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Mobile Banking and Bank Performance: Do Bank Ownership Types Matter?

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Abstract:
In Indonesia, mobile banking users and transactions continue to increase. Regulators and banks anticipate that digitalization will improve banking performance and financial stability. In contrast to technology-based financial services or FinTech, the digitization of banking services in Indonesia is considered somewhat tardy. FinTech, which offers digital services, is a threat to banks. Covering 138 commercial banks in Indonesia from 2004 to 2018, this study investigates the influence of mobile banking on bank performance in Indonesia. Additionally, this study investigates whether bank ownership influences the performance-enhancing effects of mobile banking based on bank ownership. A dynamic panel data analysis approach with a two-step GMM system is used to test the hypothesis. This study finds that mobile banking significantly improves bank profitability and stability in Indonesian banking. These results are more significant for private banks. Moreover, digitalization is crucial in the banking sector, particularly with the adoption of mobile banking because it encourages banks, particularly private banks, to perform better than those that do not use mobile banking. This is the first study investigating the impact of mobile banking on banks' performance and financial stability based on bank ownership in Indonesia.

Keywords: mobile banking, bank ownership, bank profitability, bank stability.

手机银行和银行绩效：银行所有权类型重要吗？

摘要：
在印度尼西亚，手机银行用户和交易持续增长。监管机构和银行预计数字化将改善银行业绩和金融稳定性。与基于技术的金融服务或金融科技相比，印度尼西亚银行服务的数字化被认为有些迟缓。提供数字服务的金融科技对银行构成威胁。本研究涵盖 2004 年至 2018 年印度尼西亚的 138 家商业银行，调查手机银行对印度尼西亚银行绩效的影响。此外，本研究调查了银行所有权是否会影响基于银行所有权的移动银行的

绩效提升效果。使用两步 GMM 系统的动态面板数据分析方法来检验假设。本研究发现，手机银行显着提高了印尼银行业的盈利能力和稳定性。这些结果对私人银行更为重要。此外，数字化在银行业至关重要，尤其是在采用手机银行的情况下，因为它鼓励银行，尤其是私人银行，比那些不使用手机银行的银行表现更好。这是第一项基于印度尼西亚银行所有权调查手机银行对银行业绩和金融稳定性影响的研究。

关键词：移动银行、银行所有权、银行盈利能力、银行稳定性。

1. Introduction

Mobile banking is one of the most recent mobile technology developments. Mobile banking is also the most significant strategic change in retail banking in more than a decade, and it has fast progressed beyond merely being internet banking via a smartphone (Inegbedion et al., 2022). This is not the case with ATMs (automated teller machines), telephones, and online banking, all viable distribution channels for traditional banking products. It is at the heart of the client connection and soon becomes a point of difference and a possible income generator for forward-thinking institutions. Attracting new customers and maintaining existing ones are critical to the long-term viability of m-banking companies (Shaikh & Karjaluoto, 2016; Tam & Oliveira, 2017). Mobile banking will become an essential future distribution channel for banks to use as part of their multi-channel distribution strategies since it offers the possibility of a competitive edge (Shaikh et al., 2022). Additionally, despite the availability of technology and the benefits it provides to both banks and clients, mobile banking is still in its early stages of adoption, particularly in areas with high cell phone penetration, which has increased the number of banks offering innovative services across banking products to expand their client base. Although it is vital to measure the impact of bank usage, mobile banking has yet to live up to its promises (Bhatt & Bhatt, 2016; Kejela & Porath, 2022).

In Indonesia, mobile banking users and transactions are increasing. The growing number of Indonesian banks that have adopted mobile banking demonstrates this trend (Figure 1). The number of customers using e-banking (SMS banking, phone banking, mobile banking, and internet banking) increased by 270% between 2012 and 2016, according to the Financial Services Authority (OJK), from 13.6 million to 50.4 million. Meanwhile, the number of e-banking transactions increased by 169 percent, from 150.8 million in 2012 to 405.4 million in 2016. Furthermore, according to Bank Indonesia (BI), the total value of digital payment transactions in 2018 reached Rp47.19 trillion. This figure has grown fourfold since the value of transactions in 2017 was Rp. 12.37 trillion. Indeed, in several large banks, mobile banking has surpassed SMS banking, phone banking, and internet banking. There are 15.46 million internet banking users and 24.21 million mobile banking users in the company. According to a recent McKinsey & Company report, active mobile banking users in Indonesia make more purchases than those who do not. Increased financial activity may impact not only monetary but also fiscal policy in Indonesia, which currently requires significant funding (Musviyanti et al., 2022).

