financial system. This objective indicates the contexts of the EAC financial system developments; as well as the macroeconomic environment that the system has been operating in, taking into account the effect of the implementation of a number of the macro-economic, and financial reforms. We started by assessing the financial system outlook, and later we present the recent macroeconomic and macro-financial developments. This entails ascertaining whether efforts made to support the financial system development during the infant stages have had impacts on recent financial system developments.

2.1. Background to the Chapter (Study)

Most of the East African Countries (EAC) have experienced economic growth between 1960s and the beginning of the 1970s (Ndulu & O'Connell (1960) and Ndulu et al., (2008)). However, this period was followed by a serious economic depression and major bank insolvencies in mid 1980s and early 1990s (Caprio & Klingebiel (1996), Demirgüç-Kunt (2005) and Laeven & Valencia (2008)). This was partly caused by problems in mechanisms and channels through which economic conditions and structural characteristics of the banking system across the EAC region. This enthused the interest of many policy makers and observers alike in ensuring financial system stability, partly leading to the introduction of reforms in the financial sector. Consequently, most of the EAC countries implemented a number of economic and financial reforms (legal, structural and institutional) in 1990s. These reforms entail banking deregulation, developing financial markets and strengthening financial institutions.

Since then, the analysis of the financial systems behavior and performance has been very topical, considering the policy objective underlying the impending EAC monetary union (Cihák & Podpiera, 2005). Among others, Ngugi & Kabubo (1998), Yona & Inanga (2014) and Mwamba, et al., (2016) examined liberalizations of monetary policy (interest rate) and the financial sector in the bank regulations and supervision and their impacts on the financial sector

development and financial inclusion in the EAC economies. The EAC in collaboration with the IMF, World Bank and other development partners focused on strengthening the foundation for the financial sector development and integration. This includes strengthening financial inclusion and market participation; harmonization of financial laws, regulations and market practices; mutual recognition of supervisory agencies; integration of financial infrastructure; and other developments towards harmonization of capital and the regional equities market.

It is indicated that the financial sector liberalization in general has relatively contributed to a deepening of the financial system and domestic savings. However, access to financial services is still a challenge for the rural areas as most of the formal financial services are concentrated in the urban areas (Nyaga (2014) and Lepetit, et, al., (2015)). Besides, loan recovery appeared to remain an issue despite the improvement in loan appraisal that in the pre-reform period. Some adverse consequences have also been observed, such as the widening spread between lending and deposit rates have also been observed. In addition, the increased relationship between banks and other institutions such as financial markets and microfinance institutions expose the financial system to credit risks, necessitating the need to put in place and oversight mechanism.

Therefore, this study intends to ascertain the effects of the macroeconomic and financial sector reforms on the EAC banking system after the implementation of financial sector reforms in 1990s. This entails understanding whether the financial sector reforms have significantly contributed to the financial system development and lead to the robust financial system stability. Using the EAC financial system outlook as a case study, this chapter intends to sketch a brief overview and post developments of the financial sector reforms in the EAC economies by looking at financial system developments for the period 2000 - 2018.

The rest of the chapter is organized as follows. The next section, 2.2 presents the existing literature on the theory and empirical studies on integrated financial systems. Section 2.3 presents the empirical methodology that used in the study including data collection and analysis. Section 2.4 briefly surveys the EAC financial systems focusing on the impact of the financial sector reforms implementation and the trends in macroeconomic environment, which map the environment that financial systems operate and indicates developments of financial intermediaries across the region. Section 2.5 presents the results and discussion of the descriptive analysis that maps the architecture of the current financial sector and finally, Section 2.6 provides the concluding remarks.

2.2. Related Literature Review

This section outlines the existing literature review on the evolution of the EAC financial system considering developments of the regional financial integration. Economic intuition of the financial systems in the financial integration highlights potential threats to the financial system that need to be considered. This section includes both theoretical and empirical literature review, the conceptual framework and summary of the literature reviewed.

2.2.1 Theoretical Review

Economic literature posits that an organization is a dynamic system, whose survival and growth is determined by the changes in its environment, both internal and external. The **Theory of Dynamical Systems** underscores the fact that financial system is a complex system and highly interconnected, which carries contagion risk because it involves linkages within financial sector (stemming from both the asset and the liability sides of their balance sheet) and the real economy (Thore, 1969; Carfı and Caristi, 2008; Ho et al., 2013). Effectively, that means in the financial perspective, determinants of the financial system instability encompass multilevel and multidimensional aspects of the institutions, covering both the micro and macro environment of the institutions due to its interconnectedness nature (Neu and Kühn, 2004; Gatchev et al., 2010; Kali and Reyes, 2010; Wang et al., 2018). The instability events are from multiple variables, which could either be interrelated or interdependent. With financial markets around the world so interconnected, the analysis of "networks" in the financial system would help deepen understanding of systemic risk and is key to addressing or preventing future financial crises.

When financial systems are integrated within either a single currency area which is optimal or financial integration, there are positive rewards to financial stability as it lessens the probability of asymmetric shocks and risk of cross-border financial contagion; and augment the capacity of economies to absorb shocks (Beine et al., 2010; Umutlu et al., 2010; Yu et al., 2010). Conversely, a non-optimal monetary union can lead to financial instability (De Grauwe and Ji, 2013). The **theory of Optimal Currency Areas (OCA**), which was developed by Mundell and further developed by McKinnon (1963) and Kenen (1969) suggests that monetary unions will become sub-optimal in the presence of asymmetric shocks, rigours in the labour markets, and inflexible fiscal policies. This is because of the trilemma among the stabilization policies variables (Schoenmaker, 2011). In the presence of asymmetric shocks, inflexible fiscal policies are incompatible with financial integration and financial stability.

2.2.2 Empirical Evidence

Financial integration broadens and deepens financial links within a region by eliminating cross-border investments barriers and differential treatment of foreign investors within the region. It also extends to harmonizing legislation, policies, and institutions, which over time can lead to national financial markets effectively functioning as one. However, in order for the region to realize financial stability, a sound and stable regional financial system that (i) facilitate both an efficient allocation of economic resources (financial processes) and effectiveness of other economic processes; (ii) assess, price, allocate and manage financial risks; and (iii) maintains its ability to absorb external and internal shocks is crucial (Fecht et al., 2012). This entails the establishment of macroeconomic stability and its regulatory framework; adequate financial regulation, supervision and surveillance frameworks; and adequate legal system that supports regional competitive growth. Financial integration increases the scope for cross-border leakages of macro prudential policy and thus requires greater emphasis on strategies to maintain financial stability.

Financial integration normally tends to increase the scope for cross-border leakages of macro prudential policy, requiring a greater emphasis on strategies to address these leakages. This is the case with the East African Community (EAC) as well, whereby a number of initiatives are underway in order to enhance regional financial stability (Turner, 2013). In support of that, this research is going to be conducted at the time when regional policy reforms towards harmonization and integration are underway. This research intends to contribute to the increasing response of the regional interconnected financial institutions and the lessons that might be learned with particular reference to financial system stability.

Studies have also shown that there is a trade-off between alternative stabilization policy goals (monetary independence, exchange rate stability and free capital mobility) and financial stability. Evidence of the impact that a single currency has on a full-fledged banking union shows that boosting further financial integration may be a commendable objective. The harmonization of rules for smooth functioning of the single market neglects the breadth of the interventions required in the common currency area to deal with governments' moral hazard driven by competition on funding cost. This home bias can lead to an imperfect banking union by intensifying friction in credit markets and, thus, hampering the transmission of monetary policy and threatening the stability and, possibly, economic growth.

Therefore, since the EAC is a potential common currency area, it is important to assess dynamics of the financial system as far as financial stability is concerned. It is worth looking

at a number of lessons from other currency areas (regional monetary unions), such as Euro zone experiences in order to avoid potential problems that come with integration. There is no doubt that financial integration comes with a number of advantages, such as the elimination of exchange risk and addresses key financial constraints such as small market size and high cost of intermediation. In contrast to the advantages a region can enjoy from integration, the European Financial Crisis (EFC) has highlighted negative effects, such as the fact that integration cannot eliminate systemic risk irrespective of the economic strength of member countries involved in the integration. A good example is the contribution of Greece debt crisis (the smallest member country in the EMU) to the European crisis. This underscores the need to conduct analytical assessment of prospects for and constraints on financial system stability within the EAC region.

2.3. Data and Methodology

This section is designed to map the extant evidence of the financial system evolution by analysing the background of the EAC financial system development following the financial sector and economic reform that was implemented prior to the re-birth of the EAC in 2000. Specifically, it analyses the performance of the financial systems and the environments in which the EAC financial system has been operating. This entails ascertaining whether efforts made to support the financial system development during the infant stages have had impacts on recent financial system developments. Further, the study analyses the EAC financial system outlook, the integrated financial market and provide the recent outlook of the macroeconomic and macro-financial developments for the period 2000 – 2018.

Data for this objective of the study was extracted from the World Bank, IMF and African Financial Sector databases. The dataset includes macroeconomic and macro-financial data. The study used aggregated institutional data for each country over time. Due to data availability, the study used aggregated data in order to be able to study the behaviour of each financial system over time and across member states. Thus, in order to assess the overall determinants of the financial system stability reliably, an extensive range of indicators was examined, as well as projected its likely future development. The study uses quarterly data, which allows for more accurate analysis as compared to annual data. For the case of unavailability of quarterly data, such as data extracted from IMF country reports, the study used data manipulation process such as linear interpolation to change the frequency from annual data to quarterly data.

2.4. The EAC Financial Sector Reforms and Development

The EAC countries experienced a number of bank insolvencies resulted into banking crises, currency crises, debt crises and debt restructuring across the region during the 1980s and 1990s (Caprio & Klingebiel (1996) and Laeven & Valencia (2008)). The magnitude of these crises ranged from affecting banking system assets of more than 50 percent banking system assets in Tanzania and Uganda while in Kenya it was below 50 percent. Among other factors, increased public sector employment, which pushed up the budget deficit and monetary expansion fueled inflation; fast and significant credit growth than the real GDP; declined export to GDP and terms of trade ratios; increased interest rates and nonperforming loans; and inadequate banking supervision were suggested to be one of the factors that led to these crises.

Cognizant, the EAC countries implemented a wide range of reforms in order to liberalize and restructure the banking system. However, the expected positive effects from financial sector liberalization were slow to emerge (Beck, et, al., (2010) and Lepetit, et, al., 2015)). These reforms notwithstanding, the current nature of the EAC financial systems is still segmented and dualistic (formal and informal) in structure. The financial systems comprise of a wide and growing array of institutions, and they are slowly becoming diversified. Consequently, the financial access and usage have relatively deepened, however still limited.

2.4.1. Brief Background of the Financial Sector Reforms

Burundi experienced banking crisis in 1980s, galvanizing the implementation of financial reforms, which aimed to initiate the liberalization process of this sector in 1990s. However, banking system in Burundi continued to experience banking distress from time to time due to political and economic instabilities. For instance, the level of nonperforming loans reached 25 percent in 1995 leading to the liquidation of one major bank (Caprio & Klingebiel, 2002). Consequently, Burundi in collaboration with the World Bank established the private and financial sector development project in 2009 in order to strengthen Burundi's financial sector and improving regulatory environment that will lead to a better business enabling environment.

Despite implementation of the financial sector reforms, Burundi financial system has very limited range of traditional services that are in the market, which had a very limited effect on the country's economy (Nkurunziza, 2010). For instance, as of 2014 only 7 percent of the population had access to formal finance that includes 9 banks and 6 insurance companies, with the assets accounting for 31.6 and 2.1 percent of the GDP, respectively as of 2015 (World Bank, 2018a). The obvious difficulties in access to finance and narrow range of service available is mainly attributed to high economic and political risks, which have led to high transaction cost,

constraints facing loan market and lack of prominence of formal institutions, which increases the bankers' risk aversion. These necessitate regulations that will effectively reform the sector and enhance financial inclusion.

Kenya experienced a number of banking and currency crises between 1985-1993 (Caprio & Klingebiel, 1999). For instance, in 1985-89, about 4 banks and 24 non-bank financial institutions faced liquidity and solvency problems together accounting for 15 percent of the financial system liabilities, while 1992-95 local banks were faced with serious solvency problems accounting for more than 30 percent of the financial system assets. Real loss growth was about -7.4 while real GDP growth was about 1.4 during the period covered 1990-93 and the level of nonperforming loans reached 19 percent in 1996. Among other factors, the rapid growth of financial institutions as a result of relaxation of licensing requirements; credit growth; inadequate prudential framework; terms of trade shock and drought fueled the financial crises.

Following the crises episodes, Kenya implemented a wide array of financial sector reforms aimed to reform indirect monetary policy instruments, including reserve ratios, liquidity ratios, liberalized market-based interest rates, exchange rate floating and trade liberalization. Consequently, the reforms led to fundamental changes in the conduct of monetary and exchange rate policies in 1990s (Kimenyi & Ndung'u, 2009). As of 2015, Kenya had 42 commercial banks with bank assets accounting for 41.5 percent of the GDP; 64 listed companies with market capitalization of 24.36 percentage of GDP; 51 insurance companies, assets accounting for 5.7 percent of the GDP and pension funds' assets accounting for 9.7 percent of GDP (World Bank, 2018a).

Generally, Kenya is fairly well-developed financial system made notable inroads in the financial inclusion. As in 2017, Kenya has managed to include 81 percent of its population in the financial services. The vibrant of the Kenyan financial system reflects the higher industrialization of the economy as well as the fact that it has opened to private banks since its independence. This is attributed to the most active and vibrant commercial banks, with branches across the region, financial markets and mobile money operators in the region. Financial system in Kenya is well regulated, which contributes to its growth.

Apart from civil war, **Rwanda** experienced economic and financial crises, in particular currency crisis in 1985-1993 largely due to a rapid decline in coffee export (Caprio & Klingebiel, 2002). For instance, in 1991 one of the major banks in Rwanda, which had a well-established network was closed due to the currency crisis. These political, economic and financial instabilities gave impetus to the implementation of a wide range of financial sector reforms in late 2000s aiming at promoting a steady growth of the banking sector, encourage

market-determined prices for financial services and enhance market competition (Malunda & Serge, 2012). This has contributed to a notable economic and financial sector developments.

Rwanda is one of the most regulated financial systems in the region (Ndikubwimana & Berndt, 2016). It is being guided by the service sector policy that captures the key service sub-sectors such as the financial sector, which includes banking as the dominant institution, followed by insurance, capital market and related financial advisory services. As of 2015, Rwanda had 11 commercial banks. Their assets accounting for 37.1 percent of the GDP, while 4 listed companies had market capitalization of 26.0 percentage of GDP. There were 14 insurance companies with assets accounting for 5.1 percent of the GDP, and pension funds' assets accounting for 9.1 percent of the GDP (World Bank, 2018a). Currently, the Rwanda's financial system includes about 50 percent of its total adult population. However, access to affordable domestic credit is a still a serious challenge in Rwanda due to high interest rates.

Tanzania is the second most country that has experienced banking crisis, currency crisis, debt crisis and debt restructuring in between 1987 and 1995. The scope of these crises includes the main financial institutions had arrears amounting to half of their portfolio. In 1995, NBC, which accounts for 95 percent of the assets of the banking system has been insolvent for the last 3 to 5 years possibly longer (Caprio & Klingebiel, 1999). In 1987, implied losses amount to nearly 10 percent of GNP. This has led to the financial sector reforms, which were introduced in 1991 to develop a sustainable, efficient and effective (markets-based) financial system. The reforms entailed financial sector liberalization, private sector participation and financial sector restructuring and enhancing financial inclusion (Yona & Inanga, 2014). However, the expected results of these reforms are relatively less positive significant in respect to the banking competition and quality of service delivery.

As of 2015, Tanzania had 36 banks, with their assets accounting for 23.9 percent of the GDP; 21 listed companies with market capitalization of 18.1 percentage of GDP; 30 insurance companies with assets accounting for 0.7 percent of the GDP; and pension funds' assets representing for 8.8 percent of the GDP (World Bank, 2018a). The financial system is well regulated, and as a result, they have been growing and strengthened. In particular, the banking system and mobile money services have been booming in recent years. Despite the banking system growth, it is only 47 percent of the population have access to financial sector services.

Uganda is the country that has most experienced the highest incidences of banking system insolvencies. Between 1980 and 1998, half of the banking sector faced solvency problems, including banking crisis, currency crisis, debt crises and debt restructuring (Caprio & Klingebiel, 1999). In response to that, the country implemented a series of financial sector

reforms (financial sector liberalization, private sector participation and financial sector restructuring) to develop an efficient and effective financial system.

Despite of these reforms, lending to the private sector is still relatively low due to high transaction cost, constraints facing loan market, lack of prominence of formal institutions particularly in rural areas (Frederick, 2014). It is only 59 percent of the population that have access to formal banking services. As of 2015, Uganda had 25 commercial banks, with banking assets accounting for 22.6 percent of the GDP; 12 listed companies with market capitalization of 3.3 percentage of GDP; 29 insurance companies with assets representing for 1.2 percent of the GDP; and pension funds' assets accounted for 7.2 percent of the GDP (World Bank, 2018a). The financial system in Uganda is a fairly well-regulated financial system.

Notably, the economic and financial sector reforms have contributed to the awake of the EAC financial system. It is evident that while the role of financial intermediation has relatively grown over the years, the EAC financial system is still relatively small, shallow and bank-centric (Drummond, Wajid, & Williams, 2015). This is mainly attributed to the level of economic development, low capitalization and liquidity. This can be evident in their respective liquid liabilities, which represents the overall size of the financial system in the region. As indicated in the Table 2.1, a relative slow increase has been indicated in the liquid liabilities across the countries. Kenya has the largest liquid liabilities compared to the other EAC economies, which is a bit low when compared with the average of Sub-Saharan Countries level

Table 2.1 Liquidity Liabilities (Broad money as the percentage of GDP ratios)

Country Name	1988	1992	1996	2000	2004	2008	2012	2016
Burundi	15.4	16.9	22.3	17.2	22.3	25.3	26.1	24.2
Kenya	28.9	36.5	35.8	35.2	39.3	36.1	40.9	38.4
Rwanda	17.1	13.9	16.1	16.9	15.7	16.7	18.3	20.8
Tanzania	17.4	22.1	21.8	17.1	22.6	22.8	23.9	22.2
Uganda	9.9	9.6	12.5	16.1	17.2	23.6	20.5	22.8
SSA (excluding high income)	33.0	32.8	31.9	31.2	35.2	38.6	38.0	36.4

Source: World Development Indicator (World Bank, 2018b)

2.4.2. The EAC Financial System Outlook Post Reforms

Following the implementation of financial sector reforms and macroeconomic policies, the EAC region has experienced notable growth in their financial development, albeit slowly, with Kenya being ahead of other member states (Figure 2.1). As suggested by Lepetit et al., (2015), the pace of financial sector development is likely to lead towards the transformation of

the EAC economy; and thus, ensuring that financial system stability is given appropriate attention as economic integration takes shape.

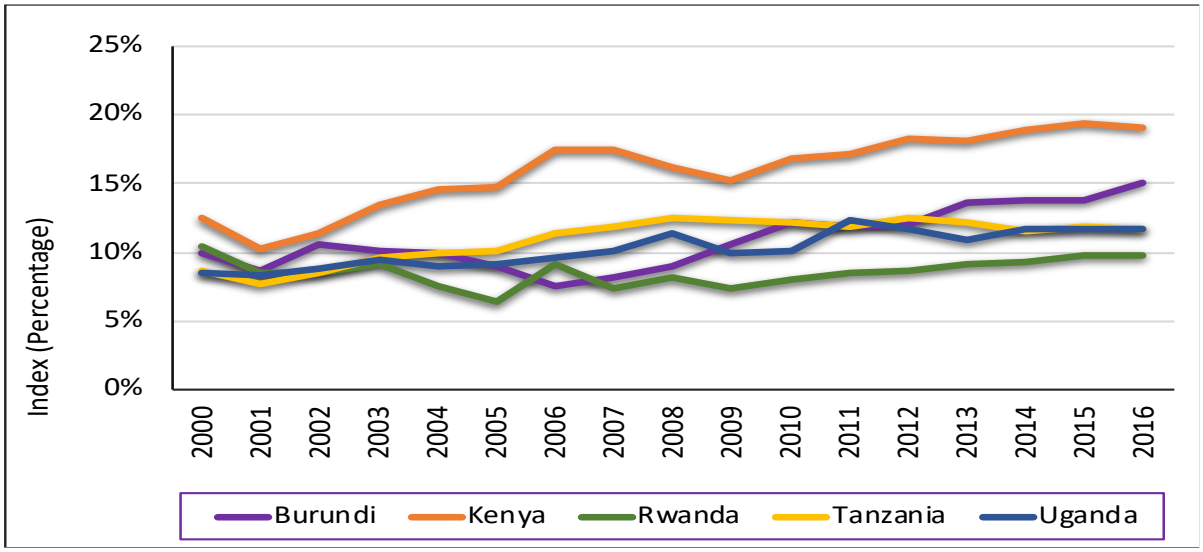

Figure 2.1 EAC Financial Development Index
Source: Financial Development Indicators (IMF, 2019)

Despite the good overall financial performance of banks in EAC, there are a couple of banks declaring losses across the region (Ongore and Kusa, 2013; Yona and Inanga, 2014; Tsuma and Gichinga, 2016). In some cases, market solutions towards mergers and acquisitions have been implemented and thus forestalling potential risks to the system, while other solutions emanated from regulatory and supervisory intervention. Besides, this similar pattern of bank distress across the region contribute to the considerable improvements in the institutional arrangements regarding financial stability and monetary union (Lepetit et al., 2015) Similarly, there have been attempts by member states to improve their respective regulatory and supervisory framework further.

2.4.2.1 The EAC Financial Institutions Outlook

The nature of the EAC financial systems is segmented and dualistic (formal and informal) in structure. It comprises a wide and growing array of institutions, and they are becoming increasingly diversified (Beck et al., 2010b; Lepetit et al., 2015). This includes banking institutions (commercial banks, microfinance banks, development banks, cooperative banks and community banks) and non-banking institutions (mortgage finance companies, credit institutions, credit reference bureaus, foreign exchange bureaus, money remittance providers, insurance companies and pension funds). There is an increase in the number of financial institutions, albeit at a slower pace (Table 2.2).

Table 2.2 Number of Financial Institutions

Year	Banking Institutions					Non-Banking Institutions					
	Burundi	Kenya	Rwanda	Tanzania	Uganda	Burundi	Kenya	Rwanda	Tanzania	Uganda	**Total**
2004	9	44	6	22	15	22	47	13	9	8	**195**
2005	8	45	6	22	15	14	46	494	10	11	**671**
2006	7	41	6	22	15	14	50	472	10	10	**647**
2007	7	42	6	24	16	83	49	173	10	9	**419**
2008	8	43	8	25	20	71	48	228	11	7	**469**
2009	8	44	8	27	21	66	48	228	13	7	**470**
2010	8	43	8	29	22	69	48	1035	14	6	**1282**
2011	8	43	9	31	23	78	102	1031	17	7	**1349**
2012	10	43	9	32	24	82	57	1021	18	7	**1303**
2013	10	43	9	34	25	84	58	1031	19	6	**1319**
2014	10	43	11	34	25	87	58	1038	19	7	**1332**
2015	10	42	12	36	25	94	61	1038	23	8	**1349**
2016	10	42	11	39	25	92	66	997	25	9	**1252**
2017	10	42	11	41	24	92	66	1003	27	9	**1155**

Source: Financial Access Indicators (IMF, 2019)

A notable increase in EAC financial institutions is largely on the non-banking institutions, which are relatively less regulated compared to the banking sector (Nyaga, 2014). Despite the increase in the non-banking institutions, the overall banking institutions dominate the financial institutions in the region, which accounts for 80 percent of the total assets of the financial sector. Table 2.3 presents a snapshot of financial institutions' total assets.

Table 2.3 Financial Institutions Total Assets as in 2015 (US$ million)

	Banks	Insurance Companies	Pension Funds	Total Assets
Burundi	917.06	68.66	-	985.72
Kenya	34,164.56	4,683.09	7,963.42	46,811.06
Rwanda	3,061.74	423.55	735.25	4,220.53
Tanzania	13,362.86	358.10	4,926.76	18,647.72
Uganda	6,703.08	351.04	-	7,054.12
Total	58,209.30	5,884.44	13,625.42	77,719.15

Source: African Financial Sector Database (AfDB, 2018)

On the aggregated way, Kenya has the largest financial institutions with total asset amounting to US$ 46,811 million, which accounts for 60 percent of the total regional assets. Notably, the banking institutions dominated the EAC financial system. The dominance of the banking institutions in the financial system is a common phenomenon in developed and developing economies, particularly in Africa due to its role in the growth process of an economy (Levine, 2005; Anatolyevna and Ramilevna, 2013; Inoue and Hamori, 2016).

Despite the banking institutions dominance, in recent years, mobile money operations have gained more popularity due to its rapid growth and activeness; to the extent, it has become the largest competitor of the banking industry in terms of a number of customers. This has significantly improved the role of financial intermediation across the region. Figure 2.2 shows the percentage of the population with access to financial services.

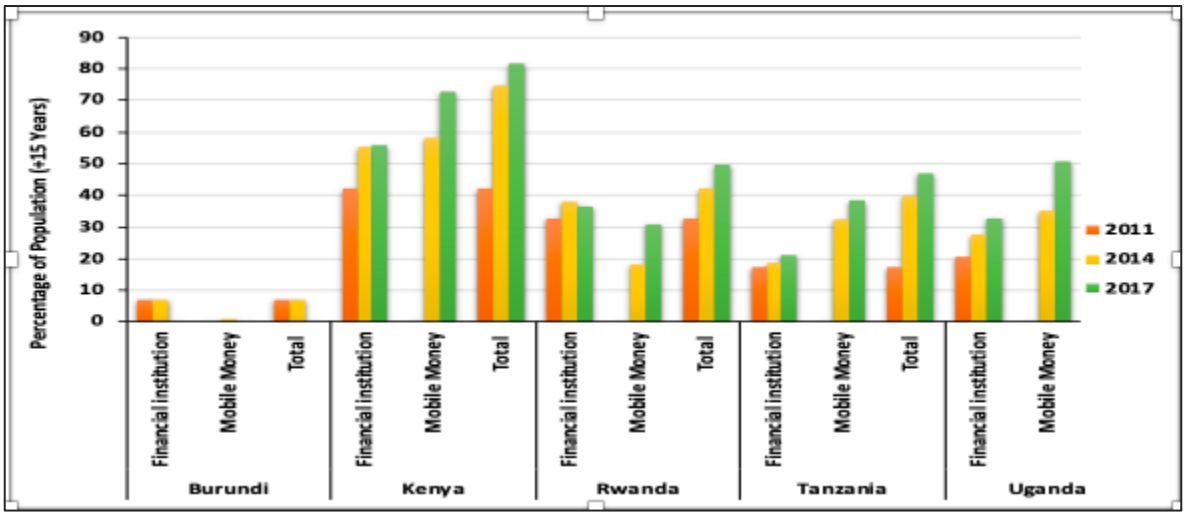

Figure 2.2 Number of Accounts as a Percentage of Population (15+ years)
Source: Global Financial Inclusion (World Bank, 2018a)

The role of financial institutions is to provide better financial services at a lower cost and make a significant contribution to economic growth. This can only be achieved when financial institutions operate efficiently. One of the reasons for the financial sector reforms was to enhance financial institutions efficiency. However, as indicated in the survey conducted by the IMF, the EAC financial institutions efficiency has always been ranged between 30 – 65 percent over the period 2000 – 2017 (Figure 2.3). If we benchmark the region member countries, Kenya has operated at an average of 50 percent slightly below Tanzania despite it being the largest with more financial institutions across the region. Uganda, Rwanda and Burundi have operated slightly below the average. This appeal for an analysis which explains the driving force that hinders efficiency across the region.

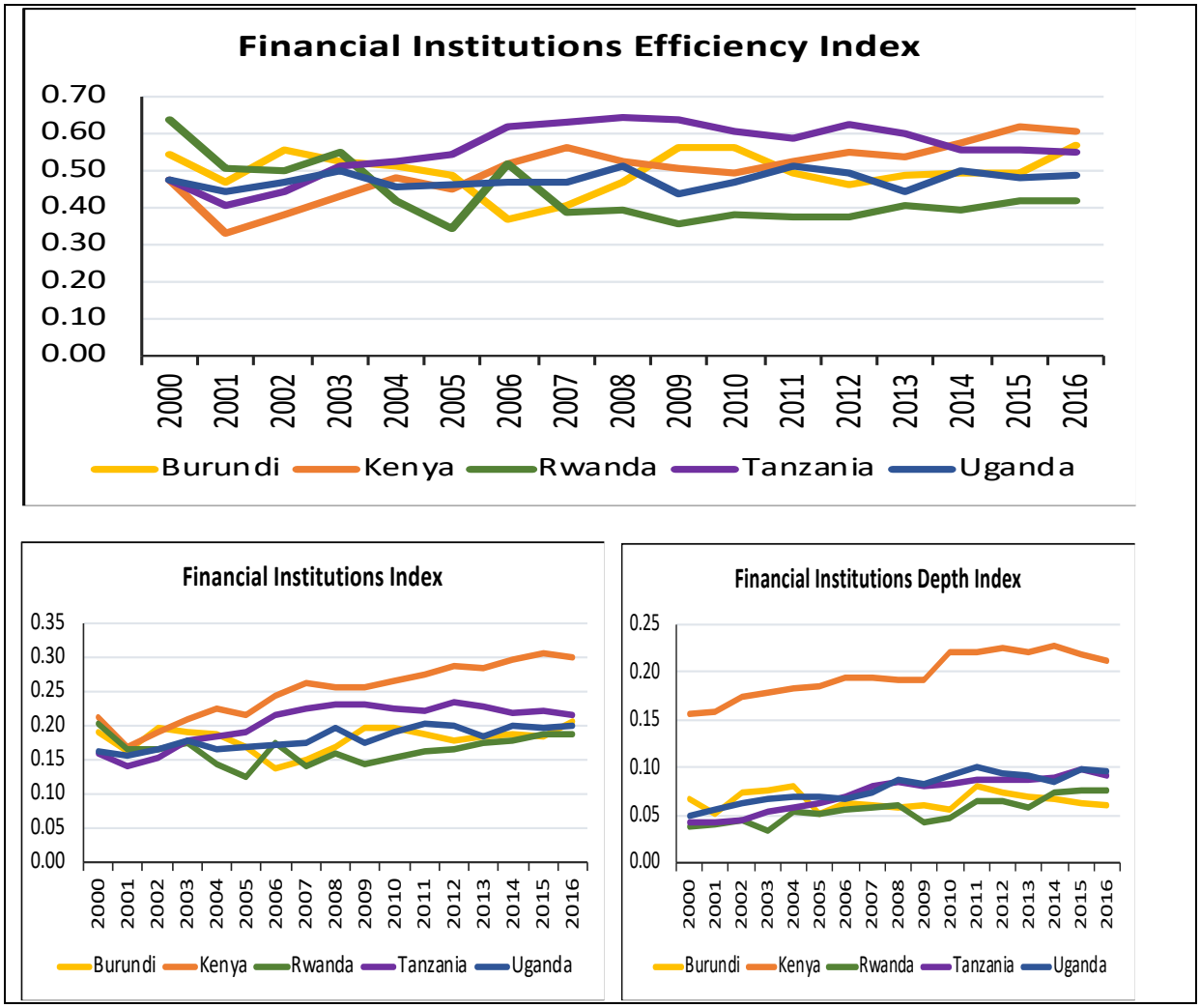

Figure 2.3 EAC Financial Institutions Efficiency Index
Source: Financial Development Indicators (IMF, 2019)

2.4.2.1.1. Banking Institutions

The EAC banking sector is playing an important role in propelling regional integration. This sector has continued to grow in terms of a number of institutions, banks size and their contribution to their respective economies (Table 2.4). This has been happening at the backdrop of the financial sector reforms, with banks have operated in the market-based structure. Kenya has the largest banking sector followed by Tanzania and Uganda, while Rwanda and Burundi are the least. Despite being small, Rwanda has shown remarkable growth in the bank total assets growth and its contribution to the economy. Looking at the ratio of bank assets to GDP, Rwanda increased gradually to 40 percent in 2017 from 37.1, 20.7 and 15.7 percent in 2015, 2010 and 2005, respectively. This trend is in contrast to all other countries where there was a significant decline in 2015. This decline implies a decline in banks' efficiency, underlying the need for further assessment of the underlying reasons and develop mitigation measures.

Table 2.4 The EAC Banking Sector Growth

Indicator Name	Country	2005	2010	2015
Number of commercial banks	Burundi	8	8	10
	Kenya	45	43	42
	Rwanda	6	8	12
	Tanzania	22	29	36
	Uganda	15	22	25
Number of bank branches	Burundi	56	103	169
	Kenya	534	1063	1523
	Rwanda	34	99	142
	Tanzania	232	473	690
	Uganda	153	394	578
Total Assets (US$ Million)	Burundi	316.7	707.2	917.1
	Kenya	8,434.2	21,186.9	34,164.6
	Rwanda	405.4	1,179.6	3,061.7
	Tanzania	3,644.0	8,491.4	13,362.9
	Uganda	2,066.4	5,194.3	6,703.1
Bank Assets as % of GDP	Burundi	28.4	35.6	28.2
	Kenya	45.0	53.4	41.5
	Rwanda	15.7	20.7	37.1
	Tanzania	25.6	28.3	23.9
	Uganda	20.6	26.4	22.6

Source: African Financial Sector Database (AfDB, 2018)

2.4.2.1.2. Non-Banking Institutions

The non-banking sector includes insurance companies, social securities companies, SACCOS, and Mobile Network Operators (MNO's). The non-banking sector has continued to grow in terms of a number of institutions, company size and their contribution to the economy. As indicated in Table 2.5 Kenya leads the region. The tremendous growth of the non-banking segment, especially mobile money operators (MNOs) underpins the improvement in access to financial services (Nyaga, 2014; Gosavi, 2018). However, this segment has increased competition to the banking sector as some of the non-bank institutions such as MNOs offer traditional products previously offered by traditional banking services.

Table 2.5 Selected Indicators of Non-Banking Institution Growth

Indicator	Country	2005	2010	2015
Number of Companies	Burundi	14	69	94
	Kenya	46	48	61
	Rwanda	494	1,035	1,038
	Tanzania	10	14	23
	Uganda	11	6	8
Total Assets (US$ million)	Burundi	9.2	35.84	68.66
	Kenya	1,194.45	2,564.37	12,646.50
	Rwanda	58.34	219.82	1,158.79
	Tanzania	127.83	246.96	5,284.86
	Uganda	473.91	187.28	351.04
Assets (as % of GDP)	Burundi	0.7	1.8	2.1
	Kenya	6.4	6.5	11.7
	Rwanda	2.3	3.6	5.1
	Tanzania	0.9	0.8	5.6
	Uganda	1.5	1.0	1.2

Source: African Financial Sector Database (AfDB, 2018)

This has led to spread profitability between banks and non-banks, which might affect the bank return on investment, as the operational risk was heightened. Since banks dominate the financial system, this risk may be not only a threat to the viability of the banking sector but also the financial system as a whole. Besides, since this segment is relatively less regulated, the question is then to what extent of a wider range of these institutions; the degree of supervision and regulation may be necessary to avert potential instability.

2.4.2.2 The EAC Financial Markets Outlook

The regional financial markets largely comprise of capital markets and money markets. Most of the African financial markets are characterized with fragmentation, illiquidity, information inefficiency, limited size and capacity, inefficient regulatory schemes, excessive risk factors, death of risk-sharing and hedging mechanisms, and legal and contract enforcement issues, which led to performance inefficiency. This has been the case with the EAC financial markets. Over the past 2 decades, the EAC financial markets have been growing at a low pace, and the average efficiency level is below 10 percent. As it is evident in Figure 2.4, Kenya being the most active market has demonstrated a relatively deeper link to the world market, as it experienced a rapid downfall during the 2008 financial crisis.

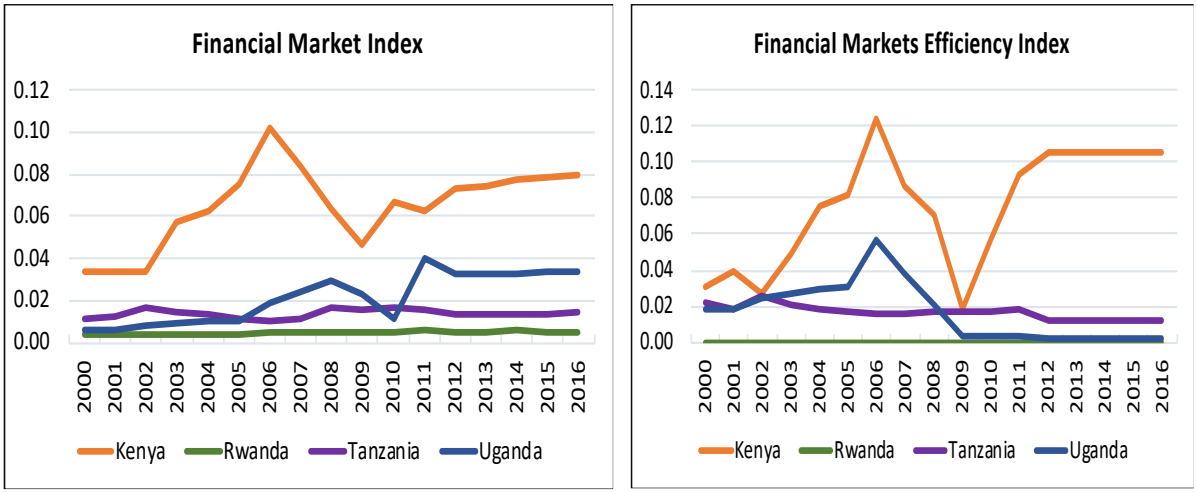

Figure 2.4 Performance of the EAC Financial Markets
Source: Financial Development Indicators (IMF, 2019)

In 2012, the region integrated all its markets, which significantly raised the private capital flows within the region. Okiro et al., (2015) argued that there is an increase in capital structure and firm performance in the companies. This was partly influenced by good corporate governance. It is expected that financial markets continue to improve due to the continuous economic growth across the region that may also increase the number of domestic and international investors, in particular, financial institutions and stimulate market efficiency.

2.4.2.2.1. Capital Market

The regional capital markets have grown, albeit slowly and the integration remains limited.[3] These markets are widely disparate in size, investor base, infrastructure, and regulatory and supervisory capacity. Most of these markets are still considered to be a frontier and fragmented markets with high returns, high risks, and low liquidity. As it is evident in Table 2.6, the EAC markets are characterized by a relatively low number of listed participants.

Born et al., (2014) argued that most of the financial markets in developing countries face the same challenges: low market capitalization, governments' dependency on external sources of financing, asymmetric information, and coordination problems, which lie at the heart of the potential risks to financial stability. The EAC is not exceptional. The EAC markets, which initially were confined to domestic boundaries, have increasingly become integrated into regional and global markets, seeking alliances across national borders in order to remain viable in an increasingly competitive environment. A well-developed and executed strategy fosters market efficiency and effectiveness that yield the optimum benefits for all the stakeholders.

[3] Kenya, NSE is the largest and most active stock exchange in the region, which existed since 1954, followed by Tanzania, DSE in 1996, Uganda, USE in 1997 and Rwanda, RSE in 2011. Burundi is yet to establish one.

Table 2.6 Snapshot of the EAC Stock Markets as of 2017

	Country	2005	2010	2015
Number of Listed Firms	Kenya	48	55	64
	Rwanda	-	2	4
	Tanzania	8	15	21
	Uganda	5	7	12
Market Capitalisation (US$ million)	Kenya	6,128.65	13,752.53	20,048.31
	Rwanda	-	1,169.80	2,147.48
	Tanzania	2,283.03	3,367.96	10,062.02
	Uganda	105.92	909.70	975.12
Market Capitalisation (as % of GDP)	Kenya	32.7	34.6	24.4
	Rwanda	-	20.5	26.0
	Tanzania	16.1	11.2	18.0
	Uganda	1.1	4.6	3.3

Source: African Financial Sector Database (AfDB, 2018)

2.4.2.2.2. Money Market

The EAC money markets include among other instruments, treasury bills and bond, commercial papers, interbank deposits, bills of exchange, government bond and repurchase agreements. The money markets in the EAC have continued to grow and diversified. Notably, Rwanda is one of the few sub-Saharan African countries to have issued sovereign bonds. As indicated in Table 2.7, the Kenyan debt market is more liquid and diversified compared to other member state's debt markets.

Table 2.7 EAC Domestic Debts (As of end-2015)

	Burundi	Kenya	Rwanda	Tanzania	Uganda
T-Bill (US$ millions)	-	3,821	274	1,347	1,013
T-Bill (% of GDP)	-	6.2	3.3	3.0	4.1
Bonds (US$ millions)	-	10,485	152	2,781	2,243
Bonds (% of GDP)	-	17.1	1.8	6.2	9.1
Total Domestic Debt (US$ millions)	675	14,970	526	4,318	3,256
Total Domestic Debt (% of GDP)	23.4	24.4	6.4	9.6	13.2
Banking Institutions (% of Domestic Debt)	87.8	54.8	76.2	69.7	46.0
Pension Funds (% of Domestic Debt)	-	25.7	-	16.1	37.0
Insurance companies (% of Domestic Debt)	-	8.6	-	7.9	2.0
Others (% of Domestic Debt)	12.2	10.9	23.8	6.3	15.0

Source:Alper et al., (2017)

Kenya and Uganda show a more diversified government domestic debt holder profile, with the banking sector holding about half of the domestic debt. Tanzania, Rwanda, and Burundi, the share of the banking sector is more than 70 percent of the domestic debt. Besides, banking institutions have been the dominant player in the domestic debts across the region. This implies that banks have continued to use money market to create a cushion of liquidity as well as a safety net in the event of a loss or anticipated outflow of funds. Since the banks dominate the regional financial systems, it follows that the money market is highly associated with bank risks. The dominance of banks in the domestic debts raises the alarm, in case of banking system default. It is thus essential to ensure that gradual and orderly transformation of the market so that abrupt change in the size and composition of the market are averted.

2.4.2.3 The EAC Financial Market Infrastructures Outlook

Since 2009, the EAC countries have continued to strengthen their financial market infrastructures at both national and regional levels. This entails the whole paraphernalia of platforms and systems that facilitate market transactions and flow values arising from such transactions. This includes regulatory frameworks, trading platforms and payment and settlement systems. However, these platforms and systems are still being developed at a time when financial stability in each member country is still relatively good (Kodongo and Ojah, 2016). The increased use of technology in trading platforms and payment systems brings with it, significant challenges both for policymakers and supervisors. This underlines the need to enhance regulations and closely monitor the whole infrastructure system from a macroeconomic perspective in order to ensure that financial stability is maintained. Therefore, assessing efficiency and effectiveness of the trading platforms: regulatory and payment systems is essential in promoting safe and sound financial system stability.

2.4.2.3.1. Financial Regulatory Infrastructure

A series of legal and regulatory reforms such as numerous revisions to the Banking Acts, Central Bank Statutes and prudential guidelines have been implemented since the mid-1990s across the region. Mainly in order to strengthen arrangements concerning bank licensing, corporate governance, capital adequacy, risk classification of assets and overall risk management to avoid a repeat of the banking crises experienced in the 1980s and 1990s. Despite tremendous improvements in economic fundamentals across the region, there is a substantial degree of divergence in these, supplemented with even greater differences in the institutional environment in place across the region (Lepetit et al., 2015; Ojah et al., 2010). These differences of financial systems regulatory infrastructure from country to country are

due to differences in legislation and regulatory structures, reflecting both local market conditions and varied historical background.

As shown in Table 2.8, there is no explicit deposit insurance system in Burundi and Rwanda, and there is no harmonization on activity restrictions and capital adequacy requirements across the region. Inadequate credit rating agencies within the regions hinder effective and efficiency lending activities. Credit bureaus, collateral registries and credit rating systems are only beginning to be developed in Kenya and Tanzania. Nonetheless, there are also some initiatives being pursued towards establishing and strengthening Deposit Insurance Funds (DIF), which are often seen as an integral part of a financial safety net (Beck et al., 2008; Drummond and Williams, 2015).

Table 2.8 Summary of the Financial System Regulations in the EAC (2010)

	Burundi	Kenya	Rwanda	Tanzania	Uganda
Deposit insurance system	No	Yes	No	Yes	Yes
Risk concentration limit (%)	20	25		25	25
Credit flow counter- cyclical regulations/tools	No	No	No	No	No
Regulatory Capital Adequacy Regime					
Basel I	-	All Banks	-	-	-
Basel II	-	-	-	-	-
Leverage ratio	-	-	-	-	-
Required Minimum Capital Adequacy Ratio (%)					
Total	8	12	15	12	12
Core tier 1	-	8	10	10	8
Risk Covered by the Required Minimum Capital					
Credit risk	No	Yes		Yes	Yes
Market risk	No	No		Yes	No
Operational risk	No	No		No	No
Activity Restrictions					
Foreign Subsidiary, Branch and Joint Venture Entities	No	No		Yes	Yes
Securities activities	Unrestricted	Restricted	Unrestricted	Unrestricted	Restricted
Insurance activities	Prohibited	Prohibited	Unrestricted	Permitted	Permitted
Real estate activities	Restricted	Permitted	Permitted	Permitted	Permitted
Supervisory Power to declare Bank Insolvency	No	Yes	Yes	Yes	Yes

Source Bank Regulation and Supervision Survey (World Bank, 2012)

Besides, there are notable improvement efforts made by the EAC member states as they have taken measures towards strengthening their financial market infrastructures at both national and the regional level (Döveling et al., 2018). In this regard, the EAC aims to achieve an effective functioning of a single market in the financial systems by moving towards legal and regulatory harmonization against the international standards known as the Basel Core Principles (BCPs). Currently, the EAC countries are working towards adoption of Basel II and III core principles; Twin Peak Model of regulation and Principles of Market Financial Infrastructure. Some of the efforts are underway to harmonize the framework for monetary policy operations, the legal and regulatory frameworks for banking and arrangements for crisis management and resolutions, and to link the financial market infrastructure.

2.4.2.3.2. Payment and Settlement System

Developments that have taken place over the last decade have had an impact on the provision of financial services in EAC countries, and significant integration of payment and settlement systems and infrastructures is taking place at a very fast pace. In 2015 the EAC launched the regional payment and settlement system (PSS) in order to maintain the integrity of the regional payment flows. This development comes with its own risks.

The payment system is associated with a low probability of systemic risk. However, if it occurs, the cost is very high (Acharya and Thakor, 2016). This kind of risk cannot be ignored while designing and putting in place frameworks and designing the financial system structure of the EAC as long as it will be linked with other non-EAC members and international financial sectors. Thus, the proposed regulatory structures must take into consideration the need to avoid stifling innovations in the payment system to ensure the integrity of the flow of payments.

2.4.2.4 The EAC Financial System in the Integrated Market

Theoretical and practical evidence supports the fact that the decision to establish a monetary union deepens the integration of East African economies and in so doing enhance the benefits arising from the recently launched East African Common Market. Much as the primary rationale of the monetary union is to reduce the transactional related costs and risk of doing, business across the national boundaries. The integration brings with it the risk of transmitting shocks and vulnerabilities across the economies in the region. Financial integration within the EAC would lead to increased interconnectedness in the EAC financial systems, and thus the potential for intense negative cross-border spillovers.

According to Asongu (2014) and Foresti (2017), most monetary unions without a large degree of political integration have failed. Of course, there are a number of drawbacks that

come with enhanced financial integration, as evident from the recent financial crises. In addition, as the experience of the European Monetary Union (EMU) has demonstrated, forming a monetary union is a complicated project, and there is a non-negligible risk of failure. Therefore, there is a need to ensure that the pre-conditions for monetary union formation are adequate for strong political support and an extensive institutional framework that handles both current political and technical issues (Durevall, 2011).This underscores the need to address the challenges of gradual convergence of all East African economies, particularly in the financial systems.

2.4.2.4.1. Policy and Institutional Issues in the EAC

The EAC financial system prudential supervision is broadly similar, albeit with different modes of prudential supervision. One of the EAC's objectives is to harmonies the regulatory framework and supervision (Bank, 2002; Lepetit et al., 2015; Drummond and Williams, 2015; Döveling et al., 2018). However, due to these differences, there is an ongoing discussion about how to address conduct supervision, consumer protection and enforcement of competition rules. While Kenya is considering using a "twin peaks" model, Rwanda is planning to assign the conduct of supervision and consumer protection task for other than capital markets activities to the Financial Stability Department at the Rwanda National Bank. Tanzania has not fully implemented financial consumer protection despite having it in the mandate of the competition authority. Nevertheless, all member states have established or are in the process of establishing or reforming a financial stability forum, with the exception of Burundi.

All EAC countries have enacted capital markets legislation with the exception of Burundi and South Sudan (Turner, 2013). Capital Markets legislation in Kenya, Tanzania and Uganda are similar since they are based on the British Common law system. In consonance with the spirit of harmonization, Rwanda despite having a French civil law background developed it's the capital markets laws in tandem with the laws of Kenya, Tanzania and Uganda. Burundi and South Sudan are in the process of developing capital markets framework spearheaded by their national central banks. With the EAMU in place, the regional capital market is under the East African Securities Regulatory Authorities. In the run-up to the monetary union, member states have agreed to the macroeconomic policy framework, which comprises monetary, fiscal and exchange rate policies in order to achieve macroeconomic stability, economic growth and balanced development. However, a relevant question is how much efforts each country should put into harmonizing various criteria to be complied with before the monetary union is formed.

2.4.2.4.2. Cross-Border Financial Linkages in the EAC

Currently, there is a notable increase of financial system cross-border activities in particular for banks and insurance companies, stock exchanges and integrated payment and settlements systems within the EAC region (Kodongo, 2016; Kodongo and Ojah, 2017). As indicated in Table 2.9, Kenya is the leading country with a large number of subsidiaries across the EAC, partly due to increased access to financial services, improvements in macroeconomic policies and progress in institutional reforms. However, a study conducted by Wang (2010) has shown that most of the banks surveyed are yet to achieve full integration of their operation in the region, with most of their operations being carried out at the individual country level.

Table 2.9 Commercial Banks with Cross-border Operations within the EAC as of 2019

Name of the Bank	Burundi	Kenya	Rwanda	Tanzania	Uganda
ACCESS Bank*			√	√	
Bank of Africa*		√	√	√	√
Bank of Baroda*		√		√	√
Bank of India*		√		√	√
Barclays Bank*		√		√	√
Citi Bank*		√		√	√
Commercial Bank of Africa*		√		√	
Crane Bank[U]			√		√
CRDB Bank[T]	√			√	
Diamond Trust[K]	√	√		√	√
Ecobank Bank*	√	√	√	√	√
Equity Bank[K]		√	√	√	√
Exim Bank*		√		√	
Habib Bank*		√		√	
I&M Bank Limited[K]		√	√	√	
Imperial Bank[k**]		√			√
KCB Bank[K]	√	√	√	√	√
NIC Bank Limited[K]		√		√	
Stanbic/Standard Bank*		√		√	√
Standard Chartered Bank*		√		√	√
United Bank of Africa*		√		√	√

Source: Author's Compilation
Note (i)* Multinational Bank; ** In Receivership (Under management of the Central Bank) (ii) [K] Kenyan Bank; [T] Tanzanian Bank; [U] Ugandan Bank.

Partial integration has taken place in the areas of ICT, risk management, customer service, and treasury operations. The study has further shown that two-thirds of the banks state that regionalization has facilitated the introduction of financial products and services that would not have been possible in the absence of scale. Wang (2010) supports the argument made in SSITR that scale is important to increasing breadth and depth of financial access. Accordingly, there is a reason to stay alert to the risks that come with increasing cross-border financial links (Drummond and Williams, 2015). Further, growing cross-border investments in financial services within member states also pose a challenge particularly in addressing cross-border issues related to, for instance, the finality of transactions, insolvency regimes etc.

2.4.2.4.3. Impact of Financial Integration to the EAC Financial Systems

Over the past seven years, economic and financial integration in Africa has increased; in particular, cross-border capital flows due to improvements in its own continent's macroeconomic performance and easy global monetary conditions (Dobronogov and Farole, 2012). This is the case for EAC as well. However, financial integration also tends to increase the scope for cross-border leakages of macro-prudential policy. Hence, there is a need for a greater emphasis on strategies to address these leakages.

Growing inter-linkages between banking systems with mobile money platforms create operational and cyber risks, thus creating the ground for adverse challenges and prospects for financial system stability. According to different reports of the EAC central banks, inter-linkages between the real economy and financial institutions, financial markets and infrastructure have exposed regional financial systems to possible contagion and other risks (Drummond and Williams, 2015). A case in point is FBME Bank in Tanzania, which was recently declared by US Fin Cen that it is associated with money laundering, resulting in regulatory intervention in Cyprus and Tanzania. As the Borio (2014) suggested, for the large and integrated financial system, it is very crucial to establish structured measures that contain the resulting risks. Therefore, studying the impact of the EAC financial system developments on intervening resolutions or restructuring weak banks; avert systemic shocks, and maintain financial stability within the region may be worth considering.

Capital markets are becoming increasingly integrated and accessible to each member state and other parts of the world (Yabara, 2012). New initiatives such as EAPS and other technological innovations in terms of financial markets infrastructures and payment systems, in particular, have come to the fore. Kenya has the most well-developed financial sector, larger in size and with an efficient banking system and a higher private sector credit to GDP ratio;

followed by Tanzania, Uganda, and Rwanda, respectively. As a result of an increase in banking competition, the region is more exposed to unprecedented banking risks that may lead to a financial crisis.

Furthermore, the lack of adequate legal and regulatory frameworks threatens regional financial stability. Legal and regulatory barriers include different legal systems, licensing categories (e.g. while Kenya provides for an Investment banking license, Uganda does not), capital adequacy requirements (given the different levels of market development), and different securities clearing and settlement regimes (Securities Central Depositories (SCD)) characterize the legal infrastructure landscape (Muluvi et al., 2012). For instance, laws in the different member states do not permit securities clearance and settlement across the different EAC SCD. The lack of harmonized legal regimes is one of the major bottlenecks for secondary trading of shares in cross-listed companies on the Uganda Securities Exchange.

Civil strife and political instability in some parts of the EAC may adversely impact on the security and economic performance of the region (Suphian, 2017). These problems seem to have made building a successful integration process a daunting task for the EAC, despite its perceived importance in the increasingly globalized world. EAC countries need to take integration not only as a Pan-African ideology but also, more importantly, as an economic survival strategy. The experience of the Eurozone reinforces the point that successful economic and monetary union requires member states to relinquish sovereignty to a much greater degree than was, perhaps, initially thought.

2.5. Recent Macroeconomic and Macro-Financial Developments

The financial systems development cannot be analysed without setting it in the context of the general macroeconomic environment. There is a causal relationship between macroeconomic conditions and financial systems performance through the capacity of depositing, borrowing and repaying the existing loans, which affects financial system profitability and the economy at large. This section reviews the macroeconomic and financial sector developments in order to indicate the potential signs that influence banking risk following the implementation of the financial sector reforms.

2.5.1 Macro-Economic Developments

In recent years, the decline in global growth, economic and political imbalances in many countries have precipitated uncertainty in the global economic and financial environment. This was largely attributed to deterioration of advanced economies, in particular, Chinese economic rebalancing, global financial sector condition, the European economy and low commodity prices, which led to the decline in emerging market economies and global financial market volatility. Consequently, the decline in global economic poses a potential risk to growth in many Sub-Saharan African countries.

While Sub-Saharan economic growth has shown signs of weakening with varying degree across countries, the EAC region has generally maintained a relatively good economic growth, albeit vulnerable to macroeconomic shocks. As it is evident in Figure 2.5, the EAC GDP growth rate was slightly impacted by the recent global financial crisis, 2008/09 compared to the Sub-Saharan economic growth rate. The less severe spill in the impact of the global financial crisis has been attributed to the limited link between the global economy and the EAC region (Lunogelo et al., 2009). However, this does not mean their systems are not vulnerable to both exogenous and endogenous risk factors, including sub-sector specific, which are systemic in nature.

The inflation rates across the region have generally experienced fluctuations for about two decades. To the extent, in 2008 and 2009, the region economy experienced a period of dramatic tightening and the subsequent easing of domestic liquidity conditions. However, since 2010, the region has experienced low and stable inflation of average inflation rates varying from 6-11 percent, which contributed to a steady regional GDP growth averaging 6 percent. This has contributed to the current favorable macroeconomic conditions in the region, which is essential for a resilient financial system.

In terms of trade among EAC countries, there has been phenomenal growth over the period. For instance, between 2004 and 2009, trade grew by 96 percent from 1.81 to 3.54 USD billions. Customs Union implementation appears to have contributed to the increased scope of trade opportunities among EAC entities and individuals. However, the proportion of intra-EAC trade to their total trade is reported to have declined slightly, mainly reflecting challenges in non-tariff barriers. Suphian (2017) argued that FDI and real exchange rate largely contributes to the trade balance in the EAC region. Thus, the EAC countries should concentrate on export-oriented development policies to attracts more FDI and improve the trade balance.

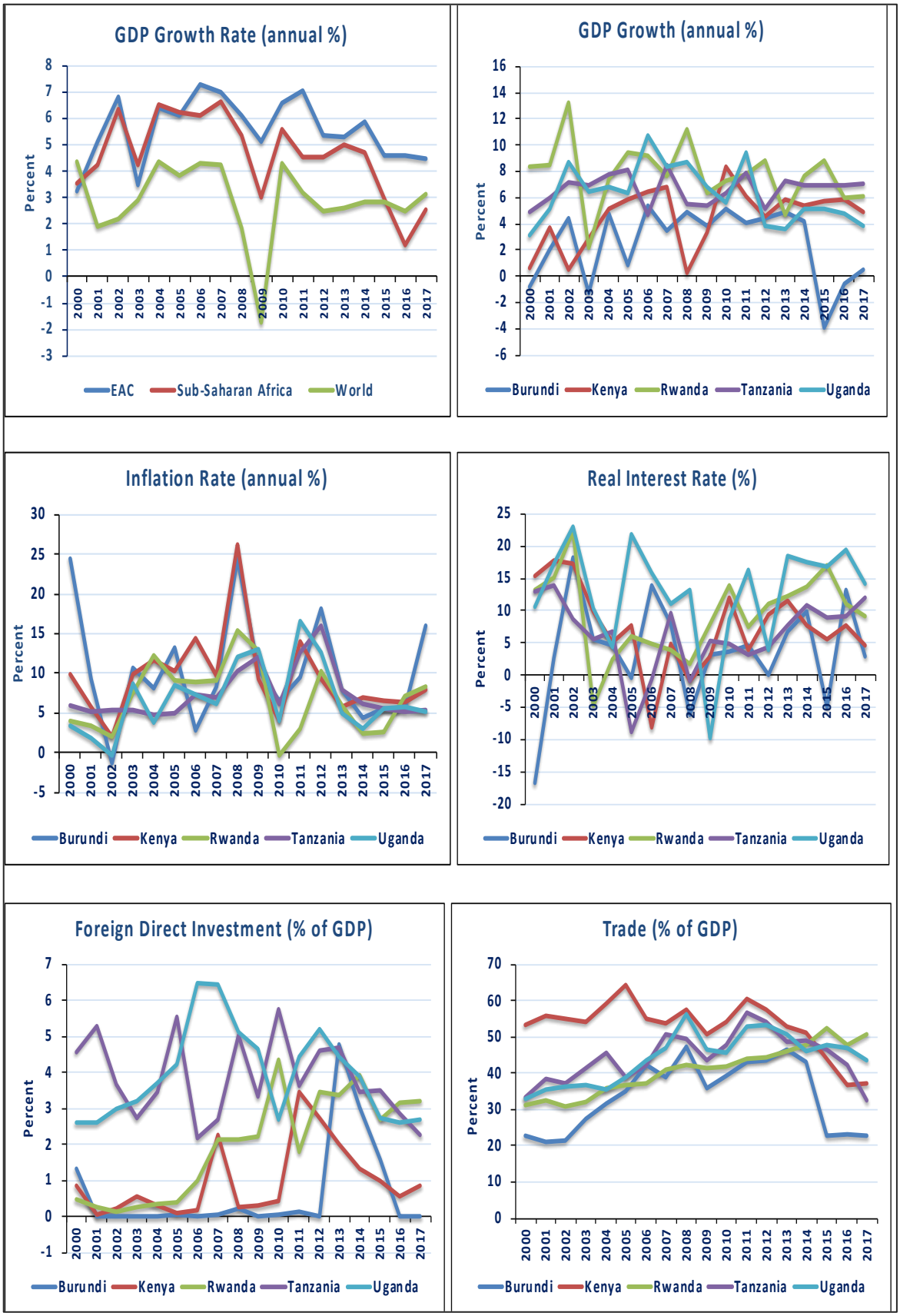

Figure 2.5 Selected Macroeconomic Indicators
Source: World Development Indicators (World Bank, 2018b)

2.5.2 The Macro-Financial Developments

Consistent with macroeconomic developments, financial systems across the region have seen both positive and adverse developments in recent history. This has significantly shaped emerging structural landscape, nature and scope of risk factors to financial stability and related policy responses intended to avert potential threats to banks and economy at large. As shown in previous studies, the banking system has recovered from a period of restructuring, banks are now better capitalized, provisioned, and liquid following regional improvements in macroeconomic policies and progress in institutional reforms (Beck et al., 2010a; McAuliffe et al., 2012; Ndirangu and Nyamongo, 2015), they are still exposed to some risks. On the one hand, improvements in the macroeconomic environment and financial sector reforms, which was accompanied with financial inclusion agenda and innovation in digital finance platform (mobile money operations) have led to the increase in the number of licensed entities and expanding market structures.

