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*By Universitas Muhammadiyah Sidoarjo*

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## Table Of Contents

<b>Journal Cover</b> .....	1
<b>Author[s] Statement</b> .....	3
<b>Editorial Team</b> .....	4
<b>Article information</b> .....	5
Check this article update (crossmark) .....	5
Check this article impact .....	5
Cite this article.....	5
<b>Title page</b> .....	6
Article Title .....	6
Author information .....	6
Abstract .....	6
<b>Article content</b> .....	7

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## Digital Transformation and Bank Profitability in Indonesian Commercial Banking

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### Abstract

**General Background:** Digital transformation has reshaped commercial banking by expanding technology-based financial services, digital transactions, and collaboration between banks and financial technology firms. **Specific Background:** Indonesian commercial banks experienced rapid growth in digital banking transactions from 2019 to 2024, yet profitability remained inconsistent, showing a gap between digital financial activity and financial performance. **Knowledge Gap:** The manuscript identifies limited empirical clarity on how digital banking and fintech collaboration relate to profitability when bank size and non-performing loans are considered as internal banking factors. **Aims:** This study aimed to examine the relationship between digital banking, fintech collaboration, bank size, non-performing loans, and profitability in Indonesian commercial banking. **Results:** Using panel data regression with the Common Effect Model on selected Indonesian commercial banks, the study found that digital banking had a negative and statistically significant relationship with return on assets, while fintech collaboration had a positive but statistically insignificant relationship. Bank size showed a positive and significant relationship, whereas non-performing loans showed a negative and significant relationship. The model had strong explanatory power, with an R-squared value of 0.924793 and a significant F-statistic probability of 0.000000. **Novelty:** This study examines digital transformation in Indonesian commercial banking by combining digital banking, fintech collaboration, bank size, and credit risk within a 2019–2024 panel data framework. **Implications:** The findings suggest that banks need stronger digital investment strategies, risk management, and long-term evaluation of fintech collaboration to support sustainable profitability.

#### Highlights:

- ROA declined significantly as digital banking values increased.
- Bank size showed a positive and significant relationship.
- Credit risk remained a major negative determinant.

**Keywords:** Digital Banking, Fintech Collaboration, Profitability, Return on Assets, Non-Performing Loan

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## Introduction

Significant structural changes have been brought about by the advancement of information and communication technology in a number of economic sectors, including the banking sector. In addition to changing how banks function, this shift has also changed consumer behavior, company strategies, and methods for creating value in the financial industry. In this regard, banks have developed into technology-based organizations that offer quick, effective, and easily available digital financial services; they are no more just conventional financial intermediaries [1]. As a result, digital transformation is now a crucial component in evaluating how competitively banks can respond to technological innovation and growing competition in the financial sector.

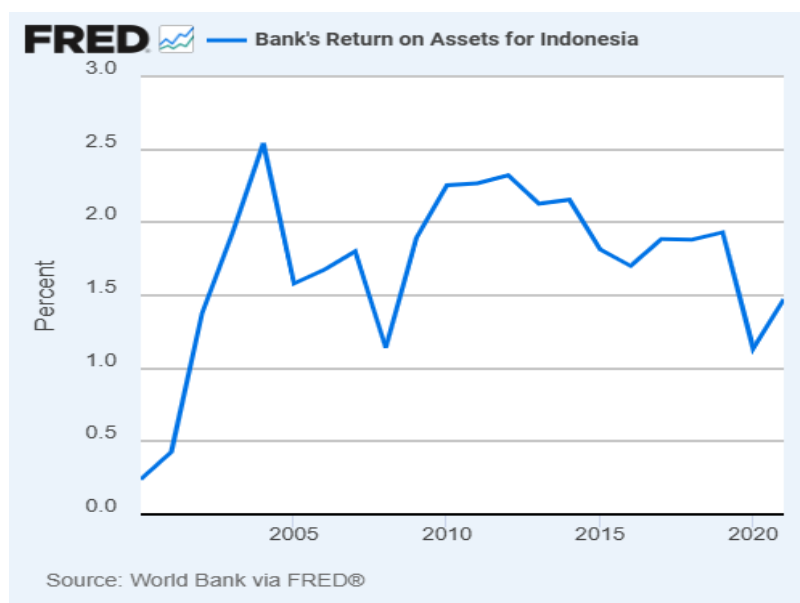
The growth of digital banking services, such as online and mobile banking, is one of the main ways that banking is undergoing digital transformation. Customers can do financial transactions on their own, without regard to time or location, thanks to these services. Additionally, the development of partnerships between banks and financial technology (fintech) firms also known as fintech collaboration has been aided by technical developments. This partnership exemplifies the application of the open innovation idea, in which businesses use outside resources to improve efficiency, creativity, and service quality [1]

Since 2019, the digital transformation of Indonesia's banking industry has progressed dramatically, and during the COVID-19 epidemic, it escalated even more. Physical activity restrictions have prompted consumers to switch to digital financial services, which has led to a significant rise in the volume and frequency of digital transactions.