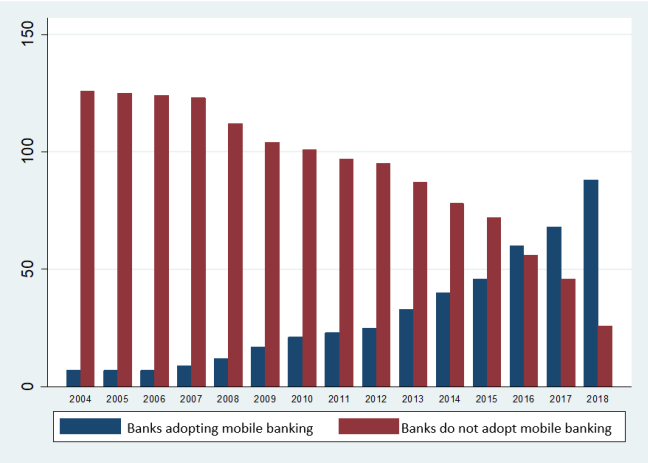

Figure 1. Number of banks adopting mobile banking and banks not adopting mobile banking in Indonesia between 2004 and 2018

As part of the banking digitization process, regulators have enacted various regulations to ensure that banking digitalization continues to advance in response to the rise of mobile banking. Numerous regulations, such as Law No. 11 of 2008 on Information and Electronic Transactions, Law No. 21 of 2011 on the Financial Services Authority, Financial Services Authority Regulation No. 1/POJK.07/2013 on Consumer Financial Services Sector Protection, Presidential Regulation No. 82 of 2016 on the National Strategy for Financial Inclusion, and Regulation of the MFI, have been enacted to support this objective. Moreover, the government is constantly encouraging the improvement of good corporate governance and accountability in all corporate sectors, not just the banking sector (Amalia et al., 2022; Kusumawardani et al., 2021a; Ulfah et al., 2021).

Indeed, banking digitalization is expected to improve banking performance and financial stability by regulators and banks. The question then becomes, what is the impact of mobile banking as part of the banking digitization process on banking performance in banks? This is an important question to answer because the use and transactions of mobile banking are growing. Meanwhile, various regulations have been enacted to aid in the banking digitization process. However, compared to technology-based financial services, or FinTech, the digitization of banking services in Indonesia is late. FinTech, which also provides digital services, is challenging banks.

FinTech in Indonesia has been shown empirically to reduce bank profitability (Phan et al., 2019; Yudaruddin, 2022b). Without precise regulation and

establishing a regulatory sandbox, FinTech's presence can undermine the banking industry's optimal role, while its rapid development can also pose risks to the financial system (Bank Indonesia, 2017). Although Navaretti et al. (2017) stated that as long as banks continue to adopt new information management technology and FinTech practices do not exploit regulatory loopholes to avoid unfavorable regulation (regulatory arbitrage), the threat to banks via liquidity risk and credit channels appears to be limited.

Covering 138 commercial banks in Indonesia from 2004 to 2018, the study examines the impact of mobile banking on the profitability and stability of banks in Indonesia as one of the emerging countries. This study will estimate the impact of mobile banking on bank profits and stability using a dynamic panel data analysis approach with a two-step GMM system. Additionally, we examine whether bank ownership affects the impact of mobile banking on the profitability and stability of banks.

This study makes three substantial contributions. To begin, this study examines the impact of mobile banking on the performance and financial stability of Indonesian banks. Numerous previous studies have concentrated exclusively on the impact of digital banking, particularly internet banking, on bank performance (Le & Ngo, 2020; Meifang et al., 2018; Scott et al., 2017; Shaikh et al., 2017; Daniyan-Bagudu et al., 2017; Harelimana, 2018; Del Gaudio et al., 2021). Meanwhile, other research examines the effect of information technology adoption on bank credit risk (Pierri & Timmer, 2020). As a result, this study fills that void. In other words, we want to explore not only how mobile banking affects performance, but also how it affects banks' financial stability.

Second, this study specifically provides empirical evidence to regulators and banks on the impact of mobile banking on the performance and financial stability of banks in Indonesia based on bank ownership. This is important because it provides specific policy implications based on bank ownership to regulators and banks related to the impact of banking digitalization in Indonesia. Very few empirical studies provide evidence of how mobile banking impacts the performance and financial stability of banks based on bank ownership. Another body of research indicates that government-owned banks are less competitive than private banks. For example, Cull et al. (2017) argue that the inefficiency of government-owned banks' operations and low intermediation quality due to high agency costs erode their competitiveness.