As it is evident in Figure 2.6, the access to financial services (deposits and borrowing) has increased, which has led to an increase in Bank assets. Kenya remained the leader in financial development. The recent financial access growth, which begun from 2010 indicated that implementation of the financial sector reforms, in particular, financial inclusion efforts have successfully increased the access to financial services, particularly financial access for households, which is likely to lead to a positive impact on efficiency and growth. Loans constitute the largest share of assets, and lending continues to be primarily deposit-funded, although the increased competition for deposits has led some banks to become more leveraged (Toniolo and White, 2015). Profit margin (interest rate spread) has been decreasing, and the ability of the financial sector to channel funds to the private sector (private sector credit to GDP ratio) remains limited.

On the other hand, improvement in access to financial services has come with potential risks. As argued by Crowe et al., (2012); and Sahay et al., (2015), a faster pace of financial deepening (i.e., credit boom) increases a higher risk of bank crisis and macroeconomic instability, other things being equal. This is the EAC case, whereby the implementation of macroeconomic and financial sector reforms, which led to a positive impact on efficiency, profitability and robust growth have also contributed to a sharp acceleration in credit expansion particularly to the private sector. Consequently, the financial systems face high market concentration, credit and operational risks, which raise particular concerns about their stability.

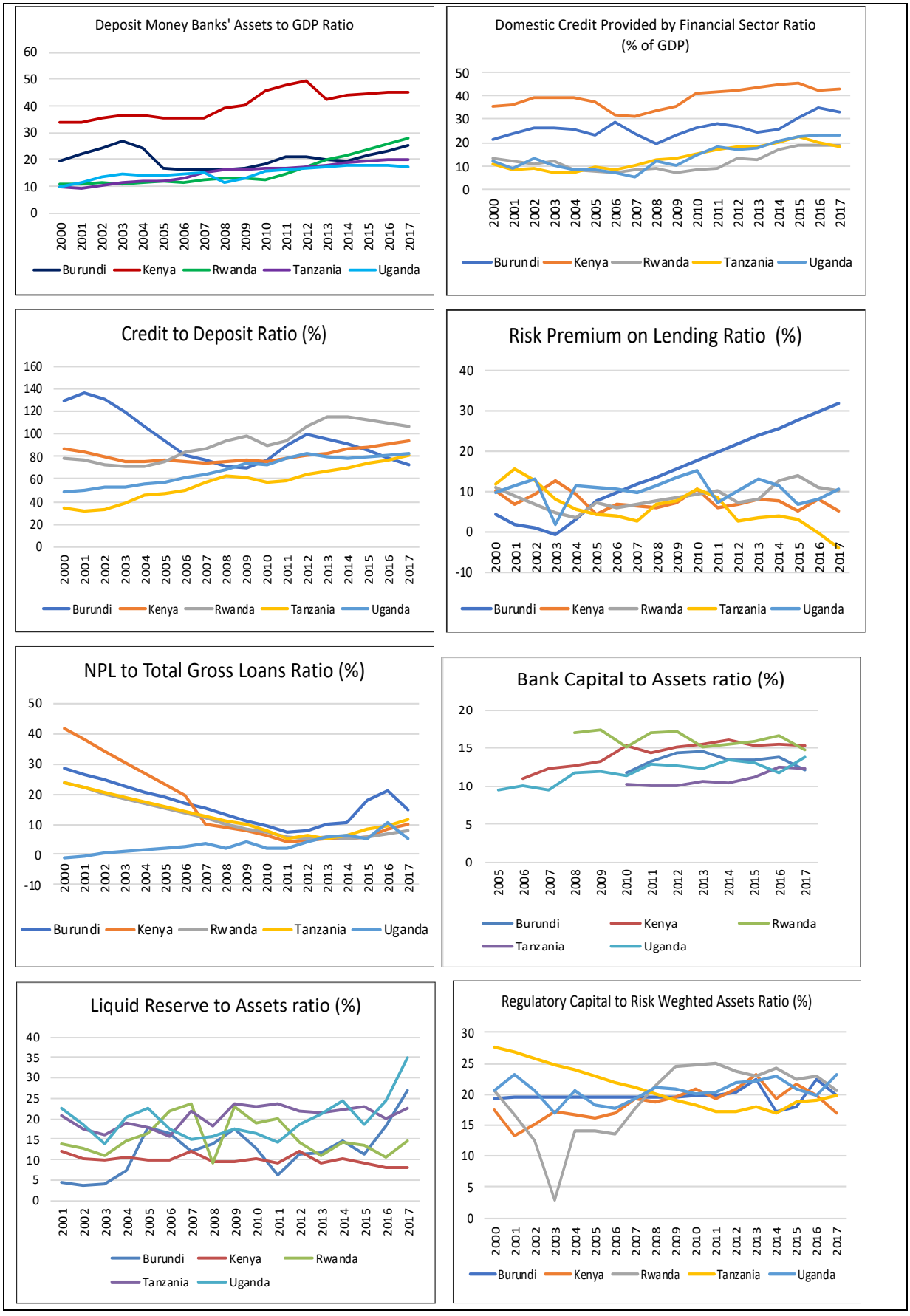

Figure 2.6 Selected Macro-financial Indicators
Source: World Development Indicators (World Bank, 2018b)

The regional banking system is characterized by a relatively large interest rates margin, which in one hand it is indicating banks profitability and growth, while on the other hand, it is indicating gaps in the financial infrastructure (credit risk agencies) and riskiness of lending combined with weak property rights (Dobronogov and Farole, 2012; Ogola et al., 2015). Inadequate credit rating agencies within the region hinders effective and efficiency lending activities. Credit bureaus, collateral registries and credit rating systems are only beginning to be developed in Kenya and Tanzania. Other countries are yet to establish credit rating agencies.

Regarding, the risk premium on lending, which is the interest rate charged by banks on loans to the private sector customers minus the risk-free treasury bill interest rate at which short-term government securities are issued or traded in the market. In 2017, Burundi recorded a higher rate of 32 percent, Rwanda Kenya and Uganda recorded an average of 10 percent, while Tanzania recorded a low of -5 percent (Figure 4.6). This implies that banks in Burundi anticipated the private sector to be higher risk compared to the government while in Tanzania, banks anticipated that government to be higher risk compared to the private sector. This trend indicates that banks anticipate risk from both the bank's assets and poor economic condition.

Looking at the quality of bank assets, most of the EAC banks has continued to remain sufficient to cover the unexpected losses, albeit vulnerable to banking risk stemming from declining asset quality. The capital adequacy ratio measures the bank's capital in relation to its risk-weighted assets. It further, promotes financial stability and efficiency in economic systems throughout the world. As shown in the capital to total assets ratio graph in Figure 4.6, the banks' capital was gradually increasing in the mid-2000s, following the financial sector reforms. However, starting from 2010, the quality of the bank assets has been deteriorating and fluctuating between 10 and 16 percent, which is slightly higher than the minimum requirement of 8 percent under the Basel Accords. This was mostly due to an increase in non-performing loans. A more granular balance sheet analysis of the EAC member states points to some vulnerabilities and potential risks (increase in NPL).

The problem of non-performing loans gradually decreased from 2000 to 2010 following the financial sector reforms. However, it started to pick up again in 2011 across the region. This indicated the increased risk in the bank's assets, which might adversely impact the quality of the assets. The more recent expansion of loans might lead to a further uptick in NPLs. Besides, several studies of banking crisis all over the world have shown that poor loans deteriorate the quality of the assets, which is one of the critical factors of bank failures (Acharya and Naqvi, 2012; Alhassan et al., 2014). The deterioration of the banking sector's assets quality, which manifested itself in the rise and worsening of the NPL position. Clarifying on

the problem, as it is evident in Figure 4.6, the NPLs rose to 12 percent in 2015 from 5 percent in 2011 indicating that the region is facing risk stemming from declining asset quality.

Although differences exist at individual country's level, the regional liquidity ratio has continued to remain below 25 percent (which is slightly above the regulatory requirement of 20.0 percent) and maintain adequate liquidity to meet short-term obligations for the past 15 years. Similarly, bank liquidity reserve ratio has significantly increased from an average of 10 to 25 percent in 2010 and 2015, respectively across the region. This is partly associated with the impact of NPLs to gross loans, whereby banks have become more risk averse. Studies such as Oloo, (2010); Ongore and Kusa (2013); and Tsuma and Gichinga (2016) have indicated that there are a couple of banks declaring losses.

2.6. Chapter Summary

The chapter Two assessed the financial sector developments in the EAC, taking into account the effect of the implementation of a number of the macro-economic and financial reforms. This entails mapping the architecture of the current financial sector, which answered the research question 1 as per the introduction chapter, hence meeting the first objective of the study. Findings indicated that the EAC financial system is composed of a wide and growing array of institutions, and it is becoming increasingly diversified. However, the diversity and divergences in the emerging structure of its financial system have raised fresh concerns, particularly in relation to cross border vulnerabilities.

Furthermore, we found that the EAC financial system appeared to be relatively stable, albeit vulnerable to shocks. In particular, deterioration of the banking sector's assets quality, which manifested itself in the rise and worsening of the NPL position. Several studies of the banking crisis all over the world have shown that poor loans deteriorate the quality of the assets and argued that it is one of the critical factors of bank failure. This highlights the need to identify potential risks to financial system stability. The following chapter focuses on identifying factors that contribute to the build-up of vulnerability in the EAC financial system.

Hitherto, findings indicated that the EAC financial systems had experienced both positive and adverse developments that led to the implementation of a number of macro-economic and financial sector reforms. Interestingly, despite the implementation of these reforms, the EAC financial system has remained relatively stable, albeit vulnerable to shocks. This then suggested that the issue of financial system stability is of great concern and empirical studies should be conducted in order to understand better the dynamics of the financial system and factors that may enhance or hamper the financial system stability in the EAC region.

CHAPTER THREE

3. DETERMINANTS OF CREDIT RISK IN THE EAC FINANCIAL SECTOR

This chapter addresses the second objective (hence answering the research question 2 as per the introduction chapter) of the study. This objective intends to ascertain factors that contribute to the financial system stability in the East African Community following the implementation of the macroeconomic and financial sector reforms in the region. It is believed that once the factors are clearly identified, then the future occurrence may be easily prevented. As indicated in the previous chapter 2, the credit risk, which has been viewed through assets quality deterioration, is seen as one of the major risks that threaten financial system stability by way of contributing to banks' distress/failure across the region.

3.1. Background to the Chapter (Study)

Implementation of financial sector reforms have strengthened the role of financial systems across the region. Measures such as the liberalization of interest rates and credit allocations have indeed enhanced financial development and the expansion in size and diversity of the financial system, albeit relatively small (Lepetit, et, al., 2015). A wide range of financial services has become available and there has been an increase in the financial sector competition due to the opening of the new local and foreign banks and mobile money services.

In addition, lending to the private sector has increased tremendously, which is strongly correlated with macroeconomic investments, productivity, and growth (Schmidt, 1999). The capital adequacy of banks in the region is, in general, low by international standards, with many banks regarding the benchmark stipulated by the Central Banks as a target to meet rather than a minimum to maintain. There is still a need for enhancing the range of banking services in particular to cover rural areas, which tend to be underbanked (Nyaga, 2014). While mobile money services have provided a means of easy transactions, there is room for the expansion of formal or semi-formal banking services.

There is no doubt that increased competitive environment in the financial sector has improved the common good for the public and economy at large. However, greater competition may increase the risk of bank distress and possibly failure due to reduced profit margin, lending to possible losses (Beck (2008) Sanya & Gaertner (2012) and Fungáčová & Weill (2013)). This

will ultimately see some of the affected institutions pricing themselves out of market to cover up their losses, which would result into potential distress/failures.

3.1.1. Motivational of the Study

Following the financial sector reforms, the EAC macroeconomic and financial environment currently appears to be relatively stable. However, the increase in nonperforming loans and the surge in declining assets quality across the region underline the need to have a clear understanding of the potential effects of financial system instability on the real economy. These phenomena highlight the fact that financial system stability needs to be measured in a comprehensive manner. It is against this backdrop that this study seeks to examine the impact of the ongoing economic and financial developments on financial systems and evaluate determinants of credit risk in the EAC.

Besides, one of the most common indicators that used to identify credit risk is the ratio of nonperforming loans (NPL), which cause asset quality decline. Asli Demirgüç-Kunt & Detragiache (1998), Davis & Karim (2008) and Babecký et al., (2012) discovered that NPL typically precede banking distress that could eventually reach systemic proportions. Osoro & Santos (2018) in their analysis of the EAC banking sector responding to market shocks argued that the recent slow pace of private sector credit growth was accompanied by heightened increase in NPL, which affected the liquidity and profitability of commercial banks. While at this juncture the surge in NPLs is not viewed as an immediate destabilizing factor, the feedback effects from the banking system to economic activity undermine a sustained recovery and may pose significant vulnerabilities going forward. These developments create a desperate need for the financial regulators to develop better information, monitoring and supervisory systems.

Moreover, the adverse impacts, which were observed in the aftermath of the macroeconomic and financial reforms are supportive of several studies that suggest that financial instability/crises occur as the economy enters a recession, following a prolonged boom in economic activities that was possibly fueled by financial liberalization, with upsurge in access to finance, credit exposure, capital inflows, and accompanied by an overvalued currency. For instance, Drees & Pazarbasioglu (1998) suggested that many countries which implemented financial and macroeconomic reforms (deregulations, removal of cross-border restrictions on capital flows, financial innovation and increased competition in financial services) in 1980s encountered sharp credit boom, which were followed by a period of financial fragility, as lower asset quality and interest margins weakened bank's balance sheets. Different studies have analysed determinants of credit risk in different ways.

3.1.2. Problem of the study

The EAC financial systems have seen both positive and adverse developments despite the implementation of economic and financial sector reforms. Although it is to a relative extent, banks experienced financial distress/crisis across the region. This call for a better understanding of the factors that cause the problem, whereas decline in the asset quality could be a point to start the analysis. As indicated in previous studies, credit risk is the most important aspect in the study of financial stability as it is one of the major factors likely to cause a financial institution to fail. Ali & Daly (2010) argued that although key improvements in credit risk modelling such as the Basel Accords (capital adequacy standards) have been put in place and financial system regulators ensure their effectiveness, yet the current turmoil in the global credit markets could not be forecasted and subsequently avoided.

Besides, emperical studies have also indicated that financial instability/crisis is often preceded by exceptional economic growth, asset price, domestic credit expansion during the boom years and later the increase in nonperforming loans, which detoriarate the asset quality that eventually turn into bursts. In their studies on causes and consequenses of the financial crises, Rose & Spiegel (2011) and Claessens & Köse (2013) argued that financial crises are often associated with substantial changes in credit volume and asset prices; severe distruptions in the financial intermediation and the supply of external financing to various actors in the economy; significant imbalance sheet of both private and public sectors; and significant government support (liquidity support and recapitalization). Thus, assessment of the determinants of credit risk in the EAC financial system is vital.

3.1.3. Objective of the Study

This study intends to ascertain factors that determines the credit risk behaviour in the EAC banking system after the implementation of financial sector reforms in 1990s. This entails understanding if credit risk in the EAC is mostly driven by internal factors or external factors. Using the EAC banking system as a case study, this chapter intends to sketch an account of problems encountered with loan repayment in the EAC economies for the period 2000 - 2017.

3.1.4. Significance of the Study

Contrary to the vast majority of the existing literature on determinants of credit risk using the problem loans behavior, this study intends to empirically study the impact of financial sector reforms on the financial system. The study presents findings regarding the factors that contributes to the credit risk behaviour in the EAC banking system, despite the implementation

of macroeconomic and financial sector reforms. In particular, the study contributes to enriching the current literature on the factors that drives the level of nonperforming loans mainly in a monetary union context in developing and emerging economies.

Exploiting both static and dynamic panel data variation in nonperforming loan trends is likely to yield more robust results than an analysis of individual countries since time series for NPLs are typically short, covering at most 15 years of annual data. Besides, studies based on bank-by-bank, while very useful in micro-prudential context, are only available for few economies so that the impact of cross-country differences with respect to structural characteristics on asset quality cannot be studied. Our findings agree with the literature as both internal and external factors appear to exert a powerful influence on the nonperforming loans in the EAC. This entails the importance of using both macroeconomic and macro-financial factors as part of the early warning system in ensuring financial system stability.

The rest of the chapter is organized as follows. The next section, 3.2 presents the existing literature on the theory and empirical studies on bank credit risk. Section 3.3 presents the empirical methodology that used in the study including data collection and analysis. Section 3.4. presents the results and discussion of the econometric analysis of the determinants of credit risk in the EAC and finally, Section 3.5 provides the concluding remarks.

3.2. Related Literature Review

This section outlines the existing literature review on the factors that determines the credit risk behavior. As investigators believe that once the factors are clearly identified, then the future occurrence may be easily prevented. It includes both theoretical and empirical literature review, the conceptual framework and summary of the literature reviewed.

3.2.1 Theoretical Review

Traditionally, the market economy is associated with asymmetric information problems (such as high cost of transactions, lack of complete information at appropriate time and methods of regulation), which lead to adverse selection and moral hazard. To address these asymmetric information problems, financial intermediaries emerged. Based on the **Financial Intermediation Theory**, the financial system as a financial intermediary plays an important role in redistribution and inter-temporal adjustment of consumptions by providing liquidity services, promote risk-sharing and solve information asymmetry problems by allowing small savers and borrowers enjoy the financial services at a lower cost (Scholes et al., 1976). Thus, a well-functioning and the efficient financial system promotes greater economic efficiency by

channeling funds from economic agents with savings to those wishing to harness productive investment opportunities for a sound and vibrant economic growth and stability.

Studies have shown that there is a significant and positive nexus existing between financial deepening and economic growth as financial deepening promote economic growth (Calderón and Liu, 2003; Valickova et al., 2015). Financial development is an important factor in fostering long-run economic growth, as finance can facilitate growth by enabling efficient intertemporal allocation of resources, capital accumulation and technological innovation. In addition, a recent empirical analysis conducted by Inoue and Hamori (2016) on the effects of financial access on economic growth in Sub-Saharan Africa (SSA) indicated that financial access has a statistically significant and robust impact on increasing economic growth in SSA.

Besides, the performance of the financial system, in particular, banks have critical implications for the economic growth of a country. The banking system is the largest and credible financial intermediary in most economies and the most vulnerable to instability compared to other financial institutions in the financial system (Mishkin, 2009; Beck et al., 2010c). This is because distress or bankruptcy that could happen in the banking system will have a contagion effect that can lead to banks runs, crises and bring overall financial turmoil and economic tribulations.

While studies have shown that financial deepening promotes economic growth, activities in the financial system, in particular, banks and financial markets at times produce financial crises, a major disruption in financial markets, which are characterized by a sharp decline in asset values and the failure of many financial and non-financial firms. This is what has typically happened in countries where financial crises have occurred. Hyman Minsky proposed The finance **theory of Financial Crises** (financial instability hypotheses), explaining about the relationship between the business cycle and interest rates (Minsky, 1992; Crockett, 1996; Wolfson, 2002; Acharya and Naqvi, 2012). As presented in Figure 3.1, Bhattacharya et al., (2015) argued that lowering market's interest rate below the natural rate will eventually lead to a credit-induced expansion thus ultimately setting the economy on an unsustainable growth path; hence the inevitable crisis and downturn. This exposes firms to the financial risks because if income flows turn out to be less than expected, or if finance costs rise, firms might not be able to meet those debt payment commitments.

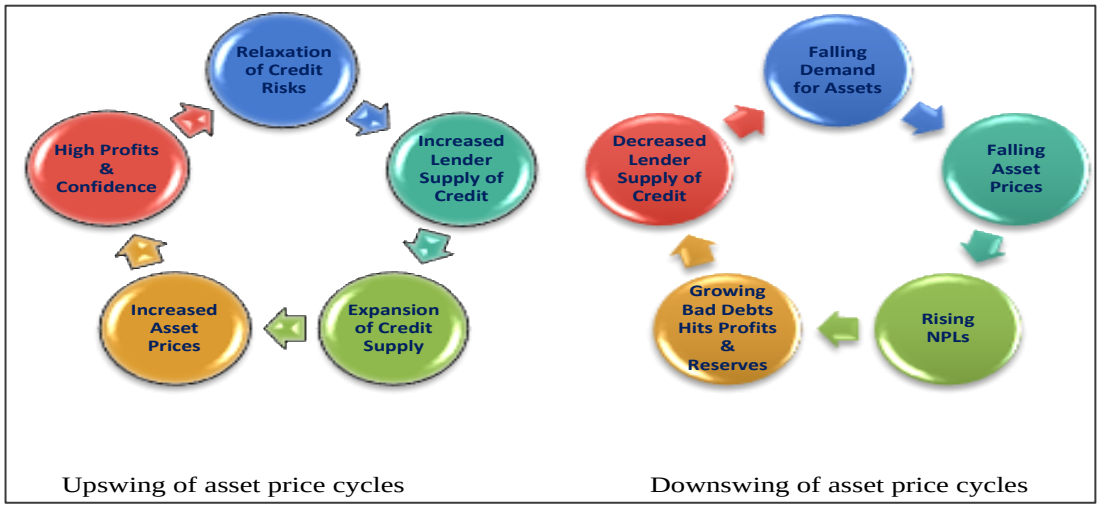

Figure 3.1 The credit growth behaviour and the asset price cycle

The finance theory of Financial Crises posits that financial system is inherently unstable and credit booms tend to be the driver of the business cycle through its multiplier impact, which leads to financial system fragility and follows by the crisis (Summers, 2000; Van den Hauwe, 2016). This theory is based on the links between financial instability hypothesis, in particular, fluctuations in credit, interest rates and fragility of the markets, in the business cycle of an economy. Minsky's model of credit system suggests that economic expansion paces a greater willingness to borrow, which leads to credit expansion and risk begin to change. In such a vulnerable situation, fragility grows as debt levels increase the proportion of short-term debt rises, and liquidity declines. This might take the economy to the brink of the financial crisis unless the government steps in to control them through regulations, central banks action and other tools. Thus, a critical review of the potential risks to financial stability associated with the financial system innovations may be necessary.

Although it has been suggested that asset price decline threatens banking system's solvency and profitability, periods of too fast credit growth (booms) have also been associated with financial crises (Mendoza and Terrones, 2008; Langfield and Pagano, 2016) However, these periods of fast credit growth seem to create more havoc in advanced economies than developing countries due to the limits of a country's capacity to absorb financial deepening at each point in time without disrupting the economy (Arena et al., 2015). In addition, the decreased growth rate, which results from the decrease in the saving rate, encourages some improvements in risk-sharing and household credit markets. Consequently, a need to understand whether the credit boom reflects a process of financial deepening, or it represents a credit bubble arose. Answers to this may depend on a particular economic context, and level of financial sector development.

To minimize the negative impact of credit growth and procyclical effects on the supply of credit without compromising banks' long-run solvency targets, a set of prudential regulations were under Basel Accords for managing credit risk and market risk. **The theory of prudential regulation**, which recognizes the close inter-linkages between real economy and the financial intermediaries emphasizes on ensuring the balance sheets of the individual institutions and the banking system as a whole are robust to shocks (Osinski, Seal, & Hoogduin, 2013). Since most of the financial intermediaries, in particular banks concentrate on commercial lending and related activities thus a measure of credit risk became the foundation of the Basel Accords. One of the accords, Basel II, which is a second international banking regulatory accord expanded rules for credit risk management by setting minimum capital requirements, regulatory supervision and market discipline as among other prudential regulations (Hamerle, Liebig, & Rösch (2003), Decamps, Rochet, & Roger (2004), Kashyap, Stein, & others (2004), Jakubik (2007) and Balin (2008)). These requirements allow banks and supervisors to evaluate properly the various risks that banks face.

As it is evident, existence of these three theories indicates the importance of examining the credit risk behavior and find ways to mitigate the formation of the credit risk. However, there is currently no standardized method used by financial institutions for assessment of credit risk as most of the evaluations are based on judgement method, credit-scoring and portfolio models (Kalapodas & Thomson, 2006). These methods highlight a number of limitations when used on their own. Accordingly, there is a need to analyse credit risk taking into account the effect of macroeconomic and macro-financial factors that influence the credit risk behavior.

3.2.2 Empirical Evidence: Risks to financial System Stability

Empirical literature on the risks to financial system stability is vast and dynamic. A common finding of risk behaviour is the positive relationship between economic and financial reforms, credit cycles and financial crisis in different economies. Studies such as Kaminsky and Reinhart, (1999); Acharya et al., (2009); and Dell'Ariccia et al., (2012) examined financial crises and found a significant relationship between credit cycles, prudential regulations and financial instability of the banking sectors. Furthermore, other studies suggested that some of the banking crises are not necessarily caused by deregulation, rather they were associated with unfavourable macroeconomic developments such as economic downturn, declines in income and depressed asset markets (Caprio and Klingebiel, 1996, 2002; Cornett et al., 2011). Among other risks, credit risk has been identified as one of the major sources of financial instability.

The first strand of the literature analyses determinants of credit risk based on the judgement method, credit-scoring and portfolio models. A number of these studies have analysed the asymmetric effect of the business cycle dynamics on credit risk (Lown and Morgan, 2006; Marcucci and Quagliariello, 2009; Gilchrist and Zakrajšek, 2012). Other studies have been carried out in order to understand the herd behaviour of bank managers taking more risks can leading to a deterioration of credit standards during the economic boom, which increases the probability of default during the economic recession and upsurge of credit risk/bank crisis (Godlewski, 2006; Laeven and Levine, 2009). Most of these studies indicated a close relationship between credit risk (high risk-taking appetite) and macroeconomic environment. Thus, the good macroeconomic environment tends to increase the bank's risk-taking appetite, in particular to the banks which have high profitability ratio.

The second strand of the literature analyses determinants of credit risk based on the econometrics models. Most of the empirical studies have examined determinants of credit risk in into two broad groups such as bank-specific and / or macroeconomic factors. The first group of literature, such as Ahmad and Ariff (2007) and Akter and Roy (2017) suggests that credit risk is influenced by bank-specific factors. In their studies, they used non-performing loans as a proxy of credit risk. Results indicated that bank-specific factors, in particular the regulatory capital, interest rates, liquidity, management efficiency and total assets, contribute towards credit risk behaviour. Thus, a negative impact of credit risk (an increase of NPLs) on bank lending behaviour indicating that the higher the risk-taking behaviour, the higher the increase in NPL. Also, banks with larger loan portfolio tend to require a higher net interest margin to compensate for the higher risk of default that reduces the bank's returns on assets and increases exposure to credit risk.

The second group of literature, such as Ali and Daly (2010) and Škarica (2014) suggests that credit risk is influenced by economic conditions. Among other factors, the non-performing loans have been attributed to a drop-in economic activity. This entails GDP, interest rates, debt to GDP ratio, exports, monetary aggregated M2, import, unemployment rate, consumer price index and real interest rates significantly impact the quality of assets and increase credit risk.

The other group of the literature indicated that both macroeconomic (liquidity risk during the recession) and bank-specific (cheap credit and low lending standards, which lead to credit expansion) factors contributed significantly to the lending boom and housing frenzy that laid the foundation for the crisis when the financial regulatory system is weak. These studies include Brunnermeier (2009) and Cornett et al., (2011), which found GDP growth rate, domestic credit, rapid past credit growth, inefficiency, net interest margin capital ratio and

market power are variables that explain credit risk. They further argued that most of the decline in bank credit production (bank assets, deposits, capital and off-balance sheet, undrawn loan commitments) during the height of the crisis could be explained by liquidity risk exposure.

In terms of case studies in the EAC region, Ng'etich Joseph Collins (2011), Warue (2013) and Washington (2014) examined the effect of both macroeconomic (real GDP, GDP per capital, CPI, inflation, government expenditure, exports and imports, exchange rate, money supply, interest rate spread) and bank-specific variables (credit risk management techniques, bank structures, quality management) on NPLs in Kenya. Similary, Wachira (2017) examined credit risk management in Kenya. Results suggested that credit risk management influences nonperforming loans amongst commercial banks in Kenya. This was also earlier confirmed by Sabeza, Shukla, & Bajpai (2015) who assessed credit risk management practices and performance of commercial banks in Rwanda and found a direct relationship between credit risk management and profitability of commercial banks.

Kariuki, Kimundi, & Makambi (2018) analyzed the interaction between growth in outstanding bank credit, deposit growth and assets quality (NPL ratio) in Kenya and found that lagged credit growth has a positive significant effect on the NPL ratio, which causes a decrease in asset quality. Also, they found a negative significant relationship between both contemporaneous deposit and credit growth and NPL ratio. In Uganda, Haniifah (2015) analyzed the causal effect of economic determinants on NPL in Ugandan commercial banks over the period of 2000-2013. Results indicated the selected factors such as interesting results that all the macroeconomic variables have insignificant effect on NPLs. Negative effect GDP growth, inflation, exchange rate while there was a positive relationship with interest rate.

For the case of Tanzania, Viswanadham & Nahid (2015) ascertain the determinants of NPL using interview and questionnaire results, which indicate that interest rate, GDP, loan supervision capacity and economic condition influence the level of NPL. Interestingly, they found insignificant relationship between concentration of lending activities and nonperforming loans. Further, Mataba, Aikaeli, & Kirama (2016) analyzed the link between cost efficiency and nonperforming loans and found a significant relationship between banks' cost efficiency and NPL of the community banks.

3.2.3 Conceptual Framework

As indicated in Figure 3.2, we propose 11 variables to test their impact on the credit risk behavior in the EAC banking system. We also use the ratio of nonperforming loans as a proxy of credit risk, similar to other previous studies such as (Jakubík & Reininger (2013), Waqas,

Fatima, & Khan (2017) and Mpofu & Nikolaidou (2018)). The proposed explanatory variables have been selected from both internal (bank-specific) and external (macroeconomic) factors.

Besides, the theoretical review emphasizes on the importance of including both internal and external factors as influencers of credit risk. On one hand, the Minsky hypothesis posits macroeconomic factors such as economic growth, money supply, interest rates, exchange rate and terms of trade influence loan payment; and hence nonperforming loans. On the other hand, the prudential theory also suggests that bank-specific factors such as financial intermediation, profitability, efficiency, management, and capital adequacy influence the credit risk behavior. Cognizant of these three theories, this study intends to examine the extant evidence of the drivers of the credit risk behavior in the EAC banking system including both internal and external factors.

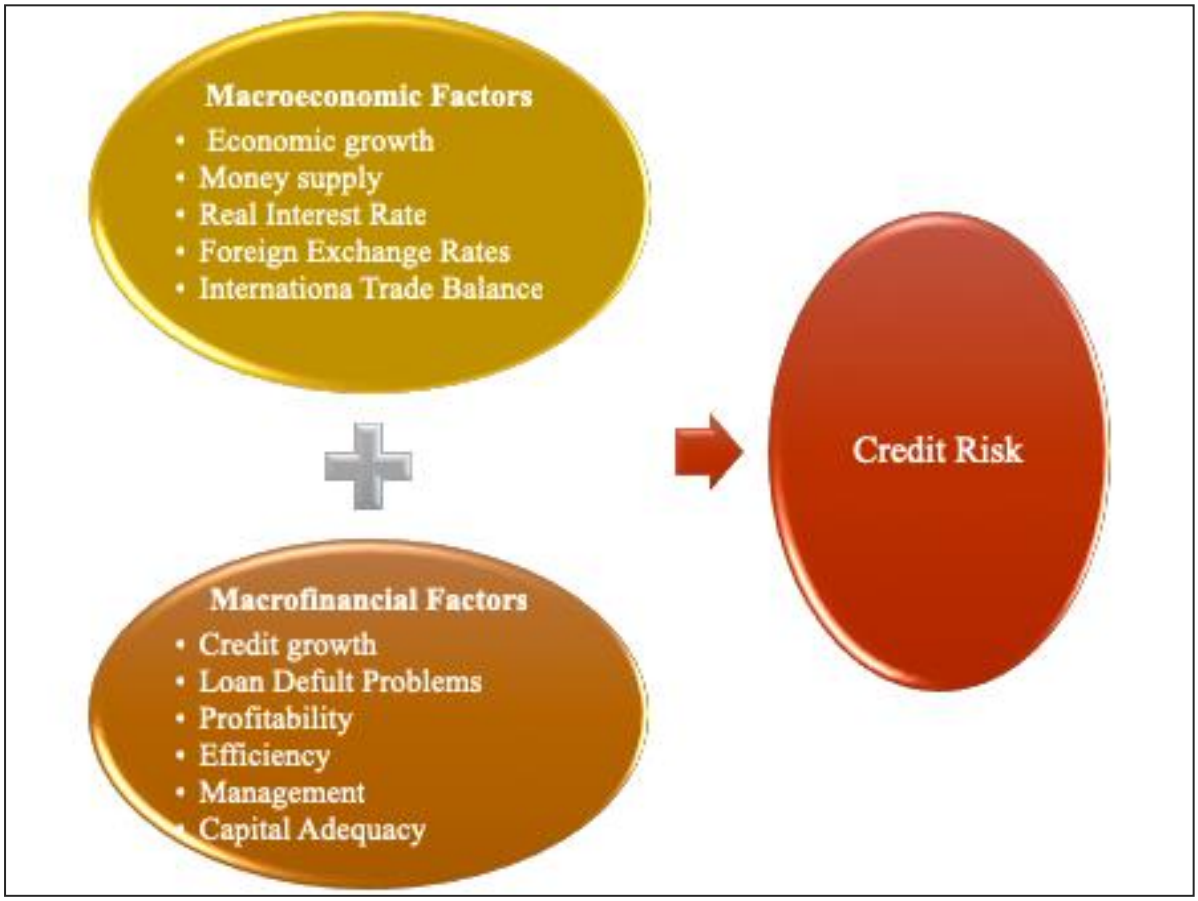

Figure 3.2 Conceptual framework for the Determinants of Credit Risk in the EAC
Source: Researcher, 2019

3.2.4 Conclusion and Gap in the Literature

The existing empirical and theoretical literature has highlighted one of the major factors, which caused most of the financial crises is credit risk. Studies have highlighted that several economic, social, and institutional factors that affect NPLs through borrowers' capacity to

repay; and banks' ability to manage risks have a significant impact on credit risk behavior. To a large extent, most of these studies suggested that credit risk is influenced by either or both bank-specific and macroeconomic variables. Besides, the theoretical review emphasizes on the importance of including both internal and external factors as influencers of credit risk. On one hand, the Minsky hypothesis posits that macroeconomic factor such as economic growth, money supply, interest rates, exchange rate and terms of trade influence loan payment; and hence non-performing loans. While on the other hand, the prudential theory also suggests that bank-specific factors such as financial intermediation, profitability, efficiency, management, and capital adequacy influence the credit risk behaviour.

Credit risk is not peculiar to developed and emerging countries. Few studies have been conducted in the developing countries, in particular EAC countries. As noted in the introductory section, this study aims at enriching the scant literature on credit risk determinants in the EAC banking system. One of the most important contributions of this study is the attempt to analyse factors that influence assets quality decline, which increases probability of credit risk after the implementation of a wide range of financial sector reforms across the region. Besides, the current banking distress across the region thereof motivated this study to evaluate the determinants of bank risk in particular the credit risk factors.

Against this backdrop, we propose 11 variables to test their impact on credit risk behaviour in the EAC banking system. We use the ratio of non-performing loans as a proxy of credit risk, similar to other previous studies (Jakubík and Reininger, 2013; Waqas et al., 2017; Mpofu and Nikolaidou, 2018). The proposed explanatory variables have been selected from both internal (bank-specific) and external (macroeconomic) factors. Therefore, the following section present a methodological approach in examining the extant evidence of the drivers of the credit risk behaviour in the EAC financial system.

3.3. Data and Methodology

In this section, we examine more systematically possible drivers of the financial system stability, in particular, the credit risk behaviour. Following the observation from the stylized facts, in particular, the fluctuations (decline) of the quality assets, the adverse impact of the increase in non-performing loan ratio across the region has drawn attention on what could be the possible factors of the decline in the quality of regional bank assets, which led to the increase in credit risk. Therefore, this study investigates whether credit risk is sensitive to cyclical, macro-financial and/or macroeconomic factors.

3.3.1 Measurement of Variables

The study used the ratio of non-performing loans (NPL) as a proxy of credit risk. NPL is the ratio of non-performing loans to gross loans, which represents how much of the bank's loans and advances are becoming nonperforming and indicates the extent of credit default risk that the bank sustained. As the NPL increases, it erodes the bank's profitability and weakens the quality of assets (Imbierowicz and Rauch, 2014). Thus, making it to be one of the major indicators of banks' credit risk.

In addition, in most cases, dynamic behaviour is induced by the fact that many economic decisions are heavily influenced by what the people anticipate of the future. Thus, the NPL persistence may influence banks to increase interest rates in order to hedge the anticipated risk of their loans in future. We include NPL-1 in the analysis in order to provide an adequate characterization of the credit risk.

Besides, it is important to assess the forces that drive the bank's crises by including the analysis of possible economic factors (Borio and Lowe, 2002; Athanasoglou et al., 2014). Due to unavailability of micro-data across the region, the study macro-data, which includes both macroeconomic and macro-financial determinants depending on their possible contribution to the credit risk behaviour. While many variables were considered in the estimation process, the baseline specification for the determinants of credit risk in our study is presented below.

3.3.1.1 Macroeconomic determinants

Economic growth is one of the major factors that influence the behaviour of credit risk. Empirical studies showed a mixed relationship between economic growth and non-performing loans. The economic growth tends first to reduce the rate of NPL and contributes to the increase in NPL in the long run. Several empirical studies have observed that the economic growth tend to increase income to both consumers and firms, which increases their ability to borrow and sufficient stream of income to service their debts, upsurge the rapid credit growth (Ali and Daly, 2010; Inekwe, 2013). However, it is during the same economic booming period where banks relax and issue lower-quality loans. Consequently, the level of NPL increases during the recession. The study used real gross domestic product (RGDP) growth as a proxy of economic growth in the analysis.

We also consider the effect of monetary policy in determining credit risk behaviour. One of the approaches used by the central banks in maintaining price stability is controlling of money supply in the economy. The increase in money supply (expansionary monitory policy), increases the ability of borrowers to pay back their obligations and to acquire new loans. This

rapid credit growth might raise the NPL if these loans were issued with less prudent lending standards, especially in the presence of inadequate supervision. Interestingly, empirical studies have observed a mixed relationship between money supply and credit risk. Nikolaidou and Vogiazas (2017) found a significant negative relationship, while Adeola and Ikpesu (2017) found a positive relationship between money supply in credit risk. Thus, this study uses broad money as a percentage of GDP (BMGDP) as a proxy of the money supply.

Another monetary policy approach is controlling the exchange rates by strengthening the domestic currency against foreign currencies. Empirical studies have observed that during the periods of currency pressure (depreciation periods) exports decline and lead to the increase in trade deficits, which worsen of the quality of bank's loan portfolio especially in developing countries (Drummond and Williams, 2015; Otašević, 2015). One of the measures of domestic currency strength is the nominal effective exchange rate (NEER), which shows a country's international competitiveness in terms of the foreign exchange market. Therefore, the study includes NEER in the analysis as a proxy of the exchange rate.

Market interest rate is another monetary policy approach, which is an important factor of the credit risk as it affects the debt burden. While banks increase their profitability with interest rate hikes, interest rates volatility (increase) induces effect on private capital flows by increasing the cost of borrowing. Dell'Ariccia et al., (2014) and Waqas et al., (2017) argued that higher interest rates might cause borrowers to experience cash-flow problems, forcing them to default on their loan repayments, which increases credit risk. The study uses real interest rate (RIR) as a proxy of the market interest rate. RIR is an interest rate that has been adjusted to remove the effects of inflation in order to reflect the real cost of funds to the borrowers and the yield to the lenders.

Lastly, in the macroeconomic factors, the study considered Terms of Trade (TOT), which indicates the country's economic health. TOT represents the ratio between a country's export prices and its import price. (Kavkler and Festić, 2010; Kodongo and Ojah, 2013) found a significant impact of TOT and the bank's asset quality as weaker TOT surge economic contraction, which in turn reduces the borrower's ability to service their existing loans.

3.3.1.2 Macro-financial determinants

The first variable to consider in our analysis of the drivers of credit risk is credit growth. Empirical studies showed a mixed relationship between credit growth and non-performing loans. In most cases, studies have argued that economic growth easy loan access and increases credit growth, both healthy and risky loans (Keeton, 1999; Foos et al., 2010). As a result, this

acceleration in credit growth leads to a surge in loan losses provisions, which relatively decreases the bank's interest income and lowers its capital ratio. Besides, other studies have suggested that the credit growth increases high debt burdens to debtors, which affects their income making debtors more vulnerable to adverse shocks (Dell'Ariccia et al., 2012; Jokivuolle et al., 2015). Accordingly, the study used domestic credit provided by the financial sector as a percentage of GDP (DCFSGDP) as a proxy of credit growth.

Another factor is the banks' risk-taking behaviour. Credit risk is linked with the risk-taking behaviour of banks due to the fact that most banks increase their profits by issuing more loans. Studies have indicated a negative impact of credit risk on bank lending behaviour, indicating that the higher the risk-taking behaviour, the higher the increase in NPL (Cucinelli, 2015). We use return on assets ratio (ROA) as proxies of profitability that indicates bank's risk-taking behaviour. ROA is the profitability ratio which measures the bank's net income produced by total assets.

This was also confirmed by other studies, which have indicated that banks with larger loan portfolio tend to require higher net interest margin to compensate for the higher risk of default, which increases NPL and reduce bank's returns on assets (Makri et al., 2014; Akter and Roy, 2017; Mendoza and Rivera, 2017). Therefore, the study includes also net interest margin (NIM) as proxies of the bank's risk-taking behaviour. NIM measures the profit a bank makes on its investing activities as a percentage of total investing assets.

Further, the study includes the bank's efficiency as one of the factors that drive credit risk. Studies indicated that lower bank efficiency granger-causes higher credit risk as the increase in NPLs may temporarily precede a decline in cost efficiency related to higher costs of dealing with more NPLs (Podpiera and Weill, 2008; Mataba et al., 2016). Besides, in most cases, banks with a low level of efficiency tend to try to boost returns by lowering the operating standards in order to attract more loans, such as less intensive monitoring of credit. We use bank cost to income (BCI) ratio as a proxy of the bank's efficiency ratios. BCI measures the operating costs as a percentage of its operating income.

The study includes bank's liquidity indicator in the analysis because of the interaction between credit risk and liquidity risk, which have long been associated with the bank instability (Ahmad and Ariff, 2007; Brunnermeier, 2009; Ghenimi et al., 2017). One of the measures of liquidity risk is the ratio of liquid assets (cash and government securities) to total assets (LATA). This ratio presents information about the general liquidity shock absorption capacity of a bank. According to Basel III (2013), banks require sufficient liquidity coverage to promote the short-term resilience of their liquidity risk profile. Empirical studies have argued that the

higher the liquidity coverage ratio, the lower the credit supply, which as well reduces the credit risk (Cornett et al., 2011). We use LATA as a proxy of liquidity risk.

Lastly, we include the capital adequacy indicator, which is one of the major factors designed under Basel III accord to improve the bank's leverage ratio. In order to minimize the impact of credit risk, banks tend to increase their capital as a cushion to absorb potential losses that might arise from an anticipated NPLs. Empirical studies have found that capital adequacy has a significant positive impact on the bank's profitability which minimizes credit risk (Ashraf et al., 2016; Ozili, 2017). Therefore, we use the ratio of a bank's regulatory capital to risk-weighted assets (RCRWA) as a proxy of capital adequacy.

Most of the previous studies, which analysed credit risk determinants focused on the macroeconomic and microeconomic (bank-specific) data. However, due to unavailability of micro-data across the region, this study chose to examine exclusively aggregated data for the EAC region in the study instead of using bank-specific data similarly to other few studies (Ali and Daly, 2010; Castro, 2013; Makri et al., 2014). Besides, aggregated data allows capturing of the country-specific effects and the unobserved differences between countries, overcome the obstacle of disaggregated data unavailability and reduce the risk of non-representativeness of the selected sample.

3.3.2 Methods of Data Analysis

The study used linear regression method to analyse determinants of credit risk behaviour in the EAC region. Linear regression analysis assesses whether one or more explanatory variables explain the behaviour of the dependent variable. The linear regression model is denoted as:

$$Y_{i,t} = \beta_0 + \sum \beta_n X_{n_{i,t}} + \varepsilon_{i,t} \quad \textit{Equation 3.1}$$

Where: Y represents the dependent variable, β represents the coefficients, X represents independent variables, ε represents the error term and i, t, and n represent the country, time and number of independent variables, respectively.

In order to provide meaningful results, this method assumes that error terms are independent. This implies that the error term is a random variable that has a linear relationship, normally distributed with no or little multicollinearity, no autocorrelation, and has constant variance (homoscedasticity). However, this is not the case for most the economic data. Most of economic data are not normally distributed, autocorrelation and homoscedasticity due to size differences and relationship they have among each other (Dielman, 1983; Holtz-Eakin et

al., 1988). Similarly, we expect these assumptions to be violated because this study uses economic variables to analyse credit risk in the EAC countries which have economic differences such as small and medium economies.

Therefore, this study chose methods that are suitable for the EAC data set. We prefer to use dynamic panel methods over static methods such as OLS to examine the credit risk determinants with time effect. Static models calculate the system in equilibrium (time-invariant) while the dynamic models take into consideration the changes appeared in the variables over time. In this regard, the study examined whether the time effect of credit risk behaviour and some of the independent variables are among other factors that determine the credit risk behaviour in the EAC banking system. For robustness check, the study uses two different econometrics methods to analyse determinants of credit risk behaviour in the EAC countries. Below is the presentation of these methods in details.

3.2.2.1 Autoregressive Distributed Lag (ARDL) Method

We first use the Autoregressive Distributed Lag method to analyse the relationship between the proposed variables and the credit risk. The ARDL model was developed by Pesaran (1997); Pesaran and Shin (1998); and Pesaran et al., (2001) in order to test for the short-run and long-run relationships among variables. The ADRL is among the standard least square regression methods, which particularly includes lags of both the dependent and independent variables. Each of the underlying variables stands as a single long-run relationship equation. It is one of the dynamic models that play a vital role when there is a need to analyse the economic scenario, such as the case of this study. Due to time effect, most of the economic variables, in particular macroeconomic variables such as our proposed variables, are not stationary and have unit root problem, which results into spurious regression (Nelson and Plosser, 1982).

There are a number of analyses that can be used to circumvent the nonstationary problems such as unit root test and cointegration tests. However, according to Choi et al., (2004), these methods are not quite reliable to solve the spurious regression issues such as misspecification, autocorrelation and collineriality. This is because one of the major causes of spurious regression is the missing variables (lag values). Thus the ARDL approach avoids spurious regression problem and comes up with an appropriate (long-run relationships) interpretable model, which does not require unit root pre-testing (Blackburne III and Frank, 2007; Nkoro and Uko, 2016).

The ARDL method is a suitable method to use when the regressors are either stationary at level, first difference or both (not at second difference). One of the advantages of using the ARDL approach, compared to other cointegration techniques, is that this model uses a combination of endogenous and exogenous variables, which are strictly for endogenous variables. Thus, this method provides unbiased long-run estimates. Also, it is relatively more efficient in case of small and finite sample data size, which is the case in this study.

The ADRL Method involves 2 different models in analysing the long-run and short-run effects. The First model estimates the long-run relationship, while the second model estimates the short-run effects. The null hypothesis assumes that the coefficients of the long-run equation (Equation 3.1) are all equal to zero (0), which implies that there is no cointegration. The bound test is used to confirm the significance of the ARDL null hypothesis. Therefore, the parameterized ARDL (*p, q, …, q*) model for long-run effects is specified as follows:

$$Y_{i,t} = \beta_0 + \sum_{n=1}^{p} \beta_i Y_{i,t-1} + \sum_{n=0}^{q-1} \beta'_i X_{i,t-1} + \varphi_{i,t-1} + \varepsilon_{i,t} \text{.....} \textit{Equation 3.2}$$

Where Y represents a dependent variable, β represents the coefficients, Y_{t-1} represents lagged dependent variable, X represents independent variables, φ represents unit-specific fixed effects; ε represents the error term; *i, t* and *n* represent a number of countries, time and number of independent variables, respectively; and lastly, *p* and *q* represent optimal lag orders of the dependent variables and regressors, respectively. Results obtained from the bounds test indicate the relationship between the variables. If results from the long-run equation suggest rejection of the null hypothesis, then we proceed with Equation 3.2 and estimate the Error Correction Model (ECM). The ECM is used to mitigate the false results of the over-parameterized model, which is likely to produce insignificant coefficients due to multicollinearity of the regressors. Therefore, the re-parameterized ARDL (p, q, …, q) model for short-run effects is specified as follows:

$$\Delta Y_{i,t} = \beta_0 + \sum_{n=1}^{p} \beta_{i,j} \Delta Y_{i,t-j} + \sum_{n=0}^{q-1} \beta'_{i,j} \Delta X_{i,t-j} + ECT_{i,t-1} + \varepsilon_{i,t} \text{.....Equation 3.3}$$

Where ECT_{t-1} represents the error correction term obtained from the long-run equilibrium relationship, which is a group-specific speed of adjustment coefficient; In a nutshell, the ARDL method results of long-run relationship is detected through the *F*-statistics of the bound test results, while the short-run relationship is detected through the *t*-statistic on the independent variables (short-run coefficients results).

3.2.2.2 Generalized Method of Moments (GMM) Method

For robustness check for credit risk determinants, we use the Generalized Method of Moments (GMM), which was developed by Hansen (1982) to analyse the influences of the proposed variables on credit risk. Since most of the most economic models have some endogeneity issues, thus the study needs to use a prominent method that addresses the misspecification, autocorrelation and collineriality problems. The GMM is one of the efficient methods used in the macroeconomic analysis (Hansen and West, 2002). This is largely attributed to its ability to take care of the linear variables, which are subject to nonlinear restrictions as most of the macroeconomic variables have dynamic conditions that give rise to intractable likelihoods but feasible moment relationships.

The GMM method incorporates the OLS and instrument variables techniques (moment conditions), which makes it more efficient when the error term is heteroscedastic, and produce consistent results (Wooldridge, 2001; Baum, 2013). The OLS method is used when all linear assumptions hold, while the GMM allows a certain degree of correlation between the error term and regressors, and heteroscedasticity in the regression model. For that reason, the GMM method tends to be unbiased, consistent, efficient and asymptotically distributed in relation to the error term compared to OLS (Pedroni, 2001; Gujarati, 2009). Thus, GMM is the best choice and gives best consistent estimates when there is an endogeneity issue in the data set.

The suitability of GMM method results is assessed by using the lags data as instrument variables, whereas the number of valid instruments is proportional to the number of available lags. This makes Thus, the dynamic panel regression equation is

$$Y_{i,t} = \beta_0 + Y_{i,t-1} + \sum \beta_n X_{n_{i,t}} + \varepsilon_{i,t} \quad \text{.....Equation 3.4}$$

Where Y represents the dependent variable, β is the coefficients, $Y_{i,t-1}$ represents lagged dependent variable, X represents independent variables, ε represents the error term, i, t and n represent country, time and number of variables.

In order to validate the proportional to the number of instrumental variables used in the GMM method are sufficient enough and not over identified, we use the Sargan-Hansen test (*J*-statistics) of overidentification restrictions (Sargan, 1958; Hansen, 1982). This test determines whether there is a problem of overidentifying moment conditions (too many instruments) in the model and analyse if there is any correlation between the instruments and errors, which is not the preferable condition (instrument and the error term should be serially uncorrelated).

Arellano and Bond (1991) introduced another variant of GMM, which use transformation of the data by the first difference before applying GMM estimators known as first difference GMM (GMM-FD). This kind of transformation eliminates both the constant term and individual effects. Nevertheless, Arellano and Bover, (1995); Blundell and Bond (1998) and Roodman (2009) argued that the Arellano-Bond approach may suffer from potential over identification issues and instruments proliferation if time period is larger than the cross-section, which is our case. The instrument proliferation may overfit endogenous variables that lead to a loss of power.

Besides, Arellano and Bover (1995), further argued that the GMM-FD method has a weakness of magnifies gaps in unbalanced panels (which is our case). They suggested an alternative method of transformation known as GMM forward orthogonal deviations (GMM-FOD), which is an extension of exploits an assumption about the persistence of the data series. This method minimizes data loss by transforming data using orthogonal restrictions under assumption of independent and homoscedastic residuals, produces consistent parameter estimates. This transformation eliminates permanent effects as well as country-specific effects and keeps the orthogonality among the transformed errors, which produce valid instruments in the transformed equation through lags of predetermined variables.

Pesaran et al., (1999) and Windmeijer (2005) argued that GMM produces inconsistent results when the time dimension (T) is larger than number of cross-sections (N) (which is our case) because this model was designed for the panel data which has a limited T with large N. However, Soto (2007) confirms that GMM has a lower bias compare to the higher efficiency that it posits even when T is larger than N provided that there is persistency in the series. This indicates that we can still use GMM estimation and get reliable results. Besides, Hayakawa (2009); Guo et al., (2015); and Phillips (2018) analysed the GMM with first difference and forward orthogonal deviations approaches and posit that forward orthogonal deviations produced reliable results compared to first difference. Cognizant, the study chose to use endogeneity robust GMM with forward orthogonal deviations.

3.2.2.3 Empirical Model Specification

The study examines factors that determine the credit risk behaviour in the EAC countries. As defined earlier, the study uses 12 variables: 11 variables are explanatory variables, which are grouped into two categories (macroeconomic and macro-financial determinants) to explain the credit risk behaviour using the NPL as a proxy of credit risk. This study employs both static and dynamic linear panel data models to provide a thorough understanding of the drivers of

credit risk in the EAC. Specifically, Equation 3.6 and 3.7 present the general static and dynamic linear panel data models identified in Equation 3.4 and 3.5, prospectively:

$$NPL_{it} = \beta_0 + \beta_n ME_{it} + \beta_n MF_{it} + \varepsilon_{it} \quad \textit{Equation 3.5}$$

$$NPL_{it} = \beta_0 + \beta_n NPL_{-1it} + \beta_n ME_{it} + \beta_n MF_{it} + \varepsilon_{it} \quad \textit{Equation 3.6}$$

Whereas NPL is the ratio of non-performing loans to gross loans, which is a proxy of credit risk; β represents conditional variance; ME represents macroeconomic determinants, MF represents macro-financial determinants, ε represents the error term; i represents individual country; t represents time dimension; n represents a number of conditional variances, and NPL-1 represents the lagged value of the current NPL.

The study uses empirical specifications based on 4 different linear regression estimations in order to capture the categorical influence of each variable on credit risk behaviour. We, therefore, divided all proposed variables in the two categories such as macroeconomic and macro-financial determinants into two sub-categories: growth, management and control variable, according to their respective contribution to the financial/economic aspects. This implies that the study has four sub-categories namely, financial sector growth and financial sector management, which are from the macro-financial determinants category; and economic sector growth, economic sector management and controlling variable which is from the macroeconomic determinants category. Following is the presentation of the 4 linear panel data models proposed to be used in the analysis.

We begin the analysis by examining the influence of the jointly impact of growth in the financial sector and the economic sector on credit risk. This is an assessment of the level at which credit growth (DCFSGDP), banks' profitability (ROA), banks' cost to income (BCI) together with the economic growth (RGDP) contribute to the credit risk behaviour. The estimating equation is specified as follows:

$$NPL_{it} = \beta_{14} + \beta_{15} DCFSGDP_{it} + \beta_{16} ROA_{it} + \beta_{17} BCI_{it} + \beta_{18} RGDP_{19} + \varepsilon_{it} \quad \textit{Equation 3.7}$$

We further consider the influence of macro-financial determinants and economic sector growth indicators on the credit risk behaviour in the second model. This model analyses the joint impact of credit growth (DCFSGDP), banks' profitability (ROA), bank cost to income (BCI), bank net interest margin (NIM), bank liquid asset ratio (LATA) and bank regulatory capital to risk-weighted assets (RCRWA) and economic growth (RGDP) to the credit risk behaviour in the EAC banking system. The estimating equation is specified as follows:

$$NPL_{it} = \beta_{32} + \beta_{33}DCFSGDP_{it} + \beta_{34}ROA_{it} + \beta_{35}BCI_{it} + \beta_{36}NIM_{it} + \beta_{37}LATA_{it} + \beta_{38}RCRWA_{it} + \beta_{39}RGDP_{it} + \varepsilon_{it} \quad \textit{Equation 3.8}$$

The third model analyses the combined effect of macroeconomic determinants (without terms of trade) and macro-financial determinants on credit risk behaviour. This includes the impact of credit growth (DCFSGDP), banks' profitability (ROA), bank cost to income (BCI), bank net interest margin (NIM), bank liquid asset ratio (LATA) and bank regulatory capital to risk-weighted assets (RCRWA) and economic growth (RGDP), money supply (BMGDP), interest rate (RIR) and exchange rate (NEER). This entails assessing how do the four sub-categories jointly contribute to the build-up of the credit risk in the EAC banking system. The estimating equation is specified as follows:

$$NPL_{it} = \beta_{40} + \beta_{41}DCFSGDP_{it} + \beta_{42}ROA_{it} + \beta_{43}BCI_{it} + \beta_{44}NIM_{it} + \beta_{45}LATA_{it} + \beta_{46}RCRWA_{it} + \beta_{47}RGDP_{it} + \beta_{48}BMGDP_{it} + \beta_{49}NEER_{it} + \beta_{50}RIR_{it} + \varepsilon_{it} \quad \textit{Equation 3.9}$$

Lastly, we analyse the combined effect of factors on the credit risk in the fourth model. This includes credit growth (DCFSGDP), banks' profitability (ROA), bank cost to income (BCI), bank net interest margin (NIM), bank liquid asset ratio (LATA) and bank regulatory capital to risk-weighted assets (RCRWA) and economic growth (RGDP), money supply (BMGDP), interest rate (RIR) and exchange rate (NEER) and terms of trade (TOT). This entails assessing the influence of both macro-financial determinants and macroeconomic determinants jointly in the build-up of non-performing loans, which increases (decreases) the credit risk in the EAC banking system. Therefore, the estimating equation is specified as follows:

$$NPL_{it} = \beta_{51} + \beta_{52}DCFSGDP_{it} + \beta_{53}ROA_{it} + \beta_{54}BCI_{it} + \beta_{55}NIM_{it} + \beta_{56}LATA_{it} + \beta_{57}RCRWA_{it} + \beta_{58}RGDP_{it} + \beta_{59}BMGDP_{it} + \beta_{60}NEER_{it} + \beta_{61}RIR_{it} + \beta_{62}TOT_{IT} + \varepsilon_{it} \quad \textit{Equation 3.10}$$

For the dynamic panel data model GMM, we follow the same procedure indicated in Equation 3.7 – 3.10 and add the lagged values of the dependent variable ($NPL_{-1i\,t}$) in order to test the impact of the persistence of the previous credit risk behaviour on the contemporaneous credit risk behaviour. In addition, since the financial crisis theory indicated that economic growth and credit growth are among other major factor contributing to the credit risk behaviour, which might lead to the financial instability or financial crisis; the study also analyses the impact of the persistence of the previous economic growth and credit growth to

the credit risk behaviour. Before performing the empirical analysis, we perform preliminary analysis to ascertain whether the key assumptions of linear regression analysis hold.