According to data from Bank Indonesia, the value of digital banking transactions rose from IDR 26,639 trillion in 2019 to over IDR 60,000 trillion in 2024, indicating a notable increase in the public's use of digital financial services [2]. Additionally, the Financial Services Authority (Otoritas Jasa Keuangan/OJK) [3] notes that both the number of fintech businesses and the level of cooperation between banks and fintech companies in creating an integrated digital financial ecosystem are steadily rising [3]

Theoretically, there are a number of ways in which digital transformation is anticipated to increase bank profitability. Digital technology adoption can increase the reach of financial services, lower transaction costs, and improve operational efficiency. Additionally, fintech collaboration improves resource usage efficiency by giving banks access to cutting-edge technology without having to fully develop them internally. [4]. Return on Assets (ROA), which indicates a bank's capacity to make money from all of its assets, is frequently used in banking research to gauge profitability [5]

Empirical data, however, indicates that higher levels of digital activity do not always result in steady increases in bank profitability. The profitability of Indonesian commercial banks has fluctuated between 2019 - 2024, despite the ongoing rise in digital transaction values.



**Figure 1.** illustrates the growth of bank ROA in Indonesia.

Figure 1 show increased digitalization does not always result in better financial performance, as evidenced by the drop in profitability during specific times, especially during the epidemic. This demonstrates a discrepancy between empirical reality and theoretical predictions. High information technology investment costs, system maintenance costs, cybersecurity threats, and comparatively low profit margins from high-volume digital transactions are some of the elements that could account for this occurrence [5]

Furthermore, not every bank has the same capacity to successfully execute digital transformation. Larger banks typically have more resources to implement digital technology and effectively manage related risks, as evidenced by bank size. On the

other hand, by raising provisioning costs and lowering interest revenue, higher credit risk, as shown by Non-Performing Loans (NPL), can lower bank profitability [6]. Therefore, internal bank characteristics must be taken into account as control factors when studying how digital transformation affects bank profitability.

PT Bank Central Asia Tbk (BBCA) and PT Bank Rakyat Indonesia (Persero) Tbk (BBRI), two significant commercial banks in Indonesia that exhibit a high degree of digital banking adoption, fintech collaboration, and consistent financial reporting, are the focus of this study. These banks were chosen because of their advanced degree of digital transformation and their critical positions within the national banking system. This study uses a panel data regression approach with bank size and non-performing loans (NPL) as control variables to investigate the impact of digital banking and fintech collaboration on bank profitability.

In light of the aforementioned discussion, the purpose of this study is to empirically examine how the digital revolution has affected Indonesian commercial banks' profitability between 2019 - 2024. The results are anticipated to add to the body of knowledge on digital transformation in banking and offer useful guidance for regulators and the banking sector in developing successful, efficient, and long-lasting digital strategies.

## Method

This study uses a quantitative methodology to examine the connection between Indonesian commercial banks' profitability and digital transformation. The study design, which is categorized as causal associative research, aims to investigate the cause-and effect relationship between the dependent variable bank profitability as determined by Return on Assets (ROA) and the independent variables digital banking, fintech collaboration, bank size, and non-performing loans. Because it allows for objective, quantifiable, and statistically tested analysis, a quantitative approach is suitable [7]

Secondary data from reliable sources, such as the Financial Services Authority (Otoritas Jasa Keuangan/OJK), Bank Indonesia (BI), and bank annual financial reports, were used in this study. Purposive sampling was used to choose PT Bank Central Asia Tbk (BBCA) and PT Bank Rakyat Indonesia (Persero) Tbk (BBRI) based on data availability, consistency, and relevance. The observation period, which spans 2019–2024, reflects the Indonesian banking sector's acceleration of digital transformation.