Third, this study focuses on banking in Indonesia, where no empirical study has been conducted to examine the impact of mobile banking on the performance and financial stability of banks by ownership type. Furthermore, no analysis of Indonesian banks has ever examined the entire industry over a more extended period. Wirdiyant (2018) examines the impact of digital banking technology adoption on bank efficiency using a sample of 95 banks from 2012 to 2017. Sudaryantia et al. (2018) examined the impact of mobile banking on bank performance in Indonesia in 2017.

2. Literature Review

The financial technology innovation is taking the form of mobile banking. Numerous previous researchers have examined the impact of mobile banking on banking financial performance and stability.

Mobile banking, part of digital banking, is central to the banking industry. Empirical studies conducted by Meifang et al. (2018), Scott et al. (2017), and Shaikh et al. (2017) showed that digital banking has a positive impact on the banking industry. Shaikh et al. (2017) found several relationships between the stimulation of financial innovation and the reform of the financial and banking sectors. Scott et al. (2017) focused on banks in Europe and America and found that adopting innovations in financial services affects long-term profitability for both small and large banks. Meifang et al. (2018) showed that financial innovation, particularly the development of technology of payment methods in developing countries, has driven the development of the financial industry and accelerated the process of industrial evolution.

Other empirical studies also show that, specifically, mobile banking improves bank performance (profitability). The findings of an investigation into Nigerian banks carried out by Daniyan-Bagudu et al. (2017) showed that respondents believe that mobile banking significantly impacts banks' profitability. Harelimana (2018) investigated the relationship between the volume of mobile banking transactions and Unguka Bank Ltd's financial performance using quantitative and qualitative methods. This study also found that the volume of mobile banking transactions positively impacted the bank's performance. Additionally, not all mobile banking services were used, although the secondary data were obtained during a very short period (almost three years), and clients were unfamiliar with the mobile banking system. For instance, while withdrawals were the method that was used the most frequently, deposits and transfers were used at a quite low level. Haabazoka (2019) focused on banks in Zambia and found that a positive and significant effect of mobile banking transactions on commercial bank income. According to Del Gaudio et al. (2021), the use of information and communications technology (ICT) in banks, such as automated teller machines, the internet, and mobile banking, all play a role in increasing bank profitability and, as a result, financial stability. Furthermore, they discovered a correlation between mobile banking and bank profitability. More specifically, the growing popularity of mobile banking has demonstrated a positive impact on the banking industry's information technology endowment. They also suggested that developed information and communications technology (ICT) dimension increases the financial industry's overall distance from default.

Although various empirical studies show a positive side, the impact of mobile banking on bank performance also indicates a negative side. Adhitya and Sembel (2020) discovered that the adoption of mobile banking technology has a negative impact on return on equity (ROE) and non-performing loan (NPL) performance for seven banks in Indonesia between September and December 2019. Mittal et al. (2016) predicted that retail banks that do not adopt the digital model would experience a decline in return on equity (ROE) of about 18% over five years or vice versa.

In Indonesia, studies on the implications of mobile banking for the banking industry were reviewed by Wirdiyant (2018) and Sudaryantia et al. (2018). Wirdiyant (2018) examined the impact of digital banking technology adoption on bank efficiency, which has important implications for the performance of the banking industry. As a result, it was found that there was a non-linear effect of the adoption of digital banking technology in the Indonesian banking sector on bank efficiency. The impact of digital banking technology adoption creates a trade-off between bank performance efficiency and market outreach. The behavior of banks that are less aggressive in adopting digital banking technology results in lower market outreach; on the other hand, banks that are too aggressive can face lower financial performance efficiency. Sudaryantia et al. (2018) focused on 36 banks in 2017 and found that mobile banking had an insignificant impact on bank performance in Indonesia.

H1: Mobile banking has a positive impact on bank profitability.

Mobile banking, as part of digital banking, not only impacts bank performance but also banking financial stability, although, until now, the impact of mobile banking on financial stability has received limited attention in various studies. This study relates to several previous studies on digital banking, part of financial innovation, on financial stability (Ahamed & Mallick, 2019; Fuster et al., 2018; Neaime & Gaysset, 2018; Banna & Alam, 2021; Senou et al., 2019).