3.3.3 Data Collection

Data were obtained from the International Monetary Fund (IMF) and World Bank (WB) as indicated in Table 3.1. The study used quarterly frequency data for the period 2000Q1 – 2017Q4 to incorporate a degree of seasonality that may distort the relationship between the variable. Therefore, we primarily used a dataset from the IMF, which was reported every quarter and extend it backwards using the World Bank data, which was reported on an annual basis and be converted to quarterly basis using econometrics techniques of data manipulation (linear interpolation) on the E-views and Stata software programs.

Table 3.1: Summary of Data

Variable (Ratio)	Expected Sign	Source
Non-performing loans (NPL)	+	IMF
Real GDP Growth (RGDP)	-	IMF
Money Supply (BMGDP)	-	IMF
Exchange Rate (NEER)	+	IMF
Real Interest Rates (RIR)	+	IMF
Terms of Trade (TOT)	+	IMF
Credit Growth (DCFSGDP)	-	WB
Returns on Assets (ROA)	-	IMF
Bank costs to Income (BCI)	-	WB
Net Interest Margin (NIM)	-	WB
Liquidity to Asset (LATA)	+	IMF
Regulatory Capital (RCRWA)	-	IMF

3.3.4 Preliminary Data Analysis

Following the linear regression assumptions, there is a number of preliminary tests that need to be performed before the analysis in order to understand the characteristics of our data set and ensure all necessary conditions required are met. These assumptions are normality distribution, no multicollinearity, serial correlation and heteroscedasticity. However, since the study uses panel regression analysis, it is not necessary to perform serial correlation and heterogeneity analyses. Besides, the dynamic models such as ARDL and GMM take into consideration the effects of autocorrelation and heteroscedasticity.

3.3.4.1 Descriptive Statistics Analysis

Descriptive statistics analysis provides a brief description of the coefficients that summarizes a given data series of a particular study in a meaningful way. This includes a number of measures such as measures of central tendency (mean, median and mode), measures of dispersion/variation (range, variance and standard deviation) and measures of data

distribution (skewness, kurtosis and Jarque-Bera). In the research using large data, these statistics measures help to manage the data and present it in a more meaningful way, which allows a simpler interpretation of the data series. Therefore, we first perform descriptive statistics to our data set in order to understand the causes of events and behaviours of the credit risk. The summary statistics results are presented in Table 3.2.

Table 3.2 Panel Summary Statistics (percentage)

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	J-Bera	ProB.
BCI	59.624	57.918	99.488	42.041	9.104	0.969	4.333	82.996	0.000
BMGDP	24.547	22.476	43.245	1.441	8.476	0.539	2.893	17.605	0.000
DCFSGDP	20.972	18.933	45.212	5.492	11.307	0.575	2.126	31.327	0.000
LATA	37.809	33.604	160.713	-99.842	33.765	-0.278	7.276	278.959	0.000
NEER	103.616	99.478	164.123	74.185	16.353	1.230	4.856	142.462	0.000
NIM	8.874	8.664	14.775	3.785	2.142	0.403	2.913	9.853	0.007
NPL	15.856	10.495	103.990	1.862	15.619	2.819	13.375	2091.483	0.000
RCRWA	19.692	19.626	28.475	2.900	3.336	-0.815	6.640	238.527	0.000
RGDP	4.898	5.554	11.159	-14.157	3.731	-1.889	8.729	706.398	0.000
RIR	7.818	7.913	22.996	-31.198	7.112	-1.109	6.963	309.309	0.000
ROA	2.722	2.690	8.984	-0.180	1.165	1.228	7.207	355.919	0.000
TOT	85.421	88.230	143.558	-13.113	24.139	-0.877	5.175	117.152	0.000

Notes: Credit growth (DCFSGDP), banks' profitability (ROA), bank cost to income (BCI), bank net interest margin (NIM), bank liquid asset ratio (LATA) and bank regulatory capital to risk-weighted assets (RCRWA) and economic growth (RGDP), money supply (BMGDP), interest rate (RIR) and exchange rate (NEER) and terms of trade (TOT).

Results of the measure of tendency, mean and median indicate that exchange rate has the highest average and middle values followed by terms of trade, which have 103.62 percent and 85.42 percent average values and 99.48 percent and 88.23 percent median values, respectively. The lowest values of the measure of tendency are on the bank's profitability and economic growth, which have 2.72 percent and 4.9 percent average values and 2.69 percent and 5.55 percent median values, respectively. This implies that the dataset is more evenly distributed from the lowest to highest median values (2.69 percent for ROA and 103 percent for NEER). This indicates there are outlier values in the dataset.

The measures of dispersion range and standard deviation indicates that the data set is widespread, and the same variable that has a minimum value has the highest standard deviation. In particular, the NEER has the maximum of value 164.12 percent while LATA has the minimum value of -99.8 percent. On the other side, LATA has the highest standard deviations of 33.77 percent, and ROA has the lowest standard deviation of 1.16 percent. These results are in line with numerous economic assertions that argues that the higher the exchange rate the lower liquidity ratio, and the higher the liquidity ratio's deviation, the lower the profitability ratio. Consequently, these distributions affect the banks' stability.

In addition, results of the skewness and kurtosis indicate that our data is not normally distributed as it is expected for most of the economic variables. The normal skewness is 0 while normal kurtosis it is 3. We have seen mixed results of skewness and kurtosis, which are above the normality range. In addition, this result of normality is being supported by the results of Jarque-Bera, which indicates that all the probability values are highly significant (below significant level of 0.05) that leads us to reject the null hypothesis of a normal distribution.

3.3.4.2 The Correlation Analysis

The correlation analysis determines whether and how strongly pairs of variables are related. Only three pairs of variables: credit growth and money supply, liquidity to asset and money supply; and exchange rate, which have correlation coefficients of 0.78, 0.52 and 0.55, respectively are correlated (Table 3.3). These results appear to support the hypothesis that each independent variable has its own specific information value in its ability to explain the credit risk. Besides, the coefficient signs between credit risk (NPL) and most of the independent variables are in line with economic theories. For instance, the relationship between economic growth, credit growth and credit risk indicate that economic boom increases credit expansion, which in turn raise the level of NPLs when other factors remain constant.

Table 3.3 Panel Correlation Analysis

	NPL	BCI	BMGDP	DCFSGDP	LATA	NEER	NIM	RCRWA	RGDP	RIR	ROA	TOT
NPL	1											
BCI	0.353	1										
	(7.2)***	-----										
BMGDP	0.182	-0.001	1									
	(3.5)***	(-0.3)	-----									
DCFSGDP	-0.090	-0.252	-0.780	1								
	(-1.7)*	(-4.9)***	(23.5)***	-----								
LATA	-0.142	-0.306	-0.525	-0.390	1							
	(-2.7)***	(-6.1)***	(-11.6)***	(-8.1)***	-----							
NEER	0.087	-0.312	-0.488	-0.424	0.551	1						
	(1.6)*	(-6.2)***	(-10.5)***	(-8.8)***	(12.8)***	-----						
NIM	0.254	0.257	-0.221	-0.433	0.348	0.284	1					
	(4.9)***	(5.2)***	(-4.3)***	(-9.1)***	(7.1)***	(5.6)***	-----					
RCRWA	-0.185	-0.438	-0.294	-0.135	0.289	0.338	-0.060	1				
	(-3.5)***	(-9.2)***	(-5.8)***	(-2.5)***	(5.7)***	(6.8)***	(-1.1)***	-----				
RGDP	-0.198	0.187	-0.171	-0.221	-0.199	0.098	-0.191	0.100	1			
	(-3.8)***	(3.6)***	(-3.3)***	(-4.3)***	(-3.8)***	(1.8)***	(-3.6)***	(1.8)***	-----			
RIR	0.008	-0.001	-0.022	-0.051	-0.203	-0.065	0.141	0.153	-0.051	1		
	(-0.2)	(-0.1)	(-0.4)	(-0.9)	(-3.9)***	(-1.2)	(2.7)***	(2.9)***	(-0.9)	-----		
ROA	0.313	-0.201	0.045	-0.185	0.382	0.349	0.564	0.222	-0.255	-0.022	1	
	(6.2)***	(-3.8)***	(-0.8)	(-3.5)***	(7.8)***	(7.1)***	(12.9)***	(4.3)***	(-4.9)***	(-0.4)	-----	
TOT	-0.474	-0.009	-0.024	-0.027	-0.366	-0.222	-0.156	0.173	0.299	0.512	-0.183	1
	(-10.1)***	(-0.1)	(-0.4)	(-0.5)	(-7.4)***	(-4.3)***	(-2.9)***	(3.3)***	(5.9)***	(11.2)***	(-3.5)***	-----

3.3.4.3 Stationarity (Unit Root) Test

Linear regression requires all data to be stationary. Thus, we performed three different unit root tests namely Im, Pesaran & Shin W-stat; ADF-Fisher; and PP-Fisher Chi-square tests in order to ensure our data series is stationarity (Im et al., 2003; Maddala and Wu 1999). These tests allow for individual unit root to process so that may pi vary across the cross-section. The null hypothesis of all these tests assumes that all panels' data series have unit root (non-stationary). Findings presented in Table 3.4 indicate mixed results of the stationary level. Eight out of twelve variables are stationary at level while four variables become stationary after the first difference.

Table 3.4 Panel Unit Root Test

	Im, Pesaran & Shin W-stat	ADF - Fisher Chi-square	PP - Fisher Chi-square	Stationarity Level
NPL	0.092	0.048	0.000	L(0)
BCI	0.001	0.004	0.000	L(1)
BMGDP	0.032	0.032	0.005	L(0)
DCFSGDP	0.025	0.051	0.000	L(1)
Lata	0.000	0.000	0.000	L(0)
NEER	0.014	0.029	0.000	L(1)
NIM	0.000	0.000	0.000	L(1)
RCRWA	0.003	0.003	0.098	L(0)
RGDP	0.000	0.001	0.003	L(0)
RIR	0.000	0.000	0.003	L(0)
ROA	0.002	0.003	0.000	L(0)
TOT	0.084	0.064	0.332	L(0)

Notes: Credit growth (DCFSGDP), banks' profitability (ROA), cost to income (BCI), net interest margin (NIM), bank liquid asset ratio (LATA) and regulatory capital to risk-weighted assets (RCRWA) and economic growth (RGDP), money supply (BMGDP), interest rate (RIR) and exchange rate (NEER) and terms of trade (TOT).

3.3.4.4 Multicollinearity

The study performed correlation analysis using the first difference transformed data series as suggested by the stationarity results in order to determine whether there is multicollinearity problem in the data set. The correlation coefficient is between 0 and 1, indicating weak and strong multicollinearity problem, respectively. Results shown in Table 3.5 indicate that only credit growth (DCFSGDP) and money supply (BMGDP) have a significant correlation close to 1. This implies the problem of multicollinearity among the variables is not strong to the data set even when transformed. These findings provide the confidence of using the data series in the linear regression analysis when transformed to their first difference. This implies that all the linear regression assumptions hold. Thus, the first difference data series can be used with no problem in fitting the model and interpret the results. The following section presents the empirical results of all the proposed models used to determine the credit risk behaviour in the EAC.

Table 3.5 Panel Multicollinearity Test

	DBCI	BMGDP	DDCFSGDP	LATA	DNEER	DNIM	RCRWA	RGDP	RIR	ROA	DTOT	NPL
DBCI	1											
BMGDP	-0.05	1										
	(-0.94)											
DDCFSGDP	0.011	0.063	1									
	(-0.199)	(-1.182)										
LATA	0.053	-0.517	-0.11	1								
	(-0.989)	(-11.3)***	(-2.07)**									
DNEER	0.059	0.259	0.023	-0.157	1							
	(-1.114)	(5.07)***	(-0.44)	(-2.99)***								
DNIM	0.212	0.061	0.043	-0.175	0.01	1						
	(4.08)***	(-1.143)	(-0.802)	(-3.34)***	-0.182							
RCRWA	0.001	-0.292	0.107	0.311	-0.331	-0.102	1					
	(-0.027)	(-5.75)***	(2.027)**	(6.1)***	(-6.6)***	(-1.9)*						
RGDP	-0.039	-0.173	0.058	-0.185	-0.256	0.03	0.097	1				
	(-0.739)	(-3.29)***	(-1.093)	(-3.5)***	(-4.9)***	(-0.557)	(1.8)*					
RIR	0.011	-0.03	0.056	-0.175	0.093	-0.115	0.152	-0.076	1			
	(-0.212)	(-0.571)	(-1.052)	(-3.34)***	(1.754)*	(-2.2)**	(2.9)***	(-1.4)				
ROA	-0.028	0.053	-0.125	0.371	-0.048	-0.079	0.216	-0.229	-0.004	1		
	(-0.520)	-(1.004)	(-2.36)**	(7.52)***	(-0.899)	(-1.498)	(4.2)***	(-4.41)***	(-0.09)			
DTOT	0.096	-0.099	0.098	0.232	0.057	0.032	0	-0.108	-0.025	-0.023	1	
	(1.81)*	(-1.871)*	(1.843)*	(4.47)***	-1.065	-0.606	-0.006	(-2.033)**	(-0.46)	(-0.432)		
NPL	-0.027	0.166	-0.207	-0.124	0.228	0.238	-0.231	-0.187	0.007	0.268	-0.008	1
	(-0.512)	(3.17)***	(-3.968)***	(-2.355)**	(4.4)***	(4.6)***	(-4.5)***	(-3.57)***	-0.126	(5.2)***	(-0.15)	

Notes: (i) Values in parenthesis are *t*-statistics. (ii) ***, **, * denote 1, 5 and 10 percent significance levels, respectively. (iii) Credit growth (DCFSGDP), banks' profitability (ROA), bank cost to income (BCI), bank net interest margin (NIM), bank liquid asset ratio (LATA) and bank regulatory capital to risk-weighted assets (RCRWA) and economic growth (RGDP), money supply (BMGDP), interest rate (RIR) and exchange rate (NEER) and terms of trade (TOT).

3.4. Empirical Results and Discussion

This section presents the regression analysis results of the determinant of credit risk behaviour in the EAC region for the period 2000 - 2017. The study used aggregated quarterly data set to analyse their contribution to credit risk that hinders financial system stability in the EAC. This data set includes variables such as ratios of non-performing loans to gross loans (NPL), real gross domestic product growth (RGDP), percentage of broad money to GDP (BMGDP), real interest rate (RIR), nominal effective exchange rate (NEER), terms of trade (TOT), percentage of domestic credit provided by financial sector of GDP (DCFSGDP), percentage of bank return on assets (ROA), ratio of the bank cost to income (BCI), bank net interest margin (NIM), bank liquid to asset (LATA) and percentage of bank regulatory capital to risk-weighted assets (RCRWA).

The preliminary data analysis indicated that our dataset was not normally distributed and had a unit root problem. Consequently, variables that were not normally distributed at level were transformed into their first difference order of the original series in order to ensure data stationarity. The study used different linear panel regression methods: ARDL and GMM with 4 different hypotheses in investigating credit risk determinants. The use of 4 hypotheses provides a thorough investigation by capturing the significant impact of each variable when jointly combined with other variables interchangeably, as indicated in Equation 3.8 - 3.10. The use of variables interchangeably also helps to avoid the problem of collinearity.

Specifically, NPL was used as a proxy of credit risk, which was regressed with macroeconomic determinants (RGDP, BMGDP, NEER, RIR and TOT) and macro-financial determinants (DCFSGDP, ROA, BCI, NIM, LATA and RWRCA). The regression methods: ARDL and GMM used produced mixed results, however the relationship between credit risk and most of the determinant variables are in line with economic theories. Generally, results indicated that there are many significant factors influencing credit risk behaviour in the EAC banking system. Nevertheless, economic growth (RGDP), money supply (BMGDP) and credit growth (DCFSGDP) are by far the most significant determinants of credit risk in the EAC banking system. These factors can be used as early warning factors that contributes to the build-up of risks to the EAC financial system stability. Thus, call for establishment of framework and control strategies that will control credit growth threshold and monitor risk-taking behaviour during the economic booms which increase credit risk during the economic recession. Detailed results of each regression approach are present as follows.

3.4.1 Long-run and Short-run Effects of Credit Risk Determinants

The ARDL method estimates the long-run effects jointly with the short-run effects. This method is one of the appropriate methods used to account the effects of shocks in the models. The null hypothesis of the ARDL model assumes that coefficients of the long-run equation are all equal to zero, implying that there is no cointegration. Consequently, if there is evidence of the long-run relationship in the ARDL model, the specification of both short-run and long-run effects are reported using error correction model (ECM). The ECM determines the equilibrium relationship of long-run and short-run dynamics. Therefore, the study uses the ARDL method to estimates the long-run and short-run causality between credit risk and the proposed determinants of credit risk behaviour in the EAC banking system.

One of the crucial steps in performing the ARDL method is the usage of the optimal number of lags in the model in order to produce significant results. This is because any

additional lag leads to an over-parametrization, which impedes the significance of the results. The study uses an automatic optimal lag selection of the ARDL method in the E-views programs. Different approaches can be used to test the over-parameterized problem in the model. We prefer to use the Wald test, which is also known as bound test that was developed by Wald (1943) for the joint significance as suggested by Pesaran et al., (2001) in order to validate if there is an over-parameterized problem in our models.

One of the advantages of using the Wald test is that it only requires the estimation of the unrestricted model, which lowers the computation burden as compared to other tests. Therefore, the Wald test results confirm the significance of the cointegration analysis results obtained from the ARDL method indicating the evidence of the long-run relationship among the variables in our models (Table 3.6). In particular, the long-run relationship is detected through the F-statistics of the Wald test results.

Table 3.6 ARDL – Bound (Wald) Test Analysis Results

	Model 1	Model 2	Model 3a	Model 3b	Model 4
DCFSGDP	0.487	0.294	0.513	1.091	2.038
	(2.85)***	(2.31)**	(3.11)***	(4.22)***	(13312.17)***
ROA	2.078	3.005	-1.714	2.535	1.456
	(3.20)***	(4.77)***	(-2.6)***	(2.55)**	(2791.44)***
BCI	0.62	0.586	-0.31	0.317	0.213
	(6.36)***	(7.37)***	(-4.3)***	(2.93)***	(985.99)***
LATA		-0.135	0.064	-0.181	0.004
		(-4.61)***	(1.74)*	(-2.72)***	(0.24)
RCRWA		-0.144	-0.419	-0.073	0.567
		(-0.87)	(-1.34)	(-0.29)	(6412.12)***
NIM		-0.85	2.468	0.72	1.202
		(-2.28)**	(5.83)***	-1.48	(1529.64)***
RGDP	-0.198	-0.773	-1.154	-0.301	-3.19
	(-1.36)	(-4.71)***	(-5.1)***	(-1.02)	(-8634.8)***
BMGDP			-0.858	-0.126	-2.214
			(-4.2)***	(-0.62)	(-3169.34)***
NEER			-0.68		
			(-4.7)***		
RIR				-0.253	
				(-2.13)**	
TOT					-0.446
					(-9641.24)***
F-Statistics	15.959***	15.42***	47.16***	5.928***	779000000
Lag Selection	2a	1b	1b	1b	4b
Critical Values	3.04 - 4.24	2.50 - 3.77	2.50 - 3.77	2.50 - 3.77	2.50 - 3.767
Cointegration	Yes	Yes	Yes	Yes	Inconclusive

Notes: (i) Models 1, 2, 3a, 3b and 4 analyse the contribution of combined bank-specific factors and macroeconomic factors to the credit risk behaviour in the EAC financial system. (ii) Values in parenthesis are *t*-statistics. (iii) ***, **, * denote 1%, 5% and 10% significance levels, respectively. (iv) Critical values are extracted from Narayan (2005) (v) a and b represent the Akaike and Schwarz information criterions, respectively that were used to select the optimal number of lags.

As it is evident in the ARDL (static model) results indicate there is a long-run relationship (cointegration) between determinants variables per se on the credit risk (except for model 4). The most of the variables' t-statistic (which tells if statistically significant, long-run causal effects are inferred) posit expected coefficient sign, which is in line with economic theories and is statistically significant. T-statistic results indicate that DCFSGDP, ROA, BCI, LATA, have a positive long-run impact to the credit risk, while NIM, RWRCA, RGDP, BMGDP, NEER and RIR posit negative relationship with credit risk.

Further, results from the F-statistics of the Wald test (bound test) results indicated that all models used are statistically significant. This decision was made based on the critical value tabulated in Narayan (2005) at 5 percent level when the model has unrestricted intercept and no trend. Except for Model 4, the F-statistics exceed the upper bound values concluding that credit risk and its determinants are cointegrated. This implies that there is a strong theoretical justification for a long-run relationship to exist between credit risk and its determinants *(*both macro-financial and macroeconomic determinants jointly with an exemption of Terms of Trade in the build-up of NPLs, which increases/decreases the credit risk in the EAC banking system). Consequently, the study examines the short-term and the long-term effects in all models that posit long-run stochastic trend (cointegration).

The study further examines short-run dynamic effects and the long-run equilibrium relationship between the variables by using an error correction model (ECM). The ECM estimates short-run coefficients and error correction term (ECT), which captures the group speed of adjustment such that when the credit risk exceeds the long-run relationship with the determinant variables, they adjust downwards at a rate within the range. The ECT also represents residuals of the long-run analysis used in the ECM. Therefore, long-run and strong causal effects are inferred in the model the models when ECT coefficient result is negative, and its t-statistic is significant at 5 percent level.

The error correction model results presented in Table 3.7 show that persistence of NPL is the main strong driver of the credit risk in the short run at 1 percent significance level. It was followed by BCI, RGDP and NEER, which are significant at 5 percent level in one or two models. The remaining variables posit the expected coefficient signs, albeit insignificance in relation the credit risk behaviour in the short run. The ECM results also show that the error correction terms (ECT_{t-1}) are all correctly signed (negative) and significant at the 1 percent level in all models ensuring the attainment of long-run equilibrium in both macroeconomic and macro-financial determinants following a system shock. However, it is only about 3 percent of

the previous quarter credit risk shock adjust back to the long-run equilibrium in the current quarter, other things being equal. This applies on average in all models.

Table 3.7 The Summary of ECM Model Results

	Model 1	Model 2	Model 3a	Model 3b
ECT t-1	-0.038	-0.057	-0.033	-0.037
	(2.04) **	(-2.57) **	(-3.66) ***	(-3.25) **
D (NPL (-1))	0.789	0.571	0.357	0.432
	(10.79) ***	(9.21) ***	(5.10) ***	(6.64) ***
D(DCFSGDP)	-0.324	-0.286	-0.173	-0.188
	(-1.45)	(-1.86) *	(-0.90)	(-0.79)
D (DCFSGDP (-1))	0.118			
	-1.16			
D(ROA)	-1.307	-0.542	-0.099	0.116
	(-1.65)	(-0.74)	(-0.15)	-0.22
D (ROA (-1))	0.581			
	-1.56			
D(BCI)	-0.172	-0.113	-0.07	-0.096
	(-2.28) **	(-2.13) **	(-0.99)	(-1.82) *
D (BCI (-1))	0.128			
	(1.66) *			
D(LATA)		0.017	0.017	0.011
		-0.71	-1.12	-0.92
D(RCRWA)		0.027	0.082	0.023
		-0.15	-0.35	-0.09
D(NIM)		-0.29	-0.376	-0.486
		(-1.03)	(-1.46)	(-1.66) *
D(RGDP)	0.072	0.033	-0.01	-0.018
	-0.35	-0.24	-0.06	(-0.14)
D(BMGDP)			-0.104	-0.228
			(-0.32)	(-0.76)
D(NEER)			0.017	
			-0.43	
D(RIR)				0.016
				-0.44
C	-1.573	-1.232	3.407	-1.123
	(-2.01) **	(-2.60) **	(3.80) ***	(-2.85) ***

Notes: (i) Models 1, 2, 3a and 3b analyse the contribution of combined bank-specific factors and macroeconomic factors to the credit risk behaviour in the EAC financial system. (ii) Values in parenthesis are t-statistics. (iii) ***, **, * denote 1%, 5% and 10% significance levels, respectively. (iv) Critical values are extracted from Narayan, (2005). (v) a and b represent the Akaike and Schwarz information criterions, respectively that were used to select the optimal number of lags.

In a nutshell, no strong evidence of any variable that affect the credit risk in both short-run and long-run. The ARDL results indicate that DCFSGDP, ROA, BCI, LATA, have a positive long-run impact to the credit risk, while NIM, RWRCA, RGDP, BMGDP, NEER and RIR posit negative relationship with credit risk. On the shot-run, credit risk has only been affected by the persistence of NPL. RGDP, BMGDP and RIR that have similar impacts in all models, albeit insignificant. RGDP and BMGDP are negatively related to the credit risk, while RIR is positively related to the credit risk. Interestingly, DCFSGDP, ROA, BCI have a positive relation to the credit risk in the long-run but are negatively related in the short-run. LATA and NEER are negatively related to the credit risk in the long-run but positively related in the short-run. RCRWA and NIM have both positive and negative relationships in both long-run and short-run, depending on the model performed. This concludes that the credit risk in the EAC banking system is not fully motivated by RCRWA, NIM and RIR but rather is strongly motivated by the persistence of NPL, DCFSGDP, ROA, BCI and RGDP.

3.4.2 Robustness Check for Credit Risk Determinants

The study uses the Generalized Method of Moments (GMM) with orthogonal deviation restrictions to examine the relationship between macroeconomic and macro-financial determinants of credit risk in the EAC banking system. The coefficients result of all variables have the expected signs in line with economic theories and are statistically significant (Table 3.8). In particular, the persistence of the non-performing loans, credit growth, banks profitability, economic growth, money supply and interest rates, which are statistically significant at 1 percent level have the most impact on the credit risk behaviour. It followed by bank cost to income, liquid assets to total assets, capital to risk-weighted assets, interest margin, which are significant at 5 percent level.

Table 3.8 Summary of Panel Static GMM-FOD Results

	Model 1	Model 2	Model 3	Model 4
NPL(-1)	0.95	0.964	0.959	0.959
	(447.93)***	(212.9)***	(259.44)***	(257.68)***
DDCFSGDP	-0.344	-0.42	-0.286	-0.235
	(-8.26)***	(-5.76)***	(-3.64)***	(-2.81)***
ROA	-0.582	-0.489	-0.447	-0.459
	(-16.79)***	(-8.55)***	(-6.2)***	(-7.10)***
DBCI	-0.022	-0.051	-0.041	-0.037
	(-2.04)**	(-2.49)**	(-2.49)**	(-2.07)**
LATA		-0.003	-0.007	-0.006
		(-1.88)*	(-2.16)***	(-2.25)**
RCRWA		0.075	0.048	0.055
		(5.59)***	(2.69)***	(3.18)***
DNIM		-0.664	-0.287	-0.306
		(-6.71)***	(-2.81)***	(-3.17)***
RGDP	-0.331	-0.689	-0.5	-0.4
	(-9.35)***	(-10.22)***	(-8.21)***	(-6.27)***
RGDP(-1)	0.291	0.592	0.436	0.338
	(8.38)***	(10.43)***	(7.83)***	(5.65)***
BMGDP			-0.048	-0.044
			(-3.61)***	(-3.48)***
DNEER			0.09	0.086
			(2.42)***	(2.06)**
RIR			0.09	0.012
			(2.12)***	(1.66)*
DTOT				-0.029
				(-2.40)**
J-statistic	165.83	111.465	126.869	128.838
Prob(J-statistic)	0.299	0.835	0.412	0.365

Notes: (i) Models 1, 2, 3 and 4 analyse the contribution of combined bank-specific factors and macroeconomic factors to the credit risk behaviour in the EAC financial system. (ii) Values in parenthesis are *t*-statistics. (iii) ***, **, * denote 1%, 5% and 10% significance levels, respectively. (iv) Critical values are extracted from Narayan, (2005). (v) a and b represent the Akaike and Schwarz information criterions, respectively that were used to select the optimal number of lags.

These results are supported by other measures such as It should be noted that we faced no problem with residuals, since, according to the Jarque Bera test, they were found to be normally distributed. Since it is crucial to use strong instruments in the moment conditions for

the consistency of the GMM estimates, we used instruments from within the dataset, which is the lags of the exogenous regressors as instruments. The probability results of J-statistics exceed the critical value of 5 percent significance level, suggesting that we reject the Sargan-Hansen null hypothesis of over-identifying restrictions. Therefore, this indicates that all instrumental variables involved in the analysis are valid, and there is no issue of overidentifying restrictions, and the model is well specified.

The GMM results provide a wide range of significant impact of almost all variables in determining the credit risk behaviour in all 4 models suggesting that the credit risk behaviour in the EAC banking system is influenced by both macroeconomic and macro-financial factors (Table 3.8). Nevertheless, findings show weak evidence of long-run effects in bank liquid asset ratio (LATA) in model 1, and real interest rate (RIR) in model 4, which are significant at 10% level of confidence. On the one hand, these findings indicate that the credit risk behaviour in the EAC financial system is not fully motivated by the bank cost to income, liquid to asset, and real interest rates. On the other hand, findings suggest that the credit risk behaviour in the EAC financial system has been driven by both macroeconomic and macro-financial factors such as persistence of NPLs, credit growth (DCFSGDP), banks' profitability (ROA), bank net interest margin (NIM), and regulatory capital to risk-weighted assets (RCRWA) and economic growth (RGDP), money supply (BMGDP), and exchange rate (NEER) and terms of trade (TOT).

3.4.3 Results Discussion on the Determinants of the Financial System Stability

The study employs two different regression methods to analyse the impact of the macro-financial and macroeconomic determinants on credit risk behaviour in the EAC banking system for the period 2000 - 2017. These methods include ARDL using Wald test and ECM and GMM using orthogonal deviation restrictions. Findings from these three approaches indicate mixed results. However, the relationship between credit risk and most of the determinant variables are in line with economic theories. The GMM estimation results tend to be the best method among the three methods due to the highly significant results of the impact of all the proposed determinants on credit risk behaviour in all models. The study concludes the findings by reporting the most significant variables that influence the credit risk in all three regression methods used in the analysis. Significance results of each model are presented below.

The results indicate a significant impact of growth in both the financial sector and economic sector on the credit risk. We found robust evidence that growth in both the financial sector and the economic sector have a significant influence on the build-up of credit risk. This is in line with other studies (Louzis et al., 2012; Gulati et al., 2018). Our findings in Model 1

indicated that the persistence of non-performing loans, credit growth, banks' profitability, and economic growth jointly determine the credit risk behaviour in the long-run and short-run analysis. These findings reinforce the previous results of the influence of individual sector growth, which implies the financial sector in collaboration with economic sector growth jointly drives the credit risk behaviour in the long. It is implying that improvement in economic development and banking sector reduces the credit risk in the EAC.

Looking at the second model, the impact of macro-financial determinants together with economic sector growth determinants results indicated that there is influence the credit risk in both static and dynamic conditions. Consistent with other studies, we found significant a significant impact of macroeconomic determinants on credit risk (Warue, 2013; Akinlo and Emmanuel, 2014; Adeola and Ikpesu, 2017). Surprisingly, our study indicated a relatively weak relationship between the real interest rate and credit risk in both long-run and short-run. The persistence of NPLs, credit growth and bank cost efficiency are significant in the long-run and short-run while banks' profitability, liquidity, cost efficiency, required capital, interest margin and economic growth influence the credit risk behaviour in the long-run.

Furthermore, we identified that both macro-financial and macroeconomic determinants have an on the credit risk in both static and dynamic models. This is in line with economic theories and previous studies (Adebola et al., 2011; Louzis et al., 2012; Warue, 2013; Nikolaidou and Vogiazas, 2017). In our study, we have found a significant long-run relationship between all the determinants and the credit risk behaviour, with the exception of real interest rate, which indicated (Model 3 and 4). Surprisingly, we have also found a relatively weak influence towards the credit risk implying that the interest change in the EAC banking system does not lead to the credit risk behaviour across the region. This is contrary to economic theory, which assumes that interest rates volatility (increase) induces effect on private capital flows by increasing the cost of borrowing (Dell'Ariccia et al., 2014).

Turning to the relationship between individual determinants and the credit risk, results indicated the expected signs as per economic theories. For instance, we have found that the contemporaneous NPL is the indicative legacy effect of NPLs management in both short-term and long-term at 1 percent level in all models. This result is in line with other studies, which revealed that the persistence of bad loans influences the contemporaneous credit risk behaviour (Makri et al., 2014; Amuakwa-Mensah et al., 2017). Thus, a shock to NPLs takes time to come back to the long-run equilibrium, which might influence banks to increase interest rates in order to hedge the anticipated risk of their loans in future. This is evident through the large interest margin that the EAC banking system enjoys.

As it is expected, there is significant evidence that improvements in the banks' profitability, cost efficiency, liquidity, interest margin, terms of trade, money supply and economic lower the credit risk in the EAC banking system. While the increase in credit growth, exchange rate, interest rates and required capital to risk-weighted assets contribute to the credit risk. This suggests that the credit risk deteriorates in response to the economic boom period, which contributes to the improvements in credit growth, profitability, cost efficiency, liquidity, interest margin and terms of trade. As a result, during the economic recession borrowers are adversely affected and face difficulties in servicing their loan, resulting in higher NPLs.

Interestingly, we have found mixed results of the impact of credit growth and economic growth, similar to Nikolaidou and Vogiazas (2014). Results indicated that persistence of the credit growth and economic growth changes their impacts towards credit risk with time. The contemporaneous economic growth is negatively related to the credit risk, while the previous economic growth is positively related to the credit risk. Contrary, the contemporaneous credit growth is positively related to the credit risk, while the previous credit growth is negatively related to the credit risk. This implies that improvements in the economic growth influence credit growth and reduces credit risk. However, with time, it contributes to the credit risk.

3.5. Chapter Summary

In this chapter, we focused on the second concept of this research study, determinants of the credit risk to the financial system stability. The section answers research question two, which ascertaining to examine the key determinants of the major risk that hinders the EAC financial system stability. Besides, this research work is an attempt to respond to that question that continues to preoccupy policymakers as they seek for corrective actions to moderate the impact of certain vulnerabilities and fragilities in the financial system. Following findings from chapter 2, the EAC financial system has largely been affected by credit risk, among other factors. Thus, we examined the influence of different groups of macroeconomic and macro-financial variables in relation to the short run and long run effect of credit risk behaviour in the EAC banking system.

Findings from this study support the economic theory that suggests that credit risk is responsive to the dynamics of countries' macroeconomic and macro-financial variables. Profound evidence has indicated that credit risk is the indicative legacy effect of the economic growth and credit growth and previous NPLs management both in short-run and long-run. Secondly, we found that macroprudential and micro prudential policies help to lower the credit risk. However, external adverse impact, such as economic recession might dampen the positive

impact of the prudential soundness indicators. This is especially the case if the banking system meets the prudential requirements at the minimum level, as the case of EAC banking system, which has been operating in that way over the past two decades.

Thirdly, we found that both macro-financial and macroeconomic determinants appear to exert a powerful influence on the credit risk in the EAC banking system. Prudent macroeconomic policies intended to stabilize inflation and exchange rates, which stimulate economic growth, which increases the capacity to borrow that influence credit growth. At the same time, credit growth with less prudent lending standards increases the ratio of nonperforming loan raising credit risk during the recession.

Hitherto, these findings provide a strong justification to use the significant variables as early warning indicators in ensuring financial system stability. The following chapter is going to examine financial system resilience (stability) using some of the identified variables in this chapter that determine the EAC financial system stability.

CHAPTER FOUR

4. EXTANT EVIDENCE OF THE EAC FINANCIAL SYSTEM RESILIENCE

This chapter addresses the third objective, which is to measure and forecast the financial system resilience in the EAC financial system. In order to measure the financial system resilience (stability), the study developed a comprehensive measure of financial system stability Index (AFSSI) that combines various indicators relating to financial system development, vulnerability, soundness and macroeconomic climate. By using quarterly data spanning 2000-2017, the aggregated index has successfully shown the performance of the EAC financial systems over the sample period.

We further used econometric methods to validate the AFSSI results and the effects of critical macroeconomic indicators on financial stability. Moreover, the study used AFSSI results to forecast the stability trend for the following three years (of out-of-sample). Findings indicated that the EAC financial systems have remained relatively stable, albeit vulnerable to shocks. Despite the differences in financial instability characteristics across the region, the review has shown that the region has faced similar financial system instability patterns. The forecast results indicate that that the EAC continues to enjoy financial system stability. Other factors held constant. This chapter's findings, among others, flags the usefulness of leading indicators (AFSSI) in predicting crisis incidences.

4.1. Background to the Chapter (Study)

4.1.1. Overview

An economy cannot function well without an efficient, effective, and stable financial system, which facilitates secure money circulation, and thus a resilient financial system. Financial system plays a vital role in redistribution and inter-temporal adjustment of consumptions by providing liquidity services, promoting risk sharing and solving information asymmetry problem (King & Levine (1993) and Mishkin (2009)). As a result, a well-functioning and efficient financial system fosters sound and vibrant economic growth and stability. In contrast, a dysfunctional and inefficient financial system adversely affects productive and economic activities and may in extreme cases destroy the fabric of economic structures supporting a particular society.

Following the global financial crisis (2008) financial system stability has become more topical due to the impact of interconnectedness of the financial system and the economy. Consequently, a need to identify potential risks to the financial system aroused. One of the advantages of measuring financial system stability is to ensure that the financial system is running in a stable, orderly and resilience to both internal and external shocks by identifying potential risks to the financial system (Borio, et. al., 2011). This is because once the financial system is exposed to risk; the risk will disrupt or perhaps destroy the economic stability of the country as well. If handled properly, it could enhance risk diversification and may even drag on to long-term stable growth of the regional economy.

4.1.2. Motivation of the study

Structural, institutional, and macroeconomic aspects of financial system stability are receiving growing attention both nationally and in international fora due to the complex nature of financial system. The soundness of financial institutions is also a key part of the infrastructure for strong macroeconomic performance and effective monetary policy at the national level. Hence, central banks and governments are paying increasing attention to monitoring the health and efficiency of financial institutions and markets, and to macroeconomic and institutional developments that pose potential risks to financial stability.

As a result, international institutions such as the World Bank and IMF developed financial soundness indicators (FSIs), with aim of supporting analysis and assessing strengths and vulnerabilities of financial systems. Ideally, the FSIs include both aggregated information on financial institutions and representative of markets in which financial institutions operate. However, these indicators can be used depending on the country-specific circumstances. The IMF indicated that advancing international comparability of FSIs and convergence toward best practice are important goals for further work in this area.

Given the linkages between microeconomic and macroeconomic conditions and overall financial system stability, the monitoring of financial system developments and policy responses to ensure financial stability poses special challenge. This challenge highlighted the need for more research and analysis to improve understanding of what determines financial system resilience and to deal with the considerable conceptual and statistical difficulties that arise in defining and compiling indicators of financial stability. In this chapter, we propose four sets of indicators that are considered useful for the purpose of periodic monitoring, and for compilation and dissemination efforts by national authorities like the EAC region.

4.1.3. Problem of the Study

Emerging developments within the national boundaries and in the context of EAC threaten to introduce some elements that may lead to increased vulnerabilities and shocks, and potentially financial instability within the region. While there is a notable increase in financial systems development such as increase in the number of licensed entities and expanding market structures, the banking industry (which is the dominant industry in the regional financial system) is characterized by a relatively large interest margin and high non-performing loans. This reflects the increased risk aversion by banks partly due to gaps in their financial infrastructure provisioning and riskiness of lending. Besides, the increase in non-performing loans of the banks (both domestic and foreign banks) across the region indicates that there are vulnerabilities and potential risks emanated from the economic activities. Thus, the more expansion of loans might lead to a further uptick in the level of non-performing loans (Sahay, Čihák, et al., 2015). As a result, it may lead into credit risk, liquidity risks and profitability, which may be a base for adverse challenges for financial system stability.

4.1.4. Objective of the Study

Therefore, while the current EAC financial system appears to be relatively stable, deepening regional economic and financial integration initiatives, coupled with the evolving global macroeconomic and financial developments, may require assessment of the impact of the ongoing economic and financial developments on the financial system stability (Guo, Chen, & Huang (2011), Hasman (2013) and Asongu & De Moor (2017)). For this reason, the study intends to assess financial system stability within the EAC region from its inception, 2000 to 2017 and forecast the regional financial system stability. In the process, we developed an Aggregate Financial System Stability Index (AFSSI) to measure the financial system stability of the EAC region. Results of this study will appropriately develop a better understanding of the EAC financial system stability dynamics and inform policymaking on an effective framework and design model that will have a scientific and effective alert system for early warning of the potential financial instability/crisis.

4.1.5. Significance of the Study

This chapter established the Construction of AFSSI, and its constituent sub-indices aims at enhancing a set of existing macroprudential tools of monitoring and assessing the stability of a financial system. The AFSSI would also aims at broadening the scope of macroprudential surveillance by identifying potential risks to the stability of the financial

system and signals of resilience of the financial system to the public, key stakeholders and policy makers for macro-prudential policy action(s) as may be necessary.

Monitoring and analysis of FSIs are just one element in an overall assessment of financial stability. Other elements include analyses of macroeconomic developments, market-based data such as stock prices and credit ratings, structural information on the financial sector, and qualitative assessments, in particular assessments of observance of relevant international standards and codes. These elements, which feed into macroprudential analysis, will help to identify various dimensions of risks as well as the capacity of the system to cope with and manage these risks, thereby helping to form a judgment on overall financial stability. While these tools remain imperfect and continue to evolve, over time, macroprudential analysis can reduce the incidence of crises by providing national authorities with a set of tools to comprehensively assess their financial sectors and identify weaknesses at an early stage.

As an early warning indicator, the FSSI will be used to capture various macroeconomic and financial vulnerabilities and enable analysts and/or policy makers to design appropriate macroprudential policy action(s) that would turnaround the situation in the event of adverse economic or financial situations. Unlike stress testing and cob-web models, the FSSI portrays hints of the build-up of potential risks and estimate levels of stability of the financial system over a long period of time. Also, the index provides possibility of comparing the level of stability of the financial system in different periods. The Index can as well give the outlook of financial stability with acceptable level of precision. Besides, movement/episodes of the Aggregated Financial System Stability Index over a period can be used to observe the effect of macroprudential policy actions. For example, the turnaround of the index after macroprudential policy implementation would provide the signal of policy effectiveness.

The remainder of this chapter is organized as follows. Section 4.2 recapitulates the related literature on measuring financial system stability. Review of the methodology of constructing a new-based index (AFSSI) for measuring financial system stability in the EAC and data collection for this study is presented in Section 4.3. Discussion of the presentation and interpretation of the results of the analysis is presented in Section 4.4 presents and interprets the. Section 4.5 validates the AFSSI analysis using econometric techniques and Section 4.6 presents the forecasting analysis of the regional AFSSI. Finally, Section 4.7 concludes.

4.2. Related Literature Review

4.2.1 Theoretical Review

The recent global financial crisis highlights the validity of the **Keynesian Monetary Theory**, which was denounced by monetarists as ineffective and undesirable (Öner, 2015).[4] Keynes made three important points: participants in the stock markets are independent fundamental force, which influences financial markets and the real economy; labour market is not an auction and unemployment rate can potentially end up in many possible equilibrium states; and governments can intervene in the recession through expansionary fiscal policy (Farmer, 2012; Jahan et al., 2014). In order to improve macroeconomic conditions by achieving full employment and stable economy, government intervention through its fiscal and monetary policies and regulation of the real sector and financial sector of the economic integration is needed.

Another economic theory underpinning the regulation and supervision of the financial system in order to ensure financial system stability is prudential theories. These theories include Micro prudential and macro prudential theories. The **Micro Prudential Theory** is mainly based on the regulatory and supervisory assessment of the individual market participants, on a stand-alone basis regardless of their relationship with other market participants in the financial system and in isolation of macroeconomic environment in which they operate (Barth et al., 2001; Acharya, 2009; Campbell and Garcia, 2009; Čihák and Schaeck, 2010). These regulations (Basel I and II capital accords) tend to view financial institutions in isolation and aim mainly at ensuring that each is individually solvent.

The fundamental idea underlying the micro-prudential approach is that as long as the individual market participants are sound and stable, then the whole financial system is sound and stable as well (Čihák and Schaeck, 2010). Yet solvency and liquidity of the individual institution is not sufficient condition for the stability of a system as a whole (Acharya, 2009; Hanson et al., 2011). The interconnectedness among banks and other financial institutions can generate externalities with adverse effects on the real economy. The theory of micro-prudential regulation/supervision undermined the impact of the systemic risk in the economy. The

[4] Despite the criticisms, Keynesians' theory is still being used as a theoretical underpinning of economic policies as a key fundamental theory while developing economic policies to address crisis effects (Öner, 2015). Both Keynesian and Monetarist are right in different ways. Consequently, many governments, including the United States, the United Kingdom and South Africa adopted both Keynesian and Monetarism schools of thought when ensuring the financial stability of their countries. This is because monetarism has not solved the problems that Keynesian policies have failed to solve during the great depression.

prudential balance sheet restrictions focus on solvency rather than liquidity. A case in point, capital ratios set independently of the business cycle may be a source of systemic risk. With these externalities, this theory needs to be supplemented with tools (macro-prudential policies) designed to safeguard the financial system as a whole.

The **Theory of Macro Prudential** is based on addressing systemic risk, the risk of developments that threaten the stability of the financial system as a whole and consequently the broader economy (Galati and Moessner, 2013; Hanson et al., 2011). One of the key purposes of macro-regulation is to act as a countervailing force to the natural decline in measured risks in a boom and the subsequent rise in measured risks in the subsequent bust. This entails smoothening financial and credit cycles in order to prevent systemic crises and provide a cushion against their adverse effect. The standard view of these policies is that they address the time and cross-sectional dimensions of systemic risk in the financial system and corrects market failures by using macro prudential surveillance; macro prudential tools and instruments; and implementation of macro prudential policy framework.

Following the debate on financial system regulations, the institutional theory provides justifications of the alternative approach of financial system regulations (Tanasković and Jandrić, 2015). The **Institutional Theory** emphasizes on the effectiveness of regulatory structure of financial regulation to achieve multiple regulatory objectives, attaining financial stability has to be facilitated by effective implementation of both monetary and financial stability policies (Hasan et al., 2009; Meyer and Rowan, 1977). The theory argues that the ultimate solution to the economic crisis requires not only government intervention but also a reflection of the role of the financial system as well as indicated in Table 4.1. This entails ensuring the integrity of the financial system, supporting the general economic policy of the Government, and well-functioning financial intermediation process, smooth market functioning, monetary stability and capacity of the financial system to facilitate economic growth and withstand shocks (Anatolyevna and Ramilevna, 2013).

Against this backdrop, lack of analytical frameworks to help predict and cope with the global build-up of financial imbalances whose sudden slowdown has had severe macroeconomic consequences has remained an issue. The GFC reawakened regulators on the importance of broadening the regulation and supervision regime to go beyond individual market participants and to cover the systemic risks. In addition, studies have identified that countries with inadequate legal and regulatory frameworks; less harmonized market structures; and no deposit insurance and credit registries are at a high risk of having an adverse impact on bank's risk-taking incentives due to the increase in banking system competition beyond the

country's limit. This could perhaps also be true of developing countries such as EAC member countries where such risks could be much more pronounced given the inadequacies in the legal and regulatory infrastructure.

Table 4.1 Financial System Regulation and Supervision tools

Tool Set		Goal	Instrument
Prudential Policy	Micro prudential	Limit distress of individual institutions.	E.g. Quality/Quantity of Capital, Leverage ratio.
	Macro prudential	Limit financial system-wide distress.	E.g. Countercyclical capital charges.
Monetary Policy		Price Stability.	Policy rate, standard repos.
		Liquidity Management.	Collateral policies; interest on reserves; policy corridors.
		Lean against Financial Imbalances.	Policy rate; reserve requirements; mop-up of liquidity; FX reserve buffers.
Fiscal Policy		Manage aggregate demand.	Taxes; automatic stabilizers; discretionary countercyclical measures.
		Build fiscal buffers in good times.	E.g. Measures to reduce debt level; taxes/levies on the financial system.
Capital Controls		Limit system-wide currency mismatches.	E.g. Limits on open foreign exchange positions; constraints on the type of foreign currency assets,
Infrastructure Policies		Strengthen the resilience of the financial infrastructure.	E.g. move derivatives trading on exchanges.

Source: Hannoun (2010)

4.2.2 Empirical Evidence

The recent Global Financial Crisis (GFC), 2008 rekindled the importance of ensuring individual banks and the financial system as a whole is sound and stable. Financial system stability relates not only to the absence of actual financial crises but also the ability of the financial system to limit, contain, and address imbalances before they crystallize into a threat to the financial system or economic processes. Financial stability has two major facets; macroeconomic and structural conditions in the real economy; and resilience and robustness of the system. Equally important is, sufficient political and social consensus. Financial system failures (instability) can emerge from either within the financial system or as a result of external shocks associated with the real economy imbalances or contagion shocks (Summers, 2000; Schinasi and et al., 2011; Betz et al., 2014). Thus, a single quantitative indicator cannot fully explain its complex nature, and difficult to forecast. Its underlying policies tend to involve a

trade-off between resilience and efficiency and its policy requirements may be time inconsistent.

There are different kinds of financial crises that a country can face, depending on the nature of risk factors that the financial system has encountered (Allen, et, al., 2009). Numerous empirical studies have shown that there are three major types of financial instability crises such as the banking crisis, the sovereign debt crisis and the currency crisis; and they are normally co-exist under form of twin crises or can be even the triple crisis (Kaminsky & Reinhart (1999), Laeven & Valencia (2008), Laeven (2011) and Bordo & Haubrich (2017)).[5] All these financial crises have a contagion effect, that might cascade to other industry and adversely impact the economy at large. The GFC is a vivid example of the impact of the financial system failure, whereby the collapse of several financial institutions has had significant adverse effects on the economy at large.

The GFC further underscores the caution with which a notion of 'too big to fail' should be taken into consideration. The crisis showed that there is a high possibility of failure of large interconnected financial institutions to trigger systemic risk and spill over to the whole financial system. And thus, the need to strengthen the macroprudential approach of the regulatory and supervisory frameworks was seen inevitable. According to the study conducted by Dewatripont, et. al., (2010), Beck (2014) and Goodhart (2016) on the analysis of the GFC, one of the lessons from the GFC regarding financial stability relates to the importance of broadening the regulation and supervision regime beyond the individual market participants to cover the financial system as whole.

There are several models that have been adopted in order to ensure financial system stability. One method is by using early warning systems (EWS), which can forecast the probability of a financial crisis occurrence, but it neither includes all the risks to which the system is exposed, nor information related to the shocks' response capacity. The stress tests technique allows the identification of potential shocks. It estimates the financial system resistance, but they give no possibility to compare the stability level during different periods or the stability level of two or more financial systems. The aggregated financial stability index includes the EWS and stress tests techniques and forms an independent technique, which is complementary to other techniques (Albulescu, 2010).

[5] A case in point of twin financial crises are the currency and banking crises that occurred in Asia – 1997, Russia – 1998, and Turkey – 2000; currency and sovereign crises occurred in Mexico – 1994, Brazil – 1999 and Argentina – 2001; as well as European financial crisis which was banking and sovereign debt crises.

Another method is the aggregated financial stability index (AFSI), which offers the possibility to make comparisons between different periods, different systems, and enable the observation of the stability level dynamics. Despite the argument of Borio et al., (2011), who argues that AFSI is auxiliary to other more complex techniques; AFSI presents numerous advantages such as high transparency, easier access to statistic data, simplicity of calculations and possibility to forecast financial stability level (Albulescu, 2010). Besides, since financial stability represents dynamic processes, then stress tests must be included in any technique of measuring financial stability.

Moreover, available literature has suggested the best way to analyse a multidimensional economic phenomenon such as financial stability is by means of the synthetic index, which aggregates different basic indicators (Gadanecz and Jayaram, 2012). This kind of analysis captures the dimension of financial stability by using different indicators, which highlight financial system development and efficiency, consumer confidence in the financial sector and macroeconomic context. In addition, according to Jakubík and Slačík (2013), the main objective of the synthetic index is to broaden the scope of macro prudential surveillance by enhancing the set of existing tools of monitoring and assessing systemic stability of the financial system. The synthetic index considers the complex nature of the financial and economic systems and provides the possibility of identifying sources which build-up systemic risks over time, even in the absence of extreme events; and prepares policymakers to take policy actions on time. This index can thus be used as an early warning system.

4.2.3 Conceptual framework

As indicated in Figure 3.2, we propose 11 variables to test their impact on the credit risk behaviour in the EAC banking system. We also use the ratio of nonperforming loans as a proxy of credit risk, like other previous studies such as (Jakubík & Reininger (2013), Waqas, Fatima, & Khan (2017) and Mpofu & Nikolaidou (2018)). The proposed explanatory variables have been selected from both internal (bank-specific) and external (macroeconomic) factors.

Besides, the theoretical review emphasizes on the importance of including both internal and external factors as influencers of credit risk. On one hand, the Minsky hypothesis posits macroeconomic factors such as economic growth, money supply, interest rates, exchange rate and terms of trade influence loan payment; and hence nonperforming loans. On the other hand, the prudential theory also suggests that bank-specific factors such as financial intermediation, profitability, efficiency, management, and capital adequacy influence the credit risk behaviour. Cognizant of these three theories, this study intends to examine the extant evidence of the

drivers of the credit risk behaviour in the EAC banking system including both internal and external factors.

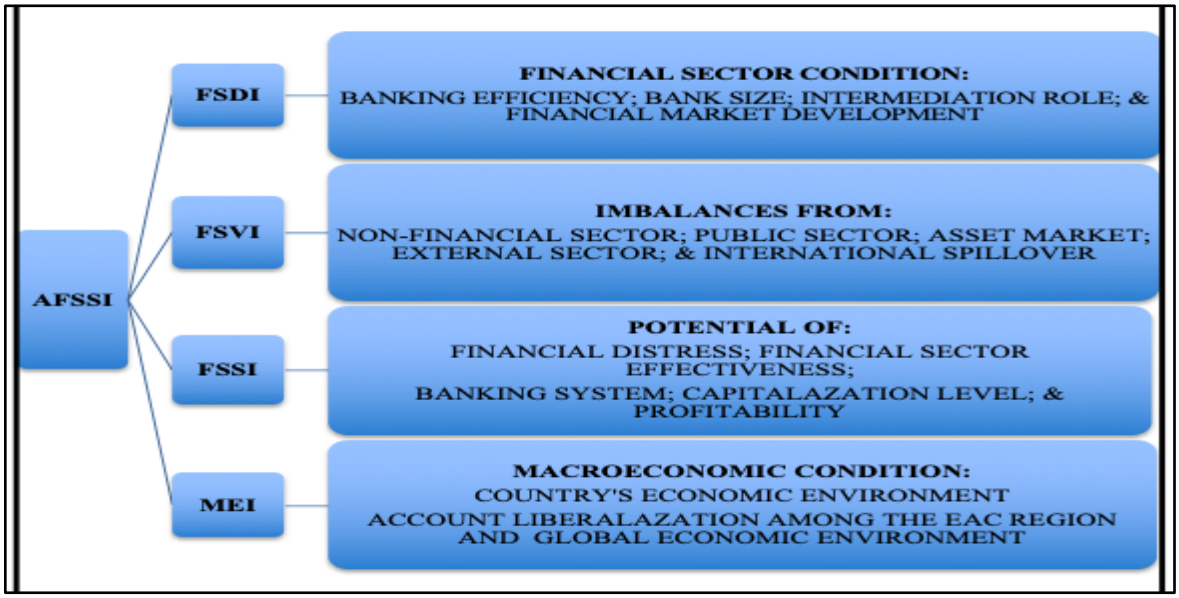

Figure 4.1 Conceptual framework for the Determinants of Credit Risk in the EAC
Source: Author's Construction

4.2.4 Concluding Remarks and Gap in Literature

In this regard, it is evident from the foregoing that most of the studies have been focused on the assessment of individual countries, and less attention is given to the financial system stability issues for African countries. Besides, the survey of the literature suggests no aggregated financial system stability index has been developed for the EAC countries despite the recent deepening of financial integration. Therefore, this study intends to develop an AFSSI for the EAC to measure the EAC financial system resilience and forecast its robustness. The index will contrast some well-known IMF's Financial Soundness indicators, with an addition of other relevant financial and macro prudential indicators. This is to ensure that the study captures all possible potential risk factors emanating from different sectors. The study contributes to the enhancement of the set of financial system stability analysis used by policymaking authorities.

4.3. Data and Methodology: Measuring Financial System Resilience

Following the observation from the stylized facts of the evolution of the EAC financial system the decline of the quality assets, the adverse impact of the increase in NPL across the region has drawn attention on how resilient the financial system has been for the past two decades. Cognizant, the study intends to we measure and forecast financial system resilience

in the EAC financial system. In the process, we developed an Aggregate Financial System Stability Index (AFSSI) in order to measure the financial system stability of the region.

4.3.1. Measurement of Variables

Following the study conducted by Gersl et al., (2007) on advantages and disadvantages of financial stability indicators; and their use in the assessment of financial system stability, the study selected a total of twenty-four selected indicators to assess systemic stability level of the financial system in the EAC. The index contrasts some well-known IMF financial soundness and macro prudential indicators. However, several variables are not included for conceptual reasons underlying drivers of the financial system stability due to substantial data unavailability. These data are such as banking system concentration ratios, frequency of banking crises, financial market infrastructure ratios and institutional, regulatory, and legal framework ratios. Therefore, it makes sense to focus on the relevant indicators with substantial data that represent the system.

For this purpose, we organized the selection of individual indicators for financial stability according to the underlying structure. Individual indicators are grouped into the four composite (or partial) stability indexes, which reflects the dimension of the financial system stability. The general assumption is that all indicators increase over the period and have an impact on financial system stability.

The first sub-index, FDI, comprises of financial development indicators. The FDI is a broad multi-dimensional approach to aggregate financial development. These indicators show how developed financial system is in terms of the depth (size and liquidity of markets), access to financial services, and financial system efficiency. High level of FDI is considered to promote financial stability and boosts economic growth (Hayat, 2019). However, if these developments are not well regulated and supervised, financial developments can lead to financial instability. Therefore, it is important to assess financial development because of the trade-offs between financial growth and stability as financial instability risks increase with financial institution depth.

The second sub-index, FVI, comprises of financial vulnerability indicators. FVI comprises of leading indicators, which are used for stress test analysis and acts as early warning indicators of recession or crises. The FVI includes indicators which assess macroeconomic conditions (stability) and funding structure of banking institutions. Emerging market economies, which heavily often rely on external borrowing and other capital inflows for their economic growth, are especially vulnerable to reversals in investor sentiment. Thus, this index

enables one to recognize the vulnerability of a financial system to a financial crisis at an early stage and prevent further build-up of vulnerabilities or alternatively enhance the shock absorption capacity of the financial system. The sustainable values of these vulnerability indicators show that the financial system is sound and capable of respond to potential shocks.

The third sub-index, FSSI, comprises of indicators used in assessing the solvency of financial systems, particularly one dominated by commercial banks. The FSSI has taken into an account core set of financial soundness indicators that are used to determine the financial soundness of banks (Basel II). These indicators assess the strengths and weaknesses of countries' financial sectors. These indicators can be used as tools to mitigate vulnerability and assess financial system's sensitivity to market risk, including changes in interest rates and exchange rates. Key signals are loan quality of the system; banking system capitalization level and the amount of buffers the banking system should guard against shocks to earnings; profit obtained by the credit institutions; and banking institutions' solvability.

