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EMPIRICAL ANALYSIS ON THE IMPACT OF FINANCIAL TECHNOLOGY AT THE FINANCIAL SYSTEM TOWARDS THE PERFORMANCE OF FINANCIAL INSTITUTIONS IN MALAYSIA

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ABSTRACT

This research aimed to identify the impact of financial technology in the financial system towards the performance of financial institutions in Malaysia, in the short run and long run. The performance of financial institutions which refers to the profitability of the financial institution after the utilization of financial technology into the daily transactions. A framework which included return on equity (ROE) as a dependent variable, fintech application, size of financial institutions, age of financial institutions as independent variables while Gross Domestic Product (GDP) and inflation act as controlled variables was designed. Quantitative methods which involved secondary data from eight local banks financial reports that range from 2004 to 2023 were analyzed using the panel data analysis with the help of software like Stata and MS Excel. The highlight of this study is the financial technology application which was represented by the digital innovation index. The analysis begins with unit root test, then followed by diagnostic tests such as autocorrelation, normality, stability, multicollinearity, heteroskedasticity tests will be conducted to ensure the validity and the reliability of the model. The findings revealed that mobile banking, earnings per share, size and GDP had a significantly positive relationship with the institutions performance. All other factors were found to be insignificant.

INTRODUCTION

Over the past decade, digital innovation has surged a rapid growth that resulted in a widespread integration of financial technology into the financial system. Due to the advancement of technology that increases connectivity and efficiency, financial technology (fintech) has become a popular tool for users to engage in various financial activities, including mobile payments, online banking, Peer-to-Peer (P2P) transfers, personal finance management, wealth management, asset management, crowdfunding, and cryptocurrency, among others. Digital innovations and fintech are deeply intertwined as fintech helps in smoothing the financial process with big data analytics, artificial intelligence, machine learning, compliance tools and risk management. Thus, fintech is known as an application of technology within the financial industry that covers a wide range of activities like contactless payment, financial data, financial analysis, financial software, digitized processes until various payment platforms such as Buy Now Pay Later (BNPL) and digital wallets (Arner, Barberi, Buckley, 2015; Chong et al., 2019). With the application of fintech, it could enhance the functionality of existing services for customers by improving accessibility, speeding up processes, enhancing security, and offering a better user experience, while also focusing on personalization and customization (OECD, 2020). Additionally, it enhances accuracy for business leaders by employing electronic identities and biometric authentication to verify customers (Zeidy, 2022), as well as improving the efficiency through the digitization of paperwork via blockchain technology and helps reduce economic informality by increasing transparency for governments (Lee & Teo, 2015).

PROBLEM STATEMENT

Due to convenience and preferences to use, fintech adoptions like mobile banking, internet banking, P2P lending, crowdfunding and robo-advising, artificial intelligence, machine learning, cloud computing have stopped the public users to step into financial institutions or the other branches physically (Malaysia Fintech Report, 2022; Yusoff et al., 2022; Varma et al., 2022). Additionally, the arising of blockchain, cryptocurrency and those stock exchange apps have provided greater choices for customers to foot-stepping on their investment. These fintech adoption facilitates the usage of financial services and causes an increase in the number of customers. It results in an injection of money into financial institutions which in turn, strengthen their financial status as well as helping them to invest more in assets and generate more profit (Almulla & Aljughaiman, 2021). Inversely, it is not easy to develop financial services and integrate them with technology because it's highly regulated, which causes high cost for digital solution development (Beccalli, 2007).

In Malaysia, a huge capital is used for research and development by financial institutions because they are still at their developing competitive technologies stage (Konasilan & Murugiah, 2020). When higher investment is injected into technology development, it increases the operational cost while decreasing their profitability in Malaysia. Furthermore, emergence of fintech in the financial system lessens their performance since it is related to the size of the financial institutions, specifically stronger on larger financial institutions compared to smaller ones. Larger financial institutions may respond slow in digital innovation as they are bearing heavy costs in re-organizing due to their legacy proprietary systems. On the other hand, smaller financial institutions can adapt both internal and external changes in their operating environment with greater responsiveness than larger financial institutions (Phan, Narayan & Hutabarat, 2018).

Besides the size of financial institutions, the age of the financial institutions can also influence the performance. As younger financial institutions are willing to accept innovative developments and operate the reorganization which goes along with technological innovation, they are found to be more successful in using technology innovation compared to the matured ones (Phan, Narayan & Hutabarat, 2018; Mallinguh, Wasike & Zoltan, 2020). As of the challenges mentioned above, it clearly indicates the need to establish the digital innovation index especially for the financial institutions. The absence of such an index highlights the need for a comprehensive framework that can effectively evaluate financial institutions. Developing this index is essential for benchmarking progress, guiding strategic decisions and ensuring the full potential of digital transformation in financial institutions is realized. Therefore, this research seeks to fill the gap by developing the digital innovation index to represent fintech in order to evaluate its impacts of financial technology on the performance of financial institutions in Malaysia.

