

DIGITAL BANKING ADOPTION, BANK SIZE, AND BANK PERFORMANCE IN INDONESIA

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ABSTRACT

Introduction: The adoption of technology has become prevalent in the banking sector. This research investigates the potential correlation between the implementation of digital banking adoption and the bank performance (Return on Assets and Operational Efficiency Ratio), while considering the factor of bank size.

Methods: This research utilizes panel data regression to assess the effect of digital banking adoption on the performance of banking firms. Additionally, it explores whether the bank size influences the strength of the relationship between the independent and dependent variables.

Results: Digital banking adoption (DBA) has a significant negative impacts Return on Assets (ROA) and has a significant positive effect on the Operational Efficiency Ratio (BOPO). The bank size weakens the negative impact of DBA on ROA; the bank size also weakens the positive impact of DBA on BOPO.

Conclusion and suggestion: This study demonstrates the occurrence of the profitability paradox and economies of scale in Indonesian banking companies. For decision-makers in banking companies, these findings can be considered when determining the optimal company size to enhance digital banking adoption and improve banking performance.

INTRODUCTION

The advancement of technology and its application, as part of the Fourth Industrial Revolution, has significantly influenced the role of technology in the business world, as evidenced by the use of digital financial services. A survey conducted by McKinsey in 2021 revealed that, in the Asia-Pacific region, there was an increase in digital banking usage by consumers and market penetration of digital banking products from 2017 to 2021. This surge in digital banking usage was driven and accelerated by prevailing trends, such as the

increased use of digital channels for various transactions and the impact of the COVID-19 pandemic.

PwC, through its publication titled PwC's Digital Banking Survey 2023, conducted a survey to gather information on digitalization efforts among banks in Southeast Asia, the current competitive landscape, and key areas of focus for digitalization. The survey results indicate that banking companies are striving to enhance their digital transformation efforts to maintain competitive advantage in the industry. They are working to boost customer engagement, improve customer experience, and increase operational efficiency across all office functions.

The advent of digitalization presents unique challenges for banking companies, both internally—such as infrastructure readiness and human resource preparedness—and externally, including cybersecurity threats. These efforts are undertaken to achieve better performance for the banks. However, do these digital transformation activities actually enhance the performance of banking companies? This study aims to explore this topic.

This study also examines the effect of bank size. [Hughes et al. \(2019\)](#) argue that larger banks tend to diversify their products, which reduces costs and enhances their ability to achieve operational cost savings on a larger scale. This phenomenon is referred to as economies of scale, where cost savings occur as a company increases its production scale. The ultimate expected outcome of achieving economies of scale is an improvement in the bank's performance.

[Mankiw \(2013\)](#) explains that economies of scale often arise because higher levels of production enable specialization among workers, allowing each worker to become more proficient in their assigned tasks. Higher levels of production, depicted through the company's assets, are associated with lower costs and higher production margins. This study attempts to adopt economies of scale by using bank size as a proxy to strengthen (or weaken) the influence of digitalization on company performance.

LITERATURE REVIEW

Profitability Paradox

One measure of company performance is productivity. [Brynjolfsson \(1993\)](#) provides an initial overview of the productivity paradox. He highlights the genesis of this term as stemming from economist Robert Solow's assertion regarding the absence of "computers" in statistical calculations of productivity. The decline in productivity coincided with the rapid increase in the use of information technology. This slowdown in productivity began in the early 1970s.

[Becalli \(2007\)](#) emphasizes that a bank's productivity is connected to its profitability. Therefore, it can be argued that investments in technology are crucial for enhancing productivity and, ultimately, bank profitability. There are at least five main

reasons supporting this argument. First, technological advancements have enabled the creation of new and more sophisticated products and services. Second, technology investments influence how banks operate, with the adoption of new technologies expected to reduce costs over time. Third, technology investment is essential for achieving rationalization and cost management. Fourth, banks consider technology investment necessary to meet strategic goals, such as enhancing quality through commercial activities. Finally, technological advancements are identified as major drivers of change in the banking industry.

