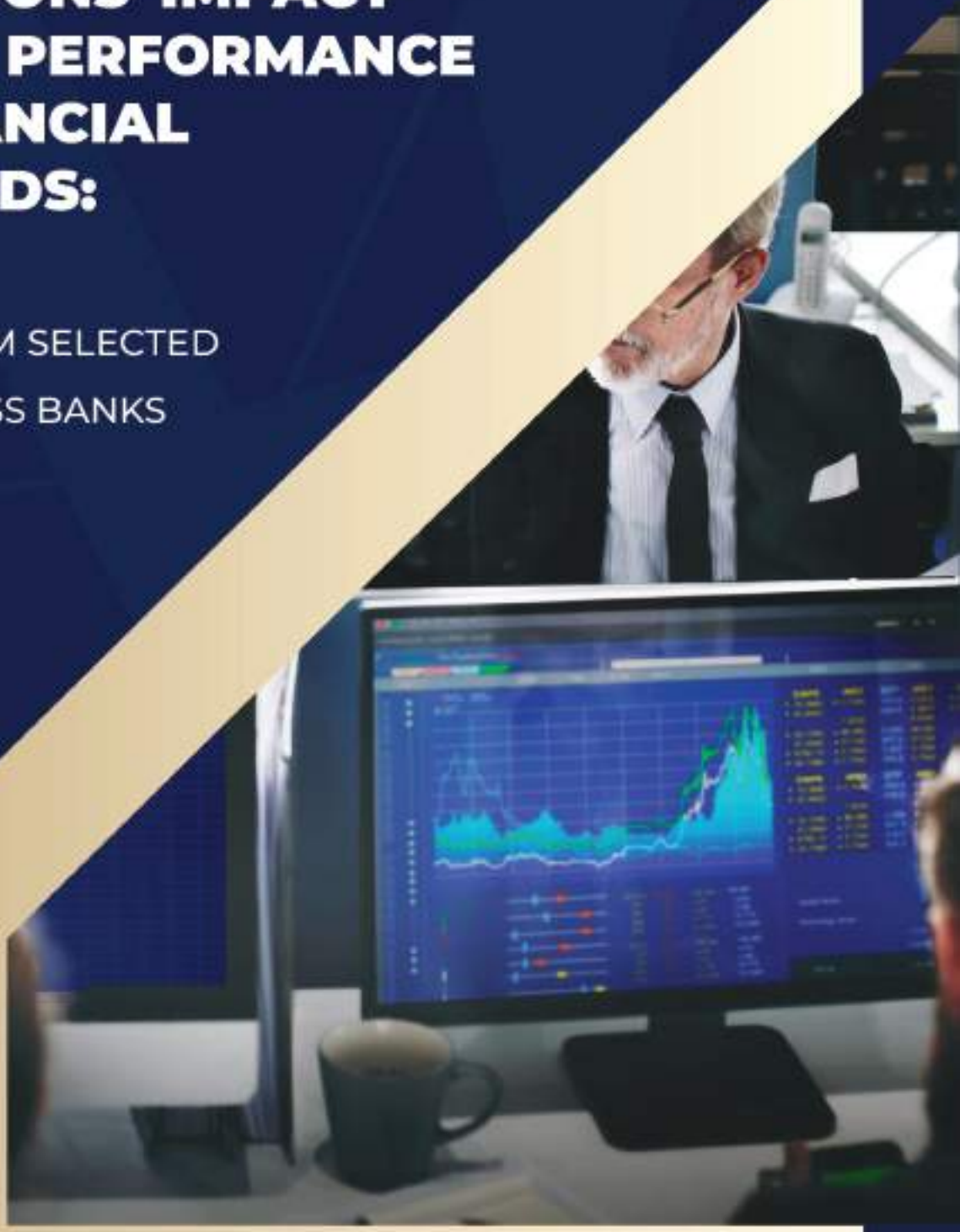
FINANCIAL TECHNOLOGY INNOVATIONS' IMPACT ON BANK PERFORMANCE AND FINANCIAL STANDARDS:

EVIDENCE FROM SELECTED ASEAN BUSINESS BANKS



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EUROPEAN INTERNATIONAL UNIVERSITY 2023

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EVIDENCE FROM SELECTED ASEAN BUSINESS BANKS

by

Mohamed Mousa

Submitted to European International University in partial fulfilment of the requirements for the Degree of Doctor of Business Administration

Declaration Page

I hereby declare that this DBA dissertation is my original work and it has been written by me in its entirety. I have duly acknowledged all the sources of information which have been used in this dissertation.

This DBA dissertation has also not been submitted for any degree in any university previously.

Mohamed Mousa

30 October 2023

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His career highlights include playing a key role in the launch of Qatar's first FinTech application , which expanded the organization's digital reach and solidified its position as a financial sector trailblazer. Dr. Mousa's expertise spans leadership, strategic planning, business development, and team management. He also has a strong background in financial strategy and compliance

Mohamed Amgad

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Abbreviations

AEC	ASEAN Economic Community
AMBD	The Autoriti Montari Brunei Darussalam
API	Application Programming Interface
ASEAN	Association of Southeast Asian Nations
ATM	Automated Teller Machine
BIS	Bank for International Settlements
BNM	Bank Negara Malaysia
BOT	Bank of Thailand
BSP	Bangko Sentral ng Pilipinas
CAR	Capital Adequacy Ratio
CDO	Chief Digital Officer
CGI-MP	Common Global Implementation-Market Practice
DFS	Digital Financial Services
Fintech	Financial Technologies
FIX	FIX Trading Community
FpML	Financial products Markup Language
GDP	Gross Domestic Product
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
ISO	International Organization of Standardization
ITMX	Interbank Transaction Management and Exchange
MAS	The Monetary Authority of Singapore
MMF	Money Market Funds
MSME	Micro, Small and Medium Enterprise
MT	Message Type

M&A	Merger & Acquisition
NAPAS	National Payment Corporation of Vietnam
NETS	Network for Electronic Transfers
NPL	Non-Performing Loan
NRPS	National Retail Payment System
OLS	Ordinary Least Squares
OFWs	Overseas Filipino Workers
PayNet	Payments Network Malaysia Sdn Bhd
PSD2	Payment Services Directive Two
QFB	Qualifying Full Bank
RBI	Reserve Bank of India
RINTIS	PT Rintis Sejahtera
RPV	Resources- Processes-Values
RTGS	Real Time Gross Settlement
RTP	Real Time Payments
ROA	Return on Assets
ROE	Return on Equity
SEP	Standard Essential Patents
SEPA	Single Euro Payment Area
SMEs	Small and medium sized enterprises
SWIFT	Society for Worldwide Interbank Financial Telecommunications
TAG	Technical Advisory Group
TC68	ISO Financial Services Technical Committee 68
XML	Extensible Markup Language

Abstract

This paper aims to provide an overview of the main findings and conclusions of the research conducted.

The financial technology (fintech) sector is seeing significant growth, leading to a proliferation of research papers and articles focusing on the acceptance and innovation of fintech within the industry. Nevertheless, there exists a scarcity of empirical investigations that provide a quantitative examination of the impacts of financial technology (fintech) and financial standards on the performance of banks, as measured by financial indicators. This dissertation aims to address the existing research vacuum by examining the influence of mobile banking technology adoption by commercial banks on the financial performance of banks in five ASEAN nations that have implemented financial standards. Based on an empirical study utilizing longitudinal panel data spanning from 2010 to 2017, this research examines the adoption of mobile banking technologies by 36 local commercial banks in ASEAN countries, namely Singapore, Malaysia, Philippines, Thailand, Qatar and Brunei Darussalam. The findings of this study reveal several notable outcomes: firstly, the adoption of mobile banking technologies has a positive impact on various aspects of banks' operations, including fee income, operating costs, consumer loans, money market deposits, and overall profitability. Secondly, the effects of mobile banking technologies are particularly pronounced among smaller banks in the Philippines and Thailand. Lastly, the study identifies a significant mediating effect of financial standards on bank profitability, observed in both large and small banks across the ASEAN region. In summary, this study asserts that the influence of fintech and financial norms on the financial performance of certain commercial banks in the Association of Southeast Asian Nations (ASEAN) region is mostly beneficial

1. Introduction

1.1 Overview

In a general sense, financial technologies (fintech) include a convergence of novel technologies and advancements that provide a diverse range of financial services, including but not limited to mobile payments, electronic wallets, marketplace lending, robo-advisory, and digital currencies. The global fintech industry has been seeing robust expansion. According to KPMG (2018), there has been a significant increase in global investment in fintech enterprises, with the amount almost doubling from U$13.3 billion in 2014 to U$50.8 billion in 2017. According to the KPMG Pulse of Fintech 2018 study, the global fintech industry had significant growth in 2018, reaching a record value of U$111.8 billion. This growth was mostly attributed to mergers and acquisitions (M&A) as well as buyouts, resulting in a substantial increase of 120% compared to the previous year. The quantity of fintech transactions saw a significant rise, escalating from little over 1,100 in 2013 to over 2,200 in 2018. This notable development underscores the sustained interest of investors in advancements within the financial industry. In terms of geographical distribution, the United States emerged as the predominant area in 2018, representing over 50% of the global fintech investment. This substantial share, amounting to $52.5 billion, was mostly facilitated by mergers and acquisitions. Europe followed suit with a total investment of $34.2 billion. According to KPMG (2018), the overall investment in the fintech sector in Asia saw a significant rise from U$12.5 billion in 2017 to U$22.7 billion in 2018. Notably, the largest transaction in this period was China's Ant Financials, which secured a substantial investment of U$14 billion.

According to the 2018 ASEAN Fintech Census Report by EY, investments in financial technology (fintech) within the Association of Southeast Asian Nations (ASEAN)1 amounted to around $14 million in 2012. However, this figure saw a substantial growth, reaching $338 million by September 2017.

The following Figure 1 shows the growth of fintech investment in ASEAN:

Figure 1: Fintech funding in ASEAN (Source: UOB (2017) State of Fintech in ASEAN).

In the year 2015, there was a significant increase in fintech investment in the ASEAN region, rising from $27 million in 2014 to $190 million. This represents a substantial growth of 604%. According to Deloitte (2018), the total amount of fintech investments in the ASEAN region in 2018 surpassed $5.7 billion, indicating a notable increase of 30% compared to the previous year. In conjunction with the conventional approach of securing financial support from angel investors and venture capitalists, the ascent of ASEAN fintech investments has been further facilitated by the inclusion of crowdsourcing, venture loans, and bank venture funds. The increase in financing may be attributed, at least in part, to the 2025 ASEAN Economic Community (AEC) Vision. This vision aims to attract investments and innovations in the field of financial technology (fintech) with the goal of bridging the digital divide and establishing financial market infrastructures that are more inclusive and connected, benefiting both consumers and companies. The unbanked population in the area is anticipated to exceed 70% of the overall population, including over 450 million persons. The AEC Vision aims to enhance the digital preparedness of its community, specifically targeting micro, small, and medium-sized enterprises (MSMEs) as well as lower income groups. This includes promoting technological innovation and implementing open regulatory initiatives. These efforts are intended to foster the growth of fintech and promote financial inclusion throughout the ASEAN region.

The Business Times (2018) Going cashless in ASEAN, 23 August 2018

The increased demand for fintech in the ASEAN region may be attributed to the rapid acceptance of internet services and the increasing rates of cellular/mobile phone penetration, as seen in Figure 2.

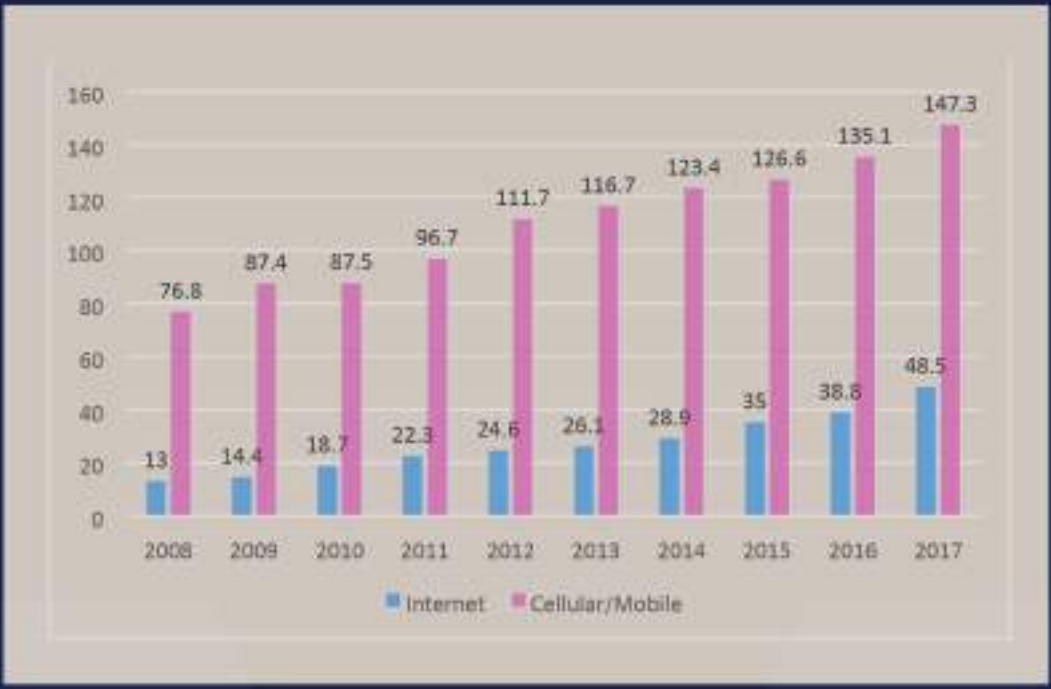

Figure 2: Trend in Internet Service and Cellular/Mobile Phone Density per 100

Persons in ASEAN, 2017-2008 (Source: ASEAN Statistical Yearbook (2018)

The area has seen a significant surge in the use of internet and cellular/mobile phones during the last decade. According to Figure 2, there was a significant increase in the overall number of cellular/mobile phone users in the area, with an almost twofold rise from 76.8% in 2008 to 147.3% in 2017. Similarly, the aggregate quantity of internet customers within the Association of Southeast Asian Nations (ASEAN) attained a rate of 48.5 per 100 individuals in 2017, in contrast to a little 13 in 2008.

The adoption of financial technology (fintech) in the Association of Southeast Asian Nations (ASEAN) region is being propelled at an accelerated pace, mostly due to a significant part of the population being comprised of young individuals, as shown in the accompanying figure.

Figure 3: Population age structure (% to total) in ASEAN, 2017-2000 (Source: ASEAN Statistical Yearbook (2018).

The ASEAN area, which had a population of 642.1 million in 2017, is characterized by a significant demographic of young and economically active individuals. This particular segment of the population has traditionally faced limited access to banking services. In 2017, the region's entire population was comprised of 34.5% individuals below the age of 19 and 50.4% individuals between the ages of 20 and 54. The proportion of the young population has shown a decline from 40.7% in 2000 to 34.5% in 2017. Conversely, the proportion of the working-age population that is actively engaged in productive activities has seen an increase from 48.1% to 50.4% during the same time frame. Fintech investments and innovation in the ASEAN region have consistently prioritized the promotion of financial inclusion. Therefore, financial technology solutions that are specifically designed to cater to the requirements of those who do not have access to traditional banking services or have limited access to such services have a tendency to garner investments. The primary emphasis within the field of financial technology (fintech) has mostly revolved on the domains of payments and mobile wallets, serving as the first stride towards achieving greater financial inclusivity. The provided figure illustrates the distribution of fintech investments in the ASEAN region, highlighting that payments and mobile wallets have received the greatest amount of money in comparison to other financial services.

Figure 4: Share of ASEAN fintech investments (Source: UOB (2017) State of Fintech in ASEAN)

The primary catalysts for the surge in payments innovation may be attributed to the increased availability of internet connectivity and the growing number of mobile and smartphone subscribers, as seen in Figure 2. Given that fintech investments are mostly drawn towards payments and mobile wallets in this particular location, the study emphasis of this dissertation has been focused down to the mobile banking sector.

Simultaneously, the process of standardizing fintech has gained significant traction. Within the framework of the International Organization for Standardization (ISO), professionals from many industries are working together to create and implement shared standards for the expanding fintech sector, with the aim of promoting global interoperability. The establishment of the Fintech Technical Advisory Group (TAG) took place in March 2017, falling under the purview of the ISO Financial Services Technical Committee 68 (TC68). The Technology Advisory Group (TAG) serves as a consultative forum for players in the financial sector and fintech firms to engage in discussions pertaining to the establishment of data and technology standards necessary for ensuring safe global commerce.

In the realm of international payments, the SWIFT MT system has emerged as the widely accepted and often used financial standards. The Society for Worldwide Interbank Financial Telecommunication (SWIFT) was established in Belgium in 1973 with the primary objective of establishing uniform standards for the safe transmission of financial communications within the SWIFT network. SWIFT now establishes connections with over 11,000 banks, financial institutions, and corporations situated in excess of 200 nations and territories over the globe. The institutions that are part of the SWIFT network engage in the exchange of around 32 million standard messages on a daily basis.

The adoption of payment standards in the Asia Pacific region gained momentum with the implementation of a domestic high value payment system known as the Real Time Gross Settlement System (RTGS) by central banks in the 1990s. These central banks chose to use the SWIFT MT standards for the operation of the RTGS. A significant number of Real-Time Gross Settlement (RTGS) systems in the Asia Pacific region, including Singapore, Thailand, the Philippines, Malaysia, Hong Kong, Taiwan, Australia, and New Zealand, have implemented the SWIFT MT standards. Commercial banks participating in the Real-Time Gross Settlement (RTGS) system were required to adhere to the Society for Worldwide Interbank Financial Telecommunication (SWIFT) Message Type (MT) requirements for both domestic and international financial transfers via the RTGS. Several banks in the ASEAN region that participate in the Real-Time Gross Settlement (RTGS) system have been affiliated with the Society for Worldwide Interbank Financial Telecommunication (SWIFT) since the 1980s. These banks have obtained certification from SWIFT, enabling them to engage in the exchange of standardized financial transactions with their respective counterparts. The SWIFT MT standards persist in their use and upkeep to align with the demands of the payment sector. However, SWIFT has undertaken efforts in recent years to advance and advocate for the ISO 20022 standards, which aim to rectify several deficiencies found in the MT standard. The ISO 20022 message standard is characterized by its abundance of data and its well-organized structure

. This standard also provides compatibility for local character sets, including Japanese and Chinese. Furthermore, the XML syntax used by ISO 20022 facilitates seamless integration with contemporary computer systems. ISO 20022, first implemented in 2004 for the Single Euro Payment Area (SEPA) in Europe, has been widely embraced by financial market infrastructures across over 90 nations as a replacement for outdated formats in payments and securities transactions. In the Asia-Pacific region, the real-time gross settlement (RTGS) systems of China, Japan, India, and Brunei Darussalam are now operational in a live mode, using the ISO 20022 standard. According to projections, ISO 20022 is expected to have a dominant presence in global high-value payments by the year 2025. It is anticipated that ISO 20022 will support around 79% of the volume and 87% of the value of transactions conducted globally. ISO 20022 is widely recognized as the primary standard used in real-time retail payment systems throughout several regions, including Europe (Sweden, Denmark), Canada, and Asia Pacific (such as Hong Kong, Australia, Singapore, Malaysia, Thailand, and the Philippines).

Within the framework of the Association of Southeast Asian Nations (ASEAN), member nations are actively involved in the process of modernizing and integrating their financial market infrastructures. This includes the enhancement of payment clearing and settlement systems, which will serve as a foundation for the establishment of a regional real-time payment framework. These efforts align with the AEC 2025 Vision, which aims to promote economic integration and development within the ASEAN area. In the year 2012, the ten central banks of the Association of Southeast Asian Nations (ASEAN) unanimously accepted the adoption of ISO 20022 norms as a shared financial standard for the purpose of regional financial integration. In the year 2017, a Memorandum of Understanding (MoU) was established. A Memorandum of Understanding (MOU) was executed among prominent payment system operators in the region, including NETS in Singapore, PayNet in Malaysia, ITMX in Thailand, NAPAS in Vietnam, and RINTIS in Indonesia

The MOU signifies a widespread agreement to adopt the ISO 20022 financial standard as an initial measure towards establishing regional connectivity for real-time payments. Nevertheless, in order to effectively implement the Memorandum of Understanding (MOU), the Association of Southeast Asian Nations (ASEAN) seems to face a deficiency in terms of a regional regulatory framework, which is present in other regional markets like the European Union. In the absence of legal requirements, such as the Payment Services Directive 2 (PSD2) that has facilitated more innovation and competition in European commercial banks via open banking rules, the ASEAN area will need to foster stronger agreement in order to transition towards regional innovation and interoperability. Given the considerable diversity observed in ASEAN across various dimensions such as socio-economic conditions, languages, cultures, politics, and religions, it becomes evident that the region lacks a comprehensive regional regulatory framework. Consequently, the adoption of a shared financial standard, such as ISO 20022, holds significant advantages in facilitating efficient and secure financial transactions within ASEAN. At present, the use of ISO 20022 payment systems is seen in many Southeast Asian countries, including Singapore, Brunei Darussalam, Malaysia, Thailand, and the Philippines. The adoption of standards is now in progress not only in the other ASEAN nations, but also across the areas of the United States, United Kingdom, Europe, and Africa. The ISO 20022 standard provides a means for financial businesses to communicate using a shared business language, with standardized techniques, processes, and procedures. This promotes interoperability across diverse financial systems and user populations spanning several nations.

1.2. Problem Identification

The uncertainty around the influence of fintech advancements on banks and their business models persists due to the dynamic nature of these innovations. While several market analysts estimate that the range is between According to the Bank for International Settlements (2017), there is a potential danger of 40-10% of revenues and 60-20% of retail banking profits being affected in the next decade. However, there are contrasting views suggesting that banks may be able to adapt to the presence of new rivals, leading to enhanced efficiency and capacities.

The consultation paper issued by the Bank for International Settlements (BIS) cautions that established banks face potential threats to their income and profitability. However, it also emphasizes the potential for these institutions to counter the entry of fintech companies into the market via strategic acquisitions and by improving their service and product offerings to cater to their clients. The estimations presented by McKinsey (2015) were cited by the Bank for International Settlements (BIS), which highlighted the potential danger of financial technology (fintech) causing a loss of up to 40% in consumer financing and up to 60% in retail banking profits by the year 2025. This corresponds to around 9% of the return on equity (ROE) of the mentioned firm, as assessed by McKinsey to now range between 12-10%. According to McKinsey's estimation, a significant proportion of revenues (30%) and earnings (35%) in the banking sector are potentially vulnerable in relation to payment industry.

In the 2017 annual Global FinTech Report, PwC posited that prominent financial institutions worldwide may see a decline of 24% in their revenues during the next three to five years due to the emergence of financial technology businesses. According to a survey conducted among over 1,300 executives in the financial industry, it was found that consumer banking, particularly personal loans, was seen as the sector most vulnerable to risk.

According to the survey results, a significant majority of respondents, namely 88%, expressed concerns over the vulnerability of their businesses to independent financial technology (fintech) enterprises operating in sectors such as payments, money transfers, and personal finance.

China has emerged as a prominent exemplar of widespread fintech adoption. Alipay and Tenpay (WeChat) have emerged as prominent players in the realm of consumer payments and financial services. In addition, the emergence of online-only banks such as MYbank and WeBank has significantly expanded financial inclusivity for a substantial demographic that previously lacked access to traditional banking services or had little engagement with them. As a consequence, there has been a notable shift among retail consumers in China from cash transactions to electronic payments, thus bypassing the use of conventional bank cards. This trend has therefore impacted the prospective revenue streams of traditional Chinese banks. According to a report by E&Y (2017), it was found that the potential loss in revenue from bank card fees alone was anticipated to be $22.8 billion in 2015. This figure is projected to increase to almost $60 billion by the year 2020.

The relevance of global fintech trends in altering the financial sector was also emphasized at the ASEAN Finance Ministers' and Central Bank Governors' Meeting (AFMGM) that took place in Singapore in April 2018. The AFMGM (Association for Financial Market Governance and Management) advocated for more cooperation among member nations in order to strengthen their capacities and leverage fintech potential, all while maintaining financial stability. In line with the ASEAN economic integration, AFMGM has acknowledged the potential of secure, efficient, and interconnected payment systems in advancing ASEAN economic integration. It has also advocated for the establishment of wholesale payment systems linkages within ASEAN by adopting international standards such as ISO 20022.

Singapore, as a prominent global fintech center, is now seeing severe competition within the fintech industry.

According to the Global FinTech Report (2017) conducted by PwC, a significant majority of conventional financial institutions, namely 73%, were seen to be embracing the emergence of financial technology (FinTech).

Singapore was concerned about the potential loss of business to the fintech industry. In 2017, the Monetary Authority of Singapore (MAS) emphasized the potential consequences for banks in Singapore that failed to address the emergence of fintech. Specifically, it warned that these banks might see a reduction of over 5% in their operational revenue due to disintermediation. According to the Financial Stability Review report released on November 30th, 2017, the Monetary Authority of Singapore (MAS) issued a strong recommendation to all banks operating within Singapore to undertake appropriate measures in response to disruptions caused by financial technology (fintech). According to their statement, a significant portion of the decline in operational revenue is expected to be attributed to disintermediation within the payments sector, whereby an increasing number of fintech firms provide payment alternatives that directly rival traditional banking institutions.

In a similar vein, the Governor of Bank Negara Malaysia (BNM), Datuk Muhammad, In his study, Ibrahim (2016) cautioned about the possible adverse effects on income stemming from the emergence of fintech technologies.

Malaysia is a Southeast Asian country located on the Malay Peninsula and the island of Borne During the Global Islamic Finance Forum held in 2016, Datuk Muhammad Ibrahim urged financial institutions to adopt a positive stance towards financial technology (fintech), seeing it as an opportunity rather than an adversarial force. The speaker emphasized that the potential consequences of these technological disruptions are substantial. It is projected that between 10% and 40% of the total income generated by banking institutions may face potential danger by the year 2025. This risk is attributed to the emergence of fintech innovations from non-banking entities, which possess the ability to attain a substantial price advantage.

Governor Nestor A. Espenilla, Jr. (2018) of the Bangko Sentral ng Pilipinas (BSP) has also emphasized the need for all banks in the Philippines to be updated on the latest trends and advancements in the field of financial technology (fintech). According to the speaker, there is rapid advancement in new technologies such as mobile banking, social networking, big data, and cloud computing, which are leading to significant disruptions in the business. In order to maintain competitiveness and relevance, as well as maximize advantages, it is essential for banks to identify potential areas of expansion and build collaborative relationships with emerging entities (The BSP, 2018). The implementation of the National Retail Payment System (NRPS) is now underway as a component of the digitization plan by the BSP. This initiative aims to develop a payment ecosystem that is secure, cost-effective, and capable of facilitating seamless transactions across various platforms. Furthermore, the NRPS is expected to serve as a foundation for fostering fintech advancements. In reference to the National Payment and Settlement System (NPRS), the Bangko Sentral ng Pilipinas (BSP) released a Memorandum in November 2018 to formally declare the formation of the Task Force responsible for implementing the international standards ISO 20022 for the NPRS.

The payments and settlement systems in the Philippines aim to enhance worldwide interoperability. The BSP acknowledges the significant potential of fintech in promoting financial inclusion and reducing remittance costs for the Philippines' vast population of over 10 million Overseas Filipino Workers (OFWs), who play a crucial role in supporting the country's domestic economic growth.

The Thai government is actively engaged in encouraging the growth of financial technology (fintech) and digital innovation as integral components of the country's bigger initiatives, namely the Smart Cities and Thailand 4.0 programs. The Bank of Thailand (BOT) is at the forefront of establishing a fintech ecosystem and promoting the integration of fintech within domestic banks. This is being accomplished through various endeavors, including the organization of the 2018 Bangkok Fintech Fair and the implementation of the National e-Payment Master

During the 2018 Fintech Fair, Veerathai Santiprabhob, the Governor of the Bank of Thailand (BOT), highlighted three fundamental principles that should guide the development of fintech. These principles include enhancing productivity through improved efficiency and cost reduction, assisting banks and businesses in managing and mitigating risks to ensure immunity, and promoting inclusivity by facilitating financial access for individuals and communities who are currently unbanked or underbanked (BOT, 2018). The Bank of Thailand (BOT) has expressed its dedication to facilitating the integration of financial technology (fintech) into the operations of financial institutions. This commitment is aimed at fostering innovation in the fintech sector, while also assuring effective management of associated risks (BOT, 2018).

The Autoriti Monetari Brunei Darussalam (AMBD) serves as the central bank of Brunei Darussalam, with a primary objective of fostering a competitive and innovative fintech environment. In pursuit of this goal, the AMBD also capitalizes on its experience in the field of Islamic finance. This initiative is a component of Brunei Darussalam's Wawasan 2035, a comprehensive national strategy that outlines the economic aspirations for the country in the next twenty-year period. The 2035 vision includes the cultivation of a diverse, dynamic, and sustainable economy, as well as the establishment of an internationally recognized Islamic financial center, with a significant reduction in dependence on oil-related industries. According to Yusof Abdul Rahman, the Managing Director of AMBD, there have been notable advancements in Islamic fintech across various nations. These innovations have opened up fresh avenues for emerging participants to access the economic prospects within the area (AMBD, 2017). In May 2018, the Autoriti Monetari Brunei Darussalam (AMBD) and the Monetary Authority of Singapore (MAS) entered into a collaborative FinTech Cooperation Agreement. The primary objective of this agreement is to facilitate and promote the development of innovative financial services within the respective jurisdictions of Brunei Darussalam and Singapore. According to AMBD (2018), the purpose of this initiative is to enhance the exchange of information on advancements

in financial technology (fintech) and to build a structure that enables regulatory authorities to provide assistance to fintech businesses in comprehending the regulatory framework and potential prospects within each jurisdiction.

The overarching business challenge lies in the fast disruption of the conventional banking intermediary business model by fintech, which is driven by innovative technology-based enterprises, rendering the previous model outdated. Illustrative instances include mobile banking and crowd platforms that provide peer-to-peer transactions, including payments, loans, and borrowing, therefore circumventing the involvement of middlemen. The aforementioned alterations provide a substantial danger to conventional financial institutions, as they confront a considerable jeopardy of income loss if they fail to take appropriate action. Simultaneously, the integration of fintech into banking enterprises may serve as a valuable complement by facilitating the development of novel goods and services, while concurrently mitigating expenses and risks via the use of automated processes. Hence, the study at hand aims to answer a tripartite business challenge.

The inquiry pertains to whether investments in fintech will result in enhanced bank performance across all financial metrics, including revenue streams, cost structures, and balance sheet components, or just limited to certain financial indicators.

2) This study aims to investigate the impact of investment in financial technology (fintech) on bank performance, specifically examining whether such investment yields positive outcomes for all commercial banks or just for chosen banks with specified characteristics, such as size or business emphasis.

3) This study investigates the potential impact of financial norms on the interplay between fintech and traditional financial institutions.

The impact of innovations on bank performance has been a subject of academic interest and research.

1.3 Objective Clarifications

The objective of this study is twofold. The primary objective of this study is to assess the influence of financial technology (fintech) advancements on the operational effectiveness and financial outcomes of banks operating within the Association of Southeast Asian Nations (ASEAN). This will be accomplished by using a diverse range of financial indicators for analysis. Furthermore, this study aims to assess the potential impact of implementing financial rules on both fintech advancements and bank performance. The financial statistics are derived from the income statements and balance sheets of banks. The assessment of fintech advancements is determined by the extent to which ASEAN banks have embraced mobile banking technology. The measurement of financial standards is based on the extent to which ASEAN banks have adopted these standards over a period of time.

This study chose a panel data sample consisting of 36 local commercial banks in the ASEAN countries of Singapore, Malaysia, Thailand, Philippines, and Brunei Darussalam. The reason for selecting these banks is because they are all publicly listed, ensuring the availability of their historical financial data for analysis. The use of panel data analysis is chosen due to its capacity to provide time-series analysis, hence enabling a more comprehensive examination of the spread and adoption of technology across various banks during a certain period.

This study only focuses on local commercial banks that primarily operate inside domestic markets, since they are chosen to assess the impact of fintech on their domestic operations. This study excludes global banks operating in the ASEAN area because to their relatively lesser presence compared to their home nations. Consequently, only historical financial data from their headquarters is accessible for analysis.

The selection of the five ASEAN nations for this study is based on their adoption of financial standards for both national payment operations and cross-border financial operations in recent decades. This allows for the observation and tracking of historical consequences related to these standards. In contrast to other ASEAN member nations

such as Indonesia, Myanmar, Cambodia, Vietnam, and Laos, whose national payment systems rely on proprietary formats, these countries have not yet embraced international financial standards for their domestic payment operations.

The study period was chosen to span from FY 2010 to FY 2017 due to specific justifications. Following the global financial crisis in 2010, banks shifted their attention towards technology investments and innovations. During this period, banks began to embrace mobile banking technology in response to the increasing rates of mobile and smartphone use, as well as the widespread availability of broadband internet access. Furthermore, the decision to use FY 2017 as the termination point was based on the availability of pertinent financial data throughout the research process conducted in 2019.

This study aims to investigate the influence of mobile technologies and financial norms on several bank performance metrics, including revenue streams, cost structures, and balance sheet constructions, among the five ASEAN nations from 2010 to 2017. This study will specifically investigate whether the impact of fintech is seen in all banks or limited to a subset of banks with specified characteristics, such as bank size.

The primary objective of this study is to address the existing research vacuum in the field of fintech within the banking sector of the ASEAN region. Currently, there is a notable absence of substantial empirical research in this specific geographical area. The objective of this initiative is to enhance the comprehension of the financial consequences arising from fintech developments and financial standards for central banks, banks, and financial institutions operating within the ASEAN region as well as globally.

This study aims to provide empirical research on fintech from a financial perspective, with the goal of offering valuable insights to banks. By examining the factors that influence the importance of fintech investments and adoptions, this research seeks to enhance business practices, performance, and economic contributions in the ASEAN region. Additionally, this study will provide valuable insights into the impact of financial rules on bank performance within the dynamic fintech industry.

The acquisition of this sort of knowledge is crucial for both scholars and industry professionals who are interested in obtaining information on the early accomplishments of fintech innovations, investments, and the implementation of financial norms by commercial banks in the Association of Southeast Asian Nations (ASEAN).

1.4 Research Pinpoints

The present dissertation is structured into five primary chapters. Chapter 1 of the document has an introductory section, a problem statement, and a mission statement. Chapter 2 presents a comprehensive literature analysis including ideas related to technology advancements, fintech, financial standards, and the influence of fintech innovations, financial standards, and macroeconomics on bank performance. Chapter 3 of the study centers its attention on many key components, including the research framework, theoretical constructions, hypotheses, methodology, sample data, research variables, and analytical procedure. Chapter 4 presents the findings of the data analysis, specifically focusing on the results of the regression analyses conducted and the outcomes of the hypotheses that were evaluated. The dissertation is concluded in Chapter 5.