The empirical analysis conducted by Neaime and Gaysset (2018) in MENA countries reveals a very close association between financial innovation and bank stability. Ahamed and Mallick (2019) discovered a highly substantial effect of financial innovation on bank stability in their empirical investigation. Financial innovation appears incomplete in some circumstances without the deployment of digital financial inclusion, which plays a critical role in promoting financial inclusion. Senou et al. (2019) conducted an empirical study in West Africa. They found that cost, accessibility, and availability of digital financial inclusion must be considered to promote financial innovation in the region. Banna and Alam (2021) stated that an interconnected digital financial system among rising Asian banks is more than simply a method for preserving banking stability; it also enables equitable and sustainable economic development, which helps financial sustainability and, eventually, the attainment of the SDGs by 2030. Digital financial inclusion helps maintain banking stability, and an interconnected digital financial system among rising Asian banks is more than simply a way to keep banks stable. Fuster et al. (2018) studied how financial technology innovations have increased the efficiency of financial intermediation in the mortgage market. This affects the effectiveness and efficiency of the mortgage-making process, such as slow processing times, capacity constraints, and funding. FinTech (financial technology) processes mortgage loan applications more quickly and adjusts supply more elastically than non-FinTech loans. Additionally, FinTech lending quicker responds to the "shock" of mortgage demand (Karsh & Abufara, 2020).

A recent study by Pierri and Timmer (2020) and Chavali and Kumar (2018) analyzed the implications of mobile banking, as part of financial innovation, on the financial stability of banks. Chavali and Kumar (2018) focused on the adoption of mobile banking services by respondents in the UAE and perception of risk factors. Using the model developed in the customer adoption process in mobile banking, they found time risk, financial risk, and performance risk as the most dominant risk factors compared with other risks in the mobile banking adoption process. Moreover, they show that mobile banking helps in proper financial planning because of continuous transaction monitoring and time savings. Pierri and Timmer (2020) analyzed heterogeneous US commercial bank IT adoption rates during the crisis period. They show that banks with higher levels of IT adoption experienced a much lower increase in NPLs than banks with lower levels of IT adoption during the global financial crisis. Additionally, banks with higher IT adoption rates provided more credit during the global financial crisis. Therefore, adopting IT has helped banks select better borrowers and produce more robust and more stable loans.

H2: Mobile banking has a positive impact on bank stability.

In comparison to private banks, government-owned banks (public) are probably slower to adopt and use technological innovations. According to another body of research, government-owned banks are less competitive than private banks. For instance, Cull et al. (2017) argue that government banks' competitiveness is harmed by their operational inefficiency and low intermediation quality due to high agency costs. Numerous studies have concluded by comparing the performance of government-owned and private banks. They discovered substantial evidence in favor of private banks (Shaban & James, 2018; Tan, 2016; Fukuyama & Tan, 2022). As a result, when market competition intensifies due to new entrants, government-owned banks are disproportionately affected.

H3: Mobile banking has a positive impact on bank profitability, particularly for private banks.

H4: Mobile banking has a positive impact on bank stability, particularly for private banks.

3. Method

3.1. Variables

The variables used consist of the dependent and independent variables, which are presented in Table 1. For the dependent variable, this study uses bank performance and stability variables. According to Tan (2016) and Yudaruddin (2017b, 2022b), bank performance is measured using ROA (return on assets), which is the ratio of net income to total assets. The higher the ROA value, the higher the bank's performance in terms of profitability. Following Defung and Yudaruddin (2022), Yudaruddin (2022a), Saif-Alyousfi et al. (2020), Riadi et al. (2022), and Maria et al. (2022), bank stability is measured by the Z-score, which is the sum of ROA plus the ratio of total equity to total assets, which is then divided by the standard deviation of ROA. The ROA standard deviation of each bank is measured based on the entire observation period. The higher the Z-score, the more stable the bank (the lower the bank's risk or the bank's probability of bankruptcy). However, the lower the Z-score, the more unstable the bank is.

The independent variable was mobile banking. Mobile banking is banking transactions through mobile media, either in the form of the mobile banking application or the mobile operator's default application. Following Harelimana (2018) and Adhitya and Sembel (2020), the measurement of mobile banking uses a dummy variable of 1 if the bank uses mobile banking and 0 if the bank does not use mobile banking.