Several earlier studies have confirmed the existence of the profitability paradox. [Abusharbeh \(2023\)](#) conducted research on this productivity paradox in Palestine. The study found that technology investments have a long-term negative impact on bank profitability. This finding supports the productivity paradox and provides evidence that existing theories still apply in the banking context. Similar research findings were also obtained by [Becalli \(2007\)](#), [Arora and Arora \(2013\)](#), [Gupta et al. \(2018\)](#), and [Roy and Thangaraj \(2021\)](#).

Numerous studies have indeed failed to confirm the profitability paradox, showing that increased spending on digital banking significantly boosts the performance of banking companies. [Chhaidar et al. \(2023\)](#), in their research on information technology investment and profitability in European countries, demonstrated that IT investments have a positive and significant impact on bank performance. This positive effect is attributed to cost reduction. According to transaction and agency theory, digital technology reduces various costs, such as monitoring costs, information reporting costs, transaction costs, and agency costs. Similar results were found in studies by [Gunawan and Serlyna \(2018\)](#), [Dong et al. \(2020\)](#), [Otieno \(2020\)](#), and [Huong et al. \(2023\)](#).

[Nguyen et al. \(2023\)](#) states that despite numerous researchers conducting studies on the profitability paradox, research findings regarding the relationship between digitization and bank profitability have not yet reached a consensus. This may be due to two reasons, there is no uniform and standardized definition of digitization and measure for assessing bank digitization.

In the banking industry, bank performance measures are Return on Assets (ROA) and Operational Efficiency Ratio (BOPO), which will be used in this research. Overall, the theoretical argument for a negative relationship between digitization and bank performance is stronger and more convincing. Therefore, we propose the following hypothesis:

H1: There is a negative influence of digital banking adoption on bank ROA.

H2: There is a positive influence of digital banking adoption on bank BOPO.

Bank Size

Hughes et al. (2019) researched the influence of bank size on profitability, uncovering several key patterns: (1) medium-sized and large banks achieve better efficiency and financial performance; (2) average operating costs, including regulatory compliance and technology costs, decrease as bank size increases; (3) large banks can utilize their scale to enhance lending to small businesses; and (4) medium-sized and large banks, despite having higher credit risks, are more efficient at disbursing loans to commercial enterprises compared to small banks.

Blatter and Fuster (2022) found a strong relationship between bank size, efficiency, and profitability, indicating the existence of economies of scale. Consequently, bank size has become increasingly crucial for efficiency and profitability in recent years. The growing importance of digital technology in banking offers significant economies of scale, as larger banks can distribute their IT costs over a larger asset base. The presence of control variables further strengthens economies of scale, suggesting that larger banks typically exhibit characteristics linked to better efficiency.

Overall, there is a strong argument for a positive relationship between bank size and bank performance. Blatter and Fuster (2022) argue that digitization will drive economies of scale, even though their study does not specifically include digitization variables. Therefore, we propose the following hypothesis:

H3: The bank size will weaken the negative impact of DBA on the bank's ROA.

H4: The bank size will weaken the positive impact of DBA on the bank's BOPO.

RESEARCH METHODS

This study is an applied quantitative research endeavor that seeks to apply existing theories. The researchers aim to illustrate the presence of the profitability paradox and economies of scale within banking companies in Indonesia. The study utilizes panel data, which combines both time series and cross-sectional data. Data for this research is sourced from existing sources, primarily secondary data.

The sample used in this study consists of data from 30 banks listed on the Bursa Efek Indonesia for the period 2013-2022. The criteria for sample selection are as follows: (1) Banking companies listed on the Bursa Efek Indonesia; (2) Banking companies that are conventional, regional, and/or Islamic, excluding Bank Perkreditan Rakyat (BPR) and Bank Perkreditan Rakyat Syariah (BPRS); (3) Having adequate data related to the variables used in this research.

The data analysis technique employed in this study is panel data regression. To determine the appropriate approach for panel data regression, several tests are conducted, including the Chow test, the Hausman test, and the Lagrange Multiplier test.

These tests help in deciding whether the regression equation should be performed using the Common Effect (CE), Fixed Effect (FE), or Random Effect (RE) methods.