RESEARCH OBJECTIVE

The general objective of this research is to investigate the impact of fintech application in the financial system towards the performance of the financial institutions in Malaysia. The specific research objectives are as follows:

i. The development of the digital innovation index.
ii. To evaluate the impact of digital innovation index on the performance of the financial institutions in Malaysia.
iii. To analyze whether size and age influence the performance of the financial institutions in Malaysia.
iv. To estimate whether control variables, GDP and inflation influence the performance of the financial institutions in Malaysia.

LITERATURE REVIEW

Recently, fintech is one of the frequently used applications in the financial sector. Alternative payment methods such as direct debits and e-wallet, digital technology apps such as online banking and mobile banking, automation such as artificial intelligence and distributed ledger technology such as blockchain are the most commonly seen fintech in the financial sector (Dorfleitner, Hornuf, Schmitt & Weber, 2016). Along the range line, the fintech industry can be categorized into four major subsets which include financing, asset management, payments and other fintech like insurance, search engines and comparison sites. Within the four major subsets, various dimensions have been included which are payment and lending, crowdfunding and investments, artificial intelligence, machine learning and robo-advisors, Blockchain and cryptocurrency, cloud computing and big data as well as insurtech and regtech.

Payments and transfers are the most popular investments in fintech (Rodin, Ganiev, & Orazov, 2019). E-wallet, scanning QR codes through mobile phones and debit cards are used frequently for digital payments. Mobile money allows users to make transactions without having a bank account as users can transfer and withdraw money with their smartphones. Same goes to fintech lending that enables the whole application processes to be automatically completed online. Fintech lending provides a wide range of lending solutions like P2P loans, credit cards, mortgages and home improvement financing without requiring customers to step into any bank's branches or financial institutions (Antosz, 2023).

Crowdfunding is a fund-raising method through online platforms to collect small amounts of money from a large pool of people for project purposes. Artificial intelligence is the field of intelligence that studies the synthesis and analysis of computational agents which could act intelligently (Poole & Mackworth,

2010). It is a transformative technology that reshape personnel, businesses and industries by automating tasks, enhancing decision-making as well as unlocking new possibilities for innovations. Robo-advisors is another digital advisory platform that replaces human financial advisors (Agarwal & Chua, 2020). It generates investment advice according to customer data through computer programs and represents a cheap alternative to human wealth advisors through machine learning (OECD, 2020).

Blockchain is a distributed database of records or public ledger, where all the participating transactions or digital events are stored in a list of blocks that have been executed and shared among the committed parties (Zheng et al., 2017; Crosby et al., 2015). Cryptocurrencies are digital tokens that enable users to make payment to each other directly through the online platform. They are forms of virtual assets that utilize distributed ledger or blockchain to allow flexible transactions (Wisetsri et al., 2022).

Cloud computing provides a model that allows convenient, on-demand network access to a shared pool of configurable computing resources (Ashraf et al., 2013). This technology enables the storage and management of data and applications via the internet and centralized remote servers. Meanwhile, big data refers to vast and complex datasets that deliver the right information to the right users at the right time, made possible by advancements in technology. It surpasses the capabilities of traditional data management systems, encompassing large volumes of digital information from various sources, including databases, devices, sensors, audio and video files, log files, networks, transactional applications, and social media (Riahi, Riahi, 2018; Mediratta, 2015).

Insurtech refers to insurance technology aimed at improving insurance models. It operates effectively through the use of data analytics, the Internet of Things, machine learning, artificial intelligence, and the sharing economy within the insurance sector. Similarly, regtech, or regulatory technology, encompasses a range of software applications designed to manage regulatory compliance, enhancing cost efficiency and saving time. It leverages emerging technologies like blockchain, big data, and artificial intelligence to reduce financial risk, combat money laundering, and improve regulatory compliance (KPMG, 2019).

Fintech's Development

Fintech development has gone through a long journey and evolved from one era to another according to the distinct time period. Each stage is marked by technological advancements and changing financial needs. The early digitalization that happened in the 19th century has been known as Fintech 1.0 or Analogue Industry. The first age of financial globalization crafted the mark in history when the first transatlantic cable between Europe and America was interconnected (Setiawan, Maulisa, 2019). During this period, plenty of valuable technologies were invented such as telegraphs, railroads, canals and steamships in order to speed up the financial transactions as well as enabling fast transmission of financial information (Arner et al., 2015).

