Journal of Islamic Monetary Economics and Finance, Vol. 9, No. 4 (2023), pp. 559 - 588
p-ISSN: 2460-6146, e-ISSN: 2460-6618

THE DETERMINANTS OF DIGITAL BANKING ADOPTION AMONG BANKS OFFERING ISLAMIC BANKING SERVICES

Achmad Hidayat[1] and Salina Kassim[2]

[1] IIUM Institute of Islamic Banking and Finance, Malaysia, achmadh2017@gmail.com
[2] International Islamic University Malaysia, Malaysia, ksalina@iium.edu.my

ABSTRACT

Technology advances in the financial sector have been a topic of much discussion within the banking industry. It is believed that the adoption of digital banking by banks depends greatly on their characteristics and the market they operate. This study examines the relationship between bank and market characteristics and the adoption of digital banking among banks that offer Islamic banking services in Indonesia. Data are gathered from banks' annual reports, their first mobile banking app, financial reports, and banking statistics from 2010 to 2022. A panel logistic regression is utilized in the analysis. The results indicate that bank and market characteristics have a meaningful impact on a bank's decision to adopt digital banking. Additionally, it is found that banks are more inclined to adopt digital banking during the COVID-19 pandemic.

Keywords: Digital banking, Islamic banking, Internet banking, Mobile banking.
JEL classification: G2.

Article history:
Received : February 21, 2023
Revised : September 24, 2023
Accepted : November 30, 2023
Available online : December 1, 2023

https://doi.org/10.21098/jimf.v9i4.1688

I. INTRODUCTION

Financial technology is the most significant development within the banking industry. Over the years, banks have expanded their technology adoption from Automated Teller Machines in the 1970s to Internet banking in the 1990s and mobile banking afterwards (Mullan et al., 2017; Thakor, 2020). Electronic or digital platforms have become a primary alternative channel for banks to deliver their financial services (Liebana-Cabanillas et al., 2013). It is expected that technological innovation in the banking sector will be more intense as banks seek to lower costs as well as to cater to increasing demands for digital transactions, driven by requests from the new generation (Schindler, 2017) and the present COVID-19 pandemic (IFSB,2020). A bank that adopts and adapts to this emerging trend would potentially retain its market share (Stulz, 2019; Thakor, 2020).

Despite the critical importance of technology adoption, digital transformation in Indonesia's banking sector is slow (Bank Indonesia, 2019; Paminto et al., 2022). A survey conducted by the Central Bank of Indonesia/Bank Indonesia (BI) reveals that the adoption rate of digital banking is still relatively slow (Bank Indonesia, 2019). This may also have occurred in Islamic banking as a lack of information technology has been identified as an obstacle to development, leading to the inability to create competitive products and services and differentiation (Indonesian Ministry of National Development Planning, 2019; OJK, 2021a). Considering the importance of digital transformation, Indonesia Financial Services Authority/Otoritas Jasa Keuangan (OJK) has promoted accelerating digital transformation as a strategic direction of national banking 2020-2025 to respond to the challenges in national banking, including the Islamic banking digitalization (OJK, 2021c). In particular, digitalization has been identified as the key factor supporting Islamic banking development in the Indonesia Islamic Banking Development Roadmap 2020-2025 (OJK, 2021a). Thus, there is an urgent need to assess digital transformation and technological adoption in Indonesia.

In the literature, previous studies have identified mixed results concerning the effect of bank-specific factors on the decision to adopt digital banking; for instance, some studies suggest profitability as a significant factor in the decision to adopt Internet banking (Furst et al., 2002; Hernández-Murillo et al., 2010) whilst others find no evidence for its significance (Malhotra & Singh, 2007). Moreover, cost reduction is theoretically the motive for the emergence of financial innovation (Van Horne, 1985); however, Malhotra & Singh (2007) confirm no evidence concerning the effect of labour cost on the decision to adopt digital banking. These results may lead to an uncertain conclusion on factors influencing the decision to adopt digital banking. Moreover, it is essential to conduct further research taking the bank's perspective as most of the studies regarding the adoption of financial services innovations such as Internet banking and mobile banking are investigated from the view of consumers (Nejad, 2016; Mullan et al., 2017).

Along the lines of these studies, the present examines bank-specific and market-specific factors driving digital banking adoption by banks offering Islamic banking services in Indonesia. It differs from previous studies in that this study concentrates on the dual banking system with a focus on banks offering Islamic banking services. The paper contributes to the literature in twofold. Firstly, it extends the literature on the adoption of digital banking by examining the

determinants of digital banking adoption. Secondly, the present study examines the determinant of digital banking adoption among banks offering Islamic banking services in the dual banking system.

The rest of the paper is structured as follows. Section 2 reviews relevant literature on digital banking, including previous studies on adoption. Section 3 presents this study's conceptual framework and the hypotheses. Section 4 elaborates on the research methodology, which consists of data, variables and model specifications utilized in this study. The results of panel logit regression are deliberated in section 5, along with the discussion and the study's implications. Lastly, section 6 concludes the findings of the study.

II. LITERATURE REVIEW

2.1. Digital Banking

Digital banking enables customers to access banking services through digital channels vis-a-vis the Internet and mobile banking (Garzaro et al., 2021; Levy, 2022; Chauhan et al., 2022). The main difference between the Internet and mobile banking for the customers is the medium to access both channels (Laukkanen, 2007; Shaikh & Karjaluoto 2016). Whilst Internet banking enables them to perform online transactions using a computer, Personal Computer (PC) or laptop anytime and anywhere by accessing a bank's website, mobile banking is accessed interactively using a mobile device or mobile telecommunication such as a mobile phone, smartphone or tablet, normally by downloading the mobile application (Berger, 2003; Barnes & Corbitt, 2003; Tiwari et al., 2006; Laukkanen, 2007; Hoehle et al., 2012; Laukkanen, 2016; Shaikh & Karjaluoto, 2016; Sullivan & Wang, 2020; Garzaro et al., 2021; Chauhan et al., 2022; Levy, 2022). Data telecommunication to access mobile banking has excluded phone banking, voice dial-up, and dial-up services from the mobile banking category (Barnes & Corbitt, 2003).

Banks with physical branches embrace digital banking by employing a multi-channel strategy in which the banks adopt Internet banking and/or mobile banking along with the physical branches (Scornavacca & Hoehle, 2007). As the banks integrate Internet banking and mobile banking to deliver digital banking services to the customers seamlessly, personalized and consistently, the banks employ an omnichannel strategy (Verhoef et al., 2015; Komulainen & Makkonen, 2018; Hamouda, 2019; Verhoef, 2021). A digital bank is a fully digital company that employs fully digital banking without physical branches, such as an internet-only or digital-only bank (Schaechter, 2002; Berger, 2003; Choi et al., 2020; Verhoef, 2021). In this study, digital banking refers to adopting Internet banking and mobile banking to offer and deliver banking services and not specifically to the digital bank.

2.2. Digital Banking Adoption

Diffusion of Innovation theory has been considered the most popular to explain the adoption of innovation and new technology in consumer studies (Puschel et al., 2010; Al-Jabri & Sohail, 2012) as well as organizational studies (Mullan et al., 2017). Diffusion of Innovation theory reveals that characteristics of adopters and

attributes of innovation play a role in explaining the diffusion of innovation or technology (Mullan et al., 2017; Dearing & Cox, 2018). Attributes of innovation consider the relative advantage of the innovation, complexity, compatibility, observability and trialability as key factors influencing the adoption of innovation.

Reducing the costs to achieve efficiency has stimulated the emergence of financial innovation, such as financial technology (Van Horne, 1985; Merton, 1992). For the banks, reducing costs, particularly overhead costs related to the physical branch, such as premises and labour costs, has driven banks to adopt digital banking services (Tiwari et al., 2006; Shah & Clarke, 2009) as well as is the source of their competitive advantage (DeYoung et al., 2007).