Operational Definition of Variables

This study employs eight variables consisting of two dependent variables, one independent variable, one moderating variable, and three control variables. The DBA (Digital Banking Adoption) variable as the independent variable is defined as a parameter measuring the extent of bank company utilization of technology involving the use of mobile phones or other electronic devices to conduct financial transactions. The formula used to calculate the DBA parameter is as follows:

$$DBA = \frac{\text{Informational Technology Expense}}{\text{Total Operating Expense}} \times 100\%$$

The first dependent variable, ROA (Return on Asset) ratio, is an accounting ratio that measures how effectively a bank utilizes its assets to generate income. The formula used to calculate the ROA parameter is as follows:

$$ROA = \frac{\text{Earnings after Tax (EAT)}}{\text{Total Assets}} \times 100\%$$

The second dependent variable, BOPO (Biaya Operasional Pendapatan Operasional) ratio, measures bank efficiency. This ratio is used to assess the difference between banks in terms of efficiency, where higher values indicate lower efficiency. The formula used to calculate this parameter is as follows:

$$BOPO = \frac{\text{Operating Expense}}{\text{Operating Income}} \times 100\%$$

The variable TA (Total Asset) is chosen in this study to serve as a proxy for bank size. This variable acts as a moderating variable in the research. The presentation of the TA variable is in natural logarithms, to mitigate potential violations of the data normality assumption. The researcher extracts the total asset values of banking companies from the balance sheet financial statements.

The NPL (Non-Performing Loan) ratio serves as the first control variable in this study. The NPL ratio can be defined as loans whose interest or principal payments are past due. The NPL ratio provides an overview of the portion of unproductive assets held by the bank relative to total assets. The more unproductive assets a bank holds, the more it will reduce the bank's income. The formula used to calculate the NPL ratio is as follows:

$$NPL = \frac{\text{total value of non-performing loans}}{\text{total loans}} \times 100\%$$

The Loan to Deposit Ratio (LDR) or Loan to Funding Ratio (LTF) functions as the second control variable. LDR is calculated as the ratio of loans extended to third parties in Rupiah and foreign currency, excluding loans to other banks, to: (a) third-party funds,

including demand deposits, savings deposits, and deposits in Rupiah and foreign currency, excluding interbank funds; and (b) securities in Rupiah and foreign currency meeting specific requirements issued by the Bank to obtain funding sources. The formula used to calculate the Loan to Deposit / Funding Ratio is as follows:

$$LDR = \frac{\text{Total loans}}{\text{Total value of deposits non GWM}} \times 100\%$$

Interest serves as the primary source of income for banks. The interest generated by banks is obtained from the difference between the loans extended and the interest paid for third-party fund placements. Therefore, loans / credits are one of the main profit generators for banks. The formula used to calculate the growth of loans / credits is as follows:

$$dLoan = \frac{\text{Total loans}_t - \text{Total loans}_{t-1}}{\text{Total loans}_{t-1}} \times 100\%$$

Research Model

Bank performance and DBA are the main topics of this research. Bank performance is divided into profitability and efficiency. Profitability is represented by ROA, while efficiency is represented by BOPO. The equations used in this research are as follows.

$$ROA_{it} = \beta_0 + \beta_1 DBA_{it} + \beta_2 Ctrl_{it} + \varepsilon_{it} \quad (1)$$

$$BOPO_{it} = \delta_0 + \delta_1 DBA_{it} + \delta_2 Ctrl_{it} + \varepsilon_{it} \quad (2)$$

Where; Ctrl = Control Variables; i = cross-sectional dimension; t = time dimension. Equations (1) and (2) are used respectively to test hypotheses 1 and 2.

This research also accommodates moderating variables to further understand the "second independent variable" that strengthens or weakens the relationship between the independent and dependent variables. The moderating variable used is Total Assets, which represents bank size. When applied in the research model, the resulting equation is as follows:

$$ROA_{it} = \beta_0 + \beta_1 DBA_{it} + \beta_2 TA_{it} + \beta_3 DBA_{it} TA_{it} + \beta_4 Ctrl_{it} + \varepsilon_{it} \quad (3)$$

$$BOPO_{it} = \delta_0 + \delta_1 DBA_{it} + \delta_2 TA_{it} + \delta_3 DBA_{it} TA_{it} + \delta_4 Ctrl_{it} + \varepsilon_{it} \quad (4)$$

Where: TA = Bank Size. Equations (3) and (4) are respectively used to test hypotheses 3 and 4.