This study includes several control variables that are widely used in studies on banking financial performance and stability. Following Maria et al. (2022), Riadi et al. (2022), Yudaruddin (2022b), Saif-Alyousfi et al. (2020), Yusgiantoro et al. (2019), and Tan (2016), the control variables used are bank concentration (CR5), inefficiency (BOPO), bank size (SIZE), bank intermediation (LDR), bank liquidity (DPKTA), inflation (INF), economic activity (GDP) and the index of economic freedom (EF).

Bank concentration (CR): Increasing the bank concentration will increase bank profitability and financial stability (Saif-Alyousfi et al., 2020; Ozili & Uadiale, 2017; Riadi et al., 2022; Yudaruddin, 2022a; Maria et al., 2022).

Inefficiency (CI): Inefficiency will reduce bank profitability and banking financial stability (Le & Ngo, 2020; Srairi, 2019).

The size of the bank (SIZE): The bigger the bank, the better and more stable it is because large banks tend to be more diversified, have easier access to capital markets, have fewer credit constraints, and are more skilled in risk management than small banks (Srairi, 2019; Tan, 2016).

Bank intermediation (LDR): The higher the LDR, the higher the bank's profit and stability. However, it will be a source of risk if given in excess (Saif-Alyousfi et al., 2020; Yusgiantoro et al., 2019; Tan, 2016).

Bank liquidity (DTA): Banks with higher levels of liquidity have higher profitability and stability. A higher loan volume will decrease bank profitability and stability if the bank does not have a good risk management system (Saif-Alyousfi et al., 2020; Tan, 2016; Kusumawardani et al., 2021b).

Inflation (INF): Inflation reduces bank profitability and stability. However, if the bank anticipates adjusting interest rates or managing operating costs accordingly to make income increase faster than costs, it will increase the profitability and financial stability of the bank (Saif-Alyousfi et al., 2020; Yudaruddin, 2017a; Hadjaat et al., 2021).

Economic activity is measured by growth in the gross domestic product (GDP). When economic activity increases, the demand for credit also increases, thereby increasing the performance and financial stability of banks (Le & Ngo, 2020; Saif-Alyousfi et al., 2020; Yudaruddin, 2017b, 2020).

The index of economic freedom (EF): The Index of Economic Freedom is measured on a scale of 0 to 100. The higher the index value, the more openness is in the economy. Economic openness, in particular, opens up financial markets, allowing more foreign capital to flow into domestic markets. Thus, the banking system can take advantage of these funds to increase their liquidity and diversify their investments into various projects to increase the profitability and financial stability of banks (Bui & Bui, 2019; Arias et al., 2019; Lestari et al., 2022).

3.2. Data and Sources

The data used in this study is banking data covering 138 Indonesian commercial banks (including Islamic banks) during the years 2004–2018. Unbalanced panel data are used in this study because not all selected banks have available information for all years, so this study does not lose degrees of freedom. Regarding data sources, mobile banking is obtained from bank annual reports, bank websites, news, and other sources. For the bank concentration variable, bank-specific data come from the OJK (Financial Services Authority) and BI (Bank Indonesia) databases, while for macroeconomic data (inflation and annual GDP growth rate) the data comes from the Indonesian Central Statistics Agency (BPS). Finally, the Index of Economic Freedom is a measure of economic freedom whose data are obtained from the Heritage Foundation.

3.3. Regression Model

This research model was developed based on the work of Yudaruddin (2022b), Riadi et al. (2022), Pierri and Timmer (2020), Le and Ngo (2020). Equations 1 and 2 describe how an econometric model is constructed to analyze the impact of mobile banking on the financial performance and stability of banks. This is consistent with the research objective, which is to determine the effect of mobile banking on banks' performance and financial stability.

$$ROA_{i,t} = \alpha + \beta_1 ROA_{i,t-1} + \beta_2 MB_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 CR_t + \beta_5 CI_{i,t} + \beta_6 LDR_{i,t} + \beta_7 DTA_{i,t} + \beta_8 INF_{,t} + \beta_9 GDP_{,t} + \beta_{10} EF_{,t} + \varepsilon_{i,t} \quad (1)$$

$$Zscore_{i,t} = \alpha + \beta_1 Zscore_{i,t-1} + \beta_2 MB_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 CR_t + \beta_5 CI_{i,t} + \beta_6 LDR_{i,t} + \beta_7 DTA_{i,t} + \beta_8 INF_{,t} + \beta_9 GDP_{,t} + \beta_{10} EF_{,t} + \varepsilon_{i,t} \quad (2)$$

