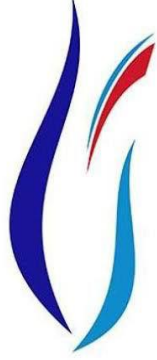


**REPUBLIC OF TURKEY
MANISA CELAL BAYAR UNIVERSITY
LİSANSÜSTÜ EĞİTİM ENSTİTÜSÜ**



**YÜKSEK LİSANS TEZİ
ULUSLARARASI TİCARET VE FİNANS ANABİLİM DALI
YÜKSEK LİSANS PROGRAMI**

TECHNOLOGY AND FINANCIAL DEVELOPMENT: EVIDENCE FROM LIBERIA

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MANISA- 2024

TAAHHÜTNAME

This dissertation is my original work and has not been presented for the award of a degree at any other university. Therefore, I hereby declare that this thesis, **Technology and Financial Development: Evidence from Liberia** prepared in the Graduate School of Manisa Celal Bayar University, Department of International Trade and Finance has been written in accordance with academic and ethical standards. All literature used in this thesis has been referenced, and it is entirely my own work. I affirm that proper citation has been provided for every quotation, and that no artificial intelligence or program contrary to academic and ethical rules has been utilized in the writing of this thesis.

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Bugün, araştırmacılar ve politika yapıcılar, teknolojinin finansal işlemleri ne ölçüde etkilediğini veya nasıl etkilediğini anlamak istemektedirler. Ülkenin ekonomik genişleme ve finansal kapsayıcılığını nasıl etkilediğini anlamak için teknolojinin özellikle mobil para ve internet erişimi şeklindeki etkisini anlama ihtiyacı bulunmaktadır. Bu tezin nihai amacı, 1991'den 2021'e kadar olan zaman serisi verilerini kullanarak Liberya'da teknoloji ile finansal gelişme arasındaki ilişkiyi değerlendirmektir. Teknoloji, Mobil Hücreli Abonelikler ve İnternet Penetrasyonu kullanılarak ölçülmekte, finansal gelişme ise Net İç Borç ve Para Arzı kullanılarak ölçülmektedir. Ampirik sonuçlardan, bulgular Liberya'da teknoloji ile finansal gelişme arasında para arzı ve net iç kredi kullanılarak finansal gösterge olarak hem kısa hem de uzun vadeli olarak önemli bir negatif ve pozitif ilişkinin bulunduğunu göstermektedir. Sonuç olarak, bu çalışma sürdürülebilir, verimli ve etkili bir finansal sistem oluşturmak için teknolojiyi dahil etmenin önemini vurgulamaktadır. Bu, hükümetin Liberya'da finansal faaliyetleri artırmak için teknolojiyi dahil etmek suretiyle güvenli bir ortamı sağlamasını ve teşvik etmesini gerektirdiğini ortaya koymaktadır.

Anahtar Kelimeler: Teknoloji, Finansal Gelişme, ARDL modeli, Bound Test

ABSTRACT

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Today, researchers and policymakers want to understand how or to what extent does technology influence financial transactions. There is a need to understand how technology, specifically in the form of mobile money and internet access, has affected economic expansion and financial inclusion in the country. The ultimate objective of this thesis is to assess the relationship between technology and financial development in Liberia using time series data from 1991 to 2021. ARDL model and bound tests were used to examine the relationship between technology and financial development. Technology is measured using Mobile Cellular Subscriptions and Internet Penetration while financial development is measured using Net Domestic Credit and Money Supply). From the empirical results, the findings indicate that there exists a negative and positive significant relationship between technology and financial development in Liberia using money supply and net domestic credit as a financial indicator in both short term and long-term. Ultimately, this study highlights the importance of incorporating technology to maximize financial activities that to sustainable, efficient, and effective financial system. This reveals that government should ensure and encourage a safe environment that improve financial activities in Liberia through the incorporation of technology.

Keywords: Technology, Financial Development, ARDL model, Bound Test

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Hence, I willingly accept responsibility for any errors or views expressed in this dissertation, and I anticipate that this study contributes meaningfully to the ongoing discussion of technology and finance.

Patrick NYENKAN

Manisa, 2024



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CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Technological revolution has rapidly transformed the global world through digital innovation in the 21st century. This technology is changing how people conduct their activities and has created a need for every sector to adopt digital solutions to solve complex problems (Konovalova et al., 2019). The role of digital technologies in increasing business entities' investment opportunities. The primary role of technological innovation is to provide digital services through the internet and to enhance organizations in achieving their goals. The distribution of goods and services at a cheaper cost, as well as high efficiency and productivity which leads to increased customer satisfaction can all be improved through digital platforms. The financial services sector has benefited greatly from the use of technology, which has played a vital part in the sector's development. Today, technology is revolutionizing the way we live, work, and do business, and it has a vital role play in shaping global market activities. The incorporation of technology has been essential in addressing the complex problems in various sectors, particularly in the financial services sector.

Moreover, the COVID-19 epidemice has had a huge influence on the world economy, slowing physical transactions and hurting both the public and private sectors in a wide range of ways. Developing countries, particularly those in Africa with weaker economies, have been especially affected due to their less developed economic systems. It clear that even major economies have experienced a significant decline as a result of the outbreak.

The impact of covid-19 on GDP during the first quarter of 2020 resulted in significant differences among major countries, with the United States experiencing a decrease of 4.9 percent, the Eurozone experiencing a decrease of 14.4 percent, and China experiencing a decrease of 34.7 percent. These variations can be attributed to the timing of when each country's outbreak of covid-19 occurred (Canuto, 2020d). This is important to understand how

different countries were affected by the pandemic which exposed how limitations of many sectors and businesses regarding the use of technology.

Whereas the African continent with its less developed economies, is particularly vulnerable to the negative impacts of the coronavirus pandemic. The virus has reportedly triggered the first recession in the sub-Saharan region in 25 years, according to Africa's Pulse, a biannual study from the World Bank. In contrast to the region's moderate rise of 2.4 percent in 2019, the analysis projects a reduction in economic growth in 2020, with estimations ranging from a decrease of 2.1 percent to 5.1 percent. It emphasizes the severe impact of the pandemic on African countries and the need to take this into account when considering the economic consequences of the outbreak.

On the other hand, the coronavirus pandemic has highlighted the importance of digitalization in the modern economy. This includes the use of technology to facilitate business and financial transactions, as well as the use of digital tools to increase productivity, efficiency, and overall effectiveness in both large and small organizations. This need for digitalization has been reinforced by the challenges presented by the pandemic and the need to adapt to new circumstances. Ultimately, it can be said that the pandemic has brought to the forefront the significance of digitization in today's economy.

According to Canuto (2020d), the present COVID-19 epidemic will have a huge impact on how businesses and other organizations operate their operations, especially in the fields of manufacturing and the provision of public services.

As a result of the pandemic, many companies and government agencies have been forced to quickly adopt digital technologies to continue functioning effectively and efficiently. This accelerated adoption of digitalization is like to continue even after the pandemic subsides, particularly in areas such as education, financial services, and international business transactions. The study also indicated that the changes brought about by the pandemic will have a lasting impact on how these industries operate.

Before the outbreak of the virus, many businesses and organizations that relied on face-to-face interactions and traditional forms of service delivery may have seen a significant decrease in revenue. This is due to the restrictions put in place by government authorities to

limit public interactions to control the spread of the virus. In contrast, institutions that had the capability to utilize digital platforms and technology were able to continue providing goods, services, and essential commodities to their customers and clients through innovative means, such as online deliveries and virtual interactions, this shift towards digital platforms allowed these entities to continue operating and serving their customers, even when there is a worldwide pandemic.

Subsequently, in the Liberia's context, this research can be approached from several perspectives. One is the technological perspective, which focuses on the development and adoption of new technological services, products internet access, and penetration in Liberia. Another perspective is the financial development perspective, which looks at how technology has affected financial participation and national economic development.

From a technological perspective, to increase customer satisfaction, the Liberian economy has recently started implementing technology in the delivery of goods and services to the public. However, the 14 years of civil conflict have hindered progress in key sectors. Despite this, the previous ten years, Liberia has taken steps to strengthen its economy by implementing economic initiatives that have led to some progress in both real and financial industries. Liberia has made significant progress in recent years in terms of ATMs, mobile money, and internet access. Technological financial services have been introduced in the country since 2009 and have been widely adopted by the population. The Liberian government has also made efforts to increase internet access, with the goal of reaching 40% internet penetration by 2020.

In term of financial development, Liberia has traditionally had minimal financial inclusion, with a limited number of formal financial institutions and minimal financial service utilization. However, financial inclusion in the nation has significantly increased when mobile money was introduced, and internet access was expanded. Mobile money has enabled individuals and small businesses to access financial services and has also provided a platform for digital transactions.

However, despite these advancements, there are still barriers to the adoption and usage of technology in the Liberian financial sector. These include an absence of confidence in online

financial services, a limited understanding of technology, and a lack of regulation and oversight of the sector.

Most importantly, there is no evidence to understand the empirical, sustainable and infrastructure contribution of technology to financial activities within the economy. In others, it has become of pressing need to have empirical justification to craft policies in seeking opportunities and mitigating present and future challenges.

1.2 Statement of the Problem

Liberia, the oldest independent nation in Africa, has experienced a severe economic decline because of a civil war that lasted for about 20 years. Historically, the country was a major contributor to the global iron ore market and was the seventh-largest producer of iron ore in the world and the top producer in Africa in 1980. This helped to drive economic growth and development across various sectors. However, as the civil conflict escalated, it caused significant damage to the economy, infrastructure, and human capacity, leading to the closure of nearly all economic operations and leading to a decline in the overall economy.

However, in 2006, after a period of conflict and turmoil, a ceasefire was established, and a democratically elected government was formed. This led to an improvement in the overall economic situation of the country. Programs were implemented, and assistance from the international community was given, which aided in the growth of the economy. Therefore, economic activity increased in both the manufacturing and service sectors. Additionally, due to the growth of banking operations, the financial institutions sub-sector considerably contributed to the expansion of the economy. More specifically, in 2006, the GDP increased from the \$401.8 million of the previous year to \$433.3 million.

Banking industry financial assets had significant growth in 2016, with an increase of 5.4 percent total assets, 21.2 percent capital, and 3.8 percent in deposits, respectively. This portrays a notable improvement over the expansion seen in the year prior, when the rates were, respectively, 7.5 percent, 0.8 percent, and 16.0 percent in 2015. Additionally, there has been an increase in the incorporation of telecommunication companies as providers of financial services through mobile banking. Particularly, there were 2,110 mobile money agents in November 2016, a growth of 11.9% from December 2015's total of 912 agents, which

represented an increase of 9.12%. Furthermore, Commercial banks have expanded the spread of their branches in response to the rising needs of customers for their services. Although policy frameworks have aided in the recovery and expansion of the banking sector. By incorporating digital platforms to offer a variety of goods and services, the entire financial system has become more resilient and has embraced technological innovations.

Despite the introduction of ATMs, E-banking, mobile money, and increased internet access and penetration in Liberia, the influence of technology on the nation's financial progress is only dimly understood. While mobile money has enabled individuals and small businesses to access financial services and has also provided a platform for digital transactions, there are still barriers to the adoption and usage of technology in the Liberian financial sector. These include factors such as diminished confidence in digital financial services, imitated comprehension of technology, and inadequate regulatory scrutiny within the sector.

Considering these challenges, understanding the connection between Liberia's financial progress and technology is important. Specifically, there is a need to understand how technology, specifically in the form of mobile money and internet access, has affected economic expansion and financial inclusion in the country. Additionally, it is necessary to determine the obstacles and enablers to the adoption and application of these technologies in the financial sector of Liberia.

Therefore, the focal challenge that this thesis seeks address revolves in understanding the technological progress on Liberia's financial sector. Furthermore, it delves into the obstacles and catalysts influencing the adoption and utilization of technological innovations within the financial domain.

1.3 Objective of the Study

This study's main objective is to evaluate the effect of technology on financial sector growth focusing on the Liberian financial sector.

1.3.1 Specific Objectives

The main objective will be achieved through the below specific objectives:

1. To examine how technology, specifically internet access, subscriptions and penetrations has affected financial inclusion and economic growth in Liberia.
2. To identify the barriers and facilitators to the adoption and usage of technology in the Liberian financial sector.
3. To understand the short or long-run relationship between technology and financial sector development in Liberia
4. To evaluate the implications of technology improvement on financial development in Liberia and how these can be addressed.

The first objective will focus on understanding the relationship between technology, specifically internet access, subscription and penetration, inclusive finance, and economic advancement in Liberia. The second objective keenly emphasis on understanding the barriers and facilitators to the incorporation of technology in the Liberian financial sector. This will include understanding the factors that influence the technology usage and adoption, as well as the social and cultural factors that impact the acceptance of technology in the country. The third objective focus on providing a comprehensive understanding of the short and long run impact of technology on financial development in Liberia. Finally, the fourth objective focus on assessing the implications of technology on financial development in Liberia and understanding how these can be addressed.

1.4 Research Questions

To achieve the purpose of this study, the study attempts to answer the below research questions:

1. How has technology, specifically new technological services, internet access, penetration, and subscriptions affected financial sector development in Liberia?
2. What are the barriers and facilitators to the adoption and usage of technology using Mobile Cellular Subscriptions and Internet Penetration in the Liberian financial (Net Domestic Credit and Money supply) sector?
3. Is there a short or long-run relationship between technology (Mobile Cellular Subscriptions and Internet Penetration) and financial sector development (Net Domestic Credit and Money supply) Liberia?
4. What are the implications of technology on financial development in Liberia and how can these be addressed?

The first research question aims to understand the relationship between technology, specifically internet access, subscription and penetration, and financial sector development in Liberia. It will explore the extent to which technology has been successful in promoting financial inclusion and economic growth in the country.

The second research question aims to assess the short and long-run relationship between technology and financial development. i.e. using mobile cellular subscription and internet penetration as indicator of technology, whereas net domestic credit and money supply are used to measured financial development. These proxy variables are used in understanding the short and long runs correlation between independent variables and dependent variables in the study.

The third research question aims to understand the barriers and facilitators in acquiring and usage of internet net and mobile subscription as well as access to domestic credits and money supply in the Liberian financial sector. This will include understanding the factors that influence the adoption and usage of these proxy variables, as well as the social and cultural factors that impact the acceptance of technology in the country.

The fourth research question aims to assess the implications of technology on financial development in Liberia and how these can be addressed. It will explore the potential negative impacts of technology on financial development and the steps that can be taken to mitigate them.

1.5 Justification of the Study

In today's digital age, economies, and financial industries in developing countries are using technology to improve the delivery of products and services to citizens. This includes using technology to reduce the cost of production, increase efficiency and productivity, and provide more professional and convenient services. In addition, the use of technology has led to a decrease in the use of cash in financial transactions, as more and more transactions are being conducted digitally without the exchange of physical money. This is a significant change compared to the situation 10 years ago, where the use of cash in financial transactions was more prevalent.

According to Mukherjee and Tomar (2022), e-commerce can establish a worldwide image, open access to international markets, offer competitive prices, increase accessibility, decrease information imbalances, and incorporate technology.

The success of a business ecosystem is dependent on the economy and financial system. A robust financial industry can positively impact businesses and improve economic productivity. Additionally, this study is unique in that it aims to provide in-depth evidence of the benefits that a technologically advanced financial sector can have on the economy and financial activities. This will attract the attention of governments, financial institutions, economists, and decision-makers, encouraging them to invest in and adopt technology, particularly around financial inclusion in the finance sector.

On the other hand, the importance of understanding the impact of technology on financial development in Liberia is significant to this study. From the first angle, understanding the impact of technology on financial development in Liberia is crucial because of the country's low level of financial inclusion and the need to promote economic growth. Liberia has traditionally had a low level of financial inclusion, with a limited number of formal financial institutions and low usage of financial services. However, with the introduction of new digital

platforms such as ATMs, E-banking, Swift payment mobile money, and increased internet access, there has been a significant increase in financial inclusion in the country. Mobile money has enabled individuals and small businesses to access financial services and has also provided a platform for digital transactions. By understanding the impact of technology on financial development in Liberia, policymakers and practitioners can identify ways to promote financial inclusion and economic growth in the country.

From another standpoint, studying technology and financial development in the context of a developing country is significant because of the unique challenges and opportunities that exist in these contexts. Developing countries often face challenges such as limited infrastructure, low levels of education and financial literacy, and limited access to financial services. At the same time, they also could leapfrog traditional models of financial development and adopt new technologies that can promote financial inclusion and economic growth. By studying technology and financial development in the context of Liberia, this research aims to provide insights that can be used to inform policy and decision-making in other developing countries.

In a nutshell, this study is important because it aims to understand the impact of technology on financial development in Liberia and the barriers and facilitators to the adoption and usage of technology in the financial sector. It will contribute to the overall understanding of the relationship between technology and financial development in Liberia and provide insights that can be used to inform policy and decision-making in the country. Additionally, studying technology and financial development in the context of a developing country is significant because of the unique challenges and opportunities that exist in these contexts.

1.6 Scope of the Study

This research aims to evaluate the effects of technology on financial growth in the digital age. The study's coverage is confined to the financial system of Liberia, using annual data from the years 1991 to 2021. The study will analyze the data to understand the impact of technology in financial development within the Liberia context.

1.7 Organization of the Study

The study is organized into chapters as follows: Chapter two provides theoretical and empirical evidence on the formal and informal structure of the financial activities of Liberia. Chapter three gives theoretical review of literature on the role of technology in finance. Chapter four highlights the relationship between technological activities and financial improvement. Chapter five outline the methodology, data sources, justification of variables. Chapter six outlines the econometric techniques and analysis. Lastly, chapter six focuses on the conclusion and limitation of the thesis; and policy recommendations.

CHAPTER 2

OVERVIEW OF THE FINANCIAL SECTOR OF LIBERIA

2.1 Introduction of the Chapter

This chapter examines how technology has been incorporated into the financial system of Liberia, explaining how digital services have changed over time and how new payment methods have been introduced. It will also explore the function of nonbanking institutions and how they add to Liberia's broader financial system. In addition, a great deal of attention will be paid to the development and expansion of mobile money operations, emphasizing their influence on financial accessibility and inclusion in the nation.

2.2 Introduction of the overview of the financial sector

Liberia has an economy that operates using two different currencies, the Liberian dollar (LRD) and the American dollar (USD). This means that economic and financial activities in the country take place using both currencies. Additionally, the financial system in Liberia is divided into two parts, the formal and informal sectors. Despite facing various challenges, the financial industry in Liberia is trying to expand its reach across the country with the help of the Central Bank of Liberia. The banking sector is the primary driving force behind the financial industry in the country. According to the Central Bank of Liberia (CBL) in 2010, the banking sector is the major driver of the financial industry. In 2016, CBL indicated that banks and non-banking institutions in Liberia have introduced new services and expanded their branches. As a result, the number of licensed and operational banks in the country's banking sector has grown to 9 in 2016 compared to 4 in 2003. The reports also show that there was an increasing trend for banks and non-banking institutions in Liberia to expand their services and operations. Subsequently, the Central Bank of Liberia's annual report for 2021 indicates that there are still 9 commercial banks operating in the country. The financial sector in Liberia includes both banks and non-bank financial institutions, such as insurance companies, brokerage firms, financial development companies, deposit-holding microfinance institutions, authorized credit unions, money remittance companies, Rural Community Finance Institutions, currency exchange companies, village saving and lending organizations. Furthermore, with the recent advancements in the industry, there are additional financial service providers operating in

Liberia, such as Lonestar Cell MTN Mobile Money Inc. and Orange Money, a division of Orange Communication Company. These are the two Mobile Money Providers operating in Liberia during the period of review as per the Central Bank of Liberia's report in 2020. This indicates that there is a diverse range of financial service providers operating in Liberia, including commercial banks, non-financial banks, mobile money providers, and other forms of financial institutions. This diversity of service providers in Liberia's financial system implies that citizens have more options to choose from and access to a wide range of financial services, and it also reflects the growth and development of the financial sector in Liberia.