The last sub-index of AFSSI indicates the macroeconomic economic environment (MECI). These indicators reflect macroeconomic condition. Due to interconnected nature of financial systems, it is important to include the regional and global economic indicators in the financial system stability analysis. Most risks arising from world and regional economic and financial developments are exogenous in nature, which EAC has limited macro prudential policy actions or mandate to manage. In this regard, the study also takes into consideration these indicators such as world inflation, world and regional economic growth.

4.3.2. Methods of Data Analysis

Available literatures such as Gadanecz and Jayaram (2012) have suggested that the best way to analyse a multidimensional economic phenomenon such as financial stability is by means of synthetic index, which aggregates different basic indicators. Efforts to develop a comprehensive mechanism (synthetic index) to detect and analyse financial distress heightened after Asian Crisis in 1997 and global financial crisis in 2008. For instance, in 1999 and 2006, the IMF developed a set of financial soundness indicators, which monitor variables focusing on market pressure, external vulnerability and banking system vulnerability aimed at better safeguarding global financial stability.

The main objective of synthetic index is to broaden the scope of macro prudential surveillance by enhancing the set of existing tools of monitoring and assessing systemic stability of the financial system. The index takes into account the complex nature of the financial and economic systems and provides the possibility of identifying sources which build-

up systemic risks over time, even in the absence of extreme events; and prepares policy makers to take policy actions on time (Albulescu, 2010). The synthetic index can thus be used as an early warning system. Against that background, this study intends to develop an Aggregated Financial System Stability Index (AFSSI) that measures financial stability levels in the EAC financial system.

4.3.3. Empirical Model Specification

Following Albulescu (2010), construction of AFSSI uses a standard three-step approach found in the literature on reducing multidimensional data into one summary index: (a) normalization of variables; (b) aggregation of normalized variables into sub-indices representing a particular functional dimension; and (c) aggregation of the sub-indices into the final index. This procedure follows the OECD Handbook on Constructing Composite Indicators, which is an excellent reference for methodological suggestions (Commission, 2008). Therefore, for this study, we construct a total of four indices, which assess at varying levels of abstraction how financial system stability is across countries.

4.3.3.1 Normalization of Variables

Combining individual indicators into a single aggregated index requires all indicators to be transformed into a standard base/scale for ease of comparison (Illing and Liu, 2006; van den End, 2006). This is because these individual indicators do not always have the same accuracy or the same measurement unit, which complicates their aggregation. Hence, there is a need to normalize all indicators' values.

There are different methods of transforming an indicator into a standard base or scale (normalization) such as: statistical, empirical, axiological and mathematical normalization (Commission, 2008). The methods most used in economics and financial analyses are empirical and statistical normalization methods. Empirical normalization uses the range of maximum and minimum as scaling factor. Usually, the benchmark is represented by the value of the indicator in a reference year. The minimum value, which is zero (0), implies unfavourable financial condition and maximum value, which is usually one (1), implies favourable financial condition. While statistical normalization transforms all indicators into a standard scale with a mean of 0 and standard deviation of 1, and standard deviation becomes a scaling factor.

This study adapts the statistical normalization method known as z-score methodology used by Cheang and Choy (2011); and Nasreen et al., (2015) order to avoid the disadvantage of empirical normalization method whereas the minimum and maximum values can be

unreliable outliers and therefore have distortion effect on the normalized indicator. Therefore, to obtain normalized value indicators (Z_t), the mean value is subtracted from each indicator, and its standard deviation divides the result. (Z_t), is distributed with the mean of zero and standard deviation of one, meaning that the value of indicator X_t is normally distributed N (0,1). The z-score formula is computed as:

$$Z_t = \frac{X_t - \mu}{\sigma}$$ .....*Equation 4.1*

Whereas Z_t represents the normalized value of the variable of interest (indicator); X_t is the value of the variable of interest during period t; μ is the mean value of X, and σ is the standard deviation of variable X.

4.3.3.2 Weighting of Indicators

Studies on measuring financial stability by using aggregated index have shown that there are different approaches to determining weights of relevant variables (Gersl et al., 2007; Gadanecz and Jayaram, 2012; and Morris, 2010). Usually, the number of indicators under each sub-index determines their respective weights to the overall financial system stability index. The most used methods are such as: assigning equal weight to all indicators with an assumption that all indicators have the same importance; assigning different weights to each indicator with an assumption that each indicator matters differently.

The study used the statistical method of weighting analyses, in particular the principal component analysis (PCA) in line with other studies (Cheang and Choy, 2011; Arzamasov and Penikas, 2014). One of the benefits of using PCA in constructing financial system stability index is its ability to determine the individual importance of a large number of indicators so that the weight each receives is consistent with its historical importance of fluctuations in the broader financial system (Brave and Butters, 2011). We also found no significant difference in results between equal weights and PCA. Besides, our data set is not too large hence it does not necessarily require PCA method to transform it into low-dimensional representations in an adaptive and insightful way.

This study uses the principal component analysis (PCA) standard procedure Thus, the normalized indicators are then aggregated into four different sub-indices namely, Financial System Development Index (FSDI), Financial System Vulnerability Index (FSVI), Financial System Soundness Index (FSSI), and Macro-Economic Environment Index (MEI). Thus, the general weighted average equation of each sub-index is given as:

$$z_t^{\rightarrow k}\, z_t^{\rightarrow} = 1$$.....Equation 4.2

Where Z_i is vector of the initial factor's weight in the i-th principal component (of difference sign). To ensure that weights generated from the PCA method are positive, this paper takes the mean of all the principal factors generated from the PCA method as follows:

$$z_{ji} = \frac{\sum_{i}^{k=1} c_{ij}}{\kappa} \quad \text{.....Equation 4.3}$$

Where k is total number of principal factors, *j* is a factor index number and *i* is the selected sub-index. This is then normalized to one as follows:

$$\tilde{z}_{ij} = \frac{z_{ij}}{\sum_{i=1}^{n} z_{ji}} \quad \text{.....Equation 4.4}$$

Where n represents the total number of variables in the sub-index involved in the PCA method. The PCA produces both negative and positive weight results and ascribing the highest amount of variance and skews the results of the analysis. Thus, to neutralize the effect of negative results obtained from the PCA method, we include the uniform weight in the computation of our total weights for sub-indices and use the average of the two results. Thus, the final weight computation is denoted as the average of uniform and PCA weighting methods as follows:

$$W_i = \frac{1/n + \widetilde{z_{ji}}}{2} \quad \text{.....Equation 4.5}$$

Where W_i represents the mean of the weights computed from uniform and PCA weighting methods. Therefore, we compute the sub-index using the following equation:

$$SI_{it} = \sum_{i=1}^{n} W_i I_i Z_i \quad \text{.....Equation 4.6}$$

Where SI_{it} represents sub-index at the period time t; I_i is the impact of individual indicators on financial stability; W_i is weight assigned to each indicator, and Z_i is the value of normalized indicator X_t and n is the number of variables.

4.3.3.3 Aggregation of Sub-indices into the composite Indicator

The aggregated financial system stability index (AFSSI) comprises the four sub-indexes reflected in section 4.3.1 and Equation 4.6. Procedures of aggregating all sub-indices into a single AFSSI follows the same procedure used in the aggregation of variables in to one single index (sub-indices). The AFSSI has similar characteristic as its sub-indices such that it has a mean of zero and standard deviation of one. Therefore, the AFSSI is denoted as follows:

$$AFSSI_{i,t} = \sum_{i=1}^{n} W_{i,t} SI_{i,t} \quad \text{.....Equation 4.7}$$

Where $AFSSI_{i,t}$ is the aggregated financial system stability index of a particular country at time t; $W_{i,t}$ is the weight attached to each sub-index, and $SI_{i,t}$ represents sub-indexes.

Furthermore, the study aggregates financial system stability indices of all five countries to analyse the evolution of regional financial system stability. We used volume of the regional intra-trade of each country as a percentage share of its GDP to compute weight of each country in the aggregation of EAC financial system stability. Therefore, the regional financial system stability index is denoted as follows:

$$RAFSSI_{i,t} = \sum_{i=1,t}^{5} \frac{E_{i,t}+I_{i,t}}{GDP_{i,t}} \quad \ldots\ldots\ldots\ldots \textit{Equation 4.8}$$

Where RAFSSI is the Regional Aggregated Financial System Stability Index; $E_{i,t}$ is the volume of exportation to all EAC countries; $I_{i,t}$ is the volume of import to all EAC countries; and $GDP_{i,t}$ is the economic growth. The stability indicators can be reported for the entire financial system as well as for the individual index. Interpretation of results implies that negative values indicate periods of instability and positive values denote periods of stability of the financial system.

4.3.4. Data Collection

Data was extracted from several databases such as indicated in Table 4.2. The study used panel balance sheet data instead of market data which are more volatile and enables a short run forecast of financial stability due to unavailability of data. Nevertheless, panel data helps to study the behaviour of each financial system over time and across space. In addition, in order to assess the overall systemic stability in a reliable manner, we used a very broad range of indicators to examine and project the likely future development of the EAC financial system stability. The study used quarterly data spanning 2000 quarter one to 2017 quarter four, which allow more accurate analysis as compared to the annual data.

Table 4.2 Aggregated Financial System Stability Index (AFSSI) Indicators

Name	Indicator (percentage)	Impact	Explanation	Source
Financial Development Index (FDI)	Deposit money banks' assets to GDP	+	This reflects information related to the financial intermediation level. The highest the level, the more developed and more mature the banking system is considered.	World Bank
	Total Domestic credit to GDP	+	This reflects information related to the financial intermediation level. The highest the level, the more developed and more mature the banking system is considered.	World Bank
	Broad money to GDP	+	Broad money to GDP indicates the money supply, which is the totality of assets that household and businesses can use to make payments as a share of GDP	IMF
	Bank net interest margin	+	Net interest margin, which represents the difference between the bank's interest income and expenses over total assets.	World Bank
	Stock Market Capitalization to GDP	+	This is a buffet indicator, which indicates the development of capital markets. Increases in this valued leads to improvements in the financial system stability	World Bank
Financial Vulnerability Index (FVI)	Bank credit to bank deposits	-	This reflects how much a bank lends out of the deposits it has mobilized. Higher ratio indicates the asset-liability mismatch, which affects bank's capacity adequacy.	*IMF*
	Total Private Credit	-	This reflects non-governmental credit. If these loans will not be well managed, they will become NPLs. Thus, its decline reflects a favourable situation.	World Bank
	Bank liquid reserves to bank assets	+	Bank liquidity reserves represent a guarantee related to the bank's capacity to respond to severe withdrawals of money. Liquidity preference is important because the stronger the cash payments preference manifests, the more significant the increase of withdrawals probability is	World Bank
	Risk premium on lending	+	This reflects the banking system income (profitability). Higher interest spread characterizes a high profitability and efficiency level of the banking industry in intermediation and allocation of resources. (It is a percentage of lending – deposit interest rate)	World Bank
	Fiscal Deficit/Surplus to GDP	-	This analyses the government performance. Higher budget deficit tends to discourage investors' confidence in the government's capacity to ensure a future sustainable growth.	IMF

Name	Indicator (percentage)	Impact	Explanation	Source
	Inflation Rate	-	This is a macroeconomic vulnerability indicator as it represents price stability. Low and stable inflation rate increases investor's confidence and stimulate business growth.	World Bank
	Current Account Deficit to GDP	-	This signals the country's susceptibility to external shocks. Higher deficit leads to an increase in foreign direct investments (FDIs) as a correction measure to sustain country's consumption. Thus, in case of decrease in FDIs due to different causes, the financial system becomes vulnerable	IMF
	Real Effective Exchange Rate	-	Excessive appreciation or depreciation volatility of the REER implies that the economy undergoes major corrections by means of the exchange rate, which can affect the stability of the financial system.	IMF
	Forex Exposure to Equity	-	Foreign currency denominated assets to total assets. This indicator has a negative effect on the performance of listed commercial banks	IMF
Financial System Soundness Index (FSSI)	Liquid Assets to Total Asset	+	This is a ratio between effective and required liquidity.	IMF
	NPL to Total Loans	-	This reflects the loans quality. Higher NPLs indicate the higher the possibility of financial distress.	IMF
	Weighted Regulatory Capital Risk	+	Regulatory capital to risk weighted asset ratio reflects the banking sector capitalization and indicates banking institutions' solvability.	IMF
	Return on Assets	+	This reflects indicates the profitability of the Bank.	IMF
	Z-Score	+	This reflects the probability of the banking system's default (bank solvency). A higher value indicates lower probability of insolvency.	IMF
Macro-Economic Climate Index (MECI)	Country's GDP growth	+	Liberalization of the capital account among EAC member states and later to the rest of the world will stimulate investments and growth within the region. This will lead to improvement of stability of the financial system	World Bank
	EAC GDP growth			
	Global GDP growth			
	Global Inflation Rate	-	This is a macroeconomic vulnerability indicator as it represents global price stability. High inflation impedes the economic growth	

It is worth noting that, the collected data obtained for this study were in different frequency such as yearly and quarterly depending on the nature of data reporting from a particular data source. Most of the data reported at the WB are on annual basis while IMF are quarterly basis. In addition, the starting period of the data obtained from the IMF was largely informed by the absence of comprehensive quarterly data for the period preceding 2005. For the case of unavailability data, the study used data manipulation process to generate the required data. The data manipulation process includes computing the missing data by using statistics methods (interpolation), codding and changing the frequency.

4.3.5. Preliminary Data Analysis

Before we develop the AFSSI and analyse the financial system stability trend of the EAC countries, it is important to examine the descriptive statistics and correlation among all the variables used to develop the AFSSI for the whole panel. This helps us to understand the underlying distribution of each variable relative to the normal distribution. According to the central limit theorem and the theoretical distribution theory, normal distribution variables has the mean equal to the median and mode; and kurtosis ≈3.0 and skewness coefficient = 0 (Rosenblatt, 1956; Bera and Jarque, 1981; Balakrishnan and Scarpa, 2012). In addition, Jarque and Bera suggested than variables are normally distributed when the probability of Jarque-Bera test (JB) is greater than 5 percent. As it is evident in Table 4.3, results from the central limits (Mean and median); the probability distribution (skewness and kurtosis) and JB test indicate that we should reject the null hypotheses for all series. This means that our variables are not normally distributed at the 99 percent level of confidence.

Table 4.3: Summary Statistics

VARIABLE	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
DM	23.2032	17.3973	12.5314	0.7445	1.9606	29.6789	0.0000
TC	22.1751	18.0568	12.7925	0.5031	1.7188	23.8846	0.0000
BM	27.1147	22.9649	8.5058	0.6222	1.7962	26.9812	0.0000
NIM	8.7333	8.3775	1.9857	0.5552	3.0566	11.1240	0.0038
IRS	9.8220	9.7537	2.5095	0.2079	2.2390	6.7692	0.0339
SMC	16.0439	9.1750	16.8053	1.4848	4.9396	113.2265	0.0000
BCD	67.7766	73.6050	15.6165	-0.6385	2.5009	16.9180	0.0002
TPC	16.6344	13.9398	8.6257	0.5686	2.0239	20.2144	0.0000
BLR	17.0240	17.3301	5.5996	0.1581	2.3722	4.4478	0.1082
RPL	8.2127	8.2052	3.4770	-0.4520	3.4225	8.9612	0.0113
FBB	-5.2050	-3.4961	4.8529	-1.3757	4.4907	88.1256	0.0000
IR	7.9608	6.7645	3.9775	1.2135	5.4399	106.5894	0.0000
CAD	-5.2774	-5.5095	3.1808	0.0558	1.9779	9.5144	0.0086
REER	99.9495	102.256	16.7914	-1.4164	5.5069	128.7874	0.0000
FFX	4.0302	0.5858	8.8416	0.8048	2.5160	25.4242	0.0000
LATA	36.9918	33.8387	38.5932	-0.4851	6.6254	126.7652	0.0000
NPL	11.1184	7.2891	10.3560	1.3966	4.3535	86.7079	0.0000
RWCA	20.1924	19.7511	2.9035	0.5487	3.2449	11.3796	0.0034
ROA	3.5681	3.5989	1.1765	-0.4146	3.2750	6.8681	0.0323
ZS	11.1103	10.9563	2.3070	0.1467	2.5903	2.2859	0.3189
CGDP	5.7382	5.8927	2.0476	-0.8533	4.2318	39.8713	0.0000
RGDP	5.5082	5.5951	1.1850	-0.7521	3.5994	23.5994	0.0000
GGDP	2.9810	2.8558	1.3011	-0.9156	5.6140	91.6740	0.0000
GIR	3.6707	3.5201	1.4502	1.2103	5.4306	105.9085	0.0000

In addition, to strengthen the results of the descriptive statistics above, a simple correlation analysis was performed in order to analyse the correlation among the variables that might hinder the accuracy of our results (Pearson, 1920). The null hypothesis suggests there is no relationship between the variable if the coefficient value of correlation and its p-value is less than the significance level of 5 percent. The results in Table 4.4 indicate that most of the variables are not relative to highly correlated (less than 0.5 correlation). This indicates that the multi-co-linearity problem in the data sample is not relative serious.

Table 4.4: Correlation Analysis

	DM	TC	BM	NIM	IRS	SMC	BCD	TPC	BLR	RPL	FBB	IR	CAD	REER	FFX	LATA	NPL	RWCA	ROA	ZS	CGDP	RGDP	GGDP	GIR
DM	1.00																							
TC	**0.97**	1.00																						
BM	**0.97**	**0.95**	1.00																					
NIM	-0.40	-0.42	-0.47	1.00																				
IRS	-0.25	-0.21	-0.22	0.37	1.00																			
SMC	0.34	0.41	0.31	-0.09	-0.05	1.00																		
BCD	**0.72**	**0.77**	**0.65**	-0.28	-0.37	**0.55**	1.00																	
TPC	**0.97**	**0.97**	**0.96**	-0.43	-0.28	0.40	**0.81**	1.00																
BLR	**-0.80**	**-0.71**	**-0.83**	0.29	0.14	-0.11	-0.49	**-0.79**	1.00															
RPL	-0.17	-0.15	-0.13	0.28	**0.76**	0.09	-0.18	-0.16	0.09	1.00														
FBB	-0.22	-0.26	-0.12	0.31	**0.67**	0.05	-0.32	-0.22	-0.06	**0.66**	1.00													
IR	0.28	0.23	0.30	-0.26	-0.34	0.20	0.28	0.29	-0.32	-0.13	0.12	1.00												
CAD	-0.01	-0.03	0.02	0.20	**0.56**	-0.05	-0.18	-0.07	-0.20	0.28	0.47	-0.20	1.00											
REER	-0.11	-0.16	-0.16	-0.12	-0.49	0.06	-0.10	-0.12	0.13	-0.18	-0.47	-0.05	-0.46	1.00										
FFX	0.43	0.44	0.42	0.03	0.26	0.00	0.07	0.34	-0.37	0.00	0.13	0.12	0.36	**-0.57**	1.00									
LATA	-0.48	**-0.52**	**-0.53**	0.42	0.02	-0.23	**-0.65**	**-0.57**	0.45	0.00	-0.12	-0.30	-0.18	0.45	-0.02	1.00								
NPL	0.23	0.30	0.35	-0.41	0.35	-0.08	0.03	0.24	-0.29	0.05	0.32	0.03	**0.51**	**-0.55**	0.34	**-0.61**	1.00							
RWCA	-0.46	-0.47	-0.46	0.09	0.36	0.06	**-0.53**	-0.49	0.39	0.33	0.21	-0.26	-0.05	0.42	-0.34	0.48	-0.13	1.00						
ROA	-0.07	-0.14	-0.16	**0.54**	-0.07	0.16	-0.06	-0.09	0.05	0.10	-0.06	0.04	-0.26	0.46	-0.15	0.52	**-0.69**	0.32	1.00					
ZS	**0.73**	**0.73**	**0.72**	-0.46	-0.25	0.31	0.44	**0.70**	-0.53	-0.16	-0.26	0.24	-0.25	0.22	0.19	-0.29	0.24	0.01	0.06	1.00				
CGDP	-0.35	-0.46	-0.34	0.19	-0.35	-0.24	-0.33	-0.36	0.12	-0.15	-0.12	-0.14	-0.19	**0.52**	-0.49	0.38	-0.49	0.14	0.37	-0.22	1.00			
RGDP	0.04	-0.09	0.09	0.06	-0.29	0.05	-0.01	0.03	-0.23	-0.04	0.20	0.22	-0.15	0.10	-0.17	-0.03	-0.23	-0.19	0.15	-0.04	**0.53**	1.00		
GGDP	-0.07	-0.06	-0.06	0.24	0.17	-0.11	-0.16	-0.09	0.09	-0.07	0.09	-0.16	0.19	-0.21	0.12	0.04	0.18	0.01	0.07	-0.14	0.03	-0.05	1.00	
GIR	-0.10	-0.21	-0.04	0.12	0.02	-0.12	-0.22	-0.13	-0.14	0.11	**0.50**	**0.55**	-0.02	-0.19	0.14	0.03	-0.02	-0.04	0.16	-0.10	0.10	0.47	-0.02	1.00

Note: DM is Deposit money banks' assets to GDP, TC is Total Domestic credit, BM is Broad money, NIM is Bank net interest margin, IRS is Bank lending-deposit spread, SMC is Stock market capitalization to GDP, BCD is Bank credit to bank deposits, TPC is Total Private Credit, BLR is Bank liquid reserves to bank assets, RPL is Risk premium on lending, FBB is Fiscal Deficit/Surplus to GDP, IR is Country's Inflation Rate, CAD is Current account balance, REER is Real Effective Exchange Rate, FFX is Net Foreign Exchange to Capital, LATA is Liquid Assets to Total Assets, NPL is NPLs to Total Gross Loans, RWCA is Regulatory Capital to Risk-Weighted Assets, ROA is Return on Assets, ZS is Bank Z-Score, CGDP is Country's Specific GDP growth, RGDP is EAC GDP growth, GGDP is Global GDP growth and GIR is Global Inflation Rate.

4.4. Empirical Results and Discussion

This section presents the empirical analysis results of the financial system stability in the EAC by using AFSSI. Equal weights assigned to each indicator explain the episode of AFSSI. Mostly massive weights are assigned to vulnerability index because they capture a wide range of risks in macroeconomic and bank-specific factors. This means that AFSSI has considered the contra-effects of all indicators, which have positive and negative effects on the stability of the financial system. It, therefore, follows that when AFSSI is above the historical mean value (zero), it indicates the period of financial system stability and when it is below the mean value, it implies the opposite case. Besides, the rise of the index (upward trend) implies the improvement of the financial system stability and the vice versa.

4.4.1 The EAC Financial System Stability

Generally, results have highlighted two folds. On the one hand, the regional macroeconomic and structural condition has continued to record relative strong economic growth, with low inflation. The macroeconomic outlook remains stable, though vulnerable to external shocks. The continuous fiscal budget deficits, current account deficit and low private sector development has continued adding pressure to the economy. These macroeconomic effects have also been revealed in the financial vulnerability indicators whereby during economic distress, these indicators increased, and the banks' liquidity reserve has also deteriorated. This adds a constraint on financial system stability.

On the other hand, the regional financial system has continued to develop, albeit slowly, particularly in relation to its intermediation role. This was revealed by higher lending rates and limited access to private credit across the region despite the extraordinary progress made on the side of financial inclusion (mobile money transfer system). This led to a continuous profit decline due to the increase in NPLs. However, the financial system remained well-capitalized, commercial banks met the minimum core and total capital adequacy ratios despite the current poor asset quality. Thus, financial systems have been able to remain sound and stable.

As shown in Figure 4.2, the regional financial system has remained sound and stable after experiencing several instability incidences during 2000 – 2009. During that time, regional financial systems were less developed compared to the current period, operating in a weak macroeconomic environment with fairly inadequate regulatory frameworks; and thus, making the financial system more vulnerable to shocks. However, following the financial sector reforms implemented across the region in the early 2000s and the integration initiatives after

signing of the EAC Common Market Protocol in 2010, some improvements on the financial system stability have become noticeable.

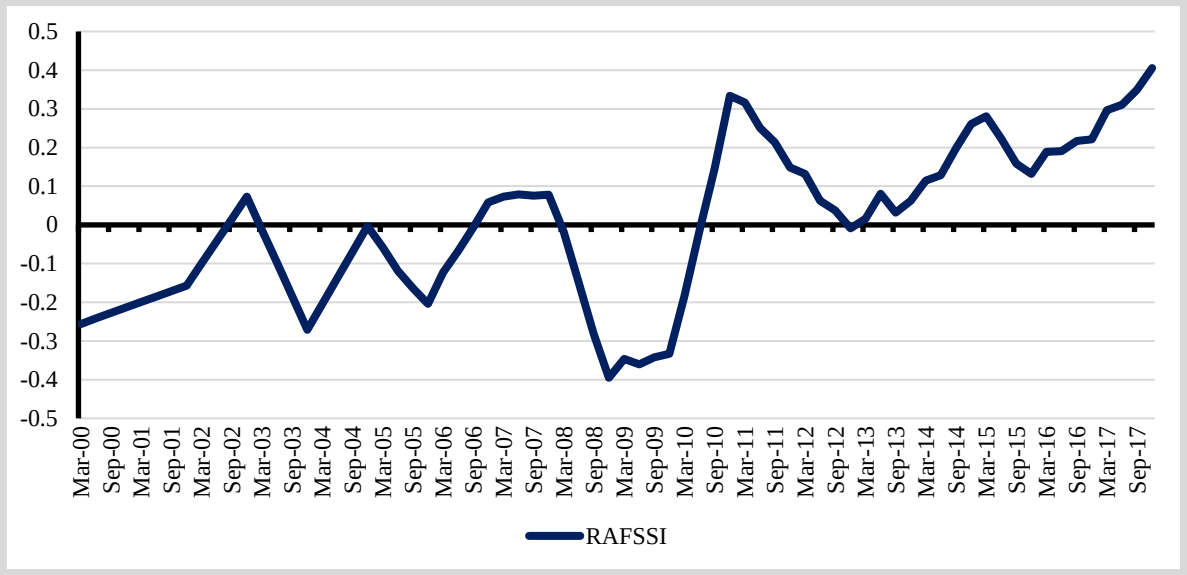

Figure 4.2: The EAC Financial System Stability Index

The period between 2000 and 2009 was mainly characterized by considerable strains in the financial system stability, largely underpinned by insufficient financial soundness of the system with less financial system development and relative weak macroeconomic condition. As shown in Figure 4.3, FSSI was below the average throughout the period. However, a notable improvement of FSSI was seen from 2010 when the FSVI deteriorated and FSSI, FSDI and MEI started improving gradually. These improvements were also attributed to macroeconomic and fiscal policies that have been implemented since 2010 such as an increase in financial inclusion and harmonization of regulatory and legislative frameworks and policies.

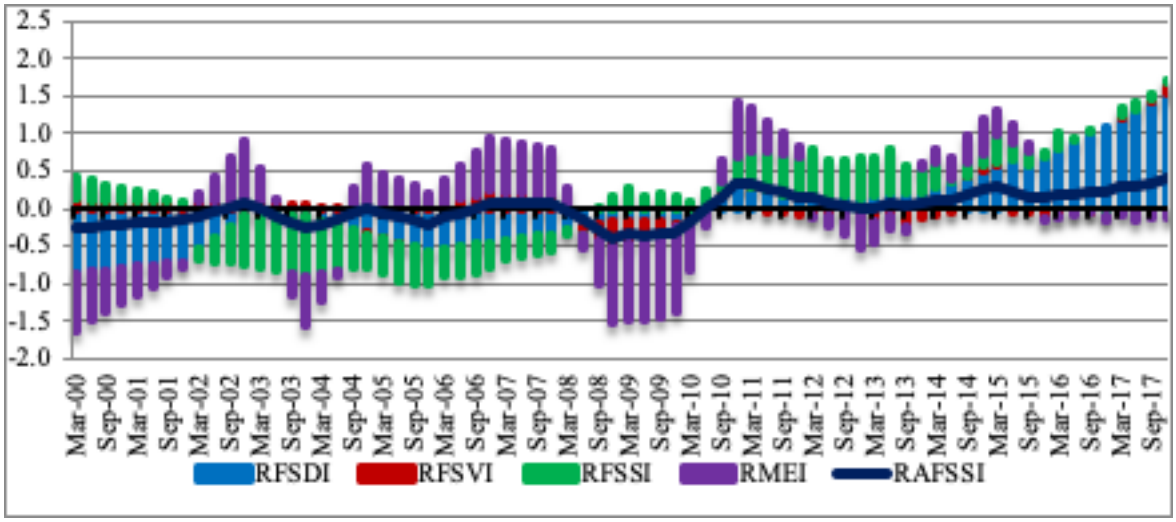

Figure 4.3: The EAC Financial System Stability Index and its Decomposition

Comparison across peer countries' financial system stability, results show different trajectories with slightly similar tides (Figure 4.4). However, Kenya appeared to be the most advanced and vibrant, and yet the most vulnerable financial system in the region. On the one hand, financial systems in Rwanda, Tanzania and Uganda have registered a moderate performance. On the other hand, Burundi recorded the least financially stable in the region, and the least developed and most vulnerable financial system.

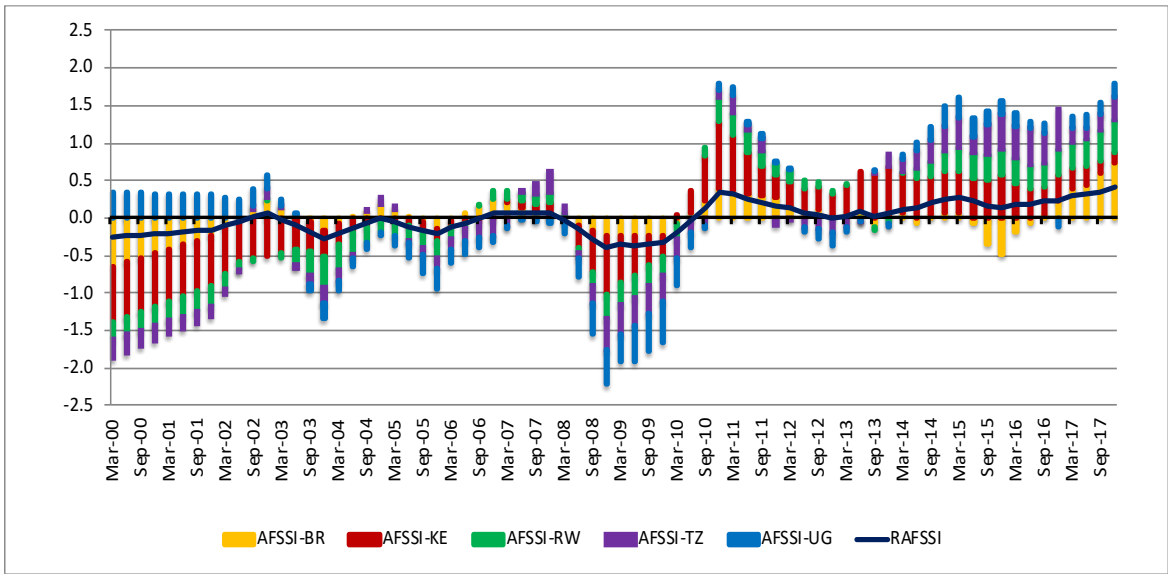

Figure 4.4: Financial System Stability Index and its Decomposition in EAC

The EAC financial systems development recorded an average performance. Looking at the AFSSI sub-indices in the analysed countries, results show quite a similar picture. As indicated in Figure 4.5, the regional financial system is growing at a steady pace, albeit still relatively underdeveloped.

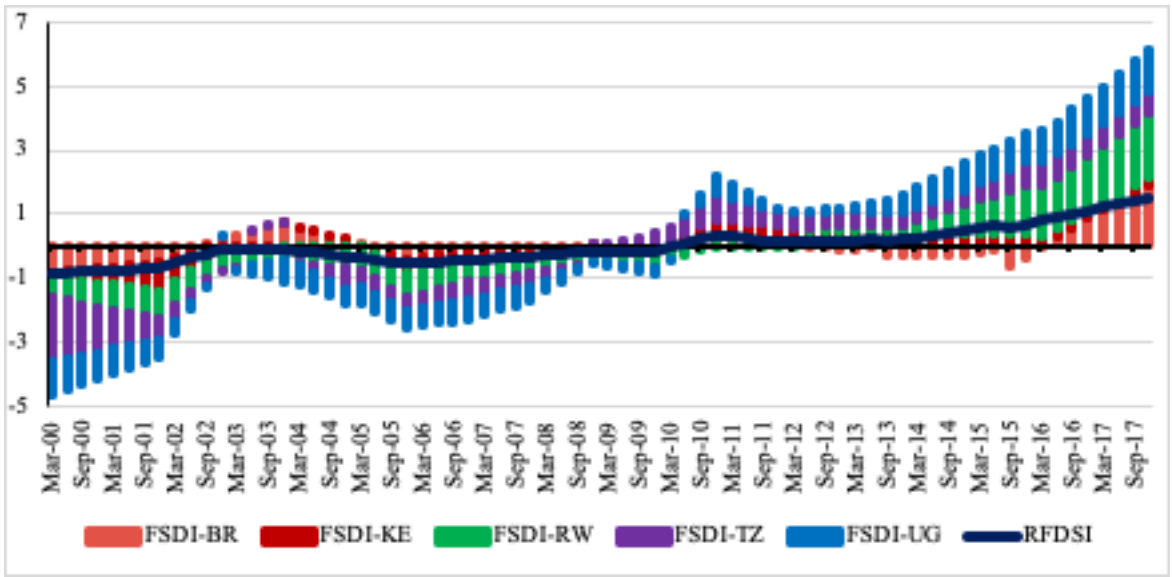

Figure 4.5: Financial Development Index and its Decomposition in EAC

A notable rapid improvement has been seen since 2010 in almost all countries, despite the systems being small and medium-sized domestic financial system, fragmentation, with relatively large interest rate margin that reflects gaps in their financial infrastructure and riskiness of lending. However, improvement of the financial system growth in the region reflects the impact of monetary union convergence of policies.

In the same way, the regional vulnerability condition has shown similar relative patterns (Figure 4.6). Although the regions' financial linkages with the advanced economies are relatively weak, the deterioration of the external economic environment has an adverse impact on the EAC economies, mainly through trade and investment flows. For instance, the period between 2007 and 2010 was mainly characterized by relative higher vulnerable condition across the region. During that time, inflation in many African countries, including EAC member states raised to double-digit levels to about 30 percent in 2008, mainly due to increasing oil, fertilizer and food prices. Besides, current account deficits; fiscal deficits and public debt increased significantly across the region; outweighed the positive effect of GDP growth that the EAC member countries have struggled to achieve. This implies that the region is vulnerable to similar risks, which compile at the same time.

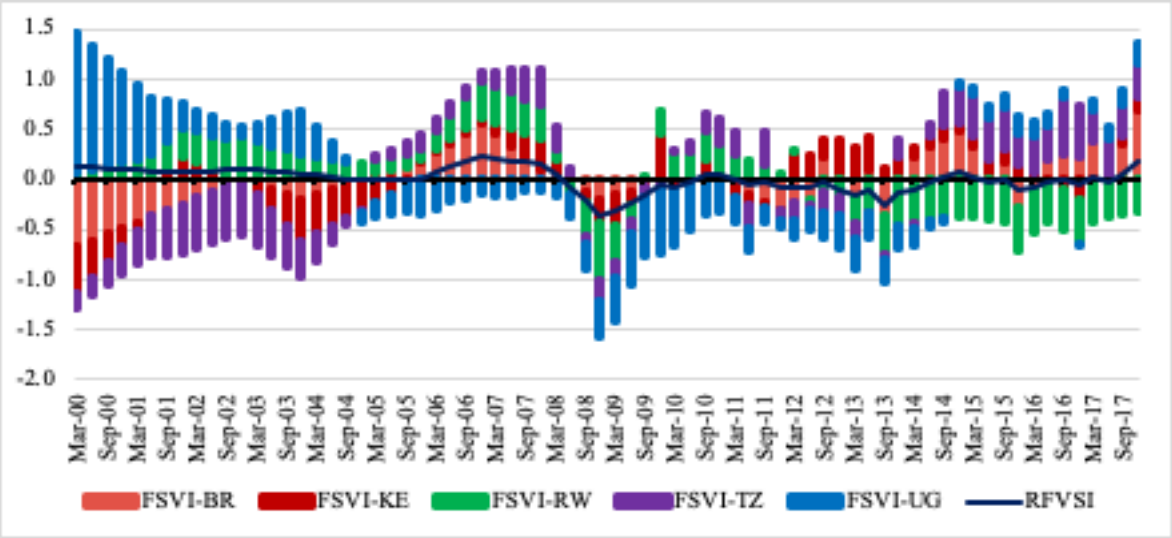

Figure 4.6: Financial Vulnerability Index and its Decomposition in EAC

Looking at the health of the financial systems in the region, results have shown different trajectories with slightly similar tides across the region (Figure 4.7). Results have shown that the regional financial systems have managed to remain relatively sound, though vulnerable to financial risks. Among other factors, NPL has remained stubbornly high, constraining growth in the private sector credit and economic activity across the region. As a result, despite the good performance of the financial system stability over the last decade, the region faced with similar risks such as credit and profitability risks stemming from declining of the asset quality

from 2013 due to the increase in NPLs. This common trend indicates similar credit growth threats and vulnerabilities that may potentially bring about financial instability in the region.

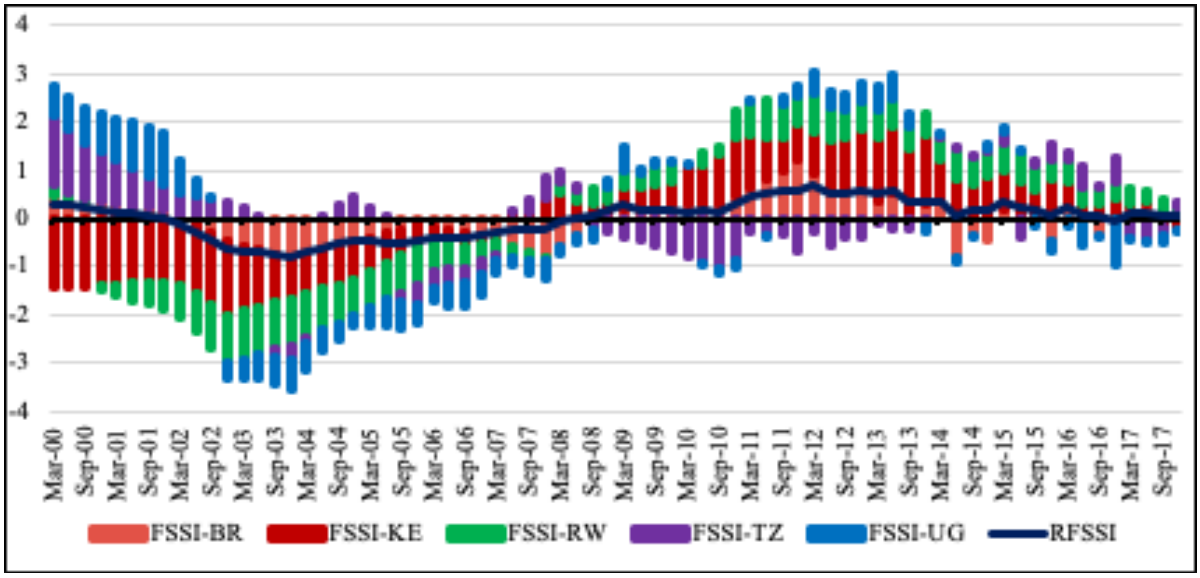

Figure 4.7: Financial Soundness Index and its Decomposition in EAC

Similarly, to other AFSSI sub-indices, the macroeconomic environment within the region has been relatively the same. Results have shown a similar trend of macroeconomic growth, despite the differences in the country's economic growth (Figure 4.8). For instance, each country's economic growth (GDP annual growth) decreased during the global economic downturn. This has been the case in 2003/04 (global geopolitical uncertainties in 2002/03), 2006 (US economic slowdown), 2008/09 (global financial crisis), 2012 (global economic crisis) and 2015/16 (global trade slowdown). This trend indicates that all countries are vulnerable to external shocks similarly.

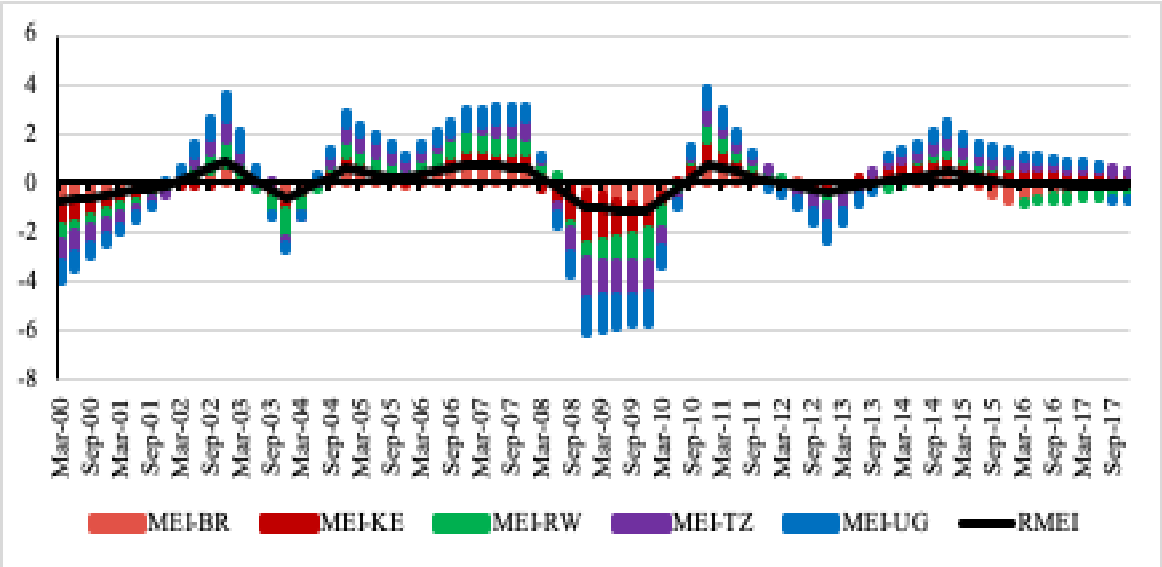

Figure 4.8: Macro-Economic Environment Index in the EAC

In conclusion, overall, the stability of EAC financial systems has improved over the last decade, but noticeable vulnerabilities remain. The analysis has highlighted three-folds. First, the regional financial system has continued to develop, albeit slowly. This is due to the persistence of poor asset quality, which continuously leaves the financial sector with minimum core and total capital adequacy ratios. Secondly, despite the significant domestic economic growth that has been recorded over the period, the region witnessed vulnerability pressures emanating from both domestic and global imbalances. Lastly, the region financial systems have been faced with similar financial risks emanated from similar factors such as higher interest rate spread, inflation rate, NPLs and global economic slowdown (transmitted to the region through trade, investment, aid, grants and remittance flows to complex price discovery for financial and non-financial products). Following is the analysis of financial system stability of each EAC member countries.

4.4.2 Financial System Stability in Burundi

The overall financial system stability in Burundi has been gradually fluctuating at both stability and instability level of AFSSI (Figure 4.9). The effects of the macroeconomic conditions, which affected the financial system development as well as the soundness of the financial system, mainly account for the fluctuating trend. Looking at the first phase of the analysis (2000 -2008), the region registered increased financial stability, albeit with instability periods in 2004 and 2008.

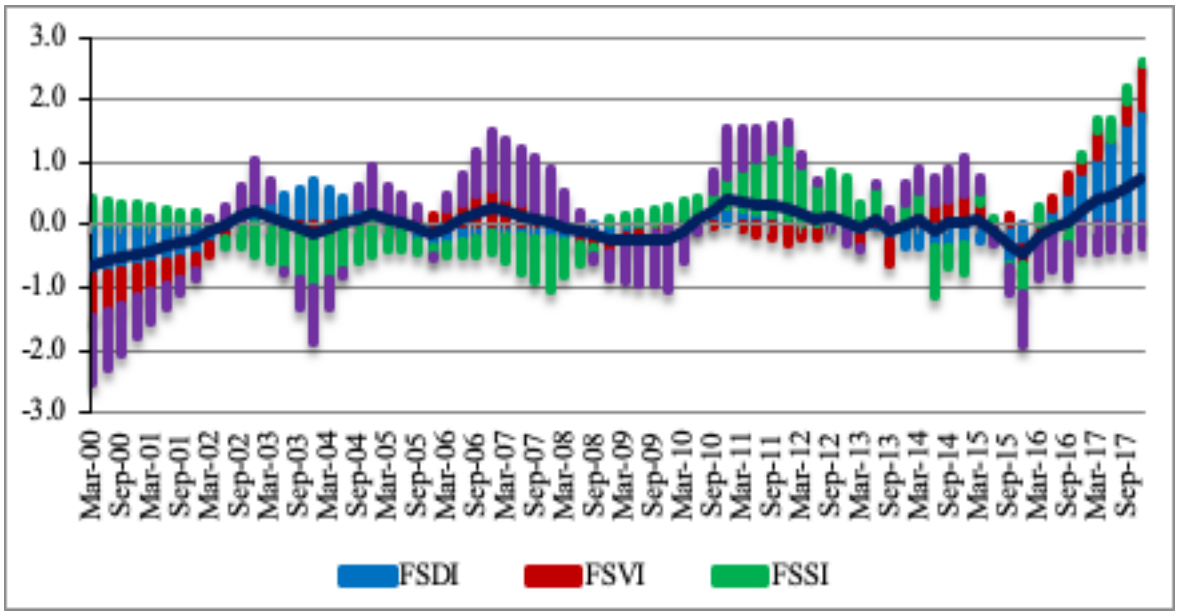

Figure 4.9: Financial System Stability Index and It's Decomposition in Burundi

In the second phase (2009 – 2017) the region quickly recovered from the effects of the global financial crisis (2008) and maintained more extended periods of stability with a slight drop in 2013 and 2016. Among other factors, prudent macroeconomic management and bold structural reforms explain the improvement in financial stability, while the weak macroeconomic conditions and political instability that the country has faced during the period under review has led to the deterioration of the financial system stability.

The period between March 20015 and June 2016 was mainly characterized by considerable strain in a liquidity crisis. This underpinned by deterioration in all four sub-indices, which was primarily attributed to political instability, sharp trade decline, depreciation of their national currency, and reduced global economic growth, particularly in Burundi's main trading partners. Currently, Burundi financial system is recovering and is now experiencing favourable macroeconomic conditions. It is expected that this condition will also improve financial system development and soundness. However, a close follow-up is required on the financial system soundness; and the asset quality needs to be improved.

Looking at the development index, we have found that it was not until 2016; Burundi's financial sector has not improved significantly. This was attributed to the weak macroeconomic conditions that the country has experienced during the period. Besides, as shown in Figure 4.10 the financial system has been characterized by higher interest rate spread and low net interest margin from time to time despite the increase in domestic credit provided by the banks and deposit money bank's asset to GDP ratios. Following the monetary policy stance (central bank's policy of relaxing refinancing conditions) in 2016, financial development indicator such as assets, broad money and interest rate spread improved significantly.

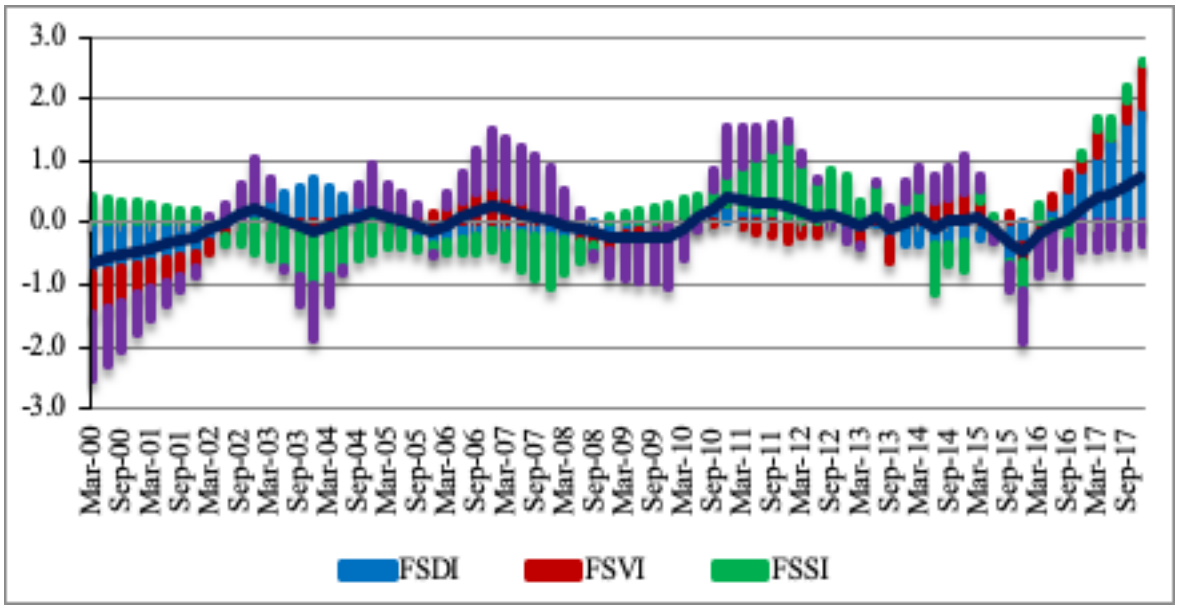

Figure 4.10: Financial Development Index and It's Decomposition in Burundi

For the case of financial vulnerability indicators (FSVI), as shown in Figure 4.11 we have found that the continuous increased domestic indebtedness (private sector credit, current account deficits, public debt, budget deficit, currency depreciation and bank credit to bank deposit ratios) have affected the financial system stability. Moreover, the decrease in the level of a net open position in foreign exchange and bank liquidity reserve to bank asset has also weakened the financial system stability and lead to the banks' credit portfolio deterioration.

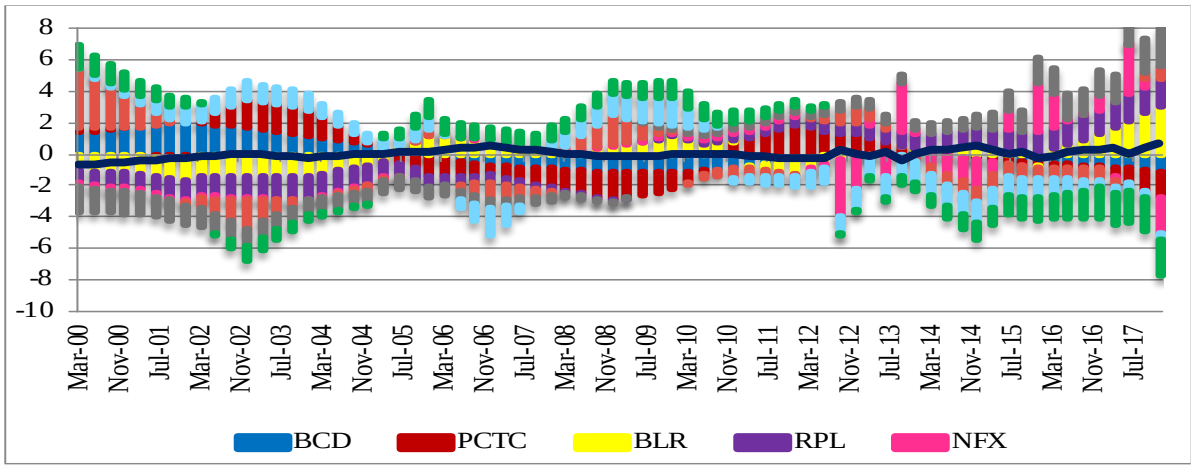

Figure 4.11: Financial Vulnerability Index and It's Decomposition in Burundi

Moreover, results have revealed deterioration trend in the financial system soundness indicators (FSSI). As indicated in Figure 4.12, poor asset quality (NPLs ratio) with low capital adequacy and liquidity ratio remained to be an issue as far as financial stability is concerned. This was attributed to the increase in lending rates, which has affected the level of overdue loans rate and adversely impacted the bank's profitability, which led to financial distress. In 2015 Burundi experienced a liquidity crisis, which was linked to the sharp decrease of credit portfolio quality, banks sector equity, liquidity ratio and capital adequacy ratio. This calls for an intervention from the policymakers to ensure improved financial system performance and lessens against the potential occurrence of other episodes of financial distress or crisis.

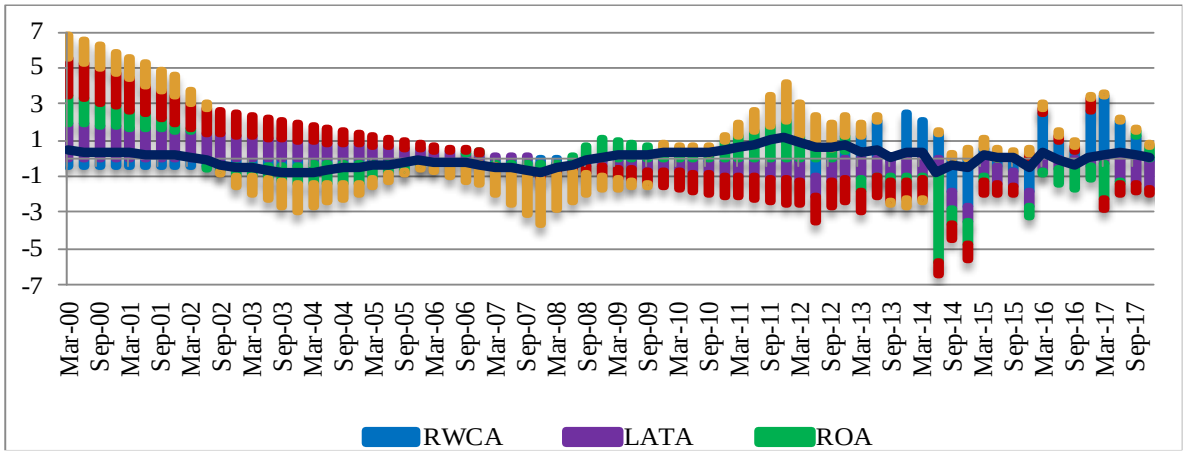

Figure 4.12: Financial Soundness Index and It's Decomposition in Burundi

Concerning the macroeconomic environment in Burundi, results have shown that the country has remained volatile with weak economic growth (Figure 4.13). The economy has been affected by both internal and external shocks, with the internal factors significantly accounting for this state of affairs. For instance, despite the effects of regional and global macroeconomic condition, extensive state controls and structural problems, regulatory inefficiency, and lags in productivity growth due to drought, the decline in tax revenues and usage of 2015 budget to facilitate re-election costs are among other internal shocks that mostly hampered the recent economic growth, 2014 to 2017. On the side of external factors, the decline in trade due to non-tariff barriers and cut off the donor's aid have led to the decline in the government budget, hindering economic growth.

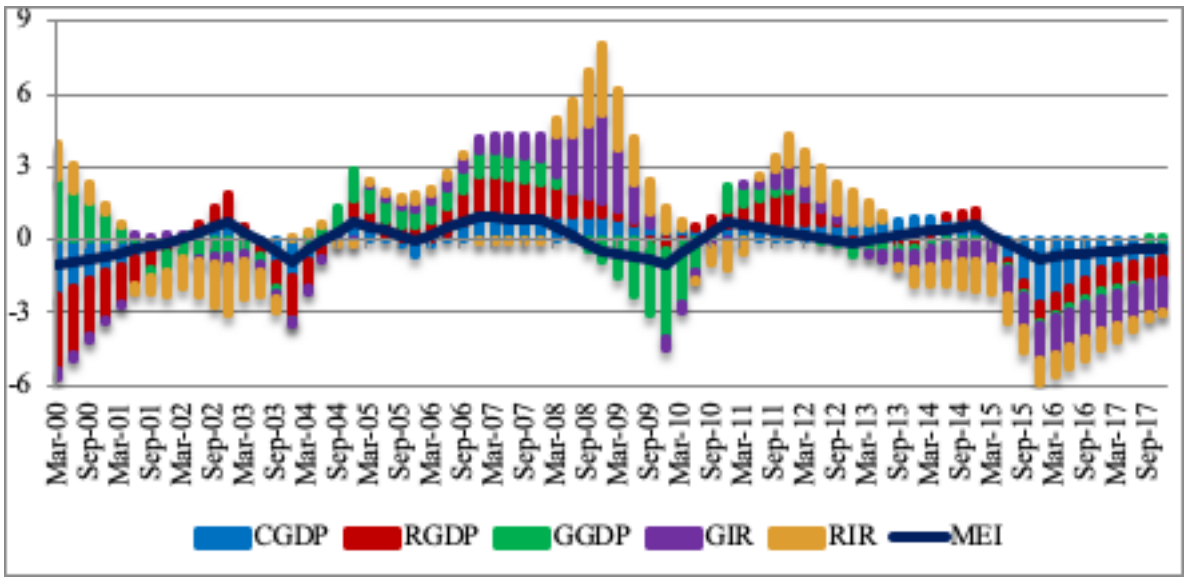

Figure 4.13: Macro-Economic Environment Index and It's Decomposition in Burundi

Against this backdrop, Burundi financial system stability has been fluctuating, with several instability episodes stemming from the macroeconomic shocks. The slowdown of economic growth affects the financial system performance and cascades to monetary instability risk. Besides, limited access to private credit and higher lending interest rates has continued to be one of the most constraints in the financial system performance. Improvements in the regulation and supervision of the financial system to facilitate the growth of a healthy industry are essential to ensure resilient financial system stability in Burundi.

4.4.3 Financial System stability in Kenya

The Kenya financial system has grown significantly, becoming more complex and highly integrated. Its financial system stability registered strong growth (Figure 4.14). It was not until 2008, Kenya recorded financial stability improvement during the first phase.

Thereafter, the country recovered quickly and maintained robust stability in the second phase. This strong growth was mainly buoyed by the vibrant and robust growth of the financial system, in particular, mobile money technology, which has led to the increased access to and usage of finance. In addition, favourable monetary policies and improvement of financial access have significantly contributed to this development.

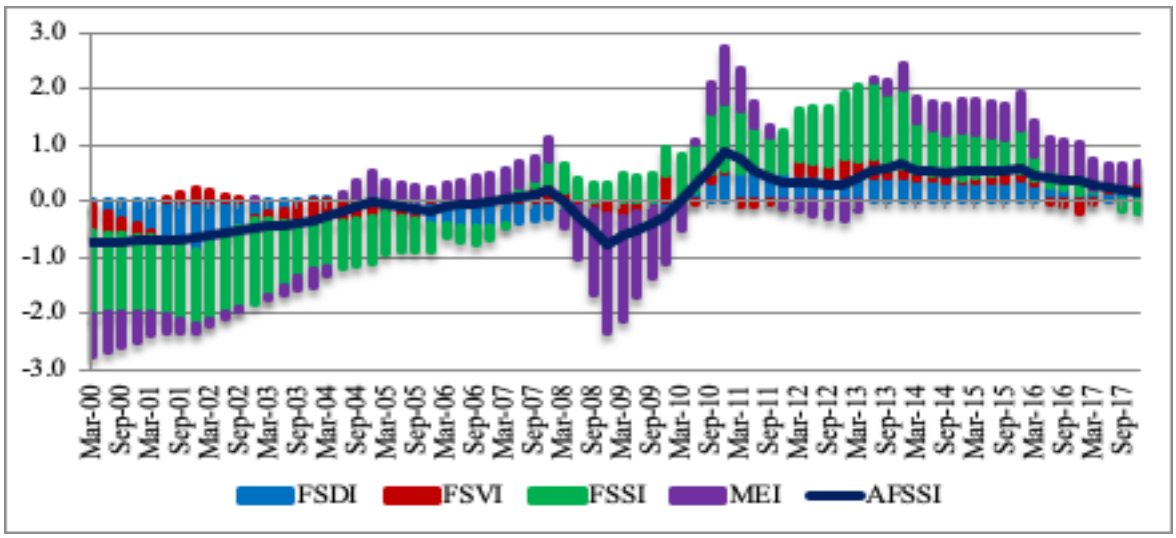

Figure 4.14: Financial System Stability Index and It's Decomposition in Kenya

Kenyan financial system stability has mainly been affected by macroeconomic shocks. For instance, during the financial crisis (2008), the country became more vulnerable, and this affected the financial system development and its soundness. Besides, the current deterioration, which started in 2015, has been triggered by the marginally slowing economy, tightened access to liquidity and a worsening credit portfolio and increased pressure on financial system stability. To rescue the situation, the Central Bank of Kenya improved its monetary stance and supervision regulations by reducing the interest caps in end-2016 expects to improve the development and soundness of the financial system.