The generalized method of moments (GMM) was used as the analytical tool in this study. Because many economic variables are dynamic, a dynamic model is used. A dynamic relationship is defined by the presence of a lag between the dependent and independent variables. Additionally, the GMM approach is used to resolve the model's endogeneity issue (Arellano & Bond, 1991). For GMM, it employs a two-step GMM system as described by Blundell and Bond (1998) to generate more efficient estimates than one-step GMM (Baltagi, 2005). Additionally, to account for Windmeijer's (2005) limited sample correction and to develop orthogonal transformation instruments capable of explaining unobservable factors associated with bank-specific characteristics. Generally, when the AR (2) and Hansen-J tests are not rejected, the system GMM approach is valid.

4. Results and Discussion

Tables 1 and 2 contain descriptive statistics and correlation analyses of the research data. The study collected 1791 observations of 138 banks in Indonesia over 15 years, from 2004 to 2018. The ROA value is used to evaluate a bank's performance. Over the last 15 years, the bank's average ROA has been 2.06 percent. This demonstrates that banks in Indonesia, on average, are capable of profiting from their assets. Bank stability (Z-score) is calculated as the sum of ROA plus equity to total assets divided by the ROA standard deviation. Z-score ranges from 16.23 to 11.66 on average. Generally, the mean value of all research variables is less than the standard deviation, indicating that the mean value of each variable can be used to represent the variable under analysis. Alternatively, each variable has a low standard deviation. Additionally, the presence of a strong relationship between the independent variables indicates that the model contains multicollinearity. The correlation coefficients between the independent variables are shown in Table 2. The correlation matrix indicates that there are no issues with multicollinearity.

Table 1. Statistics description (The authors' calculation)

Variable	Definition	Obs.	Mean	SD
ROA	ROA represents the return on assets (%)	1791	2.06	2.27
Z-Score	ZSCORE = (ROA + EQTA)/SDROA; EQTA is the ratio of total equity to total assets; SDROA is the standard deviation of the return-to-assets ratio.	1791	16.18	11.66
MB	Dummy variable, 1 if the bank adopts mobile banking; 0 otherwise	1791	0.25	0.43
Size	Log Natura of Total Assets	1791	15.67	1.84
CR	5-firm concentration ratio in the banking sector	1791	49.89	1.91
CI	Total cost to total income (%)	1791	83.59	22.98
LDR	Loan to Deposit Ratio (%)	1713	91.54	51.37
DTA	Deposit to Total Asset (%)	1791	0.66	0.22
INF	Annual inflation rate (%)	1791	6.77	3.92
GDP	Growth of GDP (%)	1791	5.55	0.59

Note: SD - standard of deviation

Table 2. Matrix correlation (The authors' calculation)

Variable	MB	SIZE	CR	CI	LDR	DTA	INF	GDP	EF
MB	1.00								
Size	-0.03	1.00							
CR	0.02	0.00	1.00						
CI	0.59	-0.18	-0.20	1.00					
LDR	0.02	-0.09	-0.01	0.04	1.00				
DTA	-0.09	0.04	0.01	0.00	-0.54	1.00			
INF	-0.27	0.19	-0.05	-0.28	-0.11	0.14	1.00		
GDP	-0.24	-0.34	-0.06	-0.18	-0.09	0.13	0.30	1.00	
EF	0.45	-0.17	0.09	0.39	0.19	-0.23	-0.55	-0.45	1.00

The regression analysis examines the relationship between mobile banking (MB) and bank performance (ROA and Z-Score). The previous stage consisted of repeated samples broken down by government-owned and private banks. The baseline regression is shown in Tables 3 and 4, along with the result obtained using two-step GMM estimation. By first determining the significant coefficients of the lagged dependent variables used to confirm the dynamic nature of the model specification, the estimation results point to stable coefficients. Second, the AR (2) and Hansen-J tests are not statistically significant at the 5% level.