Furthermore, as seen by improvements in a number of measures, the financial industry has remained comparatively steady, sound, and secure during this time. The number of commercial banks that have been licensed and are now operating in Liberia has grown from 4 in 2004 to 9, with 93 branches distributed across 11 of the 15 counties. This suggests that the commercial banking sector in Liberia has grown and developed significantly since 2004. The expansion in the number of branches in different counties highlights the efforts made by these banks to reach more customers and expand their services across the country. This increase in the number of licensed commercial banks, and the expansion of their branch networks in different counties, demonstrate the growth and development of the commercial banking sector in Liberia, as well as its contribution to the overall financial system of the country. With more than 80% of the whole financial system's assets concentrated in this subsector, it is the biggest of all the financial sectors. Furthermore, as of October 31, 2018, there were 6,203 mobile money agents, up from 3,525 in 2017. This demonstrates how the financial industry has developed over time, with more banks and mobile money providers operating in the nation, which may be viewed as a sign of the sector's stability and progress. Around 85% of the financial sector's total assets are made up of the banking sector, which saw a significant expansion in the size of its balance sheet in 2018. Specifically, the total assets of commercial banks increased by 44.6 percent when compared to the growth rate of 26.0 percent in 2017. Additionally, the total capital of commercial banks grew by 46.9 percent, compared to the growth rate of 21.7 percent in 2017. Furthermore, the total deposits in commercial banks increased by 38.0 percent, compared to the growth rate of 20.9 percent in 2017. This indicates that the commercial banking sector in Liberia is expanding, and the balance sheet size has grown significantly in 2018. These figures show a strong growth in different areas of commercial banks' assets, which can be seen as a positive sign of the sector's overall

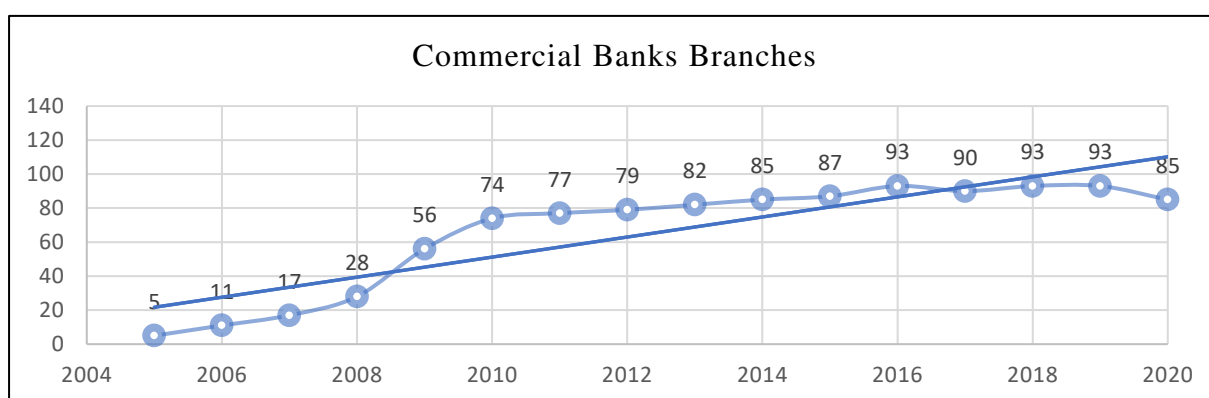
performance and stability. The sector has exhibited a strong liquidity position throughout the year, with a liquidity ratio of 40.7 percent, which is 25.7 percentage points higher than the minimum requirement of 15.0 percent. The sector also witnessed a growth in loans at 39.5 percent, in comparison to the 31.4 percent growth rate in 2017. It is essential to remember that these gains are partly attributed to the impact of converting the US dollar to the Liberian dollar, which is the currency reporting. The insurance sector also experienced a consistent expansion in total assets, largely due to new capital injected through real estate and cash. Despite the growth in total assets, the profitability of the insurance industry in Liberia remains a challenge, primarily because of the large operational costs and a limited market with only 19 insurance providers. In general, Liberia's financial system is robust and functional (CBL, 2019 & 2020).

2.3 The commercial Banking industry

In recent years, the number of bank branches has expanded by county; currently, at least one bank branch is present in eleven of the 15 counties. To support rising economic activity in the nation and the objective of ensuring simple access to financial services across the whole country, the expansion of branch networks is blatant evidence of the growing trust in the banking industry (CBL, 2016).

Ten of Liberia's fifteen counties were covered by the bank network. From 86 stated in 2019, there are now 85 bank branches overall, including annexes and windows. In Montserrado County, the majority of bank branches were located. LBDI and Ecobank continued to maintain most bank branches in individual bank networks, with International Bank Liberia Limited coming in second (IBLL) (CBL, 2019). With 93 branches nationwide, the same number of licensed banks functioning in the economy in 2019 (9) as in 2017 (9) remained. This constancy in the number of branches is a sign of rising confidence in the banking industry and its support for the growth of economic activity in the nation. Because of this expansion of branch networks, the Central Bank of Liberia (CBL) report from 2019 additionally emphasizes the objective of facilitating simple access to financial services throughout the nation. This implies that although the number of licensed banks has stayed constant, the number of branches has grown, indicating a rise in trust in the banking industry and a need to make financial services more accessible. This suggests that while the number of licensed banks has remained constant, the number of branches has increased, signaling growing confidence in the banking sector and a push to make financial services more widely accessible throughout the country.

Figure 2.1 : Expansion of Bank Network Across Liberia



Source: Central Bank of Liberia

Despite the strong growth and development of the banking sector in Liberia, primarily foreign entity still controls the country's banking system, except for Liberian Bank for Development and Investment (LBDI). Even in the case of LBDI, there is a significant level of foreign involvement. This suggests that most banks operating in Liberia are owned and controlled by foreign entities, and the level of domestic ownership and control of the banking sector is relatively low. This could have implications on the country's economy and financial system, as the decision-making and investment priorities of foreign-owned banks may not align with the needs and goals of the country and its citizens. See the table below.

Table 2.1: List of Commercial Banks, Ownership, and Group Relationships

Name Of Bank	Core Business	Ownership	Group Relationship	Started Date
Liberia Bank for Development Investment (LBDI)	Mortgage	Domestic	N/A	1961
International Bank (IB)	Commercial Banking	Foreign	N/A	2000
Guaranty Trust Bank	Commercial Banking	Foreign	Guaranty Trust Bank PLC	2009
Ecobank	Commercial Banking	Foreign	Ecobank Transnational Incorporated ETI	1999
United Bank of Africa	Commercial Banking	Foreign	United Bank of Africa Plc	2008
Access Bank	Micro-Finance	Foreign	Germany Access Micro-Finance Holding Ag	2009
Global Bank	Commercial Banking	Foreign	AMCOM	2004
Afriland First Bank	Agriculture	Foreign	Afriland First Bank Group	2011
Group Nduom Bank	Commercial Banking	Foreign	Ghana Growth Fund Limited	2016

Source: Central Bank of Liberia

The banking system

The Liberia banking system has remained stable, secure, and efficient in recent years, despite facing difficult financial situations when compared to a decade ago. The sector makes up a large portion of the total assets in the financial system, over 80.0 percent, and experienced notable gains in 2019 compared to the previous year. To be more specific, when comparing to October 2018, the total assets, capital, deposits, loans, and advances grew by 37.7 percent, 26.3 percent, 27.0 percent, and 3.1 percent respectively (CBL, 2019). Despite this progress, the banking system is still an important area for improvement in the context of providing financial services in the digital age on a global scale.

2.4 Indicators of banking system wellness

The indicators of the banking system's financial health showed that the system remained balance, secure and functional, despite the challenge of non-performing loans (NPLs) which continued to negatively affect the profitability and capital of commercial banks. Despite the high level of NPLs, the system was able to generate profits due to cost-cutting measures and the use of alternative sources of income such as government securities, fees and commissions. The banking system saw an increase in the amount of loans and advances by 13.1 percent to L\$93.7 billion as compared to L\$82.9 billion in October 2018. Additionally, there was a significant increase, by 43.7 percent, in the amount of non-performing loans (NPLs) reaching L\$15.4 billion as compared to the previous October. This results in NPLs making up 16.2 percent of total loans, which is a 2.4 percent increase from the 13.8 percent recorded in October 2018. This increase in NPLs can partly be attributed to the effects of depreciation. Despite this, the bank system saw a slight decrease in loan loss provisions, due to restructuring and reclassification, as reported by the Central Bank of Liberia in 2018.". See below



Table 2.2: Financial Soundness Indicators in the Financial Industry

Indicators (figures in '000' of L\$)	31-OCT-18	31-OCT-19
Gross Assets	157,950,847	218,321,355
Net Assets	142,059,122	195,571,302
Net Loans	63,684,721	81,990,938
Deposits	85,500,642	114,203,428
Reported Capital Net of Provisions	22,455,860	33,088,686
Reported Net Capitalization	36.1%	16.9%
Capital Adequacy Ratio	27.6%	25.6%
Classified Loans to Total Loans	15.6%	19.7%
Non-performing Loans to Total Loans	13.8%	16.2%
Provisions to Classified Loans Net of Interest in Suspense	64.3%	60.8%
Provision to Non-performing Loans Net of Interest in Suspense	74.7%	69.8%
Return on Assets	1.1%	1.5%
Return on Equity	9.6%	9.6%
Non-interest Income to Total Revenue	50.3%	47.2%
Liquid Assets to Net Assets	30.4%	30.4%
Net Loans to Deposits 43.7%	43.7%	71.6%
Liquidity Ratio	40.7%	44.5%

Source: Central Bank of Liberia

2.5 Technological innovation in the financial system of Liberia

Technological innovation in the financial system of Liberia refers to the integration of technology in the financial services industry to improve the efficiency, accessibility, and safety of financial transactions. This can include the use of digital platforms, mobile banking, and electronic payments to provide financial services to individuals and businesses. It also includes the use of data analytics and artificial intelligence to enhance risk management, fraud detection, and compliance with regulations (Lewellyn, 2009). The goal of technological innovation in the financial system is to increase financial inclusion, particularly for individuals and businesses in underbanked or unbanked areas, and to drive economic growth by making it easier for businesses to access credit and other financial services (CBL, 2016). Additionally, it can also improve transparency, and security and reduce the cost of operation. By increasing the accessibility and affordability of financial services, technological innovation can contribute to the overall development and stability of the economy.

Equally important, with the establishment of Liberia, on December 22, 1822, and the independence in 1847, July 26, the nation's financial system was traditionally operated. Pre-war and post-war Liberia financial transactions through the way of papers. This mode of transaction negatively impacted the financial environment. The old mode system of banking and transactions continues as the central strive by attracting local and foreign to enter the financial space through policies. As the result of policy innovation and the revamping of the financial structure, the financial sector witnessed growth as the number of banks increased from 4 to 9 in 2009. As a result of these efforts, access to banking services and networks has been expanded to many areas of the country, providing a wider range of individuals with access to financial services. This has also led to the introduction of new financial products, such as ATMs and VISA cards, into the market, as reported by the Central Bank of Liberia in 2009. See below

Table 2.3: Digital Platforms of Financial Transactions 2020

Indicator	LRD Volume	Value	USD Volume	Value
ATM	655,541	1,918,490,562.00	953,909	230,913,564.25
POS	1,529	680,722,100.44	180,240	19,839,865.95
Internet Banking	3,064	2,293,747,446.56	54,130	297,155,598.13
Mobile Banking	49,553	274,627,559.00	916,012	137,067,289.78
E-Money	20,655	2,464,693,897.79	14,005	663,510,681.54
Mobile Money	183,176,143	140,933,529,382.84	44,758,752	276,732,625.65
Debit Cards	520,437	1,173,495,740.00	323,724	2,739,836,851.76
Prepaid Cards	215	2,811,212,400.00	170,705	24,697,228.71
	184,427,137	152,550,519,089	47,371,477	4,252,686,415.99

Source: Central Bank of Liberia

2.5.1 Automated Teller Machine

Automated Teller Machines (ATMs) are electronic banking machines that allow customers to perform financial transactions without the need for a human teller. They are typically found in bank lobbies, shopping centers, and other convenient locations. In Liberia, the introduction of ATMs has been a significant development in the financial system. This technology has enabled banks to expand their services and increase access to financial services by larger segments of the population. ATMs allow customers to perform various transactions such as deposits, withdrawals, and balance inquiries without the need for a human teller. This has helped to improve the efficiency and convenience of banking services in Liberia. Additionally, the introduction of VISA cards has also allowed for more secure and convenient transactions. As reported by Central Bank of Liberia (CBL) in 2009, these technological advancements have allowed for greater access to financial services and have helped to improve the overall banking system in Liberia.

Ultimately, it is significant to understand that the advancements in the financial sector, Liberia's banking system saw the introduction of Automated Teller Machines (ATMs) in 2009. This has led to an increase in the number of ATMs and point-of-sale (POS) terminals, as well as more banks offering debit card services. For example, UBALL now has the capability to dispense both Liberian Dollars and United States Dollars through its ATMs, further increasing accessibility and convenience for customers. Furthermore, In the financial environment of Liberia, there has been an increase in the adoption of mobile money services and the utilization of automated teller machines (ATMs) and Point of Sale (POS) terminals. Additionally, several banks have introduced new financial products as a means of modernizing payment and transfer services in the country. The banking sector in 2012 saw a growing utilization of technology-based services, such as mobile money and ATM services, as well as the introduction of new proprietary financial products. The number of banks issuing debit cards increased, and the number of ATM machines and Point of Sale terminals also increased. According to the Central Bank of Liberia, there were 61 ATMs and 117 POS terminals in operation during this time (CBL, 2009 & 2012). See below.

Table 2.4. Point of Sales (POS) and Automated Teller Machine (ATM) Transactions

Description	2017 ('000')		2018 ('000')		2019 ('000')		2020 ('000')	
	USD	LRD	USD	LRD	USD	LRD	USD	LRD
ATMs	205,00	347,67	183,79	559,19	116,169	329,397	230,913	1,918,49
Value	3	8	7	8				1
ATMs	1,583	184	1,354	237	731	586	954	656
Volume								
POS Value	24,130	178,219	19,160	79,323	11,007	1,115	19,840	680,722
POS								
Volume	N/A	N/A	74	0.347	54	0.017	180	2

Source: Central Bank of Liberia

2.5.2 Agent Banking

Agent banking refers to a model of banking service delivery in which a bank partners with non-bank entities, known as agents, to provide financial services to customers in remote or underserved areas. In Liberia, agent banking has been introduced as a means of expanding access to financial services in remote areas, where traditional brick-and-mortar bank branches may not be present. These agents, who are typically small businesses such as grocery stores or pharmacies, are trained and equipped to offer a range of banking services such as deposits, withdrawals, and money transfers. Agent banking provides a more convenient and accessible way for customers to access banking services, particularly in rural areas.

Moreover, Consumer demand for banking services has pushed the banking sector to bring banking activities closer to the doorsteps of clients. This has witnessed the inclusion of agent banks, and new services in the sector. The establishment of this agent banking is also a contributing indication that financial activities are trending on a positive path. Additionally, the agency is a key component that facilitates the digital financial service environment and supports business the business climate of the country (UBA, 2020).

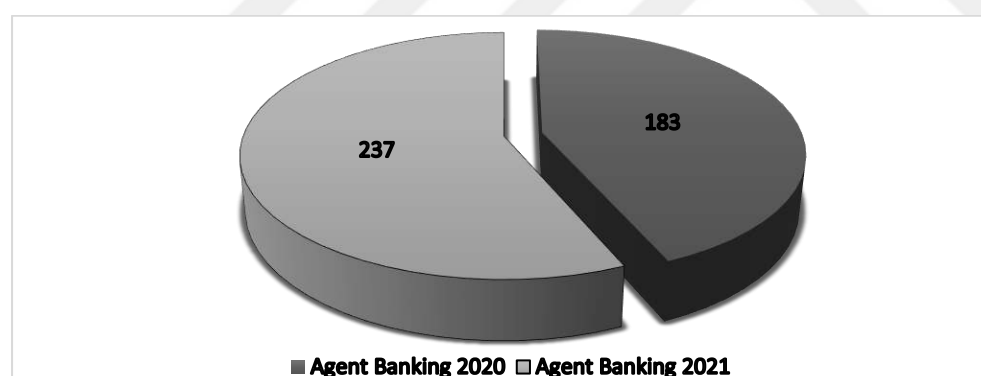
Likewise, the sector has recently adopted this new financial service, with only two commercial banks actively providing the service. According to the Central Bank of Liberia, as of 2021, there were 131 active users of the service, out of 237 registered users. The service has recorded a total volume of 257,485 transactions valued at US\$108.27 million. This growth in agent banking is an indication of the increasing popularity and adoption of this service in Liberia, as it provides convenience and accessibility for customers who may not have easy access to physical bank branches.

Table 2.5: Transactions of Agent Banking (2019-2020)

Indicators	2019	2020
No. of Agents	183	237
Active Agents	85	131
Volume	20,279	257,485
Value	1,532,228.79	108,265, 217.48

Source: Central Bank of Liberia

Figure 2.2: Total Number of Agents (2019-2020)



Source: Central Bank of Liberia

2.5.3 Retail payment system

Retail payment development in Liberia refers to the expansion and modernization of payment systems and infrastructure to support transactions between individuals and businesses. This includes the use of various payment instruments such as cash, checks, credit and debit cards, mobile money, and electronic funds transfer (EFT) systems. The Central Bank of Liberia (CBL) has implemented a number of measures to promote the development of retail payments

in the country, such as encouraging the use of electronic payment systems, issuing regulations and guidelines for payment service providers, and promoting financial literacy and consumer education. This has led to the growth of various retail payment services such as mobile money, point-of-sale terminals, and agent banking, which have increased access to financial services for a larger segment of the population, particularly those in rural and underserved areas. Additionally, the use of these payment systems has also improved the efficiency and security of transactions, reduced the risks of fraud, and increased the speed of processing (CBL, 2019).

Besides, to address the challenges related to access to finance and facilitate transactions between buyers and sellers, the Central Bank of Liberia (CBL) partnered with commercial banks to introduce retail payment systems. This allows individuals and businesses to conduct transactions using internet banking, mobile banking, and mobile money platforms. As a result, there has been improvement in financial transactions over time. In 2019, there was an increase in both the value and volume of retail payments compared to the previous year, as reported by the Central Bank of Liberia. This suggests that the system has been successful in facilitating transactions between buyers and sellers and making access to finance more efficient. The volume of mobile money transactions in Liberia for 2019 was 403.3 million, with a total value of L\$ 251.4 billion. Additionally, in terms of US dollars, the volume of transactions was 13 million, with a value of US\$1.4 billion. In the same year, ATM transactions recorded a volume of 147,210, valued at L\$606.3 million, while the volume of transactions in US dollars was 1,087,580, valued at US\$225.8 million. This data indicates that there was a significant number of transactions made through mobile money and ATM in Liberia in 2020. The volume of transactions made through POS terminals was 261,400, with a value of US\$ 28.96 million. Additionally, there were 129,330 transactions made through internet banking, with a value of US\$ 1.66 billion, and 844,630 mobile money transactions, valued at US\$ 1.42 billion (CBL 2019 & 2020).