To guarantee consistent measurement, the operational definition of variables is developed. The value of digital banking transactions serves as a proxy for digital banking ( $X_1$ ), indicating the degree of use of digital services. A dummy variable is used to measure fintech collaboration ( $X_2$ ), with a value of 1 denoting the presence of collaboration between banks and fintech companies and 0 denoting its absence. The natural logarithm of total assets is used to calculate bank size ( $X_3$ ), which is expressed as:

The ratio of non-performing loans to total loans, or  $X_4$ , is calculated as follows:

$$\text{Bank Size} = \ln(\text{Total Aset})$$

The study's dependent variable is bank profitability, which is determined by Return on Assets (ROA), which is defined as:

$$NPL = \frac{\text{Kredit Bermasalah}}{\text{Total Kredit}} \times 100\%$$

Panel data regression, which mixes cross-sectional and time-series data to produce more effective and thorough estimation, was the analytical technique employed in this work [8]. The following is the specification of the panel data regression model:

$$RoA = \frac{\text{Net Income}}{\text{Total Assets}} \times 100\%$$

Where:

$$ROA_{it} = \alpha + \beta_1 X_{1it} + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \epsilon_{it}$$

RoA it : Return on Assets (Profitabilitas Bank) ke-I pada periode ke-t

$\alpha$  : Konstanta

$\beta_1, \beta_2, \beta_3, \beta_4$  : Koefisien regresi masing-masing Variabel Independen

$X_{1it}$  : Digital Banking

$X_{2it}$  : Fintech Collaboration

$X_{3it}$  : Bank Size

$X_{4it}$  : Non Performing Loan (NPL)

$\epsilon_{it}$  : Error Term

I : Unit Cross-Section (bank)

t : Periode Waktu

To choose the best model among the Common Effect Model (CEM), Fixed Effect Model (FEM), or Random Effect Model (REM), the Chow, Hausman, and Lagrange Multiplier tests are used.

Additionally, the t-test is used to evaluate partial effects, the F-test is used to examine the simultaneous effect of independent variables, and the coefficient of determination ( $R^2$ ) is used to measure the explanatory power of the model. To

guarantee the validity and dependability of the regression model, traditional assumption tests such as normality, multicollinearity, heteroscedasticity, and autocorrelation tests are also carried out.

## Results and Discussion

### A. Panel Data Regression Results

Three methods the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM) were used to estimate panel data regression. [9] The Common Effect Model (CEM) was determined to be the most suitable model for this investigation based on model selection tests, such as the Chow test and Lagrange Multiplier test, since it produced the best statistical outcomes.

**Table 1.** displays the outcomes of the panel data regression using the Common Effect Model (CEM).

Variable	Coefficient	T-Statistic	Probability
c	-14.77686	-8.857165	0.0000
Digital Banking (X1)	-3.68E-05	-2.392206	0.0181
Fintech Collaboration (X2)	0.018533	1.139852	0.2563
Bank Size (X3)	2.690404	10.81548	0.0000
Non-Performing Loan (X4)	-0.850253	-19.91337	0.0000

Regression results reveal that while fintech collaboration has no statistically significant impact on profitability, digital banking, bank size, and non-performing loans do as show table 1.

Foreign words or terms should be italicized. It is recommended to avoid the use of foreign terms in articles written in Indonesian. A new paragraph begins 1.15 cm from the left margin, while no spacing is used between paragraphs [10]

### B. Model Feasibility Test (F-Test and R<sup>2</sup>)

**Table 2.** displays the F-test and coefficient of determination (R<sup>2</sup>) results.

Indicator	Value
F-Statistic	427.3053
Prob (F-Statistic)	0.000000
R-squared	0.924793
Adjusted R-squared	0.922628

That the F-statistic's probability value is 0.000000 as show table 2, which is less than the significance level of 0.05. This suggests that bank profitability is simultaneously statistically significantly impacted by all independent factors, including digital banking, fintech collaboration, bank size, and non-performing loans. To put it another way, the regression model as a whole is regarded as legitimate and practical for explaining changes in the dependant variable. The F-test is used to ascertain whether all independent variables jointly influence the dependent variable, and a significant result suggests that the model has substantial explanatory potential, according to [11].

Additionally, the coefficient of determination (R<sup>2</sup>) is 0.924793, indicating that the independent variables in the model account for about 92.48% of the variation in profitability (ROA). Other factors beyond the model, including macroeconomic conditions, interest rate changes, regulatory regulations, and bank-specific managerial efficiency, have an impact on the remaining 7.52%. A high R<sup>2</sup> value indicates that the model has a strong goodness-of-fit and can successfully capture the association between bank profitability and digital transformation variables. Although it should still be evaluated carefully in panel data analysis, a higher coefficient of determination, according to [12], suggests better model performance in explaining the variability of the dependent variable.

This model's high explanatory power also implies that, in addition to digital transformation variables, internal bank factors specifically, bank size and credit risk (NPL) play a major influence in predicting profitability. This result is in line with earlier empirical research, such as that of [13], which emphasizes the substantial impact of bank-specific determinants on profitability.

Overall, the F-test and coefficient of determination results verify that the regression model employed in this investigation is statistically sound and suitable for additional hypothesis testing and interpretation. The robust model performance suggests that the chosen variables are pertinent to the explanation of bank profitability dynamics in Indonesia's environment of digital transformation [14].

