College of Business & Economics

MBA Program

The Effect of Technological Innovation Uptake on the Financial Performance of Commercial Banks in Ethiopia

A thesis submitted to Addis Ababa University in partial fulfilment of the requirements for the award of the Degree of Master of Business Administration in Finance

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Statement of Declaration

I, Elbethel Darge, declare that this thesis entitled “The Effect of Technological Innovation Uptake on the Financial Performance of Commercial Banks in Ethiopia” is my original work, which has not been presented for a degree in this or any other universities and that all sources of materials used for the thesis have been properly acknowledged.

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This is to certify that Elbethel Darge has carried out her research work on the topic entitled “The Effect of Technological Innovation Uptake on the Financial Performance of Commercial Banks in Ethiopia”. The work is original in nature and is suitable for submission for the reward of the MBA Degree in Master of Business Administration (Finance).

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ADDIS ABABA UNIVERSITY
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Approval Sheet

"THE EFFECT OF TECHNOLOGICAL INNOVATION UPTAKE ON THE FINANCIAL PERFORMANCE OF COMMERCIAL BANKS IN ETHIOPIA".

By

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Abstract

A technological innovation is a new or improved product or process whose technological characteristics are significantly different from the way they were before. Technological innovation is highly used by the banking sector to create competitive advantage. It helps banks improve their services and become more cost efficient. The aim of conducting this research is to identify the effect of technological innovation on the financial performance of the Ethiopian commercial banks. The study used secondary data which was gathered from the published annual reports of the banks. The collected data was analyzed using Eviews 9. An econometric regression model was used to determine the relationship between technological innovation and financial performance for a period of seven years (2015 – 2021). Financial performance, measured by Return on Asset (ROA), was the dependent variable. Technological innovation, measured by number of internet banking users, number of mobile baking users, number of ATMs, number of debit card holders and number of POS terminals were the independent variables. Bank size was also used as a control variable to avoid the omission of important variables. The results of the regression showed that there is a positive relationship between internet banking, ATMs, POS terminals and bank size with ROA while mobile banking and debit cards have a negative one. It also showed that while the effects of internet banking, mobile banking, debit cards, POS terminals and bank size were significant, the effect of ATMs, was insignificant. The study recommends that banks should work more on creating awareness about technological innovation and integration of their systems with other banks.

Keywords: Technological Innovation, Financial Performance, Commercial Banks

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List of Abbreviations

ROA – Return on Asset

ATM – Automatic Teller Machine

POS – Point of Sale

CLRM – Classic Linear Regression Model

E-banking – Electronic Banking

CHAPTER ONE

Introduction

1.1. Background of the Study

The term innovation has been defined, interpreted, and understood in different ways throughout history. Although innovation has always existed, it is considered as a relatively recent phenomenon by many and has acquired real importance in the twentieth century. The term is usually mis-used as many people just assume innovation to be technological innovation. However, the concept of innovation is much broader and is concerned with any type of novelty: individual, social, cultural, organizational, technological, scientific, and artistic (Godin, 2008).

The Oslo Manual (2018) defines innovation as a new or improved product, service, or a combination of both that differs significantly from previous products or processes and has been made available to potential users. The authors of the manual state that innovation is very important as it is applicable to all sectors of an economy.

A high level of competition gives rise to innovation. When the products or services different companies offer to the market become indistinguishable between one another, they are required to excel in order to differentiate themselves and standout. One way to do this is to innovate as innovation is one of the most important factors in gaining a competitive advantage. It plays a vital role in changing the position a company holds in the market (Zainurossalamia et al, 2016).

It is mentioned above that the concept of innovation is very broad and can be classified into different types. However, this paper will focus on technological innovation. A technological innovation is a new or improved product or process whose technological characteristics are significantly different from the way they were before (Tilastokeskus, n.d).

Technological innovation plays a vital role in increasing productivity and brings citizens new and better goods and services that improves their standard of living, however slow it can be sometimes to materialize (Broughel & Thierer, 2019). Technology as one source of innovation is a critical

factor for increased market competitiveness. This type of innovation involves applying a new type or improved technology into a product or service delivery methods (Kylliäinen, 2019).

Broughel & Thierer (2019) argue that the changes initiated by innovation can sometimes lead to an unsettling disruption in the short-term. Some of these disruptions could be the failure of old business models and driving some individuals out of their jobs. However, in the long-run, the search for new and better ways of doing things drives human learning and eventually lead to prosperity. Also, those who lost their jobs will find other jobs and be able to serve their community in a new way.

Technological innovation is highly used by the banking sector to create competitive advantage. It helps banks improve their services and become more cost efficient. Banks can achieve this cost efficiency since they will need fewer employees and less branches. Also, applying technological innovation helps banks decrease transaction costs since they would be able to provide their customers with the necessary capacity to execute their own transactions anywhere and anytime (Chaarani & Abiad, 2018).

Jerene & Sharma (2018) state that when compared to the rest of the world, the induction of technological innovation into the Ethiopian banking sector is still at an infant stage. Although there has been a diffusion of electronic banking systems by commercial banks in Ethiopia, these services have not been widely adopted by many bank customers (Teka, 2017).

The Ethiopian banking sector has undergone a growth over the last decade in terms of applying technological innovation as different Ethiopian banks have applied technological innovations to their systems. These technological innovations are in the form of ATM's, debit cards, POS, agency banking, internet banking, and mobile banking (Temam, 2018).

Nowadays, technological advancements play a vital role in the performance of businesses as the world we are living in is becoming more digital (paconsulting, n.d). Despite this, enough studies have not been conducted on the effect technological innovations have on the financial performance

of firms in Ethiopia. Therefore, this study proposes to examine this effect and how much it has changed over the past few years in the Ethiopian banking sector.

1.2. Statement of the problem

Joseph Alois Schumpeter, regarded as one of the greatest economists of the first half of the 20th century, argued that anyone seeking to gain profits must innovate. He believed that innovation is the center of economic change. Innovation involves the different employment of an economic system's existing supplies of productive means. It revolutionizes the economic structure from within by destroying the old one and creating a new one (Sledzik, 2013)

A fierce competition in an industry gives rise to innovation, which helps firms create something different that helps them standout from competitors. Mai et al (2019) claimed that implementing innovation strategies involves taking risks as they are a huge investment, however, these risks can be out-weighted by the potential higher return for the innovators.

Involving in innovative activities may serve as an indication that a firm is performing well in the market, which helps in attracting new customers. Innovation also helps in customer retention as it increases customer satisfaction and loyalty. This is because existing customers are most likely going to be purchasing the products or services of the firm regularly and convince others to purchase its products and services, resulting in an increased revenue and profitability for the firm Narver and Slater (1990).

When a firm thinks of introducing a new product or service to the market, it should allocate a large budget to marketing strategies, market research, and investment technology. This increased cost will decrease the profitability and expected return of the shareholders of a company. The results of introducing new or better products or services are only seen after they are used and adopted by customers. Therefore, the firm should make sure that it will benefit from the innovation after sometime since it is sacrificing a huge amount of return to the shareholders (Mai et al., 2019).

Nowadays, technological innovation is considered as one on the most important tools that can affect the banking sector. It is forecasted that technological process will destroy the models used in delivering banking services and replace them with new ones. Investing in innovation has a

significant impact on the performance and profitability of banks. This is because innovation has become one of the key drivers of profitability in the 21st century and is becoming an increasingly decisive factor in the performance and competitiveness of banks (Chaarani & Abiad, 2018)

Technological innovation is becoming one of the major factors that affect the financial performance and profitability of commercial banks (Chaarani & Abiad, 2018). This makes the carrying out of this study very important. This study identified the overall effect of applying different technological innovations have on the financial performance of commercial banks in Ethiopia. It also determined whether the banks are benefiting from the technological innovations as much as they should and suggest areas of improvement to get the most of the innovations.

1.3. Research Questions

The key research question developed to be explored during the study is as follows:

What is the effect of the technological innovation uptake on the financial performance of the commercial banks in Ethiopia?

1.4. Objectives of the Study

1.4.1. General objective

The main objective of the study is to determine the effect of technological innovation uptake on the financial performance of the commercial banks in Ethiopia.

1.4.2. Specific Objectives

The specific objectives of the study include;

i. To determine the effect of internet banking on the financial performance of commercial banks.
ii. To examine the effect of mobile banking on the financial performance of commercial banks.
iii. To evaluate the effect of automated teller machines (ATMs) on the financial performance of commercial banks.
iv. To explore the effect of debit cards on the financial performance of commercial banks.
v. To appraise the effect of point of sale (POS) terminals on the financial performance of commercial banks.
vi. To analyze the effect of bank size on the financial performance of commercial banks.

1.5. Hypotheses of the study

Base on the objectives of the research and the literatures to be discussed in the next chapter, the following hypotheses are formulated.

H1: Internet banking has a positive and significant effect on the financial performance of commercial banks in Ethiopia.

H2: Mobile banking has a positive and significant effect on the financial performance of commercial banks in Ethiopia.

H3: Automated teller machines (ATMs) have a positive and significant effect on the financial performance of commercial banks in Ethiopia

H4: Debit cards have a positive and significant effect on the financial performance of commercial banks in Ethiopia.

H5: Point of sale (POS) terminals have a positive and significant effect on the financial performance of commercial banks in Ethiopia.

H6: Bank size has a positive and significant effect on the financial performance of commercial banks in Ethiopia.

1.6. Scope and Limitations of the study

The scope of this study was limited to commercial banks in Ethiopia. The nine commercial banks included in the study were chosen based on availability of data and focus on technological innovation. Return on Asset (ROA) was used to measure financial performance of the banks. This measure of profitability is chosen since ROA is the most frequently applied ratio to banks due to the difficulty to accurately construct the cash flow analysis (Maverick, 2021). ATM's, debit cards, internet banking, mobile banking and POS terminals were used as measures of technological innovation. Bank size was also used as a control variable in order to avoid the omission of important variables.

The data was collected from secondary sources. The secondary data was collected from the published annual reports of the banks. A seven-year data of the commercial banks was used to identify the effect of technological innovation on the financial performance of commercial banks in Ethiopia.