Literature Review

This section provides a comprehensive assessment of the existing literature pertaining to theories of technical advances, financial standards, macroeconomics, and recent literature on the evolution of financial technology (fintech). Fintech is a nascent phenomenon, resulting in a limited body of scholarly study. Several studies examine the influence of financial technology (fintech) on the performance of banks, and these investigations are expanding and adapting in tandem with the advancements in novel technologies. To far, little study has been conducted to assess the influence of fintech on bank performance in the Asian context. Furthermore, so far, there is a dearth of substantial empirical study investigating the correlation between fintech advancements and financial regulations, as well as their impact on the performance of banks

within the Association of Southeast Asian Nations (ASEAN). The objective of this study is to address the aforementioned knowledge deficit. Given the ongoing evolution of fintech and financial standards in tandem with the emergence of new technologies, the scope of academic research in this field remains restricted. Consequently, this study incorporates an examination of several sources, including whitepapers, government reports, and industry research papers.

2.1 Technological Innovations Theories Review

Various theoretical frameworks from diverse viewpoints provide valuable insights into the economic and organizational advantages associated with technical developments (Schumpeter, 1942 ,1934; Henderson & Clark, 1990). Schumpeter (1942 ,1934) provided a definition of innovation within the framework of economic theory, whereby he posited that entrepreneurship serves as a catalyst for economic progress. Schumpeter's (1934) conceptualization of innovation centers on the notion that entrepreneurship serves as a catalyst for economic advancement. The act of entrepreneurship, which involves the creation of novel combinations of objectives and approaches, leads to the emergence of innovation. As stated by the author, the primary role of entrepreneurs is to integrate various productive components and unite them towards a common goal (p.76).

Schumpeter (1934) provides a definition of innovation as the practical implementation of novel elements in the realms of commerce or industry. These elements might include new products, processes, methods of production, markets, sources of supply, or forms of commercial, corporate, or financial organization.

Schumpeter furthermore established a philosophy of disruption referred to as "creative destruction," which is a concept inside the realm of economic innovation. In his seminal work titled "Capitalism,"

In his work titled "Socialism, and Democracy" published in 1942, the author introduced the concept of "creative destruction" as a mechanism inside the capitalist system that generates overall economic gains.

Schumpeter used the concept of "creative destruction" in regard to Marxism, positing that capitalism, via its inherent processes, will ultimately engender its own demise, paving the way for the ascendancy of socialism. Emerging entrepreneurs contribute to the economy by generating economic value via their disruptive innovations, therefore displacing and reshaping the established enterprise's existing value proposition. The author penned the following statement:
The expansion of markets, whether they are located abroad or within the country, and the evolution of organizational structures from small-scale craft shops to large corporations like U.S. Steel exemplify a continuous process of industrial transformation. This process can be likened to a biological mutation, as it constantly revolutionizes the economic framework from within, leading to the demise of the old structure and the emergence of a new one. The phenomenon of Creative Destruction is a fundamental aspect of the capitalist system. According to the information provided on page 83,According to Schumpeter, the primary driver of enduring economic development is the introduction of radical innovations by entrepreneurs, which disturb the existing capitalist framework.

The author emphasizes that the innovations introduced by entrepreneurs have the potential to disrupt and displace established entities that previously had monopolistic power. The entrepreneurs use strategies to provide novel and inventive goods and services, therefore acquiring a larger portion of the market, sometimes to the detriment of their non-innovative rivals. According to Schumpeter, the presence of huge enterprises with monopolistic power plays a crucial role in facilitating and driving innovative activity. Large corporations have the ability to achieve economies of scale in both production and innovation, therefore ensuring the availability of enough resources for the effective execution of creative endeavors.

Schumpeter's theory has prompted several empirical investigations that have concentrated on two distinct relationships: (1) the correlation between company size and innovation, and (2) the association between market concentration and innovation. The study conducted by Fisher and Temin (1973) revealed that the presence of inventive inputs and the expansion of company size did not necessarily indicate a direct and proportional link between innovative output and firm size. This finding was attributed to the existence of economies of scale associated with bigger enterprises. The study conducted by Kamien and Schwartz (1982) focused on doing a cross-industry examination of enterprises. Their findings indicated that, outside from the chemical sector, there was insufficient evidence to support the premise that company size had a significant impact on either research and development (R&D) or inventive production beyond what would be expected proportionally.

Schumpeter's enduring influence is seen in the continued recognition he receives among economists, including his former pupil, Alan Greenspan. The ex-chairman of the United States Federal Reserve restated the concept of Schumpeter's creative destruction in relation to the emergence of globalization. It was noticed that the United States has progressively adopted and accepted the phenomenon of globalization during the course of many decades, leading to an overall improvement in living conditions. He also contended that globalization might be characterized as a phenomenon of creative destruction, in which a substantial degree of upheaval occurs throughout the course of this process. The speaker provided an example involving the recruitment and termination of a significant number of employees, specifically citing the scenario of employing and then dismissing one million workers on a weekly basis inside the United States. Greenspan emphasized the need of acknowledging the predicament faced by a minority group that finds itself disadvantaged by the process of creative destruction within the capitalist system, notwithstanding the overall advantages and advancements brought about by globalization and economic progress.

According to Schumpeter's conceptualization of creative destruction, many types of innovations are delineated, each with its own influence on the capacities of a corporation. Organizational theory posits that the development of technical advances is contingent upon the influence of organizational culture, dynamism, and routines. The principles of architectural innovation, as developed by Henderson and Clark (1990), serve to enhance the existing perspectives on radical and incremental improvements. The concept is delineated in Figure 5, which presents a classification of inventions based on two aspects. The horizontal dimension of an invention pertains to its influence on individual components, whereas the vertical dimension pertains to its influence on the interconnections between these components.

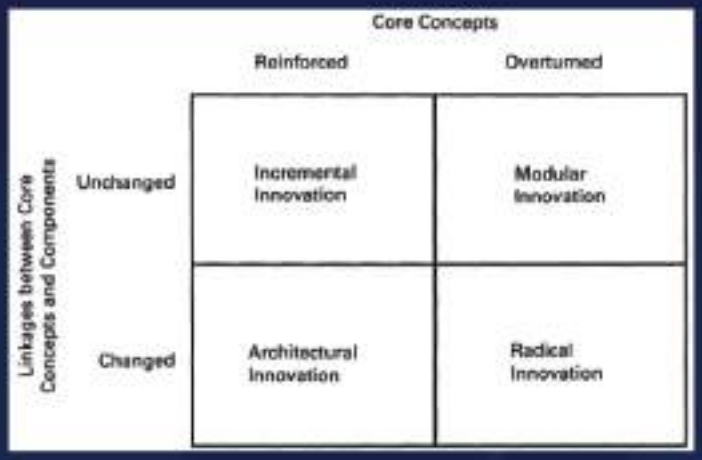

Figure 5: A framework for defining innovation (Source: Herderson & Clark,1990)

The fundamental aspect of architectural innovation is in the explicit differentiation between the constituent elements of a product and the manner in which they are incorporated into the overarching system known as the product "architecture". The architectural innovation entails the rearrangement of preexisting components, which are interconnected and linked in a novel manner. An illustration was shown of a ceiling fan in which the engine is concealed and soundproofed to minimize noise. Enhancements in blade design or motor power would constitute incremental advancements.

In instances when the primary elements remain mostly consistent, such as the blade, motor, and control system, the development of a portable fan may be considered an architectural advancement. This innovation involves the utilization of existing components inside a novel architectural framework, characterized by lower blade and motor sizes. The categorization implies that an invention may be categorized as either less radical or more architectural, without implying that all innovations must be classed into four quadrants. The transition from using a ceiling fan to adopting central air conditioning is a significant and transformative innovation. The phenomenon referred to as modular innovation occurs when there is a simultaneous loss of component knowledge and an enhancement in architectural knowledge, as shown by the transition from analogue to digital telephony. The concept of architectural innovation has great importance as it highlights the fact that while the constituent knowledge necessary for innovation remains unaltered, the architectural knowledge itself undergoes transformation. The acquisition of architectural knowledge sometimes takes the form of tacit understanding and becomes integrated into the established routines of an organization. Consequently, the task of acknowledging architectural knowledge and appropriately addressing it is sometimes arduous owing to the dynamic nature of organizational communication channels, information filters, and techniques used in the management of architectural knowledge.

The concept of architectural innovation has significant value as it offers valuable insights into various forms of innovation and the organizational capacities involved, whereby innovation may both increase and undermine competence, sometimes in nuanced ways. This statement discusses the phenomenon of incumbents' failure in implementing what first seems to be incremental innovation but is, in fact, architectural innovation, as proposed by Henderson and Clark (1990).

Clayton Christensen has expounded upon the alternative theory of innovations. In Clayton Christensen's seminal work, The Innovator's Dilemma (1997), the author expounds upon the concept of "disruptive innovation." This theory posits that a product or service initially gains traction in modest applications within the lower echelons of a market, subsequently permeating the market with unwavering determination and ultimately supplanting established competitors. In his work, Christensen offers a comprehensive analysis of the factors contributing to the collapse of top-performing organizations when they encounter certain forms of market and technology transformations. Managers within top-performing companies often encounter a predicament whereby their pursuit of optimal success entails engaging in practices such as attentively attending to customer needs, making substantial investments in emerging technologies, and cultivating unique competencies to effectively serve established major clients. However, this approach carries the inherent risk of overlooking emerging innovation trends and disregarding competitors who introduce disruptive innovations. The above image illustrates two significant components of Christensen's theory of disruptive innovation: (1) the concept of incumbents engaging in sustaining innovation, and (2) the occurrence of disruptive innovations introduced by new market entrants.

Figure 6: Theory of Disruptive Innovation (Source: Christensen, 1997)

Incumbents that engage in the pursuit of sustaining innovations have a propensity to innovate at a rate that aligns with the rapid speed of technological development, beyond the rate at which the evolving demands of the bulk of their consumers are met. Typically, this practice is used to cater to the needs of discerning and highly intelligent clients situated at the upper echelons of the market. In such segments, established players tend to prevail due to their ability to command substantial price premiums. Consequently, the current market leaders ultimately develop offerings that prove to be excessively costly, excessively advanced, and excessively intricate for a significant portion of their target clients to embrace.

Nevertheless, the pursuit of sustaining innovations inadvertently leads incumbents to inadvertently facilitate the emergence of "disruptive innovations" in the lower segments of the market. Disruptive innovation refers to a phenomenon when a significant number of previously untapped consumers at the lower end of a market have access to inexpensive goods or services, therefore establishing a firm position in the lower segment of the market and ultimately causing a substantial upheaval within the sector. Disruptive innovations in their nascent phases may exhibit some distinctive characteristics, such as reduced gross margins, narrower target markets, and simplified goods and services. Due to the comparatively lower gross margins associated with these lower market tiers, incumbent firms find them unappealing for market entry. Consequently, this situation creates an opportunity for new disruptive rivals to arise and occupy the lower end of the market. In 2000, Christensen introduced the Resources-Processes-Values framework, which posits that an organization's tangible and intangible resources, as well as the processes employed by its employees to convert these resources into value-added products and services, play a crucial role in determining the incumbent's ability to effectively respond to disruptive innovations (Christensen, 2000).

In brief, various authors, including Schumpeter (1942 ,1934), Henderson and Clark (1990), and Christensen (1997), have put forth theories on innovation that shed light on diverse forms of innovation, disruptive influences, and the emergence of start-ups. These theories provide insights into how these phenomena are shaping the world in terms of

The Schumpeterian perspective on globalization posits that it is characterized by a process of creative destruction driven by innovation. This viewpoint sheds light on the negative consequences experienced by individuals who are disrupted within an imperfect capitalist system. Christensen's idea of disruptive innovation presents an alternate perspective on the process of innovation, whereby it originates at the lower end of the market and gradually supersedes established rivals. All models emphasize the significance of corporations in maintaining competitive positions via ongoing innovations.

While these theories offer insights into the disruptive consequences, they fall short in elucidating the present era of fintech and digitization. This era is characterized by the emergence of novel technologies like mobile applications, distributed ledger technologies, and artificial intelligence, which facilitate interconnections between various industries and enable simultaneous interactions with consumers. The phenomenon of disruption has evolved beyond the confines of a certain sector and a specific segment of the market. Disruptions might potentially arise in situations where novel technologies emerge and experience rapid proliferation. After a thorough examination of ideas pertaining to technological advances and disruptions, the following part will concentrate on the existing body of literature about financial technology, sometimes referred to as fintech.

2.2 Evolution of Financial Technologies (fintech)

The financial services sector is undergoing a significant transformation due to the emergence of Financial Technologies, often referred to as "fintech." This phenomenon is characterized by the introduction of innovative solutions that enhance the efficiency and customer-centricity of the financial ecosystem. Fintech technologies such as peer-to-peer lending, cryptocurrency trading, and deep learning are progressively offering consumers and corporations enhanced access to cost-effective financial services that are more convenient in nature.

In a study conducted by McKinsey in 2016, an analysis was undertaken to explore the intersection of fintech and remittances, with a specific focus on its implications for financial inclusion. The objective was to quantitatively assess the macroeconomic and social effects and advantages of digital finance for people and small and medium-sized companies (SMEs) in developing nations. The author's findings included instances of effective digital remittances inside economies characterized by robust digital infrastructures and stringent financial laws. The study provided a comprehensive analysis of the digital finance landscape in a specific nation, aiming to forecast its future state in the year 2027. This analysis included predictions about the projected increase in the number of individuals who would get access to the financial system, the potential boost to the country's gross domestic product (GDP), the creation of new employment opportunities, as well as the anticipated rise in both deposits and credit within the financial sector. The study examined the process of digitalizing financial services in developing nations with the aim of reducing expenses for consumers and enhancing profitability for service providers, so enabling them to cater to a broader client base.
In 2017, the International Finance Corporation (IFC) conducted a comprehensive assessment of potential digital financial ventures in developing regions throughout Asia and Africa. This study examined the extent to which fintech has been able to provide financial services to persons who are economically disadvantaged and lack access to traditional banking services. It is noteworthy that a significant proportion of the global unbanked population is concentrated in these specific locations.

India has the biggest proportion of unbanked individuals, accounting for 20.6% of the global total, while China follows closely behind with a rate of 11.6%. In addition to the banking sector's endeavors to promote digital payments via collaborations with financial technology (fintech) firms, the International Finance Corporation (IFC) has recognized the significance of Asian governments and regulators actively participating in the facilitation and endorsement of fintech initiatives.

This engagement is crucial in order to facilitate financing opportunities for small and medium enterprises (SMEs) and foster the development of novel solutions for the banking industry. It has been suggested that Asian banks have successfully achieved integration with fintech solutions and have aggressively pursued strategies to save costs and address client demands by opting for collaboration rather than competition with startups. According to the International Finance Corporation (IFC, 2017), it was observed that African banks, with the exception of South Africa, exhibited a more slower pace in their response to the aforementioned transformation. South Africa, on the other hand, had a well-regulated banking industry and a digital banking roadmap that included fintech solutions. The study determined that the use of financial technology (fintech) in the Asian banking industry has shown favorable outcomes, mostly due to its ability to provide enhanced market accessibility and cost efficiency. Nevertheless, it is worth noting that African banks often faced direct competition from mobile companies. Hence, it may be inferred that the level of integration required by non-Asian banks would be greater in comparison to their Asian counterparts.

In the ongoing examination of fintech developments inside developing countries, KPMG In 2016, more study was conducted on the Indian market. Numerous financial technology (fintech) enterprises are actively engaged in endeavors aimed at facilitating enhanced financial inclusivity and facilitating payment transactions in geographically isolated regions inside India. A significant finding of the paper pertains to the crucial role played by the Reserve Bank of India (RBI), the regulatory authority.

The commendable function of supporting the growth of the fintech industry. Simultaneously, the Reserve Bank of India (RBI) is advocating a prudent strategy in dealing with issues pertaining to consumer protection and law enforcement. India is renowned for its significant contributions to the national economy via foreign remittances, which comprise a substantial portion of the country's GDP.

India had the challenge of elevated expenses associated with receiving payments, particularly due to the relatively modest quantity of remittances, which rendered it prohibitively costly for recipients. The aforementioned matter has presented a significant opportunity for fintech enterprises in India, as they have shown a strong commitment to effectively addressing the problem and developing efficient remittance platforms. The present study has furthermore formulated a conceptual framework aimed at facilitating the establishment of a prominent fintech center in India, by means of fostering cooperation across various industries and using benchmarking techniques. The paper said that banks in India should consider implementing a comprehensive strategy consisting of four key components: investment, partnership, market value chain, and cooperation. The need of establishing connections with essential stakeholders in the fintech sector was underscored. These stakeholders include universities, research institutes, government bodies, regulatory agencies, startups, investors, users, financial institutions, technology suppliers, incubators, accelerators, and innovation laboratories.

After examining India, the following area of interest is China. A study was produced by Ernst & Young and DBS in 2016, which provided a description of the fintech revolution in China. The substantial dominance of Chinese fintech investments in the global investment landscape in 2016 serves as a testament to the immense prospects of a digital financial sector. China now has the distinction of being the biggest global emarketplace for customers, owing to its significant internet and mobile penetration rates. Prominent platforms such as Taobao and Tmall (operated by Alibaba), Tencent's WeChat, and JD.com contribute to this status. Chinese IT companies are making significant investments in emerging technologies to provide advanced financial services that prioritize e-commerce, payment systems, and remittance processes. The payment markets are mostly controlled by the financial companies of Alipay and Tenpay, which serve as facilitators for mobile payments. Consequently, the incumbent banks in China are now facing significant challenges. In the year 2015, the net profit growth of China's commercial banks had a modest increase of 2.4%.

This rise was particularly notable among larger banks, as they recorded their most sluggish rate of expansion in recent years. It is anticipated that the incumbents would face increased challenges at the completion of the nation-wide implementation of the Social Credit System by 2020, due to the expanded opportunities within the fintech sector.

In a study conducted by The Bank of New York Mellon (2016), an analysis was performed on the increasing trend.

The potential of financial technology (fintech) in both the retail and wholesale payments sectors. The report the bank asserts in their publication titled "Innovation in Payments: The Future is Fintech" that the current period is undeniably characterized by the rise of financial technology (fintech). The bank emphasizes that it is insufficient for banks to just acknowledge this reality; rather, they must proactively develop a well-defined strategy to effectively adjust to and capitalize on the transformative effects brought about by fintech. The researchers said that the wholesale payment market might see disruption in the fintech sector via two primary avenues: the involvement of major technology corporations operating in the financial services industry, and the emergence of several fintech startups that possess the capacity to facilitate disintermediation. The researchers also conducted an analysis of the existing obstacles in the application of financial technology (fintech), as well as strategies for capitalizing on fintech prospects and provided suggestions for banks to enhance their involvement with the fintech community, therefore establishing a strong foothold in the digital era.

In a recent study conducted by Kuo Chuen and Teo (2015), the growth of fintech was examined, and a set of principles known as LASIC (Low margin, Asset light, Scalable, Innovative, and Compliance simple) was formed. These principles were used to analyze the performance of two prominent fintech businesses, Alibaba and MPESA. The authors suggested that the use of fintech would result in reduced operational expenses and increased profitability for businesses.

The application of the LASIC principles was employed to analyze the business model of M-PESA, a mobile payment solution in Kenya, in the context of international remittance costs. This analysis focused on how M-PESA utilizes innovative technologies to maintain a low margin business, achieve scalability in operations, ensure affordability for consumers, and comply with regulatory requirements. M-PESA demonstrated adherence to the LASIC principles and elucidated their potential to signify the triumph of fintech enterprises. The researchers reached the conclusion that only leveraging the LASIC principles is inadequate. Instead, they argue that investing in financial inclusion and catering to the underbanked and unbanked populations is crucial for achieving long-term success and ensuring sustainability.

In brief, the literature pertaining to fintech examines two primary concerns: firstly, the global obstacles associated with financial inclusion, and secondly, the role of fintech as a pivotal catalyst in fostering a more comprehensive financial ecosystem. 2) The emergence of financial technology (fintech) presents potential risks in terms of promoting disintermediation. Banks are increasingly incorporating fintech technologies into their operations in order to improve the overall customer experience and achieve cost reduction. Governments and regulatory bodies exert influence on the development and uptake of fintech. After conducting a comprehensive assessment of the existing literature pertaining to financial technology (fintech), the subsequent phase of this study will delve into the examination of the influence exerted by emerging technologies, namely fintech, on the performance of banks.

2.3 FinTech's Impact on Banks' Performance

There has been a notable increase in scholarly research examining the influence of emerging technologies, namely financial technology (fintech), on the overall performance of banks on a worldwide scale. To identify pertinent publications addressing the study inquiries about the association between fintech advancements, financial standards, and bank performance, an exhaustive search was conducted across three prominent scientific databases: EBSCO, Science Direct, and ProQuest. The scope of the investigation was limited to scholarly publications published in peer-reviewed scientific journals between 2012 and 2017. The search was conducted using specific keywords, including 'fintech', 'financial technology', 'digital', 'mobile banking', 'innovation', 'bank performance', 'financial effect', 'return on equity (ROE)', 'return on assets (ROA)', 'standards', and 'ISO 20022'. Furthermore, the use of Google Scholar was employed to identify pertinent scholarly works using same keywords. Due to the inability of Google Scholar to effectively filter peer-reviewed publications, the search results were cross-referenced with esteemed journal rankings such as Scimago, American Economic Review, UT Dallas Ranking, and the Financial Times. This process was used to identify and choose peer-reviewed journal articles. A comprehensive search yielded a total of 45 peer-reviewed journal papers, with 6 publications identified via an independent search and 39 articles discovered through the literature review conducted by scholars affiliated with Tilburg University. The subsequent discourse will provide the pertinent scholarly publications.

Hornuf, Lohwasser, and Schwienbacher (2018) conducted a recent research that examined the primary factors motivating banks to establish partnerships with fintech companies, as well as the influence of such alliances on the market value of banks in Canada, France, Germany, and the UK. The researchers obtained data on strategic alliances from bank websites, the Crunchbase database, and Factiva for the period of 2017-2007. This data was acquired for the hundred biggest banks in each of the four nations under study.

A total of 469 partnerships were identified via this process. Out of the total 469 partnerships, the predominant category consists of collaborations pertaining to products, accounting for 54% of the alliances. This is followed by financial engagements, which make up 43% of the alliances. The researchers transformed the data into a panel dataset, including bank-year observations, covering the time span from 2007 to 2017. The researchers discovered a significant correlation between the establishment of partnerships between banks and fintech companies and the implementation of a well-defined digital strategy and/or the appointment of a Chief Digital Officer (CDO). The use of a Chief Digital Officer (CDO) results in a significant rise in the frequency of contacts between banks and fintech companies, often ranging from two to three times the previous level. The statistical significance of the coefficients pertaining to bank listing on stock exchanges and bank assets is seen across all regression analyses, indicating a positive influence. This implies that larger and publicly traded banks engage in a greater degree of interaction with fintech compared to smaller and privately held banks. The regression analysis reveals a notable negative return on assets (ROA) for the bank, suggesting that banks with low profitability may exhibit a heightened interest in establishing a greater number of fintech partnerships. This strategic approach may be used as a means to expedite the process of organizational change. The study revealed that the response of markets is more pronounced when fintech alliances are announced by digital banks as opposed to conventional banks. The findings of their study indicate that digital bank stocks have positive outcomes as a consequence of forming agreements, maybe because to their enhanced capacity to assimilate the knowledge of fintech companies.

In a study conducted by Rega (2017), an empirical analysis was carried out using a data panel consisting of 38 European Banks. The objective of the study was to assess the influence of bank innovations on financial performance, specifically evaluated by the Return on Equity (ROE) metric, over the period spanning from 2013 to 2015.

The research was conducted using secondary data obtained from the annual reports of European banks during a three-year period during which banks made investments in fintech developments. The researcher used statistical software programs, namely R and STATA 12.0, to conduct data analysis. The results of the analysis revealed a statistically significant positive correlation between fintech and bank profitability. This finding suggests that financial innovation has the potential to provide cost-cutting measures and cross-selling possibilities for banks. Additionally, she discovered a negative correlation between the quantity of physical branches and the profitability of banks. In addition, the researcher observed that banks with a greater emphasis on digital operations, such as Nordea, SwedBank, Fineco, and mBank, shown an increasing level of profitability (with a return on equity ranging from 13% to 15%) despite the prevailing trend of declining interest rates. Furthermore, these banks exhibited a notable commitment to constructing a customer-centric banking institution that is well-positioned for future developments.

Scott, Reenen, and Zachariadis (2017) conducted a separate study in which they examined the effects of using SWIFT technology on the performance of banks. SWIFT is an internationally used technology backbone for interbank telephony, facilitating global financial network connectivity. The researchers used a dataset of 6,848 banking institutions.

The SWIFT system was implemented by countries in Europe and North America between the years 1977 and 2006. To assess the financial implications, the researchers directed their attention on using Return on Sales as a metric for evaluating success. The researchers observed that the use of SWIFT technology has significant long-term impacts on the Return on Sales. The realization of the effect of innovation is unlikely to occur in the near term due to the time required for technical adaption and spread. Remarkably, the primary finding of their study revealed that the benefits derived from SWIFT investment may need a considerable

span of 10 years to be completely actualized, as they noticed a notably feeble or worse outcome during the first years after the implementation of SWIFT.

Moreover, the impact on profitability was more pronounced for smaller banks, which get greater advantages from comparatively higher returns compared to bigger banks. Their study presents findings that are in opposition to Schumpeter's theory of scale economies, which posits that huge enterprises with monopolistic power play a crucial role in driving innovation. The available empirical data indicates that small banks, despite their lower scale of operations, are able to effectively exploit the use of SWIFT technology. Furthermore, these small institutions have substantially greater returns compared to bigger banks.

In their study, Campanella and Dezi (2016) conducted research on the impact of the Internet of Things (IoT) on the analysis of the interplay between the goods provided by a sample of 3,692 banks situated in 28 European nations during the year 2013. The objective of their investigation was to examine the link between these products and the banks' profitability, as assessed by the relative return on equity. The empirical research conducted in this study utilized the classification analysis method to examine the factors associated with a high return on equity (ROE) in banks. The results indicated that several characteristics were indicative of a high ROE, including the provision of Internet of Things (IoT) services to both retail and corporate customers, a wide range of home banking services, and the availability of traditional investment services.

The study conducted by Tunay and Akhisar (2015) examined the correlation between online banking and performance indicators such as Return on Equity (ROE) and Return on Assets (ROA). Panel causality tests were used to analyze banking data from a sample of 30 advanced and developing European nations throughout the time span of 2005 to 2013. The IMF Financial Soundness Indicators were used to get the performance statistics of aggregated banks Return on Equity (ROE) and Return on Assets (ROA) ratios at the national level.

The study revealed a robust and one-way causal relationship between Internet banking and bank profitability in nations within the Euro Area. Significant causal correlations between variables were not seen in countries outside the Euro Area. Hence, the only noteworthy causal association identified was seen inside the Euro Area nations. The correlation between the level of sophistication in online banking procedures in European nations and the financial performance of banks is evident. However, there was no notable association seen in less developed European nations, which might be attributed to the absence of adequate infrastructure and variations in consumer behavior.

Several studies conducted inside the nation have examined the effects of financial technology on the performance of banks. In their study conducted between 2010 and 2015, Japparova and Rupeika-Apoga (2017) investigated the impact of financial technology (fintech) on the performance of commercial banks in Latvia. The researchers assessed bank performance using three key indicators: return on assets (ROA), return on equity (ROE), and the capital adequacy ratio (CAR). There are a total of 23 commercial banks in Latvia, which may be categorized into two distinct groups based on their specialization in customer serving. The first group comprises banks that primarily focus on catering to foreign clients (BI), while the second group consists of banks that primarily serve local consumers (BD). The researchers observed that the Return on Assets (ROA), Return on Equity (ROE), and Capital Adequacy Ratio (CAR) indices were higher for BD, indicating superior financial performance. This may be attributed to the fact that BI exhibited a greater reliance on both internal and external elements within the banking industry. In brief, the advent of fintech has had a significant impact on the retail banking industry in Bangladesh, prompting a proactive shift towards digitalization in their operational processes. Banks classified as BD had more flexibility and a targeted approach towards both new and current consumers via the use of novel digital technologies, in contrast to BI, which demonstrated a slower pace of development and digital integration.

In their study, Abbasi and Weigand (2017) conducted an extensive examination of scholarly journals to assess the influence of digital financial services (DFS) on the performance of firms. The analysis included the period between 2006 and 2016. DFS, or Digital Financial Services, encompasses a comprehensive array of financial services that are accessible and provided via digital means. These services include but are not limited to payments, credit, savings, remittances, insurance, and the dissemination of financial information. The phrase "digital channels" encompasses a range of technological platforms including the internet, mobile phones, ATMs, POS terminals, NFC-enabled devices, chips, cards, biometric devices, tablets, phablets, and other similar digital systems. Abbasi and Weigand (year) conducted a comprehensive study of the literature and found a total of 39 publications published in various peer-reviewed scientific journals. These studies specifically examined the impact of DFS on the financial growth and profitability of banks. For more details, please refer to Appendix 2. Among the total of 39 papers analyzed, a significant majority of 60% were found to have been published in esteemed academic journals such as Elsevier, Emerald, Inderscience, Taylor & Francis, Wiley, and Springer. A total of 39 papers were identified, all of which were centered on the banking industry. The majority of these articles used quantitative methodologies, with the exception of a single research conducted by Kennedy and Jacky (2013), which utilized a qualitative approach. The research approach that was most often used in 70% of the studies was regression analysis (see to Appendix 1). The areas that have received the greatest geographical study attention are Europe, followed by the United nations and South Asia. Surprisingly, there has been a lack of research conducted on the member nations of the Association of Southeast Asian Nations (ASEAN). The mean sample size observed in this study was 534, with the United States having the highest representation of banks, followed by European nations. The researchers selected a range of dependent and independent factors included in the study examining the effects of Daily Fantasy Sports (DFS) on company performance.

The dependent variables most frequently cited in the research were the Return on Equity (ROE) and the Return on Assets (ROA), with approximately two-thirds of all studies referencing them (see Appendix 2). To account for the influence of other variables on financial performance while investigating the relationship between Debt Financing Structure (DFS) and financial performance, numerous studies employed various control variables. The factors included in this category consist of the dimensions of banks, as well as macroeconomic indicators such as gross domestic product (GDP), inflation rates, and employment expansion (see to Appendix 2). It has been noticed that despite the significant progress made in the field of dynamic financial strategies (DFS) over the last decade, the influence of factors on company performance has not received enough attention in academic literature. One of the primary factors contributing to this phenomenon was the tendency among studies to focus mostly on the banking sector, neglecting other sectors such as mobile network carriers and emerging fintech entities.

Let us examine the bank size, which has been often used as a control variable in previous research studies.

2.3.1 The Proportion of Size Factor

Numerous research has been conducted to examine the correlation between the size of banks and their performance. In line with Schumpeter's theory, it may be argued that an expansion in the size of banks can lead to enhanced efficiency. This is due to the potential for banks to benefit from economies of scale, whereby the costs associated with technical investments can be distributed over a larger asset base. Consequently, this can result in a reduction in average costs for banks. The expansion of banks' assets may facilitate the use of economies of scope, enabling banks to mitigate risks via the diversification of their banking activities across various business lines and geographical locations (Mester, 2010). The act of mitigating risks might potentially enhance profitability via the reduction of losses or indirectly by

incentivizing liability holders to accept lower yields, thereby diminishing banks' financing costs (Regehr & Sengupta, 2016).

However, it is important to note that larger size and economies of scale are not the exclusive determinants of bank success. The agility and flexibility of small banks may facilitate the seamless integration of new technology. Small banks have the potential to develop more robust connections with local companies and consumers compared to larger banks. This advantage enables them to have access to exclusive information that may be valuable in determining contract conditions and making better credit assessments and judgments (Berger, Allen, Miller, Petersen, Raghuram, & Stein, 2005). In their research, Fries and Taci (2005) conducted a comprehensive investigation on the efficiency of banks in 15 transition nations. The study included a sample of 289 banks and spanned the period from 1994 to 2001. The researchers reached the conclusion that the performance of banks was shown to be associated with variations in incentives, structural and institutional improvements, and the presence of a robust legal framework. Additionally, it was discovered that a bank of medium size within the sample exhibited a level of operation that closely aligns with the concept of continuous returns to scale. Conversely, the smaller banks in the sample were seen to run with significant unrealized economies of scale. According to DeYoung and Hunter (2001), small banks are more likely to provide a greater level of customized connection. As an organization expands in size, the ability to provide high-touch personal service becomes more challenging. Historically, it has been observed that major financial institutions have shown a preference for catering to clients of considerable size and scale. The authors elucidated that, in many instances, disparities in the scale of banks were predestined by the economic magnitude of the regional market and the stringency of local regulations pertaining to branching.

According to Regehr and Sengupta (2016), there is evidence to suggest that small community banks saw notable scale economies in the banking sector during both the pre-crisis and post-crisis periods

Although smaller banks may see substantial benefits from growth, the advantages derived from this expansion gradually diminish until they are ultimately depleted. The majority of mid-sized community banks have a small rise in returns in proportion to their size. In order to achieve much better returns on assets, these banks would need substantial increases in size. There is a consistent correlation between size and profitability that persists throughout both the pre-crisis and post-crisis expansions. In essence, it may be inferred that small community banks have not seen a disproportionate impact on the link between size and profitability in the economic and regulatory landscape after a crisis.

In recent years, there has been an increasing emphasis on the significance of technology advancements and their influence on the functioning of banks. Several studies were conducted to investigate the impact of financial technology (fintech) on the performance of banks on a worldwide scale. The impact of financial technology (fintech) on bank performance is subject to varying outcomes, influenced by variables like bank size, strategic approach, regulatory framework, and macroeconomic conditions. The return on assets (ROA) and the return on equity (ROE) emerged as prevalent performance indicators, while regression analysis emerged as the predominant research methodology. Europe was the most extensively studied area from a geographical standpoint, with subsequent attention given to the United States and South Asia. Hence, it is evident that there exists a notable void in research within the ASEAN region, since no empirical investigation has been conducted thus far to examine the influence of fintech on bank performance. This section will examine several scholarly works that discuss the function of standards in facilitating innovation.

2.4 Parameters that Enhance Innovation

There has been a growing body of study examining the significance of standards in the realm of information and communication technology, particularly in their role as facilitators of innovation. To start, it is important to establish a precise definition of the phrase "standards."

The International Organization for Standardization (ISO) provides the most often used definition of standards, which is as follows: According to ISO/IEC (2004), a standard is a formally recognized document that has been developed by consensus and authorized by a reputable organization. It serves as a reference for rules, norms, or characteristics that are intended to be used repeatedly in order to attain the highest level of organization within a certain context. Alternative definitions of standards emphasize the industry's optimal methods that provide direction in the administration of services, goods, processes, and systems. SPRING, the national standardizing agency of Singapore, has established standards that serve to assist industry transformation, enhance quality, expand market access, enhance productivity, allow interoperability, and bolster customer trust (SPRING, 2018). The worldwide standards establishing organization, SWIFT, and global supplier of secure financial messaging services, has underscored the importance of collaborative endeavors in developing standards and exchanging market practices with the financial sector. These initiatives aim to facilitate automation, reduce costs, and enhance efficiency.

