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# Analysis of Financial Technology Implementation and Other Factors on Banking Efficiency in Indonesia

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A B S T R A C T

The rise of Financial Technology (Fintech) has transformed the global financial landscape, including in Indonesia, where commercial banks increasingly integrate digital innovations to enhance efficiency and service reach. This study examines the impact of Fintech—represented by Peer-to-Peer Lending (P2P) and Digital Payment (PAY)—on the efficiency of commercial banks listed on the Indonesia Stock Exchange (IDX) from 2018 to 2023. Employing a comprehensive approach, the study uses Data Envelopment Analysis (DEA) to measure efficiency, panel data regression to assess the influence of variables, and classical assumption tests to validate the model. Control variables such as bank size and market concentration are also considered.

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## INTRODUCTION

The rapid advancement of information and communication technology has led to various innovations in the financial services industry. One of the most significant developments is Financial Technology (Fintech), which refers to the use of technology to enhance and automate financial services. Fintech has transformed the way people conduct financial transactions, ranging from digital payments to online lending services (Peer-to-Peer Lending). This transformation poses both challenges and opportunities for the banking sector, which has historically functioned as a central pillar of the financial system.

In Indonesia, the adoption of Fintech has accelerated since the issuance of regulations by the Financial Services Authority (OJK) in 2016. According to data from the Indonesian Fintech Association (AFTECH), the number of Fintech companies has continued to grow, indicating high interest from the public and business actors in digital financial services. Two of the most prominent Fintech services are Peer-to-Peer (P2P) Lending and Digital Payment, each playing a role in expanding access to financing and improving transaction efficiency.

Fintech is believed to enhance banking efficiency by reducing operational costs, accelerating service delivery, and expanding customer reach without the need for additional physical infrastructure. However, its impact is not always uniform. Some studies have found that Fintech improves operational efficiency, while others suggest that the adoption of new technologies may incur high initial costs, introduce technological risks, and potentially reduce the profitability of conventional banks.

Banking efficiency can be evaluated through various methodological approaches, with Data Envelopment Analysis (DEA) being among the most widely utilized. DEA is a non-parametric technique used to assess the relative efficiency of decision-making units (DMUs), which, in this context, refers to commercial banks. This study employs the DEA method to measure the efficiency of conventional banks listed on the Indonesia Stock Exchange (IDX) during the period 2018–2023. Furthermore, it examines the impact of financial technology (FinTech) alongside key banking and macroeconomic factors.

In addition, the study incorporates control variables such as Size (bank size based on total assets) and the Concentration Ratio (CR) to capture the dynamics of market structure in the banking sector. These variables are designed to provide a deeper understanding of the factors that shape banking efficiency in the context of the digital era.

Given this background, the present study is important for evaluating the extent to which the integration of financial technology affects the efficiency of banks in Indonesia. The results are anticipated to offer both theoretical and practical contributions to policymaking and the strategic progression of digital transformation within the banking industry.

## THEORETICAL REVIEW

### *Banking Efficiency*

The concept of efficiency as a performance indicator in business was first introduced by Edgeworth (1881) and Pareto (1927). In economics, efficiency refers to the optimal ratio of output to input, reflecting the optimal allocation of resources to achieve maximum productivity. In banking, efficiency indicates a bank's ability to manage its inputs (such as capital, labor, and expenses) to produce maximum outputs (such as revenues or services).

Banking efficiency can be classified into several types (Ullah et al., 2023):

- Cost Efficiency: Achieving the same output at the lowest possible cost.
- Allocative Efficiency: Optimal allocation of inputs based on input prices.
- Technical Efficiency: The capacity to generate the highest possible output using a specified set of inputs.
- Scale Efficiency: Efficiency related to the scale of operations—whether the bank is operating at its most productive scale.
- Price Efficiency: The ability to offer competitive prices and returns while maintaining stakeholder trust.

Efficiency serves a vital function in ensuring banks' sustainability and competitiveness, particularly in the face of changing market dynamics and technological disruption.

### *Measuring Efficiency: Data Envelopment Analysis (DEA)*

To measure banking efficiency, this study employs Data Envelopment Analysis (DEA), a non-parametric frontier technique widely used for benchmarking performance across similar units known as Decision Making Units (DMUs), such as banks. DEA compares the ratio of inputs (e.g., interest expenses, operational costs) to outputs (e.g., operating income) among banks to identify those operating on the efficient frontier.

DEA provides efficiency scores on a scale from 0 to 1, where a score of 1 indicates full efficiency. Two common DEA models are:

- CCR Model (Charnes, Cooper, and Rhodes): Assumes Constant Returns to Scale (CRS).
- BCC Model (Banker, Charnes, and Cooper): Assumes Variable Returns to Scale (VRS).