In Fintech 2.0, this stage is known as the Era of Digitalization. At this stage, financial institutions have adopted computers to handle back-office operations especially in record-keeping and data processing. In 1967, the first Automated Teller Machine (ATM) was launched in London by Barclays (Arner et al., 2015; Arner et al., 2017). It offered 24/7 access to customers to withdraw their money. Credit cards were also introduced at the similar time as revolutionized payment methods. The earliest credit cards like Diners Club Card and American Express offered a convenient way to make payment without cash. Subsequently, credit cards became the mainstream in secure transaction and online card payments. Bank Automated Clearing Systems (BACS)

was implemented in 1968 and 1970 in the UK and US respectively. It allows payment transfer from one bank to another bank within three working days. In 1971, National Association of Securities Dealers Automated Quotations (NASDAQ) was introduced as the first automated exchange stock market that handled electronic securities trading around the world. In 1973, Society for Worldwide Interbank Financial Telecommunications (SWIFT) was formed as a global financial managing network that sends and receives information as well as transferring money securely. In 1981, Bloomberg was developed to provide information that covered historical and current price data, real-time financial data, trading news and information. In 1983, the first commercial portable mobile phone, which was Motorola DynaTAC was invented to make communication easier. The first internet banking, which was known as Homelink, was introduced by Nottingham Building Society. In 1994, Microsoft Money personal finance software received penetration of online banking into its systems and allowed users to access their bank account through the online banking system. In 2001, there were eight banks in the US reporting that they had at least one million online banking users.

In Fintech 3.0 and 3.5, it is the era of new startups and globalization. Fintech 3.0 began in 2008, where plenty of non-bank financial startups with intelligence and capital are working on various alternatives to traditional banking where they can make business in minutes. Since PayPal became one of the most popular digital wallets for customers to make purchases in foreign online stores, many big tech companies, telecommunication providers and non-bank financial startups have invented and launched their digital wallets. In 2003, Alibaba launched Alipay in China. In 2007, Kenya introduced M-Pesa as the first mobile payment system for mobile banking and microfinancing service. After the 2007 Global Financial Crisis, digital money and cryptocurrency were well accepted as many users lost trust in traditional banking systems. In 2008, Wealthfront was founded in California, providing a wide range of financial services such as cash management, automated investment management, automated bond investing, self-directed trading and borrowings. In 2009, Kickstarter was established to introduce its reward-based crowdfunding platform. Moreover, Bitcoin was introduced as the first decentralized payment network that enabled secure and untraceable digital payments globally in the same year as well. In 2011, Transferwise was created to focus on cross-border payment transfer as well as enabling banks to provide quick and transparent processes in transaction handling. In 2012, Apple's Passbook was introduced for boarding passes, tickets and coupons. In 2014, ApplePay was launched for mobile payment transactions that were authenticated by biometric technology. In 2013, WeChat became the most popular electronic payment platform in China.

In Fintech 4.0, there are a few disruptive technologies that change consumers' behavior. The major disruptions include mobile internet, the internet of things, blockchain, artificial intelligence, machine learning and cloud technology. Aligned with the Industrial Revolution 4.0, fintech 4.0 is growing overlap with the deeply innovated industrial production by converting the traditional methods to a smart digitized system. The entry of big-tech firms has changed the context of finance where bigtechs have expanded by joining the existing fintech players. (Arner et al., 2022) specifies that Apple, Meta, Google, Amazon, Tencent and Alibaba are the globally well-known dominant information technology companies. They are taking up primary activities that include a broad set of general digital services, inclusive of telecommunications, social media, online search engine, e-commerce as well as ride-hailing, e-payments, credit and investments.

Consumers' Adoption towards Financial Technology

Since internet was invented, e-commerce activities have been applied into consumers' purchasing behavior. Online selling through e-commerce platforms like Amazon and social media's advertisers like YouTube have connected people well by plenty of information sharing. Most Malaysians are well adapted to digital technology as well as fintech products. Malaysia fintech's users adapted the fintech services well because of the usefulness of the services (Chong et al., 2019). The application of digital banking has brought such convenience to users as they can perform transactions, manage finance, make investments and others without much effort. It saves time and energy as digital apps like online banking and mobile banking have good accessibility that can be easily accessed through smartphones, tablets and personal computers as long as they get connected to the internet. Another factor that affects the consumers' adoption is the security concern. The breach of financial data and information can cause identity theft and financial loss. The information like credit card numbers and personal identification information are vulnerable if account hacking or malware attacks occur. But however, security threats can be minimized through advanced security measures like two-factor authentication to protect users' personal login information and other financial transactions.

Financial Institutions' Adoption towards Fintech Technology

The financial institutions in Malaysia normally refer to banking institutions. As of 2012, the banking sector was consolidated into eight major local commercial banks which include Affin Bank, Alliance Bank, Ambank, Hong Leong Bank, Malayan Banking, Public Bank and RHB Bank (Venkathaialam, Abdul Wahab, 2017). These financial institutions actively invest in new technology that could produce higher quality products and better services. When they adapt into financial innovation, they can boost their revenue to stay competitive in the financial market. There are many ways for financial institutions to adopt financial technology. One of the common ways is collaborating with fintech or technology companies. They can also outsource the fintech services from financial technology companies, providing venture capital to fintech, accelerating fintech startups, acquiring fintech and developing internal fintech. Since fintech provides better financial services than using digital technologies to increase revenue, reduce cost and remove friction, more than 50% of Malaysia's banks would like to set up partnerships with fintech companies to perform in the financial markets.