Various bank-specific characteristics have been predicted to affect the digital banking adoption. The adoption of technology requires the cost of adoption, which creates the size threshold for the adoption in which large banks have the capabilities to do so earlier, and over time the changing environment, such as consumer demand and cost of technology adoption, enable smaller banks to also adopt the technology (Sullivan & Wang, 2020). Firms adopt the technology according to their size, whereas the larger firms adopt it earlier than the smaller ones (Hernández-Murillo et al., 2010). The more profitable banks can cover the adoption cost and believe the adoption will assist in maintaining their competitive position (Furst et al., 2002) since the primary motive of financial innovation is profitability (Van Horne, 1985). For banks that rely less on traditional funding, adopting Internet banking is one of the ways to pursue a more aggressive overall business strategy (Furst et al., 2002). Additionally, the type of bank has also played a role in digital banking adoption. Banks affiliated with a Bank Holding Company may utilize the same infrastructure, such as a website belonging to a Bank Holding Company, to deliver Internet banking services (Furst et al., 2002). Moreover, market specifics, for instance, competition pressures, the initiative to differentiate, and attracting new customers, may induce banks to react toward digital banking adoption (Mullan et al., 2017; Dandapani, et al., 2018).

Empirical studies on determinants of digital banking have been conducted by examining Internet banking adoption (Furst et al., 2002; Malhotra & Singh, 2007; Hernández-Murillo et al., 2010; He et al, 2020; Sullivan & Wang, 2020) and mobile banking adoption (He, 2015). The previous studies investigated the adoption in the context of a conventional banking system. Mixed results have been found concerning the relationship between bank-specific characteristics, namely labour expense (L), profitability (P), deposits (D), and type of bank (T), and the likelihood of digital banking adoption, as presented in Table 1.

In addition, some studies also have been conducted on digital banking adoption in Indonesian banking taking various perspectives. Alisjahbana et al. (2020) find that technology adoption negatively affects labour demand, especially for small and moderate-size banks, while for the larger banks, the results are positive on the labour demand. Sapulette et al. (2021) reveal a significantly positive impact of Fintech on banks' stock returns of big banks during the COVID-19 pandemic, while it is negative for smaller banks. Medyawati et al. (2021) confirm the positive effect of digital banking adoption on bank profitability. Paminto et al. (2022) find that adopting mobile banking would improve bank profitability and stability, and the effect is more pronounced for private banks than for public banks. Yudaruddin

(2023a) argue that the emergence of Fintech start-ups is associated with negative bank performance, and higher Fintech start-ups categorized as P2P lending would positively impact Islamic bank performance. Using digital payment to indicate digitalization, Kasri et al. (2022) find digital payment affects banking stability in the long run while digital payment has a positive relationship with banking stability in the short run. The relationship between digital payment and banking stability is not evident in Islamic banking. Literature has shown that most studies on digital banking in Indonesia emphasize the impact of digital banking. To the best of our knowledge, none has been done to reveal factors explaining the adoption of digital banking in a dual banking system.

Table 1.
Mixed Results on Digital Banking Adoption Studies

References	L	P	D	T
Furst et al. (2002)		+	x	+
Malhotra and Singh (2007)	x	x	+	+
Hernández-Murillo et al. (2010)		-		+
He (2015) [1)]	+, x		x	
Sullivan & Wang (2020)	x		+	x

Note: L=Labour expense; P=Profitability; D=Deposits; T=Type of bank; x = insignificant relationship; + = positively significant; - = negatively significant; 1) He (2015) employed two indicators to analyze the effect of labour costs

III. CONCEPTUAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

3.1. Conceptual Framework

Diffusion of Innovation theory posits that the characteristics of the adopter influence the adoption of innovation (Dearing & Cox, 2018). The theory has also identified attributes of innovation as key to the adoption of innovation. Namely, the advantages carried by innovation, the degree of complexity of using the innovation, and the compatibility of the innovation with the values, and strategy or objectives are several attributes of innovation that have been identified to play important roles in adopting innovation. Besides, studies on financial innovation have found that the adoption of innovation in the financial sector increase efficiency by reducing cost and consequently boost profitability (Van Horne, 1985). The emergence of financial innovations has been to meet the needs of customers in the market. As a financial innovation, digital banking has been identified as having the capability to lower costs due to the automation of the process and to increase the customer experience with the expectation of expanding the customer base. By adopting digital banking, the bank has employed a business strategy to improve its performance.

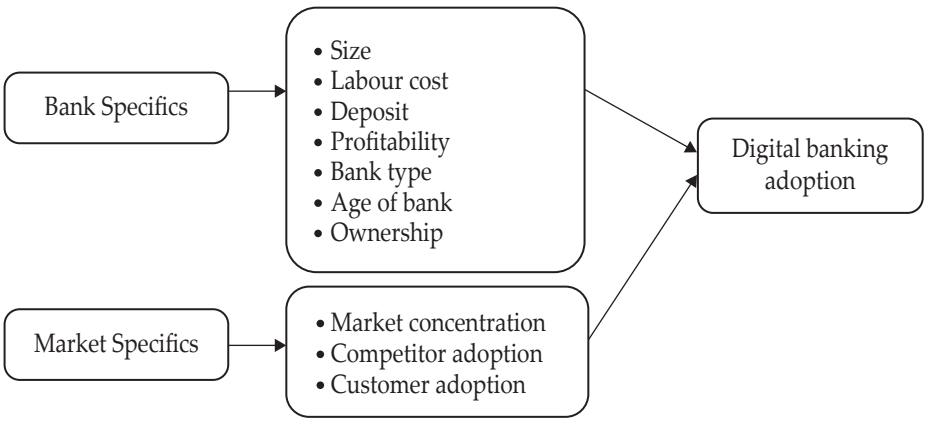

Figure 1.
Conceptual Framework of The Study

A study on digital banking adoption needs to consider the environment where the bank operates (Mullan et al., 2017). Diffusion of innovation reveals that the adoption of innovation occurs when the innovation is communicated to members of a system and communication between the those who have adopted the innovation and those who have not. As digital banking potentially increases the customer experience, the bank that has yet to adopt digital banking is threatened to lose customers to a bank that has embraced digital banking. Accordingly, in the market, the bank's adoption of digital banking may be influenced by the competitor's adoption. The conceptual framework of the adoption of digital banking by a bank is illustrated in Figure 1.

3.2. Hypotheses Development

3.2.1. Bank Size and Digital Banking Adoption

The size of the bank contributes to the likelihood of the adoption given that large banks can manage a broader range of activities due to economies of scale and a greater return on investment stemmed from the likelihood of large product sales (Frame & White, 2004). Adopting digital banking technology requires an initial investment to establish the technology, maintenance, and operational costs (Dandapani et al., 2018), and not all banks can adopt the technology. Large banks with more capacity thus can adopt digital banking earlier. In contrast, small banks tend to adopt later following the changes in the environment, especially the cost related to the technology adoption and customer willingness (Sullivan & Wang, 2020). Hence, large banks tend to adopt digital banking earlier than small banks. The size of the bank is predicted to influence digital banking adoption positively.

H1. Bank size has a significantly positive relation with digital banking adoption.

3.2.2. Labour Cost and Digital Banking Adoption

Cost reduction has been assumed as the relative advantage of digital banking, especially the reduction in overhead costs stemming from personnel supporting physical branches and substituting the personnel with the automated process (Tiwari et al., 2006; Shah & Clarke, 2009). In the case of an internet-only bank where the bank has no physical branches to operate, eliminating branches will decrease the operational cost due to eliminating expenses related to the physical components, such as labour cost, premises and fixed asset costs (DeYoung et al., 2007). The effect is quite similar to click and Mortar banks, which combine the physical branches and digital banking channels. Physical branches may be substituted by digital banking channels, which also reduce costs related to managing the physical branches (De Young et al. 2007). Banks with higher labour expenditure are more attracted to digital banking (Malhotra & Singh, 2007). Thus, a bank with higher labour expenditure is be more likely to adopt digital banking. Based on this, the present study expects a positive relationship between labour cost and the likelihood of digital banking adoption.

H2. Labour cost has a positive relation with digital banking adoption.

3.2.3. Bank's Deposit and Digital Banking Adoption

"Anytime and anywhere" in accessing banking services is the relative advantage of digital banking for customers. The digital banking allows customers to use banking services without having to visit bank branches, regardless of the customers' location. It is more convenient for the customers and impacts positively the customer experience. A bank relying less on traditional funding or core deposits is more motivated to adopt digital banking to pursue a more aggressive business strategy (Furst et al., 2002). Traditional funding or core deposits are considered to influence the adoption of digital banking by the bank. In addition, Sullivan & Wang (2020) find that the size of deposits positively correlates with Internet banking adoption. The bank that focuses more on the client base (i.e. deposits of the bank) tends to adopt Internet banking than the bank with a smaller number of deposits (Malhotra & Singh, 2007). Therefore, the direction of the effect of this variable is ambiguous.

H3. Banks' deposit has a relation with digital banking adoption.