2.6 Payments System Improvement

In Liberia, the Central Bank of Liberia (CBL) has been working to improve the payments system by introducing new technologies and services. This includes the use of mobile money, Automated Teller Machines (ATMs), Point of Sale (POS) terminals, internet banking, and agent banking services. These new services have allowed for easier access to financial services and transactions for a larger segment of the population. Additionally, it has also

increased the number of financial products offered by banks as part of the modernization of payment and transfer services in the country. These developments have led to an increase in the volume and value of retail payments in recent years. However, there is still room for improvement in terms of the accessibility and affordability of these services, particularly for those in rural areas (CBL, 2017).

The Central Bank of Liberia has been working to modernize the country's national payment system by adopting digital technology to improve efficiency and reduce costs in the banking sector. In 2010, the bank received funding from the African Development Bank to support this modernization as part of a larger project in West Africa Monetary Zone member countries. The initiation of this modernization project for the national payment system was intended to incorporate digital technologies to reduce transaction costs, minimize risks, and increase efficiency in the banking sector. The project was implemented by the West African Monetary Institute (WAMI) and aimed to upgrade the payments system by installing electronic systems such as the Real Time Gross Settlement System (RTGS), Automated Clearing House (ACH), Automated Check Processing (ACP), and Scrip less Securities Settlement System (SSS) in the central banks. This modernization is expected to improve trade and financial intermediation and increase access to financial services in the short term (CBL, 2016).

In 2016, the first quarter report showed that the CBL amplified efforts by fully utilizing solution instruments: the RTGS, SSSS, ACH, and core banking application went live and become operational. The banking sectors have begun to witness the rewards associated with the systems. Categories of collected revenue of government by the bank are swept into the consolidated Revenue Account at the central bank of Liberia and transactions include checks, direct credit for salary payment, and interbank customer transfers carried out by the system. Recently, the Systematically Important Payments systems (SIPs) performance showed an increase in financial activities with the usages of these mediums (CBL, 2019).

In 2016, the Central Bank of Liberia (CBL) made significant strides in modernizing the National Payment System by adopting digital innovations which are vital for the development of the economy and the financial sector activities. The CBL implemented the modernization by utilizing solutions such as the Real-Time Gross Settlement System (RTGS), Automated Clearing House (ACH), Automated Check Processing (ACP), and Scrip-less Securities Settlement System (SSS) in the central banks. The modernization of the payment system has

led to an increase in financial activities, as seen in the first quarter report of 2019, and has contributed to facilitating trade, financial intermediation, and access to financial services. See below

Table 2.6. Development in Financial Channels.

Medium	2018				2019			
	Volume '000'		Value '000'		Volume '000'		Value '000'	
	USD	LRD	USD	LRD	US	LRD	USD	LRD
National Electronic Pymt Switch	11	-	1,476.27	-	5	-	699,320.00	-
Automated Teller Machine	1,084	632	177,333.57	1,505.66	731	586	116,169.45	329,397.32
Point Of Sales	68	0.35	19,081.45	82,428.95	54	0.017	11,006.92	1,115.42
Direct Credit	11	6	13,017.61	574,685.81	10	7	9,517.89	3,767,365.61
Real-Time Gross Settle.	12	2	304,432.12	19,506,252.88	15	3	274,750.68	25,824,079.69
Automated Check Proce.	86	24	660,109.50	28,378,332.70	61	118	433,075.04	22,949,565.89
Mobile Money	553	382	42,043.76	26,887.75	804	19,408	539,292.11	49,078,714.49
Total Electronic Trans.	1,826	1,047	1,217,494	48,570,093.75	877	20,121	845,219	101,950,238.43

Source: Central Bank of Liberia

2.6.1 The National Electronic Payments Switch

The National Electronic Payments Switch (NEPS) is a digital infrastructure implemented by the Central Bank of Liberia (CBL) to modernize the country's national payment system. The NEPS is designed to facilitate the interconnection of various payment channels, such as Automated Teller Machines (ATMs), Point-of-Sale (POS) terminals, and mobile money platforms, among others. The NEPS allows for real-time, secure, and efficient electronic transactions between banks, financial institutions, and other payment service providers (CBL, 2016).

The NEPS aims to increase access to financial services and reduce the cost of transactions for consumers and businesses. It also helps to enhance the security of electronic transactions by using advanced technology and processes to protect against fraud and other financial crimes. Additionally, the NEPS is expected to improve the overall efficiency of the financial system and contribute to the growth of the economy.

The Central Bank of Liberia made efforts to implement the National Electronic Payments Switch as part of its overall reform of the payments system. This initiative aimed to improve the efficiency, reliability, security, and cost-effectiveness of interbank electronic funds transfers and clearing services for the Liberian banking industry and bring it up to international standards. The Switch would work in conjunction with other systems such as the Real Time Gross Settlement System, Automated Clearing House, Automated Check Processing, and Scripless Securities Settlement System. The switch will allow customers of one bank to use their bank cards (debit, credit, or prepaid) to make transactions at ATMs of other banks and to purchase goods and services at any point of sale (POS) with different merchants. This initiative also aims to promote financial inclusion, particularly for the unbanked population through the introduction of other innovative financial products such as mobile money. The introduction of plastic payment instruments also helps the national switch to effectively contribute to reducing the use of cash (CBL, 2013).

The National Electronic Payment Switch (NEPS) was put in place because of efforts to modernize the national payment system. The service provider completed the installation of necessary hardware and software and connected four banks (UBA, Ecobank, GTBank, and LBDI) to the Central Bank of Liberia's shared switch for the interoperability of ATMs. In 2020, the CBL sought technical assistance from the World Bank to evaluate the infrastructure and suggest a plan to achieve the CBL's goals of a cost-effective, efficient, and interoperable digital payment ecosystem as part of the National Financial Inclusion Strategy. The government of Liberia also aimed to use the payment system as a means of promoting financial inclusion and developed a two-year plan for the digitization of the economy. These efforts were expected to serve as a foundation for the use of existing infrastructure for both wholesale and retail payments in the country (CBL, 2020).

2.7 Non-Bank Financial Institutions

Non-banking financial institutions (NBFIs) in Liberia refer to organizations that provide financial services but are not classified as banks. These institutions include microfinance institutions, insurance companies, money remittance companies, and other financial intermediaries. They play a crucial role in providing access to financial services to unbanked and underbanked populations, as well as in supporting small and medium-sized enterprises (SMEs). NBFIs in Liberia are regulated and supervised by the Central Bank of Liberia (CBL) to ensure they operate in a safe and sound manner. They provide services such as loans, savings, and insurance to individuals and businesses, and act as intermediaries for larger financial institutions such as banks. Their services are often more accessible and affordable to the underprivileged and low-income population than those offered by banks.

According to the Central Bank of Liberia's 2020 annual report, there are 14 licensed insurance companies operating in the country with 32 branches. Additionally, there are 2 insurance brokerage firms actively in business in the non-financial sector. In the microfinance sector, there are 2 deposit-holding institutions and one finance company, the Liberia Enterprise Development Finance Company (LEDFC) is exclusively operating in the market as well as the Diaconia MDI as the single deposit-accepting microfinance institution in the financial industry.

2.7.1 Microfinance Sector

The Microfinance sector in Liberia refers to the provision of financial services, such as loans and savings, to individuals and small businesses who may not have access to traditional banking services. These services are typically provided by microfinance institutions (MFIs), which are specialized financial institutions that provide financial services to low-income individuals and small businesses. The sector is considered an important tool for reducing poverty, promoting economic growth and development, and increasing access to financial services for underserved communities. The Central Bank of Liberia (CBL) reports that there are two deposit-holding microfinance institutions operating in the country, and one deposit-accepting microfinance institution. These institutions provide services such as microloans,

savings accounts, and other financial products to help individuals and small businesses access credit and build financial resilience.

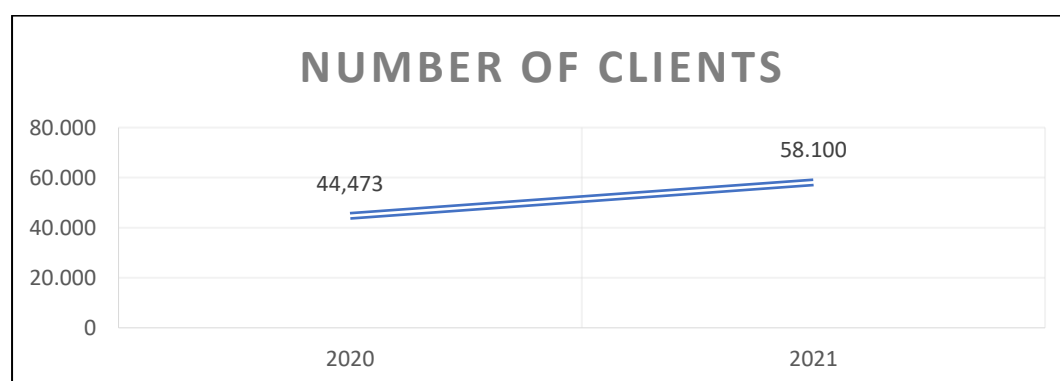
The microfinance sector has a total of number of 18 microfinance institutions operating across the country. The sector is concentrated in Montserrado County close to the capital, Monrovia. The sector is controlled by local institutions with one international institution, BRAC Microfinance which is gradually expanding its network across the country (CBL, 2009).

2.7.2 Developments in the non-deposit-taking Microfinance Institutions

The microfinance sector in Liberia has been growing in recent years, with a focus on providing financial services to individuals and small businesses that may not have access to traditional banking services. Non-deposit-taking microfinance institutions (NDMIs) are a key part of this sector, as they provide a range of services such as loans, savings, and insurance to their clients. These institutions typically serve low-income communities and focus on financial inclusion. They operate under the supervision of the Central Bank of Liberia, which sets regulations and guidelines to ensure the safety and soundness of the sector. Some of the key developments in the non-deposit-taking microfinance sector in Liberia include the growth in the number of institutions operating in the country, the introduction of new products and services, and efforts to increase financial inclusion and access to credit for under-served populations (CBL, 2020).

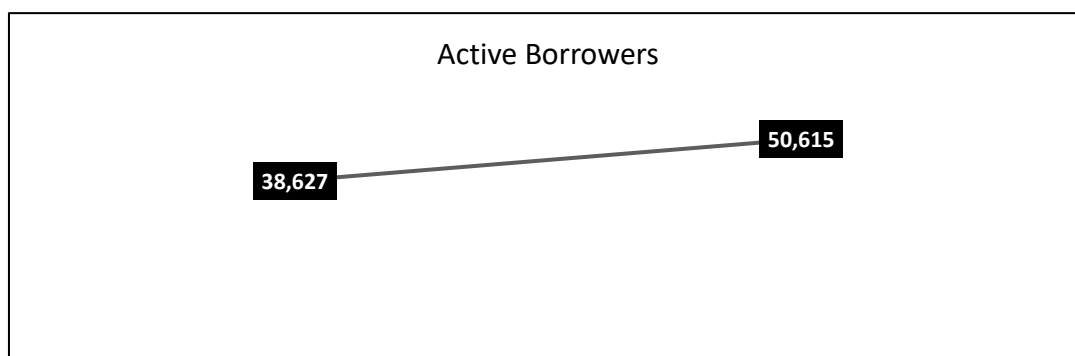
The Central Bank of Liberia's 2020 report shows that there was a 31% increase in the number of clients and active borrowers using non-deposit-taking microfinance institutions, with a total of 58,100 clients compared to 44,473 the previous year. See below.

Figure 2.3: Total Number of Clients of Non-deposits Taking Microfinance



Source: Central Bank of Liberia

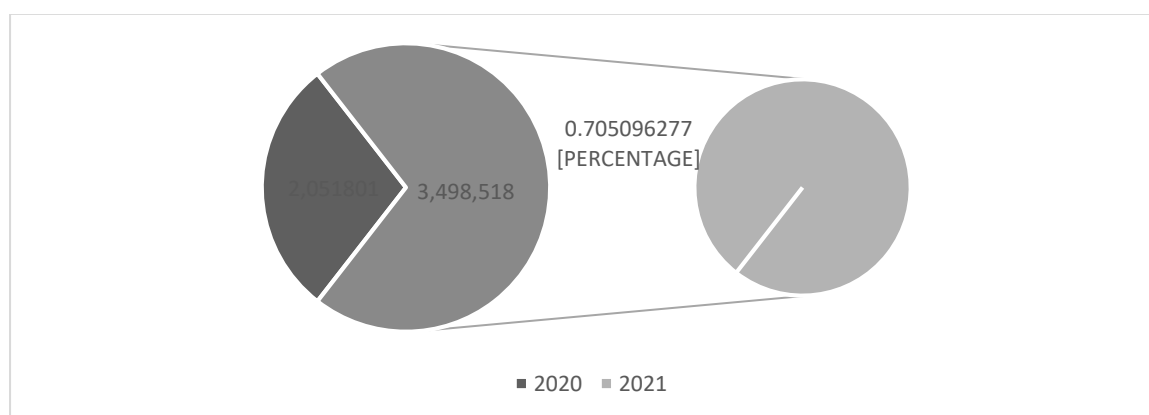
Figure 2.4: Microfinance Industry Active Borrowers



Source: Central Bank of Liberia

According to the Central Bank of Liberia's 2020 report, the microfinance sector saw an increase in the value of outstanding loans by 71 percent at the end of the year, reaching a total of US \$3.4 million. This is a significant increase compared to the previous year, where the value of outstanding loans stood at US \$2.0 million at the end of the business cycle in 2019. This growth in the microfinance sector highlights a significant increase in the number of clients and active borrowers transacting with non-deposit-taking microfinance institutions. Overall, this trend suggests a positive development in the microfinance sector in Liberia. See below.

Figure 2.5: Microfinance Loans Disbursement Value (2020-2021)



Source: Central Bank of Liberia and Microfinance institutions

2.7.3 Financial performance

The sector experienced a significant increase in assets, with a 60 percent rise in assets worth 16.81 million in 2021 compared to the 10.54 million recorded in the previous year. The

total capital also increased by 55 percent, reaching 8.02 million compared to 5.20 million in 2020. However, the total operating revenue decreased by 80.74 percent, amounting to L\$0.72 million compared to the previous year's L\$3.75 million. Additionally, total expenses decreased by 87 percent, totaling L\$0.44 million, which was higher than the previous year's L\$3.39 million. Furthermore, the sector also saw a decline of 31 percent in net income, valued at L\$0.18 million, compared to L\$0.26 million in the previous year. The decline in net income was attributed to an increase in loan loss provision and total operating expenses (CBL, 2021). See below.

Table 2.7: Performance Indicator Balance Sheet and Income Statement (2020-2021)

Description	2020	2021	Growth/declined
Total assets	10,537,143	16,809,181	60%
Total capital	5,202,323	8,023,490	55%
Total operation revenue	3,754,445	723,133	-81%
Total expense	-3,885,753	-441,877	-87%
Net income	256,031	177,102	-31%

Source: Microfinance Institutions

2.8 Foreign Exchange Institutions

Foreign Exchange Bureaus (FXBs) are financial institutions that offer foreign currency exchange services to individuals and businesses. In Liberia, FXBs are licensed and regulated by the Central Bank of Liberia (CBL). They are authorized to buy and sell foreign currency, as well as provide other related services such as money transfers and travelers' checks. These institutions play a vital role in the country's economy by providing a reliable source of foreign currency for trade, tourism, and other economic activities. They also help to stabilize the exchange rate by providing a market for foreign currency. However, the sector has been facing some challenges such as the lack of proper regulations, weak supervision, and poor compliance with Anti-Money Laundering (AML) and Combating the Financing of Terrorism (CFT) regulations. The CBL has been working on improving regulations and supervision of the sector to address these issues.

According to the CBL's 2020 report, the number of bureaus increased by 7, totaling 188 across the country. These bureaus are divided into two categories: category "A" which includes 132 bureaus and category "B" which includes 56 money remittance entities. These bureaus play a crucial role in the country's economy by facilitating foreign exchange transactions and providing currency conversion services to individuals and businesses.

2.9 Rural Community Finance Institutions

Rural community finance institutions (RCFIs) are financial organizations that provide financial services to individuals and communities in rural areas. These institutions are typically established and operated by local communities, with the goal of increasing access to financial services for people who may not have access to traditional banking services. RCFIs can take various forms, such as cooperatives, microfinance institutions, or savings and credit associations. In Liberia, the Central Bank of Liberia (CBL) has been working to promote the establishment and operation of RCFIs, in order to increase access to financial services in rural areas and support the development of local economies. This includes initiatives such as providing technical assistance and training to RCFIs, as well as developing regulations and supervisory frameworks to ensure the safe and sound operation of these institutions. Overall, the goal of RCFIs is to provide rural communities with access to the financial resources and services they need to improve their livelihoods and support economic development in their communities.

Moreover, these institutions are significant in the nonbanking sector. In 2009, the RCFIs' plan for implementation was approved by the Central Bank of Liberia expressing government efforts in creating a comprehensive financial atmosphere. This financial inclusion strategy aimed to integrate the system and incorporate the rural areas in the traditional banking sector. As the 2020 report indicates, the total number of rural community institutions is 12 actively operating across 8 of the 15 counties. They provide multiple services like the payment of salaries of government workers, remittance (money gram and western union), local transactions (mobile money), and allow deposits from depositors. The report also illustrates that the RCFIs experienced thereby recording deposits of 22.36 percent L\$ 227.57 million compared to the previous year of L\$185.98 million; loans and other institutions' advances rose by 43.95 percent (CBL, 2020). see below.

Table 2.8: Financial Performance (2020-2021)

Column	2020		2021	Percent change
	L\$			
Deposit	185,975,841.01		227,566,979.46	22.36
Loan & Advance	128,516,368.77		185,005,477.86	43.95

Source: Central Bank of Liberia and RCFIs

2.10 Development in the insurance sector

The insurance industry in Liberia is dominantly controlled by companies owned by Liberians. It is significant to understand that of the 14 licensed companies, 9 are considered domestic ownership, and the foreign ownership of 5. Furthermore, the insurance sector has experienced growth over the years. According to the Central Bank of Liberia's 2020 report, the total number of insurance companies licensed to operate in the country is 14, with 32 branches situated across the country. The report also states that 2 insurance brokerage firms are actively in business. The sector has seen an increase in the number of clients transacting with insurance companies, with a total of 60,743 clients recorded in 2019, an increase from the previous year's total of 47,838 clients.

2.10.1 Financial performance

The 2020 data on the insurance industry presented by the CBL illustrates that the sector broadly witnessed an increase in firm value and assets compared to the previous year, 2019. The sector benefited 19 percent in the form of capitalization at the same time an increase of 11 percent in total assets. Additionally, the sector has seen an increase in total premium income, with a total of L\$ 1.2 billion recorded in 2021, an increase from the previous year's total of L\$ 935 million. The report also indicates that the insurance sector has experienced a decline in the number of claims, with a total of 6,734 claims recorded in 2021, a decrease from the previous year's total of 8,398 claims. On the other hand, the sector experienced a decline in investment by 10 percent as a result of dismissing some investment products that were intended for business purposes. Also, the liability of the sector raised by 116 percent at the same time a 1

percent decline in gross premium. Besides, the sector experienced a 16 percent increase in claims on insurance companies (CBL, 2020).