The increasing prevalence of financial technologies in diverse systems and applications, which necessitate interconnection within broader market infrastructures, poses challenges that necessitate the implementation of standardized practices to ensure interoperability among networked products (Blumenthal and Clark, 1995; David and Shurmer, 1996; Jakobs et al., 2011). The concept of interoperability is often used to articulate the advantages of standards, since it facilitates the smooth management of diverse systems and applications by businesses. In general, interoperability may be categorized into three distinct levels, namely business, syntax, and semantics. The concept of business interoperability facilitates the smooth and efficient achievement of organizational goals and objectives. The concept of syntax interoperability pertains to the facilitation of data interchange across diverse applications via the use of appropriate protocols and legitimate formats. On the other hand, semantics

interoperability guarantees the consistent interpretation and understanding of the conveyed information (SWIFT, 2017). A study was conducted to investigate the significance of standards in facilitating technological advancements, which involves establishing a shared foundation for the development and expansion of innovative technologies (Blind, 2016; Blind, 2012; Blind and Hipp, 2003; Blind and Jungmittag, 2008; Blind and Gauch, 2009; Allex and Sriram, 2000; Tassey, 2000; Swann, 2010).

The systematic approach to studying innovation has raised awareness among scholars and policymakers on the significance of standards as a potent institutional mechanism that influences technological innovation and transformation. The enabling of innovation is a topic that has been extensively explored in innovation research, with many scholars emphasizing the various roles that standards play in this process (Porter, 1990; Lundvall, 1992; Ehrnberg and Jacobsson, 1997; Smith, 1997; Allen and Sriram, 2000; Tassey, 2000, Swann, 2010). Bergek (2008) conducted a comprehensive examination of the fundamental factors that impact innovation, resulting in the identification of standards that are associated with four distinct functions: legitimacy, influence on search direction, generation of positive externalities, and knowledge development and dissemination.

In a seminal study, Swann (2000) undertook an extensive examination of the available scholarly works pertaining to standards, so establishing a thorough survey. From this investigation, Swann (2000) developed a set of criteria that were found to facilitate the process of innovation.

- Standardization has a crucial role in fostering concentration, coherence, and the attainment of a significant number of participants during the first phases of technological advancements and market developments.
- Standards for measurements and testing serve the purpose of providing evidence to customers on the presence of claimed characteristics in their new goods, as well as ensuring that these items adhere to accepted levels of health, safety, and environmental dangers.

- Standards serve the purpose of formalizing and disseminating the most advanced knowledge and practices in the fields of science, technology, and best practices.
- Open standardization procedures and standards provide a competitive environment among various technologies, both within and externally, hence promoting development driven by innovation.

In general, the process of standardization produces standardized norms, which serve as a fundamental element of a company's infrastructure. As a result, they facilitate the advancement of novel ideas and concepts, while simultaneously endeavoring to safeguard against unfavorable consequences (Swann, 2000). The study conducted by Swann and Lambert (2010) used data obtained from the British Community Innovation Survey (CIS) in order to investigate the impact of standards on the facilitation or restriction of innovation. The findings indicated that the presence of standards both facilitated and limited the potential for innovation. Among the majority of organizations, almost 60%, that participated in the survey and said that standards served as a valuable source of information for their innovation endeavors, it was further revealed that laws, rather than standards, were a hindrance to their innovation operations. Concurrently, among the cohort of organizations that did not rely on standards as a source of information for their innovation endeavors, laws were not seen as a hindrance to their innovation operations. Furthermore, it was seen that individuals who acknowledged the influence and limitations of standards were more likely to achieve higher levels of creativity, as indicated by several measurements within the field of computer information systems. This implies that those who indicated that standards influenced their invention had a higher level of innovativeness compared to those who reported that standards did not play a role in their innovation. Surprisingly, organizations that faced regulatory constraints had higher levels of invention, as shown by the CIS measures of innovation, compared to those that did not face such constraints.

In a study conducted by Blind (2006), it was shown that there exists a favorable correlation between the level of research and development (R&D) investment made by firms and their propensity to participate in standardization initiatives. This finding was derived from an analysis of survey data collected from companies operating within the German electrotechnical and mechanical sector. Blind et al. (2011) conducted a study that examined the Dutch innovation survey, specifically focusing on enterprises involved in the Dutch standards institution NEN. The researchers performed comparable studies, with a particular emphasis on services. While the researchers discovered a positive correlation between the level of research and development (R&D) investment in service organizations and their probability of engaging in standardization activities, they saw a curvilinear link between the companies' turnover and market innovations.

The propensity to participate in standardizing procedures. While these studies provided an explanation for the involvement in standardization via different metrics of innovation, they asserted that there is no established causal association between research and development (R&D) or innovation activities and standardization. Hence, these data may also be interpreted as evidence of a broad positive correlation between innovation and standardization.

Regarding the qualitative analysis, a study conducted by Blind et al. (2010) investigated the effects of international information and communication technology (ICT) standards by using quantified expert views obtained from three standardization bodies. The findings of the study indicate that the implementation of ICT standards has a beneficial effect on innovation, for all commercial banks or just for chosen banks with specified characteristics, such as size or business emphasis.

3) This study investigates the potential impact of financial norms on the interplay between fintech and traditional financial institutions.

The impact of innovations on bank performance has been a subject of academic interest and research.

1.3 Objective Clarifications

The objective of this study is twofold. The primary objective of this study is to assess the influence of financial technology (fintech) advancements on the operational effectiveness and financial outcomes of banks operating within the Association of Southeast Asian Nations (ASEAN). This will be accomplished by using a diverse range of financial indicators for analysis. Furthermore, this study aims to assess the potential impact of implementing financial rules on both fintech advancements and bank performance. The financial statistics are derived from the income statements and balance sheets of banks. The assessment of fintech advancements is determined by the extent to which ASEAN banks have embraced mobile banking technology. The measurement of financial standards is based on the extent to which ASEAN banks have adopted these standards over a period of time.

This study chose a panel data sample consisting of 36 local commercial banks in the ASEAN countries of Singapore, Malaysia, Thailand, Philippines, and Brunei Darussalam. The reason for selecting these banks is because they are all publicly listed, ensuring the availability of their historical financial data for analysis. The use of panel data analysis is chosen due to its capacity to provide time-series analysis, hence enabling a more comprehensive examination of the spread and adoption of technology across various banks during a certain period.

particularly in terms of enhancing product diversity and facilitating the rapid and widespread adoption of novel goods and services.

The preceding literature analyzed the function of standards in facilitating and promoting technical advancements. Standards serve to provide a shared foundation that facilitates the development, adoption, and expansion of technology for the purpose of innovation.

On the other hand, many scholarly works have posited that standards might serve a dual purpose by both informing and restraining innovation, with the extent of this influence being contingent upon the age of the standards. This implies that both older and newer standards can impose limitations on the potential for innovation. Moreover, individuals' interpretation of blending standards with rules could have erroneously led them to see the survey as inhibiting innovation.

2.4.1 Standards 'Effect on Business Performance

A plethora of research has shown that the implementation of standards has a beneficial effect on the performance of organizations. The study conducted by Wakke and Blind (2016) examined the correlation between the engagement in formal standardization procedures and the financial success of a sample of 1,561 German enterprises. The quantification of involvement in standardization activities is assessed by the allocation of committee positions within the German Institute for Standardization. The theory posits that standard setters get advantages not just from their ability to oversee and influence the evolution of standards, but also from their access to a diverse array of knowledge sources inside the standards committee. The findings of their study indicated a favorable correlation between engagement in formal standardization processes and overall business performance. A notable trend was seen among technology-developing service providers within the service sectors, whereby the combination of patenting and standardizing shown a favorable correlation with company success. Blind and Gauch (2009) conducted a comparable investigation that focused on the significance of standards in nanotechnology, including both corporate entities and research institutions. The experts' comments indicated that the primary incentives for participating in standardization efforts in this nascent technology were the pursuit of established regulations that promote interoperability, compatibility, uniform nomenclature, and enhanced dissemination. The standardization of research findings in emerging domains of science and technology, such as liability risk reduction, legal security, and enhanced communication with other researchers and developers, has been shown to significantly contribute to improved performance (Blind and Gauch, 2009).

Pohlmann, Neuhausler, and Blind (2015) conducted an analysis to examine the impact of possessing standard essential patents (SEP) on company performance, specifically in relation to the connection between standards patents and innovations. The researchers saw the SEP as a significant source of creative production. The researchers used a dataset comprising of enterprises engaged in international standard establishing organizations, together with patent counts and patent value indicators, in order to assess the impact on company performance. The authors emphasized the financial implications associated with the establishment of a standard, since participating businesses incur significant costs due to the need of engaging personnel and incurring travel fees for frequent meetings and discussions related to standard creation. However, the researchers also discovered advantages associated with conventional development procedures, including the reinforcement of consumer confidence and acceptance. As a result, these processes have the potential to generate new markets and foster the expansion of established enterprises. The technique of integrating patented technology that is crucial for a standard and imposing royalty fees serves as a means for a business to recover its research and development (R&D) expenditures. This approach allows for the generation of licensing income and provides more flexibility in promoting the adoption of technology and the firm's own goods and services. The findings of their study revealed a curvilinear association, namely an inverted U-shaped pattern, between the ownership of SEP and a firm's return on assets (ROA). For instance, organizations operating in technology-related marketplaces have enhanced their financial performance by integrating their patent portfolio with technological standards. Now, let us examine the financial criteria used inside the banking business.

2.4.2 ISO 20022 Financial Standards as an enabler for innovation

ISO 20022 is an integral component of the ISO standards, which aims to provide uniformity and streamline financial communication and transactions via standardization and automation. ISO 20022, sometimes referred to as the universal financial sector messaging scheme, is an open standard that serves as a framework for constructing financial communications. It encompasses and embodies financial business concepts and activities. Presently, the global financial landscape encompasses around 220 ISO 20022 adoption projects spanning over 90 countries. These initiatives primarily focus on several areas within the financial sector, including payments, cash management, securities, trade, and treasury.

The ISO 20022 recipe is structured according to a three-tier architecture. The uppermost layer encompasses the essential business ideas. The middle layer is responsible for the logical messages or message models. Lastly, the lower layer handles the syntax required for the physical representation and transmission of the logical messages. The aforementioned statement highlights the primary layer of fundamental business principles that are inherently detached from any specific technological syntax. This layer serves as the focal point for identifying ISO 20022 standards that may be used and repurposed within the framework of blockchain standardization (Lindsay, 2016).

There has been an increasing proliferation of scholarly works discussing the significance of ISO 20022 standards as a pivotal facilitator for advancements and a consolidator for financial technology. The increasing prevalence of financial technology is causing significant changes in the financial services sector, characterized by both creative and disruptive influences. A significant number of startup companies have formed within the sector, resulting in the development of a wide range of standards that lack interoperability and compatibility with current market infrastructures. This situation has posed challenges to the widespread adoption of new technologies (Lindsay, 2016).

The primary contention posits that the ISO 20022 standards function as an open and collaborative standard, as well as a technology-neutral business language within the financial industry. These standards offer a comprehensive and well-established data model, facilitating global interoperability and the integration of diverse financial technologies (Hasaka, Alaerts, & O'Connor, 2017). ISO 20022 standards have been used in many ways to promote the integration of fintech. These applications include distributed ledger technologies, smart contracts, Application Programming Interfaces (APIs), real-time payments, and the securities transaction lifecycle. Several papers on ISO 20022 standards were authored by subject matter experts in the financial service industry, including banks, regulators, and standardization agencies and associations, as shown in the table provided.

Table 1: List of the articles about ISO 20022 standards

Authors (Year)	ISO 20022 application	Focus / Methodology
Hasaka, O'Connor, Dobbing & Alaerts (2017)	Financial Technologies in general	Survey, Discussion paper
Lindsay (2017)	Financial Technologies in general	Information paper
Lindsay (2016)	DLT	Information paper
Tompkins, Jafri & Arjani (2015)	Interbank payments and cheques in Canada	Quantitative & qualitative data analysis with interviews
Bracaglia, Monetta&Vanobberghen (2015)	Card payments	Case Study
Lindsay (2015)	Real-time payments	Case Study
Passi (2015)	E-invoicing in Italy	Case Study
Durkin (2014)	Corporate and CGI MP	-
Retzer (2013)	Co-existence with ISO 15022	-
Gillis & Pillay (2012)	Payments interoperability in South Africa	Case Study

applications with diverse technological foundations, poses a significant challenge. Within the financial sector, there is a need to transmit time-sensitive financial data in real-time, and this process involves the coexistence of several standards within the same function and asset class. ISO 20022 stands out as the prevailing standard for payment clearing, settlement, and regulatory reporting in contemporary practice. After examining the ideas surrounding technology developments and financial norms, this part will provide a concise overview of the ASEAN economy and banking sectors.

2.5 Macroeconomic Influence on Financial Institutions

2.5.1 Macroeconomic effect on bank performance

ASEAN commercial banks are affected directly and indirectly by macroeconomic factors including economic growth, inflation, and foreign currency pricing. In nations with more economic growth, banks may find customers and loans more cheaply (Mongid, 2016). In times of economic growth, banks invest more in growing businesses, which may boost expenditures rather than earnings. Several empirical research on macroeconomic conditions and bank performance have shown mixed results. Mongid (2016) examined the cost inefficiency of 504 ASEAN banks. The survey includes Indonesia, Malaysia, Singapore, Thailand, the Philippines, Cambodia, Brunei Darussalam, and Vietnam. The inquiry covered 2012–2008. Ordinary least squares regression study showed that inflation rates, bank-specific characteristics including loan loss provisions, staff expenses, and capital adequacy ratio positively correlated with cost inefficiency. Therefore, countries with high inflation rates have less efficient financial systems. Banks boost spending to offset growing expenses like wages during high inflation. Financial firms tend to follow central bank monetary policy to hike interest rates. Higher interest rates are meant to compensate depositors, not preserve loan portfolio quality.

Thus, financial institutions spend more on inflation resistance, lowering cost-effectiveness. Thus, macroeconomics affects bank inefficiencies.

Mongid, Tahir, and Haron (2012) examined ASEAN banks' cost inefficiency in Indonesia, Malaysia, Singapore, Thailand, the Philippines, and Vietnam. The research employed a 2008–2003 panel dataset of 625 banks. The data analysis uses Tobit regressions. Their analysis found a positive association between cost inefficiency and economic growth, indicating that economic growth decreased cost efficiency. The authors explained that when economic growth increases, businesses and individuals seek bank loans for investments and consumption. Banks demand more money as business requirements rise. However, capital acquisition costs rise with economic growth. While loan income may partly offset capital costs, banks must spend more to meet credit demand. This may cause cost inefficiencies.

Shen, Liao, and Weyman-Jones (2009) examined the financial performance of 285 commercial banks in 10 Asian nations, including five from each country.

Indonesia, Malaysia, the Philippines, Singapore, and Thailand were ASEAN members from 1998 to 2005. Stochastic frontier analysis was used to investigate macroeconomic and environmental aspects in 10 countries. These variables included GDP, GDP per capita, inflation, unemployment, and population density. The researchers found that external variables and bank-specific traits like managerial competency affected bank efficiency. As population density rises, banking costs rise. One reason is that banks in densely populated regions may need additional branches to compete and attract more customers. GDP had a negative effect, demonstrating that banks benefit from technological advances, diversification, and commercial development. They cut operational expenses dramatically due to these considerations. Positive inflation suggests that expenditures grow as inflation rises. Due to inflation, banking sector manufacturing input costs may rise. Thus, their analysis showed that macroeconomic and environmental variables equally affect bank cost efficiency.

Zetin (102) also studied financial performance in the context of the topic matter. This research evaluates GCC Islamic and conventional bank performance from 2002 to 2009. The researchers examined 13 Islamic and 38 mainstream banks using panel data analysis. The dataset includes bank-specific internal characteristics including ROE and ROA, macroeconomic indices, and ownership structure variables. A positive link between macroeconomic conditions and bank performance was found. In particular, GDP and inflation rates greatly affected Islamic and conventional bank performance. GDP is positively correlated with traditional banks' ROA and ROE. Inflation negatively affects Islamic and conventional bank ROA and ROE. The authors provided actual data showing a strong association between macroeconomic conditions and banking sector performance.

Overall, empirical data show that internal and external determinants affect Islamic and conventional bank financial performance. Interestingly, foreign ownership does not appear to affect performance.

However, Athanasoglou (2006) examined South Eastern European bank-specific factor and macroeconomic variable profitability trends. The current research covers credit institution performance from 1998 to 2002, covering 132 banks.

The year 2002. SEE includes Albania, Bosnia-Herzegovina, Bulgaria, Croatia, FYROM, Romania, and Serbia-Montenegro. A linear regression model was used to analyze how the macroeconomic climate affected the credit institution's ROA and ROE.

Inflation and real GDP per capita income are important economic indicators. The growth of real GDP per capita did not significantly affect bank performance, according to their analysis. In contrast, inflation positively and significantly affected profitability. Inflation caused banks' income to expand faster than their expenditures, which may be due to customer deficiencies.

These folks foresee inflation, unlike bank managers. This research examines the economies of five ASEAN states.

2.5.2 Clarification of sample countries economic conditions in ASEAN

The Association of Southeast Asian Nations (ASEAN), which was founded in 1967, now has ten member states: Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam. In 2017, ASEAN commemorated its 50th anniversary. The gross domestic product (GDP) of the Association of Southeast Asian Nations (ASEAN) in 2017 amounted to around U$2.77 trillion. The area is often acknowledged as the fifth biggest economy globally. The chart shown below illustrates the patterns seen in the overall value and per capita of the ASEAN GDP throughout the period spanning from 2000 to 2017.

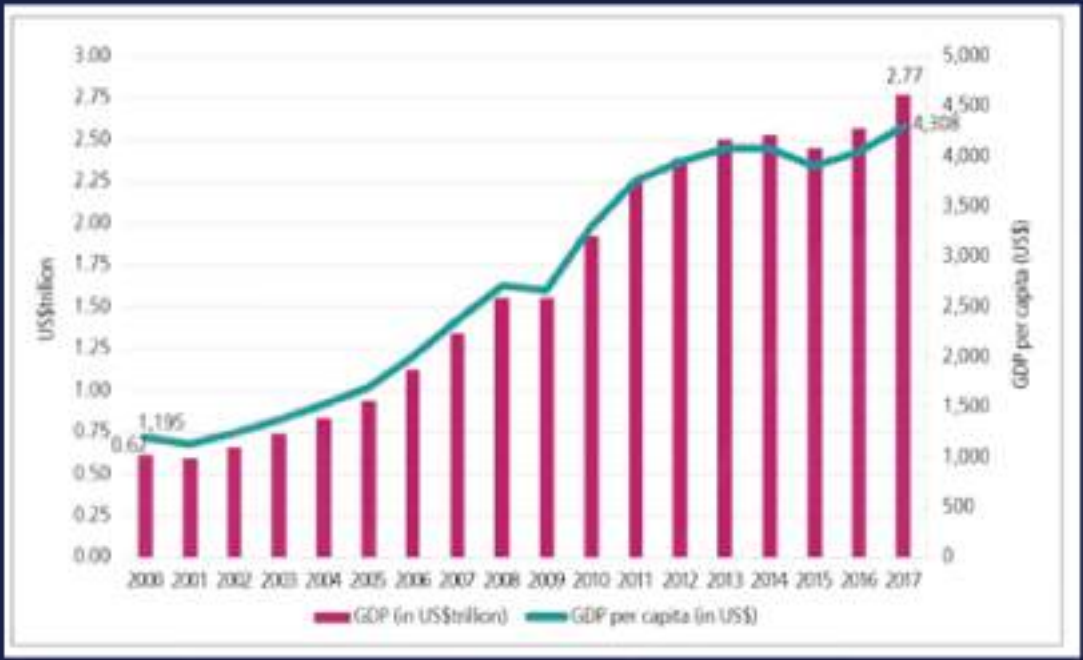

Figure 7. ASEAN GDP Total Value and per capita 2017-2000 (Source: ASEAN Secretariat (2018), ASEANstats database)

There is a strong correlation between the per capita GDP of ASEAN countries and the overall GDP trend. Following the economic downturn shown in the Asian Financial Crisis of 1998 and the Global Financial Crisis of 2008, the gross domestic product (GDP) per capita of the Association of Southeast Asian Nations (ASEAN) exhibited a sustained upward trajectory, culminating in a value of $4,308 in the year 2017.

The provided figure illustrates the variations in GDP per capita across various ASEAN member states. It is evident that Singapore and Brunei Darussalam exhibited much greater levels of GDP per capita compared to the other nations, with values of U$57,772 and U$28,986 respectively in the year 2017

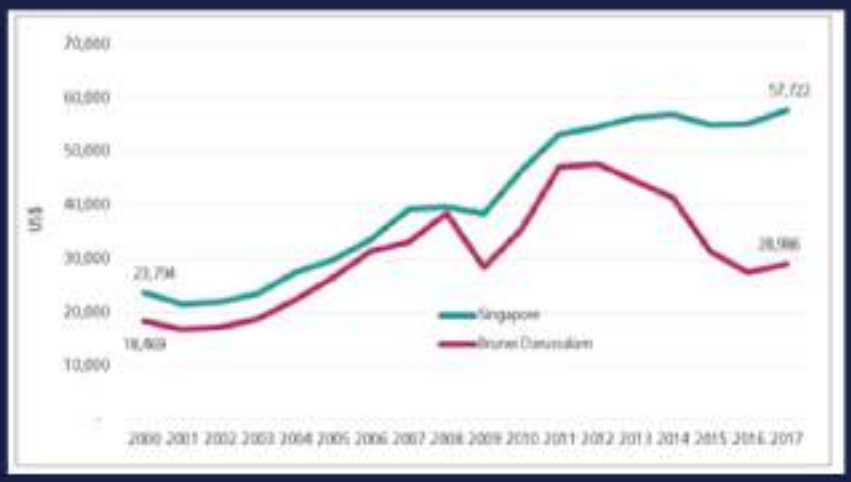

Figure 8: GDP per capita in Singapore and Brunei Darussalam (U$) 2017-2000 (Source: ASEAN Secretariat (2018), ASEANstats database) Secretariat (2018), ASEANstats database)

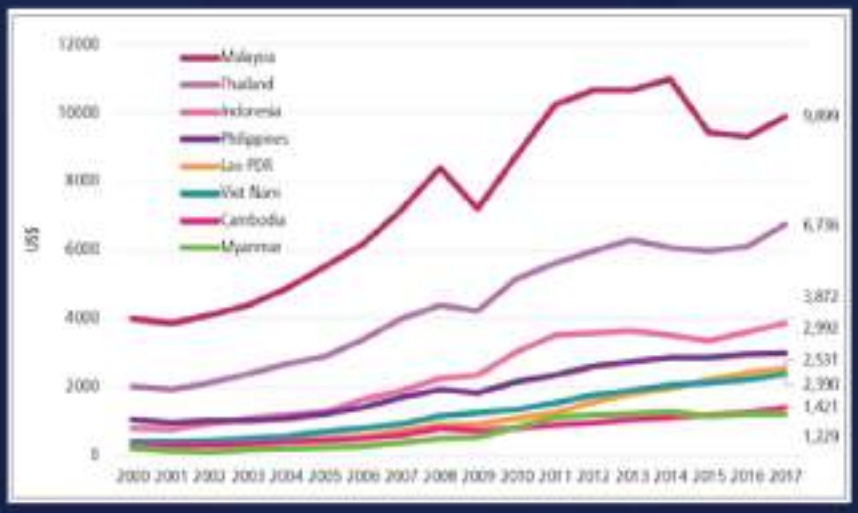

Figure 9: GDP per capita in other ASEAN Member States (U$) 2017-2000 (Source: ASEAN Secretariat (2018), ASEANstats database)

In 2017, Malaysia recorded a GDP per capita of U$9,899, while Thailand's GDP per capita was at U$6,736. Indonesia followed with U$3,872, the Philippines with U$2,992, Vietnam with U$2,390, Laos with U$2,531, Cambodia with U$1,421, and Myanmar with U$1,229. During the period of 2017-2000, there was a substantial rise in GDP per capita across all member nations. Notably, Laos saw the highest growth rate of 662.0%, followed by Myanmar with 502.3%, Vietnam with 492.3%, and Cambodia with 394.0%.

The distribution of Gross Domestic Product (GDP) is often analyzed based on three primary economic sectors, namely agriculture, manufacturing, and services. The present analysis provides a comparative examination of the breakdown of Gross Domestic Product (GDP) across several countries.

Figure 10: GDP share by main economic sectors (%) in ASEAN 2017-2000 (Source: ASEAN Secretariat (2018), ASEANstats database)

In 2017, Singapore exhibited the highest proportion of its gross domestic product (GDP) derived from the services sector, accounting for almost two-thirds (67.1%) of the country's total GDP. Following Singapore, Thailand, the Philippines, and Malaysia all shown significant reliance on the services sector, with respective contributions of 57.5 ,%58.1%, and 52.0% to their overall GDP. However, it is worth noting that the manufacturing sector played

a significant role in the economy of Brunei Darussalam, with the oil industry being a key factor contributing to this sector's prominence, accounting for 63% of the country's economic output. The agricultural sector encompasses farming, fishing, and forestry, and continues to have significant economic importance in Myanmar and Cambodia. In 2017, it accounted for 25.9% and 20.6% of the total Gross Domestic Product (GDP) of Myanmar and Cambodia, respectively. In this study focus, Appendix 4 presents a comprehensive overview of the banking scene in the member nations of the Association of Southeast Asian Nations (ASEAN).

According to the 2019 OECD Development Centre Report, several economies within the ASEAN region are anticipated to sustain a growth rate over 5% throughout the period of 2021-2019. This growth rate is expected to surpass the rates seen between 2012 and 2016. However, the report also indicates that certain member states of ASEAN are likely to encounter a deceleration in their economic development.

Table 2: Real GDP Growth in ASEAN (Source: OECD Development Centre)

	2017	2018	2019	2019-23 (average)	2012-16 (average)
ASEAN-5 countries					
Indonesia	5.1	5.2	5.2	5.3	5.3
Malaysia	5.9	4.9	4.8	4.6	5.1
Philippines	6.7	6.4	6.5	6.6	6.6
Thailand	3.9	4.5	4.1	3.7	3.4
Viet Nam	6.8	6.9	6.7	6.5	5.9
Brunei Darussalam and Singapore					
Brunei Darussalam	1.3	2.0	2.3	2.0	-1.3
Singapore	3.6	3.5	2.9	2.7	3.5
CLM countries					
Cambodia	7.0	7.0	6.9	6.9	7.1
Lao PDR	6.9	6.6	6.8	7.0	7.6
Myanmar	6.8	6.6	6.9	7.0	7.3
China and India					
China	6.9	6.6	6.3	5.9	7.3
India	6.7	7.5	7.3	7.3	6.9
Average of ASEAN-10	5.3	5.3	5.2	5.2	5.1
Average of Emerging Asia	6.5	6.6	6.3	6.1	6.8

According to projections, Singapore is anticipated to exhibit a 2.7% annual growth rate from 2019 to 2023. However, it is noteworthy that this growth rate is around 1% lower than its average growth rate of 3.5% seen over the period of 2012 to 2016. The predicted growth rate of Malaysia's Gross Domestic Product (GDP) for the period of 2023-2019 is estimated to be 4.6%.

This growth is mostly attributed to robust domestic consumption. However, it is worth noting that this expected growth rate is 0.5% lower than the growth seen during the period of 2016-2012. The yearly economic growth rate of the Philippines is projected to be 6.6%, which is consistent with the growth rate seen over the period of 2016-2012. The inflow of remittances from Overseas Filipino Workers (OFWs) remains a significant contributor to private consumer expenditures. Thailand's Gross Domestic Product (GDP) is anticipated to have an annual growth rate of 3.7%, which is a rise from the previous rate of 3.4% seen during the period of 2016-2012. The yearly growth rate of Brunei Darussalam's GDP is projected to increase by 2% between 2019 and 2023, therefore recovering from the average decline of 1.3% seen over the period of 2016-2012. The improvement in oil prices would result in an increase in export profits.

Research Scope Identification

Based on the literature examined earlier, this part examines the research framework including the delineation of bank performance, theoretical framework, research hypotheses, research methodology, sample data, research variables, and analytical methodologies.

The construction of study hypotheses drew upon three economic theories: (1) Technological Innovations, (2) Standards Effects, and (3) Macroeconomics. The purpose of this study was to conduct an empirical examination of the effects of fintech innovations and financial standards on the financial performance of several commercial banks in Singapore, Malaysia, Philippines, Thailand, and Brunei Darussalam. To do this, each hypothesis was thoroughly evaluated.

The chosen research technique for this study is multivariate panel regression, a quantitative approach. Its purpose is to empirically examine the research hypotheses about the potential correlations among various research variables related to fintech innovations, bank performance, and financial standards. The R package, ExPanDar, is used for the execution of multivariate panel regression models.

The analysis of the influence of fintech innovations and financial norms on bank performance involves the use of several data samples. The factors under investigation in this study are the fintech developments, which are being examined in terms of their impact on the adoption of mobile banking technology by banks. The measurement of the mediating impact of financial standards is conducted via the assessment of banks' implementation of ISO 20022 standards. The regression models use a range of financial indicators extracted from bank income statements and balance sheets as the dependent variables.

Regarding the analytical techniques used, the coefficients are calculated individually for each financial indicator via the utilization of ordinary least squares (OLS) regressions on a comprehensive sample including all banks. The research methodology used in this study is based on Baron and Kenny's (1986) approach to examine the mediator impact of financial norms. In the context of this study, the definition of the dependent research variable, bank performance, will be used.

3.1 Evaluation of banks' performance

Bank performance, which is often referred to as financial performance, is an evaluative metric that assesses the effectiveness with which a bank utilizes its assets and resources within its core business operations to create revenues. In accordance with the study conducted by DeYoung (2007), a comparable set of performance metrics at the bank level is chosen from the income statements and balance sheets of commercial banks in the ASEAN region.

The objective is to assess the influence of mobile banking technology on various financial indicators.

- The income statement encompasses several financial components, including bank interest revenue, interest expenditure, noninterest income (including fee income), and non-interest expense.
- The asset component of the balance sheet encompasses several items such as cash, securities, loans, return on assets, and non-performing loans.
- This academic analysis focuses on the liability and equity components of balance sheets, specifically examining deposits, return on equity, and the core tier 1 capital ratio.

The aforementioned financial indicators serve as dependent variables used to assess the influence of mobile banking technology. Their purpose is to identify the banking service or product that is most significantly influenced by advancements in mobile banking. Section 3.6 of the research paper will elucidate the chosen financial variables and their use inside the framework of this research model. Several studies have focused on a limited number of financial measurements, particularly Return on Assets (ROA) and Return on Equity (ROE), while conducting their examination of the effect of fintech. This is evident in the works of Rega (2017), Campanella and Dezi (2016), Tunay and Akhisar (2015), and Japparova and Rupeika-Apoga (2017). This study will use the methodology proposed by De Young (2007) to employ a diverse range of financial indicators. This technique will enable the investigation to assess the influence of mobile banking technology on distinct banking products and services individually.

3.2 Defining Theoretical Framework

As elucidated within the realm of ideas pertaining to technological innovations, several research investigations have undertaken the task of further exploring the Schumpeterian notion of entrepreneurial technological breakthroughs. The study in question adopts a definition of fintech innovations that aligns with Schumpeter's theory, which emphasizes the pivotal role of entrepreneurs in driving economic progress. The entrepreneurial function encompasses the integration of company objectives, operational procedures, and frameworks, ultimately leading to the generation of innovative outcomes. This study also examines the development and adoption of fintech technologies by banks, as well as their influence on bank performance. If a financial institution is using certain assets to produce income, it is vital to determine which of its products or services is most influenced by mobile technologies and their contribution to revenue production. This study aims to investigate if the adoption of fintech innovations and/or financial norms is responsible for any observed decrease in operational costs. The research approach used in this study is grounded on three primary theories, namely: (1) Technological Innovations, (2) Standards Effects, and (3) Macroeconomics. The purpose of this analysis is to evaluate each hypothesis in order to identify the following:

The inquiry pertains to the extent of influence exerted by fintech technologies on financial indicators, including either all indicators or specialized ones alone.

The question at hand pertains to the extent to which fintech innovations impact the whole of commercial banks or just a subset of banks that possess distinct traits and a particular business emphasis.

The potential impact of financial rules on the correlation between fintech developments and bank performance is a subject of inquiry.

This study model will use three prominent economic theories to examine the influence of fintech on bank performance from various angles. Two prominent theories that will be discussed in this paper are Schumpeter's theory of technical innovation and the concept of network and.

This paper examines the ideas of interoperability between financial standards and macroeconomic situations. Building upon the work of Scott, Reenen, and Zachariadis (2017), this study aims to investigate the influence of mobile banking technologies on various aspects of commercial banking products/services, business processes, and business models. By employing a theoretical framework similar to that used in the aforementioned study, this research seeks to analyze the impact of mobile banking technologies on different bank financial indicators over a period of time. The theoretical model shown below will facilitate the formulation of hypotheses on the manner in which

The aforementioned factors have an effect on the overall performance of banks.

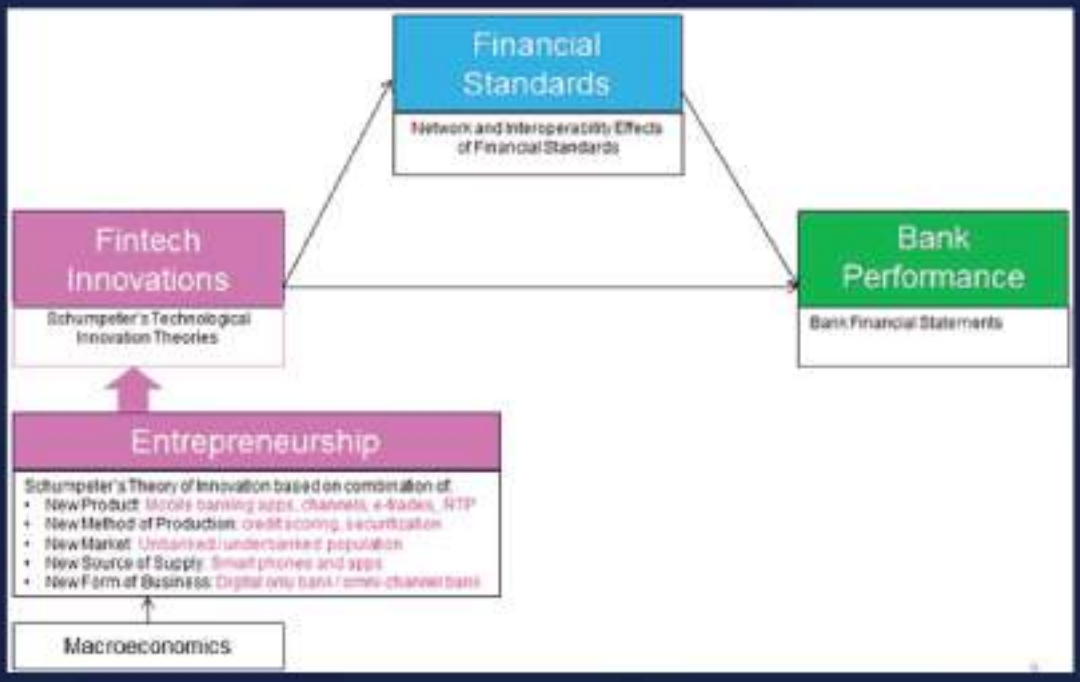

Figure 11: Theoretical

3.3 Research Assumptions and Hypotheses

3.3.1 The Evolution of Technological Innovation Theories

In fintech, Schumpeter's premise of entrepreneurial innovation as a growth driver is very relevant. Entrepreneurs create net economic gains by innovating new products, processes, production methods, markets, sources of supply, and commercial, business, or financial organizations (Schumpeter, 1934). The next sections explain each premise and examine ASEAN mobile banking technology.