3.2.4. Profitability and Digital Banking Adoption

Adopting digital banking requires a sizable investment (OJK, 2021b; OJK, 2021c) Bank profitability can generate internal funds to finance the investment in digital banking adoption. Hannan & McDowell (1984) argue that if the internally generated fund limits the investment in the innovation, then the profitable bank is more likely to have the capacity to adopt the innovation. The more profitable bank is stimulated to adopt digital banking due to the capacity for the adoption and to maintain its competitive position. In contrast, the less profitable bank is motivated to improve its performance (Malhotra & Singh, 2007) since profit is the basic reason for financial innovation to emerge in the market (Van Horne, 1985).

Therefore, the expected sign for profitability in digital banking adoption needs to be clarified.
H4. Profitability has a significant impact on digital banking adoption.

3.2.5. Bank Type and Digital Banking Adoption

Focusing relatively on a particular business or product may lead to business specialization (Deloitte, 2013). According to Boot-Thakor's model (1997), being a commercial bank or an investment bank (compared to universal bank) may influence to the likelihood of adoting innovation. More specifically, the probability of innovation would be higher in the bank with functionally separated than in a universal banking system (Tufano, 2003; Arnaboldi & Rossignoli, 2015). In the dual banking system, Islamic banking services may be offered by Islamic banks (full-fledged Islamic banks) or conventional banks through Sharia business units (Islamic windows). The corresponding conventional bank adopts an interest/ conventional banking system and an Islamic banking system, while the Islamic bank only adopts the Islamic banking system. In this regard, an Islamic bank is specialized compared to a conventional bank. In particular, Yunita (2021) finds that the profitability of Islamic banks in Indonesia is higher than that of conventional banks during the rapid adoption of digital banking (2015-2019). Since digital banking (Internet banking/mobile banking) is one example of financial innovation, Islamic banks are predicted to be more likely to adopt digital banking.
H5. Islamic banks are more likely to adopt digital banking.

3.2.6. Age of the Bank and Digital Banking Adoption

The age of the bank is also considered to affect the decision to adopt digital banking. Usually, the bank tends to have existing procedures, systems, and infrastructure in place. Banks will consider the degree to which new technology is compatible with the legacy systems, such as existing procedures, systems and infrastructure (Mullan et al., 2017). The older bank is more likely to have more profound legacy systems that make it more difficult to deploy new technology in the bank. The newer bank is considered to have no legacy system and is less likely to have managerial obstacles (Malhotra & Singh, 2007). In addition, newer banks believe that new technology creates new business opportunities (Furst et al., 2002). On the other hand, the older bank is expected to adopt digital banking due to the accumulation of experience and reduced perceived risk in investment (Malhotra & Singh, 2007). In the Indonesian Islamic banking context, Haryati et al. (2019) find no evidence of the effect of bank age on Islamic bank profitability. Therefore, the age of banks ambiguously influences the adoption of digital banking.
H6. The age of the bank has a relation with the adoption of digital banking.

3.2.7. Ownership and Digital Banking Adoption

The organizational difference in ownership has been identified to influence banks to deliver services to customers (Harun, 2023). Banks may be differentiated into public banks and private banks based on ownership. A public bank refers to a

bank directly or indirectly controlled by the state, which is characterized as more bureaucratic and much less concerned about profit. In contrast, a private bank is under the control of private capital (Kangis & Kareklis, 2001). A public bank is more likely to offer banking services in poor infrastructure facilities and technology than a private bank (Harun, 2023). Thus, the bank with private ownership is more likely to adopt Internet banking (Malhotra & Singh, 2007).
H7. A private bank is more likely to adopt digital banking.

3.2.8. Market Concentration and Digital Banking Adoption
Adopting new technology depends on the characteristics of the bank's market structure (Hernández-Murillo et al., 2010). Hannan & McDowell (1984) argue that a bank operating in a more concentrated market has a higher probability of adopting a new technology. Dandapani et al. (2018) opine that high-level competition, denoted by a low-concentrated market, encourages credit unions to differentiate their services from competitors by adopting Internet banking. A study by Cupian & Abduh (2017) finds that the Indonesian banking industry is a high-concentration market, leading to a less competitive market. Thus, the direction of the relationship between market concentration and digital banking adoption needs to be clarified.
H8. Market concentration has a relation with the digital banking adoption.

3.2.9. Adoption by Competitors and Digital Banking Adoption
Rogers' Diffusion of Innovation theory emphasizes the role of communication by the adopter to diffuse the innovation (Sullivan & Wang, 2020). Individuals or organizational adopters may influence the rate of adoption in the social system, particularly in the case of voluntary adoption. When an influential member in a social system adopts the innovation and communicates the decision to other members, then the rate of adoption is accelerated and the state of the social system changes (Dearing & Cox, 2018). Adopting digital banking can be regarded as one of the strategies to differentiate from others (Dandapani et al., 2018). Organizations take a reaction toward pressure stemming from the organization or institution around them (Mullan et al., 2017). Therefore, it is crucial to consider the proportion of banks that have adopted digital banking, which is associated with the reaction of a bank or bank strategy toward the behaviour of rivals on the adoption of digital banking (Malhotra & Singh, 2007; He, 2015). The more competitors adopt digital banking, the more pressure they exert on the bank to adopt digital banking.
H9. Competitors' adoption of digital banking has a positive impact on digital banking

3.2.10. COVID-19 Pandemic and Digital Banking Adoption
Social/physical distancing imposed on customers during the COVID-19 pandemic has encouraged customers to demand cashless transactions and anytime-anywhere services (IFSB, 2020; Mariani et al., 2021). Banks have been motivated to adopt digital banking to meet the financial needs of customers as digital banking services that provide banking services anytime and anywhere is suitable to the customers

in the COVID-19 pandemic. They have been forced to adopt digital banking to retain or attract new customers. The COVID-19 pandemic has accelerated the adoption of digital banking by banks (Mariani et al., 2021). In Indonesia, several studies have confirmed the effect of Covid-19 on bank performance. Yudaruddin (2023b) confirms Covid-19 causing a decrease in bank performance, regardless of whether they are Islamic or conventional banks. In contrast, Sapulette et al. (2021) find a significantly positive impact of the fintech on the banks' stock returns for big banks during the COVID-19 pandemic and the opposite impact for smaller banks.
H10. The COVID-19 pandemic positively influenced the adoption of digital banking by the bank.

3.2.11. Customers' Adoption and Digital Banking Adoption

Digital banking enables customers to access banking services conveniently, anytime, anywhere, seamlessly, and personalized, and hence enhancing customer experience (Laukkanen, 2007; Laukkanen, 2016; Verhoeff, 2015; Sullivan & Wang, 2020). The provision of digital banking, such as internet banking and mobile banking, is to attract new customers (Dandanpani et al., 2018). Mbama et al. (2018) opine that providing digital banking to the customers positively impacts the banks' financial performance by reaching out to more customers in remote areas and up-selling to the existing customers, thereby increasing sales. Eventually, customer preferences for digital banking services increase sales and transactions. Considering the impact of digital banking on the bank's performance, the bank is motivated to adopt digital banking.
H11. Customers' adoption of digital banking influence positively the adoption of digital banking.

IV. METHODOLOGY

4.1. Data and Sample

The Indonesian banking industry has adopted a dual banking system to provide banking services. In this dual banking system, Islamic banking products and services are offered to the customers by both *Conventional banks* through its Sharia Business Unit (Islamic windows) and *Islamic banks* (full-fledged Islamic banks or Sharia Commercial Bank). As a part of a Conventional bank, the Sharia Business Unit benefits from the bank in business strategy, information and technology infrastructure, publication of financial reports, capital requirements and others. Accordingly, this study opts for Conventional banks that offer Islamic banking products and services and Islamic banks as the study sample.

The data on digital banking adoption is hand-collected from banks' annual reports and verified with the first mobile banking application launched on the PlayStore or AppStore. Previous studies on financial innovation utilize banks' annual reports (Arnaboldi & Rossignoli, 2015; He et al., 2020) and the first mobile banking launched on the AppStore (He, 2015) to identify the adoption of financial innovation, online banking and mobile banking adoption. Firstly, we collect the banks' annual reports by downloading the reports from the banks' official websites. Banks with incomplete annual reports are excluded from the sample. Secondly,

we identify banks offering/adopting Internet and mobile banking based on annual reports. For mobile banking adoption, data obtained from banks' annual reports are confirmed with the first mobile banking application launched on the PlayStore or AppStore through website applications (www.appbrain.com, www.apptopia.com) and online newspapers. In this stage, banks are excluded from the sample for the banks with unclear information regarding Internet banking and mobile banking adoption. Lastly, we determine the time of digital banking adoption based on the first-time the bank adopting digital banking regardless of whether it is Internet or mobile banking. Banks' financial data are obtained from the banks' financial reports and banking industry statistics as of 30 June and 31 December for each year during the period of the study, which can be downloaded from the OJK website and Bank Indonesia websites. Financial data from the income statement as of 30 June is annualized before further calculation.