Table 2.9: Key Financial Indicators (2019-2020)

Indicator	2019	2020	Percent change	
	Divided by '000000'			
Capital	6,601.35	7,046.65	6.75	19
Total assets	9,796.66	9,105.68	-7.05	6.47
Investment	2,492.24	2,796.02	12.199	-9.77
Liabilities	2,558.41	2,257.44	-11.76	116
Outstanding premium	1,746.74	1,599.42	-8.43	43.51
Gross premium	9,636.71	6,327.71	-34.34	-0.55
Underwriting Result	1,276.04	2,957.47	131.77	-14.93
Net Premium	2,413.78	4,936.16	104.5	0.47
Net Income	513.01	533.62	4.02	449.5
Expenses	1,148.88	2,491.16	116.83	-53.13
Claims	1,544.09	1,649.59	6.83	16.1
Technical provision	1,051.81	1,096.70	4.27	-4.85

Source: Central Bank of Liberia

2.10.2 : Mobile money

The Central Bank of Liberia (CBL) actively worked to improve financial inclusion in the country by approving the introduction of mobile money services. The first provider of this new product was Ecobank, and later other banks also submitted requests to the CBL to engage in mobile banking. The CBL also collaborated with banks and non-bank financial institutions to expand their agent networks, making mobile money more accessible in the 15 counties of Liberia. The agent network increased from 912 in December 2015 to 2,110 by November 2016, showing a significant growth in the use and accessibility of mobile money. This demonstrates the Central of Liberia's commitment to promoting financial inclusion by implementing new and innovative financial products such as mobile money industry. The mobile money industry in Liberia saw a significant increase in subscribers and usage from December 2015 to November 2016. Starting with only 58 subscribers, the number grew to 124,071, and then to

1,034,725. During this period, there was a significant increase in the value of mobile money transactions, reaching 1.7 million and L\$320 million. The Central Bank of Liberia (CBL) licensed one mobile money company, Lonestar Cell Mobile Money Company Incorporated (LCMMCI), but later another provider, Cellcom Technologies Inc was also licensed due to the growing demand for mobile money services. The CBL also established partnerships between mobile money companies and several banking institutions such as Ecobank Liberia Limited (EBLL), International Bank Liberia Limited (IBLL) United Bank for Africa (UBA), Guaranty Trust Bank Liberia Limited (GTBLL), and United Bank for Africa (UBA) as reported in the CBL's 2016 annual report.

As of recent years, the mobile money sector in Liberia has seen significant growth and development. The mobile money market in Liberia has seen the emergence of two providers, Orange Money and Lonestar Cell MTN Mobile Money Inc. According to the Central Bank of Liberia (CBL), the use of mobile money services has increased significantly, with a growing number of people using mobile money to conduct financial transactions. The Central Bank of Liberia's report indicates that there has been a steady increase in the number of mobile money agents, growing from 2,110 in November 2016 to 3,162 in October 2017 and 6,203 in 2018. This growth in mobile money agents shows the success and expansion of mobile money services in the country. Furthermore, in 2020, the number of active mobile money accounts increased by 25 percent, reaching a total of 1.5 million active accounts. The report also states that the value of mobile money transactions increased by 30 percent, reaching a total of L\$251.4 billion. This increase in the use of mobile money services is expected to contribute to the development of the financial system and promote financial inclusion in the country. Furthermore, the CBL has implemented regulations and guidelines to ensure the security and stability of mobile money transactions, making them more accessible and reliable for citizens.

Table 2.10: Mobile Money Activities (2017-2020)

Indicator	2017	2018	2019	2020
MM Reg. Accounts	1,868,821	2,685,471	3,544,045	4,718,033
Act. Subscribers	247,042	303,581	751,175	1,230,839
Number of Agents	3,525	6,722	13,158	30,506
Active Agents	1,980	3,888	7,275	16,710
Total Vol. (US\$)'000'	382,231	425,202	1,217,124	3,277,287.00
Total Val. (US\$)'000'	26,887,745	33,062,071	76,324,936	2,483,232,460
Total Vol. (L\$) '000'	3,929,596	7,470,723	40,483,691	117,139,974
Total Val.(L\$) '000'	17,084,718	27,776,003	68,162,028	86,044,768

Source: Central Bank of Liberia

2.11 Conclusion of the chapter

The financial sector of Liberia comprises of the formal and informal sectors, including commercial and non-commercial entities such as insurance companies, remittance institutions and brokerage. The Liberian Dollar (LRD) and the US Dollar (USD) are the two currencies used for the medium of exchange or to conduct financial activities.

With a considerable rise from three to nine banking institutions, the banking industry is clearly the main driver of financial activities. This growth highlights the industry's vitality and growing significance in Liberia's economy.

Additionally, the financial environment has changed, communication companies' financial platforms-Orange Money and Mobile Money have been integrated, which has further diversified the range of services offered. For consumers nationwide, digital technologies such as agent banking, ATM networks, and other electronic services have greatly increased access to financing.

These developments indicate a significant improvement in Liberia's financial sector and emphasize how important technology is to make financial transactions easier. With this level

of progress in the financial industry of Liberia, the effects and implication of technology in finance is detailly discussed in the next chapter.



CHAPTER 3

ROLE OF TECHNOLOGY IN FINANCE

3.1 Introduction of the chapter

This chapter seeks to address the dynamic role of technology in financial activities, emphasizing the contributions it makes to different aspects of the financial environment. Specifically, focusing on how new technological services impact financial activities and makes it easier to create new goods and services that meet changing consumer demands. The chapter also look at how technology allows for more individualized interactions and efficient operations in financial institutions, which improves client satisfaction. Additionally, it examines the barriers and facilitators of technology in the financial environment, highlighting how it can increase operational effectiveness and efficiency. Finally, the chapter looks at the relationship between technology and financial development.

3.2 Introduction of the role of technology in finance

Obtaining financial services can be difficult for some businesses, particularly in developing countries. One way to improve access to finance is by utilizing technology (Ilyina & Samaniego (2011). In this study, they both argued that the presence of technology of production might greatly impacted the business world, and the use of information technology has been identified as a solution to the challenges faced by the financial sector. Information technology, which includes computer systems and telecommunications, is transforming the global economy and financial sector through the modernization of computers. Companies are using technology to improve efficiency and effectiveness in their operations. Princhard and Cole (1997), suggest that information technology encompasses the use of electronic tools and systems to provide necessary information to businesses. This includes utilizing computer systems and telecommunications to store, process, and distribute information. The use of technology, particularly information technology, has greatly impacted the global economy and the financial sector. The modernization of computers has led to companies utilizing technology to improve efficiency and effectiveness in their operations (Jayawardhena & Foley, 2000). The use of technology has become increasingly important in the field of finance, particularly in the

context of developing nations where access to finance can be limited. According to Sepehrdoust & Ghorbanseresht (2019), the advancement of information technology has provided new and innovative solutions to improve access to finance. The integration of technology has enabled companies to connect and improve efficiency and effectiveness in their operations. This has led to the modernization of the financial sector and the global economy.

Fundamentally, the introduction and development of technology in finance have played a crucial role in shaping the financial industry as outlined in Asongu, Anyanwu, & Tchamyou, (2019). The paper presence financial progress is driven by technology. From the early days of manual financial transactions, the industry has evolved to a more digitized and automated system. The widespread adoption of technology in finance has led to a few benefits, including increased efficiency, reduced costs, and improved accessibility for consumers (Chavula, 2013). One of the earliest forms of technology in finance was the use of computers for accounting and record-keeping. This allowed financial institutions to process transactions more quickly and accurately. As technology continued to advance, the internet and online banking were introduced, allowing consumers to access their accounts and conduct transactions remotely. Previous literature works stated that the development of mobile technology also played a significant role in the financial industry. The introduction of mobile banking and mobile payments has made it even more convenient for consumers to access financial services and conduct transactions (Asongu, Nwachukwu, 2016). The use of mobile apps and mobile wallets has also made it easier for consumers to manage their finances and make payments on the go.

Importantly, the role of technology in finance is the emergence of blockchain technology. Allen et al. (2011) supports the view that blockchain is a digital ledger system that allows for secure and transparent transactions. It is being used in a variety of applications, including digital currencies, smart contracts, and supply chain management.

3.2.1 New technological services impact on the financial development

Over the decades, there have been the creation and implementation of new financial products, services, and technologies that aim to improve the efficiency and effectiveness of the financial system (Merton, 1992). This can include the development of new financial instruments, such as derivatives or securitization, as well as the use of new technologies, such as blockchain or artificial intelligence, to improve the delivery of financial services. In

consistent with Levine (1997) financial innovation considered the emergence of new business models, such as online lending platforms or Robo-advisors. The goal of financial innovation is to increase access to finance, reduce costs, and improve the overall efficiency of the financial system. It can also help to increase competition and bring new products and services to market, which can benefit consumers and businesses alike.

Information gathering is crucial for financial market decision-making, especially considering the developments in contemporary information technology that have taken place since the late 20th century (Gao & Huang, 2020). According to the empirical evidence from Li et. al., (2022), reveals that Increased internet penetration in certain industries points to a more advantageous environment for information solutions that solve information imbalances for investors and investees, especially in the financial industry, and reduced search costs. Information technology and other forms of technological advancements have enhanced the working of organizations, living standards, and patterns of banking operations (Hagel et., 1997). It is through similar technologies that institutions have been suitable to achieve cost-effectiveness and have driven profit growth to greater heights. The author also presents that with the presence of technology, financial invention has significantly impacted the banking and the financial sector in the development of products and service that has been used by banks and financial institutions. This has been reflected in the capabilities of many financial institutions to strengthen and maintain a competitive edge among the competitors in the industry. Similarly, Tiwari (2012) presents that over time, information technology has increasingly converted banks' operations from the old mode to the technological mode of operation. Tiwari also indicates that technological innovation in the sector is increased banks' performance and strengthened multiple developments in the forms of structure in security, networking, connectivity, and achieving customer objectives. Additionally, Mobile and Internet banking have experienced successfully employ in the banking industry. The Financial innovation of new financial products, services, and technologies that aim to improve the efficiency and accessibility of the financial system. This can include the creation of cooperative partnerships between banks and telecommunication companies, such as online services and mobile banking, as well as the development of new financial instruments, such as derivatives and securities. These innovations have enabled financial institutions to better serve their customers and have contributed to the growth and competitive advantage of both sectors (Hinson et al., 2006).

Overall, Scholars such van Horne (1980), Merton (1992, 1995), Tufano (2003), and Frame and White (2004) have contributed to several studies that address the importance of perspective of new technological services on financial activities.

However, these studies utilized various indicators to assess technology, yet they did not independently analyze the impact of each variable concerning internet penetration and mobile subscriptions, which serve as proxy variables for measuring technology and its influence on financial services.

3.2.2 Barriers and facilitators of Technology in the financial sector

There is an urgent need to compile and synthesize the information currently accessible on the drivers of digital financial services because the literature on the subject appears fragmented and the research environment has grown more complex. Considering the advent of more recent digital financial services like digital wallets, this entails evaluating and combining research from academic sources, both generally and for individual service categories. Therefore, it's important to look at the extent of earlier studies on the elements that influence adoption over time and investigate any differences in these factors between various service kinds. Because of this, the purpose of this study is to investigate the research question on the elements that facilitate the acceptance of internet penetration and subscription as technical indicators in financial operations.

The finance and payment services sector were among the most heavily affected. These services are gradually moving into digital sector, providing more convenient ways to manage funds, handle payments, and make transactions, among other things (Kaur et al., 2020). In consistent with other literature (El Sawy & Bowles, 1997; Parasuraman & Coby, 2001; and Heinonen, 2006), the adoption of technology inclusion in the financial sector has mitigated challenges in financial transactions among its users. The bureaucracy that exists in traditional banking is automatically ruined. Because in this era of technology consumers effortlessly have access to services at their desired destination and time without experiencing the bureaucratic procedure.

Lately, distinct variations of mobile payment systems known as mobile wallets, or m-wallets, have garnered a great deal of attention in various emerging regions. M-wallets were

designed to offer users speed, ease of use, effectiveness, efficiency, transparency, and convenience. In most emerging nations, however, there is still a lack of mainstream acceptability and a restricted propensity to utilize and adopt m-wallets despite these benefits ((Kaur et al., 2020). Financial services that rely on technology have been studied from several perspectives. However, a great deal of research has focused on digital finance, mostly in three main domains: digital wallets, digital banking, and payment services.

On the other hand, this study offers a comprehensive analysis of the most potent and promising barriers or factors affecting people's behavioral intention to use digital financial services. It emphasizes the importance of technology factors along with security and trust-related factors in influencing people's choices to use these solutions.

Empirical evidence from Van Biesebroeck, (2007) shows that financial limitation is a contributing barrier to technology adoption in the financial sector to improve financial services. Information is essential to development, yet it is also a major roadblock to advancement when information is lacking. Ideas may be shaped, and decisions can be informed by information. As a result, one of the main obstacles to the adoption of technology in the financial sector is the lack of knowledge about technology and its importance to different stakeholders, such as consumers, legislators, and national governments.

According to Hollenstein (2005), the idea of complementarities is highlighted by studies as a roadblock to technological adoption in finance, based on data on patent citations. Several studies view innovation in technology as a complex, dynamic system in which different actors investigate various technology environment. The terms complementarities and synergies describe the relationships and overlaps between various technical advancements. Within the finance domain, the existence of complementarities suggests that the adoption of a certain technology could be contingent upon the accessibility and interoperability of other complimentary technologies. Therefore, if complementing technologies are absent or insufficient, or if enterprises and financial institutions are unable to easily integrate new technologies with current systems, adopting new technologies may prove difficult. The significance of considering technical complementarities during the adoption process is shown by this, as it guarantees successful implementation and maximizes the potential benefits of development in the financial industry (Fleming & Sorenson, 2001).

3.2.3 Implication of technology on financial development

The role of technology in finance has had a significant impact on financial institutions (Popelo et al., 2021). In the work of Mishkin & Strahan (1999), the findings show that technology has allowed for the automation of many processes, making them more efficient and cost-effective. Electronic banking, for example, has allowed for the delivery of banking products and services through digital platforms, which has made banking more accessible and convenient for customers. Additionally, Barbosa et al., (2014) which focus on performance measurement of information technology on Brazilian financial institutions indicates that technology enabled financial institutions to gather and analyze data more effectively, allowing them to make more informed decisions and better serve their customers. Technology has also allowed for the creation of new financial products and services, such as mobile banking and online trading, which have increased competition and innovation in the financial industry. Overall, articles on the impact of technology on financial institutions from Krey, et al., 2011; Afzali et al., 2010; Ayat et al., 2011 has proven that technology has played a crucial role in shaping the financial industry and has allowed for greater access, efficiency, and innovation for both customers and institutions.

Firpo (2005), concluded that technology has had a profound impact on the delivery of services, particularly in the financial sector. The advent of the internet and advancements in digital platforms have greatly increased the efficiency and accessibility of financial transactions (Nguyen & Mogaji 2022). The development of technology has led to the emergence of e-finance, which is a digital platform used by financial institutions for delivering financial services and marketing activities (Abubakar & Tasmin 2012). This has brought about several benefits, such as convenience, price transparency, broader access to information, and lower costs. Despite the controversies about the benefit of technological delivery of services to users, Adesina and Ayo, (2010) states that users of technology can conduct financial transactions anywhere, anytime if they have a computer and internet access.

Digital platforms and the internet have made it possible for people who were previously unbanked to access financial services, such as savings accounts and loans (Joseph & Stone, 2003). This has had a positive impact on economic growth and development, as more people are able to access the tools and resources, they need to build their financial futures (Dangolani, 2011). The author expressed the view that technology has a major influence on the structure

and process of delivering banking and financial services. Dangolani concludes as the result of technological influence on economic delivery, a wide range of different delivery instruments becomes accessible to users, the Internet, and ATMs which decentralizes delivery instruments and operations on the bank network. The development of technology, particularly in the realm of information technology and communication, has led to a shift in the way services are delivered. He further notes that the financial industry has been utilizing various technology products and services to improve their delivery system and provide more options to their customers. Likewise, the financial industry has undergone significant changes in recent years, with the incorporation of new technology leading to the expansion of various channels for the delivery of services and products (Abubakar, & Tasmin, 2012). However, traditional operations within the banking sector have remained relatively unchanged over the years, resulting in an accelerated shift in the industry's structure. As technology advances, the methods of delivery utilized by financial institutions have shifted away from traditional methods (Apte & Vepsäläinen, 1993). Electronic banking products such as internet banking, mobile banking, and various Automated Teller Machine (ATM) services have replaced the need for in-person banking transactions. Technology has greatly impacted the way in which retail banking provides financial services, as noted by Sweeny and Morrison (2004). The collaboration of hardware, software, and telecommunications companies has led to the creation of new methods for customers to access their account information, transfer funds, pay bills, and make purchases without the need for cash or checks and without having to leave their homes, as stated by Frei et al. (1998).

3.3 The relationship between technology and financial development

Comin & Nanda, (2019) examined the impact of financial market growth on the adoption of sixteen major technologies in seventeen countries from 1870 to 2000. The empirical results show that more depth in financial markets is associated with faster technology dissemination, especially for technologies that need large amounts of capital investment, although mostly in the early stages after the technology's introduction. This empirical evidence emphasizes the importance of financing in promoting experimentation, which is essential to overcome barriers related encouraging new technology.

According to similar study done in Vietnam, Kumar, (2014) empirical evidence concluded that technology has had a significant impact on the financial sector, enabling new

forms of financial innovation and improving access to financial services for individuals and businesses. Lamoreaux et al. (2007) highlighted the relationship between technology and financial development can be explored through several key areas, including the use of technology for financial inclusion, the impact of technology on financial stability, and the role of technology in financial innovation.

Empirical results from Singh, (2017) indicated that one of the key areas where technology has had an impact on financial development is financial inclusion. The use of mobile banking and digital platforms has made it possible for individuals and businesses in developing countries to access financial services that were previously unavailable to them (Chu, 2018). According to a study by the World Bank, the use of mobile banking in developing countries has led to a significant increase in the number of individuals with access to formal financial services (Kose et al., 2016).

In addition to its impact on financial inclusion, technology has also had an impact on financial stability. The use of digital platforms and automation has led to increased efficiency and speed in the financial sector, but it has also increased the risk of financial instability. For example, the use of high-frequency trading algorithms has been linked to increased volatility in financial markets (Cetorelli and Goldberg, 2012).

Ultimately, the relationship between technology and financial development is complex and multifaceted. However, empirical proof from several papers have concluded that technology has significantly contributed to financial development (Al-Mudimigh, 2020; Chu, 2018; Gangopadhyay, 2009).

3.3.1 Measurement of Technology

The empirical results of Bresnahan's 1986 study show how difficult it is to evaluate the societal benefits of current technology developments due to the lack of any specific production indices for important adopters. On the other hand, approaches that use the derived demand curve to calculate industries' willingness to pay for new technologies provide a way around this problem. It is difficult to accurately measure technology since it affects so many diverse aspects, including the dissemination of the technology, its effects on economic development and productivity (Corrado, & Hulten, 2010; Ehrnberg, 1995; Eaton & Kortum, 1999). The

approach used will depend on the study objective and the data that are available. There are various ways to measure technology.

Firstly, patent numbers are frequently used to gauge technological progress. As they offer a count of new and original innovations, patent counts are used as a proxy for technical innovation. In order to gauge the extent of technical innovation in a nation or industry, researchers have utilized patents as an indication of technological activity (Griliches, 1990).

Secondly, utilizing technology intensity indicators to assess technology. These metrics reflect the degree of technology adoption and usage volume in a certain industry or area. The capital-labor ratio, which compares a sector's or industry's capital stock to its workforce to determine how much technology is being adopted, is the most used technological intensity metric. (Jorgenson and Griliches, 1967).

Thirdly, study suggests that technology can be measured through the use of productivity measures. Productivity measures, such as Total Factor Productivity (TFP), capture the impact of technology on economic growth by measuring the output per unit of inputs (labor and capital) in a particular sector or industry (Solow, 1957).