Novel components or thoughts create product or service innovation. The introduction of ATMs, electronic trading of stocks and foreign currency, online banking, and mobile banking has led to new digital banking products and services throughout ASEAN. ATMs were initially introduced in ASEAN in the 1970s. Singapore and Indonesia introduced ATMs in 1979, followed by Malaysia and Brunei Darussalam in the early 1980s. Thailand and the Philippines adopted ATMs in 1983 and 1981, respectively (DBS, 2015). A revolutionary banking technology was the ATM. Banks may automate balance queries, cash deposits, and withdrawals with its help. Thus, human engagement in these processes was greatly decreased. Finance saw the rise of computerized securities and foreign currency trading platforms in the 1980s. ASEAN banks and central banks joined SWIFT simultaneously. SWIFT was founded by financial institutions in 1973 to automate and standardize financial transactions. Online banking became popular in the 1990s as internet technology grew worldwide. The modern era emphasizes mobile banking and technology. Mobile banking uses mobile devices to access and utilize banking and financial services.

Rajnish and Stephan (2007) say telecommunications equipment is utilized for communication. Mobile banking, a growing part of electronic banking, offers a solid foundation for automated banking and other financial services (Wessel and Drennan, 2010). Commercial banks dominate ASEAN mobile banking, which is growing quickly. Mobile phone use has skyrocketed in recent years, increasing the number of users.

Many ASEAN residents possess several mobile phones for calling, texting, buying phone credits, and doing business, according to ASEAN Statistics (2018). Thailand has 176% multi-phone users, Singapore 148%, Malaysia 140%, Brunei Darussalam 127%, and the Philippines 110%. Mobile banking allows account queries, bill payments, cash transfers, and e-commerce purchases. Mobile banking has advanced with the creation of an app that makes investing and trading stocks, bonds, foreign currency, and mutual funds easier. This software sends real-time market updates to help users make smart trading and investing decisions. Self-service and mobile trading allow banks to charge trading fees. Mobile banking makes application for auto, home, personal, and credit card loans easy. It helps refinance and repay debts and financial commitments. Mobile banking allows new financial products and services to be offered via mobile phones (see Appendix 3 for the features matrix of mobile apps in the selection ASEAN commercial banks).

A new process or manufacturing method is process innovation. Information technology has transformed banking and its processes. Bank creditworthiness, payment processing, and product distribution have changed owing to information flows, business movements, and financial market infrastructure. Credit scoring is a crucial retail lending process innovation. Most ASEAN commercial banks utilize credit scoring models for credit appraisal, approval, and establishment. Banks employ behavioral scoring to evaluate customers' creditworthiness and renew credit limits. They also use collection score to improve debt collection efficiency. Technology has increased loan applications, especially consumer loans. According to Frame, Scott, White, and Lawrence (2004) and DeYoung (2007 ,2004), credit scoring is currently used to evaluate these applications instead of human judgment. Thai and Malaysian household debt to GDP ratios reached historic highs of 88% and 85% in 2017 due to rising loan outstandings (Reuters, 2018).

The growth of lending companies and the rise in nonperforming loans have led to the creation of secondary markets to securitize loans and mitigate their risks. Instead of collecting interest margins from consumer loans like mortgages, auto loans, and credit card loans, banks may initiate and securitize them for secondary market trading. Investors who buy securities backed by these loans get interest income (DeYoung, 2004). This change has changed banks' family loan business strategy, according to Stein (2002).

Process innovation includes quick payments, which use the recipient's mobile phone number instead of their bank account information to complete transactions in seconds. Payments are instantly deposited to the payee's account. Instant payments, often called real-time payments, are handy alternatives to card-based transactions. These services are accessible 7/24, providing uninterrupted availability. Instant payments provide payers and payees immediate confirmation. Instant payment technology allows banks to increase fee income and enhance liquidity management, according to Finastra (2018). Banks can monitor their cash position and manage risks using real-time liquidity position notifications and alerts.

New markets may spur technological innovation. Over 70% of ASEAN residents are unbanked (UOB, 2016). ASEAN countries like Indonesia and the Philippines have large numbers of unbanked citizens with minimal credit history and family debt. These circumstances provide significant mobile banking development potential. In ASEAN, the Philippines' mobile phone and smartphone business is growing rapidly. This rise is expected to boost mobile banking due to the country's low banking penetration (UOB, 2016). The Philippines prefers cash transactions, with 2.5 billion payments totaling U$ 74 billion done monthly. However, just 1% of these transactions use electronic payment methods.

A large chunk of the unbanked use mobile devices and social media. Mobile technology allows firms to reach the unbanked, allowing them to surpass their non-innovative competitors. Personal identification and credit history are major barriers to unbanked people entering the financial industry. Lack of financial infrastructure and logistics and distribution issues, especially in rural areas, prevent persons without banking services from using formal financial systems. The large number of ASEAN residents without access to conventional banking services gives an opportunity for banks and fintech enterprises to innovate and increase financial ecosystem inclusion. Commercial banks in ASEAN, particularly in the Philippines, work with regulatory organizations and fintech companies to reduce financial imbalance and assist neglected sectors. This category is a new market for regional banks.

Source of emerging procurement

According to Schumpeter (1934), innovation may also result from discovering a new supply of raw materials or partly processed goods, whether existing or not. Financial firms must decide whether to deploy mobile banking technology internally or outsource it. In outsourcing, suppliers may supply banks with platforms and components that can be customized with their features and branding. Some vendors can create a mobile banking app or a fully integrated mobile solution with front-end and back-end systems, in collaboration with other financial applications and systems. ASEAN banks are outsourcing to save costs. The 2018 ASEAN Payments Insight Survey predicts a 40% to 36% fall in in-house payment app advancements over the next two years. On the other hand, off-the-shelf vendor solutions have climbed from 8% to 13% and customized third-party solutions from 23% to 25%.

Mobile banking apps from commercial banks in ASEAN are common. However, merging these apps for regional and cross-border transactions is expanding. Singapore and Thailand collaborated to integrate PayNow and PromptPay, ISO 20022 national real-time payment systems.

The declaration describes how ASEAN central banks apply ISO 20022 international standards to provide consistency and coherence in regional and cross-border financial activities. Thus, people and businesses in both countries might utilize online banking or mobile wallets to securely transfer payments instantly utilizing their Singapore and Thailand cellphone numbers. Vendors may utilize their experience working with local financial market infrastructure and organizations to create an ISO 20022-compliant payment mechanism.

Structural paradigm

Innovation may also be described as the deployment of a new organizational structure in business or industry. Recently, ASEAN has seen the rise of digital-only banks. UOB's launch of TMRW, ASEAN's first mobile-only bank, in Thailand has gained notice (UOB, 2019). TMRW is a mobile-only banking institution targeting ASEAN millennials, who largely transact on their phones. ASEAN's digital generation is the third-largest tech-savvy consumer population after China and India. Over the next five years, the digital bank aims to gain three to five million customers. TMRW is built from scratch using data-driven methods to give unique features and information to each customer (UOB, 2019).

Malaysian bank CIMB Group launched a digital banking platform in 2019 for Vietnam and the Philippines. CIMB Bancom Capital Corp, an investment banking joint venture in the nation, offers consulting services and cross-border capital market solutions to Filipino companies seeking ASEAN development and growth. The business hopes to use CIMB branches in the area to expedite inbound transactions to the Philippines. CIMB Philippines has 8,000 merchant partners, including 7-Eleven and DragonPay, known for their convenience store networks. These partnerships make cash deposits, withdrawals, and payments easy at several contact points.

The DBS Group of Singapore launched India's first mobile-only bank, digibank, in 2016. Mobile-only banking uses biometrics and AI to revolutionize financial processes. The business employed natural language technologies to make the smartphone understand customer speech and communicate effectively. SMS one-time passwords have been replaced with inbuilt soft token security. In 2018, DBS India has over 2 million customers.

The digital-only bank, or neo bank, business model offers clear advantages over conventional brick-and-mortar banks, including lower operating costs due to the absence of physical infrastructure. The firm provides digital banking exclusively via web browser or mobile app, reducing staff costs. Thus, these cost reductions may be passed on to clients in the form of lower lending rates and higher deposit interest rates. DBS Group Holdings CEO Piyush Gupta expects the digital bank's cost-to-income ratio to be lower than the brick-and-mortar approach. Schumpeter defined "creative destruction" as entrepreneurs creating net economic innovation in the capitalist system. These entrepreneurs disrupt the incumbent enterprise's value offering by creating and extracting economic value. ASEAN commercial banks favor customers who use omni-digital channels like mobile and internet banking. However, as indicated by DBS, UOB, and Maybank's falling branch visits and rising use of digital channels for financial transactions, customers tend to prefer digital-only banking. Digital banking is growing throughout ASEAN, giving incumbent banks and fintech companies new opportunities. ASEAN commercial banks with an entrepreneurial spirit may use neobanking and omni-digital platforms to create new organizational models. These banks may protect their market shares from new rivals by using digital technology. Size effect is the apparent change in behavior or attributes of a substance or system due to changes in size.

Schumpeter (1950) also believed that larger enterprises with greater research and development funds were more affected by innovation. Technical developments provide a greater return on investment for these organizations. Because they can spread technical investment costs over a larger asset base, large companies are said to profit from economies of scale. This lowers their average expenses. A larger corporation may commit money to research & development and seek new economic opportunities by offering a wider range of activities and items.

Due to smaller local economies, commercial banks are less prevalent in ASEAN mobile banking technology adoption. Scherer (1984) disagrees with Schumpeter's theory that larger firms are more conducive to rapid innovation, arguing that smaller firms, with modest market power, may be more likely to innovate quickly due to the competitive pressures that are absent in the monopolistic environment often associated with a "quiet life." Dos Santos and Peffers (1995) found mixed results on the issue. No data suggested that larger organizations utilize ATMs more efficiently. No substantial studies showed that this technology benefits smaller businesses. Lacity et al. (2014) found that cloud computing may benefit both large and small businesses in different ways. Thus, considerations beyond size and scale efficiency affect bank performance. Small banks can adapt and apply new technologies due to their agility and flexibility. Smaller banks may build stronger relationships with local companies and consumers. This advantage gives them access to unique information that may help them negotiate client contracts and make better credit judgments (Berger, Udell, Allen, Miller, Petersen, Raghuram, and Stein, 2005). Fries and Taci (2005) examined bank efficiency in 15 transition countries. The research examined 2001–1994 data from 289 banks. The researchers found that incentive structures, structural and institutional improvements, and a strong rule of law affected bank performance.

Additionally, a medium-sized bank in the sample exhibited consistent returns to scale, whereas smaller banks showed significant unrealized economies of scale. The plan suggests merging smaller local banks to save banking costs.

DeYoung and Hunter (2001) found that local banks provide more personalization. It was also noted that giant banks tend to serve large clients, making high-touch personal service difficult as they grow. This study proposes that small ASEAN banks, specifically Thai and Filipino banks, may have an advantage over large banks in Singapore and Malaysia in using mobile technologies to serve local customers, challenging Schumpeter's theory. For instance, smaller banks are nimbler in adapting to internal and external business changes, whereas bigger banks embrace new technology more slowly. Big banks have legacy systems that need sophisticated setups and slow technology adoption (Dos Santon and Peffers, 1995; Scott et al., 2017). The impact of fintech on small banks is of interest because it may show that small banks can benefit from mobile technology more than larger banks, which have more resources, assets, expertise, and economies of scale. Based on the technological progress theoretical framework, this research suggests that mobile banking innovations may assist smaller ASEAN banks. The study uses a null hypothesis and an alternative hypothesis to examine mobile banking technology and bank performance.

• Hypothesis 0: Mobile banking does not affect banking financial metrics.

The null hypothesis is accepted or rejected based on the test statistics. Alternative hypotheses were developed to explore the relationship between mobile banking technology and bank performance. Mobile banking generates interest margins from customer loans and deposit accounts and transaction fees, according to bank revenue prediction. Fee income comes from three main sources:

(1) deposit account maintenance and bill payments and funds transfers.

(2) loans like credit cards, mortgages, and car loans; and

(3) stock, bond, foreign exchange, and mutual fund investment and trading.

In 2018, the Bank of Thailand required banks to waive payment expenses and allow service usage for payment transactions. Before 2018, payment fees were a major income source for Thai commercial banks. Thailand's PromptPay rapid payment service, utilized by consumers and businesses, charges 15–2 baht each transaction, depending on the amount (Bangkok Post, 2018; Kasikorn Bank, 2019). FAST mobile payments for consumers in Singapore are free, however corporate payments cost S$ 0.20 to S$ 0.70 each transaction. These rates are greater than Giro's batch payments, which cost S$ 0.10 to S$ 0.30 apiece. Mobile banking helps banks earn payment transaction fees. According to previous research on fee-based revenue in commercial banks, DeYoung and Rice (2003) found that technological developments considerably boosted non-interest income rather than interest-based income. DeYoung and Rice (2003) found substantial relationships between fee-based revenue, bank characteristics, market circumstances, technology advancement, and bank performance. The research indicated that banks that focused client connections and service excellence earned more fees. New financial technology like cashless transactions and mutual funds enhanced banks fee revenue. A rise in fee-based income was linked to higher profitability, earnings volatility, and a worse risk-return trade-off for typical US commercial banks. In ASEAN, established markets like Singapore have witnessed lowered interest rates, leading in lower net interest margins. Thus, these margins have lost importance in this region's banks' business strategy. Thus, fees are a major revenue source for ASEAN banks. In response to fintech competition, numerous banks have used mobile technology to change their production and distribution systems. Thus, they have switched from an interest-based approach to a fee-based one. Based on the aforementioned, mobile banking technology may affect banks' fee profits more than interest incomes.

• Hypothesis 1a: Mobile banking will increase fee income for small banks more than big banks.

Mobile banking requires significant expenditures in human resources and core banking system renovation and integration. Banks must increase income and cut costs owing to large investments in the new financial system. Implementing a new expeditious payment service in the UK requires £150 million to £200 million in fixed costs. This allocation will fund technology and human resource development to help the system grow quickly. Additionally, each UK bank must spend £0.10 million to £0.50 million to join to the new payment system (Vocalink)the year was 2009. The large investment in the new mobile banking system should reduce financial institutions' operating costs. Frontier technology may minimize operating costs for a new service relative to existing networks. The US ACH and Fedwire networks used protocols developed for mainframe computers. These protocols existed before servers and the internet were popular. According to Greene et al. (2014), a new, more efficient payments service might provide equivalent or better functionality than the Automated Clearing House (ACH) system. Thus, these services may have lower unit costs.

Back-office technology integration allows banks to save costs. A payment hub design allows financial institutions to integrate new technologies into their operating structure and generate more revenue. Banks sometimes find it cheaper to integrate payment platforms via smaller connection points like the fraud management system or transaction banking system (PwC, 2016). McKinsey's 2015 report found that banks could save payments IT spending by 10% to 20% by integrating their payments infrastructure. Case studies from throughout the world inform this estimate. Mobile technology also reduces old payment method costs. Australia's National Australia Bank launched an ISO 20022-based real-time payment technology.

This should greatly cut bank administrative costs. The technology allows people and organizations to provide supporting documentation in real time with their payments, enabling quick reconciliation and inquiry (NAB, 2016). When banks adopt new technology, they may enhance internal processes and discard outdated ones. Banks may benefit beyond real-time payments via internal system improvements and efficiency. Through real-time payment information, internal processes may be optimized and risks reduced. Individuals do a variety of "activities" for various reasons. Mobile banking reduces the cost of managing cash and checks. Singapore, Thailand, and the Philippines still utilize cash. Most Singaporeans buy meals at hawker centers using cash. Low-value retail transactions still employ cheques for similar reasons, although in smaller quantities. Due to laborious printing, counting, storing, sending, and reconciling currency and checks, society pays a high price. Mobile payment technology is expected to reduce costs and boost productivity by eliminating manual procedures for consumers and banks. The above considerations suggest a link between mobile banking technology and minor bank operating costs. Hypothesis 1b states that mobile banking will affect small banks' operating costs more than big banks.

Data from scholarly literature provide light on how technology affects bank-customer loan interactions. According to the wide view, technological developments affect bank performance more in smaller transaction lending than relationship-driven lending. Commercial financing sometimes involves relationship lending, where banks learn about borrowers via their connection. By monitoring borrowers' performance under loan contracts and giving bank accounts, this is done. Thus, relationship lending is temporary. Several studies have explored the length of bank-borrower relationships and loan interest rates to address adverse selection and moral hazard. When banks provide higher interest rates to unknown borrowers, these issues occur. In succeeding times after borrower category disclosure, banks lowered rates (Diamond, 1989; Pertersen & Rajan, 1993).

The researchers also found a link between relationship length and collateral responsibilities. Early in their relationship with financial institutions, borrowers face higher interest rates and submit collateral. Borrowers may negotiate a lower interest rate and less collateral as their relationship with banks deepens. However, transaction-driven lending, which includes personal loans, credit card loans, auto loans, and mortgages, usually entails lower loan amounts and one-time borrowing or non-recurring credit needs. In this setting, customer ties are less important. Mobile technology may improve transaction-driven lending, particularly for consumer loan firms with one-time or non-recurring transactions. Accepting and processing client applications for vehicle, housing, and credit card loans is included. Mobile technology has a higher impact on transaction lending than relationship lending. Therefore, the following hypothesis is established to assess how transaction-driven consumer loans affect bank performance.

• Hypothesis 1c: Mobile banking technologies will affect consumer loans more for small banks than major banks.

Technology largely affects transaction-driven consumer loans between banks and customers. Mobile technology also allows banks to deliver value-added services to clients, improving and protecting customer relationships. The new capabilities include real-time payment monitoring, payment cost transparency, and screening for anti-money laundering and financial crime compliance. Novel offerings that can be easily distributed via mobile banking apps may boost customer loyalty and revenue. Banks might cross-sell investments, loans, and foreign exchange to their present customers. In 2008, two-thirds of UK banks that implemented real-time payment technologies through the Faster Payment System (FPS) expressed a highly positive outlook on the potential of these new payment methods to generate additional revenue. Business-to-consumer sales were projected to reach £2.9 billion by 2018, while business-to-business revenues might reach £1.9 billion (Vocalink, 2009).

Thus, mobile technology should improve bank performance. This is due to the possibility for increased income and cost savings.

Revenue growth, especially fee income, and operational expense reduction have been linked to higher profitability. Return on Equity (ROE) and Return on Assets (ROA) evaluate bank performance using net income as the numerator. Deducting expenses from revenues yields net income.

The ROA, or ratio of annual net income to total assets, measures a company's profitability relative to its invested capital. Total assets are the sum of liabilities and shareholder's equity, which fund the company's operations. This indicator shows how well a company's management uses its assets or invested money to make money. Return on Equity (ROE) measures net income as a percentage of shareholders' equity.

Divide annual net earnings by average shareholders "The equity idea". The indicator measures a firm's profitability relative to shareholder capital. The firm's capacity to effectively deploy invested capital to create increasing profits and stimulate growth for both the business and its stakeholders is measured by ROE.

The most common financial measurements for analyzing technology's impact on bank performance are ROA and ROE. This research will hypothesize that fintech innovation affects financial performance using ROA and ROE.

- Hypothesis 1d suggests that mobile banking usage will impact small banks' ROA more than big banks.
- Hypothesis 1e suggests that mobile banking adoption will impact small banks' ROE more than big banks.

Mobile banking innovations, which introduce new mobile products and services through a revamped process and business model, are expected to benefit banks, especially smaller ones in unbanked countries like the Philippines and Thailand. Thus, smaller banks are expected to outperform bigger banks in developed economies like Singapore and Malaysia. Cell technologies are available to consumers and MSMEs who have been neglected by banks. A large percentage of these creatures possess mobile phones. Small ASEAN banks should be able to adopt mobile technologies, which are economical and easy to deploy. This use may increase revenues and lower operating costs, increasing profitability.

3.3.2 Standards Theories and Concepts

Standards facilitate technological improvements and regulate fintech application usage, according to growing studies. The systematic approach to innovation has elevated researchers' and politicians' awareness of standards as a powerful institutional mechanism that drives technological advancement and interoperability. Blind (2012 ,2016), Blind and Hipp (2003), Blind and Jungmittag (2008), Blind and Gauch (2009), Allex and Sriram (2000), Tassey (2000), and Swann (2010) are cited. This research shows that standards boost technological innovation. Standards help build a common business language via agreed-upon terminology definitions, boosting credibility and social acceptance of these improvements. Standards may reduce uncertainty and disagreements, boosting consumer and investor trust and promoting innovation system information distribution.

A regional payment framework for ASEAN is outlined in the AEC 2025 Blueprint. The Blueprint calls for ISO 20022 to be implemented by 2025 to improve regional financial integration and ASEAN payment and settlement systems. Financial market infrastructures worldwide have adopted the ISO 20022 financial standard. Pan Europe and the Southern African Community employ ISO 20022 to provide effective, secure, and interoperable payment clearing and settlement systems. Through joint IT investment, the regional payment structure provides interoperability and network externalities.

This investment intends to standardize payments, decreasing operating costs and risks. SWIFT develops and maintains a standardized repository as the ISO 20022 Registration Authority. This repository contains worldwide and market-specific standard definitions. Adopting ISO 20022 standards has several benefits, including being widely accepted as the open standard in the worldwide financial industry. Adoption considerably improves global market interoperability.

- The data is comprehensive, including specifics on remittances, regulatory reporting, and taxes.
- The word "future proof" refers to a notion or technology's adaptability to new technologies and business frameworks.
- XML's technical syntax simplifies integration and information sharing.

The benefits of financial standards are generally tied to interoperability and network externalities, as discussed in the following sections. Interoperability allows systems, devices, and software to communicate.

The benefits of standards implementation are typically called interoperability. Interoperability is the ability of systems and organizations to work together (Gillis & Pillay, 2012). By establishing a common business language for managing heterogeneous systems and applications, financial standards help organizations achieve interoperability. Each ASEAN countries has its own currency and monetary system. Thus, interoperable payment clearing and settlement systems are essential for safe and efficient financial operations. These systems boost regional economic development. Uniform financial standards for payment operations are essential for regional and global interoperability, innovation, competitiveness, and cost effectiveness. The three layers of interoperability are business, syntax, and semantics.

Business interoperability streamlines company aims and objectives. Syntax interoperability facilitates data exchange between applications using proper protocols and formats. However, semantic interoperability ensures uniform information interpretation and comprehension (SWIFT, 2017). In the ASEAN regional framework, ISO 20022 should increase interoperability across all three levels. Standards set technical, functional, and security requirements for payment market infrastructure use. Message implementation guidelines and technical schemas can establish syntax and semantics requirements to ensure consistent implementation of standards and information exchanges in accordance with global market practices. Standards are essential for developing a common understanding of economic and technical requirements. According to Gillis and Pillay (2012), standards strive to enhance payment system security by avoiding fraud, creating trust, preserving integrity, assuring accessibility, and inspiring confidence. Uniform financial standards among ASEAN central banks, banks, and the financial sector might improve financial performance by enabling interoperable payment systems. This ensures safe, efficient, and seamless operations.

Network effects, or network externalities, raise the value of a product or service as more people use it.

Scholarly research on network effects in business has increased. The number of people utilizing a product or service increases its value, a phenomenon called network externalities. SWIFT, a secure banking network, is one example. This network is used by approximately 11,000 banks, financial institutions, and enterprises worldwide. SWIFT financial standards and communications services rise in value proportionately with users. Two kinds of network externalities exist. SWIFT members benefit from direct network externalities as more members join a network. Gandal (1995) states that indirect network externalities occur when independent software vendors create complementary network applications, increasing user value. New users improve the value of each network member, creating positive externalities.

The bandwagon effect occurs as the network's value increases and additional institutions join, creating a positive feedback cycle. SWIFT members' use of financial standards creates positive externalities and network effects, which benefit network users as the number of users increases. Standards can generate network externalities and increase network value by benefiting more users. Based on ideas of interoperability and network externalities, this research hypothesizes that financial standards mediate the relationship between fintech innovations and bank performance. This theoretical paradigm implies that financial standards enable fintech innovators and banks to communicate and collaborate, promoting beneficial network effects and affecting bank performance.

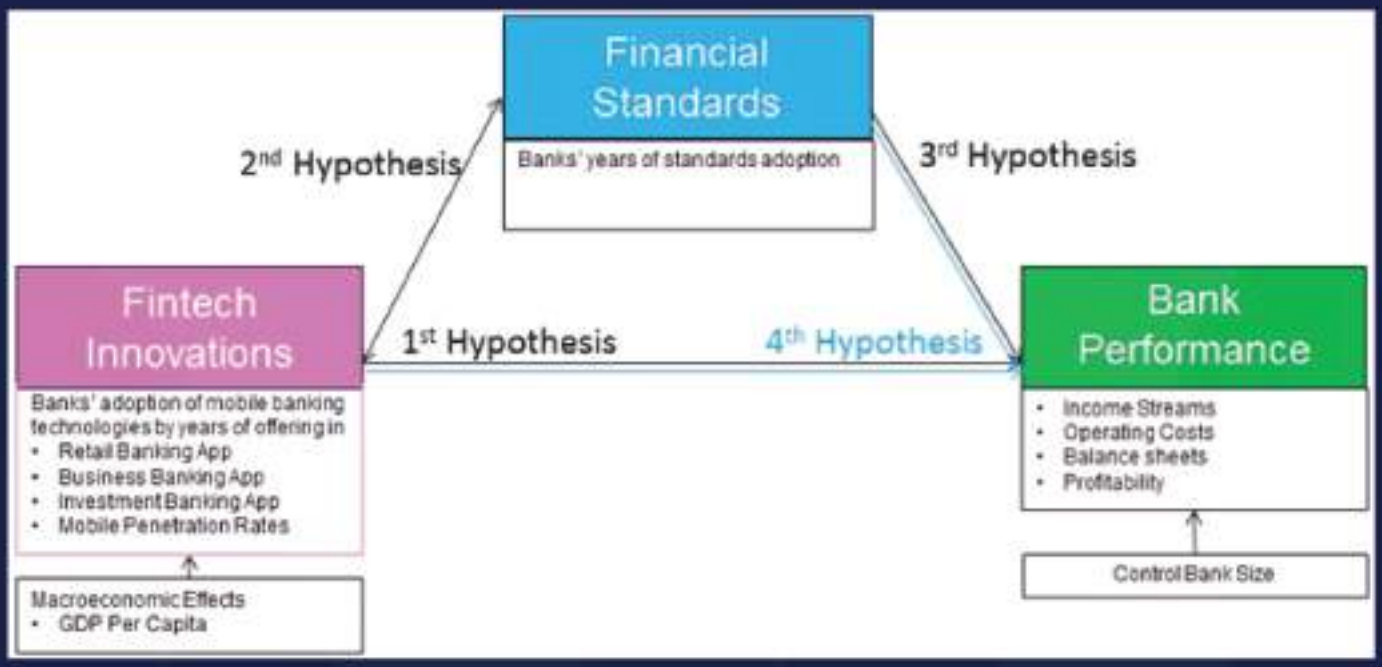

Figure 12: Research Hypotheses

The graphic above shows how "Fintech Innovations" affects "Bank Performance". Financial norms mediate causality. The use of mobile banking technology by 36 ASEAN5 commercial banks will quantify fintech innovation. As of 31 ,2017 of 36 ASEAN5 banks offered mobile banking. The research will employ Baron and Kenny's (1986) four-step method to evaluate mediator impact.

This study's initial hypothesis analyses the association between X, an independent research variable, and Y, a dependent variable.

The second hypothesis: Test X and mediator are correlated.

The third hypothesis examines the mediator-Y association.

The fourth hypothesis uses multiple regression to evaluate X, the mediator, and Y. The mediator, financial standards, was examined by assessing how much banks in Singapore and Thailand implemented ISO 20022 norms in 2017. These criteria were applied to the nations' real-time payment systems. Philippines, Malaysia, and Brunei Darussalam are considered. The cumulative duration of standards adoption is calculated by adding up the years since a bank first introduced its ISO 20022 payment service to the present. The first hypothesis in this chapter was Step 1 of Baron and Kenny's mediator test procedure. This stage examines the association between X (bank mobile banking uptake) and Y (bank performance). In Step 2, banks' mobile banking technology utilization and financial norms are examined. The null hypothesis is formed initially.

· Hypothesis: Banks' mobile banking technology will not affect financial standards acceptability.

The statistical test determines whether to accept or reject the null hypothesis. Hypotheses are established to evaluate the relationship between mobile banking technology and financial standard adoption:

Hypothesis 1: Banks' mobile banking technology will affect financial standards adoption.

Mobile banking, big data analytics, and APIs are being used worldwide in the financial industry. These advances are creating new business models and opportunities, improving bank performance. Recent technological advances and industry adoption have greatly improved ASEAN financial norms, improving efficiency and meeting user expectations. Agile approaches and accelerated standards development have been used to respond to fast technology progress.

API development using ISO 20022, open banking, and mobile banking is being standardized. This procedure comprises establishing a governance framework to standardize API deployment throughout the financial industry. Financial standards allow institutions to integrate new technology uniformly and coordinate with industry peers using standardized terminology. This use improves banking data quality and automation. Financial standards improve technology, compatibility, and network effects, improving bank performance and profitability. Based on the above logic and Step 3 of the mediator test procedure, the first null hypothesis is formulated to evaluate financial standards and bank performance.

Hypothesis 0: Financial norms do not affect banking sector financial indicators.

The alternative hypotheses evaluate whether financial standards affect bank profitability.

• Hypothesis 1a: Financial norms will affect small banks' ROA more than big banks'. Hypothesis 1b states that financial requirements will affect small banks' ROE more than big banks'. A null hypothesis has been created for Step 4 of the mediator test approach to explore how financial standards and mobile banking technologies affect bank performance prediction.

• Hypothesis 0: Mobile banking technology and financial standards do not affect banking financial indicators.

Regression results determine null hypothesis acceptance. The alternative hypotheses evaluate whether mobile banking technology affects bank profitability.

• Hypothesis 1a: Small banks' ROA will be more affected by mobile banking technology and financial requirements than major banks'.

• Hypothesis 1b states that mobile banking technology and financial laws will increase small banks' ROE more than big banks'.

3.3.3 Macroeconomic Influence on FinTech Market

GDP growth, interest rates, inflation, and currency rates affect ASEAN commercial banks' financial performance. The 1997 Asia financial crisis and 2008 Global financial crisis showed that bank-specific traits and macroeconomic issues contributed to several bank failures. Economically developed nations' banks frequently have lower operating expenses. Their capacity to quickly identify consumers and provide cheaper loans is the main reason (Mongid, 2016). In times of economic boom, banks tend to invest more in growing firms, which may raise spending without assuring income growth. Several empirical studies on macroeconomic conditions and bank performance have shown conflicting results. Mongid, Tahir, and Haron (2012) evaluated ASEAN banks' cost inefficiency factors. Economic growth was positively correlated with cost efficiency decline. Zetin (2012) and Shen, Liao, and Weyman-Jones (2009) found a favorable association between external macroeconomic parameters, internal bank features, and financial performance. Bank performance was affected by GDP and inflation. However, Athanasoglou (2006) examined South Eastern European institutions' profitability. Bank profitability was examined in relation to bank-specific parameters and macroeconomic variables including inflation and real GDP per capita income. The growth of real GDP per capita did not significantly affect bank performance, according to their analysis. In contrast, inflation positively and significantly affected profitability.

A bank's profitability will fall due to financial losses. All ASEAN commercial banks had a considerable drop in ROA and ROE during the 1997 Asia financial crisis. GDP per capita rose steadily after the recession, reaching U$4,308 in 2017.

Singapore and other ASEAN countries have variable GDP per capita. Brunei's 2017 per capita income was U$57,772, substantially greater than other countries'. Another country's per capita income was U$28,986. According to the 2017 ASEAN Statistics report, Malaysia had U$9,899 GDP per capita, Thailand U$6,736 and the Philippines U$2,992.

Many market conditions, including tax and regulatory systems, may affect bank performance. To explore the statistical relationship between mobile banking technology and bank performance, this research includes GDP per capita and mobile phone penetration rates.

3.4 Research Techniques and Methodology

The primary objective of this study is to empirically analyze whether the effects of fintech innovations on financial performance vary across various commercial banks in the ASEAN region, specifically focusing on selecting small and large banks. Additionally, it will ascertain if the advancements in financial technology (fintech) will result in improved performance across all financial metrics or just certain ones. Furthermore, the present study seeks to conduct an empirical analysis to examine the impact of financial norms on the performance of banks within the ASEAN region. Hence, a quantitative research methodology is used to systematically examine the study hypotheses on the potential link between fintech developments, bank performance, and financial norms.

Based on the literature examined, regression analysis emerges as a prevalent study methodology. Hence, this study use multivariate panel regressions in R, specifically using ExPanDaR, to assess the impact of mobile banking innovations and message standards on the performance of banks. The ExPanDaR package, created by Joachim Gassen, is designed for exploratory analysis of panel data using the R programming language. In this package, each observation is uniquely recognized by cross-sectional and time series IDs, and the variables are structured in columns.

3.5 Sampling of Data

This study will explore how fintech innovations affect local commercial banks in Singapore, Malaysia, Thailand, the Philippines, and Brunei Darussalam using multiple data sets.

Capital IQ provided bank financial statements from 2010 to 2017.

Each bank's website provided 2017–2010 yearly reports.

Mobile banking capabilities of each bank were obtained from AppAnnie.

The mobile banking capabilities of different organizations were collected from AppAnnie, an app analytics site.

The goal is to study numerous sample banks' website news and releases to determine their fintech intentions, actions, and performance. The fintech regulations and payment environment were checked on the central banks' websites in the chosen countries.

Refer to the bankers' associations or payment operators' websites for the list of participating banks in the specified countries' national payment systems. Peer-reviewed journal articles from EBSCO, Science Direct, and ProQuest are mentioned.

The selection procedure used 2017–2010 historical data. Due to rapid industrial technological breakthroughs after the 2010 global financial crisis, historical data from 2010 to the present is relevant. The eight-year term was chosen due of data consistency and availability.

Capital IQ retrieves historical revenue and balance sheets for 36 ASEAN commercial banks. Standard & Poor's Capital IQ market intelligence tool provides comprehensive private and public company research. Financial modeling and academic and business research in commercial and investment banking, stocks research, and asset management utilize the platform extensively.

This research examined bank revenue statements and balance sheets to see whether performance parameter was strongly impacted by mobile banking technologies. Regression was performed on bank revenue and cost components of the income statement.