DEA is flexible in handling multiple inputs and outputs, and does not necessitate a predetermined functional form, thereby making it well-suited for assessing banking performance (Lotfi et al., 2020; Podinovski & Chameeva, 2021).

### *Financial Technology (Fintech)*

Fintech refers to the application of digital technology to improve financial service delivery (Kudal et al., 2022). In Indonesia, Fintech adoption is driven by the rapid digitalization of banking and consumer behavior. Fintech services are generally categorized into:

- P2P Lending: Direct lending platforms that connect borrowers and lenders without intermediaries (regulated by POJK No. 77/2016).

- Digital Payment: Electronic transactions that eliminate the need for cash and physical banking infrastructure, such as mobile banking and e-wallets.

Fintech is recognized for reducing transaction costs, increasing financial inclusion, and providing customer-centric innovations (Pan & Liu, 2021; Purwanto et al., 2022).

***Determinants of Banking Efficiency***

Various internal and external variables have been linked to banking efficiency:

- Return on Equity (ROE): Reflects the effectiveness with which a bank uses shareholders' equity to generate earnings. A higher ROE signifies stronger performance and may contribute to improved efficiency (Almira & Wiagustini, 2020).
- Capital Adequacy Ratio (CAR): Measures a bank's capital in relation to its risk-weighted assets. A well-capitalized bank is generally more resilient and efficient (Wangsawidjaja, 2020).
- Gross Domestic Product (GDP): Reflects the economic environment. A growing economy can drive banking activity and improve efficiency (Shair et al., 2021).
- Inflation (INF): High inflation may affect investment and lending behavior, potentially reducing banking efficiency (Belasri et al., 2020).
- Firm Size (Size): Larger banks may have more resources to adopt Fintech and operate at economies of scale, although results across studies are mixed (Farooq et al., 2021; Goswami et al., 2022).
- Concentration Ratio (CR): Represents market dominance by the top players. High concentration may limit competition and affect efficiency either positively or negatively depending on the context (Mateev et al., 2023).

These variables, along with Fintech indicators, are expected to interact in complex ways in determining banking efficiency in Indonesia.

## METHODOLOGY

This study uses a quantitative approach with the DEA method to measure the relative efficiency of each bank. Panel data is used in regression analysis to examine the relationship between Fintech variables and efficiency. The sample consists of 47 conventional banks listed on the Indonesia Stock Exchange (IDX) during the 2018–2023 period. Input variables include interest expense and operational expenditures, while output is measured by operating income.

## RESEARCH RESULTS

In panel data regression analysis, the selection of the most appropriate model is guided by the application of diagnostic tests, specifically the Chow Test and the Hausman Test, which provide a methodological basis for determining the model that best fits the data.

***Chow Test***

The Chow test is used to determine a more precise model between the Common Effect Model (CEM) and the Fixed Effect Model (FEM). If the cross-section probability value of F ≤ 0.05, then H0 is rejected, which means the more suitable model is the Fixed Effect Model (FEM). Conversely, if the cross-section value of F > 0.05, then H0 is accepted, so the model that is considered more appropriate in the regression analysis of panel data is the Common Effect Model (CEM).

**Table 1. Chow Test**

| Effects Test | Statistic | d.f. | Prob. |
|---|---|---|---|
| Cross-section F | 14.440762 | (19,94) | 0.0035 |
| Cross-section Chi-square | 163.896630 | 19 | 0.0044 |

*Source*: Data processed by the author (2025)

Referring to the results of table 1, the probability value of Cross-section F is 0.0035 and Cross-section Chi-square is 0.0044, both of which are smaller than 0.05. This indicates that H0 is rejected. Therefore, the most appropriate model to use is the Fixed Effect Model (FEM).

***Hausman Test***

Based on the results of the Chow Test, the Fixed Effect Model (FEM) was identified as the most appropriate model for this study. Subsequently, the Hausman Test was conducted to further evaluate whether FEM or the Random Effect Model (REM) was more suitable. If the probability value for the random cross-section is less than 0.05, the null hypothesis (H0) is rejected, indicating that FEM is the more accurate model. Conversely, if the probability value exceeds 0.05, the null hypothesis is accepted, suggesting that REM is the more appropriate choice.

**Table 2. Hausman Test**

| Test Summary | Chi-Sq. Statistic | Chi-Sq. d.f. | Prob. |
|---|---|---|---|
| Cross-section random | 0.000000 | 6 | 1.0000 |

* Cross-section test variance is invalid. Hausman statistic set to zero.