In summary, measuring technology is a challenging endeavor that calls for the use of several indications and techniques. Researchers can quantify technology using patent counts, technological intensity indicators, productivity metrics, or composite indices, depending on the study topic and data accessibility.

3.3.2 Measurement of Financial Development

Measuring financial sector development is a complex task that requires the use of multiple indicators and indexes in understanding the level of financial intermediation and the level of financial deepening in an economy (Beck et al., 2000; Pill and Pradhan, 1995). Adu et al. (2013) investigated the long-term effects of Ghana's financial development on growth. Their empirical findings showed that the choice of proxy variables has an impact on the measuring of financial development. The findings suggest that the view of financial development as either negative or positive to growth depends on the proxy variable used to measure financial development.

Furthermore, measuring the development of the financial sector is an important task as it allows policymakers and researchers to understand the level of access to financial services, the efficiency and stability of the financial system, and the overall economic growth (Hasan et al., 2009; Demirgüç-Kunt, & Huizinga, 2001). Different methods have been used to measure the development of the financial sector, including the use of various indicators and indexes. There have been several literature and empirical studies on the measurement of financial sector development over the years. Scholars and researchers (economists) have expressed different views and approaches on this subject. According to empirical studies, the commonly used indicator is the level of financial intermediation, which measures the extent to which a country's financial system channels savings into investments. This can be measured by the ratio of credit provided by the financial sector to GDP. A higher ratio indicates a higher level of financial intermediation and a more developed financial sector (Beck et al., 2000).

The value of the financial industry as a percentage of the economy, or more commonly as a percentage of Gross Domestic Product, is one of the most used indicators of financial sector development (GDP). This ratio is frequently used as a proxy for the degree of financial intermediation and as a measure of the size of the financial sector in relation to the economy. The stability of the financial sector can be measured by indicators such as the non-performing loan ratio, which is the percentage of loans that are not being serviced by the borrower, and the capital adequacy ratio, which is a measure of a bank's ability to absorb losses (World Bank, 2018).

On the other hand, from an empirical findings Ito & Kawai (2018) argues that although the calculation of financial development as the ratio of private credit creation by banks to GDP offers easily accessible data and is widely used to assess the level of financial market progress, it frequently ignores the complexities and subtleties inherent in the development of financial markets. Furthermore, this measure, which is primarily focused on banking operations, ignores the development of other financial markets, such as bonds, insurance, and stocks. Crucially, a quantitative indicator also misses the qualitative aspects of financial development, like the institutional framework that surrounds financial markets and their wide range of diversity, efficiency, and liquidity.

In general, empirical studies have proven that measuring financial sector development is crucial in understanding the level of financial intermediation and financial deepening in an economy. Various measures such as the ratio of the financial sector to GDP, the degree of financial inclusion, the level of credit to the private sector as a percentage of GDP, the efficiency of the banking sector, and the degree of financial innovation are used to measure the level of financial sector development (Levine, 1997, Rajan and Zingales, 1998, Beck et al., 2007, Demirgüç-Kunt and Levine, 2008, World Bank, 2017).

3.4 Conclusion of the chapter

The incorporation of technology into financial operations has become a crucial approach to augmenting financial accessibility and promoting enterprise growth. Technology's revolutionary impact has completely changed the business environment while providing a plethora of advantages like increased productivity and financial innovation. Driven by technical advancements, financial innovation has brought about new financial services and products that improve the industry's efficacy and efficiency. Notably, the development of internet and mobile banking has shown to be a leading illustration of how technical developments foster financial innovation. Technology's presence in the banking industry has also reduced the conventional responsibilities related to customer service, giving clients easy access to a variety of services from the places of their choice. For example, clients can easily access funds and execute digital transactions with internet banking. Additionally, the digitization of financial services by institutions has resulted in enhanced cost-effectiveness and efficiency, as demonstrated by the global accessibility and convenience of e-banking. Furthermore, financial transactions, e-commerce, and e-finance have all witnessed notable advancements in service delivery standards due to technological advancements in the financial services industry. In summary, technology's widespread influence has changed financial activities and driven the industry toward increased effectiveness, efficiency, and consumer convenience globally.

CHAPTER 4

METHODOLOGY

4.1 Introduction of the chapter

This chapter provides a layout of the methodology and econometric techniques employed in this study. In addition, it outlines the theoretical and empirical approaches (model), explanation, and selection of variables.

4.2 Data sources

The study applied secondary time series data on Liberia between the period of 1991-2020 on the financial sector development. The following Data: Net Domestic Credits, Mobile Cellular Subscriptions, Internet Users, GDP, and Lending on Interest Rate were collected from the World bank Indicators Database, while Broad Money supply was collected from the Central Bank of Liberia annual reports.

4.3 Model Specification

This study tests the nexus between technological evolution (technology) and financial sector development as the result of technological influence in the economy of Liberia. In practice, the measurement and application of financial sector development are tedious due to the broad approach and diverse scope (World Bank, 2015; Ilyina & Samaniego, 2011). However, this study follows the similar empirical technique applied by Alshubiri, Jamil, and Elheddad, 2019; Prowd, 2019. In specification of the model formulation to determine growth or development, the study employed the aggregated production function written as:

$$Y = AF(K, L) \dots \dots \dots \text{Equation 1}$$

Where Y denotes total output, A denotes technological parameter, K represents Capital Input and L represents Labor input. The aggregate production function indicates a linear function. The above equation can also be written as:

$$Y = A\sqrt{KL} = A\sqrt{K}\sqrt{L} \dots \dots \dots \text{Equation 2}$$

The equation also explains the initial equation differently in the form of the square root as indicated above. That is if labor and capital inputs are scaled proportionally, result to a scale in total level. Subsequently, the per-capita equation can be formed in the framework of Cobb Douglas production function expressed as:

$$Y = AK^\alpha L^{1-\alpha} \dots\dots\dots \text{Equation 3}$$

Using the Cobb-Douglas standard production function, the per-capita equation can be written as:

$$\frac{Y}{L} = \frac{AK^\alpha L^{1-\alpha}}{L} = \frac{AK^\alpha}{L^{1-(1-\alpha)}} = A\left(\frac{K}{L}\right)^\alpha = Ak^\alpha \dots\dots\dots \text{Equation 4}$$

Now, the marginal productivity of capita can be as expressed as:

$$MPK = \frac{\partial Y}{\partial K} = AL^{1-\alpha} \propto K^{\alpha-1} = \propto AK^{\alpha-1} L^{1-\alpha} = \propto A\left(\frac{L}{K}\right)^{1-\alpha} \dots\dots\dots \text{Equation 5}$$

With the above modification, technology and capital accumulation can influence growth (Calderón & Liu, 2003). To consider this, the study established an empirical model below to measure the relationship between technology and financial development:

$$Y_t = \beta_0 + \beta_1 X_t + \beta_2 X_t + \varepsilon_t \dots\dots\dots \text{Equation 6}$$

$$FD_t = \beta_0 + \beta_1 ICT_t + \beta_2 GDP_t + \beta_3 LIR_t \varepsilon_t \dots\dots\dots \text{Equation 7}$$

Where:

FD: Financial Development

β_0 : The constant term

β_1 : Coefficient for technology Adoption

β_2 : Coefficient Gross Domestic products

β_3 : Coefficient Lending on Interest Rate

ε : The random error term

t: The time trend

As described by the equation provided above (equation seven), the model uses various proxies to measure the key variables of interest. Specifically, the model uses Net domestic Credit (NDC) and Money Supply (M_2) to measure financial development (FD). To measure technology adoption (ICT), the model used the Number of individuals using internet (% of population) or Internet Penetration Rate (IPR) and Mobile cellular subscriptions (MCS). Additionally, the model includes a control variable (X), which is measured using GDP growth (annual %) and Lending Interest Rate (LIR) to account for any other factors that may influence the relationship between technology and financial development.

The model uses an equation to represent the relationship between these variables, where FD is the dependent variable, ICT is the independent variable, GDP and LIR are the control variables, and ε and t are the error term and time, respectively. The final equation below also includes an intercept term (β_0) and coefficients (β_1 - β_3) that indicate the strength and direction of the relationship between each independent variable and the dependent variable.

$$NDC_t = \beta_0 + \beta_1 MCS_t + \beta_2 IPR_t + \beta_3 GDP_t + \beta_4 LIR_t + \varepsilon_t \dots \dots \dots \text{Equation 8}$$

$$M2_t = \beta_0 + \beta_1 MCS_t + \beta_2 IPR_t + \beta_3 GDP_t + \beta_4 LIR_t + \varepsilon_t \dots \dots \dots \text{Equation 9}$$

4.4 Variables selection

4.4.1 Financial development:

This is measured by two indicators in this study, namely: the M2 money supply and domestic credit to the private sector. These variables would likely be positively correlated with technology adoption, as technology can help to increase the efficiency and reach of financial services (World Bank. (2020).

Net domestic credit is the total of all net claims against the central government and other domestic economic sectors. In this study, the NDC is used as a development indicator for the

financial industry. Previous studies have proven that Net Domestic Credit is an indicator used for assessing financial development or performance (Boulila and Trebelisi, 2002; Jammeh, 2022; Sipahutar et al., 2016; Bui, 2020.). Besides, empirical studies from World Bank on financial development has supported these studies (World Bank, 2013). It is measured as proxy variable for financial development.

M2 Broad Money Supply: is the total amount of money in circulation and commercial banks. M2 was the metric utilized in this study to gauge financial performance. Researchers typically suggest and utilize it to perform financial soundness and health analyses World Bank, 2012; 2020, Jammeh, 2022; Calderón & Liu, 2003). Money Supply is also as proxy variable used to measure financial development in this study.

4.4.2 Technology adoption:

Technological adoption has been measured by both the number of mobile cellular subscriptions and the internet user percentage of the population (Alshubiri, et. al., 2019).

Mobile cellular subscriptions (MCS) are cellular technology used to access the PSTN (Public Switched Telephone Network) through public mobile phone services (i.e., that have been used during the last three months. (2020 World Bank; Rajagukguk et al., 2021; Evans, 2018). Technology is measured using Mobile subscriptions as one of the proxy variables to determine the impact of technology on financial development in Liberia.

Internet users: Those who have accessed the Internet within the last three months, regardless of location, are considered Internet users. Digital TVs, smartphones, laptops, and gaming consoles are just a few devices that can access the Internet. Given that internet connection is a prerequisite for using online financial services like digital payments and online banking, this variable is expected to have a positive correlation with technological adoption (Haini, & Pang, 2022; Song & Rong, 2017; Salahuddin & Gow; 2016). Internet Penetration or internet users is another proxy variable considered to measured technology in the study.

4.4.3 Control Variable

GDP growth: reflects growth in economic activities within a specific timeframe. Previous studies have revealed that GDP has been used as an indicator to measure growth (Nguyen et al

(2014; Jalil and Ma, 2008; Al Yousif (2002; Hassan et al., 2011). This is used in the study as a control variable that might impact financial development.

GDP growth (annual %): GDP growth rate expressed as a percentage per year at market prices using constant local currency. The aggregates are provided in US dollars and are based on constant prices from 2015. GDP is the total of the gross value added by all producers who are residents of the country, plus any product taxes and minus any subsidies that aren't factored into the product value. It is computed without accounting for the depletion and deterioration of natural resources or the depreciation of artificial assets (World Bank Database Indicator; Clark & Senik, 2011; Williams, M. A., Baek, et al., 2017).

Lending Interest rate (%): lending interest rate represents the bank rate that typically satisfies the private sector's short- and medium-term funding needs. Usually, this rate is split based on the financing goals and the creditworthiness of the borrowers (Darrat & Dickens, 1999 & Mutinda, 2014).

4.5 Statistical technique

To evaluate the distributive and statistical characteristics of the study's variables, several diagnostic tests were employed. The tests in question consist of descriptive analysis, diagnostic tests for ARDL, normalcy, correlation, and stationarity. The study adopted ARDL and Bound Test because the ARDL model and bound tests can handle non-stationary variables or data in and offer robustness and reliability in capturing the long- and short-term dynamics of the relationship between the variables used in the study, which justifies its selection.

The standard ARDL model is adopted as the cointegration of estimation below:

$$Y_t = \gamma_{0i} + \sum_{i=1}^p \delta_i Y_{t-i} + \sum_{i=0}^q \beta'_i X_{t-i} + \epsilon_{it} \dots \dots \dots \text{Equation 10}$$

Let Y_t be the vector, and the variables in (X_t) are permitted to be purely cointegrated of order 0 $I(0)$ or $I(1)$). Here, β and δ represent coefficients, γ is a constant, i range from 1 to k , and p and q denote the original lag orders. Additionally, ϵ_{it} is the vector of error terms constituting an observable zero-mean white noise vector process, ensuring serial uncorrelation or independence.

According to Bentzen and Engsted (1999), the Autoregressive Distributed Lag (ARDL) model is a reliable econometric instrument for determining the correlation between dependent and independent variables. Considering that the main goal of this study is to assess how technology affects financial development, the ARDL Model is used in the study. As noted by Natsiopoulou and Tzeremes, this model was selected due to its approach in conducting limits tests for cointegration and error correction modeling (2022). Because of the flexibility provided by the autoregressive (AR) and distributed lag (DL, essentially AR terms of the independent variables) components in the ARDL model, researchers in the fields of economics, environmental studies, and political science commonly use Autoregressive Distributed Lag (ARDL) and Error Correction Models (ECM), as described by Pesaran and Shin (1999). By providing a framework for analyzing and evaluating the long-term relationships between variables, these models are applied in cointegration analysis. Bounds test, which was developed by Pesaran et al. (2001) and allows for cointegration testing and level relationship estimation at the same time, is one of the popular tests for this kind of study. A suitable econometric approach for the detailed examination of economic linkages is the ARDL model, which can handle both stationary and non-stationary time series data.

Moreover, to assess and identify the existence of integration properties of the above equations, the study conducts a long run and short run dynamic equations as supported by the below criteria in empirical studies (Prowd, 2019).

As the above original ARDL model properties entail lag order and estimation aspect, the study induced the model to incorporate variables of interest as quantified below:

LONG RUN ESTIMATE EQUATION

$$\Delta \text{INDC}_t = \alpha_0 + \sum_{i=1}^{P-1} \alpha_{1i} \Delta \text{INDC}_{t-i} + \sum_{i=1}^{q-1} \alpha_{2i} \Delta \text{IPR}_{t-i} + \sum_{i=1}^{q-1} \alpha_{3i} \Delta \text{LMCS}_{t-i} + \sum_{i=1}^{q-1} \alpha_{5i} \Delta \text{LGDP}_{t-i} + \sum_{i=1}^{q-1} \alpha_{6i} \Delta \text{LLIR}_{t-i} + \lambda_1 \text{ECT}_{t-1} + e_t \dots \text{Equation 11}$$

$$\Delta \text{IMS}_t = \alpha_0 + \sum_{i=1}^{P-1} \alpha_{1i} \Delta \text{IMS}_{t-i} + \sum_{i=1}^{q-1} \alpha_{2i} \Delta \text{IPR}_{t-i} + \sum_{i=1}^{q-1} \alpha_{3i} \Delta \text{IMSC}_{t-i} + \sum_{i=1}^{q-1} \alpha_{5i} \Delta \text{LGDP}_{t-i} + \sum_{i=1}^{q-1} \alpha_{6i} \Delta \text{LLIR}_{t-i} + \lambda_1 \text{ECT}_{t-1} + e_t \dots \text{Equation 12}$$

SHORT RUN ESTIMATE EQUATION

$$\text{INDC}_t = \alpha_0 + \sum_{i=1}^P \alpha_{1i} \text{INDC}_{t-i} + \sum_{i=1}^P \alpha_{2i} \text{IPR}_{t-i} + \sum_{i=1}^q \alpha_{3i} \text{LMCS}_{t-i} + \sum_{i=1}^q \alpha_{5i} \text{LGDP}_{t-i} + \sum_{i=1}^q \alpha_{6i} \text{LLIR}_{t-i} + e_t \dots \text{Equation 13}$$

$$\text{IMS}_t = \alpha_0 + \sum_{i=1}^P \alpha_{1i} \text{IMS}_{t-i} + \sum_{i=1}^q \alpha_{2i} \text{IPR}_{t-i} + \sum_{i=1}^q \alpha_{3i} \text{IMSC}_{t-i} + \sum_{i=1}^q \alpha_{5i} \text{LGDP}_{t-i} + \sum_{i=1}^q \alpha_{6i} \text{LLIR}_{t-i} + e_t \dots \text{Equation 14}$$

First off, pre-testing the unit roots of the variables used in the analysis is no longer necessary due to the limits test. However, the test is conducted regardless of whether the study's series display $I(1)$, $I(0)$, or mutually integrated characteristics. Second, as explained by Laurenceson and Chai (2003), the ARDL approach includes enough lags to capture the nuances of the data generating process.

Thirdly, endogeneity issues are addressed. Pesaran and Shin (1999) state that endogeneity and serial correlation problems can be resolved by designing the ARDL with the necessary lags. According to Khan et al. (2005), all variables are assumed to be endogenous inside the ARDL framework, enabling the simultaneous estimation of the model's long-run and short-run parameters.

Fourth, as noted by Pesaran and Shin (1999), the ARDL has better small sample qualities than the Johansen and Juselius (1990) cointegration test. As a result, this methodology has been increasingly used in empirical research recently and is proven to be highly relevant for examining the technology-financial growth relationship in Liberia.

The process for bounds testing consists of multiple steps. First, the alternative hypothesis—which proposes the existence of a cointegrating link—is compared to the null hypothesis, which holds that there is no cointegration relationship. The non-standard distribution of Wald statistics and F-statistics is what the cointegration test is based on. For the cointegration test, Pesaran & Pesaran (1997) and Pesaran et al. (2001) have provided two sets of critical values. While the upper bound functions on the opposite assumption, the lower critical bound is predicated on the absence of cointegration among the variables.

4.5.1 Descriptive Analysis

Previous empirical study has justified that using descriptive analysis to build a solid model of technology and financial development is essential (Lawless et al., 2010). It provides a thorough evaluation of the data's statistical characteristics and numerical representation. According to Dubauskas & Teresienė (2005), several descriptive tests, including variance, skewness, kurtosis, mean, standard deviation, and Jarque-Bera normality, are used to examine finance and technology relationship. Each variable's mean is determined using the mean, and

differences from the mean were explained using the standard deviation. Variance is used to measure how the variables differed from one another, while skewness and kurtosis are used to measure how flat and peaky the variables are. The chi-square statistic for the Jarque-Bera normalcy test is produce by combining skewness and kurtosis. Relative to normality, the accompanying residuals will also diverge when a variable, such M2, is not distributed normally. As a result, t and F statistics will become unreliable since the predicted parameters obtained from this type of data will no longer follow a normal distribution (Demir, 2022; Thadewald, & Büning, 2007; Kim, 2021).

Although the underlying premise of descriptive statistics is that the data fairly depicts the population, their limitations come from their incapacity to shed light on causality or infer correlations between variables.

$$\bar{x} = \sum_{i=1}^n x_i, s = [\sum_{i=1}^n (x_i - \bar{x})^2 / (n - 1)]^{1/2} \dots\dots\dots \text{Equation 15}$$

$\bar{x}$ = mean, S = standard deviation

$$\text{Skew}(x) = \sum E \left[\frac{x-\mu}{\sigma} \right]^3 \quad \text{Kurt}(x) = \sum E \left[\frac{x-\mu}{\sigma} \right]^4 \dots\dots\dots \text{Equation 16}$$

$$JB_{obs} = n \left[\frac{s^2}{6} + \frac{(k-3)^2}{24} \right] \dots\dots\dots \text{Equation 17}$$

S = Skewness

K = Kurtosis

Hypothesis

H₀: the data is normally distributed.