The sample size is limited by the availability of data on digital banking adoption and the financial reports of the banks. This study covers Islamic and Conventional banks offering Islamic banking products and services between 2010 and 2022. 2010 is chosen as a starting point to avoid the effect of the Global Financial Crisis. Moreover, Islamic banks have grown in number only after the Global financial crisis. As of December 2022, there are 13 Sharia Commercial banks and 20 Conventional banks offering Islamic banking products and services. Following the procedure for obtaining data on digital banking adoption, the final panel sample of this study is unbalanced comprising 10 Sharia Commercial Banks and 12 Conventional Banks with 720 semi-annual observations covering the period 2010-2022. The sample covers roughly 83% of Islamic banking assets in Indonesia in 2022. Semi-annual data in this study follows a study by Alisjahbana et al. (2020) on digital technology in the Indonesian banking industry.

Note that, in 2021, there was a merger of three Sharia Commercial Banks into the largest Sharia Commercial Bank in Indonesia. All the banks involved in the merger activity, three pre-merger Sharia Commercial Banks and a post-merger Sharia Commercial Bank, are maintained as samples in the study to capture the characteristics of Sharia Commercial Banks in the digital banking adoption. 56.81% of total observations are categorized as banks adopting digital banking (adopters). Of the adopters, conventional banks categorized as adopters (60.6%) are higher than Sharia commercial banks (39.4%). Regarding bank types, 38.19% of total observations are from Sharia Commercial Banks. Data distribution is presented in Table 2.

Table 2.
Distribution of Sample

	Digital Banking Adoption		
Bank Type	**Non-adopter**	**Adopter**	**Total Observations**
Conventional Bank	197	248	445
Sharia Commercial Bank	114	161	275
Total	**311**	**409**	**720**

The adoption of digital banking has varied across observation periods, as illustrated in Figure 2. Six banks have adopted digital banking before the beginning period of observations (early adopters). We may note momentum in the adoption of digital banking in 2015. According to OJK, Indonesian banking experienced a rapid digital banking adoption in 2015-2019 (Yunita, 2021). At the end of 2022, only one bank is a non-adopter.

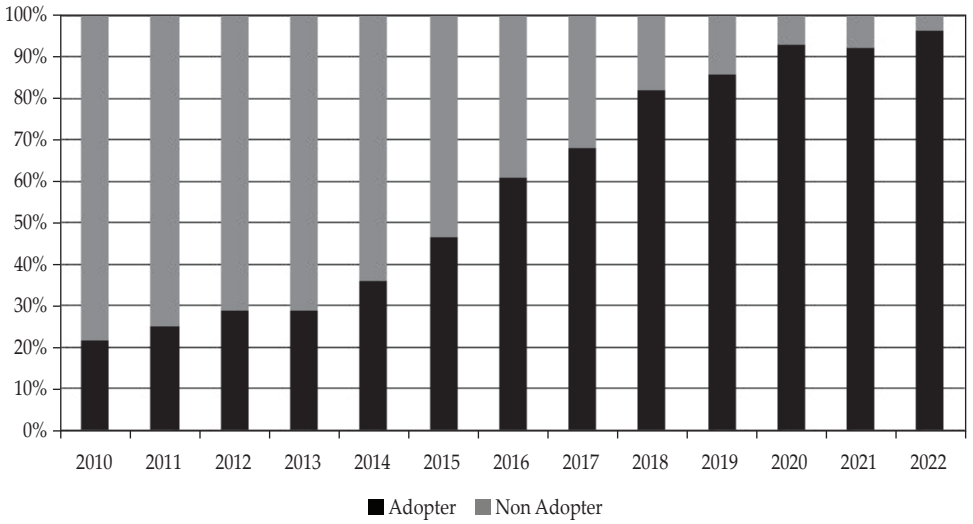

Figure 2.
Digital Banking Adoption

4.2. Variables

The choice of variables in this study is aligned with the theoretical/conceptual framework and hypotheses elaborated in the previous section. Data availability is also considered. Digital banking adoption (DBA) is the dependent variable which indicates whether a bank has adopted or has not adopted digital banking services. Digital banking generally refers to internet banking and mobile banking. A bank is assumed to have digital banking services if the bank *at least* has adopted one type of digital banking, namely, internet banking or mobile banking. Digital banking adoption is a dummy variable which takes a value of 1 if bank *i* has adopted digital banking in period *t;* otherwise, 0.

Bank characteristics can be grouped into financial characteristics, namely, bank size (ASSET), labour cost (LABOUR), bank deposits (DEPOSIT) and profitability (ROA), and non-financial characteristics, namely, bank type (BTYPE), age of the bank (AGE) and ownership type (OWNER). Market concentration is measured by the Concentration Ratio (CR5) and competitors' adoption by the share of digital banking adoption. Both represent the market characteristics. In addition, the presence of COVID-19 (COVID) and customer adoption of digital banking (CUST) are included in the model as variables of interest. Table 3 describes the variables used in this study and their data sources.

Table 3.
Variable Description and Sources

No	Variable	Description	Source
1	Digital Banking Adoption (DBA)	The dummy variable takes a value of 1 for the bank that has adopted *at least* one type of digital banking.	Banks' annual reports, www.appbrain.com, www.apptopia.com
2	Bank Size (ASSET)	The natural log of total assets	Banks' financial report
3	Labour Cost (LABOUR)	The ratio of labour expense over total assets	Banks' financial report
4	Bank's Deposit (DEPOSIT)	The ratio of total deposits over total assets	Banks' financial report
5	Profitability (ROA)	The ratio of earnings before tax to average total assets [1)]	Banks' financial report
6	Type of Bank (BTYPE)	The dummy variable takes a value of 1 for the Islamic bank and 0 for the conventional bank.	Banks' annual reports
7	Age of Bank (AGE)	The natural log of the number of years from the date of establishment to the period of analysis [2)]	Banks' annual reports
8	Ownership Type (OWNER)	The dummy variable takes a value of 1 for the private bank and 0 for the public bank.	Banks' annual reports
9	Market Concentration (CR5)	The sum of assets for the five largest banks in the Islamic banking industry divided by the total assets of the Islamic banking industry	Islamic banking statistics, Banks' financial reports.
10	Competitors' adoption (DBS)	The number of banks that have adopted digital banking over the total number of banks	Banks' annual reports, www.appbrain.com, www.apptopia.com
11	COVID-19 (COVID)	The dummy variable takes a value of 1 for the time of COVID-19 and otherwise is 0 [3)]	Government Regulation No. 21/2020
12	Customers Adoption (CUST)	Natural log of the aggregate of digital banking transactions	Proprietary channel statistics

Note:

1. The value of ROA is available in the bank's financial reports.
2. The date of establishment refers to when the bank received the license or operated, regardless if the bank had converted from a Conventional Bank to a Sharia Commercial Bank.
3. Government Regulation No. 21/2020 on Large Scale Social Restriction in the effort to handle COVID-19 was established on March 31, 2020, and the date is set as the starting point for the COVID-19 pandemic.

4.3. Model Specification

The present study specifies the probability of digital banking adoption by Islamic banks as a function of bank-specific and market-specific factors. Following Furst et al. (2002), Malhotra & Singh (2007) and Dandapani et al. (2018), a logistic model is employed (Hair et al., 2014; Pahi & Yadav, 2019). Logistic regression has the advantage of not requiring a specific distributional form of independent variables (Hair et al., 2014), and it also does not require a linear relationship between dependent variables and independent variables (Hair et al., 2014; Jaloudi, 2019). It also enables heteroscedasticity in the model (Hair et al., 2014).

The model is specified as:

$$LOGIT(DBA)_{i,t} = \beta_0 + \beta_1\, ASSET_{i,t} + \beta_2\, LABOUR_{i,t} + \beta_3\, DEPOSIT_{i,t} + \beta_4\, ROA_{i,t} + \beta_5\, X_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where DBA, ASSET, LABOUR, DEPOSIT and ROA are as defined above and X is a variable from the list of the remaining variables (bank non-financial characteristics, market characteristics, COVID-19, and customer adoption).