Banks earn interest from customer loans and deposits and non-interest from foreign exchange, investments, stocks, and other trading activities via fintech technologies. The current study does not include rental income and gain on homes and other fixed assets, which Capital IQ classifies as Gain (Loss) on Sale of Assets. This omission is justified by the premise that mobile banking technologies will not significantly impact these fixed assets.

Mobile banking requires significant human capital investment, co-banking platform upgrades, and real-time payment system integration. Wages, benefits, SG&A, and other operational costs make up the investment cost.

This research considers computerization, income, and IT variables. Mobile banking technology does not influence some cost components; hence they were eliminated from the study. These include occupancy costs, goodwill and intangible asset amortization, and real estate and affiliate losses.

The asset side, which includes loan categories, and the liability and equity side, which includes deposits, are examined separately in the balance sheet. This multivariate panel regression analysis uses adjusted ROA and ROE to assess bank profitability. These measures are based on adjusted net income, which is calculated from selected revenues and costs.

AppAnnie (www.appannie.com) evaluates banks' mobile app capabilities and release years. This platform helps identify these apps' bank account, investment, lending, and payment services.

Appendix 8 lists chosen banks' mobile banking app features. Free application analytics software AppAnnie tracks app rating changes. The capabilities matrix was manually created using AppAnnie data to compare banks' mobile apps' features and functionality.

3.6 Study Motive and Variables Identification

This study has built a theoretical framework and research hypotheses that define many research variables for analyzing the financial performance of ASEAN commercial banks that employ mobile banking technology. Research input has two components. This research explores how fintech innovation affects retail, commercial, and investment banks' mobile banking use.

The influence of financial standards may also be examined by banks' ISO 20022 implementation. This research examines how mobile banking technology and financial norms may affect ASEAN commercial banks' financial metrics. The goal is to understand how these characteristics affect banking goods and services, as well as bank properties like size.

The dependent variables are bank performance. Bank performance measures a bank's ability to utilize its assets and resources within its fundamental operating framework to generate income. This paper reviews empirical studies on internet, mobile, and digital banking. Table 3 shows that it examines 20 financial variables, including revenue streams, cost structures, balance sheet components, and profitability. The researcher can better grasp the performance measure most affected by fintech advancements.

Name of Variable	Label	Description
Independent Variables for Fintech Innovations		
MOB_AGER	X1t	Age of the retail mobile banking app offered by banks from the first release year to 2017
MOB_AGEB	X2t	Age of the business/corporate mobile banking app offered by banks from the first release year to 2017
MOB_AGEI	X3t	Age of the investment mobile banking app for trading securities offered by banks from the first release year to 2017
GDP_PC	X4t	GDP per capita of sample countries from 2010-2017
MOB_PEN	X5t	Mobile phone penetration rate of sample countries from 2010-2017
Mediator Variable for Financial Standards		
ISO_AGE	X6t	Age of the ISO 20022 standards adopted by sample banks from 2010-2017
Dependent Variables for Bank Performance		
a. Income Statement		
IINC_ASS	Y1t	Total Interest Income / Total Assets
IEXP_ASS	Y2t	Total Interest Expenses / Total Assets
FINC_ASS	Y3t	Total Noninterest Income (Fee Income) / Total Assets
SALA_ASS	Y4t	Total Salaries / Total Assets
SGA_ASS	Y5t	Total Selling General & Admin Exp / Total Assets
b. B/S (Assets)		
CASH_ASS	Y6t	Total Cash / Total Assets
SEC_ASS	Y7t	Total Securities / Total Assets
LOAN_ASS	Y8t	Total Loans / Total Assets
COMM_LOAN	Y9t	Total Commercial Loans / Total Loans
CONSM_LOAN	Y10t	Total Consumer Loans / Total Loans
NPL_LOAN	Y11t	Non-performing Loans / Total Loans
Adj_ROA	Y12t	Adjusted Return on Assets shows the ratio of average net profits to average assets
c. B/S (Liabilities and Equity)		
DEPO_ASS	Y13t	The ratio of total deposits to total assets.
DD_DEP	Y14t	The ratio of total demand deposits to total deposits is being considered.
MM_DEP	Y15t	The topic of discussion pertains to money market and savings accounts.
TD_DEP	Y16t	The term "deposits" refers to the funds that individuals or entities place into a financial institution for safekeeping or

CTI_CAP	Y17t	The ratio of total time deposits to total deposits.
Adj_ROE	Y18t	The Adjusted Return on Equity (ROE) metric quantifies the relationship between the average net profits and the average shareholders' equity.
Control Size - Grouping Criteria		
GROUP_SZ		The total sample size consists of 36 banks. The median asset size should be considered, with large banks having asset sizes more than $20.1 billion and small banks having asset sizes less than $20.1 billion.
MOB_NON		In 2017, the categorization of banks was as follows: those classified as mobile banks were assigned the value of 1, while non-mobile banks were assigned the value of 0.
GROUP_MSZ		The cardinality of the subset of 31 mobile banks. Consider the median asset size, where Large Banks have an asset size more than US 28.9 billion and Small Banks have an asset size less than US 28.9 billion.
Fixed Effects		
Bank Name		
Year		

Drawing on the literature reviews conducted by DeYoung (2007), the regression specifications are estimated using ordinary least squares (OLS) methods. The dependent variables in these regressions consist of a range of financial indicators derived from the income statements and balance sheets. Each performance metric is analyzed independently.

The assessment of the impact of financial standards is conducted by evaluating the degree to which banks have implemented ISO 20022 standards, hence indicating their level of preparedness in adhering to those standards.

A binary variable is generated to represent the bank's ISO 20022 enablement status, taking a value of 1 if enabled and 0 otherwise. The coefficient pertaining to the dummy variables will serve as an indicator of the potential relationship with the performance of banks.

To regulate the scale of banks, a categorization was used based on the median asset size, resulting in the division of sample institutions into two distinct groups: small banks, denoted as those with asset sizes below US$ 47B, and large banks, including those with asset sizes beyond this threshold. The subgroup of the thirty-one mobile banks was further categorized into two categories based on the median asset size of US$ 28.9B. Given the substantial disparity seen in the mean and standard deviation of bank asset sizes, the use of the median is deemed appropriate for classifying banks as either large or small, with reference to the mean asset size.

This research will use 2017–2010 bank financial panel data for multivariate panel regression analysis. The study will regress financial indicators against input research variables that indicate mobile banking technology usage in retail, business, and investment banking. This research also examines how financial standards affect bank performance. A conceptual model is used to examine the relationship between fintech developments, financial norms, and bank performance.

The equation is $Yit = c + \alpha * MOB\_AGEit$.

Y—bank profitability—is compared to numerous other performance measures in this research.

The constant term c exists at t. The coefficient α is the main static test. Statistically significant α values indicate bank performance. On a sample of all banks, ordinary least squares (OLS) regressions calculate the coefficients.

The variable MOB_AGE shows how long ASEAN commercial banks have offered mobile banking. Mobile banking apps fall into three categories:

MOB_AGER uses mobile technology for retail banking, especially account queries and payments.

MOB_AGEB provides mobile business banking services for SMEs and corporations.

MOB_AGEI is a mobile investment banking platform for securities trading.

This research uses MOB_PEN, an independent variable, to measure mobile phone penetration in a sample of countries.

The variable GDP_PC, the GDP per capita, is an independent variable in country analysis. The value "i" indicates the sample nations, whereas the index "t" reflects the adoption year.

Regulation of bank size is vital. This expression may be called disturbance.

A linear relationship between mobile banking technology and bank performance is calculated.

A linear regression model is represented as $Yit = c + \alpha*MOB\_AGEit + \varepsilon it$, where Yit is the dependent variable, c is the intercept term, α is the coefficient for MOB_AGEit, and εit is the error term.

A mathematical equation model was created using all the research factors:

To calculate Yit (2017-2010), multiply c plus α by MOB_AGERit, where Yit is the variable of interest observed from 2010 to 2017.

Focus is on MOB_AGEBit.

Mobile device age is of importance.

Mobile phone penetration rates, or MOB_PENit, are a crucial indicator for measuring mobile phone adoption in a community or region. This indicator is often used to assess mobile phone usage and accessibility.

This research examines GDP_PCit, or GDP per capita.

Financial standards are set and maintained by the ISO, a key mediator.

SIZEit—the impacts of bank size on different outcomes—is of interest.

Variable "ni" denotes bank name fixed effects.

The analysis includes time fixed effects (Tt) to account for data fluctuations across time.

The researchers will employ Baron and Kenny (1986)'s four-step mediation assessment method to evaluate standards. How the approach will be implemented:

To find the correlation between variables X and Y, apply the equation

$Y = \beta 0 + \beta 1X + \varepsilon$.

The equation for the correlation between variable X and mediator ISO_AGE is

$M = \beta 0 + \beta 1X + \varepsilon$.

The user's material is too short for academic rewriting. The mediator, M, correlates with the outcome variable Y, shown by the equation $Y = \beta0 + \beta1M + \varepsilon$.
We examined the link between the predictor variable X, the mediator variable M, and the outcome variable Y using multiple regression analysis. The regression model is $Y = \beta0 + \beta1X + \beta2M + \varepsilon$, where $\beta0$ is the intercept, $\beta1$ and $\beta2$ are the regression coefficients for X and M, and ε is the error term.

The research model includes bank-level fixed effects (n_i) and year/time fixed effects (T_t) in accordance with Scott et al. (2017) regression modeling. Unobserved heterogeneity is accounted for by these fixed effects. The model examines macroeconomic and market effects on bank performance using additional independent variables, nation GDP per capita and mobile phone penetration rates.

Research Consequences

This study centers on examining the impact of fintech innovation, namely the use of mobile banking technology and financial standards, on various financial indicators of chosen commercial banks in the ASEAN region, including Singapore, Malaysia, Thailand, Philippines, and Brunei Darussalam, over the period from 2010 to 2017. The use of mobile banking by commercial banks in the ASEAN region started in the 1990s, coinciding with the widespread availability of mobile phones and the introduction of short message system (SMS) services by telecommunications firms. By 2005, around 5.5 million individuals in the Philippines had used mobile phones as a means of conducting virtual financial transactions, positioning the nation as a frontrunner in the region in terms of mobile financial services. In the context of the Philippines, the inflow of financial support from relatives employed overseas plays a vital role in sustaining the livelihoods of their families residing in the country. Furthermore, the use of mobile phones enables the execution of cash-out transactions via the means of Short Message Service (SMS). The proliferation of mobile banking trends seen significant growth, particularly with the introduction of Apple's first iPhone in 2008. Consequently, financial institutions began providing mobile banking apps to cater to the needs of both individual customers and enterprises.

4.1 The state of Mobile Banking in ASEAN

Within the study sample including five member nations of the Association of Southeast Asian Nations (ASEAN), Thailand exhibited the greatest count of mobile subscribers, reaching a total of 121 million in the year 2017. Subsequently, the Philippines reported the second largest number of mobile subscribers, amounting to 115 million during the same period.

There has been a notable rise in mobile users during 2010, with Thailand seeing a growth rate of 64.1% and reaching a total of 71 million members, while the Philippines had a growth rate of 34% and reached a total of 83 million customers. When comparing the data, it becomes evident that nations with smaller populations and fewer mobile users saw notably lower rates of growth. For instance, Malaysia observed a growth of 23.1% from 2010, reaching a total of 42 million mobile subscribers in 2017. Similarly, Singapore experienced a growth rate of 13.83%, resulting in a total of 8.4 million mobile subscribers. Lastly, Brunei Darussalam witnessed a growth rate of 24.74% from 2010, reaching a total of 544 thousand mobile customers in 2017.

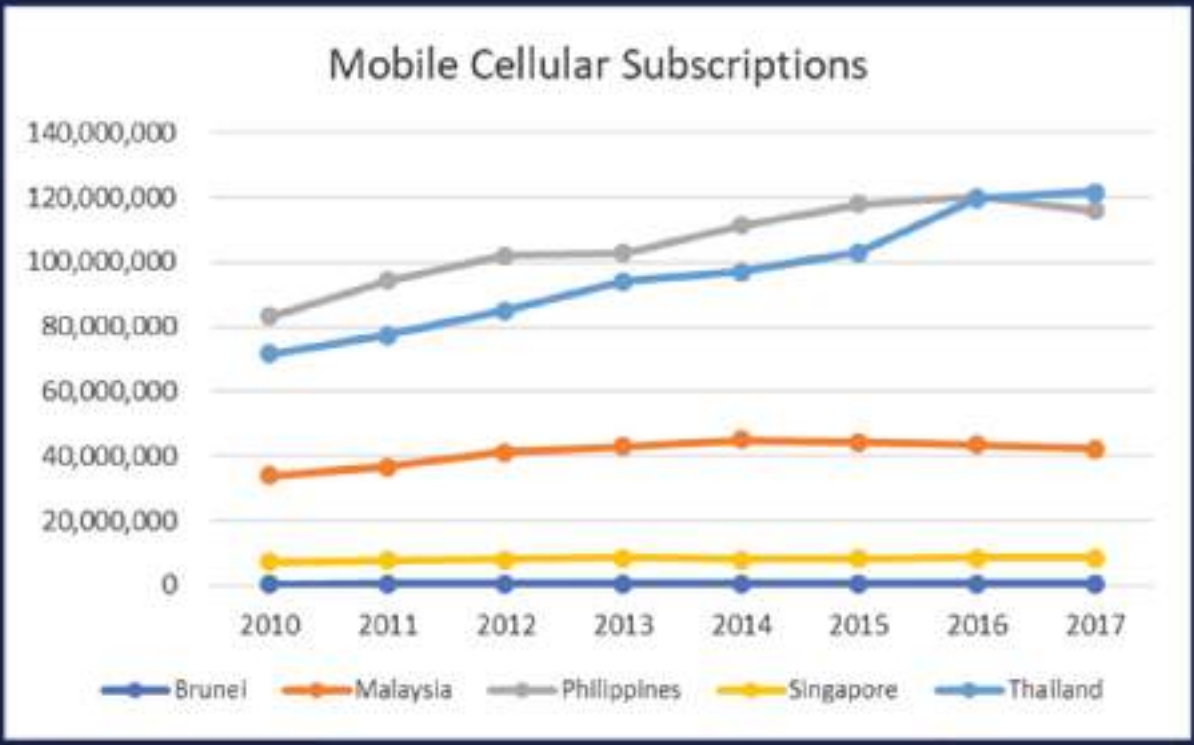

Figure 13: Mobile cellular subscriptions in the selected ASEAN countries

Concurrently with the expanding demographic of mobile device users, there has been a notable surge in the number of individuals using fixed broadband services. Thailand once again reported the greatest number of subscribers, with a total of 8.2 million, representing a significant increase of 127.24% compared to the figures recorded in 2010. Following closely behind, the Philippines reported a subscriber count of 3.3 million, reflecting a notable growth of 89.8% since 2010. Brunei Darussalam similarly had a substantial rise of 89.9% over the same time.

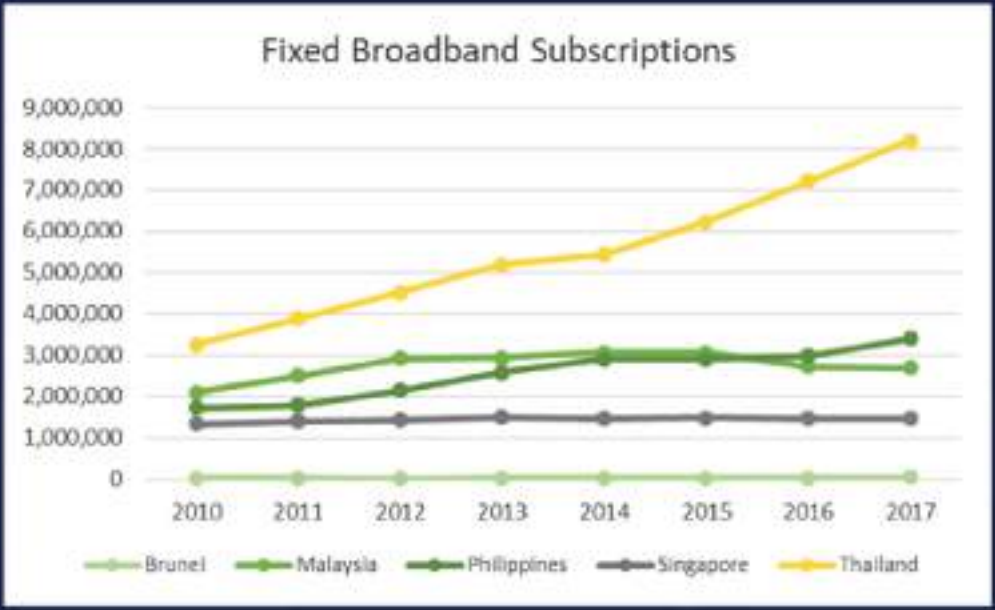

Figure 14: Fixed broadband subscriptions in the selected ASEAN countries

The advancement of mobile and online banking has shown varying rates of improvement across the area. Mobile banking penetration in less developed markets such as the Philippines and Indonesia has a somewhat slower rate of growth when compared to more established nations like Singapore, Malaysia, and Thailand. In the context of Thailand, it can be seen that mobile banking surpassed internet banking in 2015 in terms of both transaction volume and user count. This shift may be attributed to the growing preference among individuals for mobile devices, as shown in Figure 11.

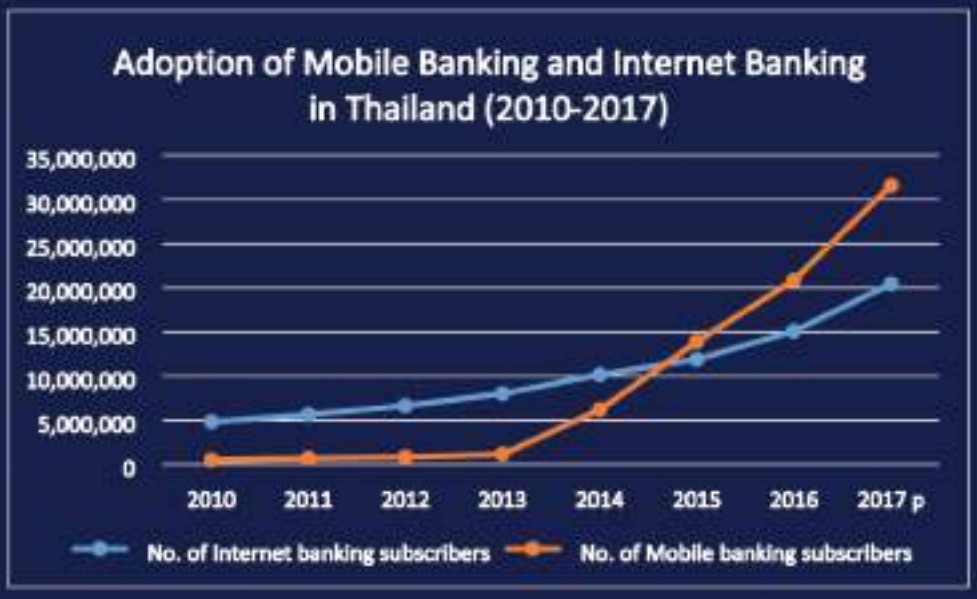

Figure 15: Adoption of mobile banking and internet banking in Thailand

In contrast, it is noteworthy that in Malaysia, the predominant mode of conducting financial transactions is via the use of internet-based platforms. The quantity of individuals using mobile banking services in Malaysia has shown a notable surge, rising from 898,472 users in 2010 to 11.34 million users in the span of eight years, representing a substantial development rate of 1163%. The quantity of individuals using online banking services has shown a consistent rise, with an average yearly development rate of 13.2% seen during the previous five-year period.

The progression is outlined as follows:

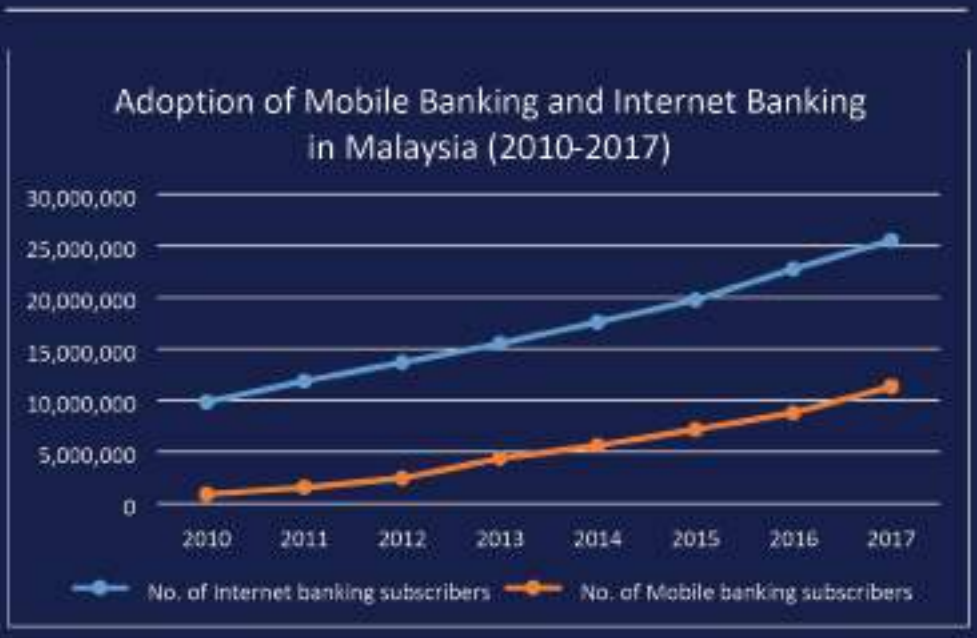

Figure 16: Adoption of mobile banking and internet banking in Malaysia

J.D. Power found that mobile banking in Singapore has grown 15% in the last year, surpassing branch banking. In 2017, Telstra found that 67% of Singaporeans used mobile banking, compared to 78% in the US and 75% in China. Around 33% of Singapore's adult population is millennial, or 34–18 years old. The astonishing 99% smartphone ownership rate among millennials is significant. According to the Telstra report, Singapore ranks sixth in millennial mobile banking usage among eight economies, including the US and China. Telstra (2017) reported a 22% wallet share for Singaporean millennials. This shows that Singapore is lagging in capitalizing on millennials' potential value growth.

In the second quarter of 2017, Brunei Darussalam has 127.4% mobile phone penetration per 100 residents, according to AITI. A large majority of mobile phones in the nation were smartphones with internet connectivity. In the second quarter of 2017, Brunei Darussalam has 121.4% mobile broadband penetration (handset) per 100 people, according to AITI. The prevalence of digital payment options has also increased.

AMBD's 2018 report on bank payment services found that internet and mobile application banking use increased 135% between 2016 and 2017. Card-based financial transactions rose 33% to $1.98 billion over the same period.

Mobile phone ownership outnumbers bank accounts in the Philippines. The 2017 Bangko Sentral ng Pilipinas (BSP) Financial Inclusion Survey found that 15.8 million Filipino adults, or 22.6% of the adult population, hold a formal account. There was a 22% rise over the 2015 survey. Due to restricted access to formal financial services, nearly 70% of the population uses cash. Financial exclusion is closely connected with cash management risks and expenditures because people use cash rather than digital means for daily financial transactions. Mobile phones let people get remittances from foreign family members by integrating financial services into their daily lives. The 2017 Financial Inclusion Survey found that 38% of Filipinos had a smart phone and 42% used the internet monthly. Additionally, 86% of respondents used mobile data to access the internet. Technological access increased in urban areas, particularly Metro Manila. Over 46% of Filipinos with bank accounts, Internet, and mobile banking were ambivalent about electronic payments, according to the research. Concerns about hacking, personal security breaches, and insecure access drive this mentality.

Accessibility, dependability, and closeness of ATMs and electronic platforms remain challenges. Around 33% of adults know PayMaya and GCash as the top electronic payment services.

4.2 Mobile Banking Adoption by Sample Banks in ASEAN

In the examined sample of 36 regional commercial banks within the ASEAN region, it was observed that 31 banks provided mobile banking apps in the year 2017. This represents a

substantial growth in comparison to the year 2010, during which only 5 mobile banks were available.

Figure 17: Mobile Banking Adoption by selected ASEAN commercial banks

The quantity of mobile banks had a twofold increase in 2011 and a threefold increase in 2012. In the year 2013, a significant shift occurred in the banking industry, as the number of mobile banks (19) surpassed that of traditional nonmobile banks (17), marking a notable turning point. The proliferation of mobile banking services has shown a steady growth trajectory, culminating in the year 2017. Appendix 3 provides a comprehensive compilation of mobile banks and non-mobile banks in the ASEAN 5 region. These banks are categorized into two distinct categories based on the median asset value of U$47.7 billion. The table shown below displays the names of banks that have launched mobile banking apps between the years 2010 and 2017.

The entities that are indicated by the green highlighting are the smaller financial institutions, characterized by an average asset size of less than $47.7 billion. In 2010, the first users of mobile banking technology were prominent financial institutions located in Singapore, Malaysia, and Thailand. OCBC, a financial institution in Singapore, has been providing mobile banking services for the longest duration starting from 2008. CIMB, a bank in Malaysia, introduced its mobile banking services a year later in 2009. Please see Appendix 3 for the complete names of the banks.

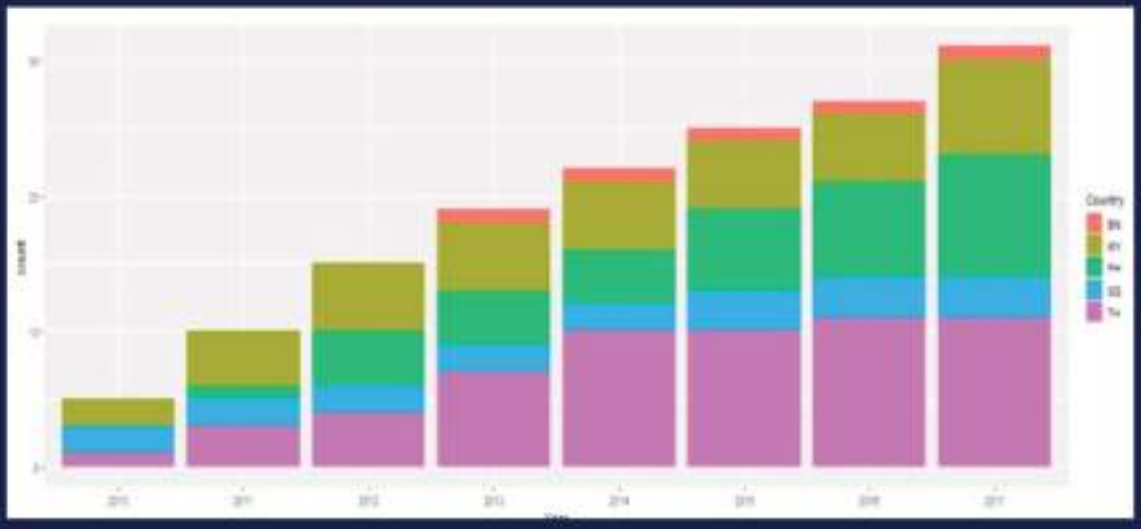

Figure 18: Mobile banking adoption in the selected ASEAN countries

The image shown above illustrates the adoption of mobile banking across different countries. Specifically, Thailand is represented by the color pink, Singapore by blue, the Philippines by green, Malaysia by brown, and Brunei Darussalam by orange. Mobile banking programs developed by several mobile banks were made available for download via the Apple App Store and/or Google Play Store. The mobile banking apps include a range of features, such as the ability to inquire about account details, make bill payments, engage in peer-to-peer payments, apply for mortgage and housing loans, submit insurance applications, and facilitate investments in mutual funds. The mobile banking features provided by each sample bank are enumerated in Appendix 9.

4.3 Real time Payment Adoption by Sample Banks in ASEAN

In March 2014, the nation of Singapore introduced a real-time money transfer service known as Fast and Secure Transfer (FAST), which operates in accordance with the ISO 20022 banking standards. The initiative was initiated by a consortium of 14 banks, including DBS, OCBC, UOB, as well as Malaysian banks operating inside the Singaporean market, such as CIMB, RHB, and Maybank, alongside several international banks.

According to ABS (2014), Scotland is home to Standard Chartered Bank and Sumitomo Mitsui Banking Corporation. In September 2015, Hong Leong Bank, a financial institution operating in Singapore, became a participant in the Fast and Secure Transfers (FAST) system. This move was made in conjunction with other prominent banks such as Bank of China, BNP Paribas, The Bank of Tokyo-Mitsubishi UFJ, and Mizuho Bank (ABS, 2015). In July 2017, the country of Singapore introduced a novel peer-to-peer money transfer service known as PayNow. This service enables users to send monies by using the recipient's cellphone number or Singapore NRIC/FIN. The transfers are facilitated by the FAST system, which operates continuously throughout the year, providing round-the-clock service availability (ABS, 2017).

The PromptPay real-time payment service was introduced by Thailand in the year 2016. PromptPay enables customers to conveniently and expeditiously transfer payments in real-time by using the mobile phone number and national identification of the receivers. In 2018, the Philippines introduced the InstaPay real-time payment service, while Malaysia's Real-time Payment Platform was launched in January 2019. The service, known as DuitNow, enables instantaneous credit transfers to bank accounts associated with mobile phones and national identification numbers, ensuring round-the-clock access of cash. Currently, Brunei Darussalam is in the process of implementing a real-time retail payment infrastructure, which is scheduled to become operational in the year 2020. However, the data from the years 2020-2018 falls beyond the parameters of this study.

Figure 19. Realtime Payment Technology Adoption by Selected Commercial Banks in ASEAN

4.4 Regression Analysis

This section presents multivariate panel regression results for income and balance sheet variables.

4.4.1 The Application of mobile technology on the income statement variables

The multivariate panel regressions in Table 5 indicate how mobile banking affects income statement factors. Mobile banking penetration was tracked from the participating banks' initial mobile app release to 2017. A thorough sample of 36 ASEAN commercial banks with 288 data was analyzed using separate panel regression models. A selection of 31 mobile banks with 248 data was studied. The analysis covered 2017–2010. Three mobile banking apps were independent variables in the study. These included MOB_AGER, a retail banking application for consumers, MOB_AGEB, a business banking application for corporate and SME needs, and MOB_AGEI, an investment banking application for securities and FX trading. To evaluate macroeconomic and market determinants, panel regressions utilized GDP Per Capita and mobile phone penetration rates as independent study variables. The table provides coefficients and associated probability values (p-values): *p<0.1; **p<0.05; ***p<0.01. This research focuses on statistically significant coefficients with p-values of less than 0.01 and 0.05 and adjusted R2 values larger than 50%.

Table 5a shows a complete 36-bank sample. Instead, Table 5b examines 31 mobile banks. Based on median asset size of U$28.9B, this group is divided into 15 small banks (Table 5c) and 16 major banks (Table 5d). Given the large difference in bank asset size mean and standard deviation, the median was used to divide the sample banks into two groups. Table 5a shows that the overall sample's interest income (INC_ASS) was positively correlated with the retail banking app (MOB_AGER, 0.152***) and negatively correlated with the business banking app (MOB_AGEB, -0.087**). This model has an adjusted R-squared of 84.3%. Modified R-squared of 66.8% shows that the retail banking app improved interest expenditures.

Table 5a: Effect of mobile technology on income statement (Full sample)

Estimation method: OLS				
Full Sample (2010-2017: 288 observations)				
Independent Variables	MOB_AGER (Retail)	MOB_AGEB (Business)	MOB_AGEI (Investment)	Adj R-sq
Dependent Variables				
IINC_ASS	0.152***	-0.087**	0.037	0.843
IEXP_ASS	0.085***	-0.016	0.002	0.668
FINC_ASS	0.083**	0.01	0.087***	0.617
SALA_ASS	0.029***	-0.032**	0.01	0.836
SGA_ASS	-0.009	0.005	0.013**	0.884
Fixed Effects: Bank Name and Year				
*p<0.1; **p<0.05; ***p<0.01				

The fee income of the whole sample, as shown by FINC_ASS, exhibited a positive correlation with the retail banking app (0.083**) and the investment banking app (0.087***).

The adjusted R2 value of 61.7% suggests that these variables explain a significant portion of the variation in fee revenue. The fee revenue comprises many components such as stocks trading fees, account service costs, foreign exchange fees, and loan and credit use fees. The remuneration of bank employees saw a positive impact from the retail banking application (SALA_ASS, 0.029***) and a negative impact from the business banking application (-0.032**), resulting in an adjusted 2 value of 83.6%. The mobile investing app had a significant impact on Selling General & Admin (SG&A) expenditures, as shown by a coefficient of 0.013** in the regression analysis. Furthermore, the modified R-squared value of 88.4% suggests that the app explains a substantial portion of the variation in SG&A expenses.

Regarding the specific category of mobile banks, it is worth noting that a total of 31 banks have implemented mobile banking applications by the year 2017. The banks may be classified into two distinct categories based on their asset size, namely the median asset size. The first category comprises small mobile banks with asset sizes below USD 28.9 billion, while the second category consists of major mobile banks with asset sizes beyond USD 28.9 billion.

Table 5b: Effect of mobile technology on income statement (Mobile banks)

Estimation method: OLS				
All Mobile Banks (2010-2017: 248 observations)				
Independent Variables	MOB_AGER (Retail)	MOB_AGEB (Business)	MOB_AGEI (Investment)	Adj R-sq
Dependent Variables				
IINC_ASS	0.078**	-0.076*	0.036	0.843
IEXP_ASS	0.025	-0.007	0.001	0.717
FINC_ASS	0.068*	0.015	0.087***	0.611
SALA_ASS	0.028**	-0.032**	0.009	0.81
SGA_ASS	-0.009*	0.005	0.013***	0.923
Fixed Effects: Bank Name and Year				
*p<0.1; **p<0.05; ***p<0.01				

A separate regression model was conducted for the subgroup of mobile banks listed in Table 5b, specifically focusing on the differentiation between small mobile banks and big mobile banks as shown in Table 5c and Table 5d. The primary conclusion of this study is that the use of mobile technology did not have a significant impact on the levels of interest revenue and interest expenditure for both small and big mobile banks.

The fee revenue of small banks was shown to have a positive association with mobile technology, as indicated by a coefficient of 0.220*** and an adjusted ⊠2 value of 59.7%.