H₁: the data is not normally distributed.

In the event where the JB is zero or almost zero, the data is regularly disseminated (Desgagné & Lafaye de Micheaux, 2018). The likelihood that the variable is regularly distributed increases with the value's proximity to zero. The normality condition of each variable was determined by the study using the chi-square and probability value. The study

fails to reject the null hypothesis that the data is normally distributed if the probability value is less than 5 percent, even when the researcher rejects the null hypothesis if the p-value of a variable is larger than 5 percent. (O Emmanuel, et al., 2020) Every variable used in this research will undergo this process.

4.5.2 Unit Root Testing

With unit root testing, the stationarity of the data is examined to assess the correctness and dependability of the analysis (Vartanian, 2010). To evaluate the stationarity of each variable in this study, the modified Dickey Fuller and Philip-Perron unit root tests were used. Assuming that the time series data are stationary is the foundation of unit root testing; nevertheless, it is limited by sample size sensitivity and the possibility of false positives or negatives when determining the data's stationarity.

4.5.2.1 Augmented Dickey Fuller Unit Root Test

Assuming uncorrelated errors, the Augmented Dickey Fuller (ADF) test is an expansion of the Dickey-Fuller test, which was first presented by Wayne A. Fuller and David Dickey in 1979. To account for any serial correlations within the error terms, the test equation includes lag terms of the variables if this assumption is not met (Mushtaq, 2011).

However, the sensitivity to model specification and possibility for misunderstanding when used to small or non-stationary sample sizes are the limitations of the Augmented Dickey Fuller Unit Root Test, which is based on the premise that the time series data follow a unit root process. The following equation can be used to express the ADF test model:

$$\Delta y = a_0 + \rho y_{t-1} + \sum_{i=1}^p a_{3t} \Delta y_{t-1} + \varepsilon_t \dots \dots \dots \text{Equation 18}$$

Hypothesis

H₀: the time series has a unit root (not stationary)

H₁: the time series does not have a unit root.

4.5.2.2 Philip-Perron Unit Root Test

As noted by Arltová and Fedorová (2016), the Philip-Perron (PP) unit root test was introduced in 1988 by Peter C.B. Phillips and Pierre Perron to address the problem of serial correlation in mistakes by adding a corrective. A modified version of the Newey-West formula is used in this test to determine the long-term variance of the error process. The PP test, like the Augmented Dickey-Fuller (ADF) test, necessitates defining a lag order, which establishes how many lags are considered when calculating long-term variance estimation (Osigwe & Uzonwanne, 2015). The PP test was used in this study's setting to validate the outcomes of the ADF test.

The Philip-Perron Unit Root Test is sensitive to structural breaks and may produce inconsistent findings in the presence of such breaks, although it assumes that the time series data show a unit root process. The presence of a unit root is predicated by the PP test's null hypothesis. The PP test is shown as follows:

$$\Delta y = \beta D_t + \pi y_{t-1} + \mu_t \dots \dots \dots \text{Equation 19}$$

Hypothesis

H₀: the time series has a unit root (not stationary)

H₁: the time series does not have a unit root

4.5.3 ARDL Post diagnostic Test

To assess the stability and uniqueness of the estimated ARDL model, the study performed a series of diagnostic tests. The post-diagnostic tests included the examination for Series correlation, the Jarque-Bera Normality Test, Stability Check, and Heteroscedasticity.

Following the estimation process, a series of tests were conducted to validate the model's fitness and distributional structure of the data. These examinations were to verify the credibility of inferences drawn from the estimated results. The tests included an assessment of model stability using the inverse root test, residual autocorrelation utilizing the LM test, and an investigation into normality using the Jarque Bera test.

4.5.3.1 Normality test

The Normality test assumes that the data are distributed normally; nonetheless, it has two limitations: it is sensitive to sample size effects and cannot identify deviations from normality brought on by outliers or non-linear connections. According to Khatun (2021), to verify the assumption that the residuals are regularly distributed, normality testing is essential. For accurate statistical inferences drawn from the ARDL model, trustworthy hypothesis testing, and confidence interval estimates, residual normality is essential (Kwak & Park, 2019). The model assumptions may be broken if the residuals do not follow a normal distribution, which could result in skewed parameter estimations and incorrect determinations of statistical significance (Hasan & Nasir, 2008). Maintaining normalcy in the residuals strengthens the ARDL model's resilience, bolstering the validity of its findings and facilitating the development of more precise and reliable understandings of the interactions between variables across time.

4.5.3.2 Serial correlation test

To determine the residuals, show autocorrelation, which would defy the assumptions of the model, the serial correlation test is crucial (Anderson, 1948). The concept of serial correlation suggests that the error terms exhibit temporal correlation, potentially resulting in ineffective parameter estimations and compromising the statistical soundness of conclusions derived from the model (Nkom and Uko, 2016). The identification and result of serial correlation is important to ensure the independence of residuals, validating the dependability of coefficient estimates, and maintaining the precision of hypothesis tests (Durbin & Watson, 1992). The model is more resilient when there is no serial correlation, which leads to more accurate and reliable understanding of the short- and long-term relationships between the variables in the ARDL framework. The Serial Correlation Test's premise is that each observation in the data is independent. However, it has two limitations: it is sensitive to model misspecification and can produce false results if the genuine underlying process is not sufficiently captured.

4.5.3.3 Heteroscedasticity test.

According to Long & Ervin (2000), the test for heteroscedasticity is very important since it looks at the residuals of the model has a constant variance. Inefficient parameter

estimations and compromised statistical inference reliability are two consequences of heteroscedasticity, or the presence of non-constant variance (Dette & Munk, 1998). To maintain the robustness of the ARDL model, heteroscedasticity must be recognized and addressed because it affects the validity of confidence intervals and hypothesis tests as well as the precision of standard errors (Koenker, 1980). Through the application of a heteroscedasticity test, researchers can improve the accuracy of parameter estimations, strengthen the statistical reliability of the model, and provide more precise insights into the dynamics of the interactions among variables.

However, The Heteroscedasticity test assumes that the variance of the error component is constant across data. However, it has two limitations: it can produce biased parameter estimates if heteroscedasticity is present but not considered, and it is sensitive to model misspecification.

4.5.3.4 Parameter stability

According to Chu et al, (1995), in the Autoregressive Distributed Lag (ARDL) model, parameter stability is essential since it ensures the robustness and dependability of the predicted relationships across time. In 2012, Kirk & Kamgaing argue that the stability of model parameters in the context of economic data indicates that the coefficients and relationships between variables hold true throughout time, suggesting that the model correctly reflects the system's underlying dynamics. The model's capacity to offer significant insights or generate precise forecasts may be hampered by a lack of parameter stability, which might produce inconsistent findings. Ahmandu-Sarkodie and Owusu (2016), researchers can have more faith in the validity of their findings by highlighting parameter stability in the ARDL model. This makes it possible to conduct more accurate assessments of long-term relationships and to facilitate wise policy suggestions that are supported by strong empirical evidence.

However, the Parameter Stability Test assumes that the link between variables stays constant over time. However, because it relies on predefined breakpoints, it may miss small changes or shifts in the relationship that occur gradually over the course of the study.

4.5.3.5 Conclusion of the chapter

In summary, the aggregated production function was employed in the model formulation in this study, and the chosen variables were accommodated to build the model. Both long-run and short-run estimate equations were developed because of testing the relationships between the variables using the ARDL model to address the non-stationarity of certain of them. Descriptive statistics, unit root tests like Philip Perron's and Augmented Dickey Fuller's, and Granger causality analysis—which analyzes causal relationships—which identifies dynamics among variables—were also used. In addition, post-diagnostic tests were performed to verify the model's resilience. These tests included evaluations for serial correlation, the Jarque-Bera Normality Test, stability assessments, and heteroscedasticity. The combination of these methodological techniques improves the study's credibility and dependability by facilitating a thorough analysis and interpretation of its findings.

CHAPTER 5

EMPIRICAL ESTIMATION AND FINDINGS

5.1 Introduction

This dissertation aims to investigate the impact of technology on financial development. In this chapter, data used in the analysis and the empirical results are exhibited.

5.2 Presentation and Analysis

To determine the normal distribution of our time series data, the study employed common statistics to assess the distribution of the data series using the Jacque Bera statistics.

5.2.1 Trend Analysis

Table 5.1: Descriptive statistics

	LogMCS	LogIPR	LogNDC	LogM2	LogGDP Rate	LogLIR
Mean	11.092	5.330	20.156	18.661	21.672	2.720
Median	12.543	0.034	20.229	18.812	21.606	2.676
Maximum	15.111	33.633	20.839	20.368	21.982	3.097
Minimum	5.166	0.000	18.973	15.848	21.291	2.518
Std. Dev	3.748	9.337	0.554	1.531	0.220	0.163
Skewness	-0.353	1.770	-0.382	-0.319	0.173	0.898
Kurtosis	1.386	4.927	1.789	1.675	1.725	2.963
Jarque-Bera	4.009	20.989	2.646	2.792	2.223	4.171
Probability	0.135	0.000	0.266	0.248	0.329	0.124
Sum	343.843	165.227	624.846	578.486	671.819	84.322
Sum-Sq. Dev	421.5	2615.1	9.2	70.4	1.5	0.8
Obser.	31	31	31	31	31	31

Source: Author's computation EViews

Table 5.1 shows the descriptive statistics used in the analysis. According to the results, the mean of MCS, IPR, NDC, M₂, GDP Rate and LIR are 11.09, 5.33, 20.16, 18.67, 21.67, and 2.72 respectively. IPR, GDP Rate and LIR are positive skewness variables indicating that these variables are left-skewed while MCS, NDC and M₂ are right-skewed. As considered, all variables are lower than the value of 3 for normal distribution, except for IPR higher than this

value. These results show that the variables have no normal distribution, which proves the results of the Jarque Bera Statistics.

Figure 5.1: Mobile cellular subscription (MCS)

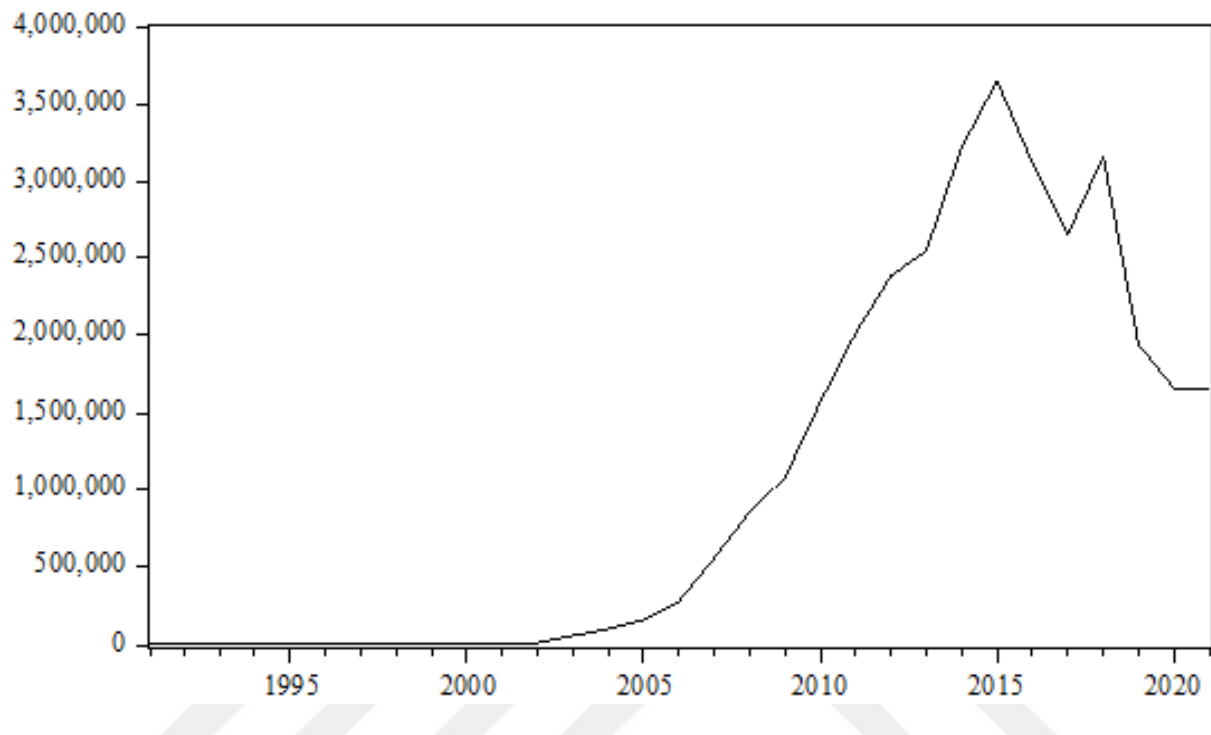


Figure 5.1 indicates that the number of mobile cellular users is comparatively zero from 1991 to 2003, likely due to the 14-year civil conflict that severely disrupts both human and physical infrastructure within the country. However, starting around 2005 and continuing through 2015, a ten-year period, there is significant increase in demand for mobile communication services, reaching its highest peak in 2015. Following this peak, there is a subsequent decrease in demand, most likely influenced by the residual effects from the Ebola crisis in 2014 and the introduction of high surcharges imposed on companies providing mobile and internet services in the nation in 2018 by the government, which might have indirectly driven up costs for users, potentially discouraging some from subscribing. Interestingly, the graph indicates a period of relative stability in the number of mobile cellular users between 2020 and 2022. This suggests that Liberia's mobile phone user base remained largely unaffected by the COVID-19 pandemic.

Figure 5.2: Internet Penetration Rate (IPR)

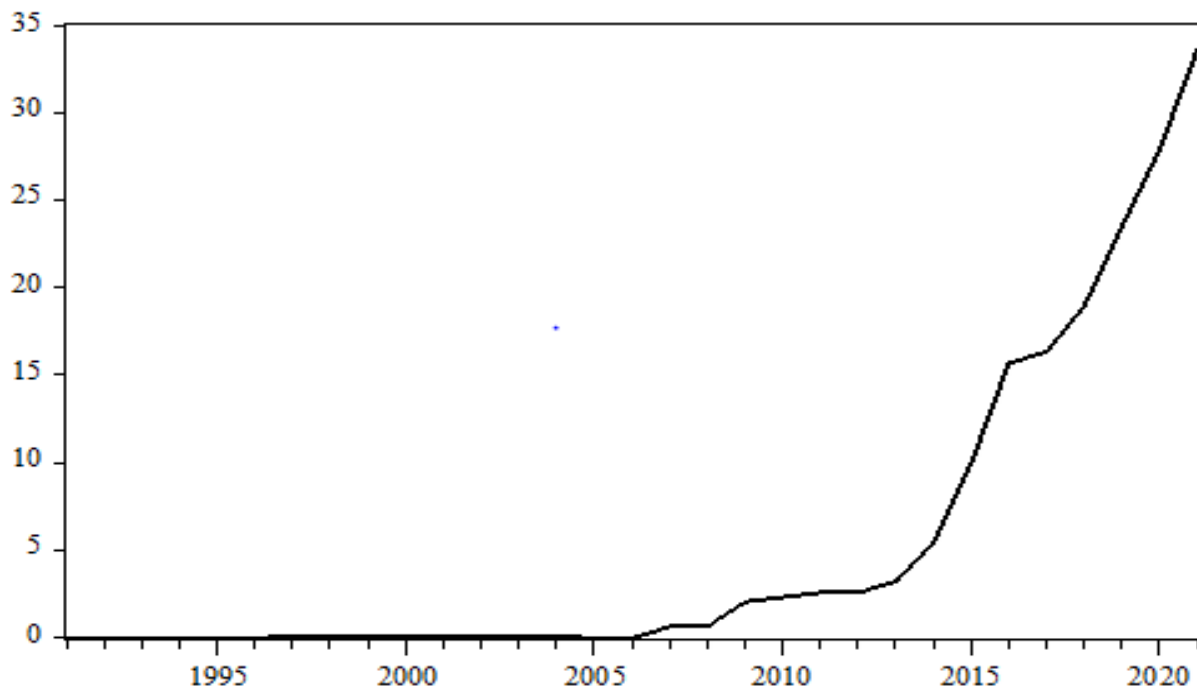


Figure 5.2 shows how internet access has evolved in Liberia from 1991 to 2022. Between 1991 to 2006, the internet penetration rate, which reflects the percentage of the population using the internet, remains relatively low. This indicates that internet services are scarce and expensive, making it difficult for most Liberians to get access to basic internet services. This limited internet access mirrors the trend observed with mobile cellular users in **Figure 5.1**. Since 2006, Liberia witnesses a remarkable rise in the number of internet users. There is a significant increase in internet penetration, indicating growing accessibility and affordability. **Figure 5.2** shows an increase in internet users from 2015 upward, even though **Figure 5.1** suggests a decrease in mobile phone users during the same period. This could be due to people switching to devices like computers for internet access, perhaps because they were already comfortable using the internet and found online communication more cost-effective due to rising surcharges for traditional calling and messaging. Coinciding with Liberia's improving economic and political stability since 2015, the number of internet users continues to rise steadily. This means a growing internet culture and potentially a more digitally connected population.

Figure 5.3: Net Domestic credit.

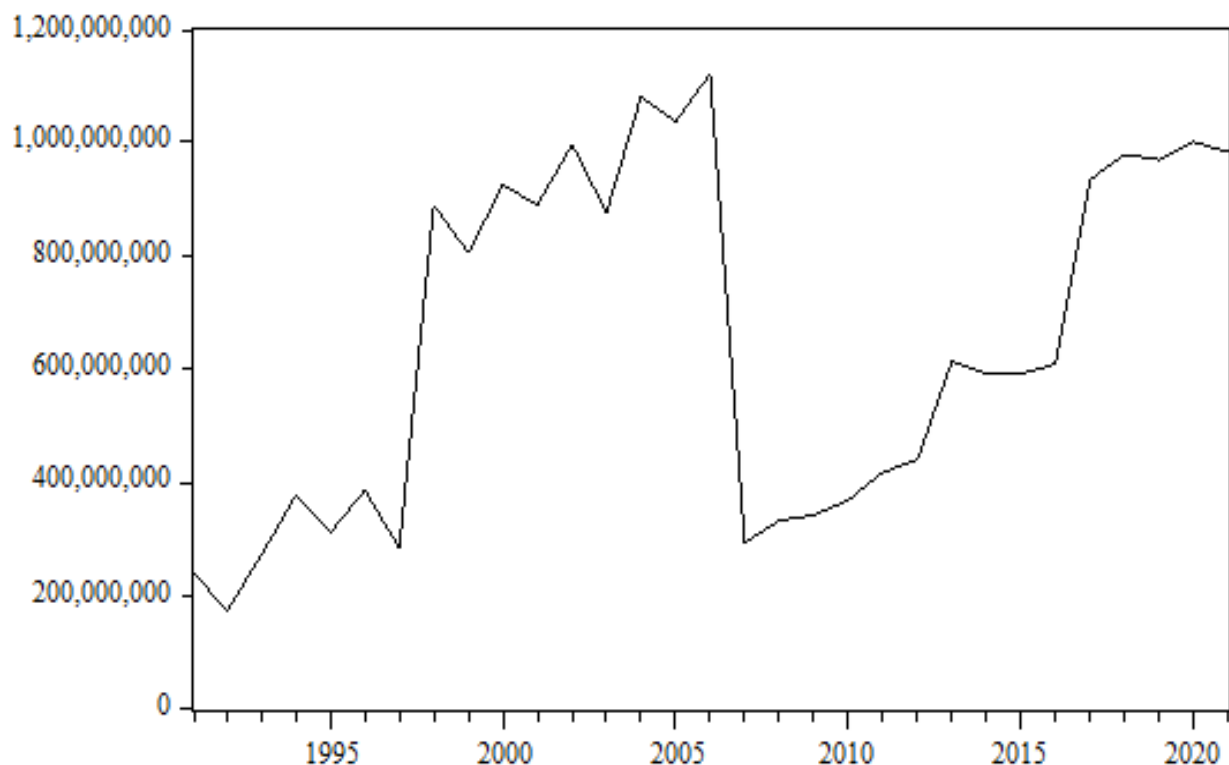


Figure 5.3 illustrates the trend in Liberia's Net Domestic Credit from 1991 to 2022. Net Domestic Credit refers to the total amount of credit extended by the domestic banking system to the government and private sector. The graph reveals a fluctuating pattern in Net Domestic Credit throughout the study period. There is an increase observed in Net Domestic Credit between 1993 and 1994, followed by a steady increase up to 2006. This indicates an expansion of credit provided by banks in Liberia during this period. In 2007, Liberia experiences a significant drop in Net Domestic Credit. This decline is attributed to the global financial crisis of 2007-2008, which caused tighter financial conditions worldwide. Since the 2007 dip, Net Domestic Credit has shown an increase, but at a minimum rate. This shows that commercial banks are cautious in extending credit after the global crisis. Furthermore, **Figure 5.3** doesn't show any major influence on Net Domestic Credit during the Ebola outbreak in 2014 or the COVID-19 pandemic in 2020. This suggests that these events may not have had a significant impact on credit availability in Liberia.