Underlying Theories

Digital innovation in the financial sector is driven by both demand and supply factors. On the demand side, consumers' awareness on applying fintech and perceived value of fintech development surged fourfold after the 2008 Global Financial Crises (Haddad, Hornuf, 2018). This rapid growth in fintech outpaced traditional financial services and encouraged more fintech products to develop, including artificial intelligence and machine learning, which have significantly enhanced the importance of codifiable information through big data (Shapiro et al., 2022). In addition, demand on fintech is closely connected to consumer expectation especially on the tech-savvy generation. Positive impacts such as better experience, greater convenience, higher speed and user-friendly features that are provided by fintech could satisfy the sophisticated consumers (OECD,2020).

On the supply side, it is primarily supported by technological advancements, including internet application programming interfaces (APIs), smartphones which are suitable for mobile banking, digital currencies, cloud computing, and blockchain technology (Carstens, 2018). There are a billion users of mobile banking apps, which have become integral to e-commerce services such as

delivery, food ordering, and ride-hailing. Additionally, reduced entry barriers for fintech intermediaries and a readiness to embrace fintech innovations have contributed to an increased supply, helping to achieve equilibrium in the financial market (Shapiro et al., 2022).

Theory of innovation is another important theory in this research. As a drastic change emerged due to technological revolution, it has forced the establishment of a new technological paradigm that brings impact to all important sides of economic functioning. Schumpeter's (1942) creative destruction concepts, supported by Kondratieff's (1935) long waves, as well as Diffusion of Innovation, Open Innovation Model and Disruptive Innovation theory ate the few important and influential theories of innovation that have been applied into the global economy until now.

Schumpeter (1942) is well-known for his creative destruction concepts. It asserts that innovation is a crucial factor in economic change, positing that innovative entrepreneurship and technological advancement are the key drivers of economic development (Naqshbandi, Singh, 2015). Schumpeter (1942) claims that the ability to innovate is closely related to the size of enterprises, where smaller firms will have a better capacity to innovate due to their flexibility. However, he later contended that larger firms might have a greater advantage in developing innovations because of their monopolistic power and increased market influence.

Next, Kondratieff's (1935) "long waves" represent a significant cycle of conjuncture. It gets expressed in long-term cyclical fluctuations of commodity prices, rent, interest, foreign trade's circulation, coal mining, mineral fuel consumption, and manufacture of pig-iron. This cycle encompasses various sectors, including clothing, mass transportation, mass production, individual mobility, and information and communication (Allianz Global Investors Capital Market Analysis, 2010). According to Kondratieff (1935), these major cycles are processes, where changes and expansions in basic capital bring benefits, even though it demands a longer time and huge expenses for production. The wave of innovations reflects the backdrop of inventions, where the presence of scientific advancements and the intensity of technical innovations demonstrate the practical application and prior progress in science and technology. This development is an ongoing process that depends on essential economic conditions, which are interconnected with advancements in science, ethics, social and economic relations, conflicts, and internal unrest. Hence, Schumpeter theorized that each of the long waves reflects a cluster of innovations.

Rogers (1962) asserted that diffusion is a process where innovation is communicated over time among participants in a social system via specific channels (Naqshbandi, Singh, 2015). This process examines the factors that decide what to invent, the speed of innovation, and how ideas are accepted within a particular culture (Dongol, 2021). Chesbrough (2003) argued that enterprises profit from innovation through significant investments in their internal research and development (Naqshbandi, Singh, 2015). This concept contrasts with traditional theories, as open innovation emphasizes the use of both incoming and outgoing knowledge to enhance internal innovation and broaden markets for external applications while seeking to advance technology. While disruptive innovation theory explains how new technologies and business models can disrupt existing markets, replacing established products or services. Christensen focused on technological innovations that can surpass superior technologies in the market, believing that innovations can create new markets and valuable networks by disrupting current markets and displacing older technologies with better alternatives.

Digital Innovation Index

In this research, technological innovation, growth potential and penetration of mobile banking are the three elements that applied to develop digital innovation index. Based on the theories or concepts that derived from Adam Smith (1870), Kondratieff (1935) and Schumpeter (1942), it said that technological innovation is the driving force on the back of economic growth (Kaya, 2015; Bazhal, 2016). According to the Neo-classical economics of Adam Smith (1870), innovation transforms inputs into outputs based on the technology utilized, which is regarded as an external factor that continuously enhances productivity (Kaya, 2015). In the context of Kondratieff's (1935) "long waves," there are five major surges of innovation. Each surge begins with an irruption phase, where innovations are supported by financial capital that highlights their potential for significant change. This phase fosters new innovations until the market reaches a stagnation point in its maturity phase, after which a new cycle begins (Lechner, 2019; Allianz Global Investor Capital Market Analysis, 2010; Narkus, 2012; Grinin, 2019). This cycle illustrates how evolutionary innovations influence market equilibrium and economic development. Neo-Schumpeterian theories suggest that technological revolutions significantly impact economic development by providing solutions and promoting the advancement of market systems. They emphasize the close relationship between technological innovation and research and development, which contributes to long-term cyclical fluctuations in economic growth (Bazhal, 2016).