This finding provides support for the first hypothesis. This observation aligns with the findings of DeYoung (2007), which suggest that new technologies mostly impact fee revenue rather than interest income/expense. This strategic diversification approach aims to decrease dependence on conventional middleman industries. The implementation of the business banking app and the retail banking app had a detrimental impact on the bank payroll and selling, general, and administrative (SG&A) expenditures of small banks. This finding provides support for the initial premise about the decrease of operating costs. As an example, an annual rise in the use of business banking applications would result in a decrease of small banks' payroll expenditures by 0.060%. The findings shown in Table 5d indicate that the income statements of major banks were essentially unchanged, so providing support for the first hypothesis on the impact of mobile technology on small banks

Table 5c: Effect of mobile technology on income statement (Small banks)

Estimation method: OLS				
Small Mobile Banks (2010-2017: 120 observations)				
Independent Variables	MOB_AGER (Retail)	MOB_AGEB (Business)	MOB_AGEI (Investment)	Adj R-sq
Dependent Variables				
IINC_ASS	0.059	-0.124	0.074	0.727
IEXP_ASS	-0.024	-0.012	-0.049	0.741
FINC_ASS	-0.001	0.06	0.220***	0.597
SALA_ASS	0.032	-0.060**	0.021	0.748
SGA_ASS	-0.019**	0.008	0.031***	0.871
Fixed Effects: Bank Name and Year				
*p<0.1; **p<0.05; ***p<0.01				

Table 5d: Effect of mobile technology on income statement (Large banks)

Estimation method: OLS				
Large Mobile Banks (2010-2017: 128 observations)				
Independent Variables	MOB_AGER (Retail)	MOB_AGEB (Business)	MOB_AGEI (Investment)	Adj R-sq
Dependent Variables				
IINC_ASS	0.038	-0.04	0.017	0.891
IEXP_ASS	-0.028	-0.017	-0.024	0.753
FINC_ASS	0.008	-0.042*	-0.027	0.812
SALA_ASS	0.003	-0.017*	0.002	0.886
SGA_ASS	0.01	0.002	0.006	0.939
Fixed Effects: Bank Name and Year				
*p<0.1; **p<0.05; ***p<0.01				

4.4.2 The application of mobile technology on the balance sheet variables - assets

Table 6 presents the impact of mobile banking technology on the asset side of the balance sheets for the whole sample. The findings of the study indicate that the mobile investing app had a significant impact on consumer loans (CONSM_LOAN, 1.562**), as seen by the higher adjusted 2 value of 82% compared to other asset classes. The mobile investment banking application enables electronic trading of stocks, bonds, mutual funds, and foreign exchange, which are often linked to lines of credit for trading and margin financing. Hence, there exists a strong correlation between consumer loans and the investment banking application.

Table 6a: Effect of mobile technology on the asset side of the balance sheets (Full sample)

Estimation method: OLS				
Full Sample (2010-2017: 288 observations)				
Independent Variables	MOB_AGER (Retail)	MOB_AGEB (Business)	MOB_AGEI (Investment)	Adj R-sq
Dependent Variables				
CASH_ASS	-0.963	1.515	2.369	0.343
SEC_ASS	-4.56	6.062	7.28	0.092
LOAN_ASS	-0.281	1.923	0.386	0.363
COMM_LOAN	1.037	-1.348	-0.662	0.76
CONSM_LOAN	-0.588	0.524	1.562**	0.82
NPL_LOAN	-0.091	0.154	0.238*	0.477
Adj_ROA	0.108***	-0.017	0.014	0.61
Fixed Effects: Bank Name and Year				
*p<0.1; **p<0.05; ***p<0.01				

In contrast to commercial loans, which need a lengthy borrower-bank relationship and in-person due diligence in order to get business loans, consumer loans are often characterized by transactional nature and singular occurrences. Loan applications and activation notifications for consumer loans may be conveniently facilitated via the use of mobile technology. In general, the adoption of mobile banking had a favorable influence on the adjusted return on assets (ROA) for banks in the complete sample, after omitting income and costs unrelated to mobile technology. The adjusted ROA was found to be 0.108***, and the adjusted R-squared value was 61%.

Regarding the specific group of mobile banks shown in Table 6b, 6c, and 6d, it is evident that mobile technology has had an impact on two key financial indicators: consumer loans and the adjusted return on assets (ROA). The most notable discovery among the variables was the favorable impact of the mobile investment banking app on consumer loans. This effect was more pronounced in small banks, as seen by the data presented in Table 6c, hence providing support for the first hypothesis. The coefficient for the consumer loan variable is statistically significant at the 0.01 level ($p < 0.01$), with a value of 5.834. The adjusted R-squared for the model is 71.8%. The correlation with the greatest magnitude is seen when there is an annual growth in the use of investment banking applications, resulting in a 5.834% rise in consumer loans for small banks.

Table 6b: Effect of mobile technology on the asset side of the balance sheets (Mobile banks)

Estimation method: OLS				
All Mobile Banks (2010-2017: 248 observations)				
Independent Variables	MOB_AGER (Retail)	MOB_AGEB (Business)	MOB_AGEI (Investment)	Adj R-sq
Dependent Variables				
CASH_ASS	0.4	1.375	2.449	0.341
SEC_ASS	-3.922	6.066	7.407	0.089
LOAN_ASS	1.604	1.757	0.485	0.311
COMM_LOAN	0.163	-1.261	-0.695	0.744
CONSM_LOAN	0.048	0.471	1.604**	0.813
NPL_LOAN	-0.154	0.177	0.244**	0.434
Adj_ROA	0.082**	-0.01	0.014	0.646
Fixed Effects: Bank Name and Year				
*p<0.1; **p<0.05; ***p<0.01				

Table 6c: Effect of mobile technology on the asset side of the balance sheets (Small banks)

Estimation method: OLS				
Small Mobile Banks (2010-2017: 120 observations)				
Independent Variables	MOB_AGER (Retail)	MOB_AGEB (Business)	MOB_AGEI (Investment)	Adj R-sq
Dependent Variables				
CASH_ASS	-0.128	1.921	5.517	0.314
SEC_ASS	-8.428	10.04	17.017	0.072
LOAN_ASS	0.193	4.288	2.96	0.277
COMM_LOAN	1.509	-1.596	-2.345	0.744
CONSM_LOAN	0.557	1.501	5.834***	0.718
NPL_LOAN	-0.195	0.036	0.510*	0.305
Adj_ROA	0.054	-0.003	0.189***	0.566
Fixed Effects: Bank Name and Year				
*p<0.1; **p<0.05; ***p<0.01				

The investment banking application had a significant positive impact on the adjusted return on assets (ROA) of small banks, with a coefficient of 0.189***. Additionally, the adjusted R-squared value for this relationship was found to be 56.6%. Table 6d presents the results of the panel regression analysis conducted on prominent mobile banking institutions. The business banking app and investment banking app had a good impact on both cash assets and securities assets in general. The investment banking application had a detrimental impact on loan assets, but consumer loans and commercial loans were not impacted.

The implementation of a business banking app had a significant beneficial impact on the non-performing loan rates of big banks, as shown by a coefficient of 0.164**. Furthermore, the adjusted R-squared value of 75.3% suggests that the app accounted for a substantial portion of the variation in non-performing loan rates across these banks. The first hypothesis is supported by the finding that the retail banking app had a positive impact on the adjusted return on assets (ROA) of major banks, with a coefficient of 0.096**, which is lower than the coefficient of 0.189*** seen for small banks.

Table 6d: Effect of mobile technology on the asset side of the balance sheets (Large banks)

Estimation method: OLS				
Large Mobile Banks (2010-2017: 128 observations)				
Independent Variables	MOB_AGER (Retail)	MOB_AGEB (Business)	MOB_AGEI (Investment)	Adj R-sq
Dependent Variables				
CASH_ASS	-0.492	0.634**	0.868***	0.71
SEC_ASS	-0.061	0.383	0.755***	0.79
LOAN_ASS	0.566	0.211	-1.112***	0.862
COMM_LOAN	0.048	-0.487	0.937	0.723
CONSM_LOAN	0.204	-0.536*	0.047	0.98
NPL_LOAN	-0.035	0.164**	0.095	0.753
Adj_ROA	0.096**	-0.009	-0.046	0.765
Fixed Effects: Bank Name and Year				
*p<0.1; **p<0.05; ***p<0.01				

4.4.3 The application of mobile technology on the balance sheet variables-liability & equity

The regression findings shown in Table 7 examine the influence of mobile banking technology on the liability and equity components of the balance sheets for the whole sample. The primary outcome of the study revealed a noteworthy impact of the investment banking application on the trading of securities and foreign exchange. This impact was observed to have a positive effect on money market deposits (MM_DEP, ,***1.756 90.6% adjusted 2), while simultaneously exerting a negative influence on demand deposits (DD_DEP, -0.661***, 91.8% adjusted 2) and fixed deposits (TD_DEP, -1.311**, 8.82% adjusted 2).

Table 7a: Effect of mobile technology on the liability and equity side of the balance sheets (Full sample)

Estimation method: OLS				
Full Sample (2010-2017: 288-188 observations)				
Independent Variables	MOB_AGER (Retail)	MOB_AGEB (Business)	MOB_AGEI (Investment)	Adj R-sq
Dependent Variables				
DEPO_ASS	-0.88	0.17	-0.023	0.496
DD_DEP	0.383	-0.077	-0.661***	0.918
MM_DEP	0.008	0.497	1.756***	0.906
TD_DEP	-0.433	-0.389	-1.311**	0.828
CT1_CAP	0.387*	-0.21	0.310*	0.72
Adj_ROE	0.3	0.466	-0.316	0.608
Fixed Effects: Bank Name and Year				
*p<0.1; **p<0.05; ***p<0.01				

In accordance with previous scholarly investigations, mobile technologies provide clients the ability to engage in easy and flexible fund transfers, enabling them to shift their funds from demand deposits with low or zero interest rates to money market deposits that offer better yields. Regarding the equity portion of the balance sheet for the whole sample, no statistically significant findings were identified.

The impact of the investment banking app on money market deposits, especially for small banks, was significant (MM_DEP, 80.9 ,***5.916% adjusted 2), as shown in Table 7b, 7c, and 7d, which represent a subgroup of mobile banks. The statement implies that an annual growth in mobile investment banking services would result in a corresponding 5.916% rise in money market deposits.

Table 7b: Effect of mobile technology on the liability and equity side of the balance sheets (Mobile banks)

Estimation method: OLS				
All Mobile Banks (2010-2017: 248 observations)				
Independent Variables	MOB_AGER (Retail)	MOB_AGEB (Business)	MOB_AGEI (Investment)	Adj R-sq
Dependent Variables				
DEPO_ASS	-1.051	0.172	-0.037	0.441
DD_DEP	0.371	-0.077	-0.662***	0.911
MM_DEP	0.233	0.47	1.758***	0.881
TD_DEP	-0.771	-0.379	-1.334**	0.822
CT1_CAP	0.618***	-0.223	0.324**	0.437
Adj_ROE	-0.041	0.535	-0.324	0.696
Fixed Effects: Bank Name and Year				
*p<0.1; **p<0.05; ***p<0.01				

Table 7c: Effect of mobile technology adoption on the liability and equity side of the balance sheets (Small banks)

Estimation method: OLS				
Small Mobile Banks (2010-2017: 120 observations)				
Independent Variables	MOB_AGER (Retail)	MOB_AGEB (Business)	MOB_AGEI (Investment)	Adj R-sq
Dependent Variables				
DEPO_ASS	-1.174	0.788	-0.302	0.367
DD_DEP	0.819	-0.9	-0.891	0.877
MM_DEP	0.526	3.376**	5.916***	0.809
TD_DEP	-2.048	-2.476	-5.509***	-0.778
CT1_CAP	0.887***	-0.873**	0.394	0.303
Adj_ROE	-0.64	0.554	1.238**	0.663
Fixed Effects: Bank Name and Year				
*p<0.1; **p<0.05; ***p<0.01				

The investment banking application had a favorable impact on the adjusted return on equity (ROE) of small banks, with a coefficient of 1.238**. Additionally, the adjusted R-squared value for this relationship was 66.3%. The Core Tier 1 Capital (CT1_CAP) ratio, an important metric for assessing the capital quality and financial soundness of banks, saw a favorable impact from the retail banking application, whereas it was adversely impacted by the commercial banking application. However, the model's lack of a well-defined nature was evident as shown by the low corrected 2 value of 30.3%. Consequently, it was deemed unsuitable for further evaluation. Table 7d presents the findings of a panel regression analysis conducted on prominent mobile banking institutions.

Table 7d: Effect of mobile technology on the liability and equity side of the balance sheets (Large banks)

Estimation method: OLS				
Large Mobile Banks (2010-2017: 128 observations)				
Independent Variables	MOB_AGER (Retail)	MOB_AGEB (Business)	MOB_AGEI (Investment)	Adj R-sq
Dependent Variables				
DEPO_ASS	-1.183**	0.002	0.017	0.72
DD_DEP	-0.499***	0.319**	-0.599***	0.981
MM_DEP	0.342	-0.924**	0.493	0.976
TD_DEP	0.387	0.779*	-0.022	0.947
CT1_CAP	0.092	0.073	0.244*	0.552
Adj_ROE	0.805*	0.613	-0.780**	0.76
Fixed Effects: Bank Name and Year				
*p<0.1; **p<0.05; ***p<0.01				

Mobile technologies have been shown to have adverse impacts on the liability and equity components of the balance sheets of major banks. The retail banking app had a significant negative impact on both overall deposits and demand deposits, with coefficients of -1.183** and -0.499*** correspondingly. The business banking app had a negative impact on money market deposits, as shown by a coefficient of -0.924 and an adjusted R-squared value of 97.6%. The investment banking application had a significant negative impact on the adjusted return on equity (ROE) with a coefficient of -0.780**. The adjusted R-squared value indicates that the model explains 76% of the variation in the adjusted ROE. The findings of this study indicate that the implementation of mobile technologies did not have a favorable impact on the financial performance of major banks.

This supports the initial premise that suggests a greater influence of technological advancements on small banks.

4.4.4 The impact of mobile technology on financial standards

The findings of the panel regression analysis shown in Table 8 indicate a statistically significant positive association between the use of mobile banking technology by banks and adherence to financial standards, namely ISO 20022. The financial standards primarily pertain to the retail and commercial banking sectors, hence the panel regression models removed the independent research variable associated with investment banking applications. The presented table displays the regression outcomes for the whole sample, indicating that the use of retail banking app and business banking app had a favorable impact on banks' adoption of ISO 20022 financial standards, with coefficients of 0.222*** and 0.189** correspondingly. The adjusted 2 value for this model was 61.4%.

Table 8a: Effect of mobile technology on financial standards (Full sample)

Estimation method: OLS			
Full Sample (2010-2017: 288 observations)			
Independent Variables	MOB_AGER (Retail)	MOB_AGEB (Business)	Adj R-sq
Dependent Variable: ISO_AGE	0.222***	0.189**	0.614

Financial standards undergo changes and advancements in parallel with technological advancements. For instance, the introduction of ISO 20022 APIs enables the facilitation of real-time payments via various means such as cellphone numbers, Facebook accounts, and NRIC numbers. Financial standards play a crucial role in promoting technical advancements and facilitating interoperability, hence enhancing the ease of adoption and use of new services across a broad range of users. The following tables provide the findings of the regression analysis conducted on a selection of mobile banks categorized as small and big.

Estimation method: OLS			
All Mobile Banks (2010-2017: 248 observations)			
Independent Variables	MOB_AGER (Retail)	MOB_AGEB (Business)	Adj R-sq
Dependent Variables: ISO_AGE	0.197***	0.187***	0.611

Table 8c: Effect of mobile technology on financial standards (Small banks)

Estimation method: OLS			
Small Mobile Banks (2010-2017: 120 observations)			
Independent Variables	MOB_AGER (Retail)	MOB_AGEB (Business)	Adj R-sq
Dependent Variables: ISO_AGE	0.062	-0.055	0.302

Table 8d: Effect of mobile technology on financial standards (Large banks)

Estimation method: OLS			
Large Mobile Banks (2010-2017: 128 observations)			
Independent Variables	MOB_AGER (Retail)	MOB_AGEB (Business)	Adj R-sq
Dependent Variables: ISO_AGE	0.168**	0.260***	0.744

There was a lack of significant impact detected in the implementation of financial norms by small banks as a result of mobile technology. In contrast, the adoption of financial norms by major banks was significantly influenced by the retail banking app and business banking app, with coefficients of 0.168** and 0.260*** respectively. The adjusted R2 value of 74.4% indicates a good explanatory power of the model. One potential rationale for this phenomenon is because among the selected mobile banking sample, the first adopters of standards were mostly prominent banks operating in Singapore. These banks started their involvement in the ISO 20022 real-time retail payment system, which was introduced in 2014. Hence, it is plausible that the statistical data mostly captured the impact on major financial institutions. In the latter half of 2014, the nation of Brunei Darussalam began the implementation of an Automated Clearing House (ACH) system that adheres to the ISO 20022 standard. PromptPay, a real-time payment service in Thailand, was introduced in 2016 by many small and major banks, using the ISO 20022 standard. By the end of 2017, around 62% of the banks included in the sample had implemented ISO 20022 financial standards, with the bulk of them being big banks. Therefore, it is probable that the panel regression findings were influenced by factors such as sample size and temporal effects.

4.4.5 The adoption of financial standards on bank's financial indicators

The regression outcome shown in Table 9 demonstrates a favorable correlation between the implementation of financial rules by banks and the adjusted return on assets (ROA) and return on equity (ROE).

Table 9a: Effect of financial standards on bank ROA and ROE

(Full sample and mobile banks)

Estimation method: OLS				
*# of observations	**Full Sample (*288)**		**All Mobile Banks (*248)**	
Independent Variables	ISO_AGE	Adj R-sq	ISO_AGE	Adj R-sq
Dependent Variables				
Adj_ROA	0.099**	0.594	0.071	0.641
Adj_ROE	0.173	0.605	0.007	0.692

The implementation of financial rules had a significant positive impact on the adjusted return on assets (ROA) of the whole sample, with a coefficient of 0.099**. The adjusted R-squared value for the model was 64.1%.

Table 9b: Effect of financial standards on bank ROA and ROE

(Small and large banks)

Estimation method: OLS				
*# of observations	**Small Mobile Banks (*120)**		**Large Mobile Banks (*128)**	
Independent Variables	ISO_AGE	Adj R-sq	ISO_AGE	Adj R-sq
Dependent Variables				
Adj_ROA	0.679***	0.631	-0.05	0.757
Adj_ROE	3.105***	0.676	0.055	0.73

The implementation of ISO 20022 financial standards has had a significant beneficial impact on the adjusted return on assets (ROA) and adjusted return on equity (ROE) of small banks. The adjusted ROA increased by 0.679***, while the adjusted ROE increased by 3.105***. These findings are supported by adjusted R-squared values of 75.7% and 73% for ROA and ROE, respectively. On the other hand, the profitability of major banks was shown to be unaffected by the implementation of financial norms, so providing support for the third hypothesis.

4.4.6 The combines adoption effect of mobile banking technologies combined with the financial standards on bank's financial indicators.

Within the realm of statistical analysis, a mediator variable assumes the role of elucidating the underlying nature of the association between the independent variable and the dependent variable. The study employed the research methodology proposed by Baron and Kenny (1986), utilizing regression analysis to examine the association between fintech innovations (represented by three distinct mobile app technologies as independent variables) and bank profitability (measured by adjusted return on assets and return on equity as dependent variables). The analysis also incorporated a mediator variable, financial standards, to assess its potential influence on the relationship between fintech innovations and bank profitability.

According to this model, the impact of fintech on bank performance is mediated by the variable of standards. The impact of financial standards is assessed by the evaluation of banks' duration of ISO 20022 financial standards implementation. By the conclusion of 2017, about 62% of the banks included in the study have implemented ISO 20022 financial standards. The adjusted return on assets (ROA) and return on equity (ROE) were subjected to regression analysis using the study variables of retail mobile banking app and business mobile banking app as independent variables in separate models.

Table 10 presents the results of the regression analysis conducted to examine the collective impact of the retail banking application and ISO 20022 financial standards on the adjusted return on assets (ROA) and return on equity (ROE).

Table 10a: Combined effects of the retail mobile banking technology and financial standards on ROA and ROE (Mobile banks)

Estimation method: OLS					
All Mobile Banks (2010-2017: 248 observations)					
Independent Variables	MOB_AGER (Retail)	M_MOB_AGER (Retail)	M_MOBAGER_ ISO (Retail)	Adj R-sq	Adj R-sq (ISO)
Dependent Variables					
Adj_ROA	0.088**	0.114***	-0.014*	0.647	0.65
Adj_ROE	-0.186	0.139	-0.183***	0.695	0.702
Fixed Effects: Bank Name and Year					
*p<0.1; **p<0.05; ***p<0.01					

The combined impact of the retail banking app and financial norms has a significant negative effect on the adjusted return on equity (ROE), with a coefficient of -0.183***. The adjusted R-squared value for this model is 70.2%. Table 10b presents the regression outcomes pertaining to the combined impact of business banking applications and financial standards on the adjusted return on assets (ROA) and return on equity (ROE). No statistically significant result was detected.

Estimation method: OLS					
All Mobile Banks (2010-2017: 248 observations)					
Independent Variables	MOB_AGEB (Business)	M_MOB_ AGEB (Business)	M_MOBAGEB_ ISO (Business)	Adj R-sq	Adj R-sq (ISO)
Dependent Variables					
Adj_ROA	-0.014	-0.051	0.027	0.647	0.65
Adj_ROE	0.621*	0.279	0.284*	0.695	0.702
	Fixed Effects: Bank Name and Year				
*p<0.1; **p<0.05; ***p<0.01					

Table 10b: Combined effects of the business mobile technology and financial standards on ROA and ROE (Mobile banks)

Regarding the subgroup of small mobile banks shown in Tables 10c and 10d, the joint impact of the retail banking application and financial standards had a significant positive influence on the adjusted return on assets (ROA) at a coefficient of 0.158***, and on the return on equity (ROE) at a coefficient of 0.646*. The adjusted R-squared values for these models were 60.1% and 66% respectively.

Table 10c: Combined effects of the retail mobile technology and financial standards on ROA and ROE (Small banks)

Estimation method: OLS					
Small Mobile Banks (2010-2017: 120 observations)					
Independent Variables	MOB_AGER (Retail)	M_MOB_AGER (Retail)	M_MOBAGER_ISO (Retail)	Adj R-sq	Adj R-sq (ISO)
Dependent Variables					
Adj_ROA	0.094	0.039	0.158***	0.537	0.601
Adj_ROE	-0.376	-0.599	0.646*	0.649	0.66
Fixed Effects: Bank Name and Year					
*p<0.1; **p<0.05; ***p<0.01					

Table 10d: Combined effects of the business mobile technology and financial standards on ROA and ROE (Small banks)

Estimation method: OLS					
Small Mobile Banks (2010-2017: 120 Observations)					
Independent Variables	MOB_AGEB (Business)	M_MOB_AGEB (Business)	M_MOBAGEB_ISO (Business)	Adj Rsq	Adj R-sq (Mediator)
Dependent Variables					
Adj_ROA	-0.032	0.015	-0.064	0.537	0.601
Adj_ROE	0.365	0.499	0.201	0.649	0.66
Fixed Effects: Bank Name and Year					
*p<0.1; **p<0.05; ***p<0.01					

Table 10d shown above displays the regression outcomes pertaining to the collective impact of business banking applications and financial requirements on the adjusted return on assets (ROA) and return on equity (ROE) of small banks. The obtained outcome did not demonstrate statistical significance.

Table 10e: Combined effects of the retail mobile technology and financial standards on ROA and ROE (Large banks)

Estimation method: OLS					
Large Mobile Banks (2010-2017: 128 Observations)					
Independent Variables	MOB_AGER (Retail)	M_MOB_ AGER (Retail)	M_MOBAGER_ ISO	Adj R-sq	Adj R-sq (ISO)
Dependent Variables					
Adj_ROA	0.076*	0.137***	-0.024***	0.761	0.786
Adj_ROE	0.473	1.022**	-0.223***	0.747	0.763
Fixed Effects: Bank Name and Year					
*p<0.1; **p<0.05; ***p<0.01					

Table 10e shown above displays the regression outcomes concerning the collective impact of the retail banking application and financial standards on the adjusted return on assets (ROA) and return on equity (ROE) of major banks. The adjusted return on assets (ROA) and return on equity (ROE) were both adversely impacted by the combined influence of the retail banking application and financial rules. Specifically, the adjusted ROA experienced a significant decrease of -0.024***, while the adjusted ROE declined by -0.223***. The adjusted ▯2 values for these variables were found to be 78.6% and 76.3% respectively. Table 10f presents the regression outcomes pertaining to the collective impact of the business banking application and financial standards on the adjusted return on assets (ROA) and return on equity (ROE) of major banks. The use of the business banking application had a significant positive impact on the adjusted return on assets (ROA) at a coefficient of 0.035**.

Furthermore, the adjusted R-squared value of 78.6% indicates that the business banking app explains a substantial portion of the variation in the adjusted ROA.

Table 10f: Combined effects of the business mobile technology and financial standards on ROA and ROE (Large banks)

Estimation method: OLS					
Large Mobile Banks (2010-2017: 128 Observations)					
Independent Variables	MOB_AGEB (Business)	M_MOB_ AGEB	M_MOBAGEB_ ISO	Adj R-sq	Adj R-sq (Mediator)
Dependent Variables					
Adj_ROA	0.008	-0.056	0.035**	0.761	0.786
Adj_ROE	0.899*	0.458	0.284	0.747	0.763
Fixed Effects: Bank Name and Year					
*p<0.1; **p<0.05; ***p<0.01					

In general, the standards mediator had an impact on both small and large banks, confirming the acceptance of Hypothesis 4. This hypothesis suggests that the integration of mobile technologies with financial standards has a favorable effect on bank return on assets (ROA) and return on equity (ROE).

4.4.7 Macroeconomics' effect after adoption

The multivariate panel regression models included the inclusion of GDP per capita as an extra independent variable, with the explicit aim of assessing the impact of macroeconomic circumstances on bank return on assets (ROA) and return on equity (ROE). Table 11 presents the results of the panel regression analysis.

Table 11a: Effects of GDP per capita, retail banking app and financial standards on ROA and ROE (Mobile banks)

Estimation method: OLS					
All Mobile Banks (2010-2017: 248 observations)					
Independent Variables	M_MOBAGER_ ISO (Retail)	M_MOBAGER_ISO (Retail)	Adj R-sq (ISO)	Adj R-sq (GDP)	GDP_PC
Dependent Variables					
Adj_ROA	-0.014*	-0.015*	0.65	0.649	0.00001
Adj_ROE	-0.183***	-0.203***	0.702	0.707	0.0003**
Fixed Effects: Bank Name and Year					
*p<0.1; **p<0.05; ***p<0.01					

Table 11b: Effects of GDP per capita, business banking app and financial standards on ROA and ROE (Mobile Banks)

Estimation method: OLS					
All Mobile Banks (2010-2017: 248 observations)					
Independent Variables	M_MOBAGEB_ISO (Business)	M_MOBAGEB_ISO (Business)	Adj R-sq (ISO)	Adj R-sq (GDP)	GDP_PC
Dependent Variables					
Adj_ROA	0.027	0.027	0.65	0.649	0.00001
Adj_ROE	0.284*	0.296*	0.702	0.707	0.0003**
Fixed Effects: Bank Name and Year					
*p<0.1; **p<0.05; ***p<0.01					

The use of retail banking app and business banking app by mobile banks had a favorable impact on the adjusted return on equity (ROE). This impact was seen in relation to the country's gross domestic product (GDP) per capita, with a coefficient of 0.0003**. The adjusted R-squared (R2) of the model including these factors was 70.7%, which is somewhat higher than the adjusted R2 of the previous model, which stood at 2.70%.

Table 11c: Effects of GDP per capita, retail banking app and financial standards on ROA and ROE (Small mobile banks)

Estimation method: OLS					
Small Mobile Banks (2010-2017: 120 observations)					
Independent Variables	M_MOBAGER_ ISO (Retail)	M_MOBAGER_ ISO (Retail)	Adj R-sq (ISO)	Adj R-sq (GDP)	GDP_ PC
Dependent Variables					
Adj_ROA	0.158***	0.167***	0.601	0.602	-0.00003
Adj_ROE	0.646*	0.624*	0.66	0.656	0.0001
Fixed Effects: Bank Name and Year					
*p<0.1; **p<0.05; ***p<0.01					

The provided Table 11c does not demonstrate any statistically significant correlation between GDP per capita, profitability, and the use of retail banking applications by small banks. However, a correlation has been identified between GDP per capita, the use of business banking apps by small banks, and the adjusted return on equity (ROE) at a significance level of 0.001**. The adjusted R-squared value for this association is 78%, which is higher than the adjusted R-squared value of the previous model, which stood at 66%. This information is shown in Table 11d.

Table 11d: Effects of GDP per capita, business banking app and financial standards on ROA and ROE (Small mobile banks)

Estimation method: OLS					
Small Mobile Banks (2010-2017: 120 observations)					
Independent Variables	M_MOBAGEB_ ISO (Business)	M_MOBAGEB_ ISO (Business)	Adj Rsq (ISO)	Adj R-sq (GDP)	GDP_PC
Dependent Variables					
Adj_ROA	-0.064	-0.073	0.601	0.602	-0.00003
Adj_ROE	0.201	0.223	0.66	0.78	0.001***
Fixed Effects: Bank Name and Year					
*p<0.1; **p<0.05; ***p<0.01					

Regarding the subset of major mobile banks, Tables 11e and 11f provide empirical evidence indicating a statistically significant association between GDP per capita, adjusted return on equity (ROE), and the adoption of retail banking applications. The observed link exhibits a high level of statistical significance at a p-value of 0.001***, with the adjusted coefficient of determination (R2) indicating that 78% of the variation in the adoption of retail banking apps can be explained by the combined influence of GDP per capita and adjusted ROE.

Table 11e: Effects of GDP per capita, retail banking app and financial standards on ROA and ROE (Large mobile banks)

Estimation method: OLS					
Large Mobile Banks (2010-2017: 128 Observations)					
Independent Variables	M_MOBAGER_ISO	M_MOBAGER_ISO (Retail)	Adj R-sq (ISO)	Adj R-sq (GDP)	GDP_PC
Dependent Variables					
Adj_ROA	-0.024***	-0.025***	0.786	0.787	0.00003
Adj_ROE	-0.223***	-0.234***	0.763	0.78	0.001***
Fixed Effects: Bank Name and Year					
*p<0.1; **p<0.05; ***p<0.01					

Table 11f: Effects of GDP per capita, business banking app and financial standards on ROA and ROE (Large mobile banks)

Estimation method: OLS					
Large Mobile Banks (2010-2017: 128 Observations)					
Independent Variables	M_MOBAGEB_ISO	M_MOBAGEB_ISO (Business)	Adj Rsq (ISO)	Adj R-sq (GDP)	GDP_PC
Dependent Variables					
Adj_ROA	0.035**	0.038**	0.786	0.787	0.00003
Adj_ROE	0.284	0.337*	0.763	0.78	0.001***
Fixed Effects: Bank Name and Year					
*p<0.1; **p<0.05; ***p<0.01					

4.4.8 Identification of market movements

The multivariate panel regression models used the Mobile Phone Penetration Rates as an extra independent variable to precisely assess the impact of external market circumstances on the bank's Return on Assets (ROA) and Return on Equity (ROE). The findings shown in Table 12a and 12b indicate a significant positive correlation between the rates of mobile phone penetration, the presence of retail and business banking applications, and financial standards on the return on assets (ROA) at a coefficient of 0.007***. The adjusted R-squared value for this model is 66.2%, which is somewhat higher than the adjusted R-squared value of the previous model, which stood at 65%.

Table 12a: Effects of mobile phone penetration rates, retail banking app and financial standards on ROA and ROE (Mobile Banks)

Estimation method: OLS					
All Mobile Banks (2010-2017: 248 observations)					
Independent Variables	M_MOBAGER_ ISO (Retail)	M_MOBAGER_ ISO (Retail)	Adj R-sq (ISO)	Adj R-sq (MOB_PEN)	MOB_PEN
Dependent Variables					
Adj_ROA	-0.014*	-0.01	0.65	0.662	0.007***
Adj_ROE	-0.183***	-0.168**	0.702	0.703	0.029
Fixed Effects: Bank Name and Year					
*p<0.1; **p<0.05; ***p<0.01					

Table 12b: Effects of mobile phone penetration rates, business banking app and financial standards on ROA and ROE (Mobile Banks)

Estimation method: OLS					
All Mobile Banks (2010-2017: 248 observations)					
Independent Variables	M_MOBAGEB_ ISO (Business)	M_MOBAGEB_ ISO (Business)	Adj R-sq (ISO)	Adj R-sq (MOB_PEN)	MOB_PEN
Dependent Variables					
Adj_ROA	0.027	0.029	0.65	0.662	0.007***
Adj_ROE	0.284*	0.292*	0.702	0.703	0.029
Fixed Effects: Bank Name and Year					
*p<0.1; **p<0.05; ***p<0.01					

The findings validate the existence of a robust correlation between individuals' use of mobile phones and the profitability of banks. Regarding the subgroup of small mobile banks, there was a positive correlation seen between mobile penetration rates and the adoption of retail and business banking applications, financial standards, as well as return on assets (ROA) and return on equity (ROE), as shown by the data presented in Tables 12c and 12d.

Table 12c: Effects of mobile phone penetration rates, retail banking app and financial standards on ROA and ROE (Small Banks)

Estimation method: OLS					
Small Mobile Banks (2010-2017: 120 observations)					
Independent Variables	M_MOBAGER_ISO (Retail)	M_MOBAGER_ISO (Retail)	Adj R-sq (ISO)	Adj R-sq (MOB_PEN)	MOB_PEN
Dependent Variables					
Adj_ROA	0.158***	0.092*	0.601	0.612	0.013*
Adj_ROE	0.646*	0.096	0.66	0.67	0.105**
Fixed Effects: Bank Name and Year					
*p<0.1; **p<0.05; ***p<0.01					

Table 12d: Effects of mobile phone penetration rates, business banking app and financial standards on ROA and ROE (Small Banks)

Estimation method: OLS					
Small Mobile Banks (2010-2017: 120 observations)					
Independent Variables	M_MOBAGEB_ ISO (Business)	M_MOBAGEB_ ISO (Business)	Adj R-sq (ISO)	Adj R-sq (MOB_ PEN)	MOB_PEN
Dependent Variables					
Adj_ROA	-0.064	-0.064	0.601	0.662	0.007***
Adj_ROE	0.201	0.197	0.66	0.67	0.105**
Fixed Effects: Bank Name and Year					
*p<0.1; **p<0.05; ***p<0.01					

For the subset of large mobile banks, mobile penetration rates had a negative relationship with banks' adoption of both retail and business banking app,

Estimation method: OLS					
Large Mobile Banks (2010-2017: 128 Observations)					
Independent Variables	M_MOBAGER_ ISO	M_MOBAGER_ ISO (Retail)	Adj R-sq (ISO)	Adj R-sq (MOB_PEN)	MOB_PEN
Dependent Variables					
Adj_ROA	-0.024***	-0.029***	0.786	0.789	-0.004
Adj_ROE	-0.223***	-0.293***	0.763	0.772	-0.065**
Fixed Effects: Bank Name and Year					
*p<0.1; **p<0.05; ***p<0.01					

The financial standards were examined, and it was found that the adjusted return on equity (ROE) was -0.065**. Additionally, the adjusted R-squared (▯2) was seen to be 77.2%, which is higher than the adjusted ▯2 of the prior model at 3.76%. These findings are shown in Tables 12e and 12f.