Figure 5.4: Broad Money Supply(M₂)

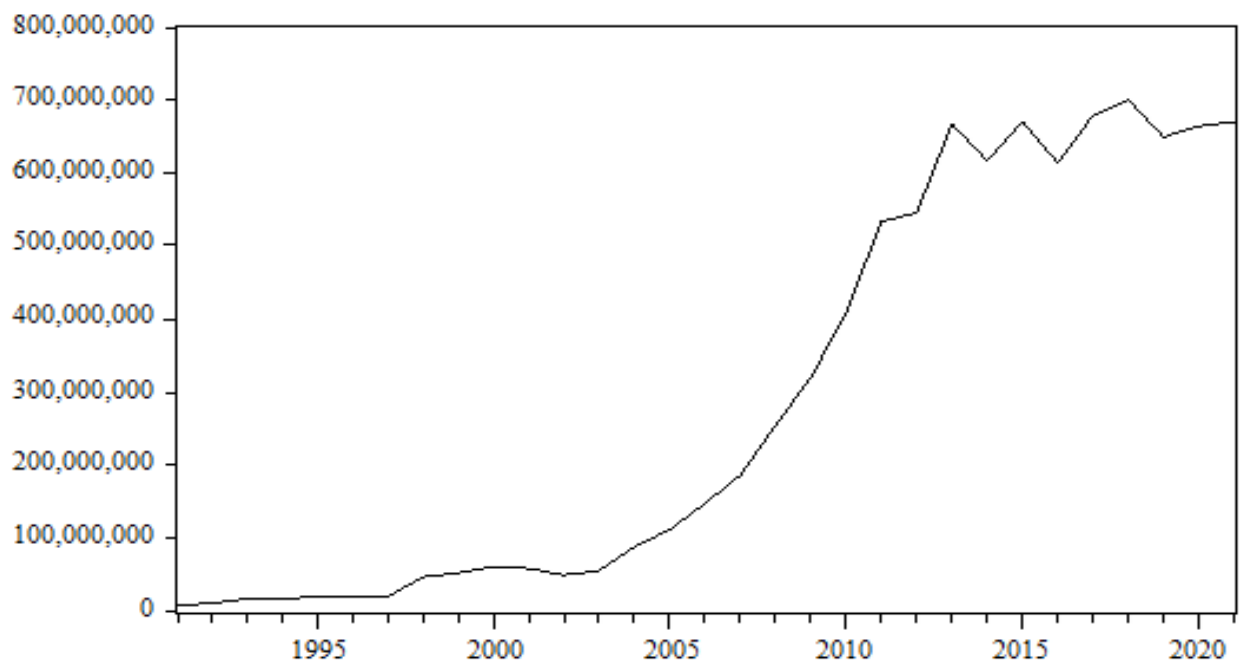


Figure 5.4 plots the trajectory of money supply in Liberia from 1991 to 2021. Money supply refers to the total amount of money circulating in the economy. The graph reveals a gradual and relatively steady increase in broad money supply, particularly since 2004. In contrast, the period between 1991 and 2003 witnesses minimal growth in money supply. This might be attributable to Liberia's 14-year civil war, which likely disrupts economic activity and limits money circulation. The money supply decreases in 2014 although not to any significant level as it may be because of the Ebola crisis during that period. However, 2019 marks Liberia's highest money supply on record, coinciding with the country's highest inflation rate according to the Central Bank of Liberia's 2019 Annual Report. Since 2019, the money supply in Liberia remains relatively stable. This stability could be due to the Central Bank of Liberia's tight monetary policy, which involves open market operations using treasury bills to fight inflation pressure.

Figure 5.5: GDP Growth Rate

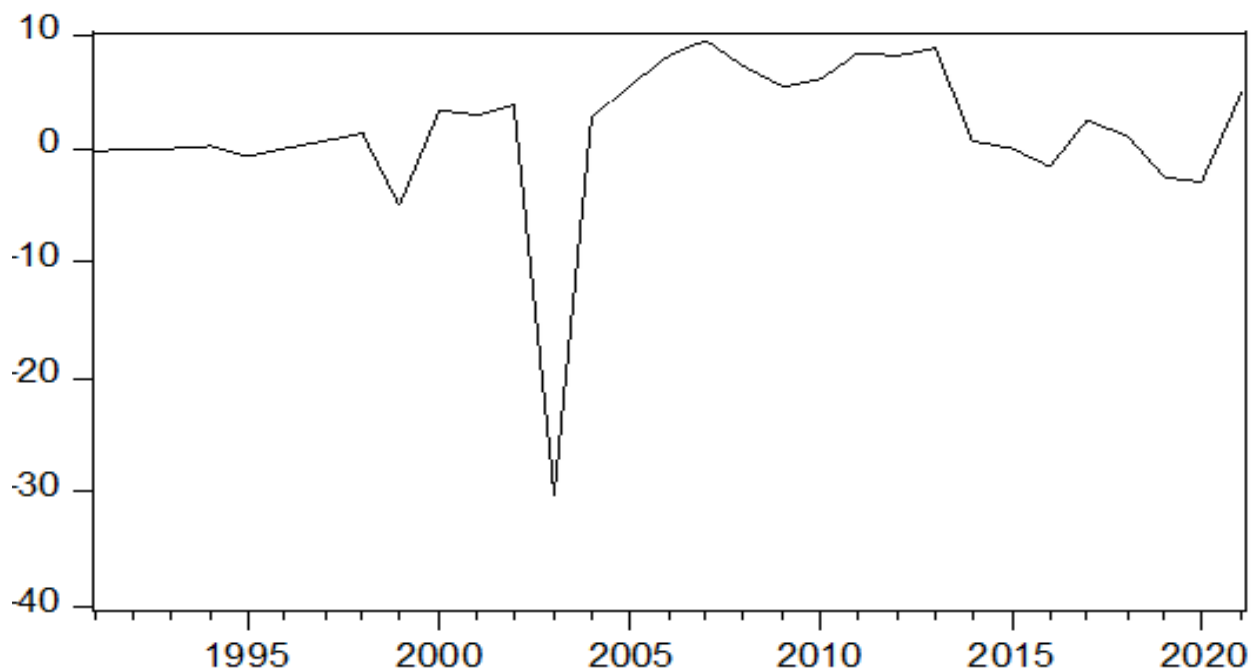


Figure 5.5 shows Liberia's GDP growth rate from 1991 to 2021. GDP growth rate reflects the expansion or contraction of the economy over time. The most significant decline in GDP growth occurred in 2003, likely a consequence of Liberia's brutal civil war that intensified that year. The graph notes a negative GDP growth rate from 2014, which coincides with the Ebola outbreak. This shows that the Ebola crisis has a lingering impact on the level of production in Liberia. As with many countries worldwide, Liberia's GDP contracts in 2020 due to the COVID-19 pandemic as result of the economic slowdowns from restricted movement, business closures, and global trade disruptions. However, the GDP growth rate appears to be improving since the end of the COVID-19 pandemic. This indicates that the Liberian economy is on the path to recovery.

5.2.2 Statistical Analysis

5.2.2.1 Unit Roots Tests

This study employed unit root tests, specifically the Augmented Dickey-Fuller (ADF) and Phillips-Perron tests, to analyze the data series as presented in Tables 11 and 12. These tests are vital to assess each variable level of stationarity.

Table 5.2: Augmented Dickey-Fuller Test Equation

Variable	At level		First difference	
	t statistics	prob.	t statistics	Prob
LNDC	-2.259974	0.4415	-6.760163	0.0000
LMCs	-0.818703	0.9521	-3.097796	0.1255
LM2	-0.894286	0.9437	-5.307571	0.0009
LIPR	2.513367	1.0000	-2.804165	0.2071
LGDP	-1.749531	0.0003	-4.809191	0.0031
LLIR	-2.501982	0.3249	-7.286888	0.0000

Source: Author's computation EViews

The unit test results are exhibited in Table 11. According to the results at level, the null hypothesis of non-stationarity is not rejected for NDC, MCS, M2, IPR, and LIR, but rejected for GDP at 5% significance level. Also, at first difference, the null non hypothesis of non-stationarity is rejected for NDC, M2, LIR and GDP growth rate at the 5 % significance level while MCs and IPR are not rejected. These results of all variables are valid for trend and intercept.

Table 5.3: Philips-Perron Stationary test

variable	at level		first difference	
	t-statistics	prob.	t-statistics	Prob
LNDC	-2.1709	0.4877	-6.7361	0.0000
LMCs	-0.3321	0.9857	-3.0646	0.1332
LM2	-0.9691	0.9336	-5.3906	0.0008
LIPR	6.4396	1.0000	-2.6477	0.2638
LGDP	-1.8314	0.6641	-4.7844	0.0033
LLIR	-2.4055	0.3695	-7.4101	0.0000

Source: Author's computation EViews

Table 5.3 illustrates the outcomes of the Phillips-Perron unit root test, conducted to corroborate the findings of the ADF test. According to the results at level, the null hypothesis for stationarity for all variables are rejected at the 5 % significance level. Besides, the null hypothesis of non-stationarity at first difference for MCs, IPP is not rejected at 5 % percent significance level, but is rejected for NDC, M2, GDP, LIR. variables.

After the test of stationarity has been conducted on the time variables used in this study, it is evident from the results that all the variables were not stationary at level and first

difference. This evident supported the decision to adopt the ARDL model as used in this study to determine the existence of cointegration between the variables of interest in the study.

5.2.2.2 Cointegration Test

The study uses the bound statistics to test for the existence of cointegration among the variables of interest. **Table 5.4** and **Table 5.5** show the cointegration test for Net Domestic Credit as the dependent variables and Money Supply as the dependent variable respectively. The study control for heteroscedasticity by using the Huber-White-Hinkley test in each estimation.

Table 5.4: Bound Test for LNDC

F- bound test		Null Hypothesis: No levels relationship		
Test Statistic		Value	Sign	I (0) I (1)
		Asymptotic: n=1000		
		4.730227053		
F- statistic			10%	2.2 3.09
K	4		5%	2.56 3.49
			2.50%	2.88 3.87
			1%	3.29 4.37
Actual	Sample			Finite Sample:
Size	30		n=30	
			10%	2.752 3.994
			5%	3.354 4.774
			1%	4.768 6.67

Huber-White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Case 3: Unrestricted Constant and No Trend

Selected Model: ARDL (1, 1, 1, 2, 1)

ARDL Long Run Form and Bounds Test

Source: Author's computation EViews

Table 5.4 displays the results of the bound test for cointegration using NDC as a dependent variable. The study used 2 lags as recommended by default for both the regressors and the regressand to obtain cointegration using NDC; this lag criteria was selected based on the Akaike Information Criteria (AIC) system. The results show that there is an existence of cointegrating relationship using NDC as dependent variable and MCS and IPR as the independent variables along with the control variables in the study as the F-statistic value of **4.730227053** in absolute term is higher than the I(1) series values at all levels of significance.

Table 5.5: Bound Test Independent Variable: M2.

F- bound test		Null Hypothesis: No levels relationship			
Test Statistic		Value	Signi	I (0)	I (1)
Asymptotic: n=1000					
F- statistic		5.543676	10%	2.45	3.52
K	4	5%	2.86	4.01	
		2.50%	3.25	4.49	
		1%	3.74	5.06	

Actual Sample Size		30		Finite n=30	Sample:
			10%	2.752	3.994
			5%	3.354	4.774
			1%	4.768	6.67

Huber-White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Case 3: Unrestricted Constant and No Trend

Case 3: Unrestricted Constant and No Trend

Selected Model: ARDL (2, 0, 1, 1, 1)

Source: Author's computation Eviews

Table 5.5 presents the outcomes of the bound test for cointegration, using M2 as the dependent variable. The study used 2 lags to obtain cointegration using M2 as a dependent variable. The findings indicate the presence of a cointegrating relationship with M2 is the dependent variable, MCS and IPR serving as the independent variables alongside the study's control variables. This is evidenced by the absolute F-statistic value of 5.543676 which is greater than the I(1) series values at all levels of significance..

Based on the findings in **Table 5.4**, it is evident that there is long-run relationship using net domestic credit as an indicator for financial development, similarly, in **Table 5.5**, it can be concluded that there is evidence of long run relationship using broad money as an indicator for financial development in Liberia.

The optimal lags chosen for each equation was based on the automatic selected lags from the ARDL estimates indicated in each equation below:

Money Supply (2,0,1,1,1)

$$LM2 = lM2 \ lMCS \ IPR \ lGDP \ lLIR \dots \text{Long Run}$$

$$\Delta lM2 =$$

$$\Delta lM2(-1) \ \Delta lM2(-2) \ \Delta lMCS \ \Delta IPR(-1) \ \Delta lGDP(-1) \ \Delta lLIR(-1) \ \Delta ECM(-1) \dots \text{Short Run}$$

Net Domestic credit (1, 1, 1, 2, 1)

$$lNDC = lNDC \ lMCS \ IPR \ lGDP \ lLIR \dots \text{Long Run}$$

$$\Delta lNDC =$$

$$\Delta lNDC(-1) \ \Delta lMCS(-1) \ \Delta IPR(-1) \ \Delta lGDP(-1) \ \Delta lGDP(-2) \ \Delta lLIR(-1) \dots \text{Short Run}$$

5.2.2.3 Long Run Estimates

The long run relationship for M2 and NDC being used as dependent variables were estimated using the bound test for cointegration as presented in **Table 5.6** and **Table 5.7** below:

Table 5.6: Long Run Estimation, M2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	-27.533334	8.240606	-3.341178	0.003431
logMCS	0.357211	0.023440	15.239571	0.000000
IPR	0.024175	0.007746	3.121076	0.005624
logGDP	1.775061	0.367641	4.828249	0.000117
logLIR	1.344326	0.394213	3.410151	0.002936

ARDL Error Correction Regression
Case 3: Unrestricted Constant and No Trend
Source: Source: Author's computation EViews

Table 5.6 displays the findings on the long run relationship with money supply as the dependent variable. It indicates a significant positive effect of mobile cellular users on money supply, observed at the 5 percent level of significance. This implies that as the number of mobile cellular users increase, a larger segment of the population gains access to mobile banking and financial services. Consequently, increase in digital transaction, potentially increasing the velocity of money and thereby stimulating demand for money.

The study also finds a positive and statistically significant long-run impact of both internet users' growth rate and money supply, with a confidence level of 5 percent. This can be due to the fact that, as internet users increase, there is a growing adoption of digital payment methods such as mobile wallets, online banking, and peer-to-peer payment platforms. These digital payment systems rely on adequate liquidity in the financial system to function efficiently. Therefore, the increasing demand for digital payments can drive the need for an expanded money supply to ensure smooth transaction processing, in the long run, money supply is expected to be more compared to the previous due to these factors as people can have swift access to their funds at anytime and anywhere.

The study also finds a positive significant long run impact of GDP growth rate and money supply at the 1 percent level. This indicates that as the economy is expanding, which often leads to increased business activities, investment opportunities, and consumer spending.

This increased economic activity creates demand for credit from both businesses and individuals to finance various projects, purchases, and investment.

Also, the study finds a positive relationship between interest rate and money supply at the 5 percent confidence level. Interestingly, this finding contradicts the theory of “money as an asset” if the interest rate is increase is from the central bank but holds true if the interest rate increase is from commercial banks. That is, higher interest rates from commercial banks may incentivize individuals and businesses to save more and hold larger deposit balances in interest-bearing accounts, as bank deposits are part of money supply, so increase in commercial banks deposits increase money supply. This increase in savings can provide banks with more funds to lend out, thereby expanding the money supply through the credit creation process. However, this effect might take time to materialize and may depend on other factors such as consumer confidence and investment opportunities, thus indicates that the impact can mainly be seen in the long run.

Table 5.6: Long run Estimates, NDC

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	2.050628	18.065893	0.113508	0.910884
logMSC	0.084083	0.034712	2.422326	0.026197
IPR	0.047925	0.011013	4.351551	0.000385
logGDP	0.341405	0.867503	0.393549	0.698537
logLIR	3.6436677	0.699421	5.209551	5.91E-05

ARDL Error Correction Regression

Case 3: Unrestricted Constant and No Trend

Source: Source: Author’s computation EViews

Table 5.7 presents the empirical results of net domestic credit serving as the dependent variable. The findings highlight a substantial positive influence of mobile cellular users on net domestic credit, evident at a significance level of 5 percent. This could be due to the fact that mobile phones have become a key tool for delivering financial services, particularly in regions with limited banking infrastructure. Mobile banking, mobile wallets, and other financial services accessible via mobile phones enable individuals to access credit more easily. So, as

the number of mobile subscribers increases, so does the potential reach of these financial services, leading to greater demand for credit and an expansion of net domestic credit.

Moreover, the study also finds a positive and statistically significant long-run impact of both internet users' growth rate and net domestic credit, with a confidence level of 5 percent. This could be that internet usage enables the proliferation of online banking services and alternative financing platforms such as peer-to-peer lending, crowdfunding, and digital wallets. These platforms provide easier access to credit for both individuals and businesses, thus contributing to the growth of net domestic credit.

Furthermore, the analysis uncovers no statistically significant relationship between GDP and interest rates concerning net domestic credit at the 5 percent significance level.

5.2.2.4 Error Correction Estimates

The short run relationship of NDC and M2 being used as dependent variables respectively presented in **Table 5.8** and **Table 5.9** below:

Table 5.7: Short Run Equation, NDC

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LMSC)	-0.281969	0.103051	-2.736204	0.013566
D(IPR)	-0.065878	0.023775	-2.770939	0.012596
D(LGDP)	-1.356616	0.667628	-2.031994	0.057182
D(LLIR)	1.389039	0.549811	2.526393	0.021115
ECT(-1)*	-0.705439	0.117143	-6.022049	0.000021

Selected Model: ARDL (1, 1, 1, 2, 1)

ARDL Error Correction Regression

Case 2: Restricted Constant and No Trend

Source: Author's Computation EViews

Table 5.8 presents the outcome for the short run relationship using domestic credit as a dependent variable. In the short run, both internet penetration rate and mobile phone subscriptions have a statistically significant negative impact on domestic credit. This suggests that as internet and mobile phone use become more widespread in Liberia, there's a decrease

in the demand for domestic credit in the short run. This inverse connection could be that mobile cellular usage might serve as a substitute for traditional banking services in Liberia. Possibly, individuals may rely on mobile money services for financial transactions rather than seeking credit from formal banking institutions in the short run. This substitution effect could lead to a negative relationship between mobile cellular usage and demand for domestic credit in the short run.