In the financial industry, growth potential indicates the firms' ability to generate profits in the financial market and represents the future potential of the firms as well. In this research, growth potential is one of the elements in developing digital innovation index because technological innovation is an important factor in influencing firms' growth potential. EPS is the most popular indicator that is used widely as a financial performance benchmark especially for strategic decision making like share valuation, management performance incentive schemes, merge and acquisition negotiations (Wet, 2013). The higher reading of EPS indicates a greater profit made and better value perceived by investors.

In the financial sector, growth potential reflects a firm's capacity to generate profits in the market and signifies its future prospects as well. This research identifies growth potential as a key component in developing a digital innovation index, as technological innovation significantly impacts a firm's growth capabilities. Earnings Per Share (EPS) is a widely used metric for assessing financial performance, particularly in strategic decision-making contexts such as share valuation, management performance incentives, and merger and acquisition negotiations (Wet, 2013). A higher EPS indicates greater profitability and a more favorable perception among investors.

Referring to the importance of its adoption into the financial system and its impact towards performance of financial institutions, the weightage of these three elements has been determined when developing the digital innovation index, which are 30% are designated to technological innovation, 20% are designated to growth potential and 50% are designated to penetration of mobile banking.

Research Gap

The development of a robust framework and digital innovation index to assess its impact within financial institutions has become increasingly important but a standardized digital innovation index remains underdeveloped, particularly in developing economies where data limitations pose significant challenges. This index should be evaluated based on three dimensions, which are technological application, the growth potential of financial institutions, and mobile

banking penetration. Additional factors like the size and age of financial institutions, along with GDP and inflation should be included as independent and controlled variables respectively, to ensure a thorough analysis. The dimensions of technological application, growth potential, size, and age are aligned with the supply of fintech applications, while mobile banking penetration, GDP, and inflation are reflecting the demand for these applications. Consequently, the selected variables are consistent with the principles of supply and demand.

Based on Schumpeter's theory of innovation, which is supported by various researchers highlighting the importance of innovation in fostering economic development, it is clear that technology acts as a vital knowledge resource. It helps mitigate diminishing marginal returns on financial products by converting those returns into increasing ones. However, some financial institutions experience operational burdens when adopting fintech, leading to negative impacts on their performance. Thus, developing a digital innovation index specifically for developing countries like Malaysia can offer valuable insights into how technological advancements can boost the efficiency and competitiveness of financial institutions. Evaluating the impact of fintech on these institutions through the lens of the digital innovation index will help to fill the gap in current research.

METHODOLOGY

Sample

The research sample comprises eight local commercial banks which are particularly relevant as they have all actively adapted to fintech innovations. They are Affin Bank, Alliance Bank, Ambank, CIMB Bank, Hong Leong Bank, Malayan Banking, Public Bank and RHB Bank. Essential to Malaysia's financial system, these banks actively participate in various commercial banking activities and lead the way in integrating technological advancements into their operations. Their adaptations involve utilizing digital financial technologies to enhance customer service, boost operational efficiency, and promote innovation in financial products.

Data

A quantitative research method is applied by employing secondary data over 20 years, from 2004 till 2023. Annual reports from each local commercial bank will be sourced from the official websites of the individual institutions. These reports will include financial statements such as income statements and balance sheets. Variables like return on equity, size, age, growth potential, and expenses on technological innovation will be extracted from these financial statements. Additionally, GDP, inflation rates, and mobile banking penetration rates will be obtained from reports issued by Bank Negara Malaysia.

Digital innovation index is developed based on technological innovation, growth potential and penetration of mobile banking. The numerical data for technological innovation and growth potential are extracted from financial statements of each bank for each year. In this research, technological innovation is evaluated by analyzing the bank's expenses on computer, software and equipment (hardware and software) since technological innovation is the process of using latest technologies to improve existing services and products. Growth potential as a widely used financial performance benchmark that can be measured by earning per share will be scrutinized as it projects the bank's future growth potential. Penetration of mobile banking in the financial system which refers to the usage of mobile banking transactions via mobile devices can be measured by the mobile banking transaction volume per capita.