### C. Model Selection test

**Table 3.** displays the outcomes of the model selection tests.

Test	Probability	Decision
Chow Test	0.4404	CEM Selected
Lagrange Multiplier	0.0597	CEM Selected

The Chow test result, has a probability value of 0.4404 as table 3, which is higher than the significance level of 0.05. This suggests that the Common Effect Model (CEM) is preferable to the Fixed Effect Model (FEM) since the null hypothesis (H<sub>0</sub>)

is accepted. To ascertain whether the model has substantial individual (cross-sectional) effects, the Chow test is utilized. [8] states that the CEM is favored if the Chow test is not statistically significant since it offers a more effective estimation without necessitating the inclusion of individual-specific effects.

Additionally, the Lagrange Multiplier (LM) test result displays a probability value of 0.0597, which is likewise higher than 0.05. This suggests that the Common Effect Model (CEM) is more appropriate than the Random Effect Model (REM) since the null hypothesis is once more accepted [15]. To determine whether the variance of the error components across cross-sectional units is significant, the LM test is employed. The random effect statement is not required if it is not substantial. This is in line with the claim made by [16] that the CEM is suitable in situations when cross-sectional units do not exhibit substantial variation.

Additionally, because there were less cross-sectional units in this investigation than there were estimated parameters, the Random Effect Model (REM) could not be accurately assessed. [17] This restriction also supports the choice of the CEM as the best model by making it challenging to estimate the variance components needed for the REM.

Thus, it can be said that the Common Effect Model (CEM) is the most appropriate and effective model for this investigation based on both the Chow test and the Lagrange Multiplier test. Because it influences the efficiency and consistency of the regression estimations, choosing the right model is essential [18]. The outcomes of this study are anticipated to offer trustworthy and scientifically valid insights into the connection between digital transformation and bank profitability by employing the CEM

## D. Classical Assumption Tests

Table 4. displays the outcomes of the traditional assumption tests.

Test	Result	Conclusion
Normality (Jarque-Bera)	0.773189 (>0.05)	Normal
Multicollinearity	< 0.80	No issue
Heteroskedasticity	> 0.05	No issue
Autocorrelation	> 0.05	No issue

That the regression model is statistically valid and dependable for additional investigation since it satisfies every criteria of the classical assumption as show table 4.

1. The Jarque-Bera statistic normality test yields a probability value of 0.773189, which is higher than the significance level of 0.05. This outcome suggests that the residuals have a normal distribution. For statistical conclusions, like hypothesis testing, to be valid, the residuals must be normal. A normally distributed error term is one of the fundamental presumptions in traditional linear regression models to guarantee impartial and effective estimators, according to). [19]
2. The multicollinearity test reveals that there is no significant multicollinearity issue in the model since the correlation values between independent variables are less than 0.80. Every independent variable contributes distinct and trustworthy information to the explanation of the dependent variable when multicollinearity is absent. According to [8], low correlation between explanatory variables is crucial since strong multicollinearity might skew coefficient estimates and lower the accuracy of regression results.
3. All probability values are greater than 0.05 according to the results of the heteroskedasticity test, indicating that the residuals' variance is constant (homoskedastic). This implies that heteroskedasticity issues are not present in the model. Because it guarantees the efficiency of the calculated coefficients and the impartiality of the standard errors, homoskedasticity is crucial.

Lastly, probability values greater than 0.05 in the autocorrelation test findings indicate that the model does not have an autocorrelation issue. In other words, the residuals are independent of time. [11] asserts that the reliability of hypothesis testing and the efficiency of regression estimates depend on the absence of autocorrelation.

Overall, the regression model employed in this study is reliable and appropriate for additional hypothesis testing and interpretation because it satisfies all traditional assumptions. This guarantees that the estimated connections between digital transformation variables and bank profitability are not skewed by statistical problems and increases the validity of the empirical findings [20].

## Conclusion

Using panel data regression, this study looks at how digital transformation represented by digital banking and fintech collaboration affects Indonesian commercial banks' profitability from 2019 to 2024. Because high investment and operating expenses in digital infrastructure have not yet been compensated by financial gains, the data show that digital banking has a negative and considerable impact on profitability. Fintech cooperation has a favourable but statistically negligible impact, indicating that its short-term profitability contribution is still constrained. Non-performing loans have a negative and large impact, emphasising the crucial function of credit risk management, whereas bank size has a positive and significant influence, underlining the significance of scale and resource capability. Overall, the results suggest that internal bank factors continue to be the primary determinants of profitability, while digital transformation contributes in a more gradual and complex way. As a result, banks are urged to improve risk management and digital investment strategies, and future

studies should include more variables and a larger sample size to better capture the long-term effects of digital transformation.

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