RESULT AND ANALYSIS

Method test

The testing of whether Equations (1), (2), (3) and (4) employ the Common Effect (CE), Fixed Effect (FE), or Random Effect (RE) methods can be examined using the Chow test, the Hausman test, and the Lagrange Multiplier test.

Table 1. Summary of Panel Data Regression Method Test

Test	Equation (1)		Equation (2)		Equation (3)		Equation (4)	
	<i>p-value</i>	Model	<i>p-value</i>	Model	<i>p-value</i>	Model	<i>p-value</i>	Model
Chow Test	0.00	FE	0.00	FE	0.00	FE	0.00	FE
Hausman Test	0.00	FE	0.04	FE	0.00	FE	0.53	RE
LM Test	-	-	-	-	-	-	0.00	RE
Conclusion		FE		FE		FE		RE

Source: data, processed

Table 1 provides a summary overview of the testing results. It can be concluded that equation (1) will use panel data regression with a Fixed Effect model, equation (2) with a Fixed Effect model, equation (3) with a Fixed Effect model, and equation (4) with a Random Effect model.

Sign Test and Significance Testing

To test whether the research hypotheses are supported or not, panel data regression is performed using equations (1), (2), (3) and (4). Table 2 provides an overview of the regression results for these equations.

Table 2. Summary of Panel Data Regression Results

Test	Equation (1)		Equation (2)		Equation (3)		Equation (4)	
	<i>coef</i>	SE	<i>coef</i>	SE	<i>coef</i>	SE	<i>coef</i>	SE
Const	0.04***	0.00	0.61***	0.05	-0.01	0.02	0.83***	0.15
DBA	-0.09***	0.01	0.72***	0.18	-0.33***	0.12	3.81***	1.04
TA	-	-	-	-	0.01**	0.00	-0.02	0.01
DBAxTA	-	-	-	-	0.02*	0.01	-0.31***	0.10
NPL	-0.47***	0.06	4.68***	0.74	-0.50***	0.06	5.13***	0.67
LDR	-0.05*	0.00	0.04	0.03	-0.00*	0.00	0.03	0.03
dLoan	-0.00**	0.00	-0.00	0.01	-0.00*	0.00	-0.00	0.01
R-squared	0.63		0.48		0.65		0.26	
Adj R-Squared	0.59		0.42		0.60		0.24	
Prob(F-Stat)	0.00		0.00		0.00		0.00	

t value : *p<0.10, **p<0.05, ***p<0.01

Source: data, processed

In equation (1), DBA has a significant negative effect on ROA; all control variables have a significant negative effect on ROA. In equation (2), DBA has a significant positive effect on BOPO; NPL has a significant positive effect on BOPO; other control variables are not significant in influencing BOPO. In equation (3), DBA has a significant negative effect on ROA; the moderation and interaction variables have a significant positive effect on ROA, indicating quasi moderation; all control variables have a significant negative effect on ROA. In equation (4), DBA has a significant positive effect on BOPO; the moderation variable has a non-significant negative effect and the interaction variable has a significant negative effect on BOPO, indicating pure moderation; NPL has a significant positive effect on BOPO; other control variables are not significant in influencing BOPO.

Discussion of Research Findings

DBA has a significant negative impact on ROA, aligning with previous studies by [Beccalli \(2007\)](#), [Gupta et al. \(2018\)](#), [Roy and Thangaraj \(2021\)](#), and [Abusharbeh \(2023\)](#). Therefore, the sample used in this study suggests the existence of a profitability paradox in Indonesia. Referring to the regression results of equation (1), the researcher agrees with [Abusharbeh's \(2023\)](#) findings in Palestine, another developing country in Asia. Abusharbeh indicates that while the digitalization process in banking increases total assets, it reduces operational income, leading to a decline in ROA. The Palestinian banking sector needs additional time to utilize this technology effectively for enhanced productivity. Furthermore, social and cultural challenges in adopting new electronic technology and the lack of technological infrastructure contribute to these negative outcomes. Similarities can be observed in other developing countries in Asia, such as comparable GDP per capita levels (Palestine's GDP per capita in 2022 was Rp 61,611,095, and Indonesia's was Rp 77,848,570) and similar social structures, including predominantly Muslim populations. The researcher also concurs with [Gupta et al. \(2018\)](#), who argue that when all banks have access to the same technology, no bank gains a competitive advantage from investing in IT. Thus, it can be concluded that Hypothesis 1 is supported.