The possible source of limitation of the study is lack of sufficient data and up-to-date literature in the area concerned with Ethiopian context. This will make it harder to compare the results of the study with that of other similar studies conducted in the country.

1.7. Significance of the study

The study will benefit the managers of the banks in Ethiopia as they will be able to use the findings to decide on which technological innovations to implement or focus on. It will help them identify which of the technological innovations they are benefitting from the most and which one's it should work on to increase the profitability and performance of the banks to maximize the return of shareholders. Afterall, the main objective of any company is to maximize the wealth of its shareholders.

Moreover, the study will be useful to other researchers who are interested in conducting a study to explore the effects of technological innovation on financial performance. The study will extend and add to the existing knowledge in the area.

1.8. Organization of the Study

The study has a total of five chapters. The first chapter is an introduction which consists of background of the study, statement of the problem, research questions, general and specific objectives of the study, scope and limitations of the study, significance of the study, and organization of the study. The second chapter explores the theoretical and empirical literatures that are related to the concepts of technological innovation and financial performance. The third chapter discusses the methodologies of the study. The fourth chapter covers regression output analysis along with the interpretation. Finally, the fifth chapter presents the summary of the findings, conclusion, and recommendation of the study.

CHAPTER TWO

Literature Review

Introduction

This part of the study is organized in two major parts: theoretical review and empirical review. The theoretical review of literatures part discusses theories related to technological innovation and the performance of firms, specifically banks. The empirical review of literatures part focuses on previous studies that intended to identify the effect of technological innovation on the financial performance of banks.

2.1. Theoretical Literature

2.1.1. Innovation

As it is mentioned above, the term innovation has been defined and understood in different ways. By the time Baregheh et al. (2009) conducted a study to propose an integrative diefinition of organizational innovation, they found 60 definitions of innovation in different scientific papers. The researchers conducted a content analysis of these definitions and arrived at a multidisiciplinary definition. They definied innovation as a multi-stage process whereby organizations transform ideas into new or imporved products, proceess, or services in order to advance, compete and differentiate themselves successfully from others in the marketplace.

2.1.1.1. Creativity vs Innovation

These days, it is becoming a common habit to use the terms creativity and innovation interchangeably. Although the two concepts are related, there is a critical difference between them (Marshall, 2013). The author identified focus as the main difference between creativity and innovation. Creativity is all about unleashing the potential of the mind to come up with new ideas and these ideas are usually something that can be seen, heard, smelled, touched, or tasted. They could also be thoughts within one's mind. Innovation, on the other hand, is all about introducing change into a relatively stable system. It deals with the work required to make a certain idea viable. The author also differentiates the two by their measurability. As creativity is subjective, it is hard to measure while innovation is completely measurable.

In short, creativity is the generation of new ideas while innovation is the accomplishment of those creative ideas. Creativity doesn't consume any money and isn't risky at all as it is just an idea. In contrast, innovation does consume money and can be risky (Ask any difference, n.d).

2.1.1.2. Importance of Innovation

Innovation is one of the key drivers of economic change and when it is successful, it contributes to the financial performance of a firm. It can also lead to better standard of living as it provides better safety, health care, quality products, and services. As the world we're living in is fast-changing, it brings challenges and opportunities to businesses and innovation can help the business make the most out of these challenges (InnosuTra, 2007).

One benefit of innovation is the reduction of cost of production. Innovation is usually associated with higher costs; however, this isn't always true. While innovating, one firm must keep an eye on the costs while pushing forward to create new solution. One way to reduce cost while innovating is by simplifying the product. This means removing the features of a product that have no use for the target market or isn't a selling point and just focusing on the ones that are valued by customers (Kaplan, 20158).

Job creation is another benefit of innovation. Although new technologies destroy jobs especially those requiring low-skills in some industries, they do create new jobs in new industries requiring different skills. Therefore, the net effect of innovation on technologies on jobs is positive as new industries replace old ones and workers adapt their skills to the changed demand (The OECD Jobs Strategy, n.d.).

Innovation can also help in increasing market share and competitiveness of a company. When a company offers a new technology to the market that its competitors have not offered yet, customers of competing companies, wishing to own the new technology buy it from that company. And then, as many of the customers become loyal, the market share of the company increases (Kramer, 2019).

Another main benefit of innovation is increased profitability and growth. Focusing on building a strong customers relationship and conducting regular surveys to identify potential product improvements translates into more sales overtime, which increases profitability. Waste reduction can also help in cost reduction and improving profit margin. Having an innovative workplace is also another way companies can profit from innovation as employees are usually the best source of ideas (bdc Website, n.d)

2.1.1.3. Types of Innovation

There are several frameworks that have been proposed to define the types of innovation. Some of them will be discussed below.

2.1.1.3.1. Clayton Christensen's Classification of Innovation

A Harvard Business School Professor, Clayton Christensen, classified innovation into three: Disruptive Innovation, Sustaining Innovation, and Efficiency-based Innovation (Strauss, 2018). The different characteristics of each innovation type will be discussed below.

a. Disruptive Innovation

A disruptive innovation is a process by which a new product or service creates a new market, eventually displacing established competitors. It creates value either by disrupting an existing market or creating a completely new market. It is one of the critical factors that contribute to the long-term success of a business. Disruptive innovation might involve the conversion of high-end products into something more affordable and accessible. This is a new-market disruption and it occurs when businesses create a new segment in an existing market in order to address the needs of unserved customers. Small businesses with fewer resources can use a low-end disruption, which occurs when a business comes in at the bottom of the market with a good enough product that is offered at a cheaper price. This is usually how new entrants win (Landry, 2020).

b. Sustaining Innovation

Sustaining innovation, in contrast to disruptive innovation, involves the improvement of a company's business by making good products and services better. Sustaining innovation doesn't

create jobs as the companies pursuing this type of innovation fight for customers who are willing to pay for an enhanced version of a product or service in a mature market. This type of innovation creates little net worth since once customers buy the latest and improved version of a product or service, they are unlikely to buy the previous version that aren't as good. As a result, no new market is created (Strauss, 2018).

c. Efficiency-based Innovation

The third type of innovation is efficiency-based innovation, which is doing more with less. This type of innovation increases free cash flow, productivity, competitiveness, and profitability of a company but also dramatically cuts jobs. It enables businesses to simplify their existing products, produce existing products at a lower cost or sell their products & services to their existing customers at lower prices (Nibusiness, n.d).

2.1.1.3.2. Henderson and Clark's Classification of Innovation

Traditionally, innovation was classified as either incremental or radical. However, Henderson & Clark (1990) disagreed with this classification as they believed it was incomplete and potentially misleading. Their model of innovation focuses on products and the distinction between components and architecture. The authors argue that these two factors play vital roles in relation to most products. They claim that although it is possible to innovate the two factors independently, the most radical innovation comes when both are done at the same time. According to Henderson & Clark (1990), innovation is divided into four: radical innovation, incremental innovation, architectural innovation and modular innovation. These will be discussed below.

a. Radical Innovation

Radical innovation is usually what people think of when they consider innovation. This is because radical innovation establishes new industries or diminishes existing ones. It also involves creating a revolutionary technology. As this type of innovation requires disrupting an existing business and creating a new business model, it is the most difficult to execute. (World of Work Project, n.d). According to Barczak, as mentioned in Carleton (2019), the return from a radical innovation is

high but so is the risk. Since a radical innovation is so different from what people are used to, it is sometimes hard for it to be accepted.

b. Incremental Innovation

In contrast to radical innovation, incremental innovation involves making a low-cost small improvement to a company's products or services. This will help the company differentiate its products or services it offers to the market from the ones offered by its competitors. This type of innovation is less risky as compared to radical innovation since consumers can adopt to small changes easily than to a completely new product or service. Although the return from an incremental innovation is lower, the risk and the capital requirement are also lower (Carleton, 2019)

c. Architectural Innovation

Architectural innovation involves changing the product innovation and combining components in new and different ways without introducing component technologies that are fundamentally new. Sometimes, identifying a particular innovation as architectural is a problem since architectural innovation is oftentimes initially accommodated within old frameworks (Magnusson, 2002). In short, in this type of innovation, the core components of the product remain the same while the relationship between the components changes (Kylliäinen, 2019).

d. Modular Innovation

In modular innovation (sometimes called component innovation), which is the exact opposite of architectural innovation, a new technology that overturns the core design concepts of individual components is introduced. The established linkages between components are relatively untouched during the process (Magnusson, 2002).

2.1.1.3.3. Business Model, Innovation and Marketing Innovation

Kylliäinen (2019), in her blog that discusses about key innovation management models and theories, mentions that looking at the source of innovation is also another perspective. Under this

perspective, innovation can fall into three categories: business model innovation, technology innovation and marketing innovation.

a. Business Model Innovation

A business model innovation describes the process by which a company adjusts its business model. This type of innovation often reflects a fundamental change in how a company delivers value to its customers. This could be through the development of a new revenue stream or distribution channel. Business model innovation allows companies to take advantage of the continuously changing customer demands (Landry, 2020).

b. Technology innovation

Wikipedia defines the term technological innovation as a process where an organization starts a journey where the importance of technology as a source of innovation has been identified for an increased market competitiveness.

c. Marketing Innovation

Marketing innovation is a very important factor that contributes to the success of a business. This is because spending time and money on business model and product development would be pointless unless people aren't able to find the product. Marketing innovation involves finding new channels and markets to promote products and creating new values to customers those competitors couldn't provide (Kylliäinen, 2019).

2.1.1.4. Theories of Innovation

In this section, the different theories of innovation scholars have produced over the years will be discussed.

2.1.1.4.1. Schumpeter's Theory of Innovation

Joseph Alois Schumpeter, regarded as one of the greatest economists of the first half of the 20th century, argues that anyone seeking to gain profits must innovate. He believed that innovation is the center of economic change (Sledzik, 2013).