Table 3. Impact of mobile banking on bank profitability (The authors' calculation)

Variable	Coef.	Std. Err.	t	P>|t|
ROA (-1)	0.244***	0.048	5.08	0.000
MB	0.170*	0.092	1.84	0.068
Size	0.012	0.187	0.07	0.947
CR	-0.071***	0.008	-8.84	0.000
CI	-0.036	0.032	-1.12	0.263
LDR	-0.001	0.002	-0.75	0.453
DTA	-0.398	0.422	-0.94	0.347
INF	-0.016	0.052	-0.31	0.755
GDP	1.839	1.403	1.31	0.192
EF	-0.071	0.061	-1.15	0.252
Constant	2.642	2.664	0.99	0.323
Dummy Years	Yes			
The number of obs.	1578			
AR (2) test	0.117			
Hansen-J test	0.181			

Note: SD - standard of deviation

Table 4. Impact of mobile banking on bank stability (The authors' calculation)

Variable	Coef.	Std. Err.	t	P>|t|
Z-Score (-1)	0.651***	0.112	5.81	0.000
MB	1.191*	0.653	1.83	0.070
Size	-0.689***	0.239	-2.89	0.004
CR	-2.315	2.485	-0.93	0.353
CI	-0.048***	0.011	-4.26	0.000
LDR	0.002	0.007	0.27	0.788
DTA	-1.704	2.061	-0.83	0.410
INF	-0.931	0.622	-1.50	0.136
GDP	17.671	15.993	1.10	0.271
EF	0.460	0.732	0.63	0.531
Constant	24.093*	12.345	1.95	0.053
Dummy Years	Yes			
The number of obs.	1578			
AR (2) test	0.137			
Hansen-J test	0.141			

Note: SD - standard of deviation

Table 3 reports the results of the impact of mobile banking (MB) on bank profitability (ROA). The coefficient for MB is positive (β = 0.170) and significant (at 0.10), which means that mobile banking significantly enhances bank profitability in Indonesian banking. The first hypothesis of this study predicted a positive association between mobile banking and bank performance measure ROA. Therefore, the findings in Table 3 support hypothesis H1 and endorse financial technology innovation that MB can improve bank performance. This finding is consistent with prior studies on mobile banking and bank performance (Haabazoka, 2019; Meifang et al., 2018; Scott et al., 2017; Shaikh et al., 2017; Daniyan-Bagudu et al., 2017; Harelimana, 2018; Del Gaudio et al., 2021). This is also consistent with the findings of previous Indonesian studies by Wirdiyant (2018), who documents the impact of digital banking technology adoption on bank efficiency, which has important implications for the performance of the banking industry.

In Table 4, the relationship between mobile banking (MB) and bank stability (Z-Score) has been tested. This study found a positive and significant coefficient (β =1.191, $p < 0.10$) of mobile banking that implies that banks that adopt mobile banking have higher stability than banks that do not adopt mobile banking, thus supporting H2. This result suggests that mobile banking, as part of digital banking, has an impact not only on bank performance but also on bank stability. Our result corroborates those of Pierri and Timmer (2020) who found that banks with higher levels of IT adoption experienced a much lower increase in bank risk than banks with lower levels of IT adoption during the global financial crisis. This finding is also in line with previous studies (Ahamed & Mallick, 2019; Fuster et al., 2018; Neaime & Gaysset, 2018; Banna & Alam, 2021; Senou et al., 2019).

In the next stage, to assess whether the effect of mobile banking (MB) is conditional to whether the ownership bank is government or private, samples were broken down between government and private as reported in Tables 5 and 6. Table 5 presents our empirical results regarding the effect of mobile banking and bank profitability in banking. It is shown that mobile banking is positively associated with bank performance measure ROA. This relationship was statistically significant at the 5% level. This finding is more pronounced in private banks. This result supports hypothesis H3, which posits that mobile banking has a positive impact on bank profitability, particularly on private banks. Meanwhile, From Table 6, we also find that the coefficient for mobile banking loads positively at the 10% level, indicating that adoption of mobile banking improves bank stability, thus supporting H4. This result suggests that adopting mobile banking has a significant impact on increasing bank stability, particularly in private banks. Our results are consistent with the notion that government-owned banks are probably slower to adopt and implement technological innovations than private banks.

Table 5. Impact of mobile banking on bank profitability: government vs. private banks (The authors' calculation)