The Digital Innovation Index formula begins by identifying the key elements needed to develop the index, which are technological innovation, growth potential, and mobile banking penetration. Knowing that these

elements do not hold the equal significance for digital innovation, weightage is assigned to each based on their relevance. Specifically, technological innovation is weighted at 30%, growth potential at 20%, and mobile banking penetration at 50%. This can be expressed in the formula below:

$$DII = (0.3 \times X_1) + (0.2 \times X_2) + (0.5 \times X_3),$$

where:

DII represents the digital innovation index that provides an overall measure of digital innovation.

X_1 represents technological innovation that is measured by dividing the expenditure on technological innovation with the total expenses, and multiplying with 100% to get the weightage in percentage.

X_2 represents growth potential that can be measured by earning per share in percentage.

X_3 represents penetration of mobile banking that is measured by the mobile banking transaction volume per capita in percentage.

Research Framework

Theory of Demand and Supply and Theory of Innovation were the two fundamental theories underpinning this research. Theory of Demand and Supply categorized the variables into market demand of fintech and market supply of fintech. Market demand was represented by mobile banking penetration, GDP, and inflation, while market supply was characterized by technological innovation, the growth potential of financial institutions, and their size and age as well. Theory of Innovation was reflected in the size and age of firms, as these factors indicate a firm's capacity to foster innovation. Financial institutions were responsible for supplying fintech products and services, even though they vary in their digital innovation indices, total assets, and operational ages. Additionally, GDP and inflation, which reflect the overall health of the economy, indicated the demand for fintech through GDP per capita, representing the average output per person and their purchasing power for fintech products.

The research framework of this study is shown as below:

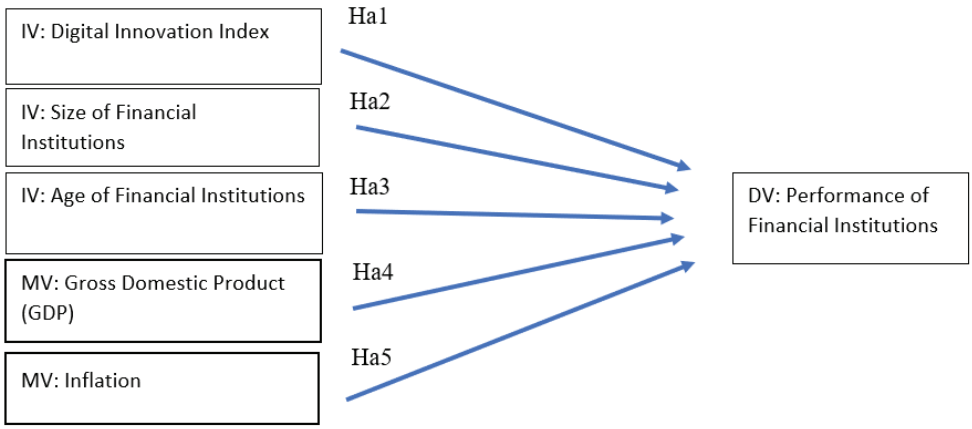

Figure 1: Research Framework

Hypothesis Development

a) Digital innovation index is a scale that is used to evaluate a country's level of digital innovation adoption and its readiness to embrace any beneficial footprints or drawbacks from digital technologies. Digital innovation can enhance efficiency within financial institutions through the adoption of various technologies. These technologies such as e-commerce, digital marketing, artificial intelligence, automation, big data

analytics, and cloud computing can help in streamlining business processes, reduce operational costs, and improve productivity by optimizing workflows and minimizing manual tasks. Additionally, digital innovation allows financial institutions to explore new market opportunities and generate substantial revenue streams by offering fintech products and services, such as online banking and mobile applications that align with customer preferences. Thus, a hypothesis can be developed as:

H_{a1}: Fintech applications can influence the performance of the financial institution in the short run and long run in Malaysia.

b) The size of financial institutions can be assessed through various metrics, including revenue or sales, market capitalization and total assets. Revenue provides insights into the scale of operations and financial performance, encompassing interest income, fees, and commissions. Market capitalization indicates the market's perception of a financial institution's size and value by measuring the total worth of its outstanding shares. Total assets serve as a common measure of size, as they include all financial assets like cash, deposits, securities, loans, and other investments. Additionally, the number of branches and employees can also gauge the size of financial institutions, as these factors indicate customer reach and operational scale. Thus, a hypothesis can be developed as:

H_{a2}: Size of financial institutions can influence the performance of the financial institution in the short run and long run in Malaysia.

c) Generally, the age reflects the length of time since a financial institution's inception, offering insights into its operational experience, financial stability, and industry reputation. Established institutions with longer service histories often enjoy brand recognition, leading to a more robust customer base. They tend to have accumulated significant experience, expertise, and a solid reputation, which can foster customer trust, enhance market capitalization, and strengthen brand identity which positively affect their financial performance. Their extensive track record allows them to build strong relationships and gain deeper insights through various economic cycles. Conversely, younger financial institutions can introduce fresh perspectives, innovative solutions, and agility to the industry. They have the potential to differentiate their products and services through modern technologies, digital platforms, and disruptive business models, which can also positively influence their financial performance. Thus, a hypothesis can be developed as:

H_{a3}: Age of financial institutions can influence the performance of the financial institution in the short run and long run in Malaysia.

d) GDP is an indicator used to assess the health of a country's economy, reflecting the total monetary value of all goods and services produced within a specific period, typically one year. As a controllable variable, GDP can significantly influence a country's financial performance. One positive effect of rising GDP is increased tax revenue, which allows the government to allocate more funds for public spending and investments in a growing economy. For the private sector, a robust GDP fosters business expansion and investment, encouraging companies to pursue new projects that can enhance profits and stimulate economic activity. A higher GDP also improves access to credit and capital, as it signifies a stable financial system that supports business growth and investments. Furthermore, strong GDP can enhance a country's trade balance by attracting foreign investment, leading to positive net exports and increased foreign exchange earnings. Additionally, a strong GDP often correlates with better employment opportunities, as a flourishing economy creates more jobs, boosts household incomes, and reduces unemployment rates, thereby driving consumer spending and investments.

Collectively, these positive impacts contribute to enhanced purchasing power, fostering economic growth and strengthening the financial performance of financial institutions. Thus, a hypothesis can be developed as:

H_{a4}: GDP can influence the performance of the financial institution in the short run and long run in Malaysia.

e) Inflation refers to the rate at which the general price level of goods and services rises over time, typically measured annually. It indicates a decline in the purchasing power of money, meaning that a unit of currency buys fewer goods and services than it did in previous years. Inflation is closely linked to a country's economy, as it can erode purchasing power and influence consumer spending habits. Interest rates are also affected by inflation, as Bank Negara Malaysia uses them as a tool to manage inflation levels. When inflation is high, the central bank may increase interest rates to curb spending and borrowing, thereby slowing down economic activity. Conversely, when inflation is low, it may lower interest rates to encourage spending and investment, stimulating economic growth. Moreover, inflation leads to a higher cost of living, impacting household budgets and reducing the overall capacity for consumer spending, which in turn can hinder economic growth. As prices rise, employees may exert wage pressure on organizations to keep pace with the increasing cost of living, potentially raising production costs for businesses and affecting their profitability and investment. Generally, high inflation can result in economic instability and currency devaluation, diminishing living standards and limiting long-term growth prospects. In contrast, moderate inflation is often viewed as a sign of a healthy economy, as it promotes spending and investment. Thus, a hypothesis can be developed as:

H_{a5}: Inflation can influence the performance of the financial institution in the short run and long run in Malaysia.

Model Formation

This research adapted a regression function to illustrate the relationship amid Fintech with the financial performance of financial institutions in Malaysia as recommended by Hair et al., (2006). The model specification is presented as below:

$$\mathbf{Y_{it} = \beta_0 + \beta 1_{it} X1_{it} + \beta 2_{it} X2_{it} + \beta 3_{it} X3_{it} + \beta 4_{it} X4_{it} + \beta 5_{it} X5_{it} + \varepsilon_{it}}$$

where:

Y is the financial performance which is measured by Return on Equity (ROE = net income / shareholders' Equity).

$X1_{it}$ is the digital innovation index which comprises technological innovation (measured by analyzing the allocation for computer, software and equipment), growth potential (measured by analyzing the earning per share) and penetration of mobile banking (measured by number of mobile banking transaction volume)

$X2_{it}$ is the size of financial institutions which is measured by the total assets.

$X3_{it}$ is the age of financial institutions which is measured by total year of operating.

$X4_{it}$ is the GDP which is acting as a controllable variable.

$X5_{it}$ is the inflation which is acting as a controllable variable.

β_0 is the gradient of the regression gauging the sum of the vary in Y linked with a unit vary in X (the beta coefficient).

i is representing the entity (across different financial institutions).

t is representing the time periods (years).

ε_{it} is the error term within a confidence interval of 5%.

FINDINGS

As this research is an empirical analysis on multiple years across many entities, a panel data analysis will be used to conduct the analysis. It will first go through the determination of whether Fixed Effect Model or Random Effect Model to be applied, by using the Hausman Test because there are some unobserved entity-specific factors not being directly measured but they have influence on the dependent variable. Then, it will go through unit root test to make sure all panels are stationary to avoid spurious regression. Wooldridge test is used to check especially for the first-degree autocorrelation to find out whether there is any correlation between a residual and another residual from immediately preceding time period. When autocorrelation occurs, Augmented Dicky Fuller will be applied for Unit Root Test, where the panel data will go through differentiation. Another important element which is heteroskedasticity is tested to ensure the validity of the regression analysis. If heteroskedasticity exists, Generalized Least Square (GLS) regression will be applied where different weights are assigned to different variance of the residuals in an inverse way to make efficient estimation.