Schumpeter's most distinctive contributions to economics are the concepts of innovation and entrepreneurship. The roles innovation and entrepreneurship played in economic growth were very common in his writings. His view in the area had changed over time. At first, the author viewed the occurrence of revolutionary change as the core of economic development, which breaks the economy out of its static mode and into a dynamic path. However, three decades later, he took a view that dynamic capitalism was executed to fail because the efficiency of a capitalist enterprise would lead to the disappearance of the entrepreneur (Sledzik, 2013).

Schumpeter's innovation theory states that the main function of an entrepreneur is the introduction of innovation in which the profit is in the form of reward given for the entrepreneur's performance. According to the author, innovation can be classified into two categories. The first category includes those activities that reduce the overall cost of production of a company. These cost reducing activities could be in the form of introducing a new method of production, machinery, and innovative method of organizing the industry. The second category includes all those activities that increase the demand for a product. These demand increasing activities could be in the form of introducing a new product, market, source of raw material and design of a product (Prajapati, n.d).

Most of the time, the profits earned from innovation only last for a short period of time. This is because competitors are eventually going to imitate the innovation. Until the innovation is imitated, the entrepreneur will enjoy a monopoly position in the market and earn large profits. But after some time, the profit will start decreasing as the entrepreneur will have to share it with those of its competitors who have imitated the innovation (Prajapati, n.d).

Schumpeter divided the innovation process into four dimensions: invention, innovation, diffusion, and imitation. According to his analysis, the invention and innovation phases have less of an impact on the state of an economy when compared to the diffusion and imitation phases. The entrepreneur believes that innovation is the creative destruction that develops the economy while an entrepreneur performs the function of the creator of change. Schumpeter's innovation and entrepreneurship concepts are universal and still evolving till this day in neo-Schumpeterian economics (Sledzik, 2013).

Even though Schumpeter's theory of innovation is widely accepted in the modern economy, it has shortcomings and has faced different criticisms. The first criticism is over the fact that the theory over glorifies the role of an innovator in his model. This is because, nowadays, innovational activities have become a routine and there is no need of an innovator (Suman, n.d).

The second criticism was due to the ignorance of savings and undue importance given to bank credit. Schumpeter assumed that innovations were financed by a bank credit. This assumption is not convincing since banks usually provide short term loans. However, in the long-run, real savings, public borrowing, and budgetary savings will be needed (Suman, n.d)..

Another area of criticism was because of Schumpeter's assumption of innovation as the main cause of economic development. This assumption of his is way far from reality as the economic development of a country depends on many economic and social factors and not only on innovation (Suman, n.d).

2.1.1.4.2. Christensen's Theory of Disruptive Innovation

Clayton Christensen, regarded as one of the world's top experts of innovation and growth, coined the term disruptive technology. The professor's theory of disruptive innovation is now more than twenty years old. The term disruptive innovation describes a process by which a product or service initially takes root in simple applications at the bottom of the market and then moves up the market and eventually displaces established competitors (Christensen, n.d).

Christensen's idea of disruptive innovation has become so common now that it is used to explain every existent or threatened disturbance. The professor angrily disagrees to this because he didn't like the fact that people take the idea, twist it, and use it to justify whatever they intended to do in the first place. However, misapplied the idea of disruptive innovation is, it is an interesting scientific conjecture (King, 2017).

The theory of disruptive innovation is an extension of joseph Schumpeter's process of creative destruction. However, it differs from the previous literature by it focusing blame for displacement of industry leaders on management rather than on flattering firm capabilities. His theory attempts

to provide an explanation for the reason why firms with abundant remaining capabilities might fail in response to new competition (King, 2017).

According to the professor, companies usually pursue sustaining innovations because it is what has helped them succeed historically. Companies that pursue this type of innovation charge the highest prices to their most demanding customers at the top of the market and by doing this, they will achieve the greatest profitability. By doing so, these companies unknowingly open the door to disruptive innovation at the bottom of the market. A disruptive innovation allows a new population of consumers at the bottom of the market the access to a product or service that was historically only accessible to consumers with a lot of money (Christensen, n.d).

Christensen has identified five important characteristics of a disruptive innovation. First, new disruptive technologies are cheaper, simpler, and more reliable than established products. Second, leading customers usually can't shift to the new disruptive technology because of the older dominant design. Third, when compared with the older technology, the new technology underperforms. Fourth, disruptive technologies improve performance after they enter the market because producers learn by experimenting. Fifth, the disruptive innovation displaces the old technology at some point, therefore, new entrants displace the incumbent firms (Rakic, 2020).

Christensen and Reynor (2003) as cited by Rakic (2020), argue that disruption is a process that continues over time and not occurs in just one given moment. A disruptive technology is not necessarily a new product or service that has a better performance than the previous one. It is rather a product that creates new markets and opportunities that can replace the incumbents. This replacement happens because existing firms fail due to an absence of investment in new technologies.

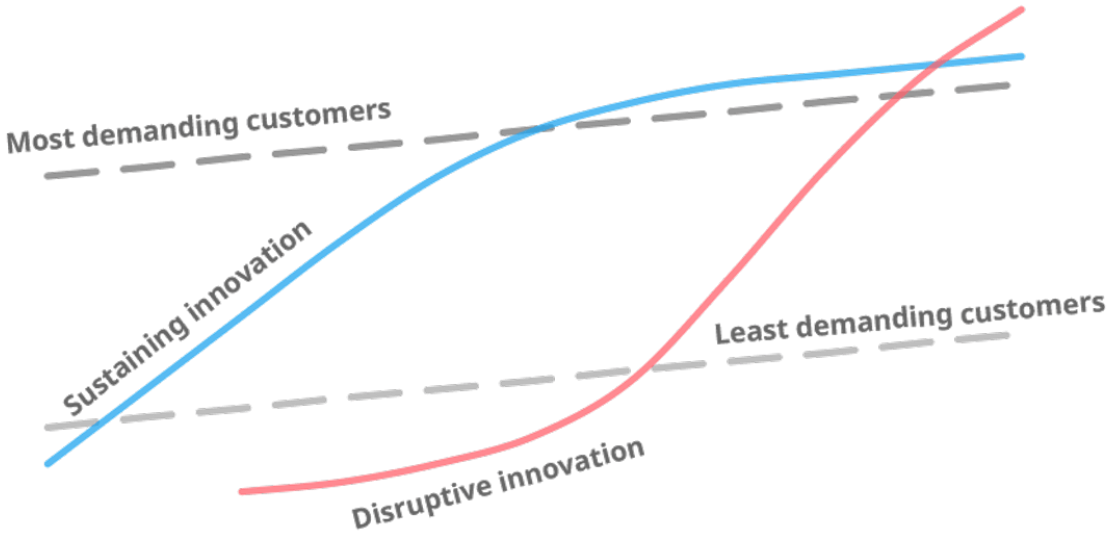


Figure 1: Disruptive vs. Sustaining Innovation

Source: https://www.viima.com/blog/innovation-management-models#the-core-of-the-dilemma

As it is shown in the figure above, disruptive innovation is below the s-curve and inferior to the existing products and services. It initially caters only to a small and not-so-profitable customer base. At this time, the incumbents are forced to only serve the more demanding customers using their existing value chain channels. However, once the disruptive technology enters the mainstream, the new entrant will be on the exponential part of the s-curve. At that point, it is often too late for the incumbents to catch up to them (Kylliäinen, 2019).

Even though Christensen's theory of disruptive innovation holds a prominent place in the business world, it has faced some criticisms. Although the theory applies well to old-school or linear businesses, it breaks down when it comes to platform businesses. As Christensen's research was over twenty years ago, it was conducted based on the linear businesses. However, platform businesses operate in a different way than the linear businesses. Platform businesses create and grow a network rather than build and refine a supply chain. Christensen's theory only looks at customers and ignores the supply side. This is the reason why misunderstandings rise when the theory is applied to platform businesses. Therefore, it is time to update the theory of destructive innovation to account for platforms (Moazed & Johnson, 2016).

2.1.1.4.3. Strategyn's Jobs-To Be-Done Theory

The jobs-to-be-done (JTBD) theory has been around for decades. However, outcome-driven innovation (ODI) is the first methodology to effectively put the theory into practice. Tony Ulwick, founder of Strategyn and pioneer of jobs-to-be-done theory, created the outcome-driven strategy. Ulwick introduced the concept of ODI to Clayton Christensen in 1999. Christensen then popularized the theory in his book: the innovators solution (2003) and labeled it the jobs-to-be-done theory. In the present day, Ulwick also refers to the theory as the jobs-to-be-done theory and describes ODI as the process that puts the theory into practice (Ulwick, 2017).

The jobs-to-be-done theory is a framework that is used to better understand customer behavior. The conventional marketing focuses on market demographics or the attributes of a product while the JTBD theory goes beyond the superficial categories and exposes the functional, social, and emotional dimensions that explain the reason behind the choices of customers. People just don't buy products or services, instead, they pull products or services to their lives to make progress. This progress is called the "job" they are trying to get done. Understanding this is what opens the possibility for innovation. It helps innovators develop a product that aligns with what customers are already trying to accomplish (Christensen Institute, n.d).

According to a blog posted on the Garage Group website, there are different schools of thought that companies can use when approaching jobs. The first one is Christensen's emphasis on consumer circumstance, which is discussed above. The second one is Ulwick's outcome-driven innovation, which is the understanding that people buy products and services to get jobs done. The people have measurable outcomes they attempt to accomplish once the jobs are completed. The third school of thought is Klement's. He claims that customer preferences and desired outcomes are the same. According to him, customer preferences and desired outcomes can't be quantified.

For most companies, failure rate of innovation is above 80 percent. This is because companies fail to define their customer's needs with precision and thus struggle to create winning products. They don't have a system to evaluate which ideas are the best and they are forced to guess, which is

often wrong. Ulwick came up with the concept of ODI trying to find a solution to this problem (Ulwick, 2017).

2.1.1.5. Types of Technological Innovations in the Banking Sector

Banks are currently investing in information and communication technologies to enhance service delivery and improve efficiency in their operations. Some of these technological innovations include the automated cheque clearing systems, Automated Teller Machines (ATM) for cash withdrawal and deposits, internet banking and cash collection and mobile banking platforms. These innovation in the banking sector are gradually changing the way services are offered by banks (Ameme & Wireko, 2016).