Table 12f: Effects of mobile phone penetration rates, business banking app and financial standards on ROA and ROE (Large Banks)

Estimation method: OLS					
Large Mobile Banks (2010-2017: 128 Observations)					
Independent Variables	M_MOBAGEB_ ISO	M_MOBAGEB_ ISO (Business)	Adj R-sq (ISO)	Adj R-sq (MOB_PEN)	MOB_PEN
Dependent Variables					
Adj_ROA	0.035**	0.031*	0.786	0.789	-0.004
Adj_ROE	0.284	0.224	0.763	0.772	-0.065**
Fixed Effects: Bank Name and Year					
*p<0.1; **p<0.05; ***p<0.01					

4.5 Defining Hypothesis and Variable Explanations

This section analyses the multivariate panel regression models' results and the four hypotheses tested. I will analyze the regression results to see whether fintech innovations have improved bank financial performance. I will examine (1) whether these improvements are seen across all financial indicators or only in specific ones; (2)

whether they are seen across all banks in the sample or only in smaller or larger banks with specific business focuses; and (3) whether financial standards mediate the relationship between fintech innovations and bank performance.

The figure includes 31 mobile banks, grouped by median asset worth of $28.9 billion into smaller and larger banks. This research compares financial metrics affected by retail, corporate, and investment banking mobile banking technology. The research covers years after banks introduced their applications, with data from 2017 included.

My research analyzes panel data from 36 ASEAN commercial banks. The data relates to these institutions' fintech adoption, especially via mobile banking apps.

Retail customers may use the retail banking app for account inquiries, bill payments, and cash transfers. Some mobile apps let customers apply for car loans, mortgages, time deposits, and accounts.

Business owners, SMEs, and corporations may use the business banking app for a variety of financial services. Its mobile app focuses on payment and transaction approval and account queries. The investment banking app lets ordinary and institutional investors trade stocks, bonds, mutual funds, and foreign currencies via a mobile platform.

Appendix 8 details selected ASEAN banks' mobile banking app capabilities. The research examined how three kinds of mobile app innovations affected bank performance using multivariate panel regressions.

4.5.1 Define the First Hypothesis

The regression analysis yielded data that led to the rejection of the null hypothesis, indicating that the adoption of mobile banking technologies does indeed have an influence on various financial indicators across all banks. This conclusion is supported by the strong association seen between the use of mobile banking technologies by banks and their overall performance.

The following table presents a summary of the outcomes obtained from the testing of the null hypothesis (H0) and the first alternative hypothesis (H1).

Table 13 presents the outcomes of the Null Hypothesis (H0) and the First Hypothesis (H1).

Hypothesis	Status	All banks			Small			Large		
Independent Variables: Mobile apps (Retail, Business, Investment)		R	B	I	R	B	I	R	B	I
H0: Adoption of mobile banking technologies has no impact on all financial indicators across all banks	Rejected	X	X	X	X	X	X	X	X	X
Ha1: Adoption of mobile banking technologies will have a bigger impact on **small banks than on large banks in terms of fee income**	Accepted	X	X	O	X	X	O	X	X	X
Ha2: Adoption of mobile banking technologies will have a bigger impact on **small banks than on large banks in terms of operating costs**	Accepted	X	X	X	O	O	X	X	X	X
Ha3: Adoption of mobile banking technologies will have a bigger impact on **small banks' consumer loans than on large banks'**	Accepted	X	X	O	X	X	O	X	X	X
Ha4: Adoption of mobile banking technologies will have a bigger impact on **small banks' ROA than on large banks'**	Accepted	X	X	X	X	X	O	O	X	X
Ha5: Adoption of mobile banking technologies will have a bigger impact on **small banks' ROE than on large banks'**	Accepted	X	X	X	X	X	O	O	X	X

Smaller Thai and Malaysian banks that deployed an investment banking application to trade foreign currency and securities including stocks, bonds, and mutual funds were most affected. The coefficient for fee-based revenue connected with the investment banking app (0.220***) increased significantly in Table 5, which shows the regression results on mobile banking technology and bank income statements. This impact was stronger in small banks. The data shows that the investment banking software, which allows e-trading of securities and foreign currency, generates fee-based income, giving banks financial benefits.

Mobile banking technology, namely the investment banking app in Table 7, improved money market deposits on the liabilities side of the balance sheet. This influence is shown by high coefficients (5.916***; p-value = 0.01). The investment banking app also hurt demand for time deposits at -5.509*** for small banks and -1.183** for major banks. This study confirms DeYoung (2007)'s findings that new technologies make it easier to transfer funds from low-interest demand deposit accounts and time deposit accounts to higher-yield money market funds. Investment banking applications have a favorable and statistically significant effect on bank performance, as measured by money market deposits to total deposits. This highlights the financial benefits of electronic trading fee income production.

Therefore, the regression models showed that mobile banking technologies have statistical relevance for fee-based income. This data strongly supports hypothesis 1a over hypothesis 0. Mobile banking use is projected to impact small bank fee income more than big banks.

Mobile technologies reduced operating costs, particularly selling, general, and administrative expenses, according to the regression study. This supports hypothesis 1b. Mobile banking is expected to impact small banks' operational costs more than major banks'. Small bank SG&A reduction was more significant. Mobile technology usage by banks was statistically associated with transaction-driven consumer loans, which are commonly made by smaller, one-time lenders. Certain ASEAN commercial banks provide mortgages, auto loans, and credit cards via mobile banking apps. However, mobile technology did not effect relationship-building commercial loans, which are larger and need in-person due diligence. The regression analysis in this study shows that the investment banking app, which allows trading stocks, bonds, mutual funds, and foreign currency, affects consumer loans. This app has high coefficients (5.834***), suggesting a strong association. This link seems statistically significant with a p-value of 0.01. The investment banking app has a greater impact on consumer lending for smaller Thai banks. Financial instrument and foreign currency (FX) trading sometimes involves margin financing and consumer credit. Hence, regression models demonstrated that fintech developments were statistically significant in consumer loans, supporting hypothesis1c, that mobile banking technology will affect small banks' consumer loans more than big banks. Small amounts of e-broking and trading and credit lines exist. This company relies on individual transactions rather than long-term connections, unlike lending and deposit-taking, which generate interest margins over time. Transaction lending theories show that mobile banking has had a higher influence on consumer loans than relationship-based corporate loans.

Mobile banking technologies affect small banks' Return on Assets (ROA) and Return on Equity (ROE), as seen in Table 5. This analysis disproves the null hypothesis and supports hypotheses 1d and 1e. Small banks' ROA and ROE were more affected than major banks'. Mobile banking apps' product and process improvements demonstrate the influence of advancement theories that emphasize ICT's role in reducing operational costs and developing new revenue streams.

4.5.2 Setting the Second Hypothesis

In order to assess the mediating impact of financial standards, multivariate panel regression models were used. The findings of the study indicated a significant correlation between the use of mobile banking technology by banks and the adherence to financial norms. The following table presents a summary of the outcomes obtained from the testing of the null hypothesis (H0) and the alternative hypothesis (H1).

Table 14: The Results of the Null Hypothesis0 and the Second Hypothesis1

Hypothesis 2	Status	All banks		Small		Large	
Independent Variables: Mobile apps (Retail and Business)		R	B	R	B	R	B
Ho: Banks' adoption of mobile banking technologies will not impact the adoption of financial standards	Rejected	X	X	X	X	X	X
H1: Banks' adoption of mobile banking technologies will impact the adoption of financial standards	Accepted	O	O	X	X	O	O

The regression models indicate a significant positive correlation between banks' implementation of mobile banking technologies and the number of years they have adopted financial standards, specifically ISO 20022. The coefficient for retail mobile banking application is 0.172***, while for business mobile banking application it is 0.202***.

The adjusted R2 value for these models is 61.2%. Hence, the regression models demonstrated that fintech innovations had a statistically significant impact on financial standards. This finding provides compelling evidence to reject the null hypothesis and embrace the alternative second hypothesis. The impact of mobile banking technologies is much greater for the retail mobile application of large banks, with a coefficient of 0.239***. Similarly, the corporate mobile application of these banks also has a significant influence, with a coefficient of 0.199***. This implies that the annual growth in the provision of mobile banking services by banks leads to a 0.106 rise in the adoption of ISO 20022 financial standards by those institutions. Financial standards undergo changes and advancements in parallel with technological advancements. For instance, the use of ISO 20022 APIs enables the facilitation of real-time payments via various means such as cellphone numbers, Facebook accounts, and NRIC numbers. The current trend in development involves the introduction of standards that are nimbler and more efficient in their implementation. Financial standards play a crucial role in promoting the widespread adoption of innovative services by allowing technology advances to be readily embraced by a critical mass of users.

4.5.3 Defining the Third Hypothesis

The findings of the regression analysis shown in Table 9 provide empirical support for the third hypothesis1a, hypothesis1b, and hypothesis1c, which examine the impact of financial standards on bank performance. The introduction of financial standards ISO 20022 enables enhanced interoperability and network externalities, leading to significant advancements in payment processing efficiency and the automation of financial operations. For example, the data that undergoes processing using ISO 20022 exhibits superior quality compared to data supplied in other forms. This facilitates the enhancement of straight-through processing, concurrently diminishing the occurrence of mistakes, so resulting in time and cost savings, as well as reduced administrative endeavors. Enhanced data quality will facilitate compliance processes, such as sanctions screening, anti-money laundering measures, counter-terrorist funding checks, and fraud detection assistance.

Table 15: The Results of the Null Hypothesis0 and the Third Hypothesis1

Hypothesis 3	Status	All banks	Small	Large
Independent Variable: Banks' Years of ISO 20022 Financial Standards Adoption				
H0: Adoption of financial standards has no impact on all financial indicators across all sample banks	**Rejected**	X	X	X
H3a: Adoption of financial standards will have a bigger impact on small banks' ROA than on large banks'	**Accepted**	X	O	X
H3b: Adoption of financial standards will have a bigger impact on small banks' ROE than on large banks'	**Accepted**	X	O	X

4.5.4 Setting the Fourth Hypothesis

The following table presents the results of the regression analysis conducted to examine the collective impact of financial standards and fintech developments on bank performance, resulting in the rejection of the null hypothesis. The adoption of mobile banking technologies and financial standards does not have a significant impact on financial indicators across all banks. However, it is accepted that the fourth hypothesis, which states that the adoption of both mobile banking technologies and financial standards will have a greater impact on the return on assets (ROA) of small banks compared to large banks, is valid. The findings also provided support for the fourth hypothesis (H1b). The effect of adopting mobile banking technology and financial regulations will be more significant on the return on equity (ROE) of small banks compared to large banks.

Hypotheses	Status	All banks		Small		Large	
Independent Variables: Mobile apps (Retail & Business adopted ISO 20022)		R	B	R	B	R	B
H0: Adoption of both mobile banking technologies and financial standards has no impact on all financial indicators across all sample banks	**Rejected**						
H4a: Adoption of both mobile banking technologies and financial standards will have a bigger impact on small banks' ROA than on large banks'	**Accepted**	X	X	O	X	X	O
H4b: Adoption of both mobile banking technologies and financial standards will have a bigger impact on small banks' ROE than on large banks'	**Accepted**	X	O	O	X	X	X

4.5.5 Macroeconomic Variables and Market Movements

Previous studies have shown that the performance of banks is significantly influenced by macroeconomic variables, including the gross domestic product (GDP) of a nation and the prevailing real interest rates. The Asia financial crisis in 1997 and the Global financial crisis in 2008 have provided evidence indicating that the combination of bank-specific features and macroeconomic circumstances had a significant role in explaining the occurrence of bank failures. The following table illustrates the impact of GDP per capita on bank return on assets (ROA) and return on equity (ROE).

Table 17: The Results of the Null Hypothesis0 and the Macroeconomic and Market Effects

Hypotheses	Status	All banks		Small		Large	
Independent Variables: Mobile apps (Retail & Business adopted ISO 20022)		R	B	R	B	R	B
Ho: Adoption of both mobile banking technologies and financial standards has no impact on all financial indicators across all sample banks	**Rejected**						
Ha1: Adoption of both mobile banking technologies and financial standards will have a bigger impact on small banks' **ROA** than on large banks'	**Accepted**	X	X	O	X	X	O
Ha2: Adoption of both mobile banking technologies and financial standards will have a bigger impact on small banks' **ROE** than on large banks'	**Accepted**	X	O	O	X	X	X
GDP Per Capita & **ROA**	**Nil**	X		X		X	
GDP Per Capita & **ROE**	**Positive**	O		O		O	
Mobile Phone Penetration Rate & **ROE**	**Positive**	X		O		X	
Mobile Phone Penetration Rate & **ROA**	**Positive**	O		O		X	

GDP per capita significantly affected bank return on equity (ROE) but not return on assets (ROA) in regression models. During rapid economic expansion, capital demand increases, resulting in more credit and liquidity in the market, which may explain a stronger correlation between GDP and ROE in the banking sector.

This phenomenon helps the ASEAN banking sector thrive by attracting money and investment into stock markets. Thus, stock markets rise, increasing banking sector profitability and return on equity. Due to its susceptibility to financial leverage, borrowing, and investments, which are more sensitive to external macroeconomic conditions, ROE is more affected than ROA. A nation's mobile banking penetration rates are positively correlate According to the above data, banks' success depends on their ability to exploit new technologies, particularly mobile banking innovations, to innovate, expand their mobile banking customer base, and boost use. Furthermore, financial technology (fintech) advancements are linked to the financial performance of banks in countries like the Philippines and Thailand, where a large portion of the population uses mobile banking. A research framework based on four economic theories on technical developments, transaction costs, standards impacts, and macroeconomic and market factors was used to analyze this empirical study's findings: First, mobile banking improved banks' fee-based revenue, consumer loans, and money market deposits. Second, these impacts were stronger for smaller Philippine and Thai banks. Finally, financial standards mediated bank profitability for ASEAN major and small banks. This research concludes that fintech and financial rules affect bank performance and promote ASEAN financial integration.

4.6 Research Suggestions and Recommendations

Based on the study results and the interpretations derived from the multivariate panel regression analysis, this part will provide suggestions for ASEAN commercial banks, ASEAN regulators/central banks, and standardizing agencies.

ASEAN Commercial Banks

First, all employees and executives in small and big financial institutions should consider developing an entrepreneurial attitude. This will allow them to maximize the mobile banking platform, stimulating innovation and improving customer banking experiences. Schumpeter defined innovation as new services and processes.

Mobile channels have helped penetrate new regions, targeting individuals without access to or low participation with conventional financial services. This strategy uses mobile phones to reach disadvantaged groups. It also requires creating a new business model that fits the changing business environment and finding new suppliers to support it. Entrepreneurship education and training for ASEAN bankers may encourage entrepreneurial thinking. This may allow technologically advanced customers to get new banking options. Such activities may also help the area become more sustainable.

Both small and large commercial banks in ASEAN must invest in and develop their mobile banking applications and technology to meet consumers' changing requirements. Technology investments must also be monitored for their implications on fee revenue, interest income, cost components, and balance sheet components. Only DBS in ASEAN has developed a systematic strategy to assess the financial impacts of digitalization. DBS uses measurements like return on equity (ROE) and cost-income ratio, which depend on consumer involvement with digital platforms. DBS's 2017 annual report shows its dedication to digital assessment. Measuring and monitoring mobile banking clientele and transactions, as well as quantifying mobile channel financial gains, would accelerate digitalization toward cash-free economies. This would promote more inclusive financial systems in ASEAN, particularly in the Philippines and Thailand.

All ASEAN commercial banks should adopt financial standards like ISO 20022 to promote standardization-related network effects.

The financial standards were examined, and it was found that the adjusted return on equity (ROE) was -0.065**. Additionally, the adjusted R-squared (▯2) was seen to be 77.2%, which is higher than the adjusted ▯2 of the prior model at 3.76%. These findings are shown in Tables 12e and 12f.

Table 12f: Effects of mobile phone penetration rates, business banking app and financial standards on ROA and ROE (Large Banks)

Regulators and Central Banks

ASEAN commercial banks' innovative solutions must be balanced with regulators' support and facilitation of financial technology (fintech) development. ASEAN central bank regulators may gather industry stakeholders and support innovative technologies and financial norms, creating an integrated financial ecosystem. Regulators might organize quarterly briefings with important industry participants to promote financial rules and their benefits. Commercial banks, government agencies, fintech startups, investors, suppliers, and the media are stakeholders. A shared vision promotes an interoperable financial ecosystem, helping banks and enterprises manage varied systems and applications. ISO 20022, the ASEAN Economic Community's recommended standard, may accomplish this goal.

ASEAN regulators may aggressively promote financial standard harmonization among its 10 member members. This harmonization would enable interoperable payment clearing and settlement systems, which are vital for secure and efficient financial operations. Regional economic development would result from these initiatives. ASEAN has worked to harmonize payment market procedures to enable smooth and interoperable payment operations. Widely agreed financial norms are essential for developing an integrated and forward-thinking financial environment in ASEAN. The authorities may also consider industry-related measures.

Stakeholders and participants will get information and suggested methods to integrate developing technology and financial standards.

It also rigorously tests these businesses' compliance with best practices. Small Philippine and Thai banks benefit from the organization's help. Mobile banking has improved these institutions' financial performance. Their financial standards adoption is slower than bigger Singapore and Malaysian banks. Small banks would benefit from regulator help in using technology and following financial rules. In a dynamic financial market, these institutions can stay competitive.

Standardization Bodies

Standardization bodies like SWIFT and ISO technical committees promote global interoperability and enable financial data exchange among user communities, applications, and systems using financial standards. Despite global standardization organizations' attempts to promote open and collaborative standards and market practices, neither ASEAN banks nor regulators are actively engaged in global talks and standardization. East Asian nations including Japan, China, and Hong Kong are increasingly involved in standard and market development. Please aware that Westerners dominate global standards working organizations. This is mostly because Western nations have far bigger financial transaction volumes than all 10 ASEAN member states combined. Bank and regulator representation from throughout ASEAN will help integrate market nuances in standards working groups. This includes using local language to streamline financial processes and attracting investment and money to ASEAN's fast-growing economies. Implementing more inclusive financial regulations and developing market norms would help ASEAN digitize and move from manual to straight-through processing. Financial standards may help ASEAN banks, particularly smaller ones, handle growing business volumes while reducing resource needs. Thus, its deployment may improve operational performance.

Standardization groups may actively lobby authorities to impose and require financial technology and financial standards throughout the industry to encourage consistent and correct implementation. Around 33% of 36 ASEAN local commercial banks were SWIFT-accredited in this survey. Financial standards implemented and used by banks via regulatory enforcement and certification may generate and extract value from financial technology and standards, improving bank performance.

Conclusion

This study conducted an empirical examination of the influence of fintech innovations on the financial performance of 36 local commercial banks in the ASEAN region, namely in Singapore, Malaysia, Thailand, the Philippines, and Brunei Darussalam. The study also investigated the mediating impacts of financial standards on this relationship. The data for this analysis spanned from 2010 to 2017.

The findings from the multivariate panel regression analysis indicate a favorable relationship between the implementation of mobile banking technologies and the fee-based revenue of small banks. This includes money generated from securities investment fees, account service charges, and foreign exchange costs. The impact of mobile technologies on financial performance shown a much greater magnitude for small banks in the Philippines, Thailand, and Brunei Darussalam compared to their larger counterparts in Singapore and Malaysia. There was also substantial empirical evidence to substantiate the impact of mobile banking technologies on the lowering of operating costs for small banks, namely in the area of selling, general, and administrative expenses (SG&A). Conversely, the influence of mobile banking technologies on operating costs for big banks was shown to be negligible. The impact on the income statement of small banks was found to be more pronounced by the investment banking app, which enabled the trading of stocks, bonds, mutual funds, and foreign exchange, compared to the other two kinds of mobile banking applications.

The primary observation on the asset side of the balance sheets is to the impact of mobile technology in investment banking applications on consumer loans held by small banks. Notably, these loans saw a favorable effect, but larger institutions did not exhibit any discernible changes. The aforementioned coefficient is the greatest value seen in the asset section of the balance sheets.

It indicates that for every year increment in the bank's use of mobile banking technology, there would be a corresponding 5.834% increase in the bank's consumer loans.

Consumer loans are often characterized as one-time, transaction-based financial arrangements, such as auto loans, mortgages, and credit cards. In the Philippines, Thailand, and Brunei Darussalam, smaller banks have developed mobile banking applications that enable users to submit loan applications via digital channels. On the other hand, it should be noted that mobile banking technologies did not have an impact on commercial loans, which are characterized by a lengthier duration of the borrower-bank relationship and need in-person due diligence for the approval of business loans.

Regarding the liabilities component of the balance sheet, it is worth noting that the use of mobile technology in investment banking applications had a notable and statistically significant impact on the money market funds of small banks, resulting in a positive effect. In alignment with prior research conducted by DeYoung (2007), the introduction of novel mobile technologies has facilitated the ability of consumers in the ASEAN region to conveniently and adaptively transfer funds from accounts with little or no interest accrual, as such as fixed deposit accounts, to accounts with greater yields, such as money market funds. The present study identifies the maximum coefficient observed, indicating that an annual augmentation in the bank's use of the investing mobile application would result in a corresponding 5.916% rise in the bank's money market funds. Simultaneously, the use of mobile technology in investment banking applications has been seen to have an adverse impact on the equilibrium between demand deposits and fixed deposits. This outcome aligns with the findings presented in the study conducted by DeYoung (2007). The implementation of mobile technology in investment banking applications favorably impacted the profitability of both return on assets (ROA) and return on equity (ROE). This impact was particularly pronounced in small banks.

The multivariate panel regression analysis revealed a significant mediating effect of mobile banking technology on the connection between the mediator study variable of financial standards.

The impact of financial standards in this study was assessed via the evaluation of banks' duration of ISO 20022 standards implementation. The study revealed a statistically significant positive correlation between the use of mobile technology in retail banking applications and the return on equity (ROE) and return on assets (ROA) of small banks. The impact of mobile technology on commercial banking applications has had a favorable effect on the return on assets (ROA) of big banks. However, it should be noted that the coefficients associated with this impact were rather tiny.

The models were augmented with supplementary independent variables, namely a country's mobile penetration rates and GDP per capita, in order to examine potential variations in the adjusted 2 within two distinct multivariate panel regression models. The analysis revealed a statistically significant impact on return on equity (ROE) for both small and big banks in relation to gross domestic product (GDP) per capita. However, no significant influence was seen on return on assets (ROA). One plausible hypothesis for the observed correlation between Gross Domestic Product (GDP) and Return on Equity (ROE) is that an annual gain in GDP may lead to a corresponding increase in ROE, and conversely, a decrease in GDP may result in a decrease in ROE. It may be argued that in the event of an economy experiencing an accelerated rate of growth, there is a corresponding need for an increased quantity of capital, loans, and liquidity within the market. The rise of Gross Domestic Product (GDP) would also have a positive impact on the banking industry and its expansion in the ASEAN countries. This would be evident via increased capital inflows and the stimulation of stock markets, resulting in higher levels of profitability for the banking sector and a stronger return on equity. A substantial positive correlation substantiates the aforementioned explanation. The impact on ROE is more pronounced compared to ROA due to its sensitivity to financial leverage and debt, which are often impacted by macroeconomic factors, resulting in increased liquidity. Furthermore, the mobile phone penetration rates in a country's market have a favorable impact on the return on assets (ROA) and return on equity (ROE) of banks.

This effect is particularly pronounced in small banks operating in the Philippines and Thailand, where there is a notable increase in the number of individuals without access to banking services or with limited access, but who own mobile phones.

According to the findings of this study, the multivariate panel regressions revealed a favorable impact of fintech on the chosen commercial banks in the ASEAN region, namely on smaller banks in the Philippines and Thailand. It is comprehensible that these nations possess a significant amount of cash in circulation, and a substantial section of their people residing outside urban centers have limited access to banking services. However, there has been a notable and fast increase in mobile phone adoption rates. Hence, the financial institutions functioning within these particular contexts possess the opportunity to broaden their client base by targeting previously underserved areas. There is a positive correlation between populations and improved financial success. Regarding future research, it is important to note that this study's focus is restricted to the banking industry within the ASEAN countries, specifically spanning an eight-year timeframe from 2010 to 2017. Conducting an analysis of the fintech impacts outside the ASEAN region, particularly in Europe, is advantageous. In Europe, for instance, the adoption of financial standards ISO 20022 by the Single Euro Payment Area (SEPA) occurred around a decade prior to the Asia Pacific region. The process of adopting and using technologies and standards, as well as the resulting impacts, need a significant amount of time. In order to enhance the generalizability and portability of study findings, future studies should include the time lag effect and encompass many nations and areas that possess comparable banking institutions.

Additionally, this study examined the diverse financial performance of domestic commercial banks throughout the ASEAN region. This study used financial indicators of banks at the headquarters level, however it is worth noting that some banks have branches and subsidiaries within the area. For instance, Malaysian financial institutions such as CIMB, RHB, Maybank, and Hong Leong have previously engaged in the real-time retail payment system in Singapore. However, in their domestic market of Malaysia, these banks are now in the process of adopting comparable technological advancements.

Hence, it would be advantageous to have a full understanding of the financial statements of banks, including both the headquarters (HQ) and the regional branch or subsidiary levels, in order to assess the impact of fintech advancements.

Furthermore, the influence of financial technology extends beyond the confines of the banking industry and has become prevalent in several businesses. Payment technologies have been more linked into several industries, including e-commerce, telecommunications, media, transport, logistics, trade, and the government sector.

For instance, consider the recent instances of the cooperation between UOB and Grab, which aims to collectively engage with the unbanked population, and the collaboration between DBS and GOJEK, which provides rides to DBS/POSB cardholders. The examination of the research's relevance extends beyond the financial and technology sector, as well as other sectors that are similarly impacted by emerging technologies, standards, and laws. These sectors include healthcare, logistics, food, and education. Examining data samples from various industries will provide a comprehensive perspective on the impact of financial technology (fintech) on the performance of firms.

In addition, it would be beneficial to conduct a more detailed analysis of the cost structure within the banking sector. This could involve examining specific expenditures on information technology, branch operations, research and development, as well as the number of full-time employees. By conducting such robustness checks, it would be possible to determine if the impact of fintech on banks varies when considering the returns on investments in technology and human capital. An intriguing avenue of exploration would include examining bank cash flow statements to assess the influence of financial technology (fintech) on cash inflows and outflows within income streams. The inability to get the necessary data prevented a more in-depth examination of the financial impacts inside this study.

Furthermore, the present study primarily examined the supply-side dynamics of technological advancements inside the banking sector. The ensuing study need to include an examination of both the supply and demand aspects of technologies. This entails analyzing not only the production and availability of technologies, but also the extent to which consumers are embracing and using these new technologies. Additionally, it is crucial to assess the level of engagement shown by customers and the specific purposes for which they are employing the technology. Examining the digital engagement index may provide valuable insights into the analysis of various user categories, enabling the examination of technology consumption habits as well as the quantification of the number and value of financial transactions.

In conclusion, it would be beneficial to conduct an examination of the adverse aspects associated with financial innovations, specifically focusing on the global financial crisis that was instigated by the "innovative process" of securitizing subprime mortgages into collateralized securities and subsequently selling them in a secondary market. This particular practice gave rise to a moral hazard, ultimately culminating in the mortgage crisis.

The further financial advancements in mobile banking, such as the convenient processing of consumer loan applications and the ability to activate several credit cards, have the potential to result in individuals excessively using credit and subsequently amassing debt, hence increasing the likelihood of default. Therefore, future study may use primary data collection methods, including as surveys and interviews with customers, in order to get insights into the experiences of debtors on the negative aspects of fintech innovation and acceptance.

This study examined the adoption of fintech and financial norms by specific local commercial banks in five ASEAN regions, namely Singapore, Malaysia, The countries under consideration include Thailand, the Philippines, and Brunei Darussalam.

The comprehensive achievement of the ASEAN 2025 Vision and its regional financial integration, which include the member nations' involvement in enhancing and modernizing their payment market infrastructures and integrating them via financial standards, is contingent upon robust regional collaboration and consensus. The extent of regional financial integration is contingent upon the broader acceptance and implementation of fintech advancements, as well as the adoption of these technical advances and financial norms by the other ASEAN nations. This study demonstrates that the current endeavors are in their nascent phases; yet, ASEAN has initiated the process of financial integration by adopting financial standards.

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Appendix

1. The Impact of Digital Financial Services on Firm's Performance: Methodology

Table 4: Articles of literature review

No	Author,Year	methodology/approach used	sample size	countries of study
1	(Dandapani et al., 2008)	regression analysis for bank specific financial variables	6348	USA
2	(DeYoung et al., 2007)	percentage change in income and balance sheet selected items	5208	USA
3	(Del Gaudio et al., 2016)	classification analysis method (classification and regression tree)	3692	Europe
4	(Lin et al., 2011)	propensity-score matching and difference-in-difference methods	2107	USA
5	(Adams et al., 2005)	structural equation modeling and multiple regression analysis	640	USA
6	(Callaway, 2011)	regression analysis	369	Turkey
7	(Hung et al., 2012)	regression and sensitivity analysis	191	Taiwan
8	(Nonpadung et al., 2009)	data envelopment analysis	165	Thailand
9	(Koshi, 2012)	regression analysis	129	Japan
10	(Ciciretti et al., 2009)	Financial ratio and regression and robust analysis	105	Italy
11	(Malhotra and Singh, 2009)	regression analysis	88	India
12	(Malhotra and Singh, 2009)	financial ratio analysis and multivariate analysis	85	India
13	(Malhotra and Singh, 2010)	Financial ratio analysis and multivariate analysis	82	India
14	(Akhisar et al., 2015)	regression analysis	62	23 countries
15	(Hernando and J. Nieto, 2007)	Financial ratio and multivariate analysis	72	Spain
16	(Delgado et al., 2007)	Financial ratio Analysis and The regression analysis of scale and experience	60	Europe
17	(Uremadu and Nwosu, 2010)	cointegration and causality approach	60	Nigeria
18	(Uddin et al., 2013)	financial ratio analysis	40	Bangladesh
19	(Ho and Wu, 2009)	data envelopment and principal component analysis	32	Taiwan
20	(Kennedy and Jacky, 2015)	qualitative analysis	30	Kenya
21	(Mohamed et al., 2015)	translog residual regression estimation and cobb-douglas production function	30	Pakistan
22	(Tunay et al., 2015)	dumitrescu-hurlin panel causality tests	30	Turkey
23	(M. Kamboh and E.J. Leghari, 2016)	regression analysis	30	Pakistan
24	(Stoica et al., 2015)	data envelopment and principal component analysis	24	Romania
25	(Sun et al., 2015)	regression analysis	20	Vietnam
26	(Ceylan and Emre, 2011)	regression analysis	18	Turkey
27	(Mohammad and Saad, 2011)	regression analysis	15	Jordan
28	(Ceylan et al., 2008)	regression analysis for bank specific financial variables	13	Turkey
29	(Siddik et al., 2016)	regression analysis	13	Bangladesh
30	(Mohammed et al., 2015)	regression analysis	13	Nigeria
31	(Georgia and Christos, 2013)	regression analysis	13	Greece
32	(Lartsin, 2013)	regression analysis	13	Romania
33	(Georgia and Christos, 2013)	data envelopment and regression analysis	12	Greece
34	(Wu and Dash Wu, 2010)	data envelopment and principal component analysis	10	USA & UK
35	(Majid and Mohammad, 2013)	regression analysis	8	India
36	(Al-Hawari and Ward, 2006)	effect of service quality on bank profitability: structural equation modeling	4	Australia
37	(Abaenewe et al., 2013)	financial ratio analysis	4	Nigeria
38	(Siva and Lazarr, 2006)	activity-based costing (ABC)	1	Georgia
39	(H. Kashanizadeh et al., 2013)	regression analysis	1	Iran

Table 6: List of techniques used

No	methodology /technique used	# of articles
1	Financial ratio, percentage change (income and balance sheet) and Regression Analysis	27
2	Data envelopment and principal component analysis	5
3	Structural equation modeling	2
4	Co-integration and causality approach	2
5	Activity-based-costing (ABC)	1
6	Propensity-score matching and differences-in-differences methods	1
7	Cobb-Douglas production function	1
8	Classification analysis method	1

Source: Abbasi, T., & Weigand, H. (2017)

2. The Impact of Digital Financial Services on Firm's Performance: Research Variables

Table 7: Dependent, Independent and control variables

No	Dependent Variable	Frequency	Independent variable	Frequency	Control Variable	Frequency
1	return on equity (ROE)	25	number of ATMs	12	bank size	15
2	return on assets (ROA)	23	internet adoption	11	loans	11
3	revenue or net income	8	online or internet banking	10	deposits	11
4	non interest income	6	number of branches	7	equity	6
5	interest income	5	point of sale (POS)	5	Gross domestic product (GDP)	6
6	domestic deposits	4	number of employees	5	inflation	6
7	growth in assets	4	credit cards	4	operating cost	4
8	operating expenses	3	debit cards	4	return on assets (ROA)	3
9	non interest expense to earning assets	3	website	4	job growth	2
10	staff costs	3	electronic banking	4	market share	2
11	daily (cash) rate/average interest rates	3	mobile banking	3	non interest income	2
12	net lending to total assets	3	IT equipment	2	return on equity (ROE)	1
13	efficiency ratio	3	Bank location	2		
14	IT costs	2	telephone /Call Center Banking	2		
15	marketing expenses	2	IT expense	1		
16	interest spread	2	Customer Service Quality	1		
17	total commission and fees to assets	2				
18	earning per share (EPS)	2				
19	global deposits	1				
20	non performing loans to asset ratio	1				
21	non performing assets to net advances	1				
22	equity to liabilities	1				
23	net interest financial margin to earning assets	1				
24	price to earning ratio	1				
25	profit per branch	1				
26	equity to total assets	1				
27	asset utilization	1				
28	willingness to improve level of business	1				

Source: Abbasi, T., & Weigand, H. (2017)

3. List of Sample ASEAN Banks by Asset Size

List of Large Mobile Banks in 2017 (2017-2010 Median Assets > U$ 28.9B)

	Bank Name	Country	Mean	Std. dev.	Median
1	DBS	SG	309759.766	61380.173	321752.88
2	OCBC	SG	261722.013	57752.239	272656.35
3	UOB	SG	216028.714	38143.005	221139.185
4	Maybank	MY	147138.931	38120.783	150557.59
5	Bangkok Bank	TH	80191.874	12389.603	83024.155
6	Public Bank	MY	79699.445	15762.746	81691.495
7	Siam Commercial Bank	TH	75720.04	16814.188	81125.59
8	Krung Thai Bank	TH	76101.835	12929.669	80546.305
9	CIMB	MY	79744.836	19158.208	80391.105
10	Kasikornbank	TH	71011.905	15181.141	72527.315
11	RHB	MY	47232.798	10903.316	47500.88
12	Hong Leong Bank	MY	40496.555	8846.366	41875.635
13	Bank of Ayudhya	TH	42462.408	14211.915	37059.99
14	BDO Uni	PH	32659.061	11280.223	33242.415
15	Ambank	MY	30731.98	3681.012	32643.09
16	Thanachart	TH	30500.551	1973.781	31358.14

List of Small Mobile Banks in 2017 (2017-2010 Median Assets < U$28.9B)

	Bank Name	Country	Mean	Std. dev.	Median
1	Metropolitan	PH	27250.939	8472.335	28041.225
2	Bank of the Philippine Islands	PH	24,671.40	7,487.67	24,868.27
3	TMB	TH	23559.254	2616.003	24227.245
4	Affin	MY	15344.52	2106.249	15879.365
5	Philippine National Bank	PH	10454.764	4020.593	11672.18
6	TISCO	TH	8558.541	1766.309	8847.25
7	CIMB Thai	TH	7623.736	2033.186	8584.37
8	China Bank	PH	8555.136	3332.675	8318.235
9	RCBC	PH	8210.462	1689.397	8269.875
10	Union Bank	PH	7605.977	2466.482	7874.75
11	Kiatnakin	TH	6914.649	1194.151	7283.77
12	Security Bank Corp	PH	7918.887	4139.828	7000.56
13	LH Financial	TH	4746.564	1909.672	4868.07
14	Baiduri	BN	2469.246	356.12	2468.745
15	Asia United Bank	PH	2144.064	1067.806	2160.485

List of Non-Mobile Banks in 2017

	Bank Name	Country	Mean	Std. dev.	Median
1	Alliance	MY	11345.096	2241.382	11499.16
2	EastWest	PH	3464.054	1671.506	3107.28
3	Philippine Trust Company	PH	2363.079	396.166	2324.06
4	Philippine Bank of Communications	PH	1227.307	415.88	1264.62
5	Philippine Business Bank	PH	961.694	434.878	987.11

4. Country Snapshot

4.1 Malaysia

The majority of Malaysia's banks are commercial, with 8 publicly listed local banks and 18 locally incorporated international banks. There are 16 Islamic banks (11 domestic and 5 foreign), 2 international Islamic banks, 11 domestic investment banks, and 2 other financial institutions (Bank Negara Malaysia, 2019). Malaysian commercial banks are regulated by Bank Negara Malaysia under the Banking and Financial Institutions Act 1989 (BAFIA). The average return on equity was 13% and the average return on assets was 1.5% for commercial banks in 2017. The Association of Banks in Malaysia (2017) reported that banks with conservative profits retention strategies have capital ratios far above the minimal regulatory standards and the Basel III Capital Adequacy benchmark. Refer to Appendix for Malaysian commercial bank profiles.