Examining development in Kenya's financial system, the system registered significant growth with short periods of deterioration from 2000 to 2009 and steady growth from 2010 to 2017 (Figure 4.15). This is linked with the continuous growth in the financial system in terms of size, intermediation and efficiency. Despite the steady growth, the financial system has faced a few challenges, which led to bank distress/failure. Besides, since 2015 there is a notable continuous steep decline in the domestic credit growth and market capitalization due to the precautionary measure adopted by banks and tightened lending standards to minimize further exposures. This highlights a contribution to the poor performance of the financial system, threatening the soundness and stability of the financial system.

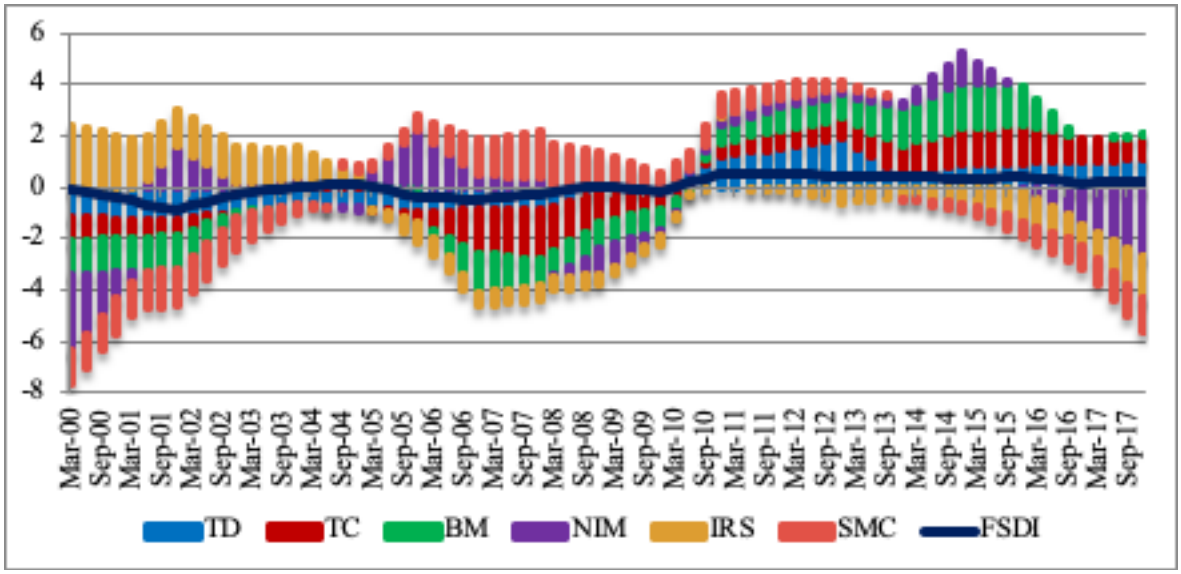

Figure 4.15: Financial Development Index and It's Decomposition in Kenya

In addition, results have shown that the financial system stability has been affected by the vulnerable conditions that the country faced (Figure 4.16). Kenya was more vulnerable during the first phase compared to the second phase. This was attributed to the improvement of the fiscal and monetary policies stance taken over the last decade. However, due to the increase in private credit, currency depreciation, current account deficit and fiscal budget deficit from 2015, Kenya has become more vulnerable again. As a result, reserves, in general, have declined, and this trend has put pressure on the financial system.

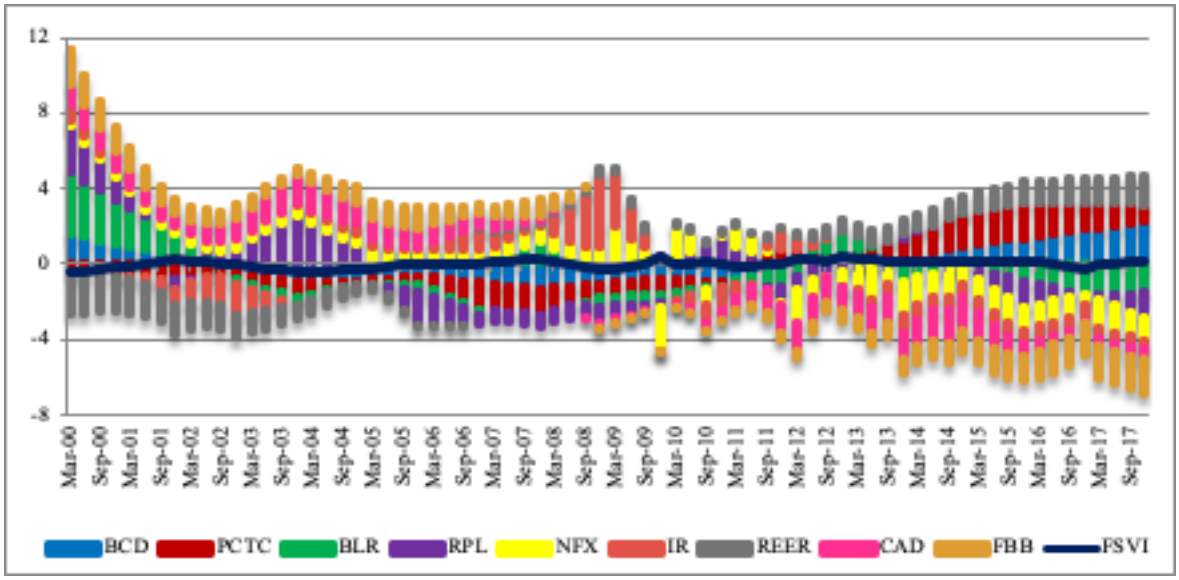

Figure 4.16: Financial Vulnerability Index and It's Decomposition in Kenya

Considering the soundness of the financial system, Kenya registered a sound and resilient financial system growth over the last decade (Figure 4.17). In particular, it has experienced a vibrant growth of capital adequacy and profitability in the financial sector for

quite some time. However, since 2011, the industry has encountered several risks: elevated credit risk, liquidity risk and declining profitability. This current poor performance is linked to the sharp decrease of portfolio quality, banking sector equity, liquidity ratio, capital adequacy ratio and the capital adequacy ratio cut across the industry. Notwithstanding, the financial sector has remained well-capitalized, albeit with minimum capital requirements.

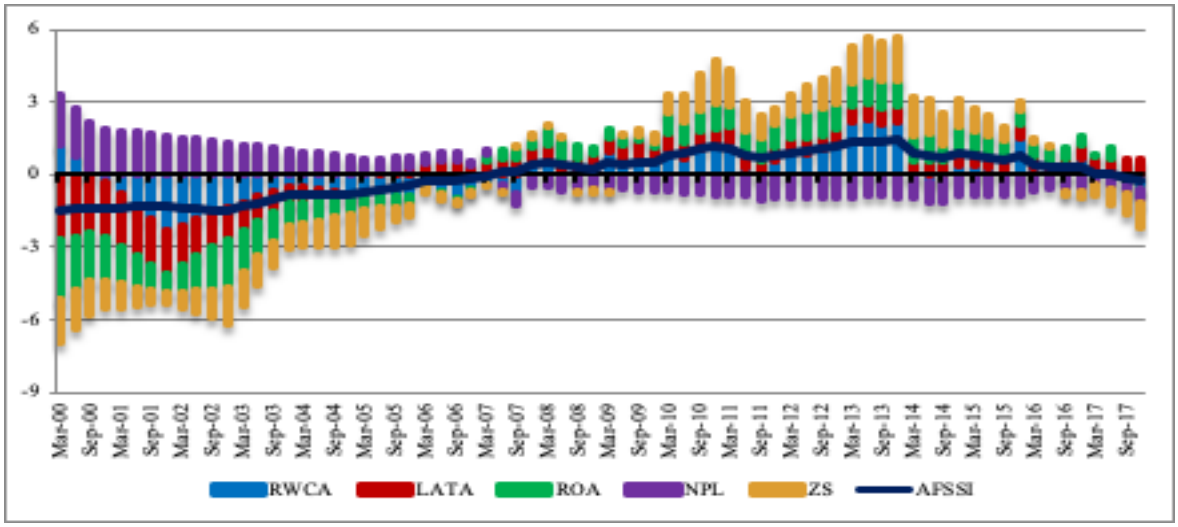

Figure 4.17: Financial Soundness Index and It's Decomposition in Kenya

Moreover, Kenya registered a steady economic growth over the years, albeit vulnerable shocks emanated from both within and outside the country. As shown in Figure 4.18, Kenya was relatively affected by the global economic downturn of 2008/09 as the country experienced a significant decline in the GDP growth rate. The adverse spill-over of the global economic decline affected Kenya economy through trade, capital inflows and exchange rate. In addition, the recent fall in GDP both in EAC and the global at large; political instability and severe drought episodes have weakened the economic activity progress in Kenya since 2015. This has contributed to the recent downfall of profitability and stock prices in the financial system.

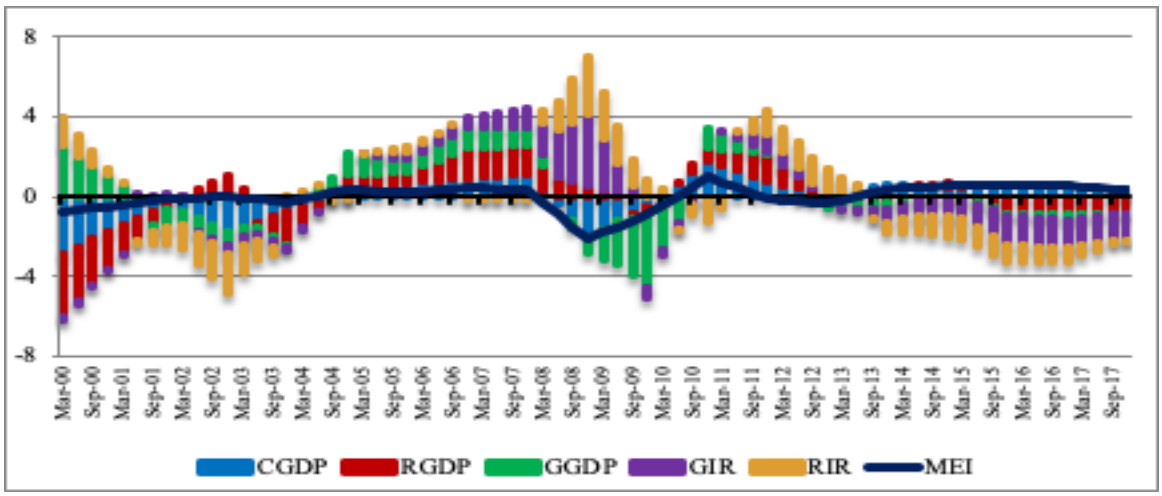

Figure 4.18: Macro-Economic Index and its Decomposition in Kenya

In this context, we conclude that the financial system in Kenya remained resilient but encountered with significant challenges originating from both exogenous and endogenous sources. The slowdown of economic growth, credit squeeze, ballooning public debt and weak global economic growth have led to the deterioration of the credit portfolio of the banking sector and increase liquidity problems that affected the financial system development and its soundness. As a result, the country faced with credit and profitability risk. All these risks have a contagion effect, which might likely hinder effective policy implementation. If this trend continues, Kenya's financial system will be more exposed to the financial instability risk that will threaten the financial system as a whole.

4.4.4 Financial System Stability in Rwanda

Rwanda made remarkable progress in rebuilding its economic stability despite the infancy of its financial system. As shown in Figure 4.19, the overall financial system stability in Rwanda has been gradually fluctuating, experiencing instability eras between 2000 and 2008 before enjoying stable and robust stability eras for about a decade. For instance, despite the impact of the global financial crisis, Rwanda experienced liquidity and credit crunch in 2008 caused by a rapid increase in interest rates and inflation, which led to a significant reduction in deposits and increased withdrawals by major depositors. However, a notable improvement was made during the second phase, as the country registered no instability episodes. Strong economic growth, economic and structural reforms as well as stricter enforcement on financial sector supervision and regulations are linked to the significant improvement and stable financial stability that the country has been enjoying over the last decade.

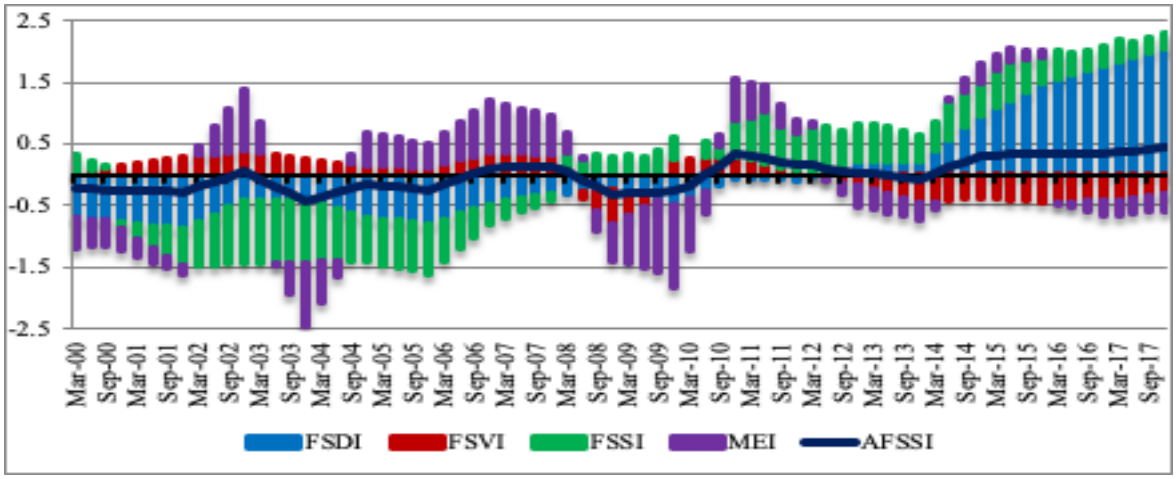

Figure 4.19: Financial System Stability Index and It's Decomposition in Rwanda

In terms of development, the financial system has remained shallow, especially outside the banking sector with limited access to credit for quite some time. For instance, it was not

until 2010, where significant positive development started coming to the fore again; the financial system was underdeveloped (Figure 4.20). This was attributed to the weak economic environment, weak credit culture, inadequate institutional, legal and regulatory frameworks. However, a number of efforts have been done over the last decade to stimulate financial system development. Most notably, the government implemented the financial sector development plan (strengthening of the institutional framework and market infrastructure) that increases the reach and efficiency of the financial sector. This effort has contributed to the recent improvement of the stability of the financial system.

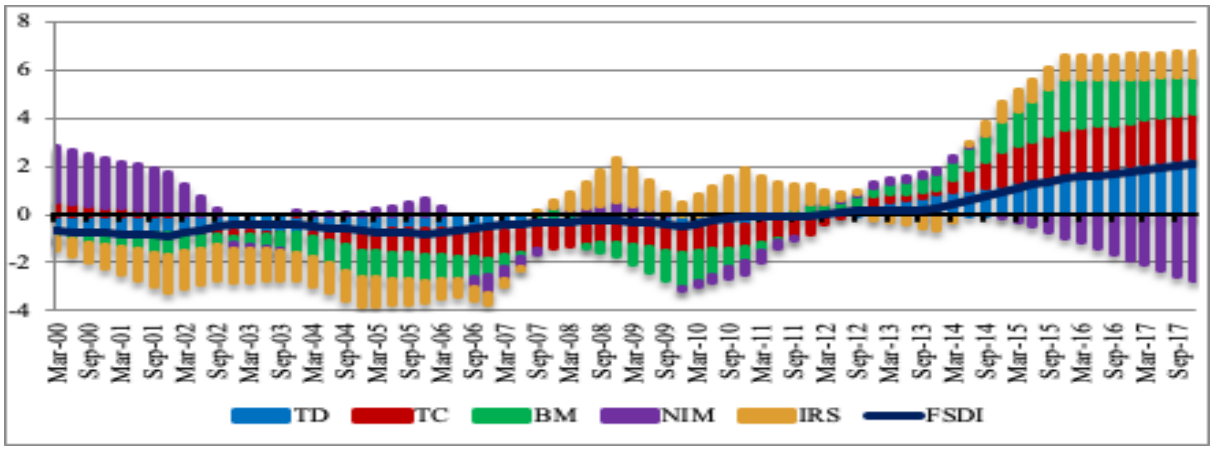

Figure 4.20: Financial Development Index and its Decomposition in Rwanda

Although the country has improved its macroeconomic environment and enhanced financial system development, Rwanda financial system stability has been affected by vulnerable conditions that the country has grappled with during the review period. For instance, as shown in Figure 4.21 the country experienced a significant vulnerable condition, which led to the liquidity crisis and credit crunch in 2008. The increased vulnerability condition was a result of the increase in interest rates and inflation, which led to a significant reduction of money supply in the economy.

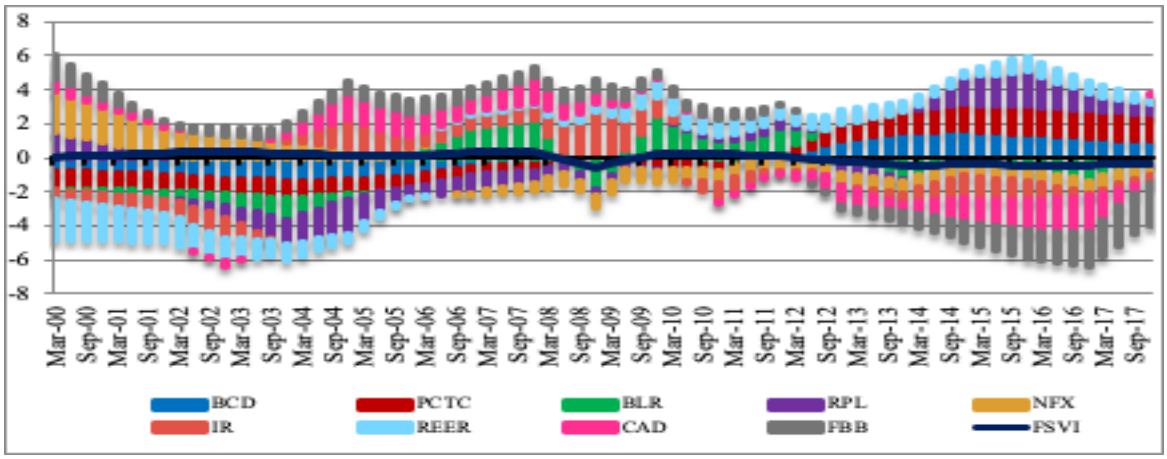

Figure 4.21: Financial Vulnerability Index and It's Decomposition in Rwanda

Signs of the rise of vulnerability in the economy have recently shown up again in 2013 after the increase in public debt and currency depreciation, which have adversely affected the financial system stability as it has led to the deterioration of credit portfolio of the banking sector (Figure 4.22). However, this was quickly corrected by the monetary policy stance that the Central Bank implemented. To minimize vulnerability conditions, the country needs to promote private sector (credit growth) external and fiscal sustainability in order to support financial system development.

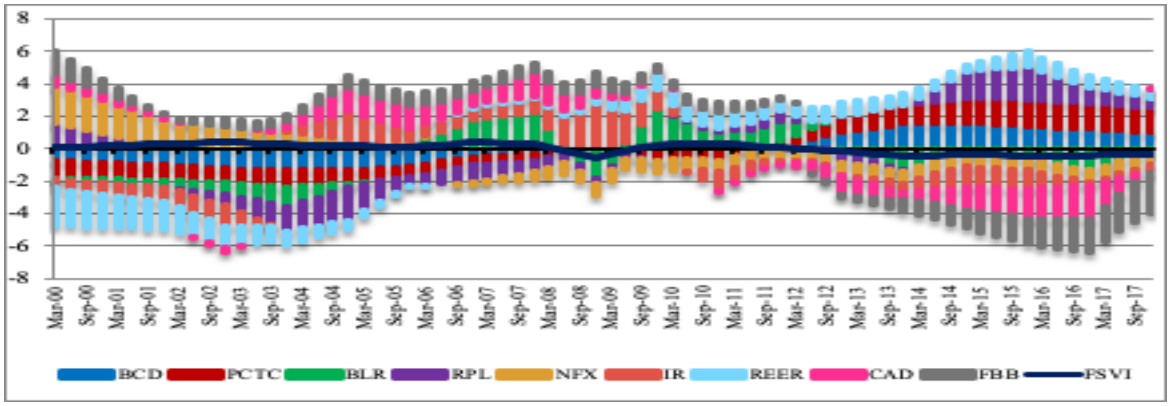

Figure 4.22: Financial Vulnerability Index and It's Decomposition in Rwanda

Turning to the financial system soundness, we have observed a deterioration trend during the first phase of the analysis and robust financial system soundness starting from 2010 (Figure 4.23). The poor performance of the financial system is associated with the weak macroeconomic environment and shallowness of the financial system. However, due to the financial reforms implemented from 2010, the financial system recorded robust financial soundness over the last decade. Although the banking sector has adequate capital and prudential liquidity ratios, the recent increase in lending rates has adversely impact on the bank's profitability. There is a notable decrease in asset quality, banking sector equity, liquidity ratio and capital adequacy ratio, which threatens the soundness of the system.

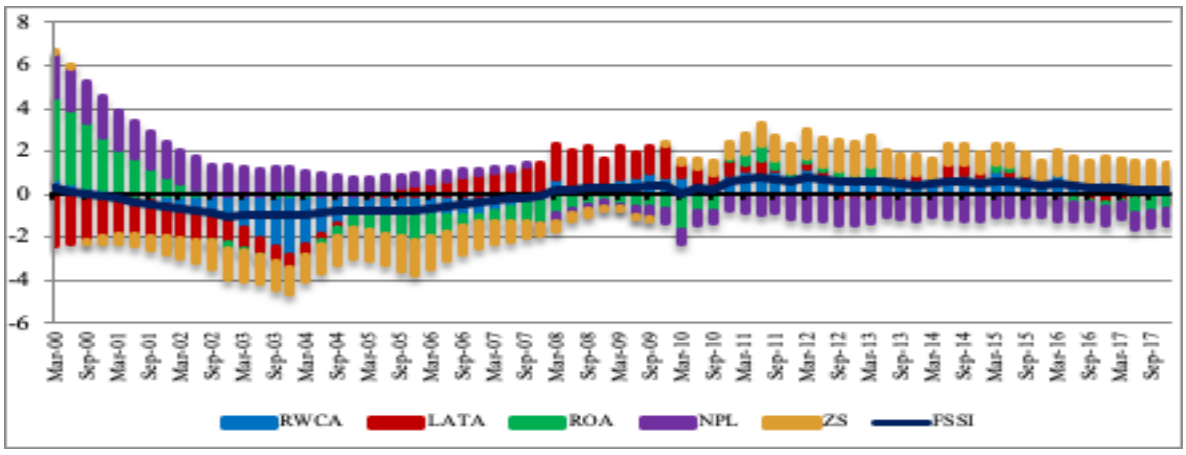

Figure 4.23: Financial Soundness Index and It's Decomposition in Rwanda

On the side of the macroeconomic condition, Rwanda recorded strong economic performance and increased its resilience over the last decade (Figure 4.24). This notable improvement is a result of the effective measures taken by the government after the country was hit by macroeconomic instability shocks during the review period. Results have shown that Rwanda has remained volatile, affected by the decline in trade, agriculture and services, weak credit culture and inadequate institutional, legal and regulatory frameworks. However, the degree of macroeconomic instability has been reduced due to the efforts of the government to address external imbalances and support sustained economic growth.

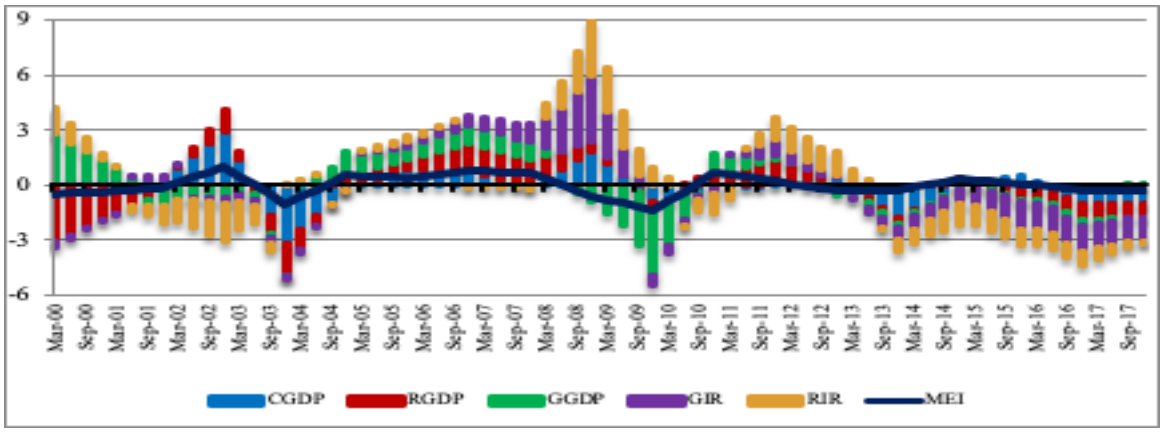

Figure 4.24: Financial Macro-Economic Index and It's Decomposition in Rwanda

In summary, Rwanda financial system stability has recently recorded resilient economic and financial conditions but with significant challenges originating from both exogenous and endogenous factors. This notable robust financial system stability was a result of effective prudent macroeconomic management, effective use of foreign aid, and sound fiscal and monetary policies. Consequently, the banking system is currently highly concentrated, stable and well-capitalized. However, since the financial system has remained shallow, there is a need to expand and promote the financial system at large through safeguarding macroeconomic stability and addressing external imbalances. This further stimulates domestic resources allocation and enhance access to credit while deepening the financial system. This will further boost financial system development.

4.4.5 Financial System Stability in Tanzania

Financial system stability in Tanzania has been gradually improving despite a few instability episodes that the country has experienced under the period under review. This was because of several macroeconomic instability incidences such as non-food inflation rate, public debt, currency depreciation, monetary expansion, and restructuring of banks that led to credit risk, which squeezes banks profitability. For instance, as shown in Figure 4.25 in 2008/09, the

country experienced strong liquidity pressures and rising inflation mainly emanating from sustained foreign exchange inflows. However, the country recuperated from instability seasons following the implementation of effective macroeconomic (monetary and fiscal) policies to contain liquidity risk spill-over.

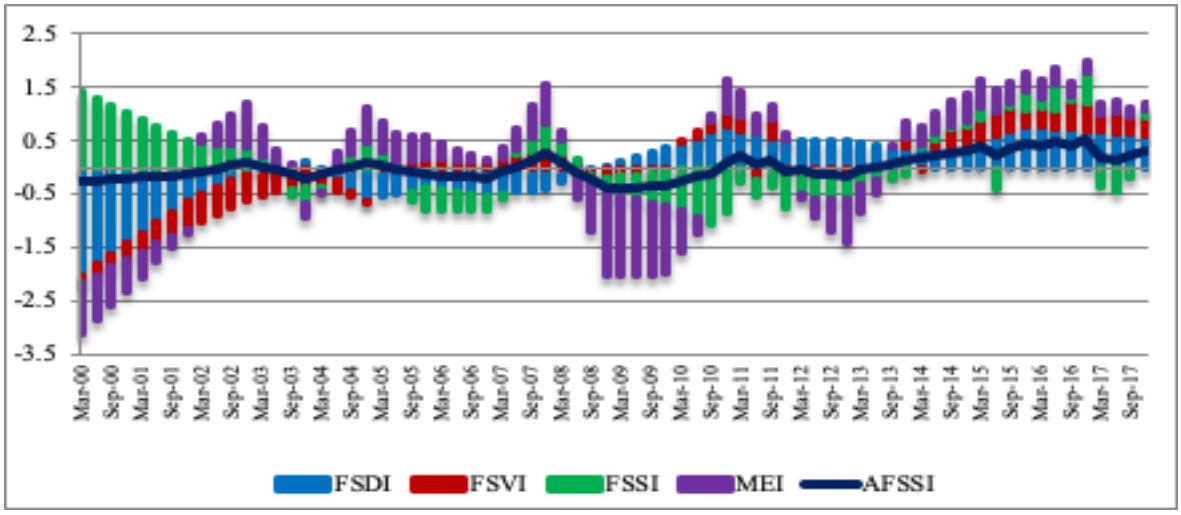

Figure 4.25: Financial System Stability Index and its Decomposition in Tanzania

For the last decade, Tanzania financial system has remained resilient, albeit vulnerable to shocks. Currently, the stability of the financial system has been deteriorating; however, it has remained stable, backed by favourable macroeconomic conditions. This deterioration was attributed to a persistence of the credit growth deterioration and heightened credit risk, which moderated its profitability. The higher loan provisions have led to credit flow decline, as banks take the precautionary lending stance. Consequently, the financial system has fallen short of what is needed for it to fully play an intermediary financial role.

Tanzania financial system has continued to develop significantly. As shown in Figure 4.26, the system has witnessed a steady growth in terms of financial system size, intermediation, efficiency and profitability. This was attributed to extensive policy reforms that have been put in place and substantial liberalization of domestic financial intermediation since the early 2000s. As a result, there is a notably accelerated pick-up in domestic credits, bank deposits and capital market capitalization. Despite the steady growth over the years, results have shown that the financial system development has been negatively affected by the sharp increase in interest rates. This was a result of the increased lending rate, reflecting banks' risk aversion amid increasing non-performing loans.

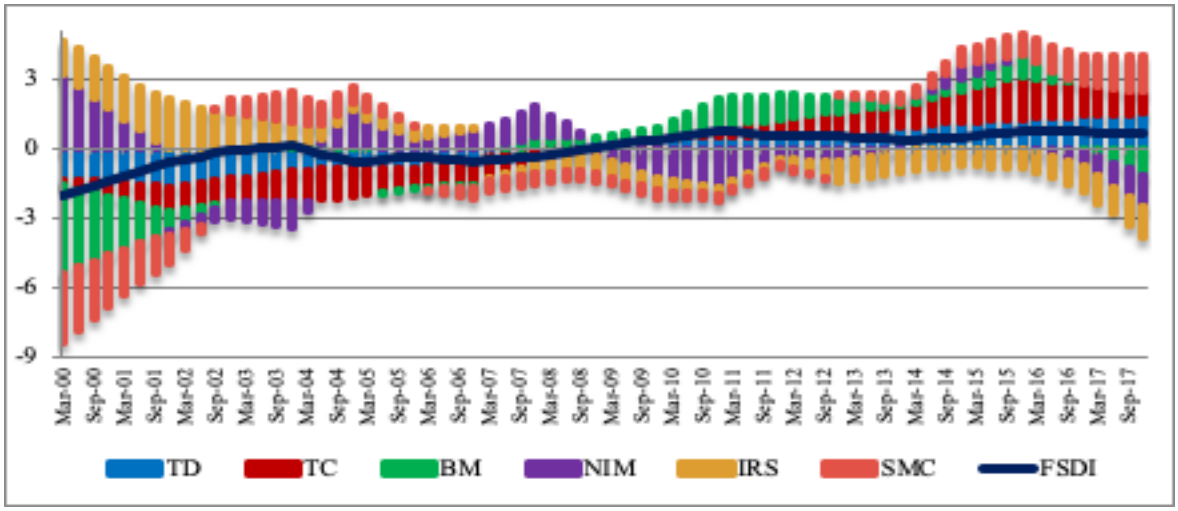

Figure 4.26: Financial System Development Index and its Decomposition in Tanzania

The effect of domestic macro-financial stress has also been revealed in the behaviour of the financial vulnerability index. As shown in Figure 4.27, risks stemming from different sectors such as the public, external, and household sectors put pressure on the financial system, contributing to the instability seasons that the country has experienced. Among other factors, the increase in domestic indebtedness private sector credit, public debt, budget deficit, current account deficit and currency depreciation ratios have contributed to the escalation of vulnerabilities in the financial system. This trend adversely impacted on the financial system stability. In the absence of an improvement in these indicators, the financial system will be more exposed to the instability risk.

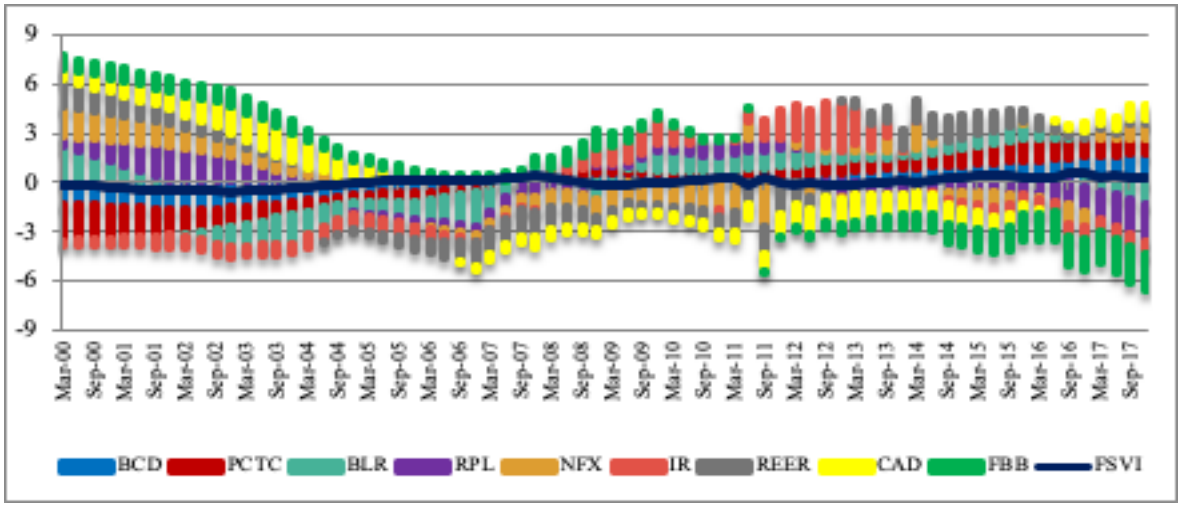

Figure 4.27: Financial Vulnerability Index and its Decomposition in Tanzania

Concerning the soundness of the financial system, as shown in Figure 4.28, results have revealed that during 2000 – 2008, the banking sector experienced a deterioration of the soundness. However, with a buffer from the Central Bank in both monetary policy stance and countercyclical fiscal measures through providing liquidity to the economy in the last quarter

of 2008/09, the soundness of financial sector improved. Nonetheless, despite the efforts done by the Central Bank in its prudent macroeconomic policies, the banking sector has continued to grapple with credit risk, which continuously tone-down the banking industry's profitability. If the growth of credit risk continues to persist, the country might face further financial instability exposures.

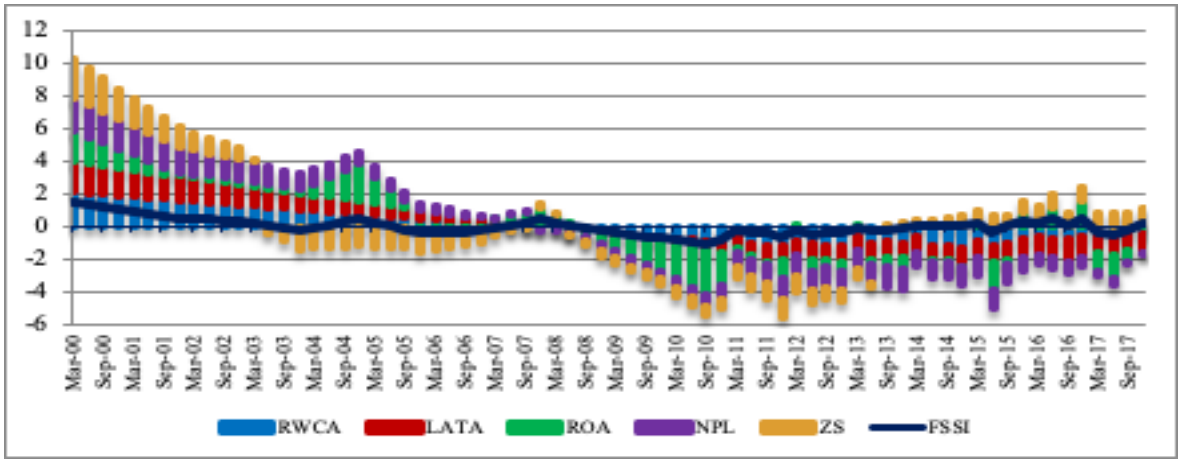

Figure 4.28: Financial Soundness Index and its Decomposition in Tanzania

The macroeconomic environment in Tanzania has been improving and remained favourable to the financial system over the decade. However, as shown in Figure 4.29, the macroeconomic condition is vulnerable to external shocks from regional and global economic instability, whose persistence of effects have generated indirect fluctuations at the origin of the cyclicality of the real economy. In 2008/09, the country faced with high inflation rates, which led to strong liquidity pressures. The country managed to contain its financial stability to be above the average level. It is worth noting that the slowdown of economic growth leads to the decline of reserves, which might cascade to monetary instability risk.

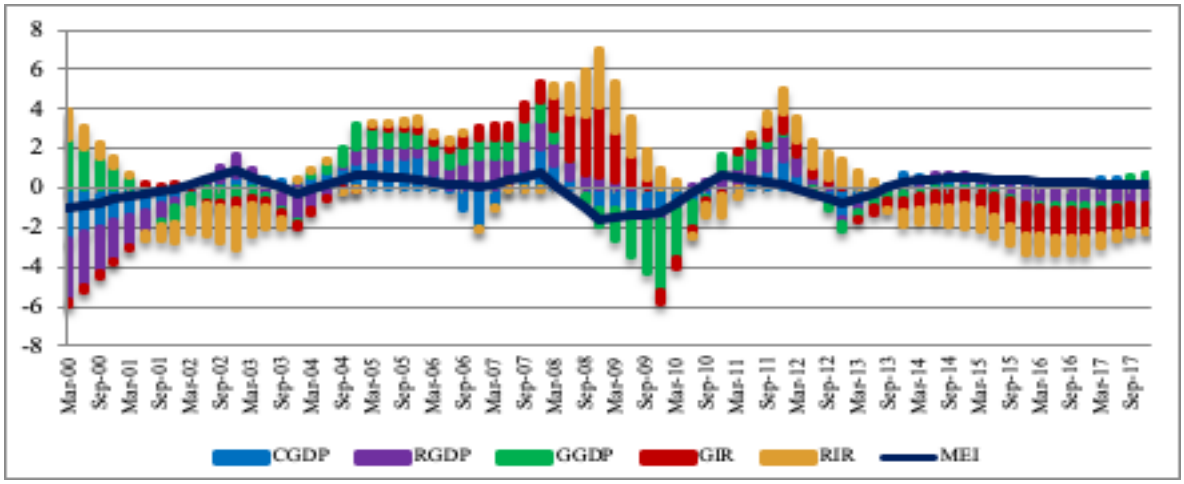

Figure 4.29: Macro-Economic Environment Index and its Decomposition in Tanzania

Given this, we conclude that the stability of the financial system in Tanzania has remained resilient but with significant challenges emanating from both exogenous and endogenous factors. Since the country is drifting towards deeper financial integration, it has become increasingly prone to global market instabilities. Thus, a significant rise in global macroeconomic volatilities may pose substantial risks (indirectly through economic activities that links Tanzania and the world) in the future, which might likely negatively affect monetary policy implementation in maintaining the financial system stability. In addition, the persistence in credit risk that the country has experienced impedes improvements in resilience of the financial system.

4.4.6 Financial System Stability in Uganda

The overall financial system stability in Uganda has been gradually fluctuating and mainly affected by external and internal developments. The result shown in Figure 4.30 indicates that Uganda faced the deterioration of its financial system stability during the first phase of analysis. The instability seasons entailed successive shocks emanating from the external economic environment (global financial crisis), which increased inflationary pressure in Uganda; and internal economic environments such as national economic imbalances, the adverse impact of weather conditions and geopolitical events in key trading partner countries. On the other hand, during the second phase, the financial system stability improved significantly. The stability episodes are linked with financial development and favourable macroeconomic environment that the country has enjoyed.

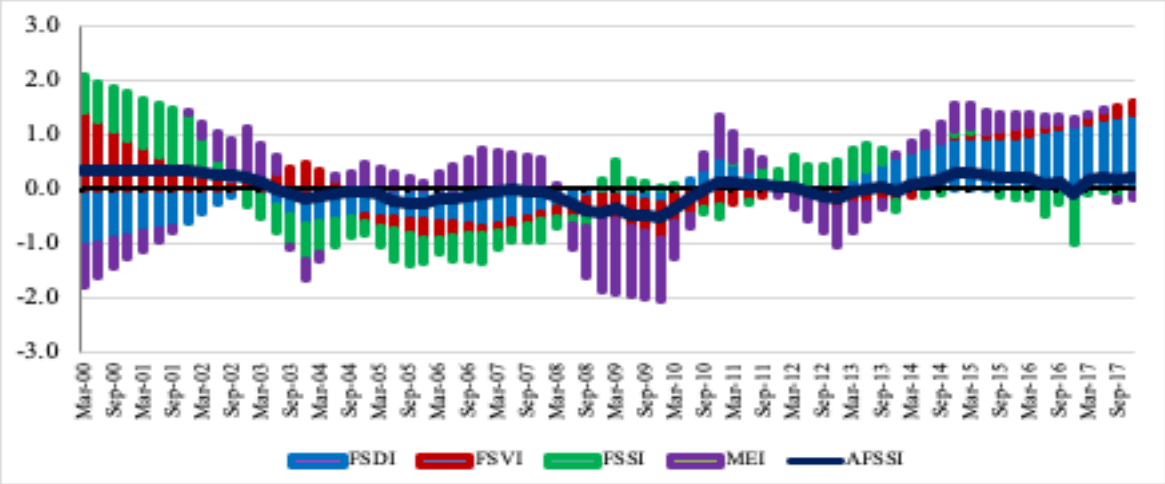

Figure 4.30: Financial System Stability Index and its Decomposition in Uganda

Currently, Uganda financial system is recovering from a 2016 sharp financial stability deterioration, which was attributed to rising inflation, poor credit conditions, exchange rate depreciation and reduced economic growth in the world in particular, in its main trading

partners such as China and Kenya. However, it did not take a while for the country to recover its stability. This recovery is linked to the measures applied through relaxed monetary policy stance, on interest rates and money supply; and strengthening of the legal and regulatory framework. As a result, the vulnerable condition was minimized, and financial system stability improved.

In terms of development, the Ugandan system registered steady growth with regards to size, intermediation, and efficiency over the last decade (Figure 4.31). However, it was not until 2010, where significant developments set in. This improvement was a result of effective macroeconomic policies and structural frameworks that the country implemented. Additionally, the introduction of agency banking, Banc assurance and digital banking presents a huge opportunity for banks to grow. Notwithstanding, since 2013, there is an increase in NIM and lending interest rate, reflecting banks' risk aversion amid increasing NPLs. However, this unsatisfactory banking sector performance was improved shortly since the Central Bank has relaxed its monetary policy stance by reducing the Central Bank rate to stimulate the financial sector development and improve access to finance.

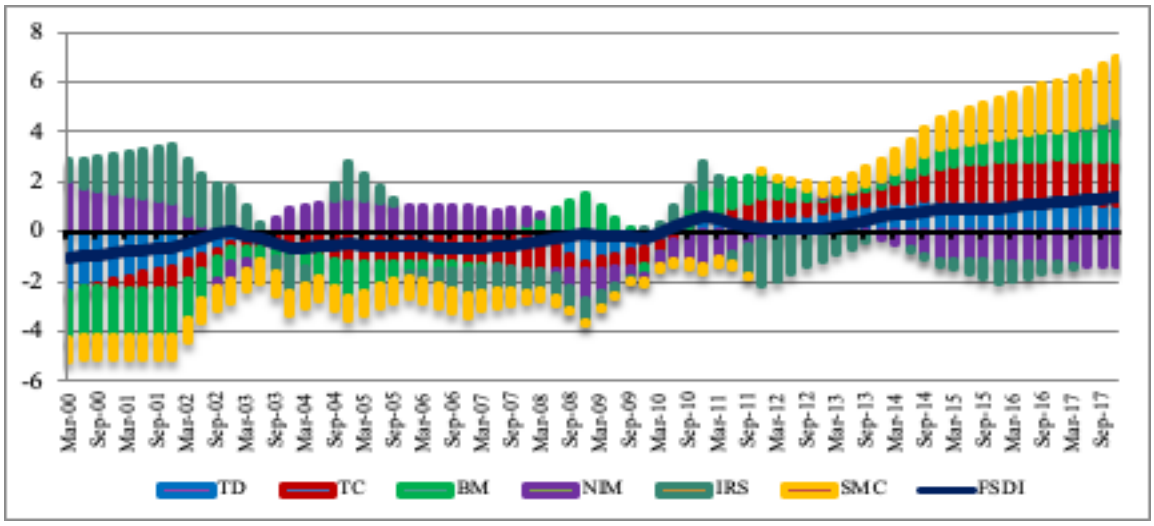

Figure 4.31: Financial Development Index and its Decomposition in Uganda

Undoubtedly, Uganda has been affected by the vulnerable conditions, such as a sharp increase in the inflation rate of about 30 percent, current account deficit, fiscal budget deficit and currency depreciation, which took place in between 2005 and 2012 (Figure 4.32). This has led to a significant increase in public debt, which lowered reserves. Consequently, it exacerbated the levels of credit risk in the economy, leading to the deterioration of the credit portfolio of the financial system as domestic financial institutions continued to be the largest lenders to the government and private sector.

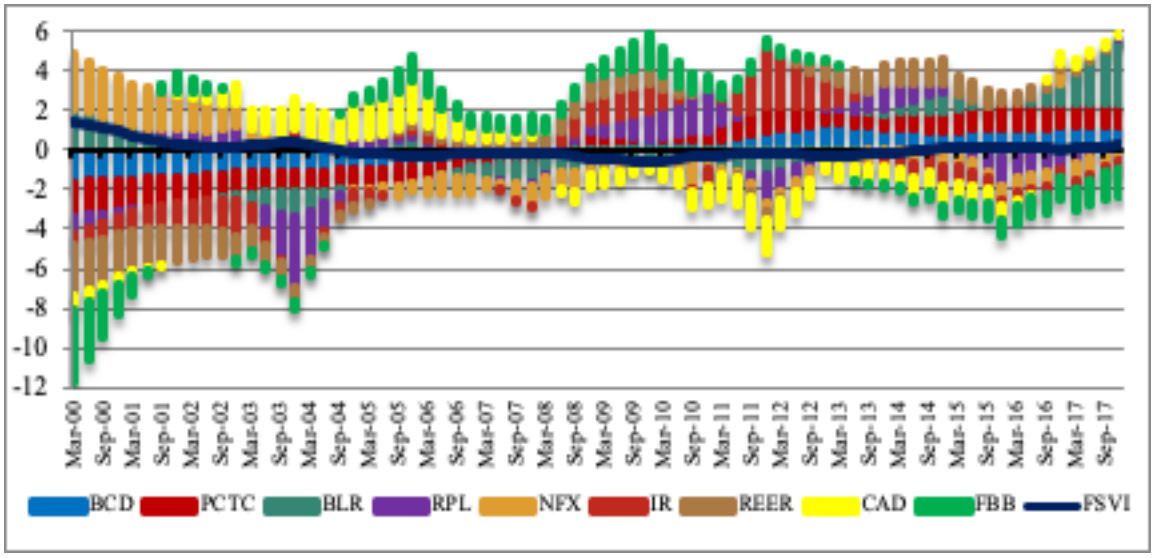

Figure 4.32: Financial Vulnerability Index and its Decomposition in Uganda

Regarding the soundness of the financial system, results have revealed a fluctuation trend on the financial system (Figure 4.33). The overall soundness of the banking system has performed relatively insufficient, with low profitability ratio while bank liquidity and capital buffers remaining slightly above the minimum requirements. Although the banking sector has sufficient prudential liquidity ratios, poor asset quality has led to an increase in lending rates due to increased risk aversion by banks, affecting the overall credit growth. The increase in non-performing loans ratio, which erodes the bank's earnings and profitability over time has led to the build-up of credit risk, which weakens net profit margin and turnover of assets.

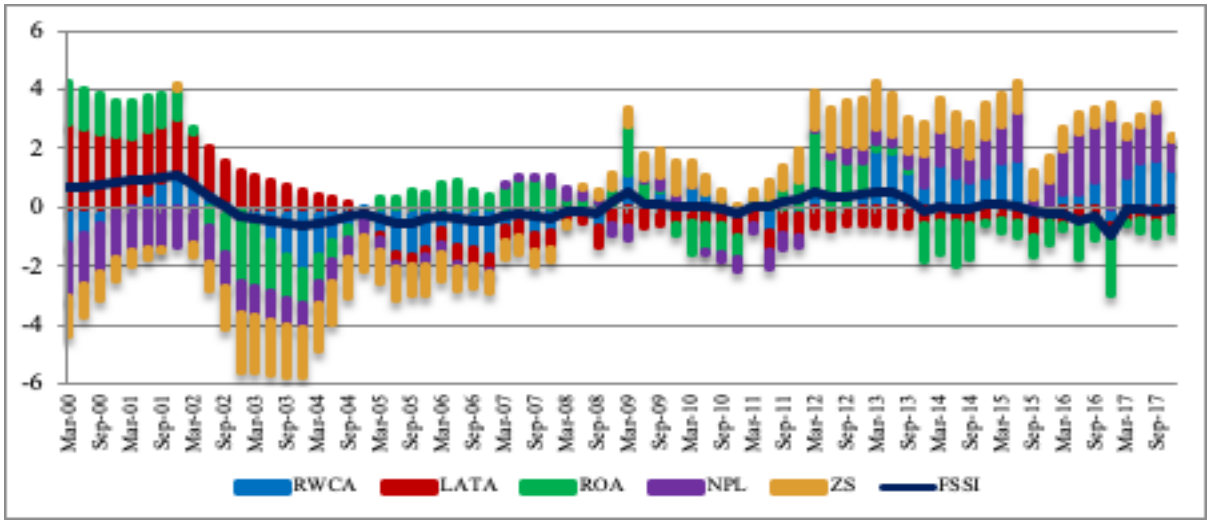

Figure 4.33: Financial Soundness Index and its Decomposition in Uganda

On the side of the macroeconomic environment, Uganda has experienced relative fluctuated economic growth (Figure 4.34). The slowing down of economic growth has been attributed to a number of reasons emanating from domestic structural bottlenecks, global

volatility and weak external demand. In particular, external economic shocks such as economic growth slowdown, which resulted in stagnation in demand of goods that brought shock to Ugandan agriculture sector; withdrawal of budget support by development partners in 2012; higher lending rates and the very long drought; are among other lag effects of the Ugandan economic slowdown.

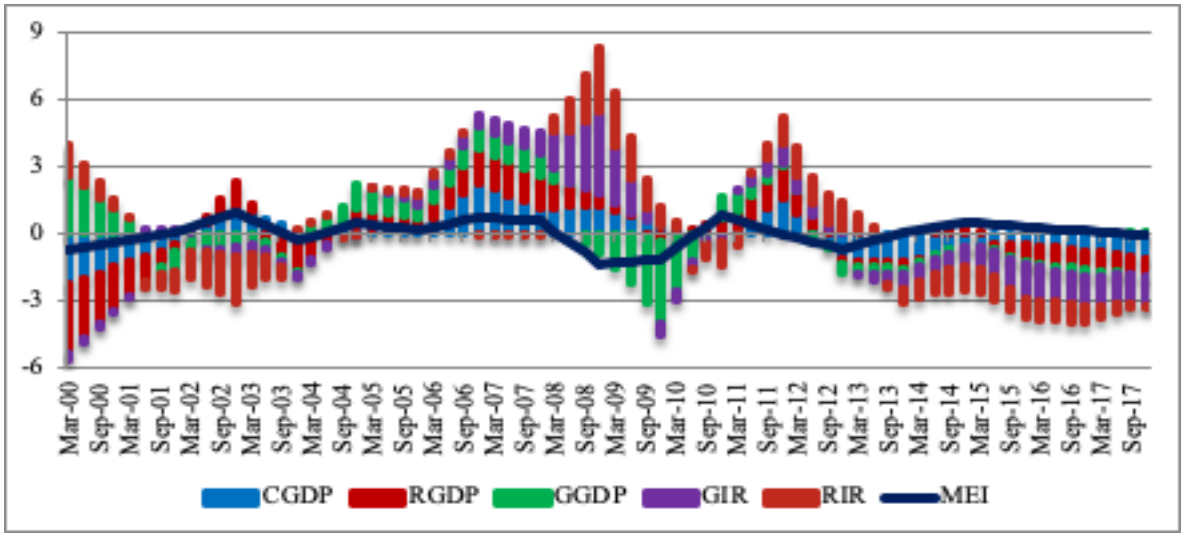

Figure 4.34: Macro-Economic Environment Index and its Decomposition in Uganda

In conclusion, the financial system stability in Uganda has remained resilient, though vulnerable to shocks. The system has mostly affected by the unstable macroeconomic environment and credit risks, which dampen the soundness of the financial system and pose the potential threat to the financial system stability. The current increase in NPLs should be monitored closely in order to improve credit risk conditions, which has remained a threat to the recovery of credit growth.

4.4.7 Risk to Financial System Stability in the EAC

The analysis of the financial system stability in the EAC has revealed that the region encountered a number of financial system instability episodes between 2000 and 2009, although the magnitude of impact varied across countries. These incidences occurred in 2004, 2006 and 2008/09. However, following a number of reforms that were implemented over the reviewed period, the EAC region enjoyed relatively stable and robust financial system stability for the period between 2010 and 2017, though with short periods of deteriorations in 2011/12 and 2015/16. Consequently, a number of banks had financial distress/failure. As it is shown in Table 4.5, Kenya, Tanzania and Uganda have recorded more incidences of bank failures and merger and acquisition (M&A) compared to Burundi and Rwanda.

Table 4.5: Stress Episodes of the EAC Banking System for the Period of 2000 – 2017

Time	Factor Instances	Effects on Banking System
2002-2003	weak domestic economic growth	Kenya: Euro Bank (2003), Tanzania: First Adili (T) Bank Ltd (2002), Furaha finance and Crown Finance (M&A, 2002) and Delphis Bank (2003)
2006	weak domestic economic growth	Kenya: Trade Bank (2007), Allied Credit Ltd (2007), International Finance Ltd (2007), Uganda: Barclays Bank & Nile Bank Limited (M&A, 2007)
2008-2009	Global Financial Crisis	Individual bank runs/panics Government bailouts some banks Kenya: Diners Finance Company Ltd (2008), Trade Finance Ltd (2008), Heritage Bank (2008), Nairobi Finance Company Ltd (2010),
2011-2012	Global Financial Crisis	Kenya: Central Finance Kenya Ltd (2012), Inter African Credit Finance Ltd (2012) Uganda: National Bank of Commerce (2012) Global Trust Bank (2014)
2015-2016	Global Financial Crisis	Kenya: Daima Bank Ltd (2014), Trust Bank. Imperial Bank (2015), Dubai Bank (2015) and Chase Bank (2016) Tanzania: FBME and Twiga Bancorp Uganda: Crane Bank (third largest Bank in Uganda)

Source: Author's observation from various reports from the EAC Central Banks, 2019.

We also assess looming risks to financial system stability by developing a financial system stability map that illustrate the relative positions of the risk factors (AFSSI Sub-indices) to financial system stability. This assessment, describe the impact of the decompose index components in important events and highlight their behaviour as a region. Our findings suggest that during 2003-2007 (before the global financial crisis), the region was mainly faced with the risks emanating from the domestic risk factors. As shown in Figure 4.35, there was a high risk increased in the financial development and vulnerability conditions in 2004 and 2006, which contributed to the financial system instability. These crises were attributed to the deterioration of the financial development in 2004 and increased vulnerable condition in 2006; both as a result of weak economic condition, in particular, GDP growth drop across the region.

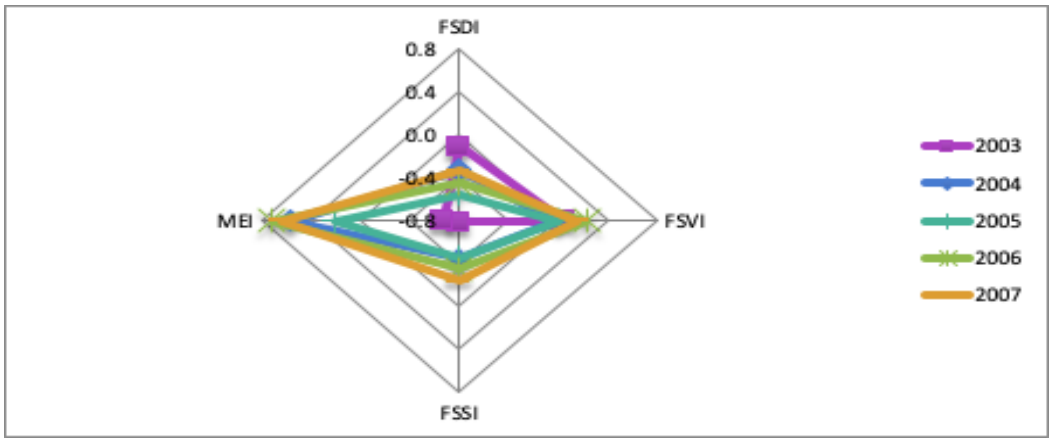

Figure 4.35: Financial Stability Map for EAC (2003-2007)

During the global financial crisis (2008 -2012), risks to FSDI and FSSI did not change much in 2010, 2011 and 2012. This was attributed to the weak MEI, in particular, declined of global and domestic GDP growth as a result of the global financial crisis, which increased the vulnerable condition in the region. The region was mainly faced with the risks emanating from both domestic and global risk factors. As shown in Figure 4.36, deterioration of MEI in 2008/09 and 2010-2012 (GDP growth dropped to negative) was reflected in the increase in vulnerable condition (high inflation rate up to 30 percent) during the same period, which impeded the FSDI and FSSI performance.

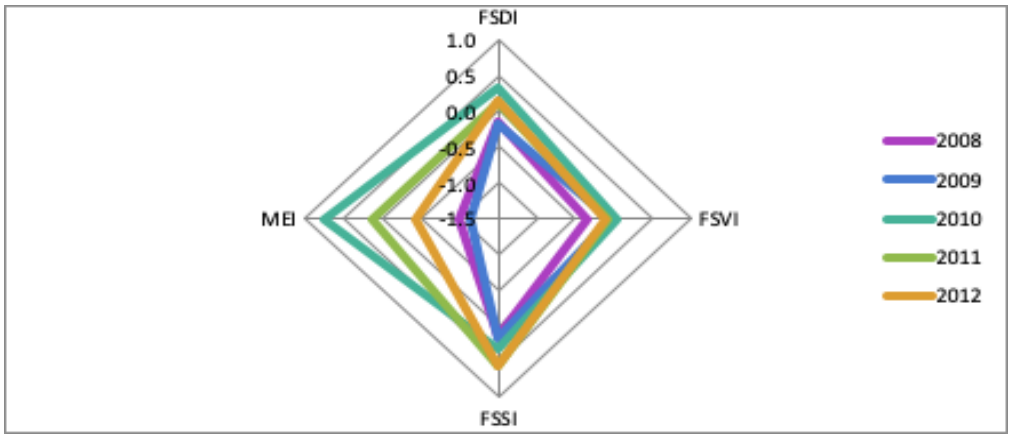

Figure 4.36: Financial Stability Map for EAC (2008-2012)

The post-financial crisis (2013-2017) has been mainly affected by the credit risk as reflected in the FSSI trend. As shown in Figure 6.37, the FSSI has been deteriorating despite the gradual improvement made on FSDI, FSVI and MEI in 2013 -2014. The sharp decline in MEI in 2015 adversely impacted the FSDI and FSVI to a large extent and slightly impacted the FSSI. However, the impact of MEI on FSSI was vividly seen in 2016/17 as when MEI, FSVI and FSDI were improving. The FSSI dropped drastically. This indicated that the region was mainly faced with the risks emanating from the domestic risk factors such as MEI, in particular domestic GDP growth drop across the region.