According to a blog written by Kaur (2021), financial institutions will need to improve digital banking experiences and prioritize technological transformation for them to stay competitive. Some of these innovations include robotic process automation, quantum computing, and blockchain.

However, Ethiopian banks are far from implementing these technological innovations. Therefore, Automated Teller Machines (ATMs), Internet Banking, Mobile Banking, Debit Cards, and POS terminals will be discussed in this study.

2.1.1.5.1. Automated Teller Machines

Duvey et al (2013) defines Automated Teller Machines (ATMs) as a new banking system in which an account holder can access his/her account anytime and anywhere with a debit card given by a bank. ATMs provide customers with the ability to perform different quick service financial transactions such as withdrawals, deposits, transfers, and balance inquiries at any given point in time.

ATMs have a lot of benefits. The first one is the provision of a 24-hour service. It also reduces the queue and work load on bankers. They are also a good source of cash for travelers. However, customers face some network problems while using the service (Settearagachew, 2017).

ATM was introduced in Ethiopia back in 2001 by the largest state-owned Commercial Bank of Ethiopia (CBE). This marked the emergence of e-banking in Ethiopia. CBE introduced the first eight ATMs in the country. It was then followed by Dashen Bank S.C (Ashenafi, 2019).

2.1.1.5.2. Internet Banking

Mai et al (2007), as cited by Al-Weshah (2013), refers to internet banking as a deployment over the internet of retail and corporate banking services that involves individual and corporate clients. These services include payments and settlements, bank transfers, corporate and household lending. It enables customers conduct business transactions anytime and anywhere faster and with lower fees as compared to using the traditional bank branches.

2.1.1.5.3. Mobile Banking

Mobile banking refers to the provision of banking services through mobile phones or tablets. It is an alternative and evolution of internet banking. Mobile users can conduct banking transactions such as paying bills, transferring money, and checking balances using their mobile phones. Mobiles banking usually involves using a software called an application. To use mobile banking, there is no need for an internet connection, just a mobile connection (Sadiku et al, 2017).

2.1.1.5.4. Debit Cards

Debit cards were originally introduced as ATM cards. It is a plastic payment card that is linked to the card owner's account at a bank. When the card is used, it assesses the money available in the card owner's bank account. To increase convenience to their customers, banks formed a network to allow their customers use their cards in ATMs owned by any bank in the network. Over time these ATM cards came to be known as debit cards (Parker et al, 2011).

2.1.1.5.5. POS Terminals

Point of sale (POS) terminals are hardware systems that are used to process card payments at retail locations. The POS terminal reads the magnetic strips of a debit or credit card to check for the availability of sufficient funds to transfer to the merchant. It then makes the transfer (Halton, 2021).

2.1.2. Financial Performance

Naz et al (2016) defined financial performance as the extent to which a company's financial health is measured overtime. It is a financial action used to generated higher sales and profitability for a company's shareholders, which is done by managing current and non-current assets, revenues, expenses, and financing. The whole point of measuring financial performance is providing a complete information to stakeholders to help them in decision making. It is also used to compare the performance of the company against others in the industry. Different ratios can be used to measure the financial performance of a company. The results of these ratios reflect the company's profitability, liquidity, and leverage (Ntuite, 2015).

2.1.2.1. Measures of Commercial Bank's Performance

According to the study conducted by Ntuite (2015), profitability is the most common measure of bank performance. Even though a commercial bank may have social and economic goals, profit is its ultimate goal. There are variety of ratios that can be used to measure the profitability of commercial banks. Among these ratios, Return on Asset (ROA), Return on Equity (ROE), and Net Interest Margin (NIM) are the major ones.

A. Return on Asset (ROA)

Corporate Finance Institute (n.d) defines Return on Asset (ROA) as one type of return-on-investment metric that measures the profitability of a company in relation to its total assets. It indicates how well a company is performing by comparing the capital it has invested and the profit it has generated from the capital. A higher return indicates a productive and efficient management in utilizing economic resources. ROA can be calculated using the following formula:

Return on Asset (ROA) = (Net Income / Total Assets) * 100

B. Return on Equity (ROE)

According to Ahsan (2012), Return on Equity (ROE) is defined as the amount of net income returned as a percentage of shareholder's equity. Rappaport (1996), as cited in the study states that Return on Equity (ROE) is the most widely used measures of corporate financial performance. It

is popular among investors since it links the income statement to the balance sheet. However, ROE can be a misleading measure of financial performance because earnings can be manipulated by changing the accounting policy (Ahsan, 2012). ROE can be calculated as below:

Return on Equity (ROE) = (Net Income / Total Equity) * 100

C. Net Interest Margin (NIM)

Net Interest Margin (NIM) is a measure of the difference between the interest income generated by banks and the amount of interest paid out to their lenders, relative to the amount of their interest earning assets. NIM can be computed using the following formula (Ntuite, 2015):

Net Interest Margin (NIM) = (Net Income / Net Sales) * 100

2.2. Empirical Literature

Several studies have been conducted to examine the effect of technological innovation on the financial performance of banks in different countries. These studies and the ones conducted in Ethiopia will be discussed below.

In Kenya, Muiruri & Ngari (2014), conducted a study titled "Effects of Financial Innovations on the Financial Performance of Commercial Banks in Kenya". The study was conducted to determine whether credit cards, mobile banking, internet banking and agency banking affect the financial performance of banks in Kenya. The researchers utilized a descriptive research design and sampled 16 out of 44 commercial banks in the country. The researchers found that some banks in Kenya had adopted innovations such as credit cards, mobile, internet and agency banking. The result of the study indicates that all the innovative features had a great impact on the performance of the banks and increased their profitability. The study is concluded by stating that Kenyan banks use financial innovations to survive the competition in the market.

Another study was conducted in Kenya by Wachira & Ondigo (2016) to determine the effects of technological innovation on the performance of commercial banks in Kenya. The study was a census and employed a descriptive cross-sectional design. The researchers categorized technological innovation into customer independent technology, customer assisted technology &

customer transparent technology and took them as the independent variables, while taking ROA as the dependent variable. The results of the study revealed that the combined effect of the independent variables on profitability was positive. The researchers concluded their study by stating that technological innovation is a key driver of bank's performance.

A similar study was conducted by Gathee (2018). The purpose of the study was to examine the effect of technological innovations on operation management of commercial banks in Kenya. This study was also a census and employed a descriptive survey research design. The dependent variable in the study was operational management while mobile innovation, process innovation and electronic funds innovation were the independent variables. The results of the study revealed that process and mobile innovation had a significant relationship with operational management while the relationship between electronic funds innovation and operational management is not statistically significant. The study was concluded by stating that mobile and process innovation help reduce operational costs and therefore, banks should invest in them.

Another study was conducted in Lebanon by Chaarani & Abiad (2018) to examine the impact of technological innovation on the performance of banks in Lebanon. ROA and ROE were used to as measures of performance, while the technological factors included investment in computer software, internet banking, mobile banking, and ATMs. The researches sampled 17 out of 48 banks in the country and used both descriptive statistics & multiple regression analysis. The findings of the study revealed that the impact of investment in ATMs and internet banking is positive. However, mobile banking and investment in computer software had no significant impact on the performance of banks in Lebanon.

In India, Kalluri (n.d.) conducted a study to determine the effects of technological innovation on the financial performance of commercial banks in India. A descriptive survey was used in the study as the main aim was to provide an explanation on the cause-and-effect relationship between the dependent and independent variables. It was a census and all commercial banks in the country were the target. The researcher used ROA as the dependent variable to measure financial performance while mobile banking, internet banking, branch networking and electronic funds

transfer at point-of-sale terminals were the independent variables. The results of the study indicated that mobile banking, internet banking, branch networking and electronic funds transfer at point-of-sale terminals have a significant positive impact on the financial performance of commercial banks in India.

Haabazoka (2018) conducted a study to determine the effect of technological innovations on the financial performance of commercial banks in Zambia. The study used a descriptive research design to explain the relationship between the variables and a monthly data for a period of four years of all 19 banks in Zambia. It focused on three areas of innovation: internet banking, mobile banking & Automated teller Machines (ATMs) to determine the effect of technological innovation on bank performance, which was measured by income. Secondary data was collected from the Bank of Zambia and various audited financial statements of individual commercial banks. The results of the study revealed that mobile banking and Automated Teller Machines (ATMs) had a positive and significant effect on the financial performance of commercial banks in Zambia while internet banking had a weak relationship.

In Ethiopia, Damtew (2016) carried out a study to determine the effect of electronic banking on the financial performance of commercial banks in Ethiopia. The study used Automated Teller Machines, debit cards and Point of Sale (POS) terminals in 10 Ethiopian commercial banks as independent variables using profit before tax and return on assets as financial performance indicators. The findings of the study revealed that Point of Sale (POS) and Automated Teller Machines (ATMs) have a negative impact on the profitability of commercial banks and a positive impact on their ROA. However, debit cards have a positive impact on the profitability as well as the ROA of commercial banks in Ethiopia.

A similar study was carried out by Temam (2018) to examine the effect of financial innovations on the financial performance of Commercial Banks in Ethiopia. The study used secondary data and sampled a purposively selected nine commercial banks in Ethiopia. Number of mobile banking users, automated teller machine terminals, new saving accounts, point of sale terminals, debit cardholders and managerial efficiency were the independent and control variables identified. Return on Asset (ROA) was the dependent variable used as a measure of financial performance.

Result of the study revealed that number of mobile banking users and new saving accounts had a positive and significant effect on the ROA of commercial banks. However, numbers of ATM terminals had a negative and significant effect on the ROA of commercial banks while the number of point-of-sale terminals and debit cardholders are insignificant to the financial performance of banks. The researcher concluded the study by stating that financial innovation had a positive effect on the financial performance of commercial banks in Ethiopia and recommended that commercial banks should work more on awareness creation about financial innovation services.

2.3. Summary and Research Gap

In summary, several studies have been carried out by different researchers to determine the effect of technological innovation on financial performance of commercial banks in many countries. The results of these studies are mostly similar. Although some of the variables showed a negative or insignificant impact on the financial performance of the commercial banks in a few studies, they mostly had a positive and significant impact.