V. RESULTS AND ANALYSIS

5.1. Descriptive Statistics

Table 4 presents the descriptive statistics of the variables. The average assets of banks, labour expenses, and deposits are IDR 48,3 trillion, IDR 766 billion, and IDR 37,35 billion, respectively. Banks adopting digital banking have higher assets, labour expenses and deposits than non-adopting digital banking. ROA averages roughly 1.9% per annum which is higher than the average ROA of banks adopting digital banking. Banks in this study have an average age of 47 years, almost similar to the age of banks adopting digital banking. The average share of digital banking adoption (DBS) and Concentration Ratio (CR5) are 56.8% and 65.1%, respectively. Of the total observations, number of banks adopting digital banking is relatively higher than the number of banks that do not adopt digital banking.

5.2. Correlation Analysis

Prior to the analysis, all independent variables are lagged one period to mitigate the endogeneity problem and winsorized at 1% and 99% is applied to mitigate the presence of outliers (Al-Najjar & Kilincarslan, 2016; He et al., 2020). In addition, the presence of collinearity is an issue for the logistic regression (Hair et al., 2014). Therefore, we conduct a correlation analysis and the results are presented in Table 5. The correlation coefficients among independent variables are all below 0.5, which indicates no serious issue of multicollinearity.

Table 4.
Descriptive Statistics

Variable	Obs	Mean	Std.Dev.	Dba(0)		Dba(1)	
				Obs.	Mean	Obs.	Mean
Asset	720	48,307	70,637	311	16,433	409	72,543
Labour	720	766	949	311	300	409	1,120
Deposit	720	37,352	53,939	311	12,753	409	56,057
ROA	720	0.019	0.024	311	0.024	409	0.015
Age	720	47	17	311	45.06	409	47.77
DBS	720	0.568	0.279	311	0.388	409	0.705
CR5	720	0.651	0.061	311	0.679	409	0.629

Notes: Asset, labour expense, deposit in IDR Billion; Dba(0) = bank non-adopting digital banking, Dba(1) = bank adopting digital banking.

5.3. Results and Discussion

Table 6 presents the estimation results of the panel logistic regression model. The Likelihood Ratio (LR) statistics for all the models are significant at one per cent level confirming that the models have a good fit and the coefficients are jointly different from zero (Malhotra and Singh, 2007; Hair et al., 2014; Jaloudi, 2019). Another measure for a good model fit is the Pseudo R^2 which is similar to coefficient determination in multiple regression. Pseudo R^2 for all the models are above 0.5 indicating a good model fit for all the models in this study (Hair et al., 2014).

The regression results in column 1 consider only bank financial characteristics as determinants of digital banking adoption. From the results, we may note that bank size positively anticipate the probability of digital banking adoption, where its coefficient is significant at one per cent level. This result is consistent with Furst et al. (2002), Malhotra & Singh (2007), Hernández-Murillo et al. (2010), He (2015) and Dandapani et al. (2018). Presumably, larger banks are more likely to adopt digital banking, stemming from their greater capability in making digital investment (OJK, 2021c). Moreover, the Diffusion of Innovation theory reveals that, coupled with its benefits, adopting new technology or innovation entails risks to the adopters. Larger banks would have more capability to handle the risks arising from the digital banking adoption. They are also driven by the scale economies in their adoption of the new technology (He, 2015).

One of the advantages of adopting digital banking is to reduce the costs related to bank branches, particularly the labour costs. However, in this study, labour cost (LABOUR) insignificantly affects the likelihood of digital banking adoption. This finding is consistent with Malhotra & Singh (2007). The finding also supports Hidayat & Kassim (2022) who find no relationship between labour costs and electronic banking transactions in Indonesian Islamic banking. Thus, reducing labour costs has not been a primary reason for banks to adopt digital banking.

In contrast to the labour cost, DEPOSIT, representing the bank's traditional funding, significantly and negatively influences the adoption of digital banking. The result supports the previous studies by Malhotra & Singh (2007) and Sullivan & Wang (2020). Banks with lower deposits are more likely to adopt digital banking to increase the customer base. The lower the deposit means that the bank relies more on traditional funding such as current accounts, saving accounts or time deposits than other sources such as money market funds. The insignificant labour expense and the significance of the deposit suggest that the bank orientation is more on the customer side by expanding the customer base than operational orientation, such as lowering the labour cost.

The results also indicate that profitability (ROA) significantly affects the likelihood of adopting digital banking. This finding is consistent with Hernández-Murillo et al. (2010). The negative sign means less profitable banks are more likely to offer digital banking to improve performance (Furst et al., 2002). In other words, digital banking is assumed to be a potential business strategy to increase performance.

In columns 2 to 8, we include non-financial bank characteristics and market characteristics in turn in the model. As may be noted in column (2), bank type (BTYPE) significantly and positively affects the likelihood of banks adopting digital banking. This means that Islamic banks are more likely to adopt digital

banking. This finding is consistent with Hannan & McDowell (1984). They note that specialisation is one of the bank characteristics accounting for innovation adoption.

Age of bank (AGE) is found to positively influence digital banking adoption. The older bank is more likely to adopt digital banking than a younger bank. This finding is consistent with the sample statistics which suggest banks adopting digital banking, on average, have longer ages than non-adopting digital banking. However, the finding contradicts Furst et al. (2002), Malhotra & Singh (2007), Hernández-Murillo et al. (2010) and Sullivan & Wang (2020). They find new banks to be more likely to adopt Internet banking. Older banks, which have been around for longer years in banking, have accumulated experience and reduced perceived risk in digital banking investment (Mahotra & Singh, 2007). Accelerating digital transformation has been stipulated as a strategic direction of Indonesian banking development 2020-2025 by OJK, and to this end, OJK has supported banks to improve synergy and technology collaborations between banks and the digital ecosystem to increase banks' competitiveness (OJK, 2021c).

Ownership type carries a positive and significant coefficient, indicating that private banks are more likely to offer digital banking than public banks. This finding supports Malhotra & Singh (2007). Customers view banking services, information and technology infrastructure used by private banks as more competitive than public banks (Harun, 2023). Private banks have been identified to use information systems more extensively than public banks (Kangis & Kareklis, 2001).

Table 5.
The Correlation Coefficient Matrix

	ASSET	LABOUR	DEPOSIT	ROA	BTYPE	AGE	OWNER	CR5	DBS	COVID
ASSET	1									
LABOUR	-0.3512	1								
DEPOSIT	0.3396	-0.0166	1							
ROA	0.0425	0.1052	0.0237	1						
BTYPE	-0.4627	0.1290	-0.1677	-0.4133	1					
AGE	0.4226	-0.1577	0.1077	0.2900	-0.5809	1				
OWNER	-0.0992	-0.1209	-0.3191	-0.2837	0.3416	-0.1551	1			
CR5	-0.1968	0.1221	0.1055	0.175	-0.0417	-0.1362	-0.0028	1		
DBS	0.2457	-0.1792	-0.1050	-0.2063	0.0412	0.1896	0.0090	-0.7414	1	
COVID	0.1397	-0.1128	-0.0499	-0.1119	0.0008	0.1257	0.0159	0.0083	0.5868	1

Note: The correlation coefficient for customer adoption is not displayed in Table 4 since the period of the sample differs from Table 4. However, the estimation for customer adoption is still maintained to avoid the correlation issue among independent variables.

Table 6.
Logit Estimation Results

	1	2	3	4	5
ASSET	23.20338*** (3.5409)	20.19121*** (1.4338)	15.29351*** (1.130459)	23.12837*** (2.575836)	25.0466*** (3.288616)
LABOUR	16.74307 (56.60565)	21.44618 (52.0402)	47.80108 (50.94396)	18.07003 (56.03316)	131.3842* (67.81675)
DEPOSIT	-26.89035*** (7.12188)	-23.22211*** (5.298187)	-16.23301*** (4.715065)	-26.67086*** (6.423183)	-21.41084*** (6.238547)
ROA	-146.2332*** (43.93985)	-128.1275*** (38.94281)	-111.3137*** (33.68386)	-138.4776*** (41.00019)	-134.3378*** (38.71092)
BTYPE		23.35401*** (4.362918)			
AGE			9.415302*** (1.625488)		
OWNER				22.07041** (10.58587)	
CR5					-35.17711*** (8.139164)
DBS					
COVID					
CUST.					
Cons.	-194.9503*** (28.92202)	-182.8454*** (14.63936)	-165.5603*** (9.344929)	-202.0588*** (22.63879)	-195.1439*** (26.34316)
LR chi2(4)	486.93***	494.43***	491.71***	493.41***	509.53***
Pseudo R2	0.657827	0.667951	0.664285	0.666573	0.688350
Obs.	691	691	691	691	691

Note: Standard errors in parentheses, *,**,*** Significant at 10, 5, and 1 per cent levels, respectively.