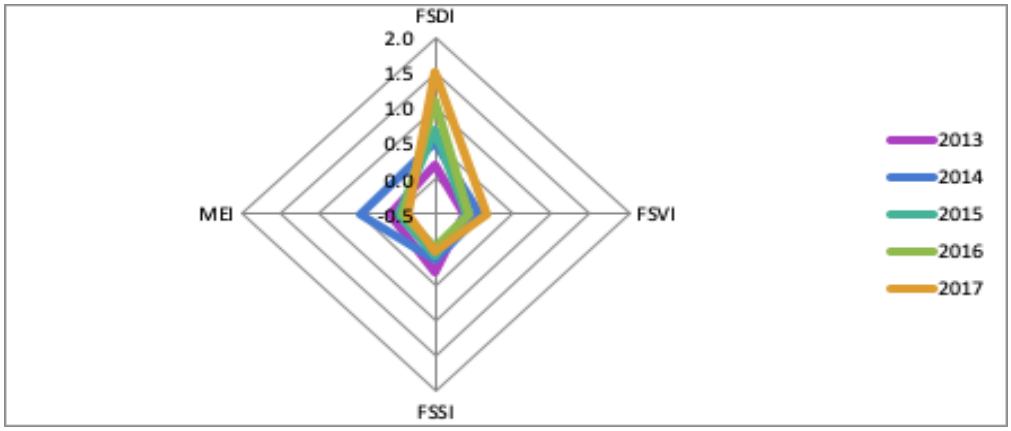

Figure 4.37: Financial Stability Map for EAC (2013-2017)

Against this backdrop, Findings indicate that despite the EAC's financial systems remained sound and stable. The region experienced a number of risks such as elevated credit risk, liquidity risk (particularly market funding) and declining profitability, which led to the financial system instabilities across the region. Major factors that contributed to the formation of risks are such as higher interest rate spread and NIM, which reflects mainly the poor performance of the financial system; increase in the domestic inflation rate, current account balance deficit, fiscal budget deficit and foreign currency imbalances, which reflect a vulnerable condition that impedes financial system stability; increase in NPLs, which shrinks the soundness of the financial system stability and weak economic growth both in the domestic, region and globally, which hinders economic activities.

In addition, findings show that the EAC banks responded to the increased competition in the post-reform period by aggressively expanding their market shares. Consequently, they ended up accumulating distressed assets that erode their bank balance sheets and fuel credit risks when the economy weakens. If the situation is not handled promptly and carefully, it might lead to systemic bank failure. This calls for an effective mechanism that monitors credit growth, which is a critical factor of financial development and minimizes threats and vulnerabilities that may potentially bring about financial crises in the region.

4.5. Econometric Analysis in Validation of AFSSI Results

Following the construction of the aggregated financial system stability index (AFSSI) as a method to assess EAC financial system stability in section 4.3, this section intends to assess the robustness of the earlier analysis in section 4.4 of the AFSSI in response to changes in macroeconomic condition. In line with other studies conducted by Albulescu et. al., (2010), Morris (2010) and Nasreen, Anwar, & Shahzadi (2015), we use alternative methods to the aggregated index such as econometric methods to validates the effect of key macroeconomic indicators on financial system stability. In this study, we have selected seven key macroeconomic variables based on literature. These variables include real interest rate, foreign exchange, global oil price, short-term debts, foreign direct investment, and total international reserve. Besides, we include lags of the index and interest rate in our model. This is due to the fact that the previous financial stability status and the impact of change in real interest rate influence the current performance of the index. Unlike other variables (foreign exchange, global oil price, short-term debts, foreign direct investment, and total international reserve), these variables have spontaneous impact on the financial stability.

The economic intuition corresponding to the algebra, particularly path dependency in matters to countries economic growth patterns, is that history matters (McCloskey, 1976). This is the case to the financial system stability performance as it is influenced not only by the current values of the independent variables, but also by historical values of the independent variables as well as its own past. Introduction of new monetary policy stance and financial reforms (such as central bank interest rates) may lag to be reflected in the performance of the financial system stability. For instance, real interest rate is an economic factor that may well in influenced by unobservable factors such as banking policy, default rate and sovereign risk.

In addition, historical past (lags) of financial crises (bank distress/failures) may occur due to psychological reasons resulted from the public panic). For instance, failure of one bank may trigger investors to withdraw their money from other banks, thinking that the other bank is going to fail as well. Therefore, including lagged in the AFSSI model has also the advantage of controlling for observed and unobserved historical factors that influence its current level, in addition to controlling for all-time variant structural condition, which influence current performance of the financial system.

4.5.1 Methodology Behind Robustness Check on Impact of economic factors on AFSSI

For robustness check, the study uses two different econometrics methods Generalized Least Square (GLS) and Generalized Methods of Moments (GMM) estimators. This robustness check will give us a clear picture of the behaviour of the AFSSI and a more accurate inference of model (AFFSI) parameters. Capturing the complex behavior hypotheses that exist between the lagged values of the dependent variable and the disturbances, we intend to use panel dynamic models due to their richness in economic content by virtue of being able to distinguish short-run and long-run effects of independent variables on dependent variables ((Alvarez & Arellano (2003) and Hsiao (2007)). This will allow us to specifically analyse the EAC financial system stability index, amid all its idiosyncrasies and differences inherent within, without necessarily treating it as an outlier over time and across space performance of the EAC financial system stability. Below is the presentation of these methods in details.

4.5.1.1 Method of Data Analysis

The study used linear regression method to validate the economic intuition of AFSSI's behaviour in response to changes in macroeconomic condition in the EAC region. Basically, linear regression analysis assesses whether one or more explanatory variables explain behaviour of the dependent variable. The linear regression model is denoted as:

$$Y_{i,t} = \beta_0 + \sum \beta_n X_{n_{i,t}} + \varepsilon_{i,t} \quad \text{.....Equation 4.9}$$

Whereas: Y represents the dependent variable, β represents the coefficients, X represents independent variables, ε represents the error term, and i, t and n represent country, time and number of independent variables, respectively.

In order to provide meaningful results, this method assumes that error terms are independent. This implies that the error term is a random variable that has a linear relationship, normally distributed with no or little multicollinearity, no autocorrelation, and has constant variance (homoscedasticity). However, this is not the case for most of the economic data. Most of the economic data are not normally distributed, autocorrelation and homoscedasticity due to size differences and causal effects relationship they have among each other (Dielman (1983) and Holtz-Eakin et al., (1988)). Similarly, we expect these assumptions to be violated because this study uses the economic variable to validate the economic intuition of AFSSI's behaviour in response to changes in macroeconomic condition in the EAC countries, which have economic differences such as small and medium economies. Following are the regression methods used in the analysis.

I. Generalized Least Square (LS) Method

Firstly, we use the Least squares method to analyses the influences of the proposed variables on credit risk. The least squares method is widely used to estimate the numerical values of parameters to fit a function to a set of data and characterized the statistical properties of estimates (Greene, 2007). There are two major versions of least square methods: Ordinary Least Square (OLS) and Generalized Least Square (GLS). The OLS is used when all linear assumptions hold, while the GLS allows a certain degree of correlation between the error term and heteroscedasticity in the regression model. For that reason, GLS method tends to be unbiased, consistent, efficient and asymptotically with the error term compared to OLS (Pedroni (2001) and Gujarati (2009)).

Nevertheless, empirical studies have argued that the least square method can produce biased and inconsistent results because it allows controlling for time-constant unobserved heterogeneity, which may give rise to dynamic panel bias resulted from the possible endogeneity of the lagged variable and fixed effects in the error term. This can be avoided by applying dynamic panel data methods, which allow for endogenous covariates and account for the time persistence (Bun & Sarafidis, 2015). The null hypothesis of GLS assumes that slope is equal to zero implying that there is no correlation between individual effect and other

explanatory variable. Consequently, we use GLS method suggested by Aitken (1936). The general model where time effects are assumed absent for simplicity, the model to be estimated may be given as:

$$Y_{i,t} = C + Y_{i,t-1} + \sum \beta_n X_{n_{i,t}} + \varepsilon_{i,t} \quad \text{.....Equation 4.10}$$

Where Y represents dependent variable, C represents group-specific constant term, β represents the slope (coefficients), X represents independent variables, Ei,t represents an error-component model; i, t and n represent country, time and number of variables.

GLS has three restriction options: pooled, fixed effects (FE) and random effects (RE) GLS methods. Pooled GLS is used to derive unbiased and consistent estimates of parameters even when constant time attributes are present. However, one of the major problems with this approach is that it assumes that all countries involved in the analysis are the same. That means, combining five countries by pooling approach we deny the heterogeneity or individuality that may exist among these five countries in the EAC. Similarly, RE assumes that all countries have common mean value for the intercept, while the FE account for time-constant unobserved heterogeneity between countries. This implies that although the intercept values may differ from country to country, the intercept does not vary over time. Thus, it allows for heterogeneity among the countries by allowing to have its own intercept value.

Most of the economic models have some endogeneity issues; thus, FE estimation is the best choice and gives the best consistent estimates when there is an endogeneity problem in the data set. The suitability of GLS model results is assessed by using the F-Test. This test compares the fits of different linear models and tells how jointly significant the explanatory variables can explain the dependent variable. The probability value of the F-statistics, which indicated the significance of the model. The null hypothesis assumes that the model is significant. This is in addition to other factors such as coefficients results, which represent the intercept of constant and explanatory variables. The coefficient signs show the direction of the relationship between the dependent variable and explanatory variables.

Furthermore, the probability values of each variable indicate the significance of that variable explains the dependent variable. Another factor is R-Squared, which is the goodness-of-fit measure for linear regression models. In particular, it tells how the explanatory variables can jointly explain much variation of the dependent variable. Also, the Durbin-Watson Stat presents the result of the test for the first order serial correlation in the error term. The rule of thumb value is less than 2 indicates a positive serial correlation in the model.

II. Generalized Method of Moments (GMM) Method

Another prominent way to address the misspecification, autocorrelation and collineriality problems is the use of Generalized Method of Moments, which was developed by Hansen (1982). The GMM has become one of the efficiency methods in the macroeconomic analysis, as it has shown a profound impact on different researches in the field of macroeconomics (Hansen & West, 2002). This is attributed mainly by its ability take care of the linear variables, which are subject to nonlinear restrictions as most of the macroeconomic variables have dynamic conditions that give rise to intractable likelihoods but feasible moment relationships. The GMM method incorporates the OLS and instrument variables techniques (moment conditions), which makes it more efficient when the error term is heteroscedastic and produce consistent results (Wooldridge (2001) and (Baum, 2013)). The suitability of GMM method results is assessed by using the lags data as instrument variables, whereas the number of valid instruments is proportional to the number of available lags. Thus, the dynamic panel regression equation is presented as follows:

$$Y_{i,t} = \beta_0 + Y_{i,t-1} + \sum \beta_n X_{n_{i,t}} + \varepsilon_{i,t} \quad \text{.....Equation 4.11}$$

Where Y represents the dependent variable, B is the coefficients, Yi,t-1 represents lagged dependent variable, X represents independent variables, Ei,t represents an error-component model, i, t and n represent country, time and number of variables.

The GMM estimation is subject to finite-sample (overidentification of restrictions) problem. In order to validate the proportional to the number of instrumental variables used are sufficient enough and not overidentified, we use the Sargan-Hansen test (J-statistics) of overidentification restrictions (Sargan (1958) and (Hansen, 1982)). This test determines whether there is a problem of overidentifying moment conditions (too many instruments) in the model and analyse if there is any correlation between the instruments and errors, which is not the preferable condition (instrument and the error term should be serially uncorrelated).

In the face of all the above-mentioned difficulties, the dynamic panel two-step system Generalized Method of Moments (GMM) introduced by Arellano & Bover (1995) and Blundell & Bond (1998) is the best option for our estimation because of its power to deal with various endogeneity issues arising from dynamic panel estimation. This technique allows us to employ internal instruments available within the panel itself, using lags. As a system GMM, the equation is estimated simultaneously at both levels and orthogonal deviation.

The GMM by first difference is widely used in econometric literature because of its ability to properly deal with inherent endogeneity by transforming the data to remove fixed effects. However, according to the recent studies on the investigation of the accuracy between first difference and orthogonal deviation methods of dynamic panel data models conducted by (Hayakawa (2009), Guo, Guo, Billings, & Wei (2015), Kiviet, et. al., (2017) and Phillips (2018) have suggested that a modification of GMM, the GMM by orthogonal deviations is found to have more accurate estimations than the first difference in many cases. Thus, motivates the use of orthogonal deviation transformation instead of the first difference looking at our data when there is potential of heteroskedastic cross-sectional is pronounced and the time-series dimension of the sample is not too small.

The system GMM estimator by orthogonal deviation is accompanied by a test of potential misspecification (instrument exogeneity condition). The GMM allows for inclusion of more than one lag of past variables as instruments. So, the test of over identification restriction (Sargan test) can be used to test the null hypothesis that all instruments included in the estimation are jointly valid. The Sargan test is the J-statistics, which test that if the instruments are exogenous, the null hypothesis cannot be rejected.

4.5.1.2 Model Specification

The study examines factors that determine credit risk behaviour in the EAC countries. As defined earlier, the study uses 7 economic variables to explain AFSSI in response to changes in macroeconomic condition. This study employs both static linear panel data model and dynamic linear panel data models in order to provide a thorough understanding of the drivers of credit risk at the static and dynamic conditions. However, static models are mostly mis-specified due to the potential serial correlation among variables, while dynamic models, which have the ability of error correction modelling tend to be corrected. Therefore, we build the following panel dynamic model:

$$AFSSI_{it} = \alpha + \beta_1 AFSSI_{it-1} + \beta_2 RIR_{it} + \beta_3 RIR_{it-1} + \beta_4 FX_{it} + \beta_5 OP_{it} + \beta_6 SDTR_{it} + \beta_7 FDI_{it} + \beta_8 TR_{it} + \delta_i + \rho_t + \varepsilon_{it} \quad \text{.....Equation 4.12}$$

Where i is observable countries, t indexes time and βi (i=1,2…8) are the coefficients of the various explanatory variables in our estimation. Following the extent literature on the determinant of financial stability, we include lag of dependent variable AFSSI (AFSSI t-1, current real interest (RIR) rate, lag of real interest rate (RIR t-1), forex (FX) and current values of oil price (OP), short debt (SDT), foreign direct investment (FDI), and treasury reserve (TR)

as our explanatory variables. δ_i is unobserved time-invariant heterogeneity that are included to purge the estimation of any country-specific fixed effects and ε_{it} is the random error term. We assume that our data, because of its short span, is free of serious economic-wide shocks.

4.5.1.3 *Data Collection*

Variables used in the robustness check on impact of economic factors on AFSSI includes secondary data from different sources as shown in Table 4.6. This was mainly attributed to the availability of data. The Word Bank data includes World Development Indicators (WDI), while IMF data includes data from World Economic Outlook (WEO), and United Nations Conference on Trade and Developments (UN).

Table 4.6 Variable Description and Sources

Variable	Variable Name	Source
AFSSI	Aggregated Financial System Stability	Author's Calculation
FX	Official Exchange Rate (LCU per US$, period average)	WDI
RIR	Real Interest Rate	WDI
OP	Primary Commodity Price	IMF
SDTR	Short-term debt (% of total external debt)	WDI
FDI	Foreign direct investment, net inflows (% of GDP)	UN
TR	Total reserves (% of total external debt)	WDI

Variables used in the robustness check on impact of economic factors on AFSSI includes the selected set of variables that are not in the composite of the AFSSI. Thus, we use AFSSI, which is the results of the aggregated financial system stability index computed in section 4.4.1 and shown in Figure 4.2 as the independent variable.

The first dependent variable is real interest rate (RIR). We used RIR in our regression to represents monetary policy stance, which indicates the financial and economic stability of the country at that particular time. During difficulty times (financial instability) when leverage among lenders dropped down and credit to private nonfinancial sector goes very slowly, central banks use discount interest rate as an economic tool in order to ease the money borrowing and control level of stability within the country's financial system. Dell'Ariccia, Laeven, & Marquez (2014) analyzed the relationship between real interest rate, leverage, and bank risk-taking. Results showed that low interest rates are one of the contributors to the buildup of financial risks or asset bubbles because during this time banks lowers credit standards to attract creditors. Consequently, the increased reliance on short term funding leads to greater bank risk taking found that when banks can adjust their capital structure, reduction in real interest rates lead to greater leverage and higher risk.

In addition, short-term real interest rates such as the deposit and lending rates of financial intermediaries change only gradually, so that the current real interest rate is quite strongly correlated with interest rates in the recent past. Consequently, it is hard to separate the effect on the current real interest rate output from the delayed effects of the real rate in earlier periods (Ajello et al., 2016). Since intermediaries' interest rates are essential determinants of cash-flow, asset prices, and the incentive to postpone expenditure thus, the slow pass-through contributes to the transmission lag from the real cash rate to activity. Therefore, we also included lags of interest rate (RIR t-1), which indicated the slow impact transmission of monetary policy in the economy.

The third variable is foreign exchange rate (FX). We defined exchange rates as the amount of local currency to one US dollar. Changes in the FX movements have a multiplier effect on the economy as it affects international trade, capital flows and macro-economic stability at large. A study conducted by Fornaro (2015) on the relationship between financial crises and exchange rate policy confirms that credit frictions and pecuniary externalities give rise to a trade-off between price and financial stability. Thus, depreciation of the FX during a financial crisis has a positive impact on welfare because the stimulus provided by depreciation sustains assets prices, collateral, and access to international credit markets.

The fourth variable is global oil price (OP). We use OP in our model because it is the most prominent indicator of economic growth. Increase in economic activities increases oil demand. A study by Guo, Chen, & Huang (2011) on markets contagion during financial crisis suggested that a part from domestic shock, stock market shock and oil price shocks are the main driving forces behind the financial crisis, in particular the credit default market and stock market variations, respectively. Besides, since the OP have a positive influence on real exchange rate, then the increase in OP weakens the domestic currency, which leads to the increase in inflation rate and affects economic activities as it increases the operational costs and prices of goods made with petroleum products.

The fifth variable is the short-term debt (SDTR). We include the SDTR as an indicator of financial crisis/instability. A study conducted by Benmelech & Dvir (2013) on the relationship between short-term debt and financial crisis during the East Asian Financial crisis in 1997-1998 found that short-term debt reflects distress in financial institutions significantly. Therefore, the excessive short-term debts increase the vulnerability condition to rollover risk and financial crisis.

The sixth variable is foreign direct investment (FDI). FDI plays a vital role in the development process of a country as it attracts capital inflow, knowledge and increase the balance of payment. Sulemana, et. al., (2018) conducted analysis on the implication of foreign bank inflows in sub-Saharan Africa bank stability and found that the presence of FDIs, foreign banks in the domestic banking sector robustly reduces the probability of bank crisis. Thus, the increase in FDI lead4s to a sustainable high trajectory of economic growth and foster financial system stability.

The last variable is the total international reserve (TR). We include TR because it is used to back liabilities and influence monetary policy. A study conducted by Obstfeld & Rogoff (2009) on global imbalances and financial crisis argues that countries tends to accumulate TR at a cheaper cost during financial stability and uses IR as buffers against future crisis. In addition, Aizenman, Cheung, & Ito (2015) on the international reserves before and after the global crisis confirms that TR has a positive relation with financial stability.

4.5.1.4 *Preliminary Data Analysis*

We firstly performed the descriptive statistics of the data set in order to identify the underlying distribution of random variables. As it is evident in Table 4.7, results from the central limits (Mean and median); the probability distribution (skewness and kurtosis) and JB test indicate that we should reject the null hypotheses for all series. This means that apart from AFSSI, our variables are not normally distributed as the p-value is less than 5 percent.

Table 4.7: Panel Summary Statistics

	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
AFSSI	-3.30E-17	-0.00580	0.29505	-0.09982	2.98841	0.59988	0.74086
FX	3.06E-16	-0.25150	0.99441	0.52832	2.61040	19.02387	0.00007
RIR	5.56E-12	-0.01043	0.99441	-0.34587	3.26430	8.22549	0.01636
OP	4.13E-16	-0.15540	0.99441	0.33984	1.81613	27.95306	0.00000
SDTR	-2.78E-11	-0.35923	0.99441	1.50297	5.82670	255.38760	0.00000
FDI	5.56E-12	-0.30370	0.99441	0.77302	3.30089	37.21191	0.00000
TR	-5.56E-12	-0.21143	0.99441	0.25636	1.83918	24.15584	0.00001

In addition, to strengthen the results of the descriptive statistics above, a simple correlation analysis was performed in order to analyse the correlation among the variables that might hinder the accuracy of our results. The results in Table 4.8 indicate that most of the variables are highly correlated with a correlation coefficient of greater than 5 percent. This indicates that there is a multi-co-linearity problem in the data sample.

Table 4.8: Panel Correlation Analysis

Correlation	AFSSI	FDI	FX	OP	RIR	SDTR	TR
AFSSI	1.000						
FDI	0.0604***	1.0000					
FX	0.5115*	0.1116**	1.0000				
OP	0.2565*	0.4800*	0.2514*	1.0000			
RIR	0.2041*	0.0003***	0.0044***	-0.2869*	1.0000		
SDTR	-0.1891*	-0.1821*	-0.1793*	-0.5444*	0.3950*	1.0000	
TR	0.2122*	0.4773*	0.1446*	0.7145*	-0.2666*	-0.540*	1.00000

, * and * denoted significance at 1%, 5% and 10%, respectively.*

We also analyse whether our variables have non-stationarity problem. As shown in Table 4.9, all variables were stationary at level or the first difference. This indicates that our variables can be used directly in the regression to establish the long-term effects after transforming the non-stationary variable into a stationary state.

Table 4.9 Panel Unit Root Test

Variable	Method	Statistic	Prob.	Obs	Stationary Level
AFSSI	Im, Pesaran and Shin W-stat	-11.1883	0.0000	348	L(1)
	ADF - Fisher Chi-square	115.454	0.0000	348	
	PP - Fisher Chi-square	109.127	0.0000	350	
FX	Im, Pesaran and Shin W-stat	-13.0836	0.0000	350	L(1)
	ADF - Fisher Chi-square	142.205	0.0000	350	
	PP - Fisher Chi-square	141.754	0.0000	350	
RIR	Im, Pesaran and Shin W-stat	-2.45282	0.0071	318	L(1)
	ADF - Fisher Chi-square	21.5388	0.0176	318	
	PP - Fisher Chi-square	57.5540	0.0000	350	
OP	Im, Pesaran and Shin W-stat	-9.04147	0.0000	340	L(1)
	ADF - Fisher Chi-square	94.8580	0.0000	340	
	PP - Fisher Chi-square	134.728	0.0000	350	
SDTR	Im, Pesaran and Shin W-stat	-1.73355	0.0415	338	L(0)
	ADF - Fisher Chi-square	18.7183	0.0440	338	
	PP - Fisher Chi-square	48.1121	0.0000	355	
FDI	Im, Pesaran and Shin W-stat	-1.8908	0.0293	334	L(0)
	ADF - Fisher Chi-square	22.8203	0.0114	334	
	PP - Fisher Chi-square	24.8419	0.0057	355	
TR	Im, Pesaran and Shin W-stat	-3.11453	0.0009	346	L(1)
	ADF - Fisher Chi-square	26.5043	0.0031	346	
	PP - Fisher Chi-square	35.3534	0.0001	350	

Since the unit root is present in some of the series, implementing the regression analysis using variables' series in their level forms is not advisable. Therefore, we checked for the probability distribution after differencing the variables (Figure 4.38). JB results indicate that variables are not normally distributed as the p-value is less than 5 percent.

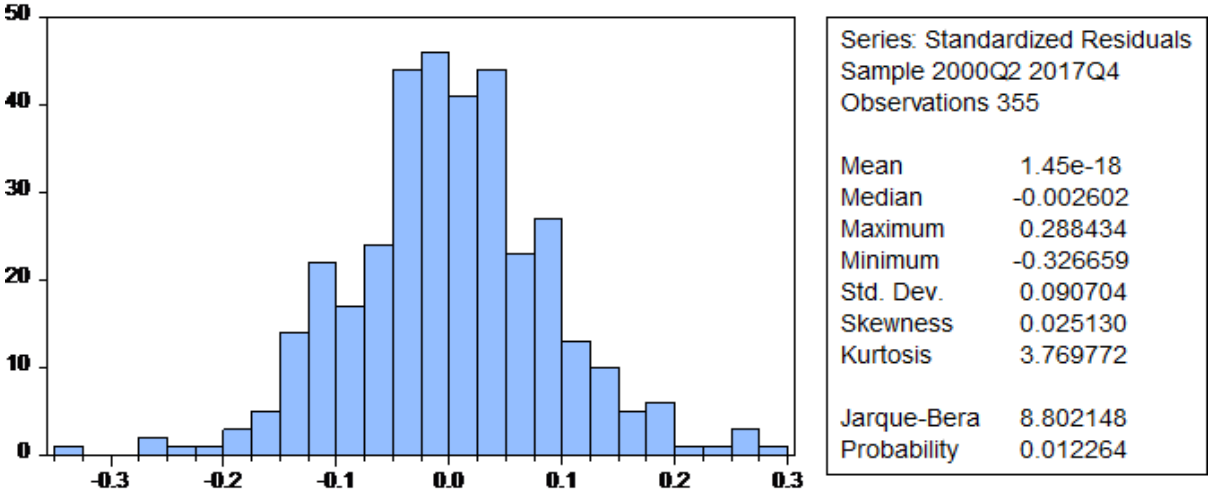

Figure 4.38 Panel Normality Test (JB Test)

Following the stationarity test results, we checked whether our variables are still cointegrated (long-run relationship) even after differencing some of the variables. Usually, when variables are differenced to attain stationarity, their long-run relationships are lost. Shown in Table 4.10, even after differencing AFSSI, FX and TR, our variables are still significantly cointegrated at 99 percent confidence level. This result suggests that the long-run relationship was found between our variable, hence can be used to fit the model.

Table 4.10 Panel Pedroni Residual Cointegration Test Results

Series: DAFSSI DDFX DTR FDI DRIR SDTR DOP

Alternative hypothesis: common AR coefs. (Within-dimension)

	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	-0.286879	0.6129	-1.594470	0.9446
Panel rho-Statistic	-5.548009	0.0000	-6.226699	0.0000
Panel PP-Statistic	-7.415299	0.0000	-8.136667	0.0000
Panel ADF-Statistic	-5.028507	0.0000	-4.671757	0.0000

Alternative hypothesis: individual AR coefs. (Between-dimension)

	Statistic	Prob.
Group rho-Statistic	-4.817445	0.0000
Group PP-Statistic	-7.428050	0.0000
Group ADF-Statistic	-4.329536	0.0000

4.5.2 Econometric Results and Interpretation

To understand the nature of the relationship between AFSSI and other relevant macroeconomic variables (FX, RIR, OP, SDTR, FDI and TR), we implement the panel regression analysis using generalized least square (GLS) and GMM methods. After performing all the necessary assumptions for our model, we implement a pooled feasible GLS estimation. For robustness check our model, we implemented the GMM – Orthogonal Deviation method. This validates the relationship between our variables.

The empirical analysis results confirm the relationship of the aggregated index and other relevant exogenous variables are consistent with the economic theories and other empirical studies. We regressed AFSSI against other exogenous variable using quarterly data between 2000 - 2017 to validate its performance. As it is evident in Table 4.11, signs of all coefficients are consistent with the economic theories and other empirical studies. Besides, the performance of AFSSI with other relevant macroeconomic variables is significant, with a 13 percent R-squared and 74 percent Probability of F-statistics.

Table 4.11: Panel GLS Regression Results

Dependent Variable: DAFSSI

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.012270	0.005061	2.424407	0.0158
DFX	-0.068367	0.031331	-2.182084	0.0298
OP	-0.026119	0.006701	-3.897583	0.0001
DTR	0.093602	0.032062	2.919397	0.0037
RIR	0.056554	0.015111	3.742619	0.0002
RIR(-1)	-0.052299	0.015295	-3.419258	0.0007
SDTR	-0.018472	0.006383	-2.894060	0.0040
FDI	0.014354	0.005859	2.449756	0.0148

R-squared	0.130871	Mean dependent var	0.009383
Adjusted R-squared	0.113338	S.D. dependent var	0.095695
S.E. of regression	0.090109	Akaike info criterion	-1.953323
Sum squared resid	2.817494	Schwarz criterion	-1.866064
Log likelihood	354.7148	Hannan-Quinn criter.	-1.918609
F-statistic	7.464337	Durbin-Watson stat	1.348605
Prob(F-statistic)	0.000000		

Following the GLS results (which show the significance of the relationship between AFSSI and other relevant exogenous variables however with a very low value of R-squared),

we performed another robust regression analysis to validate the same relationship. We regressed AFSSI against other exogenous variable using quarterly data between 2000 - 2017 to validate its performance. The performance of AFSSI with other relevant macroeconomic variables is significant at 99 percent confidence level and a Prob (J-statistics) of 42 percent.

As it is evident in Table 4.12 and in line with the economics literature creed that history matter, the value of the AFSSI in previous quarters positively impacts the present value of the index. We have also found a positive relationship between the FDI and the aggregated index. This is in line with a study done by Brambila-Macias and Massa (2010) on the analysis of the effects of FDI to the sub-Saharan countries, which confirmed that FDI and cross-border bank lending exert impacts growth. In addition, AFSSI has a positive relation with foreign reserves, indicating that the EAC countries implement a reserve management policy whereby countries have been accumulating international reserves during the good times of economic stability to be used as a buffer in times of crisis. This is in line with a study conducted by Cheng (2015) on the analysis of foreign reserve accumulation, which found that global reserve accumulation welfare changes during economic transition.

Table 4.12: Panel GMM Regression Results

Instrument specification: @DYN (DAFSSI, -2, -5) @LEV (FDI (-1) @LEV (DTR (-1)) @LEV (RIR (-1)) @LEV (RIR (-2)) @LEV (DFX (-1)) @LEV (OP (-1)) @LEV (SDTR (-1))

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DAFSSI (-1)	0.341090	0.015219	22.41284	0.0000
FDI	0.008591	0.001117	7.690891	0.0000
DTR	0.044041	0.009399	4.685928	0.0000
RIR	0.044609	0.004497	9.918749	0.0000
RIR (-1)	-0.044586	0.004289	-10.39525	0.0000
DFX	-0.059081	0.006805	-8.681710	0.0000
OP	-0.023169	0.001444	-16.04253	0.0000
SDTR	-0.016131	0.000540	-29.85039	0.0000
	Effects Specification			
Cross-section fixed (orthogonal deviations)				
Mean dependent var	-0.003637	S.D. dependent var		0.096716
S.E. of regression	0.087036	Sum squared resid		2.552837
J-statistic	250.3748	Instrument rank		255
Prob(J-statistic)	0.428136			

The signs on the real interest rate (RIR) are somewhat contradictory; the concurrent effect has a positive effect on the index while the one-period lag has a negative effect on the index. An explanatory of this outcome is provided in work done by Ajello et al., (2016). They posit that current period RIR influence the stability trend while the previous real interest rate, which was taken as a measure on monetary stance to regulate the impact of inflation in the economy. Thus, the change in the previous quarter RIR will have a negative direction with the current financial system stability.

In addition, foreign exchange rates have a negative relationship with the index. As in line with Bénétrix et al., (2015), This implies that increase in domestic currency depreciation can stimulate deterioration in the financial system stability such as by influencing an increase in the currency exposures. In addition, there is a negative relationship between oil price and the index. This indicates that a decrease in the oil price fosters financial stability, as the cost of production decreased. Moreover, a negative relationship between Short-term debt and AFFSI was observed in our results. Thus, the increase in short-term debts deteriorates the financial system stability as it leaves the system excessively vulnerable to costly financial crises.

4.5.3 Concluding Remarks

The financial system stability index represents some of many methods used to measure the level of financial stability. The index is used as an aggregate early warning indicator by macroprudential analysts and policy makers to capture the complex interactions of various economic and financial indicators with their impacts on the stability of the financial system. Given practicality and consistency of AFSSI results obtained using EAC regional data, AFSSI proves to be among the strong empirical methods of monitoring and assessing stability of financial system. Therefore, the AFSSI can be adopted as one of the tools to monitor and assess the stability of the financial system in the EAC region. Despite its plausibility, we however, acknowledge a few shortcomings of the FSSI framework as follows: FSSI cannot take into account potential risks arising from off-balance sheet activities and qualitative positive or negative impacts. Thus, more methods of analysis such as to measure financial risks and systemic risk should complement the AFSSI analysis.

4.6. Forecasting Financial System Stability in the EAC

In this session, we use the historical values of the AFSI to determine how the forecasting models accurately predict our AFSSI and using the models to perform out-of-sample forecast. We chose univariate forecasting methods because when it comes to

forecasting several steps ahead, the regression-based approaches fail to perform well, most studies adopt regression-based approaches. Besides, de Oliveira and Oliveira (2018) argued that in the regression approach, the independent variables also need to be forecasted first before using their predicted values to forecast the dependent variable.

4.6.1. Background to the Study: Forecasting the EAC Financial System Stability

Given a vector of macroeconomic and financial indicators, there is a possibility of assessing the outlook of the EAC financial system stability. Once forecasted values of explanatory variables are known, values of independent variables (AFFSI) can be predicted to project the outlook of the financial system. The Error Correction Model can be deployed for forecasting and used as the stress testing by applying adverse extreme scenarios for explanatory variables. Using econometric forecasting techniques to validate the outlook of financial system can further validate future risks' signals provided by the AFSSI.

4.6.2. Data and Methodology

Various forecasting models have been used in forecasting economic variables. Prominent among them is the autoregressive moving average (ARIMA) models due to their natural statistical characteristics (Naylor et al., 1972). The nature of our financial economic index exhibits seasonal patterns and needs a forecasting model that properly captures the effect of seasonality and trends. The seasonal ARIMA model best fits the condition. A Seasonal ARIMA model can be expressed as Seasonal ARIMA (p,d,q)(P,D,Q)s where (p,d,q) and (P,D,Q) are the non-seasonal and seasonal parts of the model respectively while s is the number of periods per season. p, d and q show the Autoregressive (AR) term, the number of times the series is differenced to obtain stationarity and the moving Average (MA) term respectively. Similarly, in the seasonal portion, P, D and Q are the seasonal AR term, the number of seasonal differences performed and seasonal MA term. For a timeseries Yt for t=1,2, …, n, the differenced series.

$$X_t = (1-B)^d (1- B^s) Y_t \quad \text{.....Equation 4.13}$$

is a stationary ARIMA process and the general Seasonal-ARIMA model could be defined as:

$$\emptyset(B)\Phi(B^s)X_t = \theta(B)\Theta(B^s)e_t \quad \text{.....Equation 4.14}$$

where B is the backshift operator written as $B^A Y_t = Y_{t-a}$ while Φand Θ are the seasonal MA and seasonal AR polynomial of order P and Q respectively with no roots inside the unit circle for each of them $e_t \longrightarrow N(0, \delta^2)$ and $Cov(e_t, e_{t-k}) = 0$ for all k ≠ 0.

However, the ARIMA models are reported to exhibit weakness in the presence of some special events and nonlinearities (Moghram and Rahman, 1989). Apart from the traditional ARIMA sets of forecasting models, a newer set of models emerged called the Exponential Smoothing models. These models use the concept of weight combinations of past observations where more weights are allocated current observations than older observations. Examples of these models are Single exponential smoothing, Holt's linear model and the Holt-Winters models. The most important significance of the exponential smoothing models, According to Moghram and Rahman (1989), is the high degree of forecasting accuracy with minimal effort on model identification.

The Simple exponential smoothing model considers the forecast of past observations and adjusts it using the forecast errors (Brown, 1959). Given that α is a constant between 0 and 1, Y_t is our time series data, the forecast for the next value, F_{t+1}, is expressed as

$$F_{t+1} = F_t + \alpha(Y_t - F_t) \Leftrightarrow F_{t+1} = \alpha Y_t + (1 - \alpha)F_t \quad \text{.....Equation 4.15}$$

Where F_{t+1} is a weighted average of past observations, which decreases exponentially. Besides, the Holt-linear model is a smoothing procedure that extends the simple exponential smoothing to linear exponential smoothing to adjust for observations with trends (Beverton and Holt, 1957; Gould et al., 2008). Hence, this approach uses to smoothing constants, α and β (which takes values between 0 and 1) as well as three equations:

Level: $l_t = \alpha Y_t + (1 - \alpha)(l_{t-1} + b_{t-1})$ .....*Equation 4.16*

Growth: $b_t = \beta(l_t - l_{t-1}) + (1 - \beta)b_{t-1}$ .....*Equation 4.17*

Forecast: $F_{t+h|t} = l_t + b_t h$ .....*Equation 4.18*

where l_t and b_t are the estimates of the level and slope of the series at time t respectively. Gardner Jr and McKenzie (1985) suggested a modification to the Holt's linear model to make room for damping of trend. In this case, they suggest a damping for each additional future time by a factor ϕ (takes values between 0 and 1). The level equation, for instance could be written as:

$$l_t = \alpha Y_t + (1 - \alpha)(l_{t-1} + \phi b_{t-1}) \text{.....Equation 4.19}$$

The Holt-Winters (Hereafter referred to as HW) models are groups of exponential smoothing models that deals with smoothing parameters which are estimated from past data (Chatfield and Yar, 1988). There are different forms of the HW models, common among them is the Addictive and Multiplicative HW. The Multiplicative HW is inappropriate for data that

contains negatives or zeros. Hence, the Multiplicative HW cannot be used for our analysis since our data contain negative figures.

For a timeseries, Yt, where t =1,2 …, n, the forecast F_{t+h} based on data upto time t is denoted by $F_{t+h|t}$ where h is the number of forecasted periods ahead. The point forecast and updating equations for the Addictive HW are written as:

Level: $l_t = \alpha(Y_t - S_t) + (1 - \alpha)(l_{t-1} + b_{t-1})$ .....*Equation 4.20*

Growth: $b_t = \beta^*(l_t - l_{t-1}) + (1 - \beta^*)b_{t-1}$ .....*Equation 4.21*

Seasonal: $S_t = \gamma(Y_t - l_{t-1} - b_{t-1}) + (1 - \gamma)S_{t-m}$ .....*Equation 4.22*

Forecast: $F_{t+h} = l_t + b_t h + S_{t-m+h_m^+}$ .....*Equation 4.23*

where m = length of seasonality (in our case, m=4 quarters in a year), lt = level of series, bt =growth, St =seasonal component and $h_m^+ = [(h-1) mod\ m] + 1$. Also, α, β and γ are smoothing parameters (probabilities values) to be determined from the observed data. Parameters close to 0 means little weight is placed on the recent observations when predicting future values whereas values closer to 1 show that much weight is put on far distant past observations.

In forecasting, errors occur if the forecasting model is unable to accurately predict the respective trend, growth, seasonal or any cyclical factor. For each time series, Yt the forecast error for Ft can be computed as $e_t = Y_t - F_t$. Several forecasting accuracy measures are used in the forecasting literature. We make use of the following:

Mean Absolute Percentage Error (MAPE) = $\left(\sum_{t=T+1}^{T+h} \left|\frac{F_t - Y_t}{Y_t}\right| / h\right) 100\%$..... ...*Equation 4.24*

Root Mean Squared Error (RMSE) = $\sqrt{\left(\sum_{t=T+1}^{T+h} (F_t - Y_t)^2 / h\right)}$.....*Equation 4.25*

Mean Absolute Error (MAE) = $\left(\sum_{t=T+1}^{T+h} |F_t - Y_t| / h\right)$.....*Equation 4.26*

Mean Absolute Square Error (MASE) = $\sum_{t=T+1}^{T+h} \left|\frac{F_t - Y_t}{(\sum_{t=T+1}^{T+h} |Y_t - Y_{t-1}|)/h}\right| / h$.....Equation 4.27

In the above accuracy measures, Ft, Yt and h are the forecasted (predicted), real value and the number of forecasting steps ahead respectively. Among these competing measures, the one with the smallest error value is the best forecasting model.

In spite of the power of the exponential smoothing models, the empirical forecasting literature suggest that there is little difference, regarding forecasting accuracy, between the ARIMA and the exponential smoothing models (Makridakis et al., 1979, 1982; Poloni and Sbrana, 2015; de Oliveira and Oliveira, 2018). Besides, according to Gelper et al., (2010) forecasts based on the Holt-Winters method (Hereafter referred to as HW) are optimal at the

linear trend models. Thus, the study intends to use both models: SARIMA and the HW to forecast the EAC AFSSI for the period of 3 years starting from 2018 – 2020. We, therefore present analysis results of all the models discussed above for the purpose of comparing and robustness checks. Our empirical result is based on the quarterly regional financial stability index (developed in the previous session) that spans from the time period 2000 to 2017.

4.6.3. Forecasting Results

We analysed different Seasonal ARIMA (SARIMA) models to determine which of them was the best among all the competing models. By using the accuracy measure, the Seasonal ARIMA (1,1,0) (2,0,0) [4] was identified as the most competing. We present the graphs and diagnosis for the SARIMA and the other models. The smoothing parameters of the Holt's-linear and Holt-Winters that were used for estimating the levels, trend and seasonal components of the model have not been reported. However, all the conditions necessary for the use of these forecasting models were checked. For example, the alpha, beta and gamma parameters were all found to fall between 0 and 1.

Figure 4.39 shows the plot of the forecasted values (in red) alongside the actual financial stability index values (in black). The presented methods of the Holt-Winters are found to have good forecast performance for the AFSSI. We observe the fit performance of each model with the actual series in all three methods: seasonal addictive, non-seasonal and single exponential smoothing forecasting methods.

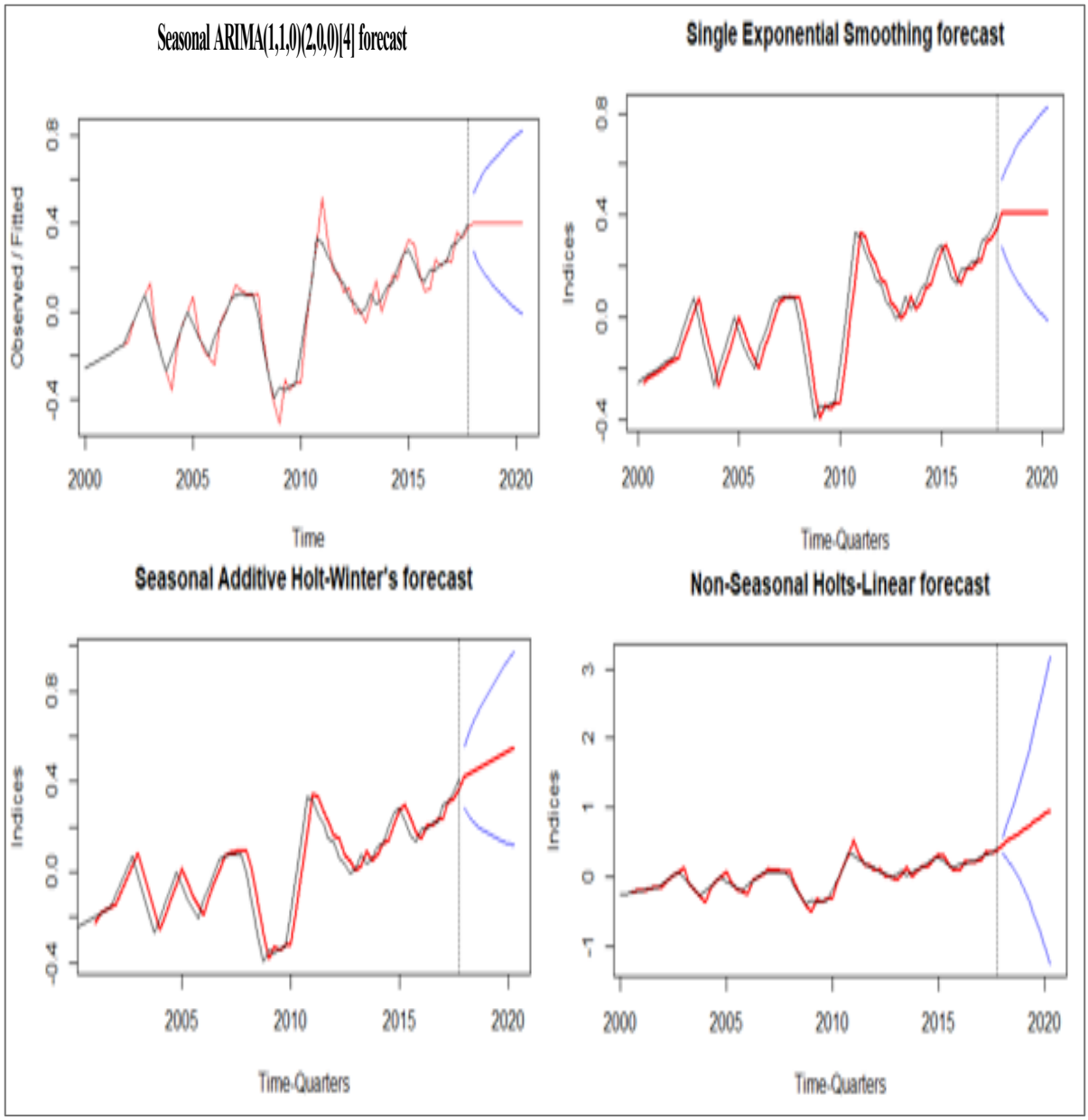

Figure 4.39 AFSSI Forecasting Models for the Period of 2018 – 2020

A close look at the graphical representation of the models clearly shows that all the models fit the original financial stability index series. Besides, we perform a three-year out-of-sample forecast (from 2018 to 2010) and, again, all the models predict increasing financial stability Up to the outlying values, the non-seasonal and single exponential smoothed series are very similar. In the forecast period, the performance of the AFSSI in all methods increased. This indicates a good sign that the financial system stability in the EAC is going to continue to improve for the next 3 years.

In Table 4.13, we present the accuracy measure statistics (RMSE, MAE, MAPE and MASE). Generally, the Non-Seasonal Holt's-linear and the Simple exponential smoothing models record similar and lower error measures. Comparing these two best performing models,

the Non-Seasonal Holt's-linear model slightly outperform the Simple exponential smoothing model when using the MAPE. However, the SARIMA model records the lowest accuracy measure except that it has relatively a higher MAPE. By using the error measures, there is no definite concluding remarks on which of the models has superior forecasting power, although the SARIMA seems obvious.

Table 4.13: AFSSI Forecasting Model Results of the Methods with their Residuals

Forecasting Method	RMSE	MAE	MAPE	MASE
Seasonal ARIMA	0.0476	0.3601	66.7094	0.2274
Seasonal Additive Holt-Winter's	0.0685	0.0539	119.2659	0.3399
Non-Seasonal Holts-Linear	0.0603	0.0398	24.6533	0.2511
Single Exponential Smoothing	0.0603	0.0398	64.7842	0.2511

4.6.4. Concluding remarks

In a nutshell, the differences in the individual accuracy measures across all models are not generally big, indicating that our AFSSI is widely robust across various forecasting models. In other words, the index can be modelled using a wide range of forecasting techniques with similar and accurate results. In what follows, we carefully chose these models that address various forecasting issues ranging nonlinearity, heteroscedasticity and stochastic features (trend, seasonality, growth, residuals).

Therefore, the forecasted results have shown that with the trend of regional aggregated financial system stability, the region is likely going to continue enjoying the stable and robust financial system stability for the period of 2018 – 2020. As it is evident in the results of all methods used to forecast the AFSSI, all methods have a good forecast performance for the AFSSI as all 4 methods were able to predict the AFSSI within the sample. However, the non-seasonal model is the optimal model for Holt-Winters three-parameters smoothing as it forecasts the AFSSI with the lowest sum of squared forecast errors. Thus, it can be used to predict the short-term AFSSI trend for the EAC.

4.7. Chapter Summary

The objective of this chapter is to examine the EAC financial system resilience and forecast its robustness. In order to examine the financial system stability, we developed the aggregated financial system stability index, which combines various indicators relating to financial system development, vulnerability, soundness and macroeconomic climate. We

further verified the performance of the index using the econometrics methods and forecast the EAC financial system stability.

Findings from the index show that the EAC financial system has remained relatively robust, albeit vulnerable to shocks. In particular, the system was vulnerable during 2000 – 2010, where the financial system was relatively less developed and operated in a weak macroeconomic environment. However, since 2010 there is a notable development in terms of access and usage of financial services, which improves the stability of the financial systems. This was largely attributed to the relatively stable economic growth, implementation of financial sector reforms as well as financial integration initiatives.

Looking at the risks to financial systems stability, we found risks that are emanating from tighter financial conditions and weaker economic growth, which led to elevated credit risk, liquidity risk and declining profitability across the region. This was largely attributed to the banks responded to the increased competition in the post-reform period by aggressively expanding their market shares. Consequently, they ended up accumulating distressed assets that erode their bank balance sheets and fuel credit risk when the economy weakens.

We further conducted the empirical robustness analysis to verify results obtained from AFSSI using its sub-index as well as other relevant macroeconomic variables. We found that AFSSI results are significantly at 99 percent confidence level, and all coefficients were consistent with the economic literature. This confirms that variables used to construct the index can be used as an early warning indicator of the potential risks to the financial system stability.

Lastly, we forecasted the EAC financial system stability. For robust forecasting results, we used 4 methods: seasonal ARIMA, seasonal addictive, non-seasonal and single exponential smoothing forecasting methods. We found that all 4 methods were able to predict the AFSSI within the sample and indicating the positive trend of the AFSSI out-of-sample for the period of 2018 – 2020. Nevertheless, the non-seasonal model is the optimal model for Holt-Winters three-parameters smoothing as it forecasts the AFSSI with the lowest sum of squared forecast errors. Thus, it can be used to predict the short-term AFSSI trend for the EAC.

CHAPTER FIVE

5. POTENTIAL SYTEMIC RISK IN THE EAC BANKING SYSTEM

This chapter addresses the fourth objective, which is to measure the systemic risk potential in the EAC financial system by focusing on the assessment of the degree of interconnectedness of the EAC banks, analysing the magnitude of systemic risk in the EAC banks, and examining if the above are linked to financial system stability in the EAC. By measuring the potential systemic risk, the results indicate whether the EAC banking sector is vulnerable and/or prone to systemic risks. It was observed that even though the EAC financial markets are less integrated to the global financial markets, the EAC banking systems' interconnectedness has significantly increased especially, during the times of economic downturn. This poses a potential for spill-over of shocks and vulnerability across the region during times of crisis.

5.1. Background to the Chapter (Study)

5.1.1. An Overview

Financial system plays a pivotal role in the economic growth by providing liquidity services, risk sharing and solving symmetric information problem amongst market participants. The interaction between financial system market players (banks, financial markets, financial infrastructure, economic activities, and investors) is highly interconnected. The recent global financial crisis showed that in a highly interconnected financial system, distress in one part of the system is likely to be transmitted to other parts of the system, which may trigger systemic risk and spill over to the whole financial system (Campbell, Covitz, Pence, and Nelson 2011).

The adverse consequences of the global financial crisis on the global financial system have highlighted the need for a better and deeper understanding of the dynamics of financial stability and how best to maintain financial stability. Thus, one critical issue is to assess the systemic importance of institutions in normal times in order to reduce the impact of systemic risks these institutions pose to the system and enhancing the financial system's resilience to shocks (Board, Financial Stability (2009)). In the same vein, several analytical works and frameworks have been put in place aiming at mitigating the systemic risks and ensure financial system stability, both individual institutions and the financial system as a whole.

Systemic risk can be defined as the negative externalities, which brings disruption to the flow of financial services and have a spillover to the real economy. Thus, interconnectedness captures situations when distress in one institution raises the likelihood of distress in other institution. Systemic risk comprises of three risks: risk of a large triggering event, financial sector propagation mechanism and macroeconomic risk (Taylor, 2010). The risk of a large triggering event can be emanated from different angles such as declined purchasing power of public sector after the suddenly contracts liquidity because of monetary contraction policy; external shocks that impede smooth running of the payments and settlement system; and financial market distress due to large financial institution failure. A good example of the triggering events that causes financial and economic crisis are the Russian government default in 1998, September 11, 2001, terrorist attacks in the United States and bankruptcy of Lehman Brothers in 2008.

The risk of financial sector propagation event can also be emanated from the financial linkages between financial institution, both direct such as interbank credit exposures, financial services dependencies and financial infrastructure dependencies) and indirect linkages such as mark to market losses for other banks, margin calls and information spillover (Kiyotaki & Moore, 2002) and (Paltalidis, et, al., 2015). This is well known as contagion effect or chain reaction. On one hand, the direct financial institutions linkage is when failure of one institution adversely affect other institutions in a chain reaction. This can be through interbank loans and derivatives contracts. Thus, failure of a certain institution, which has financial obligations to other institutions may trigger a chain of other institutions failures' arising from the inability to settle the financial obligations. On the other hand, the indirect financial institution linkage is when financial institutions have similar kind of portfolios of investments or sharing the same base of depositors. Thus, failure of a certain institution causes the balance sheets of a possibly large number of other institutions to be significantly impacted as these other institutions have similar exposure that impacted the failed bank.

The risk of macroeconomic linkages emanated from the linkages between financial sector and real sector through, which are built up from microeconomic shocks such as money supply, credit supply, asset prices and interest rates (Acemoglu, Ozdaglar, & Tahbaz-Salehi, 2015). All these microeconomic interactions function as a channel for propagation of macroeconomic shocks that impede financial institutions' profitability. Several crises were due to the parallel exposures to macro shocks: high interest rates cause banking crises of 1980s; exchange rate and business cycle triggered the Asian crises in late 1990s; and Federal reserve's

tightening of monetary policy in 2005-2007 induced turnaround in real-estate prices, which triggered the global financial crisis of 2007 – 2009. Since financial institutions depend on economic activities, macroeconomic risk may appear as an unavoidable side effect of an efficient allocation of resources for investment.

5.1.2. Motivation of the Study

Findings from the previous analysis Chapter 3 and 4 indicates that the EAC financial system is relatively robust, albeit vulnerable to shocks. Thus, call for further analysis to examine the worst-case scenario should happen. Literature reveals that effective statutory regulations and institutional framework such as crisis management frameworks can mitigate the systemic risk. However, designing a robust regulatory regime is difficult since risk build-up can remain hidden until it is too late to be known thus, there is a likely inability to prevent all future crisis ((De Larosière et al., (2009, pp. 7–12) and Claessens & Kodres (2014)).

Besides, it is hard to predict how participants' individual motives will come together to produce overall behaviour of the market during the shocks. Consequently, this suggest that for supervision, it is important to have a sense of what the risk exposure of the financial system actually is. This goes beyond at looking at the micro level whereas if each institution is safe and sound, then the system as a whole would be safe and sound. The cataclysm of 2008 rekindled the need of ensuring financial stability in a systemic approach. Thus, for prevention, it suffices to analyses the extent of risk exposure of the system as a whole when each institution is at distress. The analysis must therefore focus on whether different institutions take large exposures in similar risks (common dependence of loan customers on the business cycle).

Therefore, identifying the systemic importance of the financial system will help to reflect the potential systemic impact by using time varying, conditioned by the economic environment. Studies have indicated that under weak economic conditions financial institutions tends to have higher correlation of losses and higher risk of contagion from otherwise unimportant elements (Dell'Ariccia, Laeven, & Marquez (2014), Grilli, Tedeschi, & Gallegati (2014) and Clark & Kassimatis (2015)). This can be done by assessing primary indicators such as size of the institution, substitutability of the institution and interconnectedness among components of the system. This is the concern of this study. The Regional Financial Integration (RFI) broadens and deepens financial links within a region by eliminating cross-border investments barriers, which have fostered greater financial integration. Thus, the growing presence of cross-border banks in the EAC region raises the question about the increased inter-connectedness of EAC financial markets, which pose systemic risk threat to the financial system stability.

5.1.3. Problem of the Study

A robust and competitive financial system plays a pivot role in the economy by facilitating efficient allocation of resources and risks distribution across the economy. However, this process relies on confidence in the integrity of institutions and the continuity of markets. Studies have indicated that financial systems are highly associated with risks that pose significant threat of a market failure ((Nijskens & Wagner (2011), Paltalidis et al. (2015) and Silva, Kimura, & Sobreiro (2017)). This is due to the complex and interconnectedness nature of the financial systems together with the global financial and monetary imbalances, inappropriate regulations, weak supervision and poor macroprudential oversight.

Report on the financial supervision in the EU argues that among other factors, macroeconomic issues (ample liquidity, low interest rates, financial innovation and rapid credit expansion), risk management (failure in risk assessment: misunderstanding of the interaction between credit and liquidity, and institutions leverage) and regulatory, supervision and crisis management failures causes of the financial crisis (De Larosière et al., 2009, pp. 7–12). Therefore, as part of providing effective risk management, this highlights the importance of measuring systemic risk, which threats the financial system stability and the macro economy.

A vast majority of the studies have been conducted to address financial systemic risk management. The international experience highlighted that there is lack of clarity/knowledge of how best to manage systemic risk contribution to financial system stability and thus effect on the economy. The recent survey on the analysis of the systemic financial risk literature conducted by Silva et al., (2017), revealed gaps and opportunities for future studies on the systemic risk, in particular in the emerging markets.

In the context of the EAC, little is known at the micro-level about how the financial institutions contributes to the financial system stability when these institutions are at distress. The IMF report of November 2012 on the EAC shows that the proportion of the EAC financial sector to the overall economy has grown and become globalized, which was contributed by the relative stable economic growth. However, the macroeconomic environment and financial institutions are vulnerable to shocks. This has been reflected in their GDP growth rates and banks' asset quality. These developments highlight the issue of systemic risk. Therefore, we endeavour to measure potential systemic risk in the EAC financial systems. In the process, we hope to gain insights into possible effective ways of managing systemic risk in the financial systems to ensure financial stability.

5.1.4. Objective of the Study

Using the EAC listed banks as a case study, this chapter intends to sketch an account of banking sector vulnerability to shocks and the effect of shock spill over of one bank to the entire banking system for the period of 2004 - 2018. Specifically, this study intent to measure potential systemic risk in the EAC financial systems. This entails threefold.

Firstly, the study intends to assess the degree of EAC banks interconnectedness. This entails assessing the number of significant casual relations within the EAC financial system and see if the degree of interconnectedness among the EAC financial system has evolved across different times and casual relations have any potential for systemic risk across the region.

Secondly, the study intends to analyse the potential magnitude of systemic risk contribution of each bank to the financial system. By measuring the potential systemic risk contribution, results will demonstrate what are the systemically important banks as well as systemically important EAC economies in the region during different reviewed periods.

lastly, the study intends to identify if the above are linked to the EAC financial system stability. The study tries to answer the question if does bank size matter in systemic risk contribution in EAC? This entails to evaluate the correlation between bank size, interconnectedness, and systemic risk exposure.

5.1.5. Significance of the Study

This study contributes to the global effort of macroprudential regulations. Contrary to most of the existing literature on the macroprudential regulations, in particular systemic risk analysis, this study intends to empirically study the impact of the systemic risk contribution in the emerging monetary union, the EAC region. Cognizant, the increased financial integration across the EAC region through the ongoing establishment of a single market in financial services underlines the need to have clear understanding of the potential systemic risk in the financial systems. Consequently, this study provides a comprehensive analysis of potential systemic risk in the EAC financial system. To the extent of connectedness among individual institutions and identifies the systemically important institutions as well as economies in the region. Consequently, our results contribute to the ongoing debate on the merits of imposing systemic risk-based capital requirements on banks.

The structure of this chapter is as follows. The next section, 5.2 and 5.3 presents the existing literature on the theory and empirical studies on systemic risk, followed by the methodology. The empirical results and discussion of the potential systemic risk in the EAC is presented in Section 5.4; and section 5.6 provides the concluding remarks.