Variable	Government Banks				Private Banks			
	Coef.	Std. Err.	t	P>|t|	Coef.	Std. Err.	t	P>|t|
ROA (-1)	0.244***	0.048	5.08	0.000	0.244***	0.048	5.08	0.000
MB	0.170*	0.092	1.84	0.068	0.170*	0.092	1.84	0.068
Size	0.012	0.187	0.07	0.947	0.012	0.187	0.07	0.947
CR	-0.071***	0.008	-8.84	0.000	-0.071***	0.008	-8.84	0.000
CI	-0.036	0.032	-1.12	0.263	-0.036	0.032	-1.12	0.263
LDR	-0.001	0.002	-0.75	0.453	-0.001	0.002	-0.75	0.453
DTA	-0.398	0.422	-0.94	0.347	-0.398	0.422	-0.94	0.347
INF	-0.016	0.052	-0.31	0.755	-0.016	0.052	-0.31	0.755
GDP	1.839	1.403	1.31	0.192	1.839	1.403	1.31	0.192
EF	-0.071	0.061	-1.15	0.252	-0.071	0.061	-1.15	0.252
Constant	2.642	2.664	0.99	0.323	2.642	2.664	0.99	0.323
Dummy Years	Yes				Yes			
The number of obs.	451				1127			
AR (2) test	0.891				0.106			
Hansen-J test	0.094				0.378			

Note: ***, **, and * sig. at level 1%, 5%, and 10%

Table 6. Impact of mobile banking on bank stability: government vs. private banks (The authors' calculation)

Variable	Government Banks				Private Banks			
	Coef.	Std. Err.	t	P>|t|	Coef.	Std. Err.	t	P>|t|
Z-Score (-1)	0.487***	0.118	4.11	0.000	0.654***	0.139	4.71	0.000

Continuation of Table 6

MB	1.086	1.349	0.81	0.426	1.668*	0.862	1.94	0.056
Size	0.024	0.179	0.13	0.894	0.082	0.170	0.48	0.631
CR	-0.116***	0.036	-3.25	0.003	-0.040***	0.013	-3.01	0.003
CI	-0.027	0.271	-0.10	0.922	-0.956***	0.342	-2.80	0.006
LDR	0.063***	0.018	3.59	0.001	0.000	0.006	0.02	0.984
DTA	6.468	2.789	2.32	0.026	-3.015	2.464	-1.22	0.224
INF	0.004	0.039	0.12	0.909	-0.105*	0.060	-1.74	0.085
GDP	-0.504	0.384	-1.31	0.198	-0.206	0.415	-0.50	0.621
EF	0.009*	0.101	0.09	0.928	0.064	0.091	0.70	0.489
Constant	8.783	15.356	0.57	0.571	19.383	13.580	1.43	0.156
Dummy Years	Yes				Yes			
The number of obs.	451				1127			
AR (2) test	0.096				0.318			
Hansen-J test	0.056				0.064			

Note: ***, **, and * sig. at level 1%, 5%, and 10%

5. Conclusion

Mobile banking is one of the most recent innovations in mobile technology, provides a more effective delivery channel than other distribution channels. Mobile banking provides efficient services at any time and location, including while traveling. Additionally, as smartphone use grows, it will have a significant impact on banks' ability to offer innovative services, improve operational efficiency, and expand market share.

Banks have increased their use of mobile banking over the last 15 years. Similarly, for mobile banking users and transactions, the same holds. Regulators have responded to the growth of mobile banking as part of the banking digitalization process by enacting various regulations. It is hoped that this digitalization of banking will increase bank performance and financial stability. Although the digitization of banking services in Indonesia is considered to be lagging behind that of financial technology-based services, or FinTech. Because of this, this study examines the effect of mobile banking on the performance and financial stability of Indonesian banks.

The data were analyzed using a two-step GMM system on panel data covering 138 Indonesian commercial banks from 2004 to 2018. The study's findings indicate that digitalization is critical in the banking sector, particularly with the adoption of mobile banking, as it encourages banks to achieve a higher level of financial performance than those that do not use mobile banking. Additionally, this finding is more pronounced in private banks. This finding is consistent with prior studies on mobile banking and bank performance (Haabazoka, 2019; Meifang et al., 2018; Scott et al., 2017; Shaikh et al., 2017; Daniyan-Bagudu et al., 2017; Harelimana, 2018; Del Gaudio et al., 2021; Ahamed & Mallick, 2019; Fuster et al., 2018; Neaime & Gaysset, 2018; Banna & Alam, 2021; Senou et al., 2019).

The study's limitation is that it focuses exclusively on mobile banking as a form of financial technology innovation in a single country. As a result, further research must examine alternative forms of financial technology innovation and analyze banks across countries.

The findings of this study have policy implications for regulators and banks, particularly considering the impact of mobile banking on Indonesian banking performance. To begin, the banking digitization process must be accelerated through the widespread adoption of mobile banking to maintain banking performance in the digital financial innovation ecosystem. Second, it is necessary to accelerate government-owned banks' adoption of mobile banking to improve their performance.

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