Table 6.
Logit Estimation Results (Continued)

	6	7	8[1)]
ASSET	10.95515*** (1.749678)	19.7278*** (2.968864)	25.02299*** (5.438969)
LABOUR	210.8219 (139.952)	-20.03164 (57.84728)	31.74109 (80.87118)
DEPOSIT	-2.384714 (9.66555)	-22.61576*** (6.3033)	-33.63312*** (11.56606)
ROA	-99.60893 (63.17159)	-132.4559*** (35.99496)	-162.1646*** (45.39095)
BTYPE			
AGE			
OWNER			
CR5			
DBS	50.43323*** (8.540812)		
COVID		13.50421** (5.834077)	
CUST.			6.264183*** (1.587105)
Cons.	-127.997*** (20.62579)	-166.3926*** (25.20348)	-300.4683*** (59.46795)
LR chi2(4)	584.9***	499.02***	302.92***
Pseudo R2	0.790172	0.674153	0.6032461
Obs.	691	691	523

Note: Standard errors in parentheses; *, **, *** Significant at 10, 5, and 1 per cent levels, respectively.

[1)] Logit estimation utilises data from 2013 – 2022 following digital banking transaction data availability.

In this study, market concentration negatively affects banks' decision to adopt digital banking. High market concentration generally would lead to a less competitive market and vice versa (Cupian & Abduh, 2017). In the low market concentration, bank encounters highly competitive pressure. The cumulative organisational stress, including institutional or competitive pressure, may induce the organization to react and adapt to the pressure (Mullan et al., 2017). Adopting digital banking is a strategy to differentiate the bank from its competitors in the market, or if the competitors have adopted digital banking, the provision of digital banking to the customers is to prevent the possibility of losing market share (Dandapani et al., 2018). Thus, banks operating in low market concentration are more likely to adopt digital banking. The finding is consistent with He (2015) and Dandapani et al. (2018).

Our results also show that the share of digital banking adoption (DBS) significantly and positively influences digital banking adoption. The bank is more likely to adopt digital banking when many other banks adopt digital banking. The finding supports Malhotra & Singh (2007) and He (2015). It suggests that the digital banking adoption is also driven by the competitive pressure from peers.

Roger's Diffusion of Innovation Theory has emphasised the important roles of communication and observability. When the one who has adopted the technology communicates to others, the adoption rate will increase (Dearing & Cox, 2018; Sullivan & Wang, 2020). As one of the critical determinants influencing the pace of digital banking adoption, observability refers to the number of other banks using digital banking (Mullan et al., 2017). It is critical to communicate among the

members of the banking system, particularly between the banks that have adopted it and the banks that have not, to encourage the latter to adopt the technology. Observation and communication may increase understanding of the benefits and risks of digital banking adoption, lowering the risks for late adopters.

The COVID-19 pandemic positively influences banks to offer digital banking services. The COVID-19 pandemic situation has made banks more likely to adopt digital banking. It is necessary for banking to reach customers remotely during the COVID-19 pandemic due to social/physical distancing. The COVID-19 pandemic has changed preference of customers towards cashless transactions (IFSB, 2020) remote access to banking services. Banks need to anticipate the situation by accelerating digital banking transformation (OJK, 2021c; Mariani et al., 2021) as digital banking enables customers to access banking services conveniently anytime and anywhere.

Finally, we also note that customer adoption (CUST) as proxied by digital banking transactions influences the adoption of digital banking significantly and positively. The Diffusion of Innovation theory reveals that relative advantage is one of the attributes that would lead to the adoption of innovation. Customers prefer to use digital banking services since they are able to access banking services anytime and anywhere (Tiwari et al., 2006; Shah & Clarke, 2009), which would increase the customer experience as well as the efficiency of accessing banking services (Laukkanen, 2007). Customer preferences to use digital banking for transactions have stimulated banks to adopt digital banking as applying digital banking would increase customer satisfaction and widen customer base.

5.4. Robustness Tests

Further analysis is conducted to test the robustness of the logit estimation results in this study. Firstly, alternative measures of bank variables are used. Namely, the labour expense and Return on Assets ratio are substituted with the efficiency ratio defined as operational cost to operational income ratio (OCOI) and Return on Equity (ROE). The Logit estimation results using these alternative measures are consistent with the results of the models in this study.

Secondly, a sub-sample is constructed by eliminating the banks involved with the merger activity in 2021 (three Sharia Commercial Banks before and one commercial bank after the merger activity) and eliminating early adopter and non-adopter banks. Thus, the robustness test's sub-sample only consists of banks adopting digital banking during 2010 – 2022. Again, the logit estimation results of the sub-sample corroborate the earlier findings. For the sake of brevity, the logit estimation results for these robustness tests are presented in the Appendix.

VI. CONCLUSION AND RECOMMENDATION

The present study investigates roles of bank and market characteristics in adopt digital banking adoption among banks offering Islamic banking services in Indonesia. The sample comprises Sharia commercial banks (full-fledged Islamic banks) and Conventional banks that own Sharia Business Units. Banks' annual reports and the time of the first mobile banking application launched on the

PlayStore and AppStore are combined to derive the adoption of digital banking data by the banks in the sample. Using semi-annual data drawn from banks' financial reports and banking statistics as of June and December for each year from 2010-2022, we employ a panel logistic regression for the analysis.

The logit result confirms that bank size, deposit and profitability, significantly affect the likelihood of digital banking adoption. A bank with a larger size, lower deposit and lower profitability is more likely to adopt digital banking. Sharia commercial banks, older banks, and private banks have more probability of adopting digital banking. Adoption by competitors and customer adoption significantly influence the decision of a bank to adopt digital banking. Enhancing customer experience instead of cost orientation has motivated banks to adopt digital banking. In addition, the COVID-19 pandemic has stimulated banks to adopt digital banking to fulfil customer financial needs. Robustness tests using alternative measures and sub-samples corroborate the findings of the study. These findings should prove important in crafting initiatives to promote the adoption of digital banking in Indonesia.

Finally, we should note that this present study is limited to banks offering Islamic banking services in Indonesia. The similar analysis might be extended to other dual banking countries to gain more insights on the issue. Moreover, it is suggested that further research be conducted to include more factors such as demographic factors into the analysis.

ACKNOWLEDGEMENTS

We would like to thank Prof. Dr. Mansor H. Ibrahim, Dr. Nur Harena Redzuan, and Dr. Rifki Ismal for providing constructive comments on the earlier drafts of this paper.

REFERENCES

Alisjahbana, A.S., Setiawan, M., Effendi, N, Santoso, T., & Hadibrata, B. (2020). The adoption of digital technology and labor demand in the Indonesian banking sector. *International Journal of Social Economics, 47*(9), 1109-1122.

Al-Jabri, I. M., & Sohail, M. S. (2012). Mobile banking adoption: Application of diffusion of innovation theory. *Journal of Electronic Commerce Research, 13*(4), 379-391.

Al-Najjar, B., & Kilincarslan, E. (2016). The effect of ownership structure on dividend policy: Evidence from Turkey. *Corporate Governance: The International Journal of Business in Society, 16*(1), 135-161.

Arnaboldi, F., & Rossignoli, B. (2015). Financial innovation in banking. In Beccalli, E., Poli, F. (Eds), *Bank risk, governance and regulation* (pp. 127-162). London: Palgrave Macmillan UK.

Bank Indonesia. (2019). Navigating the National Payment Systems in the Digital Era. Bank Indonesia.

Barnes, S. J., & Corbitt, B. (2003). Mobile banking: Concept and potential. *International journal of mobile communications, 1*(3), 273-288.

Berger, A. N. (2003). The economic effects of technological progress: Evidence from the banking industry. *Journal of Money, Credit and Banking, 35*(2), 141-176.

Chauhan, S., Akhtar, A., & Gupta, A. (2022). Customer experience in digital banking: A review and future research directions. *International Journal of Quality and Service Sciences, 14*(2), 311-348.