Additionally, the analysis finds no statistically significant relationship between Liberia's Gross Domestic Product and domestic credit in the short term at the 5 percent level of significance. This implies that short-term fluctuations in economic output might not directly influence the demand for domestic credit.

Also, the study uncovers a statistically significant positive correlation between interest rates and domestic credit at 5 percent level. As interest rates rise, the analysis suggests an increase in the demand for domestic credit in the short run.

The Error Correction Term (ECT) indicates that following any short-term deviations from the long-run equilibrium, the model adjusts back towards long-run balance at a rate of 70.5% per year, assuming all other factors remain constant.

Table 5.8: Short Run Equation, M2

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LM ₂ (-1))	0.731414	0.113670	6.434558	0.000004
D(IPR)	-0.039140	0.011998	-3.262399	0.004098
D(LGDP)	0.631023	0.388352	1.624875	0.120662
D(LLIR)	2.154774	0.328028	6.568872	0.000003
ECT (-1)*	-0.771954	0.101290	-7.621233	0.000000

Case 2: Restricted Constant and No Trend**Selected Model: ARDL (2, 0, 1, 1, 1)**

Source: Author's Computation EViews

Table 5.9 depicts the short run results observed for M2 as dependent variable. The research reveals a negative link between internet penetration and money supply, a correlation deemed statistically significant at the 5 percent level over the short term. This could be attributed to the premise that heightened internet penetration might curtail the demand for physical currency. With expanded access to online banking, mobile money transfers, and digital payment platforms, individuals and businesses may opt for reduced cash holdings, consequently diminishing the overall circulation of money supply.

Furthermore, the analysis identifies no statistically significant correlation between Gross Domestic Product and money supply in the short run. This indicates that short term fluctuations in economic output may not exert direct influence on the demand for money supply.

Additionally, the study uncovers a statistically significant positive correlation between interest rates and domestic credit. As interest rates increase, the analysis posits increase in the demand for money supply in the short run.

The Error Correction Term (ECT) signifies that deviations from short-term equilibrium towards long-term balance are rectified at an average adjustment speed of 77.2 percent, assuming all other factors remain constant.

5.3 Post diagnostic estimation.

Table 5.11 displays the result of the heteroscedasticity test for NDC as a dependent variable. The null hypothesis states that the residuals are homoscedastic. The results indicate the failure to reject the null hypothesis since the chi-square 0.1004 is greater the 5 percent. This means that the residuals are homoscedastic.

Table 5.7: Heteroskedasticity test: LNDC

F- statistics	2.206804	Prob. F (10,18)	0.0691
Obs*R-squared	15.9722	Prob. Chi-Square (10)	0.1004
Scaled explained SS	9.42456	Prob. Chi-Square (10)	0.4923

Source: Author's computation EViews

Table 5.12 presents the outcome of the heteroscedasticity test conducted for M2 as the dependent variable. The findings suggest the retention of the null hypothesis, as the chi-square value of 0.1415 exceeds the 5 percent threshold. This indicates that the residuals exhibit homoscedasticity.

Table 5.8: Heteroskedasticity test: LM₂

F- statistics	1.83259	Prob. F (6,21)	0.1411
Obs*R-squared	9.62245	Prob. Chi-Square (6)	0.1415
Scaled explained SS	18.8264	Prob. Chi-Square (6)	0.0045

Source: Author's computation EViews

Table 5.9: Serial Correlation LM Test: LNDC

F-statistics	1.580844	Prob. F (2,16)	0.236
Obs*R-squared	4.785013	Prob. Chi-Square (2)	0.091

Source: Author's computation EViews

Table 5.13 displays the serial correlation results for NDC as a dependent variable. Given the result from the above table the chi-square statistic of 0.0914, above the 5 percent criterion, shows that study to fail to reject the null hypothesis because it indicates serially uncorrelated residuals. As such, the study infers that there is residual is free from serial correlation.

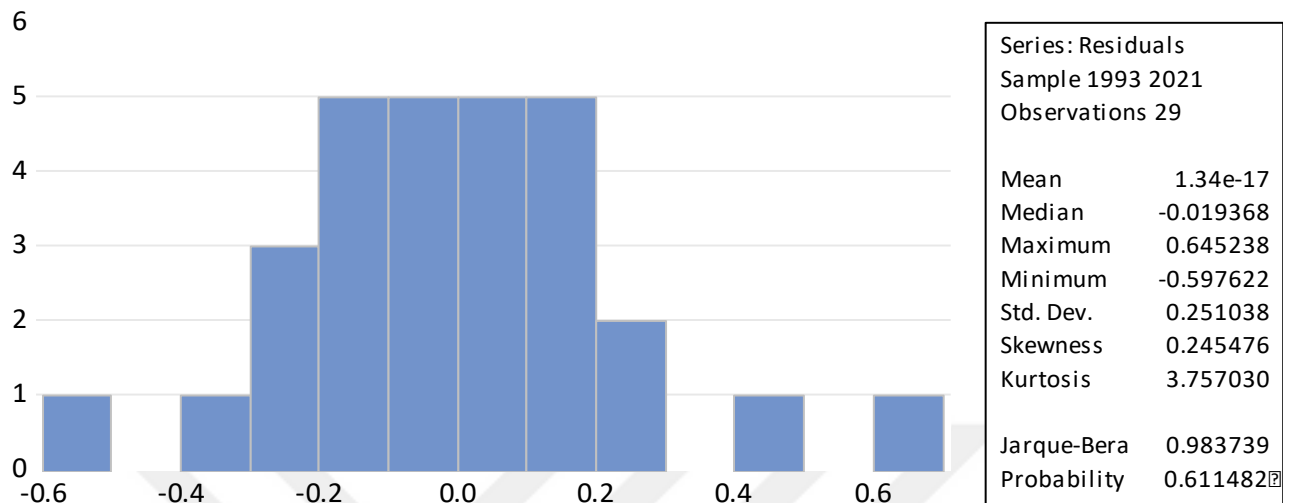
Table 5.10: Serial Correlation LM Test: M2

F-statistics	0.632968	Prob. F (2,20)	0.541
Obs*R-squared	1.666808	Prob. Chi-Square (2)	0.435

Source: Author's computation EViews

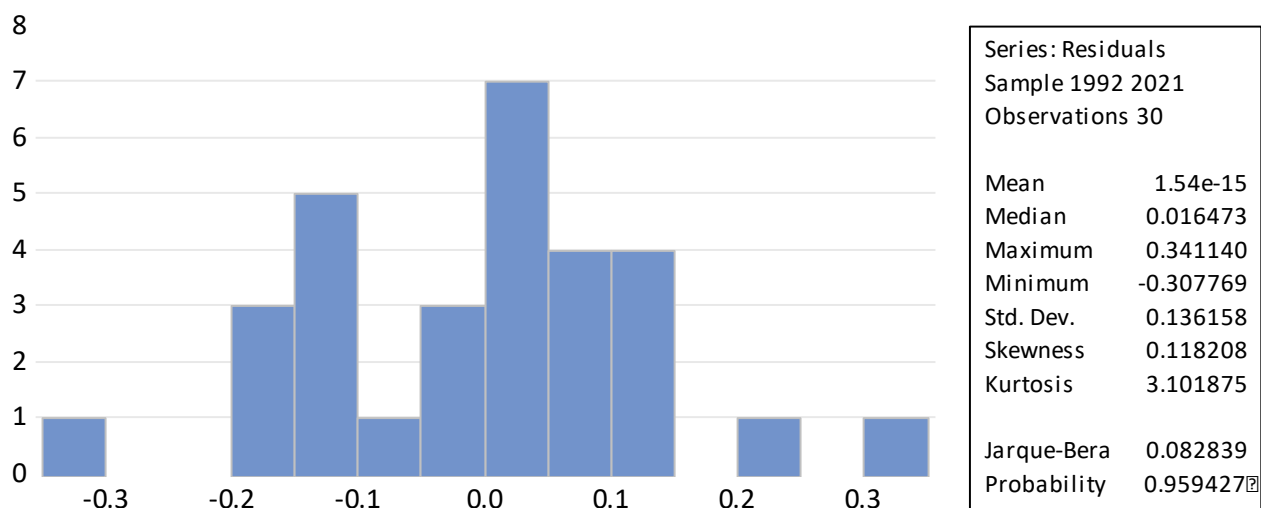
As depicted in **Table 5.14** above, the chi-square value of 0.4346 suggests the presence of serially uncorrelated residuals, surpassing the 5 percent threshold and leading to the failure to reject the null hypothesis. Thus, the study concludes that serial uncorrelation is present within the residuals.

Figure 5.9: Jarque-Bera Normality Test, NDC.



As **Figure 5.6** shows, the probability value is 0.61 NDC, which is greater than the significance level of 5 percent. Therefore, the null hypothesis, which states that the residuals have a normal distribution, as the study fails to reject null hypothesis. We conclude that the residuals have a normal distribution as a result.

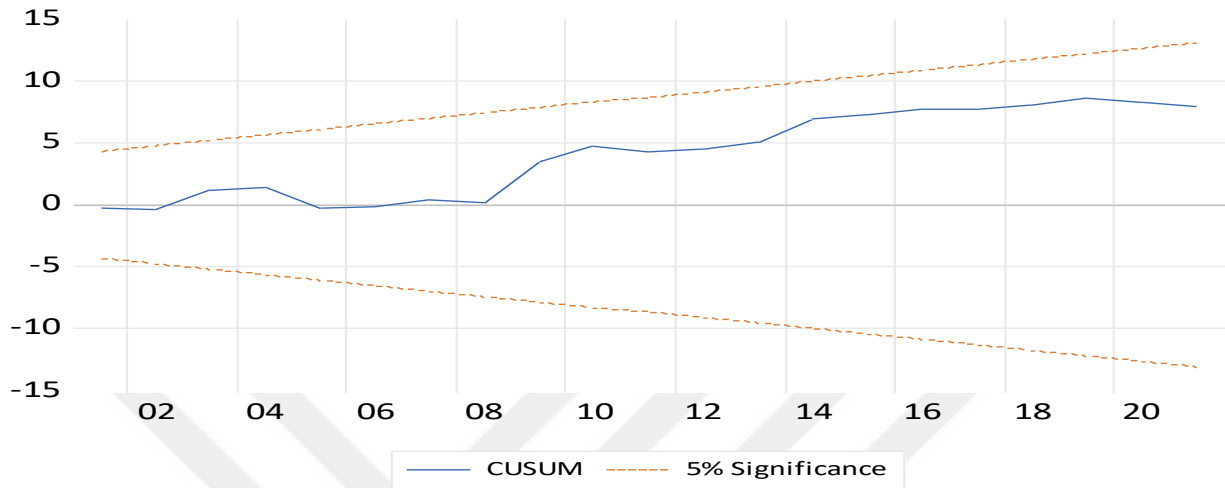
Figure 5.10: Jarque-Bera Normality Test, M₂.



As the probability value of 0.95 for M₂ in **Figure 5.7** is more than the significance level of 5 percent, the study fails to reject the null hypothesis, which states that the residuals follow

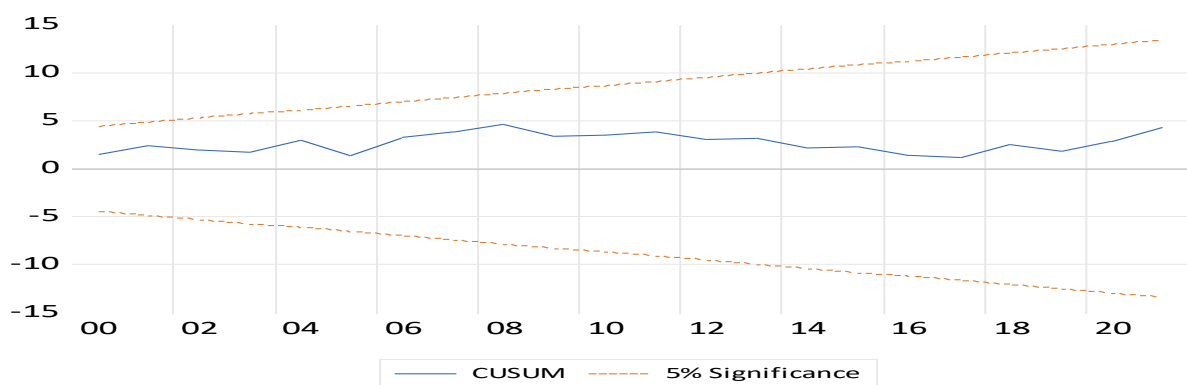
a normal distribution. We then conclude that the residuals can be thought of as regularly distributed.

Figure 5.11: Stability test.



The results shown in **Figures 5.8** clearly show that the parameters of NDC are stable because the plots of the CUSUM statistics stay within the 5 percent crucial bounds that are intended to be used to evaluate the model's parameter stability. This suggests that the parameters of the model are stable and do not display large deviations from the given constraints, hence validating the robustness of the computed coefficients.

Figure 5.12: Stability test.



The Parameter of M2 stability is clearly demonstrated by the results shown in **Figures 5.9**. The CUSUM statistics' plots routinely fall inside the 5 percent essential constraints that were set up to evaluate the model's parameter stability, which makes this extremely clear. As a

result, the derived coefficients are reliable and resilient. This observation shows that the model's parameters are stable and show little variation from the given restrictions.



CHAPTER 6

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

In this dissertation, the primary aim has been to critically evaluate the impact of technology on the economic advancement of Liberia. Specifically, the study focused on assessing the role of technological advancements, as indicated by mobile cellular subscriptions and internet penetration rates, in shaping the financial landscape of Liberia. The progress in the financial sector was measured by examining indicators such as net domestic credit and broad money supply.

In essence, the findings of this study have been robustly established. The empirical analysis reveals a significant negative and positive correlation between technological adoption and financial development in Liberia, as evidenced by the variables employed. These findings are in line with previous research: (Tadesse, 2005; Asongu, et. al., 2019; Ang, 2011; Alshubiri et al., 2019; Comin, & Nanda, 2019)

Firstly, the results show all variables have no positive long-term and short-term influence on money supply and Net Domestic Credit, except for mobile cellular subscriptions that shows both long term and short-term influence on Money supply.

Secondly, all variables indicate a positive and statistical relationship between Money supply in the long run, whereas Net Domestic Credit reveal positive implication on Mobile Cellular Subscriptions and internet penetration, and negative relationship with GDP and Lending on interest rate in the long run.

Lastly, the study also explored the relationship between GDP impact on net domestic credit and money supply, revealing negative insignificant effects in the short term, but found a positive impact on Money supply in the long run. Also, the impact of lending interest rates on and money supply is found that there is positive statistically significant relationship in both

short and long terms. In contrast, LIR has positive impact on net domestic credit in the short run and a negative relationship in the long run.

The empirical findings disclosed of this dissertation effectively address the research questions and objectives proposed in the study.

Firstly, it is evident that technological advancements, encompassing internet accessibility and penetration rates have positive influence on the development of Liberia's financial sector in the long run, however, internet penetration or access has negative and statistically significant relationship in the short term whereas mobile subscription reflects a positive and statistical contributions in the short term.

Secondly, the empirical results show that there is an existence of statistically significant positive and negative short-term correlation between technology and financial development in Liberia; and a deeper analysis reveals positive statistically significant long-term relationship between the two in Liberia in the contest where mobile cellular subscriptions and internet penetration as indicators of technology, while net domestic credit and money supply are proxied for financial development.

Thirdly, the findings further reveal that various barriers such as deficient infrastructure, governmental policies, and deficiencies in human resources and amenities hinder the widespread adoption of technology services. Conversely, stakeholders including telecommunications firms, financial institutions, governmental bodies, and international collaborators play instrumental roles in facilitating the integration and utilization of technology within Liberia's financial sector.

Fourthly, most importantly, the empirical evidence shows that the presence of technology is evidently reshaping financial services and providing multiple means of financial access and transactions for customers mitigating the challenges in the financial sector of Liberia. However, there is need to further advance and improve the service, provide information and publicity to the clients, and protect clients assess.

Overall, these findings contribute to the existing body of knowledge on the nexus between technology adoption and financial progress in Liberia, offering valuable insights for policymakers and stakeholders.

6.2 Policy recommendation

Established from the dissertation's results, several practical policy suggestions can be put forth to improve the technology's integration and application in Liberia's financial industry.

First, infrastructure development must be given keen priority by the Liberian government. Specifically, improving telecommunications networks and increasing access to dependable internet connectivity. To achieve this, budgetary appropriation should be allocated for the development of broadband infrastructure and the introduction of sophisticated telecoms to underserved areas. Furthermore, government should ensure fiscal policy that minimize the taxes levied companies or better negotiate for ensuring affordable service internet packages or communication services that enable many users to access these services to further expand or improve internet penetration and mobile subscriptions.

Second, to mitigate the barriers preventing the financial sector from widely adopting technology, government should improve the material and infrastructure well-being of its people. Government should prioritize technology as a contributing factor to development in this era through budgetary allocations. In addition, government should improve telecommunication policies and ensure that telecommunication companies comply of the laws that govern the telecommunication activities in Liberia. Furthermore, to overcome human capacity deficiencies and foster a culture of technology innovation within financial institutions, programs targeted at improving digital literacy and skill development within the workforce. Lastly, government should enter the market as a telecommunication entity or better open the market for competitions.

Third, although there exists a positive contribution of technology on the financial system in Liberia, yet there is still volume of gap that we need to improve through strong coordination and partnerships across important stakeholders. The relationship between technology and financial transactions should be vividly seen as the result of the output. The government through the monetary angle should engage innovative approach and cutting-edge research to ensure we have digital financial platform that enable all or major financial activities as the result of technology in both midterm and short term.

Lastly, technology in the financial sector of Liberia has resulted in both positive and negative implications of clients. Technology has improved financial transactions; however, we cannot negate the fact that there still some negative implication of technology to financial transactions. For instance, cyberthief, use technological financial platforms to steal clients' assets from through faulty transactions and many other ways. Both the government and digital financial institution should ensure client assets and portfolios by mitigation cyberthief and provide a safe environment that encourage and build client to carryout financial activities without any form of intimidation because of cyberthieves.

Overall, Liberia can harness the transformative potential of technology to leverage economic growth, financial inclusion, and sustainable development nationwide by putting these policy proposals into practice.

6.3 Limitation and Future Research

The dissertation limitation on technology's impact on financial development have been examined which include infrastructure, strategy, policy, governance, and management. To improve financial development, future study should focus on these undiscovered indicators to gain better understanding of the growing usage of mobile phones and internet services improve financial development. Addressing this limitation can enhance further research as additional data become accessible. Furthermore, studies aiming at improving the literature already in existence in accordance with sustainable development goals should examine the ways in which technological services support financial access and finding alternative indicators of technology to enhance the inclusive effects of these programs. Lastly, further research should consider variables that are directly and closely related to technology and financial development to have a clearer picture of their relationship.

The primary policy implication highlighted by the research suggests that leveraging technology can enhance financial development in Liberia. By enhancing the depth of the financial system, such as increasing deposits, fostering greater activity such as credit provision, and improving the efficiency of financial allocation, technology-driven initiatives can effectively address surplus liquidity challenges. Moreover, tailoring these ICT-driven approaches to the specific needs and initial levels of financial development in Liberia could significantly enhance effectiveness, ensuring achievable outcomes from policy measures.

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