4.2 Philippines

There are 36 universal and commercial banks, 55 thrift banks, and 483 rural and cooperative banks in the Philippines. Philippine commercial banks are shareholder-owned and take deposits and provide credits for interest. Personal, business, mortgage, checking, savings, foreign exchange, commodities trading, and securities investments are also available. Universal banks may invest in financial and nonfinancial allied and nonallied company stocks. Thirteen of 36 universal and commercial banks are publicly traded. Section 4 of Republic Act No.

The Philippines' central bank, the Bangko Sentral ng Pilipinas, oversees these banks' operations. Remittances from an increasing number of Overseas Filipino Workers generated 10% of GDP in 2017 and helped the Philippines' economic development. Over time, more Filipinos have worked overseas, increasing these remittances. Remittances were mostly from the US, UAE, Saudi Arabia, Japan, and Singapore. The BSP promptly books these remittances for the country's balance of payments.

Remittance beneficiaries are typically unbanked or underbanked since retail banking is not well established for distant areas. The upshot is that most Filipinos are unbanked and must use unregulated channels like moneylenders, pawnshops, and community or family financial aid. In contrast to the unbanked, the Philippines boasts strong mobile use. This opens up huge opportunity for banks and financial service providers to target the unbanked.

4.3 Thailand

There are 31 commercial banks in Thailand, comprising 14 domestic banks, 1 retail bank, 4 international subsidiaries, and 11 foreign bank branches (Bank of Thailand, 2019). Thai commercial banks are regulated by the central bank and licensed under the Financial Institutions Business Act B. E. (2008) 2551. They may take deposits and lend to households and companies. According to EY's ASEAN Fintech Census report 30 ,2018% of Thailand's 128 fintech businesses invest in payment, and the payments environment has altered dramatically in recent years. Social media, namely LINE, gives Rabbit LINE Pay to 4.5 million Thai users. Besides IT businesses, Thailand's

government has promoted digital payments via PromptPay, which has been essential. PromptPay links ID numbers and/or mobile phones to bank accounts to simplify money transfers. The national digital payment program aims to make Thailand cashless. The government's Thailand 4.0 plan aims to establish a value-based economy focused on innovation, technology, and creativity.

4.4 Singapore

Singapore is an international financial center. Banking is crucial to the financial sector. Singapore is the third biggest IFC in Asia after Japan and Hong Kong because to its strong economy, stable government, favorable legal and tax policies, reputation for trustworthiness, and tight anti-crime and money laundering laws. Three local commercial banks—DBS, OCBC, and UOB—and 117 international banks dominate Singapore's banking market. Most Singapore banks serve people, enterprises, and government entities. Commercial, retail, and private banking are offered by these institutions.

Chapter 19 of the Banking Act licenses commercial banks. Notices to Banks and updated rules from MAS control their actions. After the financial crisis in May 1999, MAS began a five-year banking liberalization strategy. Full and Qualifying Full Bank (QFB) licenses were issued to foreign banks, restricted banks were increased, and offshore banks were allowed SGD wholesale trading. The 40% foreign ownership restriction in domestic banks was relaxed. The limited banks became wholesale banks in 2001 during the second liberalization phase. QFBs might open additional sites and provide debt and special account services, and offshore banks could become wholesale banks.

4.5 Brunei Darussalam

Seven regulated banks in Brunei Darussalam provide conventional and Islamic banking. In 2015, Baiduri Bank acquired UOB Brunei's retail banking operations and became the country's largest commercial bank. Financial institution Bank of China joined the market after HSBC left in 2016. The Monetary Authority of Brunei Darussalam (AMBD) is the country's central bank and the banking sector's. Country banks have substantial liquidity, solid capital adequacy ratios, and well-managed non-performing loans. AMBD supervises all banks and maintains a credit bureau that centralizes creditworthiness information. The Brunei dollar is tied to the Singapore dollar.

Descriptive Statistics of Research Variables

Variable	N	Mean	Std. dev.	Min.	Median	Max.
Independent Variable						
MOB_AGER	288	1.955	2.444	0	1	10
MOB_AGEB	288	0.347	1.147	0	0	7
MOB_AGEI	288	0.701	1.537	0	0	7
Mediator Variable						
ISO_AGE	288	0.333	0.847	0	0	4
M_MOBAGER_ ISO	288	2.045	6.112	0	0	40
M_MOBAGEB_ ISO	288	0.538	2.801	0	0	28
M_MOBAGEI_ ISO	288	0.684	2.62	0	0	24
Dependent Variables from Income Statements						
IINC_ASS	288	4.118	1.116	1.85	3.985	8.02
IEXP_ASS	288	1.52	0.608	0.39	1.5	4.13
FINC_ASS	288	1.457	0.698	-0.05	1.3	4.05
SALA_ASS	288	0.941	0.32	0.41	0.91	2
SGA_ASS	288	0.234	0.22	0	0.19	0.94
Dependent Variables from Balance Sheets (Asset side)						
CASH_ASS	288	14.865	61.306	0.2	5.07	890.63

1. Capital IQ Definition of the Financial Indicators

Interest Income / Total Assets	IINC_ASS	Interest Income, Total is a summary line item in the banks template with the following components: Interest Income On Loans [212] and Interest Income On Investments [76]
Interest Expense / Total Assets	IEXP_ASS	Interest Expense, Total is a summary line item in the banks template with the following components: Interest On Deposits [205] and Total Interest On Borrowings [11]
Non-Interest Income / Total Assets	FINC_ASS	Non Interest Income, Total (Bank Template) is a summary line item in the banks template with the following components: Credit Card Fee [126], Income (Loss) on Real Estate Property - (Income Block) [68], Income (Loss) on Equity Invest. (Income Block) - (Bank Template) [152], Gain (Loss) on Sale of Loans - (Revenue Block) - (Bank Template) [196], Gain (Loss) on Sale of Assets - (Revenue Block) [55], Gain (Loss) on Sale of Invest. & Securities - (Rev) [61], Non Operating Income (Expenses) - (Income Block) - (Bank Template) [255], Service Charges On Deposits [298], Trust Income [338], Total Mortgage Banking Activities [79], Income From Trading Activities [337], Total Other Non Interest Income [93]

	Salaries & Other Employee Benefits / Total Assets	SALA_ASS	Salaries And Other Employee Benefits is a line item in the Banks, Capital Markets, Financial Services and Insurance templates as well as a component of Selling General & Admin Expenses, Total **[102]** that represents all salary and other employee benefits provided by a Company to its employees.
	Selling General & Admin Expense / Total Assets	SGA_ASS	Selling General & Admin Expenses, Total - (Template Specific) is a line item in the Banks, Insurance, Real Estate and Utility templates with the following components: Pre-Opening Costs [96], Equipment Expense [147], Selling General & Admin Expenses - (REIT / Utility Template) [299], Stock-Based Compensation SG&A Exp. [23515], Selling and Marketing Expenses [21561], General and Administrative Expenses [21562], Maintenance & Repair Expenses [24251], Net Rental Expense [24261], Contingent Rentals [24265], Minimum Rental Expenses [24269], Sublease Income - Part of Rental Expenses [24273], Other Rental Expense [24467],

Cash and its equivalents / Total Assets	CASH_ASS	Cash and Cash Equivalents is a line item across all templates that represents funds in the form of cash, readily convertible deposits, securities and other instruments having maturities of less than 3 months at the time of purchase. It includes short term, highly liquid investments that are readily convertible into known amounts of cash and are near their maturity as well as cash on hand consisting of coins, currency, undeposited checks, money orders and drafts, and deposits in banks.
Investment Securities / Total Assets	SEC_ASS	Investment Securities, Total is a line item in the Banks template with the following components: Deposits at Interest in Securities [1116], Investment in Government Securities [1170], Investment in
		Securities [1182], Investment in Municipal Securities [1198], Securities Purchased Under Agreements To Resell [1240], Equity Method Investments [24239]

Gross Loans / Total Assets	LOAN_ASS	Gross Loans is a line item in the Banks template that represents the gross amounts of loans advanced to borrowers. This item includes: Loans given to banks, Loans given to customers, Financial leases, Total portfolio loans
Commercial Loans / Total Loan	COMM_ LOAN	Commercial Loans represents Loans disbursed to a Corporation, Commercial Enterprise, or Joint Venture, usually short-term, as a source of Working Capital not backed by a Mortgage Security.
Consumer Loans / Total Loan	CONSM_ LOAN	Consumer Loans represents loans given to individuals for the purchase of domestic and household durable goods on hypothecation. It includes all forms of installment credit other than Home Mortgage Loans and Open-End Credits.
Total Deposits / Total Assets	DEPO_ASS	Total Deposits (Supple) is a supplemental line item in the Banks Template with the following components: Demand Deposits [3057], Money Market Account/Investments [3115], NOW Accounts [3121], Saving Deposits [3176], Time Deposits [3198], Other Deposits [3126]
Demand Deposit / Total Deposit	DD_DEP	Demand Deposits is a supplemental line item in the Bank template incl. Non-interest bearing checking accounts, Interest bearing checking accounts

Money Market Account / Total Deposit	MM_DEP	Money Market Account / Investments represents Short-term Interest Bearing Deposits dealt within Money Markets where money and other short-term liquid assets can be lent and borrowed to satisfy short-term financial requirements. Super Saver Money Market Accounts and Money Market Investments
Time Deposit / Total Deposit	TD_DEP	Time Deposits represents Interest Bearing Term Deposits accepted by banks for relatively longer periods of time which require prior notice for withdrawal of funds from the deposit.
Core Tier 1 Capital Ratio	CT1_CAP	Core Tier 1 Capital represents core tier 1 capital as reported by the company or can be derived by deducting 'Innovative/Hybrid Tier 1 Capital' from 'Total Tier 1 Capital'.

2 . Mobile Banking App Capabilities of Sample ASEAN Banks

2.1 Large banks in MY and SG – Account related services

Bank Name	Cty	Size	Mobile App Name	App Release Year	App Types	A/C Enquiry	FX Rate Enquiry	Open A/C	Open FD
Public Bank	MY	L	PB engage	2014	Retail	YES			
Public Bank	MY	L	PB Sharelink	2012	Investment	YES	YES		
Ambank	MY	L	AmOnline	2017	Retail	YES			
RHB	MY	L	RHBNow	2011	Retail	YES			
RHB	MY	L	RHB MyHome	2017	Retail	YES			
Maybank	MY	L	Maybank MY	2017	Retail	YES		YES	YES
Maybank	MY	L	M2U	2009	Retail/Info only				
Maybank	MY	L	Maybank2E	2012	Business	YES	YES		
Maybank	MY	L	Maybank Trade	2017	Investment	YES	YES		
Hong Leong Bank	MY	L	HL Mobile	2011	Retail	YES	YES		YES
Hong Leong Bank	MY	L	HL Connect	2014	Retail	YES	YES		YES
CIMB	MY	L	CIMB Clicks	2009	Retail	YES	YES	YES	YES

CIMB	MY	L	CIMB i*Trade	2012	Investment	YES	YES		
CIMB	MY	L	CIMB EVA!	2016	Retail	YES			
UOB	SG	L	Mighty	2015	Retail	YES	YES		
UOB	SG	L	UOB Business	2016	Business	YES	YES		
OCBC	SG	L	OCBC SG Mobile	2008	Retail	YES			
OCBC	SG	L	OCBC Business	2016	Business	YES			
OCBC	SG	L	OCBC Pay Anyone	2017	Retail	YES			
OCBC	SG	L	OCBC OneWealth	2016	Investment	YES	YES		
DBS	SG	L	PayLah!	2014	Retail	YES			
DBS	SG	L	DBS Lifestyle	2010	Retail/Info only				
DBS	SG	L	digibank SG	2016	Retail	YES		YES	
DBS	SG	L	DBS iWealth	2017	Investment	YES	YES		YES
DBS	SG	L	IDEAL Mobile	2011	Business	YES	YES		YES

2.2 Large Banks in MY and SG

Investment related services

Bank Name	Cty	Size	Mobile App Name	App Release Year	App Types	Mutual Funds	Stocks / Bonds	FX	Insurance
Public Bank	MY	L	PB engage	2014	Retail				YES
Public Bank	MY	L	PB Sharelink	2012	Investment	YES	YES	YES	
Ambank	MY	L	AmOnline	2017	Retail				
RHB	MY	L	RHBNow	2011	Retail				
RHB	MY	L	RHB MyHome	2017	Retail				
Maybank	MY	L	Maybank MY	2017	Retail				
Maybank	MY	L	M2U	2009	Retail/Info only				
Maybank	MY	L	Maybank2E	2012	Business				
Maybank	MY	L	Maybank Trade	2017	Investment	YES	YES	YES	

Hong Leong Bank	MY	L	HL Mobile	2011	Retail				
Hong Leong Bank	MY	L	HL Connect	2014	Retail				
CIMB	MY	L	CIMB Clicks	2009	Retail			YES	
CIMB	MY	L	CIMB i*Trade	2012	Investment	YES	YES	YES	
CIMB	MY	L	CIMB EVA!	2016	Retail				
UOB	SG	L	Mighty	2015	Retail			YES	
UOB	SG	L	UOB Business	2016	Business				
OCBC	SG	L	OCBC SG Mobile	2008	Retail				
OCBC	SG	L	OCBC Business	2016	Business				
OCBC	SG	L	Pay Anyone	2017	Retail				
OCBC	SG	L	OCBC OneWealth	2016	Investment	YES	YES	YES	
DBS	SG	L	PayLah!	2014	Retail				YES

DBS	SG	L	DBS Lifestyle	2010	Retail/Info only				
DBS	SG	L	digibank SG	2016	Retail				
DBS	SG	L	DBS iWealth	2017	Investment	YES	YES	YES	
DBS	SG	L	IDEAL Mobil	2011	Business				

2.3 Large banks in MY and SG Loan related services

Bank Name	Cty	Size	Mobile App Name	App Release Year	App Types	Car Loans	Mortgages	Credit Cards	Business Loans
Public Bank	MY	L	PB engage	2014	Retail				
Public Bank	MY	L	PB Sharelink	2012	Investment				
Ambank	MY	L	AmOnline	2017	Retail				
RHB	MY	L	RHBNow	2011	Retail				
RHB	MY	L	RHB MyHome	2017	Retail		YES		
Maybank	MY	L	Maybank MY	2017	Retail			YES	

Maybank	MY	L	M2U	2009	Retail/Info only				
Maybank	MY	L	Maybank2E	2012	Business				
Maybank	MY	L	Maybank Trade	2017	Investment				
Hong Leong Bank	MY	L	HL Mobile	2011	Retail				
Hong Leong Bank	MY	L	HL Connect	2014	Retail				
CIMB	MY	L	CIMB Clicks	2009	Retail				
CIMB	MY	L	CIMB i*Trade	2012	Investment				
CIMB	MY	L	CIMB EVA!	2016	Retail				
UOB	SG	L	Mighty	2015	Retail				
UOB	SG	L	UOB Business	2016	Business				
OCBC	SG	L	OCBC SG Mobile	2008	Retail				
OCBC	SG	L	OCBC Business	2016	Business				
OCBC	SG	L	Pay Anyone	2017	Retail				
OCBC	SG	L	OCBC OneWealth	2016	Investment				
DBS	SG	L	PayLah!	2014	Retail				

DBS	SG	L	DBS Lifestyle	2010	Retail/Info only				
DBS	SG	L	digibank SG	2016	Retail				
DBS	SG	L	DBS iWealth	2017	Investment				
DBS	SG	L	IDEAL Mobile	2011	Business				

.4 Large Banks in MY and SG

Payment related services

Bank Name	Cty	Size	Mobile App Name	App Release Year	App Types	Bills/TT Payment	Real-Time Payment	QR	Apple Watch/ ApplePay
Public Bank	MY	L	PB engage	2014	Retail	YES			
Public Bank	MY	L	PB Sharelink	2012	Investment				
Ambank	MY	L	AmOnline	2017	Retail	YES			
Affin	MY	S	AffinSecure	2017	Retail	YES			
RHB	MY	L	RHBNow	2011	Retail	YES		YES	
RHB	MY	L	RHB MyHome	2017	Retail				
Maybank	MY	L	Maybank MY	2017	Retail	YES		YES	

Maybank	MY	L	M2U	2009	Retail/Info only				
Maybank	MY	L	Maybank2E	2012	Business	YES			
Maybank	MY	L	Maybank Trade	2017	Investment				
Hong Leong Bank	MY	L	HL Mobile	2011	Retail	YES			YES
Hong Leong Bank	MY	L	HL Connect	2014	Retail	YES			
CIMB	MY	L	CIMB Clicks	2009	Retail	YES			
CIMB	MY	L	CIMB i*Trade	2012	Investment				
CIMB	MY	L	CIMB EVA!	2016	Retail				
UOB	SG	L	Mighty	2015	Retail	YES	YES	YES	YES
UOB	SG	L	UOB Business	2016	Business	YES			
OCBC	SG	L	OCBC SG Mobile	2008	Retail	YES	YES	YES	YES
OCBC	SG	L	OCBC Business	2016	Business	YES			
OCBC	SG	L	Pay Anyone	2017	Retail	YES	YES	YES	
OCBC	SG	L	OCBC OneWealth	2016	Investment				

DBS	SG	L	PayLah!	2014	Retail	YES	YES	YES	YES
DBS	SG	L	DBS Lifestyle	2010	Retail/Info only				
DBS	SG	L	digibank SG	2016	Retail	YES	YES	YES	
DBS	SG	L	DBS iWealth	2017	Investment	YES	YES	YES	
DBS	SG	L	IDEAL Mobile	2011	Business	YES	YES		

.5 Account related services

Bank Name	Cty	Size	Mobile App Name	App Release Year	App Types	A/C Enquiry	FX Rate Enquiry	Open A/C	Open FD
BDO Uni	PH	L	BDO Personal Banking	2013	Retail	YES			
BDO Uni	PH	L	BDO Deals	2012	Retail/Info only				
Bangkok Bank	TH	L	Bualuang mBanking	2013	Retail/Investment	YES			

Bank of Ayudhya	TH	L	KMA Krungsri	2012	Retail/Investment	YES			
Bank of Ayudhya	TH	L	Krungsri Biz Mobile	2015	Business	YES	YES		
Kasikornbank	TH	L	K PLUS	2010	Retail/Investment	YES	YES		
Kasikornbank	TH	L	K PLUS SME	2017	Business	YES			
Kasikornbank	TH	L	K+ Wallet	2016	Retail	YES			
Kasikornbank	TH	L	K-Corporate	2016	Business	YES			
Kasikornbank	TH	L	K-Cyber Trade	2013	Investment	YES			
Kasikornbank	TH	L	KLeasing	2014	Retail	YES			
Kasikornbank	TH	L	KS Super Stock	2015	Investment	YES			
Kasikornbank	TH	L	KS Stock Plus	2017	Investment	YES			
Krung Thai Bank	TH	L	Krungthai NEXT	2011	Retail/Investment	YES	YES	YES	
Thanachart	TH	L	Thanachart Connect	2014	Retail/Investment	YES			

Siam Commercial Bank	TH	L	SCB Easy	2011	Retail/Investment	YES			
Siam Commercial Bank	TH	L	SCB Business Net	2016	Business	YES	YES		
Siam Commercial Bank	TH	L	SCBS Stock Advisor	2014	Investment	YES			
Siam Commercial Bank	TH	L	SCB MyProvident	2017	Retail	YES			

.6 Investment related services

Bank Name	Cty	Size	Mobile App Name	App Release Year	App Types	Mutual Funds	Stocks / Bonds	FX	Insurance
BDO Uni	PH	L	BDO Personal Banking	2013	Retail				
BDO Uni	PH	L	BDO Deals	2012	Retail/Info only				
Bangkok Bank	TH	L	Bualuang mBanking	2013	Retail/Investment	YES	YES		
Bank of Ayudhya	TH	L	KMA Krungsri	2012	Retail/Investment	YES			
Bank of Ayudhya	TH	L	Krungsri Biz Mobile	2015	Business			YES	
Kasikornbank	TH	L	K PLUS	2010	Retail/Investment	YES		YES	YES
Kasikornbank	TH	L	K PLUS SME	2017	Business				
Kasikornbank	TH	L	K+ Wallet	2016	Retail				
Kasikornbank	TH	L	K-Corporate	2016	Business				
Kasikornbank	TH	L	K-Cyber Trade	2013	Investment	YES	YES		

Kasikornbank	TH	L	KLeasing	2014	Retail				YES
Kasikornbank	TH	L	KS Super Stock	2015	Investment		YES		
Kasikornbank	TH	L	KS Stock Plus	2017	Investment		YES		
Krung Thai Bank	TH	L	Krungthai NEXT	2011	Retail/Investment	YES		YES	
Thanachart	TH	L	Thanachart Connect	2014	Retail/Investment	YES			
Siam Commercial Bank	TH	L	SCB Easy	2011	Retail/Investment	YES	YES		YES
Siam Commercial Bank	TH	L	SCB Business Net	2016	Business				
Siam Commercial Bank	TH	L	SCBS Stock Advisor	2014	Investment		YES		
Siam Commercial Bank	TH	L	SCB MyProvident	2017	Retail				

.7 Loan related services

Bank Name	Cty	Size	Mobile App Name	App Release Year	App Types	Car Loans	Mortgages	Credit Cards	Business Loans
BDO Uni	PH	L	BDO Personal Banking	2013	Retail				
BDO Uni	PH	L	BDO Deals	2012	Retail/Info only				
Bangkok Bank	TH	L	Bualuang mBanking	2013	Retail/Investment			YES	
Bank of Ayudhya	TH	L	KMA Krungsri	2012	Retail/Investment	YES		YES	
Bank of Ayudhya	TH	L	Krungsri Biz Mobile	2015	Business				
Kasikornbank	TH	L	K PLUS	2010	Retail/Investment			YES	
Kasikornbank	TH	L	K PLUS SME	2017	Business				

Kasikornbank	TH	L	K+ Wallet	2016	Retail				
Kasikornbank	TH	L	K-Corporate	2016	Business				
Kasikornbank	TH	L	K-Cyber Trade	2013	Investment				
Kasikornbank	TH	L	KLeasing	2014	Retail	YES			
Kasikornbank	TH	L	KS Super Stock	2015	Investment				
Kasikornbank	TH	L	KS Stock Plus	2017	Investment				
Krung Thai Bank	TH	L	Krungthai NEXT	2011	Retail/Investment				
Thanachart	TH	L	Thanachart Connect	2014	Retail/Investment				
Siam Commercial Bank	TH	L	SCB Easy	2011	Retail/Investment			YES	YES
Siam Commercial Bank	TH	L	SCB Business Net	2016	Business				
Siam Commercial Bank	TH	L	SCBS Stock Advisor	2014	Investment				
Siam Commercial Bank	TH	L	SCB MyProvident	2017	Retail				

.8 Payment related services

Bank Name	Cty	Size	Mobile App Name	App Release Year	App Types	Bills/TT Payment	RealTime Payment	QR	Apple Watch/ ApplePay
BDO Uni	PH	L	BDO Personal Banking	2013	Retail	YES			YES
BDO Uni	PH	L	BDO Deals	2012	Retail/Info only				
Bangkok Bank	TH	L	Bualuang mBanking	2013	Retail/Investment	YES	YES	YES	
Bank of Ayudhya	TH	L	KMA Krungsri	2012	Retail/Investment	YES	YES	YES	
Bank of Ayudhya	TH	L	Krungsri Biz Mobile	2015	Business	YES	YES	YES	
Kasikornbank	TH	L	K PLUS	2010	Retail/Investment	YES	YES	YES	

Kasikornbank	TH	L	K PLUS	2010	Retail/Investment	YES	YES	YES	
Kasikornbank	TH	L	K PLUS SME	2017	Business	YES			
Kasikornbank	TH	L	K+ Wallet	2016	Retail	YES	YES	YES	
Kasikornbank	TH	L	K-Corporate	2016	Business	YES			
Kasikornbank	TH	L	K-Cyber Trade	2013	Investment				
Kasikornbank	TH	L	KLeasing	2014	Retail	YES			
Kasikornbank	TH	L	KS Super Stock	2015	Investment				
Kasikornbank	TH	L	KS Stock Plus	2017	Investment				
Krung Thai Bank	TH	L	Krungthai NEXT	2011	Retail/Investment	YES	YES	YES	
Thanachart	TH	L	Thanachart Connect	2014	Retail/Investment	YES	YES	YES	

Siam Commercial Bank	TH	L	SCB Easy	2011	Retail/Investment	YES	YES	YES	
Siam Commercial Bank	TH	L	SCB Business Net	2016	Business	YES			
Siam Commercial Bank	TH	L	SCBS Stock Advisor	2014	Investment				
Siam Commercial Bank	TH	L	SCB MyProvident	2017	Retail	YES			

.8 Small Banks in MY, PH and BN – Account related services

Bank Name	Cty	Size	Mobile App Name	App Release Year	App Types	A/C Enquiry	FX Rate Enquiry	Open A/C	Open FD
Affin	MY	S	AffinSecure	2017	Retail	YES			
Asia United Bank	PH	S	AUB	2012	Retail	YES			
Bank of the Philippine Islands	PH	S	BPI	2011	Retail	YES			

Bank of the Philippine Islands	PH	S	BPI ExpresssLink Mobile	2011	Business	YES			
Bank of the Philippine Islands	PH	S	BPI BizLink	2017	Business	YES			
China Bank	PH	S	China Bank Corp	2017	Retail	YES			
Metropolitan	PH	S	Metrobank Mobile	2017	Retail	YES			
Philippine National Bank	PH	S	PNB Mobile Banking	2016	Retail	YES			
RCBC	PH	S	RCBC Online Banking	2012	Retail	YES			
RCBC	PH	S	RCBC Online Corporate	2017	Business	YES			
Security Bank Corp	PH	S	Security Bank Mobile	2015	Retail	YES			
Union Bank	PH	S	UnionBank Online	2015	Retail	YES			
Union Bank	PH	S	UnionBank Consumer	2016	Retail	YES			
CIMB Thai	TH	S	CIMB Clicks	2013	Retail/Investment	YES			
Kiatnakin	TH	S	KK e-Banking	2016	Retail/Investment	YES	YES		

Kiatnakin	TH	S	KK Auto	2014	Retail/Investment	YES	YES	YES	YES
LH Financial	TH	S	LH Bank M Choice	2016	Retail/Investment	YES		YES	
TISCO	TH	S	TISCO Mobile Banking	2013	Retail	YES			
TISCO	TH	S	My Car My TISCO	2016	Retail/Investment	YES			
TMB	TH	S	TMB BIZ Touch	2016	Business	YES			
TMB	TH	S	ME by TMB	2016	Retail	YES			
TMB	TH	S	TMB Touch	2014	Retail/Investment	YES	YES	YES	
Baiduri	BN	S	Baiduri Personal	2013	Retail	YES	YES		
Baiduri	BN	S	Baiduri Deals	2013	Retail/Info only				
Baiduri	BN	S	Baiduri Finance	2017	Retail	YES			

.9 Small Banks in MY, PH and BN – Investment related services

Bank Name	Cty	Size	Mobile App Name	App Release Year	App Types	Mutual Funds	Stocks / Bonds	FX	Insurance
Affin	MY	S	AffinSecure	2017	Retail				
Asia United Bank	PH	S	AUB	2012	Retail				
Bank of the Philippine Islands	PH	S	BPI	2011	Retail				
Bank of the Philippine Islands	PH	S	BPI ExpresssLink Mobile	2011	Business				
Bank of the Philippine Islands	PH	S	BPI BizLink	2017	Business				
China Bank	PH	S	China Bank Corp	2017	Retail				
Metropolitan	PH	S	Metrobank Mobile	2017	Retail				
Philippine National Bank	PH	S	PNB Mobile Banking	2016	Retail				

RCBC	PH	S	RCBC Online Banking	2012	Retail				
RCBC	PH	S	RCBC Online Corporate	2017	Business				
Security Bank Corp	PH	S	Security Bank Mobile	2015	Retail				
Union Bank	PH	S	UnionBank Online	2015	Retail				
Union Bank	PH	S	UnionBank Consumer	2016	Retail				
CIMB Thai	TH	S	CIMB Clicks	2013	Retail/Investment	YES	YES		
Kiatnakin	TH	S	KK e-Banking	2016	Retail/Investment			YES	
Kiatnakin	TH	S	KK Auto	2014	Retail/Investment			YES	YES
LH Financial	TH	S	LH Bank M Choice	2016	Retail/Investment	YES			
TISCO	TH	S	TISCO Mobile Banking	2013	Retail				
TISCO	TH	S	My Car My TISCO	2016	Retail/Investment				YES
TMB	TH	S	TMB BIZ Touch	2016	Business				

TMB	TH	S	ME by TMB	2016	Retail				YES
TMB	TH	S	TMB Touch	2014	Retail/Investment	YES		YES	
Baiduri	BN	S	Baiduri Personal	2013	Retail				
Baiduri	BN	S	Baiduri Deals	2013	Retail/Info only				
Baiduri	BN	S	Baiduri Finance	2017	Retail				YES

.10 Small Banks in MY, PH and BN – Loan related services

Bank Name	Cty	Size	Mobile App Name	App Release Year	App Types	Car Loans	Mortgages	Credit Cards	Business Loans
Affin	MY	S	AffinSecure	2017	Retail				
Asia United Bank	PH	S	AUB	2012	Retail				
Bank of the Philippine Islands	PH	S	BPI	2011	Retail				
Bank of the Philippine Islands	PH	S	BPI ExpresssLink Mobile	2011	Business				
Bank of the Philippine Islands	PH	S	BPI BizLink	2017	Business				

China Bank	PH	S	China Bank Corp	2017	Retail				
Metropolitan	PH	S	Metrobank Mobile	2017	Retail				
Philippine National Bank	PH	S	PNB Mobile Banking	2016	Retail				
RCBC	PH	S	RCBC Online Banking	2012	Retail				
RCBC	PH	S	RCBC Online Corporate	2017	Business				
Security Bank Corp	PH	S	Security Bank Mobile	2015	Retail				
Union Bank	PH	S	UnionBank Online	2015	Retail				
Union Bank	PH	S	UnionBank Consumer	2016	Retail	YES	YES	YES	
CIMB Thai	TH	S	CIMB Clicks	2013	Retail/Investment				
Kiatnakin	TH	S	KK e-Banking	2016	Retail/Investment				
Kiatnakin	TH	S	KK Auto	2014	Retail/Investment	YES			
LH Financial	TH	S	LH Bank M Choice	2016	Retail/Investment				

TISCO	TH	S	TISCO Mobile Banking	2013	Retail				
TISCO	TH	S	My Car My TISCO	2016	Retail/Investment	YES			
TMB	TH	S	TMB BIZ Touch	2016	Business				YES
TMB	TH	S	ME by TMB	2016	Retail				
TMB	TH	S	TMB Touch	2014	Retail/Investment			YES	
Baiduri	BN	S	Baiduri Personal	2013	Retail				
Baiduri	BN	S	Baiduri Deals	2013	Retail/Info only				
Baiduri	BN	S	Baiduri Finance	2017	Retail	YES			

.11 Small Banks in MY, PH and BN – Payment related services

Bank Name	Cty	Size	Mobile App Name	App Release Year	App Types	Bills/TT Payment	RealTime Payment	QR	Apple Watch/ ApplePay
Affin	MY	S	AffinSecure	2017	Retail	YES			
Asia United Bank	PH	S	AUB	2012	Retail	YES		YES	
Bank of the Philippine Islands	PH	S	BPI	2011	Retail	YES			
Bank of the Philippine Islands	PH	S	BPI ExpresssLink Mobile	2011	Business				
Bank of the Philippine Islands	PH	S	BPI BizLink	2017	Business	YES			
China Bank	PH	S	China Bank Corp	2017	Retail	YES			
Metropolitan	PH	S	Metrobank Mobile	2017	Retail	YES			
Philippine National Bank	PH	S	PNB Mobile Banking	2016	Retail	YES			

RCBC	PH	S	RCBC Online Banking	2012	Retail	YES			
RCBC	PH	S	RCBC Online Corporate	2017	Business	YES			
Security Bank Corp	PH	S	Security Bank Mobile	2015	Retail	YES			
Union Bank	PH	S	UnionBank Online	2015	Retail	YES			
Union Bank	PH	S	UnionBank Consumer	2016	Retail	YES			
CIMB Thai	TH	S	CIMB Clicks	2013	Retail/Investment	YES	YES		
Kiatnakin	TH	S	KK e-Banking	2016	Retail/Investment	YES	YES	YES	
Kiatnakin	TH	S	KK Auto	2014	Retail/Investment		YES		
LH Financial	TH	S	LH Bank M Choice	2016	Retail/Investment	YES	YES	YES	
TISCO	TH	S	TISCO Mobile Banking	2013	Retail	YES	YES	YES	
TISCO	TH	S	My Car My TISCO	2016	Retail/Investment	YES			
TMB	TH	S	TMB BIZ Touch	2016	Business	YES	YES	YES	

TMB	TH	S	ME by TMB	2016	Retail	YES	YES	YES	
TMB	TH	S	TMB Touch	2014	Retail/Investment	YES	YES	YES	
Baiduri	BN	S	Baiduri Personal	2013	Retail	YES			
Baiduri	BN	S	Baiduri Deals	2013	Retail/Info only				
Baiduri	BN	S	Baiduri Finance	2017	Retail				