In Ethiopia, majority of the researches undertaken in the area of technological innovation focused on the adoption, challenges & prospects, and barriers & benefits of electronic banking as well as customer's satisfaction with e-banking. This implies that identification of the effect of technological innovation on the financial performance of commercial banks is a very important area of study in Ethiopia. Therefore, this study intended to fill this gap in literature by identifying the effect implementing technological innovation has on the Return on Asset (ROA) of selected commercial banks in Ethiopia.

2.4. Conceptual Framework

Return on Asset (ROA) will be used to measure financial performance of the banks as it is the most common measure of financial performance used in these types of studies. ATM's, debit cards, internet banking, mobile banking, and POS terminals will be used as measures of technological innovation. The conceptual framework of the relationship between the dependent, independent, and control variables is depicted below.

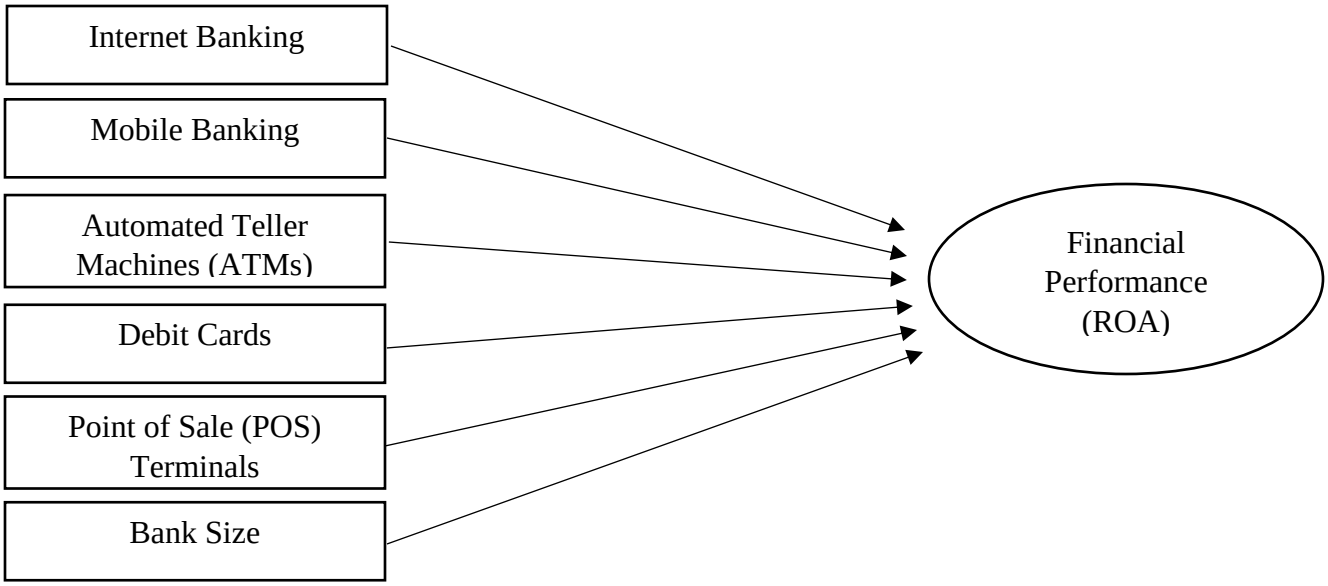


Figure 2: Conceptual Framework

Source: Developed by the researcher based on various literatures

CHAPTER THREE

Research Methodology and Design

Introduction

This chapter discusses the methods used in the research to achieve the research objectives. It contains the research design, sources of data, target population, sampling techniques and method of data analysis that were applied during the study. Each of these will be explained in detail in the following sections.

3.1. Research Methodology

A quantitative approach was used to achieve the research objective. A panel data type was used, which according to Erica (2019), can detect and measure statistical effects that pure time series or cross-sectional data can't. It also minimizes estimation biases that may arise from aggregating groups into a single time series. A secondary source of data was used.

3.2. Research Design

The study employed a descriptive research design as the main aim of the study is to describe the effect technological innovation has on the financial performance of commercial banks in Ethiopia. The study was conducted using panel data for a period of seven years on nine selected commercial banks in Ethiopia.

3.3. Sources of Data

The study used secondary sources of data in order to achieve the objectives. A quantitative secondary data was collected from the published annual reports of the banks.

3.4. Target Population

According to Lavrakas (2008), a target population defines those units for which the findings of the survey are meant to generalize. For this study, banks that focused on technological innovation and had sufficient available data were the target population. These banks are: -Dashen Bank, Bank of Abyssinia, Hibret Bank, Awash Bank, Nib International Bank, Cooperative Bank of Oromia S.C., Bunna International Bank, Zemen Bank, and Wegagen Bank.

3.5. Sampling Design and Techniques

The study employed a purposive sampling which is a non-probability sampling technique. This is because the banks are selected based on personal judgement instead of random selection. The criteria set to select banks to be studied was focus on technological innovation and the availability sufficient data.

3.6. Method of Analysis

The study used quantitative tools such as tables. Descriptive statistics and regression were employed to identify the effect of technological innovation on the financial performance of commercial banks in Ethiopia. Classical linear regression model was used to analyze the relationship between the dependent and independent and control variables. Financial performance, measured by ROA, is the dependent variable. Technological innovation, measured by internet banking, mobile baking, ATMs, debit cards and POS terminals are the independent variables. Bank size is the control variable.

3.7. Model Specification and Operational Definition of Variables

3.7.1. Model specification

This section will discuss about the model that was adopted to explain the effect of technological innovation on the financial performance of commercial banks in Ethiopia. The following model is developed based on previous literature.

ROA = α + Number of Internet Banking Users + Number of Mobile Banking Users + Number of ATMs + Number of Debit Card Holders + Number of POS terminals + Bank Size + £

$ROA_{it} = \alpha_i + \beta_1 * NIB_{it} + \beta_2 * NMB_{it} + \beta_3 * NATM_{it} + \beta 4 * NDC_{it} + \beta 5 * NPOS_{it} + \beta 6 * SIZE_{it} + £_{it}$

Where:

ROA - Return on Assets for bank i at time t

NIB_{it} - Number of Internet banking users for bank i at time t

NMB_{it} - Number of Mobile Banking users for bank i at time t

$NATM_{it}$ - Number of ATMs for bank i at time t

NDC_{it} - Number of Debit Card Holders for bank i at time t

$NPOS_{it}$ – Number of Point of Sale (POS) Terminals for bank i at time t

$SIZE_{it}$ – Bank Size for bank i at time t

£ = error term

3.7.2. Operationalization of Study Variables

3.7.2.1. Dependent variable

In order to identify the effect of technological innovation on the financial performance of commercial banks, Return on Asset (ROA), which is the ratio of net income before tax to average total assets, was used as a measure of financial performance. ROA shows the percentage of how profitable a company's assets are in generating revenue (Wikipedia, n.d).

3.7.2.2. Independent Variables

In this study, internet banking, mobile banking, ATMs, debit cards and POS terminals are used as measures of technological innovation. These variables will be briefly defined below:

a. Internet Banking

Mai et al (2007), as cited by Al-Weshah (2013), refers to internet banking as a deployment over the internet of retail and corporate banking services that involves individual and corporate clients. These services include payments and settlements, bank transfers, corporate and household lending.

b. Automated Teller Machines

Duvey et al (2013) defines Automated Teller Machines (ATMs) as a new banking system in which an account holder can access his/her account anytime and anywhere with a debit card given by a bank. ATMs provide customers with the ability to perform different quick service financial transactions such as withdrawals, deposits, transfers, and balance inquiries at any given point in time.

c. Mobile Banking

Mobile banking refers to the provision of banking services through mobile phones or tablets. It is an alternative and evolution of internet banking. Mobile users can conduct banking transactions

such as paying bills, transferring money, and checking balances using their mobile phones. To use mobile banking, there is no need for an internet connection, just a mobile connection (Sadiku et al, 2017).

D. Debit Cards

Debit cards were originally introduced as ATM cards. It is a plastic payment card that is linked to the card owner's account at a bank. When the card is used, it assesses the money available in the card owner's bank account (Parker et al, 2011).

E. POS Machines

Point of sale (POS) terminals are hardware systems that are used to process card payments at retail locations (Halton, 2021).

3.7.2.3. Control Variable

There are different internal factors such as asset quality, asset management, liquidity, management quality, and financial risk that affect the financial performance of banks. GDP, inflation, interest rate, and, exchange rate are also external factors that affect the financial performance of commercial banks.

In order to avoid the omission of important variables, bank size was used as a control variable. Bank size is measured as the natural logarithm of the value of total assets of a bank (Laeven et al, 2014). The table below summarizes the variables and measurements.

Table 3.1: Operational Definition of Variables, Expected Sign and Relationship

	Variable	Notation	Measurement	Expected Sign	Expected Relationship
Dependent Variable	Return on Asset	ROA	Net income before tax/Average Total Asset		
Independent Variables	Internet Banking	NIB	Natural logarithm of Number of Internet Banking users	Positive	Significant
	Mobile Banking	NMB	Natural logarithm of Number of Mobile Banking users	Positive	Significant
	Automated Teller Machine	NATM	Natural logarithm of Number of ATMs	Positive	Significant
	Debit Card	NDC	Natural logarithm of Number of Debit Card users	Positive	Significant
	Point of Sale Terminals	NPOS	Natural logarithm of Number of POS terminals	Positive	Significant
	Bank Size	SIZE	Natural Logarithm of bank size	Positive	Significant

CHAPTER FOUR

Data Presentation and Analysis

4.1. Introduction

The aim of this study is to identify the effect of technological innovation on the financial performance of nine commercial banks in Ethiopia using panel data for a period of seven years (2015 – 2021). The analysis of the data is done using Eviews-9. In this chapter, descriptive statistics will be discussed first and it will be followed by diagnostic test results of CLRM for heteroskedasticity, autocorrelation, multicollinearity & normality. Finally, the analysis and interpretation of the regression output will be presented.