5.2. Related Literature Review

5.2.1 Theoretical Review

The nature of financial systems can be perfectly explained as a network structure, which can be a useful representation of the interrelationships among institutions, and its effect to one another (Bookstaber et al., 2015; Poledna et al., 2015). This interaction can be a transaction between banks and other banks or any other financial institution through payment systems. The **Financial Network Theory** explains the complex and interconnected relationship among institutions in the financial system (Gai et al., 2011; Bougheas and Kirman, 2015; D'Arcangelis and Rotundo, 2016). This theory is rooted in the network theory from the study of graphs as a representation of symmetric and asymmetric relations between discrete objects. In the context of finance, the network is broadly understood as a collection of nodes (financial institution/firms) and its linkages between nodes. In addition, networks are the key fundamental aspects of understanding the dynamics of the financial systems and explain certain economic phenomena.

In the real world of business, institutions cannot operate in isolation or completely independent of others. Typically, interactions between financial institutions in the financial system are very intense, and it is this intensity that leads to dependencies among financial institutions. Such dependencies in the financial system (holding other's shares, debts, and obligations), may lead to cascading failures between the networks (Leitner, 2005; Gai et al., 2011; Acemoglu et al., 2015). For instance, failure of one of the Systemically Important Financial Institutions (SIFIs) such as the investment bank Lehman Brothers in the USA triggered a dramatic rise in the risk pricing across assets market and market failure which led to the GFC. Later, followed by a global economic downturn, the great recession and the European debt crisis. This underscores the fact that a relatively small failure can lead to a catastrophic breakdown of the whole financial system.

Following the global/regional financial crises, scholars have introduced different theories, models, and frameworks in order to support the precise assessment of the contagion effect of these crises and ensure financial stability. One way of achieving macroeconomic stability is to identify systemic risks and its underlying factors in the financial system. This is because systemic financial risks tend to trigger loss of economic value or confidence in the financial system, with serious adverse consequences to the real economy (Dewatripont and Tirole, 2012). According to the **Systemic Risk Theory**, the systemic risk may be caused by either macroeconomic imbalance; excessive leverage; balance sheet weaknesses; limited

competition and contagion (Acharya, 2009; Donath et al., 2008; Eijffinger, 2011). Systemic risk includes all events capable of impeding the stability of the banking and financial system.

There is also a different implication of excessive credit growth between advanced economies and large emerging markets compared to the developing countries. While excessive credit growth might be a sign of systemic risk, in the developing countries may reflect financial deepening instead of systemic risk build-up (Bougheas and Kirman, 2015). Using macro prudential tools based on the credit-to-GDP gap might not be appropriate for financial development in developing countries. In that connection, there is a need to explore the relationship between financial stability and financial deepening in the developing countries and develop an analytical toolkit to assess systemic risk build-up across levels of financial development.

5.2.2 Empirical Evidence

The concept of systemic risk gained more popularity after the recent global financial crisis, whereby the collapse of the Lehman Brothers Holding Inc. in 2008 triggered the financial crisis. One of the lessons from the bitter experience of that crisis regarding financial stability relates to the importance of broadening the regulation and supervision regime beyond the individual market participants (micro prudential approach) to cover the systemic risks as a whole (macro prudential approach). As expressed by Clement, (2010), Claessens et al., (2013) and Cerutti et al., (2015) implementation of micro prudential (Basel I and II) was not sufficient to limit systemic risk as it is designed to limit individual, institutional risk seen in isolation. Thus, there is a need to incorporate the macro prudential tools in order to ensure financial stability.

One way of achieving financial system stability with the macro-prudential approach is to identify systemic risks and its underlying factors in the financial system. This is because systemic risk (any event that is capable of imperilling the stability of the banking and financial system) tends to trigger loss of economic value or confidence in the financial system, with serious adverse consequences to the real economy (Donath et al., 2008; Borio et al., 2011). The impact of systemic risk highlights the need for the unsure financial system is less vulnerable to shocks and prevent financial crisis.

Several models have been adopted to measure systemic risk contribution of the financial systems (Billio et al., 2012; Girardi and Ergün, 2013; Rodríguez-Moreno and Peña, 2013). One of the main objectives of international financial regulatory institutions is to assess the level of contribution to systemic risk of the systemically important financial institutions (SIFIs) and

designing a regulatory framework capable of ensuring financial stability. For the past two decades, various methods of understanding exposure or risk contribution of the relevant institutions to systemic risk have been developed. Most of them are macroeconomic methods of analysis such as macro-equilibrium, macro-stability model, stochastic model, cobweb, financial system stability index, and real estate price indices.

On the macro prudential statistics, methods are stress testing and crisis management. For instance, Bisias et al., (2012) surveyed on the systemic risk aspects and designed 31 quantitative measures of systemic risk. These measures analyse the critical role of data when measuring systemic risk. Each measure deals with different themes and employs different indicators, and with different policy implications, although their ultimate aim is to ensure a healthy financial system. In addition to these proposed methods, global efforts that aim at measuring systemic risks more precisely entail the development of real-time leading indicators of the imbalances in the financial systems.

One of the traditional measures of risk to financial institutions focuses on the structural approach of systemic risk contribution. For instance, Billio et al., (2012) proposed a mechanism to measure the interconnectedness of the financial institutions based on principal component analysis and granger causality networks. The study analysed the network of causal relationships between the financial institutions across four sectors such as hedge funds, banks, broker/dealers, and insurance companies. Findings indicated a highly significant increase in financial institutions interconnectedness prior to the global financial crisis of 2008, which indicates a build-up of systemic risk. They also found that large institutions transmit shocks more than small institutions and banks, in particular plays a major role than other financial institutions. This mechanism can be used in risk allocation analysis.

Moreover, Acharya et al., (2017) proposed another model of systemic risk, which captures the systemic expected shortfall (SES) and marginal expected shortfall (MES) of each financial institution's contribution to systemic risk. The model analyses a financial firm's stress conditional on systemic stress. This is to say, SES and MES look at the expected loss of each institution conditional on the whole portfolio that is at distress (undercapitalized) and likely to impede the real economy. Using market data from equity and credit default swap (CDS), the study found that the expected amount of risk of an individual institution (SES) increases its leverage when the overall financial system is at distress. One of the advantages of this model is the ability of SES to predict systemic risk during the global financial crisis. This model captured the ex-ante and ex-post systemic risk.

One of the lessons from the bitter experience of the recent GFC regarding financial stability relates to the importance of broadening the regulation and supervision regime beyond individual market participants to cover the systemic risks as a whole. This entails calculating the appropriately aggregate the systemic risk contributions of individual institutions based on banks' market risk using the Value-at-Risk (VaR) models. As one of the Basel Accords, VaR models denotes as a lower tail percentile for the distribution of profit and loss of the company, which is used to determine the market risk capital requirement of that particular company. For instance, Danielsson and Zigrand (2008) proposed an equilibrium multi-asset pricing model with micro-founded systemic risk and heterogeneous investors to measure the systemic risk behaviour using the VaR method. In their study, they found that effective regulations can mitigate systemic risk. However, they found weak evidence on the relationship between price volatility, bank size and the market risk.

Adrian and Shin (2014) used the VaR model to determine the relationship between leverage and the size of the financial institutions. They found that leverage is countercyclical, not procyclical. This was also implied by the empirical evidence such as Adrian and Shin (2010) and Porta et al., (1997). Further, Adrian and Shin (2014) argued that VaR, which is able to solve bilateral incentive frictions could also generate spill-over effects across the financial system when investors adopt a widespread of risk management rules. Thus, a significant effect of fluctuations in leverage impedes financial system stability.

While VaR is one of the most usable risk measures, studies have shown that this measure (VaR) by financial institutions is not capable of capturing the systemic nature of risk. VaR focuses on the risk of an individual institution when viewed in isolation and ignores the impact of contagion risk (Berkowitz and O'Brien, 2002). Recently, there has been a growing interest in developing alternative risk measures that reflect systemic risk in the financial system that overcome the shortcomings of VaR

One of the alternative measures for VaR is the conditional value at risk (CoVaR), which measures the system's stress conditional on an individual firm's stress. Adrian and Brunnermeier (2011) proposed Conditional Value-at-Risk (CoVaR), a measure of systemic risk that captures risk spill overs among financial institutions. The prefix "Co" in the CoVaR stands for conditional, contagion or co-movement. Later, Girardi and Ergün (2013) modified the definition of CoVaR. This modified model assumes that conditioning financial distress event refers to the return of institution j being at most at its $VaR\left(R^j \leq VaR^j\right)$ as opposed to being exactly at its $VaR\left(R^j = VaR^j\right)$ in the original model.

Several existing studies have used the conditional value at risk (CoVaR), which was proposed by Adrian and Brunnermeier (2011) and found interesting results. Mainik and Schaanning (2012) findings support the Girardi and Ergün (2013) model by showing that conditioning on has great advantages for dependence modelling. Thus, the institution's systemic risk increases as its correlation with the size of the financial system increase.

Furthermore, Borri et al., (2014) used the CoVaR to analysed the systemic risk contribution of the Italian banking system. Their findings support other studies that found a significant relationship between bank size and systemic risk contribution. Moreover, Mensah and Premaratne (2017) examined the systemic risk contribution for the Asian countries banking system using CoVaR. Similar to previous studies, they found a significant positive relationship between bank size and contribution to systemic risk. These studies highlight the usefulness of the CoVaR in measuring the contribution of individual institutions to the systemic risk.

Following the proposed measures of systemic risk contributions, studies have suggested a number of systemic risk contribution determinants. The major factors are the bank size, the market risk, and the level of interconnectedness. The assumption is, the larger the bank size, the larger the market risk and the larger the systemic risk contribution of the financial institution to the whole system. For instance, Pais and Stork (2013) measure systemic risk contribution using CoVaR and VaR In their study, they analysed the impact of bank size and found a significant increase in the systemic risk contribution during the financial crisis, regardless of the bank size. They found a significant relationship between the bank's size and their systemic risk contribution. However, little evidence was found on the impact of bank size and market risk (VaR).

Laeven et al., (2016) analysed bank-specific factors that determine systemic risk during the global financial crisis. Using both CoVaR and SRISK measures of systemic risks in their study, they found a significant positive correlation between systemic risk and bank size. Interestingly, they found an inverse relationship between bank capital and systemic risk growth. As the bank increases its capital and becomes well capitalized, the systemic risk becomes lower. Thus, on the one hand, larger banks in terms of total asset pose excessive systemic risk, which attracts more attention in terms of ensuring financial stability. On the other hand, large banks, which are better capitalized, contributes to the financial system stability. These findings highlight the need to establish policies that encourage banks' growth to an optimal level without attracting systemic risk. As is evidenced, large banks provide efficiency gains by offering more services that require economies of scale.

5.2.3 Conceptual Framework

Literature highlights the relationship between bank's size and the level of systemic risk contribution. Different studies have indicated mixed results of the bank's size contribution to the systemic risk. In one hand, studies have indicated that elevated level of stress in large banks as one of the key drivers of systemic instability. (Pais & Stork, 2013) analysed the effect of bank size across ten countries and found that systemic risks increase as the bank size increase and the large the bank, the higher the systemic risk contribution. On the other hand, (De Jonghe, et. al., 2015) and found that non-interest income reduces large banks' systemic risk exposures and increases exposures to the small banks. A recent study conducted by (Varotto & Zhao, 2018) who analysed firm level systemic risk for US and European banks, found that both small and large banks pose considerable systemic threats to the financial system. Thus, in support to the Basel III there is a need to analyse systemically important.

The other strand of literature highlights the relationship of bank interconnectedness contributes to the systemic risk. It explains the impact of the transmission channels and contagion effects of certain shocks between the macro economy and financial systems. The interlinkages between financial institutions as well as exposures among banks that through their business can influence each other in situations of financial distress poses may impede economic activities. (Arnold, Borio, Ellis, & Moshirian, 2012) and (Minoiu & Reyes, 2013) analysed global cross-border banking flow found a significant evidence that the banking flows are pro-cyclical, expanding and contracting with the capital flows. They also found that country connectedness in the network tends to rise before banking and debt crises and to fall in their aftermath. In support of that, (Acemoglu et al., 2015) highlights the presence of financial network externalities, which contributes to the risk of financial contagion.

Therefore, the framework starts with the acceptance of the empirically documented direct relationship between bank size, moral hazard, bank interconnectedness, systemic risk and financial crisis. We focused on the firm level contribution of the bank size and its level of connectedness to the systemic risk, which might lead to the financial instability. As illustrated in the Figure 5.1 below, the study assumes that systemically important financial institutions through their size and influence, contributes the financial instability. We intend to analyse the relationships displayed with the dotted lines. In accord with literature, these relationships are considered to be largely positive. However, the magnitudes of these effects are an empirical question to which we seek to provide answers in the EAC context.

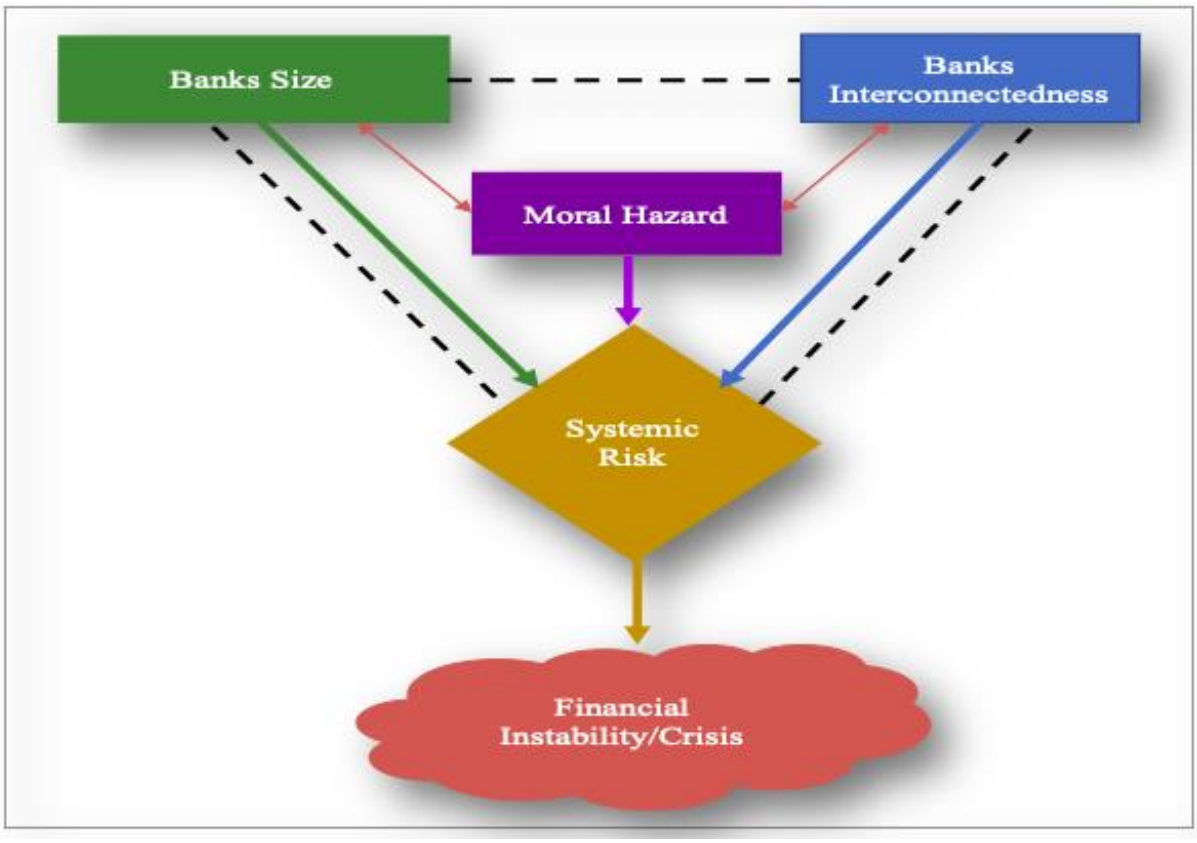

Figure 5.1 Relationship of the key determinants of systemic risk
Source: Researcher, 2019

5.2.4 Conclusion and Gap in the Literature

There is a strong positive link between financial system growth and economic growth. Economic growth influences the quality of financial services and structure of financial system, which contributes to the long-run economic growth. However, studies have indicated that the link between financial system development and economic growth has two different effects: positive and negative effects. They also found that financial system development fosters economic growth in the long run. However, as the economy matures financial system tends to experience cycles of boom and busts, which subject the financial system to systemic risk and impede economic growth.

One of the advantages of the financial system growth is that the increase in bank competition encourages banks to take more diversified risks, making the financial system less fragile to shocks. Financial sector regulations influence bank competition, which lowers credit risk and probability of default. However, during financial development banks tend to expand their assets through credit expansion during economic boom, which exposes bank to risks that tend to end abruptly, typically in the form of financial crises. In the course of monitoring credit issues, moral hazard problem and misaligned incentives during the slowdown in economic

activities are likely to accelerate the credit and liquidity risks, which might escalate to bank distress Besides, the excess of large banks' risk-taking behaviour in the name of "too-big-to-fail" increases the systemic contribution as they can be too large to save. This highlights likelihood of the potential systemic risks, especially when the financial system expands.

Therefore, to address the degree of potential systemic risk contribution in the EAC financial system we rely on the literature in two related areas to sketch a conceptual framework of the likely outcomes at the institutional level. As indicated in most of the literature, interbank connectedness, asset price and sovereign credit risk markets are the three major factors that propagated shocks in the financial systems and fuel systemic risk. Thus, with time, these factors trigger severe direct and indirect losses and cascades of defaults as economic condition deteriorates. In this regard, this study we dwell on the firm factors that determines the degree of systemic risk of an individual institution to the financial system.

5.3. Data and Methodology: Measuring Systemic Risk Potential

This chapter intends to assess systemic risk potentials by quantifying systemic impact of financial distress on the EAC's financial systems considering their interconnectedness and conditional dependence. This study employs some of the existing metrics, in particular, two measures of connectedness that are designed to capture changes in correlation, causality among financial institutions, and their systemic risk contributions.

5.3.1. Measurement of Variables

The study adopts the key determinants of the systemic risk contribution in assessing potential systemic risk spill over in the EAC banking system. In testing the fourth hypothesis (as per chapter 1), we assume that there is a direct relationship between bank size, bank interconnectedness, market risk and systemic risk contribution. We focus on the firm level contribution of the bank size and its level of connectedness to the systemic risk, which might lead to the financial instability. That means systemically important financial institutions contribute the financial instability through their size, market risk and influence from their level of connectedness. In accord with literature, these relationships are considered to be largely positive. However, the magnitudes of these effects are an empirical question to which we seek to provide answers in the EAC context.

5.3.2. Methods of Data Analysis

This section presents two measures of potential systemic risk spill-over that are designed to capture changes in correlation, causality among financial institutions and contribution of

financial institutions to systemic risk. The vast and dynamic literature on the systemic risk measures indicate that there is no perfect methodology that precisely measures the systemic risk contribution of an individual institution. It is evident that relying on a single approach hinders a thorough understanding of the systemic risk contribution and its underlying factors. Hitherto, this study assesses systemic risks potential of the financial system by quantifying systemic impact of financial distress on the EAC financial system considering their interconnectedness and conditional dependence.

The study analyses the potential systemic risk of the EAC banking industry by using two different measures that have been proposed in the literature. First, we use granger causality method to determine the causal relationships between banks and the overall interconnectedness of the EAC financial System. Secondly, we use CoVaR measure to measure the degree of risk externalities that a single institution contributes to the overall system. Below is the detailed empirical methodology in measuring the potential systemic risk contribution.

5.3.2.1. Bank's Interconnectedness of the EAC financial System

5.3.2.1.1. Measuring Causality Relationship

The study first use Granger causality tests measure the degree of interconnectedness between financial institutions as well as determine the direction of the relationship between these institutions (Granger, 1969, 1980, 1988). In particular, the test shows the degree of connectedness in the banking institutions of a certain country vary considerably through time and becomes highly interconnected during periods of systemic shocks. Also, it shows the network diagram of linear Granger causality relationships, which are adjusted for autocorrelation and Heteroscedasticity via a GARCH process. This entails identifying if there is a linear causal relationship between bank A and bank B. That is the bank A at date-t granger cause the returns of bank B at date t+1. The focus on the causal relationship does not directly considering the lending and borrowing relationship between the banks. Using monthly return indices on banks, we want to find out if Granger-causality networks are highly dynamic and become densely interconnected in the period preceding systemic shocks.

Hitherto, we compute the linear granger causality relationships between the EAC banks using a modified Granger-causality tests. Billio et al., (2010) modify the Granger-causality tests to measure the interconnectedness and direction of the relationship between financial institutions in the financial system. Specifically, X is said to Granger-cause Y if previous values

of X contain information that helps predict Y above and beyond the information contained in past values of Y alone. The form of Granger-causality equation is specified as:

$$X_t = \sum_{j=1}^{m} a_j X_{t-j} + \sum_{j=1}^{m} b_j Y_{t-j} + \in_t \quad \text{.....Equation 5.1}$$

$$Y_t = \sum_{j=1}^{m} c_j X_{t-j} + \sum_{j=1}^{m} d_j Y_{t-j} + \omega_t \quad \text{.....Equation 5.2}$$

Where m is the maximum lag length and $\in_t$ and $\boldsymbol{\omega_t}$ are two uncorrelated white noise processes. Y is said to cause X when $\mathbf{b_j}$ is not equal to zero. Similarly, X causes Y when $\mathbf{c_j}$ is not equal to zero; that is, if the p-value of the estimated parameter (coefficient) is less than 5%. When both statements hold, then there is a feedback relationship between the two-time series.

5.3.2.1.2. Measuring Degree of Bank's Interconnectedness of the EAC financial System

Following Billio et al., (2012), the analysis in this section makes use of return indices on banking institutions in the EAC region. The study measures the interconnectedness between the 20 licensed banking institutions on a quarterly basis from 2004 to 2018 using the previous 36 months return. Recall Equation 5.1 and 5.2, we calculate the number of causal relationships between financial institutions in the financial system. We later compute the dynamic causality Index (DCI) for each window in line with Billio et al., (2010) as follows:

$$DCI_t = \frac{Number\ of\ Causal\ Relationship\ in\ Window}{Total\ Possible\ Number\ of\ Casual\ Relationships} \quad \text{.....Equation 5.3}$$

Where the magnitude of the DCI directly indicates the level of interconnectedness of the financial system. Thus, a higher DCI value suggests that the system is highly interconnected and vice versa. In addition, the research estimates the number of banks that an individual bank Granger-causes at both 1% and 10% level, focusing on both large and small institutions.

5.3.2.2. Systemic Risk Contribution to the Financial System

Further the study use value at risks models to assess the effect of market risk and bank size on systemic contribution. Also, assess systemically important EAC economies. For the purpose of effective regional regulatory mechanisms, it is important to know countries whose financial sectors are deemed systemically important. This ensures that they are subjected to regular regulatory reviews. In addition, since systemic risk accumulates over the years, usually during tranquil periods where asset price volatility is low, inflation rates are moderate, and business cycle fluctuations are minimal and credit booms. Increase connectivity during this stable period increases asset opaqueness and cause instability in the financial system. That is

why it is important to examine how individual bank contributions to systemic risk differ during different periods. This gives a direction of regulatory focus in the future.

Therefore, the assessment of contribution of an institution to the overall risk is measured by using CoVaR. Adrian and Brunnermeier (2011) proposed a model of systemic risk contributions based on the balance sheet characteristics. The model uses quantile regression to estimate the lower tail quantile of financial system returns conditional on the VaR loss of an institution at a specific probability quantile.

Girardi and Ergün (2013) further define CoVaR as the conditional distribution of $R_{s,t}$ given that $R_{i,t} \leq VaR_t^i$. Thus, the difference between the CoVaR conditional on the median state of the institution and the CoVaR conditional on the institution's distress taste (institution's marginal contribution of individual institutions to overall systemic risk) is measured by $\Delta CoVaR$. Mensah and Premaratne (2017) suggested that $\Delta CoVaR$ can also measure the exposure of individual institutions to systemic risk and measure the exposure spill overs from one institution or sector to another. This makes it a very useful tool for financial supervisory authorities whose duty it is to ensure the soundness of the financial system Therefore, the study used $\Delta CoVaR$ to assess the contribution of individual banks to potential systemic risk in the EAC banking system and identify countries deemed to be of systemic importance in the region.

5.3.2.2.1 Computation of the Delta CoVaR ($\Delta CoVaR$)

CoVaR is the Value at Risk (VaR) of the financial system when an institution is in financial distress. It measures the degree of the conditional distribution of random variable captured in the financial system (i) as a whole, given that another financial institution (j) is in distress. With assumptions that: random variables Ri, t (R_t^i) represent the returns of financial institution i at time t at a confidence level q, and $VaR_{q,t}^i$ is the q-quantile of the return distribution $[Pr(R_t^i \leq VaR_{q,t}^i) = q]$. Therefore, $CoVaR_{q,t}^{i|j}$ is now the q-quantile of the following condition distribution of the following condition distribution:

$$Pr(R_t^i \leq CoVaR_{q,t}^{i|j} | R_t^i \leq VaR_{q,t}^j) = q \quad \text{.....Equation 5.4}$$

Where conditioning on $R_t^i \leq VaR_{q,t}^j$ constitutes a more general case of financial distress for institution *j*, which allows for more severe losses (further in the tail) which are beyond the $VaR_{q,t}^j$.

$$X_t^1 = \alpha^1 + \gamma^1 M_{t-1} + \varepsilon_t^1$$

$$Pr\left(X^j \leq \mathrm{CoVaR}_q^{j|1} \middle| X^1 = \mathrm{VaR}_q^1\right) = q \quad \text{.....Equation 5.5}$$

Consider $CoVaR^{i|j}$ where $i \equiv s$ is the financial system, conditional on the financial distress of an institution j. Hence, $CoVaR^{s|j}_{q,t}$ is the VaR of the financial system conditional on institution j being in financial distress. Therefore, systemic risk contribution of a particular institution j is the percentage difference of the VaR of the financial system conditional on the distressed state of institution $j\left(R^j_t \leq VaR^j_{q,t}\right)$ from the VaR of the financial system conditional on the *benchmark* state of institution j. Thus, the systemic risk of an individual institution to VaR of s is denoted by:

$$\Delta CoVaR^{s|j}_{q,t} = 100 \times \left(CoVaR^{s|j}_{q,t} - CoVaR^{s|b^j}_{q,t}\right) / CoVaR^{s|b^j}_{q,t} \quad \text{.....Equation 5.6}$$

Where b^j (Benchmark state) is a one-standard deviation about the mean event: $\mu^j_t - \sigma^j_t \leq R^j_t \leq \mu^j_t + \sigma^j_t$; μ^j_t is the conditional mean; and σ^j_t is the standard deviation of institution j.

5.3.2.2.2 Measuring Banks' Systemic Risk Contribution to the Financial System

The study follows Adrian and Brunnermeier (2011) in measuring the time variation in the joint distribution of institution and the system. This entails measuring of the relationship between systemic risk of an institution and individual characteristics such as its VaR, size and leverage. Therefore, in order to appreciate the impact of individual risk of the financial institutions on systemic risk contribution, time varying CoVaR measure was applied. The set of lagged systematic state variables (Mt-1) was employed to estimate the time-varying VaR and CoVaR. The time-varying correlation between R^s_t and R^j_t ensures that the $CoVaR^{s|j}_{q,t}$ of an institution has a time-varying exposure to its $VaR^j_{q,t}$.

Firstly, recall the first step in calculating the CoVaR (equations 3.48 and 3.49) we calculate the value at risk (VaR) of each bank in order to get each banks' risk contribution to the system over the period. Therefore, the quantile regression employed is as follows:

$$X^j_t = \alpha^j + \gamma^j M_{t-1} + \varepsilon^j_t \quad \text{.....Equation 5.7}$$

Whereas: X^j_t is the return of bank j, γ^j is the coefficient to be estimated, M_{t-1} is the set of lagged systematic state variables and ε^j_t is the error term. The predicted values from Equation 5.7 can be also denoted as:

$$VaR^j_t(q) = \hat{\alpha}^j_q + \hat{\gamma}^i_q M_{t-1} + \varepsilon^j_t \quad \text{.....Equation 5.8}$$

Secondly, we calculate the risk of the entire system jointly with a condition of an institution that is at distress. The quantile regression employed for the system is as follows:

$$X_t^{system} = \alpha^{system|j} + \beta^{system|j} X_t^j + \gamma^{system|j} M_{t-1} + \varepsilon_t^{system|j} \quad \text{.....Equation 5.9}$$

Whereas: X_t^{system} is the return of bank, $\beta^{system|j}$ j, γ^j is the coefficient to be estimated, M_{t-1} is the set of lagged systematic state variables and ε_t^j is the error term. The predicted values from Equation 3.56 can be also denoted as:

$$CoVaR_t^j(q) = \hat{\alpha}_q^{system|j} + \hat{\beta}^{system|j} VaR_t^j(q) + \hat{\gamma}_q^{system|j} M_{t-1} + \varepsilon_t^j \quad \text{...Equation 5.10}$$

Lastly, recall the second and third steps of calculating ΔCoVaR (Equations 3. 50 – 3.52), we calculate the systemic risk contribution of each bank to the system. This entails estimating the $\Delta CoVaR_t^j$, which is denoted as follows:

$$CoVaR_t^j(q) = CoVaR_t^j(q) - CoVaR_t^j(50\%)$$

$$= \hat{\beta}^{system|j} \left(VaR_t^j(q) - VaR_t^j(50\%) \right) \text{.....Equation 5.11}$$

The computation of Bank's systemic risk contribution (CoVaR) requires the weighted assets growth rate of each bank and the system as well as one of the required variables. In order to get the weighted asset growth rate, we required to compute the weighted asset of each bank. The bank's weighted asset is denoted as the Market-Valued Total Financial Assets (MVTFA), which is constructed using the balance sheet data of a particular bank. Therefore, the MVTFA, which is denoted as A_t^j; for institution j is constructed as follows:

$$A_t^j = BA_t^j \times \left(ME_t^j / BE_t^j \right) = ME_t^j \times LEV_t^j \text{.....Equation 5.12}$$

Whereas: BA_t^j is the bank j's book value of total assets, ME_t^j is the market value of bank j's total equity, BE_t^j is the book-valued total equity and LEV_t^j is the ratio of total assets to book equity. Further, the book value of total assets (BA_t^j) is defined as:

$$BA_t^j = TA_t^j - \left(TL_t^j - TIA_t^j \right) \text{.....Equation 5.13}$$

Whereas: TA_t^j is the total assets of institution j, TL_t^j is the total liability and TIA_t^j is the total tangible assets. We now then compute the Market-Valued Total Financial Assets growth rate, which is used as the weighted assets (X_t^g) of each bank. The MVTFA (A_t^j) growth rate is:

$$X_t^g = \frac{ME_t^j \times LEV_t^j - ME_t^j \times LEV_{t-1}^j}{ME_t^j \times LEV_{t-1}^j} = \frac{A_t^j - A_{t-1}^j}{A_{t-1}^j} \text{.....Equation 5.14}$$

Furthermore, we construct unique system's Market-Valued Total Financial Assets growth rates for each bank. However, in order to avoid any spurious correlation in the system weighted assets, we exclude the weighted asset growth rate of the particular bank that its systemic risk contribution is intended to be tested. Thus, the system's weighted assets growth rate for each bank is calculated based on a cross-sectional summation of all weighted assets excluding the bank that is intended to be tested (n – 1 weighted assets) as follows:

$$X_t^{s,g} = \sum_{g=1,g\neq 1}^{n} W_{g,t} X_t^{g}, W_{g,t} = A_t^{g}\left(\sum_{g=1,j\neq 1}^{n} A_t^{g}\right)^{-1} \text{.....Equation 5.15}$$

Whereas $X_t^{s,g}$ is the system's Market-Valued Total Financial Assets growth rate of institution j, and A_t^g is the Market-Valued Total Financial Assets variable used as the weighting structure. We used the lag values of the total assets' variables for the weighting, which is kept strictly positive to ensure that the resultant weights satisfy the restriction $0 \leq W_{g,t} \leq 1$.

5.3.3. Data Collection

The study employs all listed banks in the EAC region, namely Kenya, Rwanda, Tanzania and Uganda. Burundi is excluded because there is no bank in the country that has been listed. There are 29 listed banks in the EAC capital markets as of 2018. However, the scope has been reduced to 20 banks due to data availability from 2004 to 2018. Literature have shown that systemic risk tend to focus only on large banks ("too-big-to- fail") such as the study done by Girardi and Ergün (2013); however, as noted by Allen et al., (2012) smaller banks with less interconnections could also have significant systemic risk potential due to common risk factor. Moreover, Kashyap and Stein (2000) argues that when banks are distributed according to size, those found at the bottom 95 percentile (that is, smaller banks) are facing liquidity challenges, and are the main drivers of aggregate declines in loan supply. Therefore, in order to get a true nature of the potential systemic risk, the study includes 20 banks, both large and small banks.

As indicated in Table 5.1, data collection includes extracting two kinds of variable data such as Market-Valued Total Financial Assets (MVTFA) variables and systematic state variables from the *Thomson Reuters World Scope* database. The MVTFA include market data and balance sheet data for each listed bank in the EAC. The systematic state variables are the variables used as controlling variables to remove any variations in the tail risk that are not directly connected to the financial system risk exposure (Adrian and Brunnermeier, 2011).

Selection of these variables is guided by economic theory and evidence from previous studies on conditional mean predictability. The study uses the U.S market data because of two folds: inadequate of African market data and U.S is taken as a benchmark global leader because

of its size and interconnectedness whereby most of other markets follow its developments. Thus, spill over channels linking the U.S and the global economy are very high to the extent developments in the U.S economy such as policy uncertainties could hamper global growth and could are bound to have important effects on investment growth in emerging and developing economies

Table 5.1 Summary of the Data

Set of Variables	Individual Variables
Interconnectedness	Bank's stock market price
Market-Valued Total Financial Assets (MVTFA) Variables	Bank's shareholders' equity
	Bank's market value of equity
	Bank's total assets
	Bank's total liabilities
	Bank's total intangible assets
Systematic State (ST) Variables	Returns of the EAC banking sector index
	Volatility Index from Chicago Board of Options Exchange
	Liquidity spread (3-month US repo rate and T-bill's rate)
	Change in yield curve (10 years and 3-month US T-bills rates
	Change in credit spread (BAA-rated U.S Bonds and Treasury rate)
	Change in 3-month US T-bills rate

5.3.4. Preliminary Data Analysis

Table 5.2 presents the summary statistics of the EAC listed banks returns in the panel group from 2004 to 2018. Results of the measure of tendency, mean and median indicate that the K.SCB has the highest average and median values followed by the K.DTK, which have 1.986 and 1.645 average values and 2.007 and 1.728 median values, respectively. The lowest value of the measure of tendency is on the U.SBU and U.BOB, which have 0.008 and 0.036 both average values and the median values, respectively. This implies that the dataset has a symmetrical distribution, which is skewed right with no outliers.

The measures of dispersion range and standard deviation indicate that data set is widespread, and the same variable that has a minimum value has the highest standard deviation. For instance, the K.SCB has a maximum value of 2.354, while U.SBU has a minimum value of 0.007. On the other side, the K.DTK has the highest standard deviations of 0.31, and U.SBU has the lowest standard deviation of 0.001. The close gap between the highest and lowest standard deviation implies that the banks' stock returns are not spread out over a wider range of values and tend to be close to mean. Consequently, these distributions are more reliable as they are clustered closely around the mean.

Table 5.2 The Summary of Statistics

	Mean	Med	Max	Min	Std. Dev.	Skew	Kurt	J. B	Prob	Obs
K.BBK	0.100	0.099	0.133	0.070	0.014	0.077	2.233	3.957	0.138	155
K.CFC	0.795	0.792	1.053	0.561	0.103	-0.156	2.353	3.339	0.188	155
K.COP	0.143	0.144	0.195	0.082	0.027	-0.283	2.125	7.013	0.030	155
K.DTK	1.645	1.728	2.169	0.999	0.310	-0.450	2.155	9.853	0.007	155
K.EQB	0.382	0.385	0.555	0.233	0.071	0.060	2.689	0.717	0.699	155
K.HFC	0.112	0.097	0.191	0.046	0.040	0.672	2.339	14.478	0.001	155
K.IMH	0.510	0.513	0.625	0.367	0.071	-0.056	1.851	8.609	0.014	155
K.KCB	0.377	0.382	0.535	0.222	0.073	-0.096	2.313	3.286	0.193	155
K.NBK	0.079	0.074	0.148	0.047	0.024	1.020	3.547	28.82	0.000	155
K.NIC	0.298	0.313	0.392	0.182	0.053	-0.307	1.867	10.73	0.004	155
K.SCB	1.986	2.007	2.354	1.589	0.159	-0.064	2.723	0.601	0.740	155
R.BOK	0.330	0.334	0.375	0.147	0.032	-1.327	8.283	225.76	0.000	155
T.CRB	0.101	0.083	0.184	0.063	0.037	1.091	2.842	30.92	0.000	155
T.DCB	0.184	0.179	0.260	0.147	0.031	0.879	2.827	20.18	0.000	155
T.MCB	0.238	0.224	0.306	0.216	0.027	1.334	3.272	46.45	0.000	155
T.MKC	0.412	0.402	0.468	0.345	0.045	-0.228	1.405	17.77	0.000	155
T.NMB	1.160	1.222	1.271	0.729	0.132	-1.646	4.494	84.43	0.000	155
U.BOB	0.036	0.035	0.046	0.028	0.006	0.340	1.718	13.62	0.001	155
U.DFC	0.225	0.221	0.279	0.186	0.026	0.469	2.446	7.66	0.021	155
U.SBU	0.008	0.008	0.009	0.007	0.001	0.285	2.124	7.058	0.029	155

Note: K.BBK is Barclays Bank of Kenya, K.CFC is Stanbic Holdings of Kenya, K.COP is Co-operative Bank of Kenya, K.DTK is Diamond Trust Bank of Kenya, K.EQB is Equity Bank of Kenya, K.HFC is HFCK Group of Kenya, K.IMH is I&M Holdings of Kenya, K.KCB is KCB Bank of Kenya, K.NBK is National Bank of Kenya, K.NIC is NIC Bank of Kenya, K.SCB is Standard Charted Bank of Kenya, R.BOKis Bank of Kigali of Rwanda, T.CRB is CRDB Bank of Tanzania, T.MCB is Malibu Commercial Bank of Tanzania, T.MKC is Mkombozi Commercial Bank of Tanzania, T.NMB is NMB Bank of Tanzania, U.BOB is Bank of Baroda of Uganda, U.DFC is DFCU Bank of Uganda and U.SBU is Stanbic Bank of Uganda

Another linear regression assumption requires that residuals of the data series to be normally distributed. The normality distribution of data can be tested using skewness, kurtosis and Jarque-Bera (JB) tests. For data to be normally distributed, results from the Skewness should be 0 while Kurtosis should be 3 and the JB results should be below significance level of 0.05. We, therefore, used skewness, Kurtosis and JB tests to check for the normality on our variables. In our findings, the results of the skewness and kurtosis indicate that our data is not normally distributed as it is expected for most of the economic variables. As shown in Table 5.2, we have seen mixed results of skewness and kurtosis, which are above the normality range. In supportive of that, results of JB indicates that most of the probability values are highly significant (less than 0.05 significance level) that leads us to reject the null hypothesis of a normal distribution. We, therefore, confirm that our data is not normally distributed.

In addition, to strengthen the results of the descriptive statistics above, a simple correlation analysis was performed in order to analyse the correlation among the banks' stock

returns that might influence the accuracy of our results (Pearson, 1920). Understanding the correlation relationship is useful because we can use the value of one variable to predict the value of the other variable, in particular on the assessment of banks' interconnectedness. This indicates that as one bank's stock return changes in value, the other bank's stock return tends to change in a specific direction. The null hypothesis suggests there is no relationship between the variable if the coefficient value of correlation and its p-value is less than the significance level of 5 percent. Table 5.3 below presents the summary correlation analysis.

Table 5.3 Correlation Analysis

	K.BBK	K.CFC	K.COP	K.DTK	K.EQB	K.HFC	K.IMH	K.KCB	K.NBK	K.NIC	K.SCB	R.BOK
K.BBK	1.0000											
K.CFC	0.7973	1.0000										
K.COP	0.7782	0.7081	1.0000									
K.DTK	0.7913	0.7425	0.9155	1.0000								
K.EQB	0.8338	0.7734	0.9226	0.8880	1.0000							
K.HFC	0.0685	-0.059	-0.154	0.0669	-0.145	1.0000						
K.IMH	0.5158	0.4440	0.8161	0.8496	0.7393	0.0114	1.0000					
K.KCB	0.8012	0.7177	0.9635	0.8942	0.9589	-0.229	0.7732	1.0000				
K.NBK	0.3877	0.0688	0.3343	0.4397	0.2127	0.5639	0.4090	0.2457	1.0000			
K.NIC	0.7564	0.5636	0.8034	0.8619	0.7685	0.3303	0.7888	0.7634	0.6430	1.0000		
K.SCB	0.2557	0.2872	0.5960	0.5415	0.5166	-0.112	0.7247	0.5549	0.1471	0.5170	1.0000	
R.BOK	0.4929	0.4825	0.3643	0.5866	0.3523	0.5451	0.4304	0.3073	0.4971	0.5798	0.1494	1.000
T.CRB	0.0878	-0.042	-0.215	-0.011	-0.212	0.9378	-0.1669	-0.272	0.5458	0.2290	-0.289	0.474
T.DCB	0.0068	-0.184	-0.249	-0.059	-0.259	0.9520	-0.1303	-0.321	0.6229	0.2276	-0.225	0.451
T.MCB	0.1523	0.0421	-0.142	0.0523	-0.144	0.9326	-0.1232	-0.209	0.5695	0.2914	-0.27	0.546
T.MKC	-0.519	-0.625	-0.666	-0.537	-0.679	0.755	-0.427	-0.719	0.232	-0.240	-0.336	0.018
T.NMB	-0.338	-0.322	-0.147	-0.216	-0.141	-0.606	0.009	-0.069	-0.417	-0.345	0.0583	-0.497
U.BOB	0.4277	0.4274	0.0327	0.2116	0.1507	0.6969	-0.0736	0.0312	0.2447	0.3579	-0.270	0.567
U.DFC	0.3967	0.3767	0.0018	0.1104	0.1068	0.5997	-0.1970	0.0039	0.2549	0.2943	-0.309	0.419
U.SBU	0.7714	0.6925	0.4840	0.5373	0.5734	0.0394	0.1679	0.5201	0.2648	0.4655	-0.049	0.477

As indicated in Table 5.3 indicate that most of the banks especially banks from Kenya and Rwanda are relative highly positive correlated (with a p-value of greater than 0.5 correlation) compared to Banks in Tanzania and Uganda. Besides, the K.HFC, T.CRB, T.DCB, T.MCB, T.MCK and T. NMB indicated a negative correlation with several banks. Most of these banks are banks from Tanzania. This implies that when the Tanzanian banks' stock return increases, stock returns of other banks, in particular, Kenyan banks decreases. Thus, banks from Tanzania might have the opposite direction of other banks' systemic risk contribution.

Looking at the statistical probability results of all the four-unit root tests presented in Table 5.4 indicate that we reject the null hypothesis. This means that all banks' stock returns in a group analysis are significantly stationary at Level. In line with the summary of statistics, the unit root tests confirm that the mean and variances do not change over time. Thus, the dataset can be used to forecast stock returns of other banks.

Table 5.4 Group Unit Root Test Results

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu tu	-2.24219	0.0125**	20	11246
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.92617	0.0017***	20	11246
ADF - Fisher Chi-square	69.0734	0.0029***	20	11246
PP - Fisher Chi-square	122.144	0.0000***	20	11267

Note: (i) *** and ** denote 1% and 5% significance levels of probability, respectively

5.4. Empirical Results and Discussion

This section presents the empirical analysis results of the 20 listed banks in the EAC region for the period 2004 – 2018. We have divided these 15 years into three sub-periods in order to thoroughly understand the environment of the build-up systemic risk in the EAC financial System. These sub-periods capture the period where the EAC financial system was developing (first sub-period from 2004 to 2008), the period of the global financial crisis and the Eurozone debt crisis (second sub-period from 2009 to 2013) and the post-global financial crisis where the number of financial systems players have increased (third sub-period from 2009 to 2013). Lastly, we analyse the systemic risk for the full period from 2004 – 2018.

In this chapter, we intend to analyse three natural questions regarding the systemic risk. The first question is how and/or when the systemic risk is being build-up (does the network connections increases during the financial distress?). Secondly, to analyse the common notion of 'too big to fail' (does the increase in bank size increase the network connections and the systemic risk?). Lastly, do the institutions and countries constitute sources of vulnerabilities (which banks and countries are systemically more important or contribute the most to the increased vulnerability?). By answering these questions using the methodology described in section 5.3, we are able to provide answers to these questions.

Since it is difficult to measure systemic risk with just one measure, the study used two methods: Granger-causality analysis to measure the EAC banks' interconnectedness and delta CoVaR to measure potential systemic risk contribution of an individual bank to the financial system. The finding assumptions imply that the higher the banks' interconnectedness indicates the higher potential systemic risk, while the higher the delta CoVaR indicates the higher the systemic risk contribution of a bank to the system. Besides, the higher degree level of interconnectedness and delta CoVaR indicates that the financial system is vulnerable to shocks that pose a potential threat of systemic risk spill over to the financial system that might impede financial system stability and the vice versa.

5.4.1. The EAC Listed Banks' Interconnectedness

We first measure potential systemic risk via the causal interconnections between stock returns of the 20 EAC listed banks. We analysed different network topology in order to capture the effect of interconnectedness before, during and after crisis periods, in order to see the interconnectedness growth over time. We used Granger causality test to compute the number of connections that each bank's market price has a significant causal link to the other bank's market price. We then use the number of Granger-causal relations to plot a network topology that indicates the concentration of the banks' interconnectedness. We further compute the percentage of the total number for each bank DCI.

5.4.1.1. The EAC Banks Topology Network

The EAC banks topology network, which shows the level of banks' connectedness indicated that the EAC banking systems have become more connected with time. Table 5.5 presents the linear granger-causality outcomes that are statistically significant at the 5 percent level among daily returns. As expected, the number of causal links increases as the number of banks increases; however, the percentage of links decreases as the banks increase.

Table 5.5 The EAC Banks' Network Connections

	1st Sub- Period (2004-2008)		2nd Sub- Period (2009-2013)		3rd Sub- Period (2014-2018)	
Name	No. of Casual Links	% Of Total Links	No. of Casual Links	% Of Total Links	No. of Casual Links	% Of Total Links
K.BBK	2	6	7	8	7	5
K.SBC	6	19	11	13	9	6
K.KCB	4	13	9	11	12	9
K.CFC	5	16	5	6	5	4
K.NIC	2	6	7	8	9	6
K.DTK	5	16	5	6	9	6
K.HFC	5	16	3	4	2	1
K.IMH	2	6	4	5	9	6
K.EQB	-	-	7	8	8	6
K.COP	-	-	8	10	13	9
U.SBU	-	-	2	2	11	8
T.NMB	-	-	3	4	10	7
T.CRB	-	-	2	2	3	2
U.DFC	-	-	5	6	4	3
U.BOB	-	-	2	2	1	1
K.NBK	-	-	3	4	9	6
T.DCB	-	-	-	-	6	4
R.BOK	-	-	-	-	5	4
T.MCB	-	-	-	-	5	4
T.MKC	-	-	-	-	4	3
Total	31	100	83	100	141	100

Note: K.BBK is Barclays Bank of Kenya, K.CFC is Stanbic Holdings of Kenya, K.COP is Co-operative Bank of Kenya, K.DTK is Diamond Trust Bank of Kenya, K.EQB is Equity Bank of Kenya, K.HFC is HFCK Group of Kenya, K.IMH is I&M Holdings of Kenya, K.KCB is KCB Bank of Kenya, K.NBK is National Bank of Kenya, K.NIC is NIC Bank of Kenya, K.SCB is Standard Charted Bank of Kenya, R.BOKis Bank of Kigali of Rwanda, T.CRB is CRDB Bank of Tanzania, T.MCB is Malibu Commercial Bank of Tanzania, T.MKC is Mkombozi Commercial Bank of Tanzania, T.NMB is NMB Bank of Tanzania, U.BOB is Bank of Baroda of Uganda, U.DFC is DFCU Bank of Uganda and U.SBU is Stanbic Bank of Uganda.

The first sub-period, there are 31 significant granger-causal relationships from 8 banks (Figure 5.2). These banks are mainly based in Kenya. The SBC has a greater number of causal links, which has 6 links (19 percent of the total number of causal links). Followed by the CFC, DTK and HFC banks, of which each bank has 5 causal links (16 percent of the total number of causal links) each. KCB bank has 4 causal links (13 percent of the total number of links) while

BBK, NIC and IMH banks each have 2 links (7 percent of the total number of causal links). This implies that the potential spill-over effect from the SBC, CFC, DTK and HFC to other banks is higher (more than 15 percent of the total transmitting channels) compared to the remaining banks.

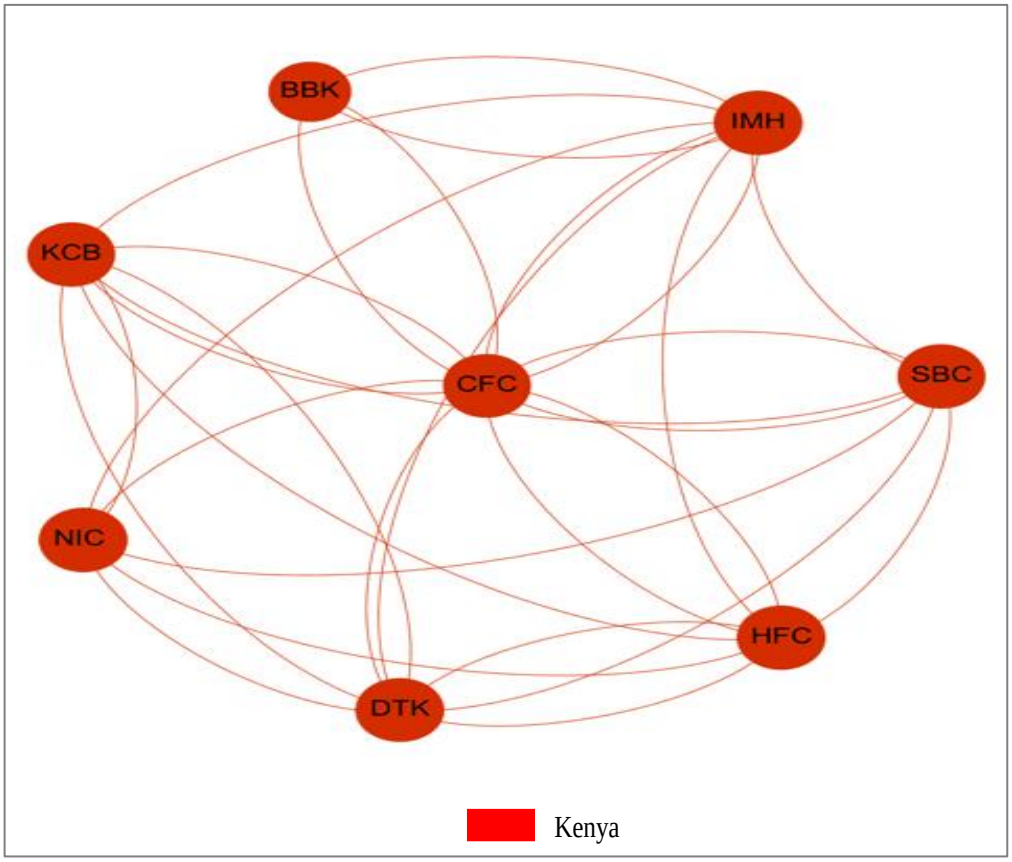

Figure 5.2 The EAC Banks Network Topology (2004-2008)
Notes: The networks represent linear granger-causality that are statistically significant at the 5 percent level among daily returns of 8 banks.

The second sub-period, there are 83 significant granger-causal relationships from 17 banks (Figure 5.3). These banks are mainly based in Kenya, Tanzania, and Uganda. The SBC bank continued to have a greater number of causal links (11 casual links). It followed by the KCB and COP, of which each bank has 9 and 8 causal links, respectively. The banks that have lowest number of causal links are 3 banks from Uganda namely BOB, DFC and SBU banks, which have 2 causal links each. This implies that the potential spill-over effect from the banks from Kenya namely SBC, KCB and COP to other banks is higher (more than 10 percent of the total transmitting channels) compared to the remaining links. The banks from Uganda have less spill-over effect, which have 2 percent each.

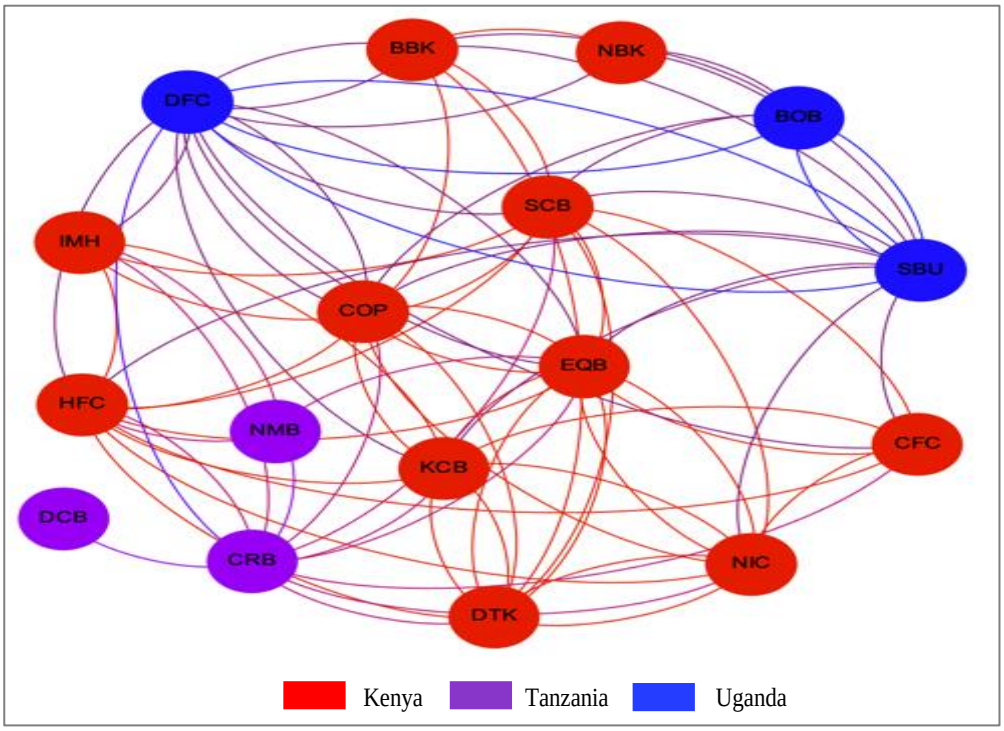

Figure 5.3 The EAC Banks Network Topology (2009 - 2013)
Notes: The networks represent linear granger-causality that are statistically significant at the 5 percent level among daily returns of 17 banks with 83 causal links.

Comparing first and second sub-sample, the SBC, has continued to have greater number of causal links (11 links), which is 13 percent of the total number of causal links. Compared to the first sub-period, which the bank has only 6 links, the percentage of links to the total links has dropped from 19 percent in the first sub-period to 13 percent in the second sub-period. This has also been the case to the KCB, COP, EQB AND CFC, DTK and HFC banks. Other banks' percentage of connectedness have increased as the number of links increased. These are banks such as BBK and NIC. Banks that have the lowest number of causal links are new banks such as SBU, CRB and BOB, which has 2 links each and the DCB has no causal link. These findings imply that the older listed banks have more potential spill over effect to other banks.

The last sub-period includes 20 banks with 141 significant granger-causal relations (Figure 5.4). These 20 banks include 3 new listed banks from Rwanda and Tanzania. Like the second sub-period, the increased number of banks has increased the number of connectedness to some banks and reduced the percentage of links to the total number of causal links. The average percentage of a causal link to the total links has reduced to less than 10 percent. Banks that have a greater number of causal links are COP, KCB, SBU and NMB with 13, 12, 11 and 10 number of causal links, respectively. Banks that have a smaller number of causal links are HFC, BOB, CRB, DFC and MKC with 1, 1, 2, 3 and 3 number causal links, respectively.

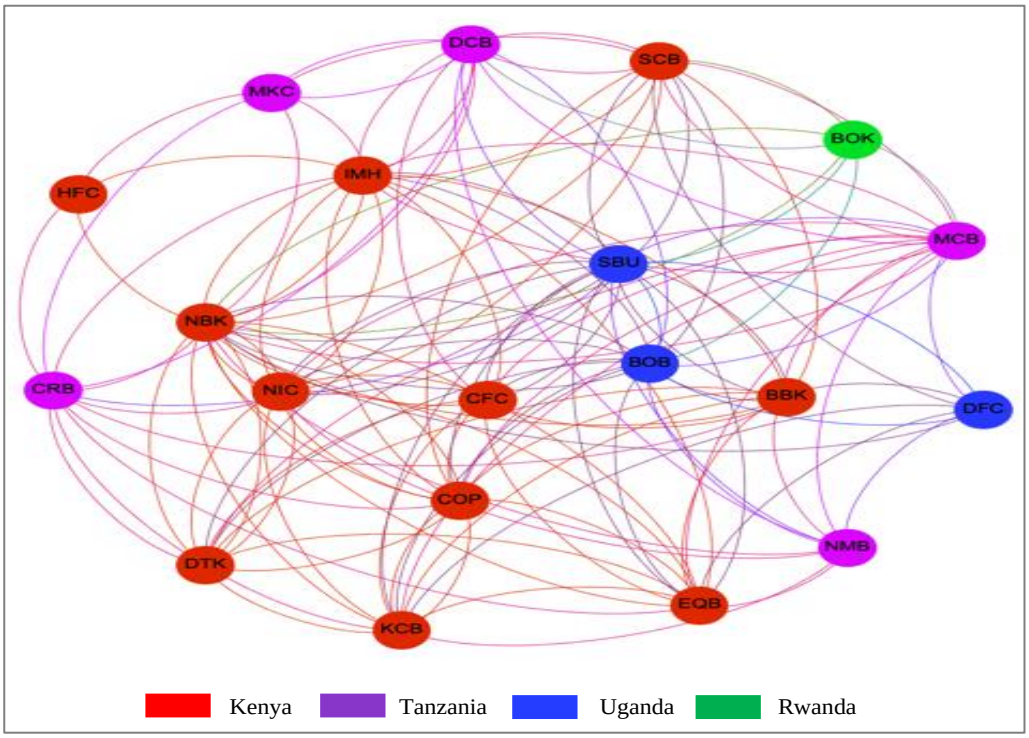

Figure 5.4 The EAC Banks Network Topology (2014 - 2018)
Notes: The networks represent linear granger-causality that are statistically significant at the 5 percent level among daily returns of 20 banks with 141 causal links.

Findings from the granger-causality analysis indicated that the EAC financial system is connected, whereby at least each bank is connected to one or more banks. There is a significant increased bidirectional causality effect between EAC banks. This implies that shocks could spill over easily among banks that have significant granger-causal relations. Besides, the number of banks causal links changes over time, which indicates that the systemic risk build-up differs from time to time. Banks from Kenya have a greater number of connectedness. Since literature indicated that the higher the number of connectedness value suggests that the system is highly interconnected and vice versa (Billio et al., 2010 and Mensah and Premaratne, 2017). Hence, Banks from Kenya may be of greater concern than banks from other EAC countries in terms of connectedness.