Choi, J., Santhanam, P., Wray, P., Shubhankar, S., & Vandensteen, J. (2020). The Rise of Digital Banking in Southeast Asia. *Boston Consulting Group. Retrieved January, 31, 2021.*

Cupian, & Abduh, M. (2017). Competitive condition and market power of Islamic banks in Indonesia. *International Journal of Islamic and Middle Eastern Finance and Management, 10*(1), 77-91.

Dandapani, K., Lawrence, E. R., & Rodriguez, J. (2018). Determinants of transactional internet banking. *Journal of Financial Services Research, 54*, 243-267.

Dearing, J. W., & Cox, J. G. (2018). Diffusion of innovations theory, principles, and practice. *Health affairs, 37*(2), 183-190.

Deloitte. (2013). Bank specialization: New strategies, new risks? *Deloitte Center for Financial Services.*

DeYoung, R., Lang, W. W., & Nolle, D. L. (2007). How the internet affects output and performance at community banks. *Journal of Banking & Finance, 31*(4), 1033-1060.

Frame, W. S., & White, L. J. (2004). Empirical studies of financial innovation: lots of talk, little action?. *Journal of Economic Literature, 42*(1), 116-144.

Furst, K., Lang, W. W., & Nolle, D. E. (2002). Internet banking. *Journal of Financial Services Research, 22*(1/2), 95-117.

Garzaro, D. M., Varotto, L. F., & Pedro, S. D. C. (2021). Internet and mobile banking: The role of engagement and experience on satisfaction and loyalty. *International Journal of Bank Marketing, 39*(1), 1-23.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). *Multivariate data analysis: Pearson new international edition*. Essex: Pearson Education Limited.

Hamouda, M. (2019). Omni-channel banking integration quality and perceived value as drivers of consumers' satisfaction and loyalty. *Journal of Enterprise Information Management, 32*(4), 608-625.

Hannan, T. H., & McDowell, J. M. (1984). The determinants of technology adoption: The case of the banking firm. *The RAND Journal of Economics, 15*(3), 328-335.

Harun, M. A. (2023). Customers' choice of the bank during the Covid-19 pandemic: The moderating effect of different banks in Bangladesh. *South Asian Journal of Marketing, 4*(1), 33-50.

Haryati, N., Burhany, D. I., & Suhartanto, D. (2019, November). Assessing the profitability of Islamic banks: The role of bank age and bank performance. In *IOP Conference Series: Materials Science and Engineering* (Vol. 662, No. 6, p. 062014). IOP Publishing.

He, D., Ho, C. Y., & Xu, L. (2020). Risk and return of online channel adoption in the banking industry. *Pacific-Basin Finance Journal, 60*, 101268.

He, Z. (2015). Rivalry, market structure and innovation: The case of mobile banking. *Review of Industrial Organization, 47*(2), 219-242.

Hernández-Murillo, R., Llobet, G., & Fuentes, R. (2010). Strategic online banking adoption. *Journal of Banking & Finance, 34*(7), 1650-1663.

Hidayat, A. and Kassim, S. (2022). E-banking adoption, labour cost and deposit in Islamic banking: Evidence from Indonesia. *The Proceeding of The International*

Conference on Islamic Economics and Finance (ICIEF) 2021, Department of Syaria Economic, Faculty of Economic and Management, IPB University.

Hoehle, H., Scornavacca, E., & Huff, S. (2012). Three decades of research on consumer adoption and utilization of electronic banking channels: A literature analysis. *Decision Support Systems, 54*(1), 122-132.

Indonesian Ministry of National Development Planning. (2019). The Indonesia Masterplan of Sharia Economy 2019-2014.

Islamic Financial Services Board (IFSB). (2020). Islamic Financial Services Industry Stability Report 2020.

Jaloudi, M. M. (2019). The efficiency of Jordan insurance companies and its determinants using DEA, slacks, and logit models. *Journal of Asian Business and Economic Studies, 26*(1), 153-166.

Kangis, P., & Kareklis, P. (2001). Governance and organisational controls in public and private banks. *Corporate Governance: The International Journal of Business in Society, 1*(1), 31-38.

Kasri, R. A., Indrastomo, B. S., Hendranastiti, N. D., & Prasetyo, M. B. (2022). Digital payment and banking stability in emerging economy with dual banking system. *Heliyon, 8*(11), e11198.

Komulainen, H., & Makkonen, H. (2018). Customer experience in omni-channel banking services. *Journal of Financial Services Marketing, 23*, 190-199.

Laukkanen, T. (2007). Internet vs mobile banking: Comparing customer value perceptions. *Business Process Management Journal, 13*(6), 788-797.

Laukkanen, T. (2016). Consumer adoption versus rejection decisions in seemingly similar service innovations: The case of the Internet and mobile banking. *Journal of Business Research, 69*(7), 2432-2439.

Levy, S. (2022). Brand bank attachment to loyalty in digital banking services: Mediated by psychological engagement with service platforms and moderated by platform types. *International Journal of Bank Marketing, 40*(4), 679-700.

Liébana-Cabanillas, F., Muñoz-Leiva, F., & Rejón-Guardia, F. (2013). The determinants of satisfaction with e-banking. *Industrial Management & Data Systems, 113*(5), 750-767.

Malhotra, P., & Singh, B. (2007). Determinants of Internet banking adoption by banks in India. *Internet Research, 17*(3), 323-339.

Mariani, P., Singh, A.V., Bahri, E., Zerhouni, K., and Sik, F. (2021). Beyond banking: Is there an opportunity for banks to go beyond banking in the UAE?. MP2-Arthur D. Little.

Mbama, C. I., Ezepue, P., Alboul, L., & Beer, M. (2018). Digital banking, customer experience and financial performance: UK bank managers' perceptions. *Journal of Research in Interactive Marketing, 12*(4), 432-451.

Medyawati, H., Yunanto, M., & Hegarini, E. (2021). Financial technology as determinants of bank profitability. *Journal of Economics, Finance and Accounting Studies, 3*(2), 91-100.

Merton, R. C. (1992). Financial innovation and economic performance. *Journal of Applied Corporate Finance, 4*(4), 12-22.

Mishra, V., & Singh, V. (2015). Selection of appropriate electronic banking channel alternative: Critical analysis using analytical hierarchy process. *International Journal of Bank Marketing, 33*(3), 223-242.

Mullan, J., Bradley, L., & Loane, S. (2017). Bank adoption of mobile banking: stakeholder perspective. *International Journal of Bank Marketing, 35*(7), 1154-1174.

Nejad, M. (2016). Research on financial services innovations: A quantitative review and future research directions. *International Journal of Bank Marketing, 34*(7), 1042-1068.

Otoritas Jasa Keuangan (OJK). (2019). Indonesia Banking Statistics December 2019, Vol. 18 No. 1.

Otoritas Jasa Keuangan (OJK). (2021a). Roadmap Pengembangan Perbankan Syariah Indonesia 2020-2025 [Indonesian Sharia Banking Development Roadmap 2020-2025].

Otoritas Jasa Keuangan (OJK). (2021b). Blueprint for Digital Transformation in Banking.

Otoritas Jasa Keuangan (OJK). (2021c). Roadmap of Indonesian Banking Development 2020-2025.

Pahi, D., & Yadav, I. S. (2019). Does corporate governance affect dividend policy in India? Firm-level evidence from new indices. *Managerial Finance, 45*(9), 1219-1238.

Paminto, A., Yudaruddin, R., Yudaruddin, Y. A., & Lesmana, D. (2022). Mobile banking and bank performance: does bank ownership types matter?. *Hong Kong Journal of Social Sciences, 60*, 60-71.

Püschel, J., Afonso Mazzon, J., & Mauro C. Hernandez, J. (2010). Mobile banking: Proposition of an integrated adoption intention framework. *International Journal of Bank Marketing, 28*(5), 389-409.

Sapulette, M. S., Effendi, N., & Santoso, T. (2021). Fintech, banks, and the COVID-19 pandemic: Evidence from Indonesia. *Buletin Ekonomi Moneter dan Perbankan, 24*(4), 559-588.

Schaechter, A. (2002). Issues in electronic banking: An overview. *IMF Policy Discussion Paper, PDP/02/6, International Monetary Fund.*

Schindler, J. (2017). Fintech and financial innovation: Drivers and depth. *Finance and Economics Discussion Series (FEDS) Working Paper, Federal Reserve Board, Washington DC, Series 2017-081.*

Scornavacca, E., & Hoehle, H. (2007). Mobile banking in Germany: A strategic perspective. *International Journal of Electronic Finance, 1*(3), 304-320.