Meanwhile, considering the moderation and interaction variables in equation (3), there is a type of quasi moderation, where the moderator variable moderates the effect of the independent variable on the dependent variable while also becoming a separate independent variable. This result is consistent with the research conducted by [Hughes et al. \(2019\)](#) and [Blatter and Fuster \(2022\)](#). Bank size becomes an independent variable that influences company profitability. Bank size also weakens the effect of DBA on ROA. Larger banks are capable of generating higher profitability. Furthermore, larger banks are better able to leverage digital banking adoption compared to smaller banks. Thus, based on the sample used in this study, it can be concluded that there are economies of scale in Indonesia. Thus, it can be concluded that Hypothesis 3 is supported.

The influence of the independent variable DBA on BOPO can be explained through the regression results of equations (2). DBA has a significant positive effect on BOPO, meaning that an increase in DBA will be accompanied by an increase in BOPO. Banks become less efficient with the increasing adoption of digital banking. The researcher agrees with the explanation provided by [Wirdiyanti \(2018\)](#). According to her, banks face a trade-off between increasing capacity through digitalization and the ability to improve efficiency. Banking institutions must then find the appropriate level of digital banking adoption to address the issues of declining profitability and efficiency resulting from these policies. Thus, it can be concluded that Hypothesis 2 is supported.

With the inclusion of the bank size moderation variable into equation (4), the regression results show that the moderation variable is not significant, while the interaction variable is significantly negative, resulting in pure moderation. Pure moderation occurs when a variable moderates the relationship between the independent variable and the dependent variable, where the moderation variable interacts with the dependent variable without becoming an independent variable itself. Size only acts as a moderator to weaken the influence of DBA on BOPO, meaning that with larger bank size, an increase in DBA will decrease the bank's BOPO. DBA can then make the bank more efficient by reducing BOPO. Thus, it can be concluded that Hypothesis 4 is supported.

The researcher suspects that these results are due to reasons similar to those found in the study conducted by [Hughes et al. \(2019\)](#). In that research, small banks tended to lend to borrowers with low risk but were less efficient in credit monitoring, resulting in higher NPL levels in small banks. Large banks, on the other hand, had lower NPL levels despite lending to riskier borrowers. The lower performance is attributed to lower efficiency in lending.

CONCLUSION

This study aimed to prove the existence of a profitability paradox and economies of scale in banking companies in Indonesia. The parameters used were company performance in terms of ROA (profitability) and BOPO (efficiency), the level of digital banking adoption, and bank size as a moderator. Using the research sample in this study, it can be concluded that there is a profitability paradox in Indonesian banking companies. Higher adoption of digital banking will reduce banking profitability. Banking institutions also do not benefit much from the efficiency side due to worsening efficiency.

This study also provides evidence of economies of scale in banking companies in Indonesia. The usage of bank size as moderating variable weakens the negative impact of DBA on ROA, also weakens the positive impact of DBA on BOPO. Profitability and efficiency will increase

with the growth of banking company size. Larger banks are more likely to benefit from the impacts of digital banking adoption through competitive advantages, thereby enhancing their financial performance.

This study can serve as a reference for decision-makers in banking companies. Upon understanding the finding that a profitability paradox exists, banks may consider the appropriate timing and scale for investment or enhancing digital banking adoption within each banking institution. For academics, this research can also serve as a reference for further studies. It is essential to include different performance parameters or alternative calculations for the DBA variable to diversify research in the field of digital banking. Furthermore, incorporating the element of time in digital banking adoption is also recommended to provide insights into the long-term relationship between DBA and banking performance.

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