5.4.1.2. The EAC Banks Dynamic Causality Links

The time-varying analysis, which is denoted by the Dynamic Causality Index (DCI), is computed with a rolling window of 13 weeks (roughly a quarter). The sample size of the study starts from 2004 – 2018. However, the first window starts in January 2006 and ends in December 2018, meaning that the results cover from January 2006 onwards. Every time the window is rolled, the shocks and the correlation between them are computed, and each correlation coefficient is tested against the null hypothesis (state the HO: 0). The test used daily

banks return to determine the interconnectedness of the banks in the EAC. Billio et al. (2012) argued that the DCI movement has the advantage of being interpreted relatively straightforward. Thus, DCI increases when banks behave similarity, which indicates the increased interconnectedness. Figure 5.5 indicates the percentage of DCI in the EAC.

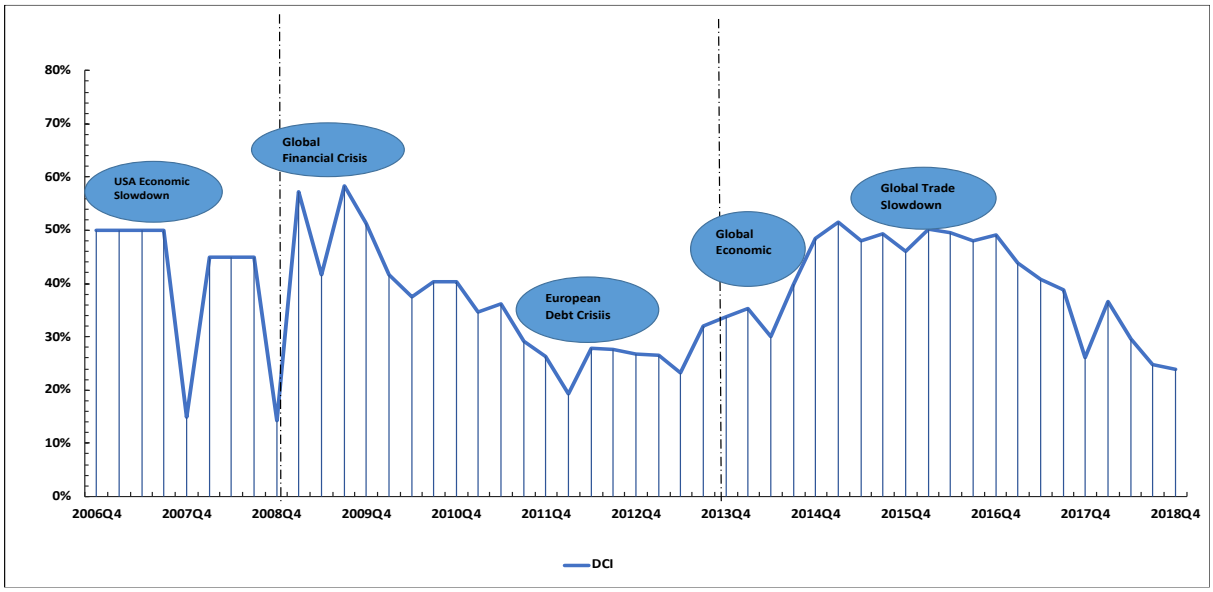

Figure 5.5 Dynamic Causality Index for the EAC listed Banks

As indicated in Figure 5.5, the overall level of interconnectedness ranges from 10 – 60 percent. The highest level of interconnectedness appeared in 2009 Q4, which was the effect of the global financial crisis that occurred in 2007-2008. This situation is akin to what is present in most of the systemic risk analysis, where higher interconnectedness appeared during the economic downturn (Billio et al., 2012; Mensah and Premaratne, 2017). During the first sample period – before the global crisis, the DCI indicates that the level of interconnectedness was dormant and declined sharply in 2007 and 2008. This was partly due to the infant stage of the financial market at that time.

The level of interconnectedness increased after the hit of the global financial crisis of 2008/09. In 2009 Q4, the EAC experienced the highest level of interconnectedness of approximately 60 percent and later decreased to approximately 15 percent in 2011. However, the level of interconnectedness increased steadily from 2012 to 2016, where the global an economy experienced economic downturn (global economic down-turn in 2013 and global trade slowdown in 2015). This indicates that the EAC banks network connectedness tends to rise before the financial crisis (banking and debt cries) and to fall in their aftermath.

5.4.2. Systemic Risk Contributions

We estimate the potential systemic risk contribution of each bank according to the △CoVaR approach described in section Equation 3.54 based on q=0.05. We analysed the EAC potential systemic risk system using four folds: bank's size, market risk, systemic risk contribution to the system and the level of connectedness. Apart from the △CoVaR, which denoted the bank's systemic risk contribution; the study used the MVTFA as a proxy of the size of the bank and the VaR as a proxy of banks market risks. VaR is one of the risk management tools used in measuring the institutions' risk exposure (market risk), which includes other risks such as foreign currency, commodities and equities. Empirical findings have indicated that most of the banks significantly contribute to potential systemic risk. Further, we have found a significant positive correlation between the bank size, value at risk and conditional value at risk.

5.4.2.1. *Relationship between Value at Risk and Conditional Value at Risk*

We first analyse the relationship between Value at Risk (VaR) and Conditional Value at Risk (△CoVaR). Table 5.6 presents the estimations of VaR and △CoVaR that was computed at 5 percent significance level in the different time frames. The risk contribution of each bank has been ranked in descending order along with its corresponding VaR. Higher negative values of both risks indicate high bank's risk contribution that might trigger financial distress and vice versa. This implies that the bank that has high negative values are the systemically important banks at that time, while the banks with positive values contribute to financial stability.

Generally, the empirical findings indicate that there is a loose link between banks' VaR and its contribution to systemic risk (△CoVaR), implying that the EAC banks that have high value at risk do not necessarily have high systemic risk contribution. Looking at the full sample period (2004 – 2018), there is a wide range of risk contribution as the VaR value ranges from -1.94 (IMH) to -0.03 (MKC) and △CoVaR values range from -3.4 (BOB) to 0.02 (MCB). These findings have shown that the banks that have high and low values at risk are not the ones that contribute to financial instability. Besides, the wide variation indicates a unique risk contribution by each bank. Our findings indicated that on the one hand there are banks that adversely contribute to the EAC financial system stability (BOB) while on the other hand, other banks positively contribute to the financial system stability as the case of MCB.

Table 5.6 The Banks' Systemic Risk Contribution (△CoVaR) and Financial Risk (VaR)

Name	First Sub-period (2004-2008)				Second Sub-period (2009-2013)				Third Sub-period (2014-2018)				Full Sub-period (2004-2018)			
	VaR		△CoVaR		VaR		△CoVaR		VaR		△CoVaR		VaR		△CoVaR	
	5%	Rank	5%	Rank	5%	Rank	5%	Rank	5%	Rank	5%	Rank	5%	Rank	5%	Rank
K.BBK	-0.11	5	-2.57	8	-0.06	16	-0.84	4	-0.04	17	-0.04	14	-0.08	14	-1.61	8
K.SBC	-0.07	8	-6.55	1	-0.14	7	-0.43	15	-0.04	13	-0.35	6	-0.09	12	-1.77	5
K.KCB	-0.15	4	-3.47	5	-0.11	12	-0.72	7	-0.07	5	-0.23	10	-0.11	7	-1.64	7
K.CFC	-0.07	7	-4.57	4	-0.15	6	-0.65	10	-0.05	11	-0.29	8	-0.10	9	-1.82	4
K.NIC	-0.17	2	-2.90	7	-0.16	4	-0.59	11	-0.06	9	-0.51	2	-0.13	4	-1.54	9
K.DTK	-0.09	6	-4.67	3	-0.13	8	-0.67	9	-0.09	1	-0.40	5	-0.11	8	-1.50	10
K.HFC	-0.29	1	-3.15	6	-0.15	5	-0.78	6	-0.08	3	-0.22	11	-0.18	3	-1.30	12
K.IMH	-0.16	3	-5.22	2	-3.33	1	0.00	17	-0.07	6	-0.34	7	-1.94	1	0.00	19
K.EQB	-	-	-	-	-0.12	11	-0.47	13	-0.08	4	-0.50	3	-0.22	2	-1.36	11
K.COP	-	-	-	-	-0.13	9	-0.79	5	-0.06	8	-0.45	4	-0.10	10	-1.76	6
U.SBU	-	-	-	-	-0.09	14	-1.91	3	-0.03	19	-0.16	13	-0.06	16	-2.11	3
T.NMB	-	-	-	-	-0.16	3	-0.57	12	-0.04	14	0.00	17	-0.11	6	-0.47	16
T.CRB	-	-	-	-	-0.13	10	-0.16	16	-0.06	10	0.09	19	-0.10	11	-0.57	15
U.DFC	-	-	-	-	-0.06	17	-2.69	1	-0.07	7	-1.11	1	-0.06	15	-2.25	2
U.BOB	-	-	-	-	-0.07	15	-2.39	2	-0.05	12	0.12	20	-0.06	17	-3.40	1
K.NBK	-	-	-	-	-0.10	13	-0.45	14	-0.08	2	-0.16	12	-0.09	13	-1.18	13
T.DCB	-	-	-	-	-0.17	2	-0.69	8	-0.04	15	-0.02	16	-0.12	5	-0.82	14
R.BOK	-	-	-	-	-	-	-	-	-0.04	16	-0.27	9	-0.04	18	-0.17	17
T.MCB	-	-	-	-	-	-	-	-	-0.04	18	0.02	18	-0.04	19	0.02	20
T.MKC	-	-	-	-	-	-	-	-	-0.03	20	-0.03	15	-0.03	20	-0.03	18

Note: (i) VaR represents the bank's value at risk estimated at the 5 percent significance level. (ii) △CoVaR represents the bank's systemic risk contribution to the system, which is estimated at 5 percent significance level. (iii) K.BBK is Barclays Bank of Kenya, K.CFC is Stanbic Holdings of Kenya, K.COP is Co-operative Bank of Kenya, K.DTK is Diamond Trust Bank of Kenya, K.EQB is Equity Bank of Kenya, K.HFC is HFCK Group of Kenya, K.IMH is I&M Holdings of Kenya, K.KCB is KCB Bank of Kenya, K.NBK is National Bank of Kenya, K.NIC is NIC Bank of Kenya, K.SCB is Standard Charted Bank of Kenya, R.BOKis Bank of Kigali of Rwanda, T.CRB is CRDB Bank of Tanzania, T.MCB is Malibu Commercial Bank of Tanzania, T.MKC is Mkombozi Commercial Bank of Tanzania, T.NMB is NMB Bank of Tanzania, U.BOB is Bank of Baroda of Uganda, U.DFC is DFCU Bank of Uganda and U.SBU is Stanbic Bank of Uganda

The first sub-period is the window leading up to the financial crisis, and it is when the EAC financial system was still at an infant stage with only 8 banks originating from Kenya. During this period, when the system was less dense, the values of VaR and △CoVaR appeared to be in the opposite ranking position in most of the banks. For instance, the highest systemic risk contributor, which was SBC with △CoVaR of 6.55 percent has the lowest VaR of 0.07 percent. This was the case to the seventh-ranked systemic risk contributors, which was NIC with △CoVaR of 0.17 percent has the highest VaR of 2.9 percent. Other banks' systemic risk contribution differs from their VaR values. This implies that even when the financial system is at its infant stage, the value at risk of a bank does not indicate the actual impact of systemic risk contribution to the system.

The second sub-period captures the global financial crisis of 2008/09 era where the EAC financial system has grown to 17 listed banks, including banks from Tanzania and Uganda. During this period the relationship between VaR and △CoVaR was like the first sub-period. Some of the banks had the opposite relation between risks, while most of the banks' systemic risk contribution does not match with their VaR. The highest systemic risk contributor, DFC with △CoVaR of 2.69 percent has the lowest VaR of 0.06 percent. Similarly, the lowest systemic risk contributor, IMH with △CoVaR of 0.0 percent has the lowest VaR of 3.33 percent. Other banks' △CoVaR differs from their VaR values. This indicates that even when the financial system has relatively expanded, the value at risk does not indicate the actual impact of a bank's systemic risk contribution to the system.

During the post-global financial crisis period, which is the third sub-period, the EAC financial system has relatively developed with 20 banks including a bank from Rwanda. During this period, the relationship between the VaR and △CoVaR is very loose, whereby most of the banks systemic risk contribution does not match with their value at risk. There are banks that adversely contribute to the EAC financial system stability (DFC with 1.11 percentage △CoVaR) while other banks positively contribute to the financial system stability as the case of BOB with -0.12 percentage △CoVaR. Interestingly, the highest systemic risk contributor in the second sub-period, DFC has continued to be the highest systemic risk contributor in the third sub-period. While the BOB, which was the second-highest systemic risk contributor in the second sub-period, is now positively contributing to the financial system stability in the third sub-period. Therefore, these findings conclude that the use of VaR as an adequate risk measure to ensure financial system stability could be misleading in terms of macro-prudential.

5.4.2.2. *The relationship between Bank Size and Value at Risk*

Following the weak findings of the relationship between the bank's value at risk and its systemic risk contribution to the system, we have decided to analyse the relationship between the bank size and its value at risk. The question behind is; since VaR represents a worst-case loss scenario of a bank with a certain probability ratio at a particular given time, then does the bank size reflects the actual market risk of a particular bank? The aim of this analysis is to provide some preliminary evidence on the relationship between size and diversification of the market risk in the EAC listed banks. This entails investigating whether bigger banks are more prone to market risk compared to smaller banks.

We employed both accounting (balance-sheet) and market-based data to explain the relationship between bank size and its potential market risk. We use Market-Valued Total Financial Assets (MVTFA) as a proxy of the bank size while stock return data was used to calculate the VaR of that particular bank. Table 5.7 reports the banks' size and their respective VaR estimated over the period from January 2004 to December 2018, with an interval of 5 years duration in each sub-period. Generally, the findings have indicated a loose relationship between the bank's size and its market risk. For instance, using the full sub-period 2004-2018 findings, the first 3 large banks, which are EQB, KCB, BBK are the 2nd, 7^{th,} and 14th VaR ranking position, respectively. While the lowest three banks in terms of size, which are DCB, MCB and MKC are the 5th, 19^{th,} and 20th VaR ranking position, respectively. Other banks such as IMH and HFC, which are ranked 13th and 17th banks in terms of the size have the highest market risk as they are ranked 1st and 3rd in terms of VaR.

Findings also indicate the mixed relationship between the bank size and their market risks. For instance, the largest banks during all 3 sub-periods appeared not to have the highest market risk. However, in some case, the banks with large bank size (at least the top 10 banks in each sub-period) appeared to have high market risk, and banks that have smaller size appeared to have low market risk as well. This implies that there is a positive but weak relationship between the size and the market risk of the bank in the EAC region. This is because large banks tend to have large capital buffers as well as well-diversified portfolios compared to smaller banks, and diversify their risk (Pais and Stork, 2013; Laeven et al., 2016; Pawlowska, 2016). Therefore, these findings denote that the size of the bank does not necessarily indicate the value of the bank's market risk when that bank is at distress.

Table 5.7 The Bank Size (MVTFA) and Financial Risk (VaR)

Name	First Sub-Period (2004-2008)				Second Sub-Period (2009-2013)				Third Sub-Period (2014-2018)				Full Period (2004-2018)			
	MVTFA		VaR		MVTFA		VaR		MVTFA		VaR		MVTFA		VaR	
	USD	Rank	5%	Rank	USD	Rank	5%	Rank	USD	Rank	5%	Rank	USD	Rank	5%	Rank
K.BBK	1,066,704	1	0.11	4	1,057,954	1	0.06	16	710,236	5	0.04	17	945,265	3	0.08	14
K.SBC	686,368	2	0.07	1	905,914	4	0.14	7	808,597	4	0.04	13	808,397	4	0.09	12
K.KCB	564,978	3	0.15	5	968,432	3	0.11	12	1,329,706	2	0.07	5	953,892	2	0.11	7
K.CFC	372,518	4	0.07	2	343,303	8	0.15	6	459,304	10	0.05	11	394,552	8	0.10	9
K.NIC	202,715	5	0.17	7	243,778	11	0.16	4	270,065	12	0.06	9	244,350	11	0.13	4
K.DTK	198,642	6	0.09	3	339,236	9	0.13	8	540,117	7	0.09	1	383,714	9	0.11	8
K.HFC	63,129	7	0.29	8	59,752	16	0.15	5	66,177	16	0.08	3	63,007	17	0.18	3
K.IMH	6,673	8	0.16	6	187,238	13	3.33	1	487,406	9	0.07	6	235,553	13	1.94	1
K.EQB	-	-	-	-	1,048,840	2	0.12	11	1,663,358	1	0.08	4	1,198,729	1	0.22	2
K.COP	-	-	-	-	681,674	5	0.13	9	905,763	3	0.06	8	765,613	5	0.10	10
U.SBU	-	-	-	-	519,546	6	0.09	14	498,199	8	0.03	19	508,642	7	0.06	16
T.NMB	-	-	-	-	412,115	7	0.16	3	674,943	6	0.04	14	549,334	6	0.11	6
T.CRB	-	-	-	-	261,486	10	0.13	10	357,873	11	0.06	10	311,808	10	0.10	11
U.DFC	-	-	-	-	103,201	13	0.06	17	148,132	14	0.07	7	126,152	14	0.06	15
U.BOB	-	-	-	-	96,676	14	0.07	15	99,363	15	0.05	12	98,048	15	0.06	17
K.NBK	-	-	-	-	95,090	15	0.10	13	44,286	17	0.08	2	69,736	16	0.09	13
T.DCB	-	-	-	-	13,394	17	0.17	2	17,258	18	0.04	15	15,411	18	0.12	5
R.BOK	-	-	-	-	-	-	-	-	243,130	13	0.04	16	244,094	12	0.04	18
T.MCB	-	-	-	-	-	-	-	-	15,308	19	0.04	18	15,308	19	0.04	19
T.MKC	-	-	-	-	-	-	-	-	8,844	20	0.03	20	8,844	20	0.03	20

Note: (i) MVTFA denotes as the Market-Valued Total Financial Assets (thousands USD), which is a proxy for the bank's size (ii) VaR represents the bank's value at risk estimated at the 5 percent significance level. (iii) K.BBK is Barclays Bank of Kenya, K.CFC is Stanbic Holdings of Kenya, K.COP is Co-operative Bank of Kenya, K.DTK is Diamond Trust Bank of Kenya, K.EQB is Equity Bank of Kenya, K.HFC is HFCK Group of Kenya, K.IMH is I&M Holdings of Kenya, K.KCB is KCB Bank of Kenya, K.NBK is National Bank of Kenya, K.NIC is NIC Bank of Kenya, K.SCB is Standard Charted Bank of Kenya, R.BOKis Bank of Kigali of Rwanda, T.CRB is CRDB Bank of Tanzania, T.MCB is Malibu Commercial Bank of Tanzania, T.MKC is Mkombozi Commercial Bank of Tanzania, T.NMB is NMB Bank of Tanzania, U.BOB is Bank of Baroda of Uganda, U.DFC is DFCU Bank of Uganda and U.SBU is Stanbic Bank of Uganda

5.4.2.3. *The Relationship Between Bank Size and Systemic Risk Contribution*

We also analyse the relationship between the bank's Systemic Risk Contribution (△CoVaR) and its size (MVTFA). Since we have found a relative positive relation between the bank size and the market risk, one would expect the same kind of relationship between the bank size and the systemic risk contribution. The △CoVaR represents a worst-case loss scenario of a particular institution with a certain probability ratio at a particular given time. The aim of this analysis is to provide some preliminary evidence on the relationship between size and diversification of systemic risk contribution in the EAC listed banks. This is in line with the argument of the "too big to fail", which denotes that an institution's size should be the key determining factor in ensuring financial system stability. We thus investigate whether the EAC bigger banks are more prone to the systemic risk contribution compared to the smaller banks.

Table 5.8 presents the banks' size and their respective systemic risk contribution. The general observation from the findings indicates that the △CoVaR and MVTFA ranks do not directly correspond with each other. There is a mixed relationship between bank size and their systemic risk contribution. For instance, the largest banks during all 3 sub-periods appeared not to have systemic risk contribution while in some cases, the banks that have large bank size appeared to have high systemic risk contribution and vice versa. One can suggest that these findings reflect a positive but weak relationship between banks' size and their systemic risk contribution to the system. Like the case of the weights of banks market risks, the positive relationship between banks' size and their systemic risk contributions is due to the reason that large banks tend to have large capital buffers as well as well-diversified portfolios compared to smaller banks, and therefore able to diversify their risk. This is similar to other empirical studies that suggested large banks tend to have large capital buffers as well as well-diversified portfolios compared to smaller banks, and diversify their risk (Pais and Stork, 2013; Laeven et al., 2016; Pawlowska, 2016).

The first sub-period indicates the inverse relationship between the bank's size and its systemic risk contribution. During this period, the financial system was less dense. Interestingly, the largest bank, BBK, had the least systemic risk contribution of 2.57% △CoVaR. While the second-largest bank, SBC had the highest systemic risk contribution of 6.55% △CoVaR. Similarly, the smallest bank, IMH, which has the highest △CoVaR of 5.22%, which is the second bank in the systemic risk contribution ranking. This implies that even when the financial system is at its infant stage, smaller banks might have higher systemic risk contribution to the system compared to the larger banks.

Table 5.8 The Banks' Size (MVTFA) and Systemic Risk Contribution (△CoVaR)

	First Sub-Period (2004-2008)				Second Sub-Period (2009-2013)				Third Sub-Period (2014-2018)				Full Period (2004-2018)			
	MVTFA		△CoVaR		MVTFA		△CoVaR		MVTFA		△CoVaR		MVTFA		△CoVaR	
Name	USD	Rank	5%	Rank	USD	Rank	5%	Rank	USD	Rank	5%	Rank	USD	Rank	5%	Rank
K.BBK	1,066,704	1	2.57	8	1,057,954	1	0.84	4	710,236	5	0.04	14	945,265	3	1.61	8
K.SBC	686,368	2	6.55	1	905,914	4	0.43	15	808,597	4	0.35	6	808,397	4	1.77	5
K.KCB	564,978	3	3.47	5	968,432	3	0.72	7	1,329,706	2	0.23	10	953,892	2	1.64	7
K.CFC	372,518	4	4.57	4	343,303	8	0.65	10	459,304	10	0.29	8	394,552	8	1.82	4
K.NIC	202,715	5	2.90	7	243,778	11	0.59	11	270,065	12	0.51	2	244,350	11	1.54	9
K.DTK	198,642	6	4.67	3	339,236	9	0.67	9	540,117	7	0.40	5	383,714	9	1.50	10
K.HFC	63,129	7	3.15	6	59,752	16	0.78	6	66,177	16	0.22	11	63,007	17	1.30	12
K.IMH	6,673	8	5.22	2	187,238	13	0.00	17	487,406	9	0.34	7	235,553	13	0.00	19
K.EQB	-	-	-	-	1,048,840	2	0.47	13	1,663,358	1	0.50	3	1,198,729	1	1.36	11
K.COP	-	-	-	-	681,674	5	0.79	5	905,763	3	0.45	4	765,613	5	1.76	6
U.SBU	-	-	-	-	519,546	6	1.91	3	498,199	8	0.16	13	508,642	7	2.11	3
T.NMB	-	-	-	-	412,115	7	0.57	12	674,943	6	0.00	17	549,334	6	0.47	16
T.CRB	-	-	-	-	261,486	10	0.16	16	357,873	11	0.09	19	311,808	10	0.57	15
U.DFC	-	-	-	-	103,201	13	2.69	1	148,132	14	1.11	1	126,152	14	2.25	2
U.BOB	-	-	-	-	96,676	14	2.39	2	99,363	15	0.12	20	98,048	15	3.40	1
K.NBK	-	-	-	-	95,090	15	0.45	14	44,286	17	0.16	12	69,736	16	1.18	13
T.DCB	-	-	-	-	13,394	17	0.69	8	17,258	18	0.02	16	15,411	18	0.82	14
R.BOK	-	-	-	-	-	-	-	-	243,130	13	0.27	9	244,094	12	0.17	17
T.MCB	-	-	-	-	-	-	-	-	15,308	19	0.02	18	15,308	19	0.02	20
T.MKC	-	-	-	-	-	-	-	-	8,844	20	0.03	15	8,844	20	0.03	18

Note: (i) MVTFA denotes as the Market-Valued Total Financial Assets (thousands USD), which is a proxy for the bank's size (ii) △CoVaR represents bank's systemic risk contribution to the system, which was estimated at the 5 percent significance level. (iii) K.BBK is Barclays Bank of Kenya, K.CFC is Stanbic Holdings of Kenya, K.COP is Co-operative Bank of Kenya, K.DTK is Diamond Trust Bank of Kenya, K.EQB is Equity Bank of Kenya, K.HFC is HFCK Group of Kenya, K.IMH is I&M Holdings of Kenya, K.KCB is KCB Bank of Kenya, K.NBK is National Bank of Kenya, K.NIC is NIC Bank of Kenya, K.SCB is Standard Charted Bank of Kenya, R.BOKis Bank of Kigali of Rwanda, T.CRB is CRDB Bank of Tanzania, T.MCB is Malibu Commercial Bank of Tanzania, T.MKC is Mkombozi Commercial Bank of Tanzania, T.NMB is NMB Bank of Tanzania, U.BOB is Bank of Baroda of Uganda, U.DFC is DFCU Bank of Uganda and U.SBU is Stanbic Bank of Uganda.

The second sub-period indicated that the relationship between bank size and systemic risk contribution got closer to reflect a positive, albeit weak relationship. For instance, the top 10 banks with higher systemic risk include both large and small banks. However, it is evident that most of the top 10 large banks have higher systemic risk contribution as well. These larger banks include BBK, KCB, CFC, DTK, COP and SBU. To the contrary, some smaller banks have inverse relation between size and systemic risk contribution. These smaller banks, such as DFC and BOB, have been ranked as the first and second highest systemic risk contributors. This indicates that even when the financial system has relatively expanded, the size of the bank does not reflect the actual impact of a bank's systemic risk contribution to the system.

During the last sub-period, findings indicated a positive relationship between bank size and systemic risk contribution. Despite the slight difference in the rankings, most of the larger banks have higher systemic risk contribution and vice versa. Looking at the top 10 banks with higher systemic risk contribution have a relatively larger bank size. This is with the exception of DFC and NIC, which have the highest systemic risk (1^{st} and 2^{nd} rank of $\triangle$CoVaR) with relative smaller bank size (14^{th} and 12^{th} MVTFA). On the downside, the top five smaller banks have lowest systemic risk contribution, implying that when the financial system has been relatively developed, the size of the bank matter in terms of the systemic risk contribution.

In summary, findings indicated that there is a relatively positive relationship between bank size and the systemic risk contribution. Such that, as the financial system grows, bigger banks tend to be more prominent to the systemic risk contribution compared to the smaller banks. There are banks that appeared to be among the top ten systemic risk contributors in all sample periods. For the case of least systemic risk contributors, there are banks that positively contributed to the financial system stability. We have also seen banks that have a large size with small systemic risk contribution in the sub-periods. These findings conclude that the use of bank size in isolation as adequate predictive risk measures to ensure financial stability could also be misleading in terms of macro-prudential regulation of the financial system.

5.4.2.4. *The Relationship between EAC Banks Size and Connectedness*

We further analyse the relationship between each bank's size and its level of connectedness to see if there is any direct relationship between the two. Without a doubt, findings showed that the EAC listed banks have continued to grow in terms of number and size (Table 5.9). For instance, in terms of listed banks with available consistency data for the period of 2004 to 2008, there were only 8 Kenyan banks that were listed in the stock market. The number of banks later increased to 15 banks, which included banks from Kenya, Tanzania, and

Uganda. In 2014, the number of listed banks grew up to 20 banks, including a bank from Rwanda. Looking at their sizes, which is denoted by the Market-Valued Total Financial Assets (MVTFA), there is a notable increase in almost all banks.

Interestingly, between the increase in the bank size and the number of causal links. For instance, in Kenya, the size of the Barclays Bank decreased from 1,067 to 1,058 USD, and the number of causal links decreased from 2 to 1 for the second and third sub-period, respectively. The bank's size further decreased from 1,058 to 710 USD, and the number of causal links increased from 1 to 8 links for the period of second and third sub-period, respectively. Similar, the size of Diamond Trust Bank increased from 199 USD, 339USD to 540USD while the number of causal links increased from 3 to 6 and later decreased to 4 links for the first, second and third sub-periods, respectively. The size of the Diamond Trust Bank Kenya increased from 199 USD to 339USD and later to 540 USD while the number of causal links increased from 3 to 6 and later decreased to 4 links for the first, second and third sub-period, respectively.

For the case of banks in Tanzania, which started from 2009, the bank size of NMB Bank increased from USD 412,115 to USD 674,944, and the number of causal links declined from 7 to 6 for the second and third sub-period, respectively. However, this was not the case for the CRDB Bank, where the increase of bank size and the number of causal links increased from USD 261,486 to USD 357,873, and 10 links to 11 links for the period of 2009 – 2013 and 2014-2018, respectively. The case of banks from Tanzania is similar to the banks from Uganda. The U.DFC slightly increased from USD 103,201 to USD 148,132 and the number of causal links increased by 1 link while the U.SBU size decreased from USD 519,546 to USD 498,199, and the number of links increased from 6 to 8 links. Therefore, these findings do not show a direct link of the larger the bank size, the higher the number of connectedness.

Against this backdrop, findings indicated that there is a notable increase in bank size and the level of banks connectedness with time. However, there is a relatively weak relationship between bank size and the level of connectedness. Despite the increase in banks size in many banks, the percentage number of causal links has diluted as the number of banks increases. These observations highlight the plausibility of the proposition that size alone cannot portray the extent to which the bank is connected to other banks in the system. Interestingly, banks with large interconnectivity are from Kenya and Uganda. Some of the banks from Tanzania recorded a positive contribution to financial system stability. These findings suggest that, in terms of connectedness, banks from Kenya and Uganda may be of greater concern than banks from Rwanda and Tanzania.

Table 5.9 The EAC Banks' Network Connections

	First Sample (2004-2008)				Second Sub-Period (2009-2013)				Third Sub-Period (2014-2018)			
	MVTFA		Causal Links		MVTFA		Causal Links		MVTFA		Causal Links	
Name	USD	Rank	Links	% of links	USD	Rank	Links	% of links	USD	Rank	Links	% of links
KN.BBK	1,066,704	1	2	6	1,057,954	1	7	8	710,236	5	7	5
KN.SBC	686,368	2	6	19	905,914	4	11	13	808,597	4	9	6
KN.KCB	564,978	3	4	13	968,432	3	9	11	1,329,706	2	12	9
KN.CFC	372,518	4	5	16	343,303	8	5	6	459,304	10	5	4
KN.NIC	202,715	5	2	6	243,778	11	7	8	270,065	12	9	6
KN.DTK	198,642	6	5	16	339,236	9	5	6	540,117	7	9	6
KN.HFC	63,129	7	5	16	59,752	16	3	4	66,177	16	2	1
KN.IMH	6,673	8	2	6	187,238	13	4	5	487,406	9	9	6
KN.EQB	-	-	-	-	1,048,840	2	7	8	1,663,358	1	8	6
KN.COP	-	-	-	-	681,674	5	8	10	905,763	3	13	9
UG.SBU	-	-	-	-	519,546	6	2	2	498,199	8	11	8
TZ.NMB	-	-	-	-	412,115	7	3	4	674,943	6	10	7
TZ.CRB	-	-	-	-	261,486	10	2	2	357,873	11	3	2
UG.DFC	-	-	-	-	103,201	13	5	6	148,132	14	4	3
UG.BOB	-	-	-	-	96,676	14	2	2	99,363	15	1	1
KN.NBK	-	-	-	-	95,090	15	3	4	44,286	17	9	6
TZ.DCB	-	-	-	-	13,394	17	0	0	17,258	18	6	4
RW.BOK	-	-	-	-	-	-	-	-	243,130	13	5	4
TZ.MCB	-	-	-	-	-	-	-	-	15,308	19	5	4
TZ.MKC	-	-	-	-	-	-	-	-	8,844	20	4	3
Total	271,338	8	31	100	7,337,626	17	83	100	9,348,066	20	141	100

Note: (i) MVTFA denotes as the Market-Valued Total Financial Assets (thousands USD), which is a proxy for the bank's size (ii) △CoVaR represents bank's systemic risk contribution to the system, which was estimated at the 5 percent significance level. (iii) K.BBK is Barclays Bank of Kenya, K.CFC is Stanbic Holdings of Kenya, K.COP is Co-operative Bank of Kenya, K.DTK is Diamond Trust Bank of Kenya, K.EQB is Equity Bank of Kenya, K.HFC is HFCK Group of Kenya, K.IMH is I&M Holdings of Kenya, K.KCB is KCB Bank of Kenya, K.NBK is National Bank of Kenya, K.NIC is NIC Bank of Kenya, K.SCB is Standard Charted Bank of Kenya, R.BOK is Bank of Kigali of Rwanda, T.CRB is CRDB Bank of Tanzania, T.MCB is Mwalimu Commercial Bank of Tanzania, T.MKC is Mkombozi Commercial Bank of Tanzania, T.NMB is NMB Bank of Tanzania, U.BOB is Bank of Baroda of Uganda, U.DFC is DFCU Bank of Uganda and U.SBU is Stanbic Bank of Uganda.

5.4.2.5. *Relationship between the Systemic Risk Contribution Determinants*

Following these interesting findings, we decided to analyse the empirical intuition of our findings and see if there is a significant relationship between the determinants of the systemic risk contribution. We have performed a simple correlation analysis in order to analyse the relationship between determinants of the systemic risk contribution, which are bank size, market risk, systemic risk contribution and the level of connectedness. This analysis provides useful information as to whether there is a significant relationship between the systemic risk contribution determinants.

As we have seen from the findings mixed relationships between bank size, market risk, systemic risk contribution and the level of connectedness, there is a need to empirically confirm their relationships. The study used a simple correlation analysis, which null hypothesis suggests there is a significant relationship between the variable if the coefficient value of correlation and its p-value is less than the significance level of 5 percent. We performed spearman rank order correlation and Pearson correlation to measure the degree of relationship or covariation between bank size, market risk, systemic risk contribution and the level of connectedness. Findings from both correlation analyses indicate that as a determinant of systemic risk contribution changes in value, the other determinant tends to change in a specific direction. Table 5.10 below presents the summary correlation analysis.

Table 5.10 Correlation analysis between the Systemic Risk Contributions Determinants

	DCoVaR	MVTFA	VaR	Connectedness
DCoVaR	1.000000			
MVTFA	0.518797	1.000000		
	(2.5747) ***	-----		
VaR	0.424060	0.263158	1.000000	
	(1.98661) *	(1.1573)	-----	
Connectedness	-0.293233	-0.078195	-0.254135	1.000000
	(-1.3032)	(-0.3328)	(-1.1149)	-----

Furthermore, findings indicate significant relationships between systemic risk contribution and the increase in bank size as well as the bank's market risk. There is a significant positive correlation between the bank size and systemic risk contribution at 1 percent significance level. This implies that bank's systemic risk contribution increases by 50 percent of each increase in a single unit of the bank size. This finding is in line with other studies that support the "too-big-to-fail" notion from the macro-prudential perspective

(Tarashev et al., 2009; Adrian and Brunnermeier, 2011; Pais and Stork, 2013; Black et al., 2016). Our findings reinforce the policy debate contained in Basel III, which suggest the imposition of capital surcharges on systemically important banks according to their size and complexity, aimed at ensuring stable and robust financial system stability. Furthermore, the relationship between bank size and market risk is positive but insignificant.

In addition, we have analysed whether risky institutions necessarily contribute more to the systemic risk contribution in the region. Findings have indicated a positive but weak significant correlation between the market risk and systemic risk contribution at 10 percent significance level. This implies that an increase in market risk leads to a 40 percent increase in the bank's systemic risk contribution. In line with other studies, this finding reinforces the previous argument that the use of market risk (VaR) as an adequate risk measure to ensure financial system stability could be misleading in terms of macro-prudential regulation of the financial system (Mensah and Premaratne, 2017). The fact that the increase in the bank's market risk does not fully indicate the increase in the systemic risk, which proofs the insufficiency of the micro-prudential regulations.

We have found a negative relationship between the level of connectedness and all other systemic risk contribution determinants. This implies that currently, the EAC financial system connectedness does not influence the banks systemic risk contribution, market risk and bank size. Even though these relationships are insignificant, we did not expect this negative relation as this finding is inconsistent with other studies. Most of the empirical studies have suggested a positive relationship between the level of connectedness and the systemic risk contribution (Mensah and Premaratne, 2017). For the case of the EAC region, this negative relationship between the level of connectedness and banks size, market risk and the systemic risk contribution might be since the EAC financial system. The financial markets are still relatively underdeveloped.

Therefore, we conclude that bank size matters in terms of systemic risk contributions. However, the size alone portrays only half of the potential increase in systemic risk contribution. We argued that the size of the institution should be among other key determining factors for the financial system regulation. Emphasis should thus be on the use of the two complementary approaches: micro-prudential (preventing the collapse of the bank-specific level) and macro-prudential (preventing the collapse of the financial system) regulatory measures in ensuring financial system stability.

5.4.2.6. *Systematically Important EAC countries*

For the purpose of macro-prudential regulation in the region, it is important not only to understand the level of systemic risk but also to understand the sources of market risk in the financial system. This entails measuring the marginal contribution of each country's financial system and rank the countries that are deemed systemically important. Knowing the country whose financial system is deemed systemically important is useful considering the reform effort of the effective financial regulations across the region. We have used a simple average ΔCoVaR during the third period where the financial system was relatively developed.

As it is evident in Figure 5.6, Tanzania is the only country that has recorded a low level of systemic risk contribution, which is about -1 percent. This implies that on average, banks from Tanzania contribute to the financial system stability. Contrary to the case of Tanzania, banks from Uganda contribute 38 percent to the regional financial system stability. This was partly attributed to the low number of banks, which relatively contributed to the systemic risk. The other systemically important country is Kenya, which contributes about 31 percent of the systemic risk in the region. Kenya has many banks with large bank size, which is diversified in terms of systemic risk contribution. Besides, most of the banks from Kenya have a larger bank size, which provides an advantage of having a large capital buffer and well-diversified portfolios. This minimises the level of risk as a country. Lastly, is Rwanda, which has only one bank that contributes around 27 percent of systemic risk.

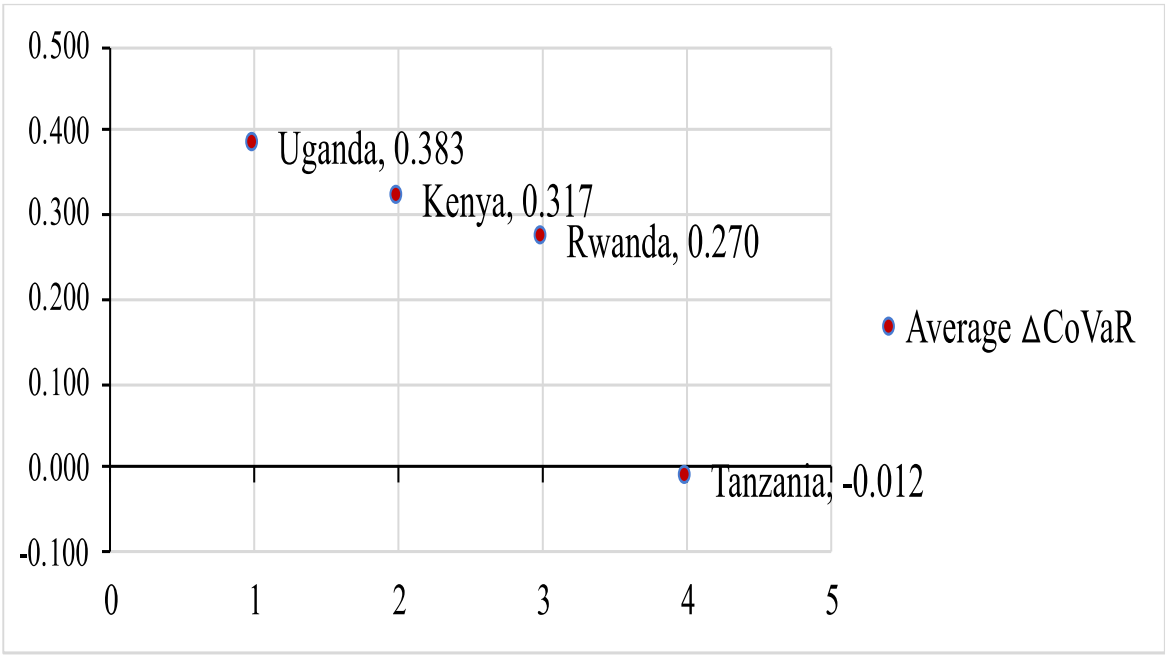

Figure 5.6 Systemically Important EAC Countries

5.5. Chapter Summary

This chapter analysed on the fourth key preoccupation of this research, potential systemic risk contribution to the EAC financial systems. The study examined the degree of banks interconnectedness; the potential magnitude of systemic risk contribution; the relationship between the systemic risk contribution determinants; and systemically important countries.

We started the analysis by determining the degree of banks connectedness assuming that higher degree of connectedness indicates the higher systemic risk. We found a significant increased bidirectional causality effect among the banks, and the degree of banks' connectedness are time varying. Most of the banks from Kenya and Uganda appeared to be more connected when comparing to banks from Rwanda and Tanzania. This implies that banks from Kenya and Uganda may be of greater concern in terms of potential spill-over effects.

Secondly, findings from the dynamic causality index indicated that a higher banks' interconnectedness mostly appeared during the economic downturn or financial crisis episodes, implying that the banks' interconnectedness is largely driven by macroeconomic environment among other factors. In view of that, there is a potential contagion effect in the EAC banking sector, which pose a potential threat to financial stability during the time of crisis.

Thirdly, we measure the degree of risk externalities that a single institution contributes to the overall system with an assumption that higher the delta CoVaR indicates the higher the systemic risk contribution of a particular bank to the system. We found that most of the banks significantly contribute to potential systemic risk. Furthermore, we found that the banks' systemic risk contributions are time varying.

Fourthly, to assess the ongoing debate of "too big to fail", we examined if there is a relation between bank size, market risk, degree of connectedness and systemic risk contribution. Most importantly, in line with other studies, we found evidence that there is a significant positive correlation between bank size and systemic risk contribution. However, we have found that the banks level of connectedness does not increase systemic risk contribution.

Lastly, we assessed the systemically important countries contribution among the EAC region. Interestingly, we found that banks from Tanzania contribute to the financial system stability, while banks from Kenya and Uganda might be posing more significant concerns in terms of systemic risk in the EAC. Should the risk to crystallise, this category of banks from Kenya and Uganda are most likely to face difficulties in raising fresh equity from the market and therefore warrant special attention from systemic risk monitors or regulators.

CHAPTER SIX

6. CONCLUSION, POLICY IMPLICTION AND RECOMMENDATION

6.1. Introduction

The global financial crisis of 2008/09 rekindled interest in a better and deeper understanding of the dynamics of financial system stability, and the policy and institutional measures required to address critical gaps and deficiencies in financial institutions and systems. Its' consequences have demonstrably raised the importance of financial system stability in most national jurisdictions. Since financial intermediaries such as banks operate at the expense of accepting deposits and issuing loans, fluctuations in the business cycle of the economy may cause a surge in credit risk, which can lead to the financial crises.

Besides, during financial development banks tend to expand their assets through credit expansion during the economic boom, which exposes the bank to risks that tend to end abruptly, typically in the form of financial crises during an economic recession. This strand of knowledge showed that financial system development fosters economic growth in the long run. However, as the economy matures financial system tends to experience cycles of boom and busts, which subject the financial system to systemic risk and impede economic growth. This highlights the likelihood of the financial system vulnerability, especially when the financial system expands.

Furthermore, the ongoing harmonization and integration in the EAC have a significant positive economic and trade development effects within the region. These effects are leading (and will further lead) to the transformation of the EAC economies. While these regional initiatives generally recognize the benefits of economies of scale, their implementation is not necessarily devoid of potential adverse pitfalls or consequences, which may vary in form and intensity. Thus, the extent to which the region continues to experience steady growth remains concerning in the light of uncertainties associated with the stability of their financial systems.

Moreover, it is important to measure the potential systemic risk due to the externalities associated with the failure of an institution. Firstly, knowing the risk exposure of the financial system enables regulators to examine those that are possible candidates for rescue in the event of a crisis. Secondly, the scale of a financial; system exposure to systemic risk makes it possible for academics and regulators to identify the underlying cause or drivers of their risk exposure and mitigate risks' impact to the economy. This underscores the need to identify the early warning indicators for financial system instability, which is the case of this study.

The primary motive of this research derives from the importance of financial systems in the economy, considering the dynamic and complex nature of the financial systems. That notwithstanding, financial systems are highly associated with systemic risks. Failure of the financial system can have cascading effects and potential for triggering the economic crisis. On that note, clarity/ knowledge of how best to manage factors affecting the EAC financial system stability (risk build-up) and thus affect the economy is needed. This clarity/knowledge can be attained by fulfilling several justifications as follows.

Therefore, in order to have a clear understanding of the potential effects of financial system instability on the real economy of the EAC, research on the topic of financial system stability is very important. Thus, this research seeks to examine the impact of the ongoing economic and financial developments on financial system stability and assess the level of the financial system stability and its determinants in the EAC, which is increasingly becoming more interconnected economically as well as in terms of trade.

Against that backdrop, this study is therefore designed to examine prospects for and constraints on the EAC financial system stability for the period 2000 – 2018. This aim is achieved by investigating whether the macro-economic and financial reforms contributed to the financial system stability, assess key determinants of the major risk (credit risk) that hinders financial system stability, measure and forecast the level of stability in the financial system and lastly examine the magnitude of institutions' systemic risk contribution in the financial system.

6.2. Summary Findings regarding the Four Objectives of the Study

6.2.1. Evolution of the EAC Financial System: A Descriptive Overview

This chapter analysed the first objective, which entails assessing the background of the financial system developments and ascertaining whether efforts made to support the financial system development during the infant stages have had impacts on recent financial system developments. We started by assessing the financial system outlook by mapping the architecture of the current financial system and indicate the contexts of its developments. We then analysed the trend of the recent macroeconomic and macro-financial developments.

Findings indicated that the financial system structure is composed of a wide and growing array of institutions, albeit slowly. Also, it has become increasingly diversified and divergences in the emerging structure of its financial system, which has raised fresh concerns, particularly in relation to cross border vulnerabilities. We found that key financial soundness indicators for the banking sector depict that the banking system strengthened its capital adequacy and liquidity buffer. However, the loan portfolio quality deteriorated, squeezing

profitability despite an increase in interest margin. This financial system vulnerability, in particular, the decline of assets quality across the region underscores the need to identify potential risks to the financial system stability.

6.2.2. Determinants of the Credit Risk in the EAC Financial Sector

This chapter addressed the second objective that ascertaining factors that contribute to financial system stability. This research work is an attempt to respond to that question that continues to preoccupy policymakers as they seek for corrective actions to moderate the impact of certain vulnerabilities and fragilities in the EAC financial system. To do this, one must gain a deep understanding of factors that hinders the EAC financial system stability. In particular, we examine more systematically possible drivers of the financial system stability.

The novelty of this analysis lies in the hypothesis that the EAC banking systems are largely affected by the credit risk despite the implementation of the financial sector reforms and steady economic growth. The study used the ratio of NPL as a proxy of credit risk and examined the influence of different groups of macroeconomic and macro-financial variables in relation to the credit risk behaviour of the EAC banking system. For robustness check, we employed two different econometric approaches. The ARDL approach produces robust results when accounting for the structural breaks of the long-run and short-run dynamics while GMM provide a robustness check of the long-run relationships.

Findings from this study support the economic theory that suggests that credit risk is responsive to the dynamics of countries' macroeconomic and macro-financial variables. In particular, profound evidence has indicated that credit risk is the indicative legacy effect of the economic growth and credit growth and previous NPLs management both in short-run and long-run. This implied that the continuous rise in economic growth stimulates credit booming and increase of non-performing loans as banks tend to lend too aggressively by relaxing some of the lending standards during the economic booms. As a result, credit risk increases during the economic recession because borrowers are adversely affected and face difficulties in servicing their loans. This has been evidenced by the recent economic growth, which fuels the increase in access and usage of the financial services and a number of banks that have been in distress or failed, largely contributed by the high non-performing loans.

In addition, our results have indicated that improvements in the banks' profitability, cost efficiency, liquidity, interest margin, terms of trade, money supply and economic lower the credit risk in the EAC banking system. However, the increase in credit growth, exchange rate, interest rates and required capital to risk-weighted assets contribute to the credit risk.

Thus, given the close and highly significant relationship between the monetary policy controls and the credit risk behaviour, any policy, which increases output is likely to have a favorable impact on credit risk and should be vigorously pursued.

6.2.3. The Extant Evidence of the EAC Financial System Resilience

In this chapter, we analyse the third objective of the research, which intends to analyse the extant evidence of the EAC financial system resilience. We measured and forecasted the stability level of the EAC financial system from 2000 - 2017. We developed AFSSI, which is a comprehensive measure of financial stability that combines various indicators relating to financial system development, vulnerability, soundness and macroeconomic climate. By using quarterly data, the aggregated index has successfully shown the performance of the financial system over the sample period. The econometric analysis was also performed to validate the effect of critical macroeconomic indicators on financial stability.

Findings from the aggregated index (AFSSI) show that the EAC financial system has remained relatively robust, albeit vulnerable to shocks. During the period between 2000 - 2010, regional financial systems were less developed compared to the current period, operating in a weak macroeconomic environment with fairly inadequate regulatory frameworks, which made the financial systems more vulnerable to shocks. However, since 2010 there is a notable development in terms of access and usage of financial services, which improves the stability of the EAC Financial systems. This was largely attributed to the relatively stable economic growth across the region, implementation of financial sector reforms across the region in the 2000s, and implementation of the integration initiatives in 2010.

Although most economies have witnessed relatively stable economic growth and expanding financial system structures, a more granular analysis of the financial system stability indicators points to some vulnerabilities and potential risks. Risks to financial systems stability relate mainly to tighter financial conditions and weaker economic growth, which has led to elevated credit risk, liquidity risk and declining profitability across the region. This was largely attributed to the banks responded to the increased competition in the post-reform period by aggressively expanding their market shares. Consequently, they ended up accumulating distressed assets that erode their bank balance sheets and fuel credit risk when the economy weakens. If the situation is not handled promptly and carefully, it might lead to systemic bank failure. This underscores the need for an effective mechanism that monitors credit growth, which is a critical factor of financial development and minimizes threats and vulnerabilities that may potentially bring about financial crises in the region.

The empirical robustness analysis conducted by using generalized method of moments (GMM) regression analysis confirms the significance of the results obtained from financial stability index approach that are consistent with economic literature. Both results of the relationship between AFSSI and its sub-indices; and performance of AFSSI and other relevant macroeconomic variables were significantly at a 99 percent confidence level. Besides, the impact and weights (coefficients) generated from the econometric analysis are consistent with the AFSSI model identification as well as economic literature. Thus, positive/negative coefficients indicate a positive/negative correlation between the variables used in the analysis of the performance of the AFSSI results. Thus, confirm that variables that composed the sub-indices are useful leading indicators of the financial instability in the EAC region and can be used as an early warning indicator of the potential risks to the stability of the financial system.

The AFSSI results were used to forecast the outlook of the financial system stability in the EAC for the following 3 years 2018 – 2020. For robust forecasting results, the study used SARIMA, and an extension of exponential smoothing designed for trended and seasonal univariate time series, which is also known as the Holt-Winters method of forecasting (the double exponential method). All presented methods of the SARIMA and the Holt-Winters' are found to have a good forecast performance for the AFSSI. All 4 methods: seasonal ARIMA, seasonal addictive, non-seasonal and single exponential smoothing forecasting methods, were able to predict the AFSSI within the sample. In addition, the Forecasting Results of the out-of-sample for all 4 models used in forecasting the in-sample data indicating the positive trend of the AFSSI for the period of 2018 – 2020. Nevertheless, the non-seasonal model is the optimal model for Holt-Winters three-parameters smoothing as it forecasts the AFSSI with the lowest sum of squared forecast errors. Thus, it can be used to predict the short-term AFSSI trend.

6.2.4. Potential Systemic Risk Contribution in the EAC Banking System

In this chapter, we focused on the last key preoccupation of this research, banks' potential systemic risk contribution to the EAC financial systems. We were trying to answer the fourth research question as to whether bank size and other identifiable financial institutions or market factors contribute to the EAC financial system stability? This entails examining the degree of banks interconnectedness; the potential magnitude of systemic risk contribution; the relationship between the systemic risk contribution determinants; and systemically important countries.

We started the analysis by determining the degree of banks connectedness assuming that the higher degree of connectedness indicates the higher systemic risk. We found a significant

increased bidirectional causality effect among the banks, and the degree of banks' connectedness are time varying. Most of the banks from Kenya and Uganda appeared to be more connected when comparing to banks from Rwanda and Tanzania. This implies that banks from Kenya and Uganda may be of greater concern in terms of potential spill-over effects.

Secondly, findings from the dynamic causality index indicated that a higher banks' interconnectedness mostly appeared during the economic downturn or financial crisis episodes, implying that the banks' interconnectedness is largely driven by macroeconomic environment among other factors. In view of that, there is a potential contagion effect in the EAC banking sector, which pose a potential threat to financial stability during the time of crisis.

Thirdly, we measure the degree of risk externalities that a single institution contributes to the overall system with an assumption that higher the delta CoVaR indicates the higher the systemic risk contribution of a particular bank to the system. We found that most of the banks significantly contribute to potential systemic risk. Furthermore, we found that the banks' systemic risk contributions are time varying. Fourthly, we examined the relationship between the systemic risk contribution determinants and found that there is a significant positive correlation between bank size (too big to fail) and systemic risk contribution. However, we have found that the banks level of connectedness does not increase systemic risk contribution.

Lastly, we assessed the systemically important countries contribution among the EAC region. Interestingly, we found that banks from Tanzania contribute to the financial system stability, while banks from Kenya and Uganda might be posing more significant concerns in terms of systemic risk in the EAC. Should the risk to crystallise, this category of banks from Kenya and Uganda are most likely to face difficulties in raising fresh equity from the market and therefore warrant special attention from systemic risk monitors or regulators.

6.2.5. Concluding Remarks around the Findings

The EAC financial system is composed of a wide and growing array of institutions, and it is becoming increasingly diversified. However, the diversity and divergences in the emerging structure of its financial system have raised fresh concerns, particularly in relation to cross border vulnerabilities. We found that (i) the EAC financial system is becoming increasingly diversified and appears to be relatively stable, albeit vulnerable to shocks. Major factors that contributed to the formation of risks are such as higher interest rate spread and net interest margin, which indicates reflects the poor performance of the financial system; increase in the domestic inflation rate, current account balance deficit, fiscal budget deficit and foreign currency imbalances, which reflect vulnerable conditions that impede financial system

stability; increase in NPLs, which shrinks the soundness of the financial system stability; and weak economic growth both in the domestic, region and globally, which hinders economic activities.

We also found that (ii) credit risk, which has been viewed through assets quality deterioration, is seen as one of the major risks that threaten financial system stability by way of contributing to banks' distress/failure across the region. This risk is a legacy effect of economic and credit growths and previous NPLs management both in the short- and long-run. As is theoretically expected, improvements in banks' profitability, cost efficiency, liquidity, interest margin, terms of trade, money supply and economic growth lower credit risks in the EAC banking system. However, increases in credit growth, exchange rate, interest rates and required capital to risk-weighted assets (with less prudent lending standards), increase the ratio of NPLs and, consequently, raises credit risks during the recession.

In terms of the financial system resilience, we found that (iii) the EAC financial systems have remained relatively stable, albeit vulnerable to shocks. In the first half of the sample period, regional financial systems were less developed compared to the second (current) period; operating in a weak macroeconomic environment with fairly inadequate regulatory frameworks, made the financial systems more vulnerable to shocks. However, since 2010 there is a notable development in terms of access and usage of financial services, which improves the stability of the EAC financial systems. (iv) Risks to financial system stability relate mainly to tighter financial conditions and weaker economic growth, which have led to elevated credit risk, liquidity risk and declining profitability across the region. (v) Robust regression analyses confirm the significance of the AFSSI, indicating that variables that populate the sub-indices are useful leading indicators to be relied upon as early warning indicators of potential risks to the stability of the financial system. (vi) The EAC financial system stability forecast shows a positive trend of the AFSSI for the period of 2018 – 2020.

Upon investigating sources of contribution to systemic risk of the EAC financial system stability, we found that (vii) there is a significant increased bidirectional causal effect between EAC banks. Most of the banks from Kenya and Uganda appeared to have more connectedness, implying that they may be of greater concern in terms of potential spill-over effects. (viii) Higher interconnectedness appeared mostly during economic downturns or financial crisis episodes. (ix) We found that banks' systemic risk contributions are time-varying, and the degree of systemic risk contribution is higher when banks are in distress condition. Most importantly, (x) in line with other studies, we found a significant positive correlation between bank size and contribution to systemic risk. Each bank's connectedness and potential systemic

risk contribution are time varying. However, banks' level of connectedness does not increase systemic risk; this suggests there is a potential contagion effect in the EAC banking sector, which pose a potential threat to the financial system stability during times of crisis.

6.3. Policy Implication of the Research

Conclusively, several observations are worthy of special remarks in terms of policy and regulatory implications for the EAC financial system. Firstly, findings indicated that economic growth has a significant positive effect on credit risk. Therefore, policymakers and bankers should create a framework and design control strategies based on structural variables as well as policy decisions regarding credit growth threshold and risk-taking behaviour. This includes putting in place effective regulatory and supervisory framework for non-banking institutions as well in order to increase accountability and mitigate risk transmission to the financial system. Such that proper underwriting and monitoring systems and background checks should be carried out by banks in order to assess the borrower's ability to repay their debt before and after the issuance of loans.

Secondly, since banks' assets quality of financial system has remained a key concern for systemic stability, policymaking authorities should promote active financial systems that fulfil their roles of effectively and efficiently allocating resources among economic agents, while managing and mitigating risks, mobilizing savings and facilitating wealth creation for broader economic development. This can be attained through effective macroeconomic policies both fiscal and monetary policies that would improve access to finance for a majority of the population, thus, raising the level of monetization in the economy for economic development and effective implementation of monetary policy.

Thirdly, this study strikes a more positive note on the usefulness of leading indicators (AFSSI) in predicting crisis incidences. Despite the differences in financial instability characteristics across the region, the review has shown that the region has faced similar financial system instability patterns. Thus, in order to manage financial system stability optimally, regulators and policymakers ought to include significant variables comprises the AFSSI, as leading indicators (early warning signs) of financial system stability.

Fourthly, there is a need to ensure effective policy formulation on the financial system regulatory and supervisory frameworks across the region. Furthermore, the significant positive correlation between banks' size and risk contribution underscores the emphasis on the implementation of macro-prudential tools in ensuring financial stability. In addition, the level of banks' connectedness and potential systemic risk contribution is time-varying underscores,

the need to ensure effective periodic risk assessment to ensure financial system stability. Lastly, in order to manage any potential systemic risk optimally, regulators and policymakers ought to include the imposition of capital surcharges according to the size of an institution.

6.4. Shortcomings of the Study and Possible Extension

Examining financial stability has been viewed to be a dynamic process due to the dynamic nature of the economy, complex nature of the financial system, and innovation of financial system's products such as mobile money. Policymakers and financial system regulatory authorities have been striving to move along with these changes in order to develop and maintain financial system stability that fosters economic growth at various time.

In addition, based on these complex and dynamic nature of financial institutions, markets and system, we recommend that research on financial system stability should follow the same dynamic trends, focusing on the different effects of financial system stability on distinct economies based on levels of economic development.

We understand that there have been several studies examining the financial system stability, most of these studies were mainly geared toward either developing countries and/or a single country, and not in the regional perspective. Literature in developing countries, in particular, in the financial integration context remains scanty and mostly nonexistent for the case of the EAC region. Undertaking such a study from time to time is believed to be crucial, especially given the rising trend in non-performing loans in the EAC over the last few years. With data availability, further studies should include other components (institutions or markets) of the financial system, such as insurance companies, for example.

Besides, another area of interest for further studies is the aspect of financial integration, which was not explored deeply in the literature review sections as it is out of the scope of this dissertation. However, such an area of study is of importance hence can be further explored by other studies.

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