4.2. Descriptive Statistics

Descriptive statistics condenses data into a simpler summary by describing the relationship between variables in a sample or a population. It is a vital step in conducting research and should always occur before making inferential statistical comparisons. It includes types of variables as well as measures of frequency, central tendency, dispersion/variation, and position (Yellapu, 2018).

In this section, the descriptive statistics of the dependent, independent and control variables used in the study will be presented. The dependent variable for this study is Return on Asset (ROA) as a measure of financial performance. The independent variables are internet banking, mobile banking, automated teller machines (ATMs), debit cards, and point of sale (POS) terminals. The control variable is bank size.

The result of the descriptive statistics, which includes the mean, median, maximum, minimum, standard deviation and other statistical values and their interpretations are presented below (Table 4.1)

Table 4.1: Summary of Descriptive Statistics

	ROA	NIB	NMB	NATM	NDC	NPOS	SIZE
Mean	0.025119	3.896014	4.818747	2.116488	5.282475	2.253435	4.480912
Median	0.024300	3.913495	5.005660	2.077364	5.309033	2.367847	4.474638
Maximum	0.044500	5.995623	6.382197	2.988113	6.113846	3.147985	5.109561
Minimum	0.003257	0.000000	2.839478	1.579784	4.176091	0.903090	3.687916
Std. Dev.	0.006533	1.046937	0.921711	0.325038	0.481594	0.559356	0.292084
Skewness	0.041078	-0.501116	-0.485502	0.344559	-0.239194	-0.398610	-0.254759
Kurtosis	5.148487	5.538232	2.513343	2.550894	2.409770	2.543113	3.123361
Jarque-Bera	9.630723	15.51478	2.457677	1.409543	1.202557	1.758969	0.572556
Probability	0.008104	0.000428	0.292632	0.494222	0.548110	0.414997	0.751054
Sum	1.255942	194.8007	240.9374	105.8244	264.1238	112.6717	224.0456
Sum Sq. Dev.	0.002091	53.70781	41.62800	5.176833	11.36469	15.33109	4.180337
Observations	50	50	50	50	50	50	50

Source: Eviews 9 Output

As shown in the table above, the mean value of return on asset (ROA) is 0.0251 or 2.51%, which indicates that the selected commercial banks, on average, have achieved 2.51% of ROA for the period of 2015-2021. The standard deviation of the ROA is 0.0065 or 0.65%, which implies that the ROA of the banks may deviate from the mean value by 0.65% ranging from 1.86% to 3.16%.

The study used five independent variables: internet banking, mobile banking, ATMs, debit cards, and POS machines and one control variable: bank size. The means of these variables are 3.9, 4.8, 2.1, 5.2, 2.3, and 4.5, respectively.

4.3. Model Validity

To undertake this study, the researcher used a multiple regression econometric model with one dependent variable, five independent variables and one control variable. All the assumptions of classical linear regression model (CLRM) were checked to prove the validity of the model before

the regression analysis was run in Eviews-9. The multicollinearity test was conducted using a correlation matrix to check for the violation of this assumption. Skewness, kurtosis and Jarque-Bera test were conducted to check for normality. White's test was conducted to check for the absence of Heteroskedasticity. Finally, the Breusch Godfrey test was conducted to check for autocorrelation. The results of these tests will be discussed below.

4.3.1. Multicollinearity Test

Multicollinearity occurs when the multiple regression analysis includes independent variables that are correlated with each other. We can say perfect multicollinearity exists when the correlation between two or more independent variables is 1 or -1. This is rarely faced in a data set. The issue of multicollinearity arises when there is a high degree of correlation between independent variables. As a rule of thumb, when the correlation coefficient between two variables is greater than 0.8 or 0.9, the multicollinearity is a serious problem (Midi et al, 2013).

Table 4.2: Correlation Matrix

	NIB	NMB	NATM	NDC	NPOS	SIZE
NIB	1.000	0.434	0.270	0.463	0.240	0.495
NMB	0.434	1.000	0.609	0.740	0.537	0.724
NATM	0.270	0.609	1.000	0.782	0.766	0.721
NDC	0.463	0.740	0.782	1.000	0.760	0.767
NPOS	0.240	0.537	0.766	0.760	1.000	0.726
SIZE	0.495	0.724	0.721	0.767	0.726	1.000

Source: Eviews 9 Output

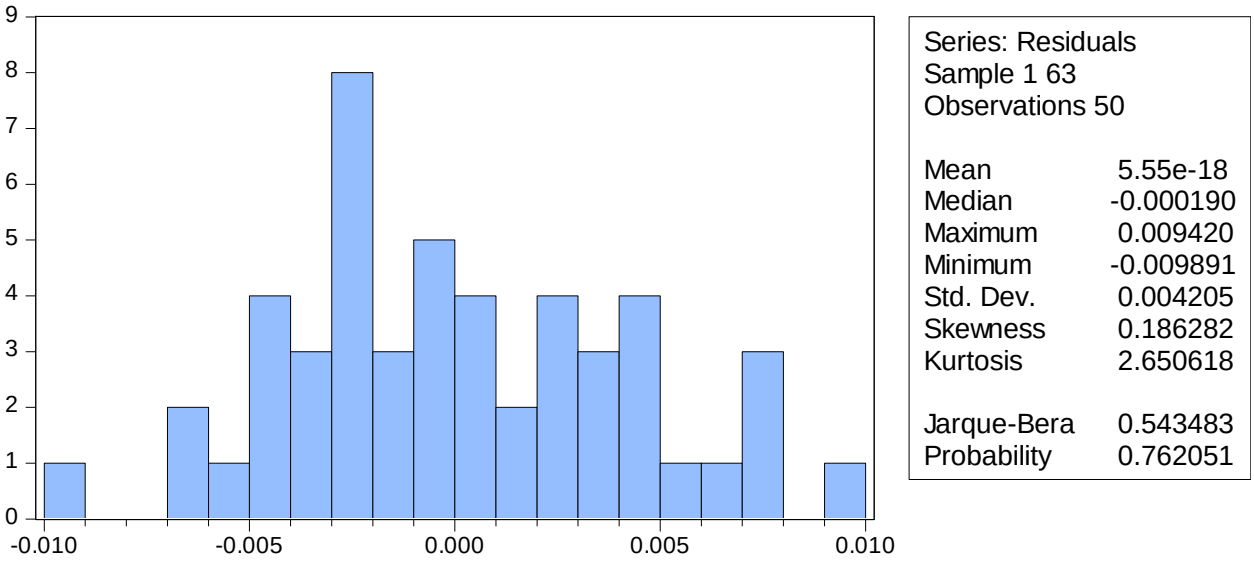
As can be seen from the correlation matrix above, although a few variables have a correlation coefficient that is a bit on the higher side (a maximum of 0.76777 between NDC and SIZE machines), none of them are above 0.8. Therefore, the researcher concluded that there is no multicollinearity issue between the independent variables.

4.3.2. Normality test

Normality tests are used to determine whether a data set is well modeled by a normal distribution or not. Normality can be tested graphically with a histogram or statistically with skewness and

kurtosis. Skewness tells the amount and direction of departure from the horizontal asymmetry. A data is said to be perfectly symmetrical when the skewness is 0. However, this is quite unlikely for a real-world data. Kurtosis tells the height and sharpness of the central peak relative to the standard bell curve. The kurtosis of a normal distribution is 3 (Kilma, 2021). The Jarque-Bera is also another common test for normality. According to Brooks (2014), if the residuals are normally distributed, the histogram should be bell-shaped and the Jarque-Bera wouldn't be significant. The result of the normality test and its interpretation are presented below.

Figure 4.1: Normality Test



Source: Eviews-9 Output

As shown in the figure above, the skewness of the residuals is 0.18, which is close to zero. And, the kurtosis is 2.65, which is close to 3. The Jarque-Bera statistic has a p-value of 0.76, which indicates that there is no proof of presence of abnormality in the data. Therefore, we don't reject the hypothesis of normality assumption at 5% significance level since the p-value is much greater than 0.05.

4.3.3. Heteroskedasticity Test

Homoscedasticity refers to a situation in which the variance of the errors in a regression model is constant. There is said to be a Heteroskedasticity when the variance of the errors is not constant (Kenton, 2021). In this study, White's test was used to test for the presence of Heteroskedasticity in the residuals. The result of the test and its interpretation is presented below.

Table 4.3: Heteroskedasticity Test: White

Heteroskedasticity Test: White

F-statistic	1.865971	Prob. F(27,22)	0.0696
Obs*R-squared	34.80269	Prob. Chi-Square(27)	0.1439
Scaled explained SS	21.24351	Prob. Chi-Square(27)	0.7748

Source: Eviews 9 Output

As can be seen from the table above, both p-values of the F-statistic (0.696) and the Obs*R-squared (0.1439) are greater than 0.05, which indicates the absence of heteroskedasticity. Therefore, we don't reject the hypothesis of homoskedasticity at 5% significance level.

4.3.4. Autocorrelation Test

Autocorrelation measures the relationship between a variable's current and past values. It represents the degree of similarity between a given time series and a lagged version of itself over successive time intervals. CLRM assumes that the covariance between the error terms over time is 0 and there is no correlation between them (Smith, 2021). In this study, the Breusch-Godfey Serial Correlation LM test was used to check for the existence of correlation or pattern between the error terms. The result of the test and the interpretation is presented below.

Table 4.4: Autocorrelation Test: Breusch-Godfrey Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.931125	Prob. F(2,41)	0.1579
Obs*R-squared	4.304566	Prob. Chi-Square(2)	0.1162

Source: Eviews 9 Output

As can be seen from the table above, both p-values of the F-statistic (0.1579) and the Obs*R-squared (0.1162) are greater than 0.05. Therefore, we don't reject the hypothesis that there is no correlation between the error terms at 5% significance level.