Table 1: Random-effects GLS Regression

Number of observations = 144						
Number of groups = 8						
R-squared (within) = 0.2511						
R-squared (between) = 0.0301						
R-squared (overall) = 0.2357						
Wald $chi^2(7)$ = 83.99; Prob > chi^2 = 0.0000						
D2TE	Coefficient	Robust std.err.	Z	P>|Z|	[95% conf. interval]	
TI	2.60e+13	2.68e+13	0.97	0.331	-2.65e+13	7.85e+13
EPSSEN	-1.27e+08	5.41e+07	-2.35	0.019	-2.33e+08	-2.09e+07
D2MBMIL	7.87e+12	4.43e+12	1.78	0.076	-8.18e+11	1.66e+13
D2TA	0.0849	0.0247	3.44	0.001	0.0365	0.1333
lnAGE	1.38e+09	1.09e+09	1.27	0.205	-7.53e+08	3.51e+09
GDP	-2.72e+09	1.07e+09	-2.54	0.011	-4.82e+09	-6.19e+08
INFLATION	7.57e+08	7.26e+08	1.04	0.297	-6.66e+08	2.18e+09
_cons	-2.212+09	4.20e+09	-0.53	0.599	-1.04e+10	6.03e+09
Sigma_u = 8.837e+08						
Sigma_e = 3.842e+09						
Rho = 0.050						

This random-effects generalized least squared regression was generated by return on equity, technological innovation, earning per share, mobile banking, total asset, age, gross domestic product and inflation, where return on equity, mobile banking, total asset have been differentiated at the second differentiation, age has been examined through log-transformation, while earning per share, gross domestic product and inflation maintain with their original level. The within-R^2 shows 0.251, indicating that 25% of within-bank variation was explain. The between R^2 shows 0.030, indicating that only 3% of between-bank variation was explained. The overall R^2 shows 0.236, indicating that the total explanatory power is modest. The Wald $X^2(7)$ shows 83.99 and p-value shows 0.0000,

indicating that the model was jointly significant. In the variance components, sigma_u shows 8.84, indicating that the standard deviation of the random effects (σ_u), which captures the unobserved, bank-specific characteristics that do not change over time such as management quality or brand reputation, was estimated at 8.837e+08. This suggests a moderate level of variability across banks. In contrast, sigma_e shows 3.84, indicating that the standard deviation of the idiosyncratic errors (σ_e), representing time-varying factors within individual banks such as quarterly performance shifts or market fluctuations, was much higher at 3.842e+09. This indicates that most of the variability in return on equity arises from changes occurring within banks over time. Additionally, the intra-class correlation coefficient (rho) was calculated to be 0.0502. This means that only about 5% of the total variance in return on equity can be attributed to persistent differences between banks, while the remaining 95% stems from time-specific or idiosyncratic factors. Overall, this suggests that return on equity was largely influenced by dynamic, time-related factors rather than by stable, bank-specific traits.

Based on the result that shown in Table 1, three independent variables are significant which include earning per share with p-value equals to 0.019, total asset with p-value equals to 0.000 and gross domestic product with p-value equals to 0.011. The insignificant variables include technological innovation with p-value equals to 0.331, age with p-value equals to 0.205 and inflation with p-value equals to 0.297. Mobile banking with p-value of 0.076 is marginal significant as it falls between 5% and 10%, where the effect is not statistically significant at 5% but it is marginally significant at 10%. Hence, the hypothesis of Fintech applications (earning per share and mobile banking) can influence the performance of the financial institution in the short run and long run in Malaysia (Ha_1) is significant. The hypothesis of size of financial institutions (total asset) can influence the performance of the financial institution in the short run and long run in Malaysia (Ha_2) is significant. The hypothesis of age of financial institutions (age) can influence the performance of the financial institution in the short run and long run in Malaysia (Ha_3) is insignificant. The hypothesis of GDP (gross domestic product) can influence the performance of the financial institution in the short run and long run in Malaysia (Ha_4) is significant. The hypothesis of inflation (inflation) can influence the performance of the financial institution in the short run and long run in Malaysia (Ha_5) is insignificant.

CONCLUSION

Examining the impact of financial technology at the financial system towards the financial institutions in Malaysia is crucial for bankers, investors as well as users. Aligned with the digital innovation, penetration of financial technology into the financial system is very important to enhance efficiency, accessibility, security and innovation in finance sector. By using the data of 8 local commercial banks from 2004 until 2023, this research focused on the impact of fintech application such as technological innovation, EPS and mobile banking, size and age, as well as GDP and inflation on the performance of financial institutions that measured by return on equity. The findings of this research revealed a positive impact of fintech application especially earning per share and mobile banking, size and GDP towards the performance of financial institutions, while technological innovation, age and inflation has no impact on the performance of financial institutions. However, the results of this research have limitation due to different sample size, types of data and variables that may limit generalizability. Thus, future research could adopt standardized datasets across diverse markets.

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