Shah, M., & Clarke, S. (2009). *E-banking management: Issues, solutions, and strategies: Issues, Solutions, and Strategies*. IGI Global.

Shaikh, A. A., & Karjaluoto, H. (2016). On some misconceptions concerning digital banking and alternative delivery channels. *International Journal of E-Business Research (IJEBR), 12*(3), 1-16.

Stulz, R.M. (2019). Fintech, bigtech and future of bank. *Working Paper 26312, National Bureau of Economic Research.*

Sullivan, R., & Wang, Z. (2020). Technology diffusion: The case of internet banking. *Economic Quarterly, 106*(1), 19-40.

Thakor, A. V. (2020). Fintech and banking: What do we know?. *Journal of Financial Intermediation, 41,* 100833.

Tiwari, R., Buse, S., & Herstatt, C. (2006, July). Mobile banking as business strategy: Impact of mobile technologies on customer behaviour and its implications

for banks. *In 2006 Technology Management for the Global Future-PICMET 2006 Conference (Vol. 4, pp. 1935-1946). IEEE, Hamburg University of Technology.*

Tufano, P. (2003). Financial innovation. In Constantinides, G.M., Harris, M., & Stulz, R.M. (Eds.), *Handbook of the economics of finance,* Volume 1A, pp. 307-335. Amsterdam: Elsevier B.V.

Van Horne, J. C. (1985). Of financial innovations and excesses. *The Journal of Finance, 40*(3), 620-631.

Verhoef, P. C., Kannan, P. K., & Inman, J. J. (2015). From multi-channel retailing to omni-channel retailing: Introduction to the special issue on multi-channel retailing. *Journal of Retailing, 91*(2), 174-181.

Verhoef, P. C. (2021). Omni-channel retailing: Some reflections. *Journal of Strategic Marketing, 29*(7), 608-616.

Yudaruddin, R. (2023a). Financial technology and performance in Islamic and conventional banks. *Journal of Islamic Accounting and Business Research, 14*(1), 100-116.

Yudaruddin, R. (2023b). Government policy response to COVID-19 and bank performance: A comparison between Islamic and conventional banks. *Journal of Islamic Accounting and Business Research, 14*(6), 952-972.

Yunita, P. (2021). The digital banking profitability challenges: Are they different between conventional and Islamic banks?. *Jurnal Akuntansi dan Keuangan Indonesia, 18*(1), 55-74.

APPENDIX

Tabel A1.
Logit Estimation Result for Robustness Test 1 (Alternative Variables)

	1	2	3	4	5
ASSET	23.63523*** (3.813782)	22.18483*** (3.415973)	14.19192*** (0.885776)	23.37555*** (3.072013)	24.41797*** (2.926083)
OCOI	**4.579126 (3.623002)**	**3.899696 (3.190459)**	**1.331609 (3.331141)**	**4.204989 (3.066675)**	**4.688133 (3.438522)**
DEPOSIT	-25.70848*** (7.190407)	-24.10411*** (6.802498)	-14.09569*** (4.330342)	-25.24529*** (6.613205)	-20.87926*** (5.947436)
ROE	**-13.95055** (6.694537)**	**-14.43592** (5.993574)**	**-14.1321** (5.559824)**	**-14.17713** (5.674951)**	**-10.09896* (5.900849)**
BTYPE		22.83237*** (6.529436)			
AGE			6.622243*** (1.431448)		
OWNER				23.48265*** (4.282691)	
CR5					-27.57855*** (7.086373)
DBS					
COVID					
CUST.					
Cons.	-203.8507*** (31.93973)	-202.8177*** (32.95033)	-146.8921*** (7.196435)	-209.0794*** (26.53743)	-196.7712*** (24.71561)
LR chi2(4)	487.41***	495.82***	486.99***	493.9***	503.56***
Pseudo R2	0.658464	0.669830	0.657906	0.667235	0.680293
Obs.	691	691	691	691	691

Note: Standard errors in parentheses, *,**,*** Significant at 10, 5, and 1 per cent levels, respectively.

[1)] Logit estimation utilizes data from 2013 – 2022 following the availability of digital banking transaction data.

Tabel A1.
Logit Estimation Result for Robustness Test 1 (Alternative Variables) (Continued)

	6	**7**	**8[1)]**
ASSET	8.855776*** (1.334937)	18.50795*** (1.785599)	18.19778*** (1.156492)
OCOI	**-0.656406 (5.769804)**	**-4.595125 (4.87186)**	**-0.023043 (5.869054)**
DEPOSIT	-1.156181 (8.29773)	-18.16296*** (5.272956)	-21.2193*** (6.390543)
ROE	**-11.0394 (9.888331)**	**-22.48715*** (7.015814)**	**-20.63129** (8.204902)**
BTYPE			
AGE			
OWNER			
CR5			
DBS	42.60169*** (5.74732)		
COVID		16.23882** (6.452769)	
CUST.			5.932353*** (1.342164)
Cons.	-101.3782*** (15.13042)	-153.7367*** (17.45312)	-239.7345*** (23.25979)
LR chi2(4)	579.49***	501.96***	300.47***
Pseudo R2	0.782868	0.678127	0.59837484
Obs.	691	691	523

Note: Standard errors in parentheses, *,**,*** Significant at 10, 5, and 1 per cent levels, respectively.

[1)] Logit estimation utilizes data from 2013 – 2022 following the availability of digital banking transaction data.

Tabel A2.
Logit Estimation Result for Robustness Test 2 (Sub Sample)

	1	2	3	4	5
ASSET	22.90298*** (3.905278)	23.41199*** (4.076504)	15.87581*** (1.992684)	23.54121*** (4.268399)	25.15203*** (4.781076)
LABOUR	16.35583 (56.4962)	15.36756 (57.34215)	94.72318 (61.9867)	3.663163 (3.363164)	137.9038** (69.2959)
DEPOSIT	-25.89594*** (7.517034)	-26.76079*** (7.705142)	-16.25501*** (5.375944)	-24.77435*** (7.550844)	-21.21477*** (6.931218)
ROA	-157.1349*** (45.76629)	-144.0036*** (43.91664)	-113.2258*** (39.98037)	-16.66588** (6.529822)	-141.7542*** (41.46941)
BTYPE		26.61835** (10.26374)			
AGE			26.22578*** (2.904319)		
OWNER				25.3314*** (7.180924)	
CR5					-36.35916*** (8.916547)
DBS					
COVID					
CUST.					
Cons.	-198.733*** (33.91147)	-212.481*** (37.49842)	-239.5581*** (14.16628)	-215.2056*** (39.60922)	-203.3855*** (39.92565)
LR chi2(4)	423.24***	430.71***	446.48***	430.65***	446.34***
Pseudo R2	0.639852	0.651139	0.674985	0.651048	0.674772
Obs.	500	500	500	500	500

Note: Standard errors in parentheses, *,**,*** Significant at 10, 5, and 1 per cent levels, respectively.

[1)] Logit estimation utilizes data from 2013 – 2022 following the availability of digital banking transaction data.

Tabel A2.
Logit Estimation Result for Robustness Test 2 (Sub Sample) (Continued)

	6	**8**	**7[1)]**
ASSET	8.046645** (3.902063)	19.91733*** (3.839284)	25.6541*** (4.118398)
LABOUR	248.996 (197.5819)	-23.75816 (59.86782)	28.20891 (82.18701)
DEPOSIT	11.06814 (14.04251)	-21.9505*** (6.915878)	-34.4629*** (10.86595)
ROA	-117.3393* (69.1399)	-138.5687*** (39.84338)	-162.7406*** (46.18667)
BTYPE			
AGE			
OWNER			
CR5			
DBS	77.33966*** (20.65775)		
COVID		28.38631*** (10.42945)	
CUST.			6.388801*** (1.588466)
Cons.	-132.1112*** (43.50299)	-173.71*** (34.24082)	-309.8116*** (48.05114)
LR chi2(4)	536.9***	435.71***	267.3***
Pseudo R2	0.811673	0.658696	0.57929151
Obs.	500	500	380

Note: Standard errors in parentheses, *,**,*** Significant at 10, 5, and 1 per cent levels, respectively.

[1)] Logit estimation utilizes data from 2013 – 2022 following the availability of digital banking transaction data.

This page is intentionally left blank