4.3.5. Hausman Test

When dealing with panel data: there are two types of panel estimator approaches that can be used: Fixed Effects Model (FEM) and Random Effects Model (REM)

The simplest types of fixed effects models allow the intercept in the regression model to differ cross-sectionally but not over time, while all of the slope estimates are fixed both cross-sectionally and over time. The random effects approach purposes different intercept terms for each entity and again these intercepts are constant over time, with the relationships between the explanatory and explained variables assumed to be the same both cross-sectionally and temporarily (Brooks, 2008). In this study, the Hausman Specification Test was conducted to examine whether individual effects are fixed or random.

Table 4.5: Hausman Test

Correlated Random Effects - Hausman Test
Equation: Untitled
Test period random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period random	8.331548	6	0.0148

Source: Eviews 9 Output

As can be seen from the table above, the p-value is 0.0148, which is less than 0.05. Therefore, the hypothesis that a random effects model is appropriate is rejected, implying a fixed effect model is more appropriate.

4.4. Regression Analysis, Interpretation and Discussion

Regression analysis is used to indicate whether independent variables have a significant relationship with the dependent variable or not, indicate the relative strength of effect of different independent on a dependent variable and make predictions (Mooi, 2014). In this study, regression was used for one dependent variable (ROA), five independent variables (internet banking, mobile banking, ATMs, debit cards, and POS terminals) and one control variable (bank size) to determine whether these independent and control variables affect the dependent variable or not.

The relationship between the dependent and independent variables is regressed using Eviews 9. The panel data contains 50 observations for five independent variables and one control variable on 9 commercial banks. These variables were converted into natural logarithms for proportionality and the dependent variable is presented in percentages. The operational model used is as follows:

$$ROA_{it} = \alpha_i + \beta_1 * logNIB_{it} + \beta_2 * logNMB_{it} + \beta_3 * logNATM_{it} + \beta 4 * logNDC_{it} + \beta 5 * logNPOS_{it} + \beta 6 * logSIZE_{it} + £_{it}$$

The result of the regression to determine the effect of the control and independent variables on the dependent variable and their interpretations is presented below.

Table 4.6: Linear Regression Model

Dependent Variable: ROA
Method: Panel Least Squares
Date: 05/05/22 Time: 20:46
Sample: 2015 2021
Periods included: 7
Cross-sections included: 9
Total panel (unbalanced) observations: 50

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.024892	0.022765	1.093431	0.2813
NIB	0.002198	0.000808	2.719135	0.0099
NMB	-0.007688	0.001292	-5.952360	0.0000
NATM	0.001372	0.004744	0.289308	0.7740
NDC	-0.012263	0.005226	-2.346534	0.0244
NPOS	0.005463	0.002641	2.068567	0.0456
SIZE	0.017469	0.006850	2.550165	0.0150

Effects Specification

Period fixed (dummy variables)

R-squared	0.661893	Mean dependent var	0.025119
Adjusted R-squared	0.552236	S.D. dependent var	0.006533
S.E. of regression	0.004371	Akaike info criterion	-7.808531
Sum squared resid	0.000707	Schwarz criterion	-7.311405
Log likelihood	208.2133	Hannan-Quinn criter.	-7.619223
F-statistic	6.036058	Durbin-Watson stat	1.311130
Prob(F-statistic)	0.000011		

Source: Eviews 9 Output

Based on the output above, the relationship between the dependent and independent variables included in the model is represented as follows:

$ROA_{it} = 0.02 + 0.002*NIB_{it} - 0.008*NMB_{it} + 0.001*NATM_{it} - 0.01*NDC_{it} + 0.005*NPOS_{it} + 0.02*SIZE_{it} + £_{it}$

4.4.1. Interpretation of R-squared and Adjusted R-squared

R-squared is a goodness of fit statistic that quantifies the proportion of variance of the dependent variable that can be accounted for by the regression model in the sample. However, the R^2 value usually overestimates the amount of variance explained in the population. Therefore, adjusted R^2, which considers the loss of degrees of freedom associated with adding extra variables, is usually used to estimate the amount of variance explained in the population (Karch, 2019).

In this study, the R^2 and adjusted R^2 are 0.661 and 0.552, respectively. This implies that 55.2% of volatility in return of asset (ROA) is explained by volatilities in the independent and control variables. Thus, it can be concluded that number of mobile banking users, number of internet banking users, number of ATMs, number of debit cards holders, number of POS terminals, and bank size collectively explain 55.2% of the change in ROA. The remaining 44.8% of the variability in ROA is left unexplained by the explanatory variables included in the study.

4.4.1.1. Internet Banking and Financial Performance

As table 4.6 shows, internet banking has a positive and significant relationship with ROA at 5% significance level. The coefficient of 0.002 indicates that holding other factors constant, a 1% increase in the number of internet banking users will on average result in a 0.2% increase in ROA and this relationship is statistically significant at 5% significance level.

This finding is similar to the result of a study conducted by Chaarani & Abiad (2018), who conducted a similar study in Lebanon. Kalluri (n.d.) also found a similar result for commercial banks in India. However, the study conducted by Haabazoka (2018) revealed a different result. The researcher found a weak relationship between internet banking and ROA.

This positive and significant relationship between internet banking and ROA could be due to the fact that internet banking reduces the cost-of-service delivery and transactions. Reduced cost results in increased profit, which in turn results in increased ROA.

4.4.1.2. Mobile Banking and Financial Performance

As shown in the table above, mobile banking has a negative and significant relationship with ROA at 5% significance level. The coefficient of -0.008 implies that holding other factors constant, a 1% increase in the number of mobile banking users will on average result in a 0.8% decrease in ROA and this relationship is statistically significant at 5% significant level.

This finding is also similar to the result of Chaarani & Abiad (2018). However, it was different from the results of Haabazoka (2018), whose study revealed a positive and significant relationship between mobile banking and financial performance.

This negative and significant relationship between mobile banking and ROA could be due to the poor telecom infrastructure in the country, which results in frequent failure of transactions. Tigre (2018) states that it could also be due to the fact that even if customers register for mobile banking, they don't actually trust the service to make transactions.

4.4.1.3. Automated Teller Machines (ATMs) and Financial Performance

The table above shows that ATMs have a positive but insignificant relationship with ROA at 5% significance level. The coefficient of 0.001 implies that holding other factors constant, a 1% increase in the number of ATMs will on average result in a 0.1% increase in ROA and this relationship is statistically insignificant at 5% significance level.

This finding is similar to the results of Haabazoka (2018) and Chaarani & Abiad (2018). However, it was different from the finding of Damtew (2016), whose study revealed a negative relationship between ATMs and financial performance.

The positive relationship between ATMs and ROA could be due to the fact that ATMs reduce cost of transactions. Reduced cost results in increased profit, which in turn results in increased ROA.

4.4.1.4. Debit Cards and Financial Performance

The result of the study reveals that debit cards have a negative and significant relationship with ROA at 5% significance level. The coefficient of -0.01 implies that holding other factors constant,

a 1% increase in the number of debit card holders will on average result in a 1% decrease in ROA and this relationship is statistically significant at 5% significance level.

This finding is similar to the result of Temam (2018). However, it contradicts with the results of Damtew (2016), who found a positive relationship between debit cards and the finanacial performance of commerical banks.

According to Temam (2018), the possible reason for the negative relationship between debit cards and ROA could be the production cost of debit cards. It could also be due to a reduced ROA as a result of COVID-19 and the war in the northern part of the country.

4.4.1.5. Point of Sale (POS) and Financial Performance

The result of the study reveals that number of POS terminals have a positive and significant relationship with ROA at 5% significance level. The coefficient 0.005 implies that holding other factors constant, a 1% increase in the number of POS terminals will on average result in a 0.5% increase in ROA and this relationship is statistically significant at 5% significance level.

This finding is similar to the result of Temam (2018). Kalluri (n.d.) also found a positive relationship between POS terminals and ROA. In contrast, the study conducted by Damtew (2016) revealed a negative relationship between POS terminals and ROA.

The positive relationship between POS terminals and ROA could be due to the income banks generate from POS terminals in the form of service charges and the reduction of transaction costs, which increases ROA.

4.4.1.6. Bank Size and Financial Performance

The result of the study reveals that bank size has a positive and significant relationship with ROA at 5% significance level. The coefficient 0.02 implies that holding other factors constant, a 1% increase in the bank size will on average result in a 2% increase in ROA and this relationship is statistically significant at 5% significance level.

This finding is similar to the result of Abebe (2019), who conducted a study to determine the effect of bank size on the profitability of commercial banks and found a positive and significant

relationship. In contrast, Alfadhli & Alali (2021) found a negative relationship between bank size and ROA.

The positive and significant relationship between bank size and ROA could be due to the economies of scale achieved by banks which results in less overhead costs and a better financial performance.

4.5. Result Vs. Hypothesis

The findings of this research indicate that while some of the results were as hypothesized, some were different. The different hypotheses against their actual results will be discussed below.

H1: Internet banking has a positive and significant effect on the financial performance of commercial banks in Ethiopia.

The researcher expected a positive and significant relationship between internet banking and ROA. The findings of the study showed that there is indeed a positive and significant relationship between number of internet banking users and return on asset. Therefore, we don't reject the hypothesis.

H2: Mobile banking has a positive and significant effect on the financial performance of commercial banks in Ethiopia.

The researcher expected a positive and significant relationship between mobile banking and ROA. However, the result of the study revealed that even if mobile banking's effect on ROA is significant, the relationship is negative. Therefore, we reject the hypothesis.

H3: Automated teller machines (ATMs) have a positive and significant effect on the financial performance of commercial banks in Ethiopia.

The researcher expected a positive and significant relationship between ATMs and ROA. However, the result of the study revealed that even if ATMs have a positive relationship with ROA, their effect is insignificant. Therefore, we reject the hypothesis.

H4: Debit cards have a positive and significant effect on the financial performance of commercial banks in Ethiopia.

The researcher expected a positive and significant relationship between debit cards and ROA. However, the result of the study shows that debit cards have a negative and significant effect on ROA. Therefore, we reject the hypothesis.

H5: Point of sale (POS) terminals have a positive and significant effect on the financial performance of commercial banks in Ethiopia.

The researcher expected a positive and significant relationship between POS terminals and ROA. The result of the study shows that POS terminals have a positive and significant relationship with ROA. Therefore, we don't reject the hypothesis.

H6: Bank size has a positive and significant effect on the financial performance of commercial banks in Ethiopia.

The researcher expected a positive and significant relationship between bank size and ROA. The results of the study showed that there is a positive and significant relationship between bank size and ROA. Therefore, we don't reject the hypothesis.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

In this part of the study, the summary of major findings, conclusions, and recommendations will be discussed.

5.1. Summary of Major Findings

This study was carried out to identify the effect of technological innovation on the financial performance of commercial banks in Ethiopia. The dependent variable was return on asset (ROA), which was used as a measure of financial performance. The independent variables included in the study to measure technological performance were: number of internet banking users, number of mobile banking users, number of ATMs, number of debit card holders, and number of POS terminals. Bank size was also included as a control variable. The study used secondary data which were gathered from published annual reports of selected nine commercial banks for the period 2015 – 2021. A descriptive statistic was conducted to summarize the relationship between the variables and a multiple regression analysis was conducted to examine the relationship between the dependent and independent variables. Diagnostic tests for heteroskedasticity, multicollinearity, autocorrelation, and normality were conducted to prove the validity of the model.

The results of the regression showed that there is a positive relationship between internet banking, ATMs POS terminals, and bank size with ROA while mobile banking and debit cards had a negative one. It also showed that while the effects of internet banking, mobile banking, debit cards, POS terminals and bank size were significant, the effect of ATMs was insignificant.

5.2. Conclusion

Based on the findings of this study, it can be concluded that technological innovation affects the performance of commercial banks positively. Some of the insignificant and negative results showed a positive and significant relationship in similar studies mostly conducted in other countries. The negative and insignificant results in Ethiopia could be due to the poor telecom infrastructure in the country and the lack of awareness among bank customers. Therefore, even if the banks invested heavily in technological innovation, as long as the issues of infrastructure and

lack of awareness improve, the banks will not be able to see the result of their investments in their return. COVID-19 also affected the financial performance of most banks in the country. Another factor that contributed to reduced ROA is the war in the northern part of the country.

5.3. Recommendation

Based on the findings of this study, the following recommendations are hereby made:

- The result of the study showed that internet banking has a positive and significant effect on ROA. Since internet banking helps banks reduce cost of transactions, which increases ROA, they should work on increasing their internet banking users and internet banking transactions. They can do this by giving short trainings on how internet banking works and explaining its advantages for their non-internet-banking customers.
- Mobile banking was found to have a significant but negative effect on ROA. Although the issue of network infrastructure is a problem of the country, banks should work on creating awareness on the advantage of mobile banking over the traditional banking system. They should also work on building trust with using the service. By doing this, they can change the negative effect to a positive one.
- ATMs were found to have a positive but insignificant effect on ROA. However, this should not discourage banks from expanding their ATM implementation across the country. They should also make sure that their ATM outlets are maintained properly. By doing this, the effect of ATMs could be significant.
- POS terminals were also found to have a positive and significant effect of ROA. To benefit more from POS terminals, the banks should work on expanding their POS terminals in hotels, supermarkets, restaurants, gas stations and the like. This would enable customers to pay for their purchases without cash only using their debit cards. This would also help in changing the negative and insignificant effect of debit cards.
- Finally, banks should work more on integrating their systems with one another. This would enable customers to transfer money via mobile or online to another bank without having to open a bank account at the other bank or going to a bank. Although most banks have

integrated their systems and ATMs with one another, a system failure occurs sometimes. Therefore, by solving the issue of integration problems, the banks will start to increase their profitability.

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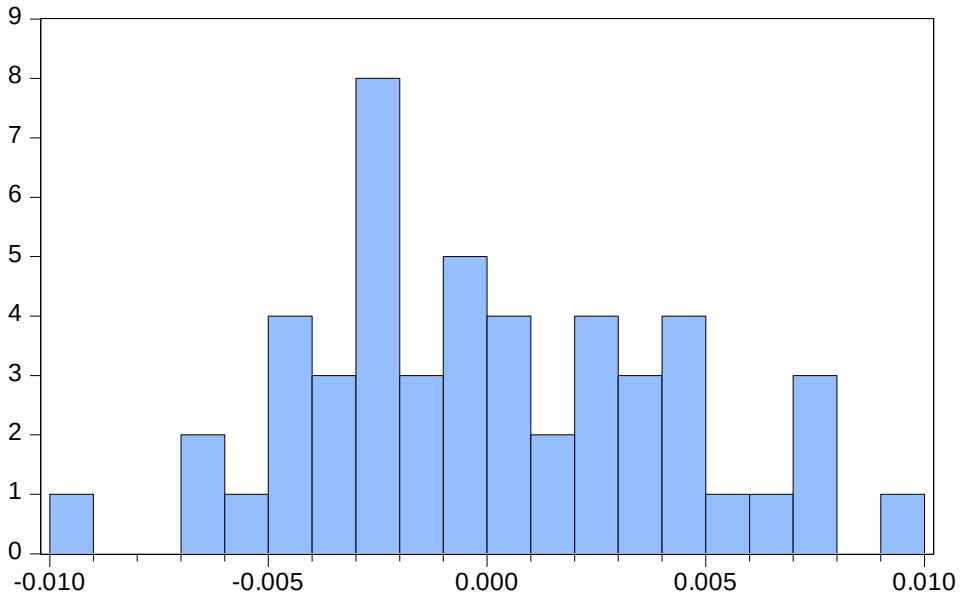
APPENDICES

Appendix A: Normality Test Result



Series: Residuals	
Sample 1 63	
Observations 50	
Mean	5.55e-18
Median	-0.000190
Maximum	0.009420
Minimum	-0.009891
Std. Dev.	0.004205
Skewness	0.186282
Kurtosis	2.650618
Jarque-Bera	0.543483
Probability	0.762051

Appendix B: Heteroskedasticity Test: White

F-statistic	1.865971	Prob. F(27,22)	0.0696
Obs*R-squared	34.80269	Prob. Chi-Square(27)	0.1439
Scaled explained SS	21.24351	Prob. Chi-Square(27)	0.7748

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 03/24/22 Time: 20:49
Sample: 1 63
Included observations: 50

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004587	0.002791	1.643145	0.1146
NIB^2	-1.88E-05	1.01E-05	-1.869519	0.0749
NIB*NMB	7.33E-06	1.60E-05	0.459451	0.6504
NIB*NATM	-0.000149	6.02E-05	-2.476966	0.0214
NIB*NDC	0.000160	4.87E-05	3.285013	0.0034
NIB*NPOS	-5.33E-05	2.85E-05	-1.868619	0.0750
NIB*SIZE	2.81E-05	5.14E-05	0.546115	0.5905
NIB	-0.000426	0.000181	-2.356883	0.0277
NMB^2	2.75E-05	1.32E-05	2.084062	0.0490
NMB*NATM	0.000247	9.90E-05	2.490731	0.0208
NMB*NDC	-2.29E-05	0.000112	-0.204541	0.8398
NMB*NPOS	4.67E-05	6.93E-05	0.673801	0.5075
NMB*SIZE	-0.000392	0.000160	-2.452078	0.0226
NMB	0.000926	0.000361	2.565299	0.0176
NATM^2	-0.000142	0.000278	-0.511410	0.6142
NATM*NDC	0.000662	0.000500	1.323412	0.1993
NATM*NPOS	-5.50E-05	0.000123	-0.447441	0.6589
NATM*SIZE	-0.000946	0.000426	-2.221832	0.0369
NATM	0.000755	0.001465	0.515069	0.6116
NDC^2	-1.79E-05	0.000273	-0.065525	0.9483
NDC*NPOS	-0.000272	0.000282	-0.962972	0.3460
NDC*SIZE	-0.000523	0.000579	-0.903143	0.3762
NDC	0.001362	0.001068	1.274753	0.2157
NPOS^2	6.94E-05	6.91E-05	1.004378	0.3261
NPOS*SIZE	0.000225	0.000223	1.008661	0.3241
NPOS	0.000186	0.000774	0.239972	0.8126
SIZE^2	0.001219	0.000452	2.699631	0.0131
SIZE	-0.004830	0.001755	-2.751374	0.0117

R-squared	0.696054	Mean dependent var	1.73E-05
Adjusted R-squared	0.323029	S.D. dependent var	2.25E-05
S.E. of regression	1.85E-05	Akaike info criterion	-18.65852
Sum squared resid	7.53E-09	Schwarz criterion	-17.58779
Log likelihood	494.4631	Hannan-Quinn criter.	-18.25078
F-statistic	1.865971	Durbin-Watson stat	1.728598
Prob(F-statistic)	0.069579		

Appendix C: Breusch-Godfrey Serial Correlation LM Test

F-statistic	1.931125	Prob. F(2,41)	0.1579
Obs*R-squared	4.304566	Prob. Chi-Square(2)	0.1162

Test Equation:

Dependent Variable: RESID

Method: Least Squares

Date: 03/24/22 Time: 20:55

Sample: 1 63

Included observations: 50

Presample and interior missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002781	0.018993	0.146425	0.8843
NIB	0.000202	0.000813	0.248967	0.8046
NMB	-0.000340	0.001298	-0.261953	0.7947
NATM	0.000633	0.004808	0.131715	0.8959
NDC	-0.000609	0.005153	-0.118164	0.9065
NPOS	0.000481	0.002516	0.191319	0.8492
SIZE	-0.000268	0.006199	-0.043208	0.9657
RESID(-1)	0.283305	0.193771	1.462061	0.1513
RESID(-2)	-0.308917	0.192782	-1.602416	0.1167

R-squared	0.086091	Mean dependent var	5.55E-18
Adjusted R-squared	-0.092232	S.D. dependent var	0.004205
S.E. of regression	0.004394	Akaike info criterion	-7.855471
Sum squared resid	0.000792	Schwarz criterion	-7.511306
Log likelihood	205.3868	Hannan-Quinn criter.	-7.724411
F-statistic	0.482781	Durbin-Watson stat	1.725439
Prob(F-statistic)	0.861255		