*Source*: Data processed by the author (2025)

Based on the results of the Hausman test shown in Table 4.7, it was obtained that H0 was accepted, which means that the most appropriate model is the Random Effect Model (REM) because the Cross-section random probability value of 1, exceeds the threshold of 0.05. However, the opinion of Faoziyyah and Laila (2020) when there is a warning that the variance in the Hausman test is invalid (Cross-section test variance is invalid. Hausman statistic set to zero), so there is no evidence to support the efficiency of individual effects. Therefore, this

study needs to refer back to the results of Chow's previous test, so the most appropriate model to use is the Fixed Effect Model (FEM).

***Panel Data Regression Analysis***

**Table 3. Fixed Effect Model Significance Test Results**

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 4.427546 | 1.034507 | 4.279862 | 0.0002 |
| X1P2P | -3.92E-17 | 1.65E-17 | -2.367887 | 0.0250 |
| X2PAY | 0.199364 | 0.031016 | 6.427845 | 0.0058 |
| X3ROE | 0.132887 | 0.050169 | 2.648785 | 0.0131 |
| X4CAR | 0.603905 | 0.151293 | 3.991631 | 0.0004 |
| X5INF | 0.022118 | 0.006532 | 3.386104 | 0.0021 |
| X6GDP | 0.004238 | 0.001830 | 2.316463 | 0.0281 |
| Z1SIZE | 2.68E-05 | 0.000658 | 0.040812 | 0.9675 |
| Z2CR | -0.138977 | 0.140871 | -0.9865556 | 0.3263 |

Source: Data processed by the author (2025)

Based on Table 3, it can be seen that the regression equation of panel data from the results of the panel regression analysis estimation which explains Financial Technology as measured through Peer-to-Peer Lending and Digital Payment and other variables, namely Return on Equity, Capital Adequancy Ratio, Inflation and Gross Domestic Product using the control variables Concentration Ratio and Size on Banking Efficiency in Indonesia for the 2018-2023 period using the Fixed Effect Model (FEM) model as follows:

EFF = 4.427546 -3.92E-17X1 + 0.199364X2 + 0.132887X3 + 0.603905X4 +0.22118X5 + 0.004238X6 + 2.68E-05Z1 - 0.138977Z2 + $\in$

Information:
EFF = Banking Efficiency
X1 = Peer-to-Peer Lending
X2 = Digital Payment
X3 = Return on Equity
X4 = Capital Adequancy Ratio
X5 = Inflation
X6 = Gross Domestic Product
Z1 = Firm Size
Z2 = Concentration Ratio
$\in$ = Error Term

***Hypothesis Test***

*Partial Hypothesis Testing (T-Test)*

**Table 4. T Test**

| Variable | t-Statistic | Prob. |
|---|---|---|
| X1P2P | -2.367887 | 0.0250* |
| X2PAY | 6.427845 | 0.0058* |
| X3ROE | 2.648785 | 0.0131* |
| X4CAR | 3.991631 | 0.0004* |
| X5INF | 3.386104 | 0.0021* |
| X6GDP | 2.316463 | 0.0281* |
| Z1SIZE | 0.040812 | 0.9675 |
| Z2CR | -0.986556 | 0.3263 |
| Ket: *Sig.5% | | |

*Source:* Data processed by the author (2024)

$$df = n - k \qquad (4.,,)$$
$$n = 120$$
$$k = 20$$
$$df = 120 - 20$$
$$df = 100$$
$$100; 0.05\% = 1.98397$$

With the known t table of 1.68830 and based on table 4, can be explained as follows:

1. Variable X1P2P has a t-statistical value |-2.367887| > t table 1.98397 with a prob value. 0.0250 < 0.05. This means that accepting H1, namely P2P, has a partial influence on banking efficiency.
2. The X2PAY variable has a t-statistic value |6.427845| > t table 1.98397 with a prob value. 0.0058 < 0.05. This means that receiving H2 i.e. PAY has a partial influence on banking efficiency.
3. The X3PAY variable has a t-statistic value |2.648785| > t table 1.98397 with a prob value. 0.0131 < 0.05. This means that accepting H3 means that ROE has a partial effect on banking efficiency.
4. The X4CAR variable has a t-statistic value |3.991631| > t table 1.98397 with a prob value. 0.0004 < 0.05. This means that accepting H4 i.e. CAR has a partial influence on banking efficiency.
5. The X5INF variable has a t-statistic value |3.386104| > t table 1.98397 with a prob value. 0.0021 < 0.05. This means accepting H5, namely INF has a partial influence on banking efficiency.
6. The variable X6GDP has a t-statistic value |2.316463| > t table 1.98397 with a prob value. 0.0281 < 0.05. This means accepting H6, namely GDP has a partial influence on banking efficiency.

7. The Z1SIZE variable has a t-statistic value |0.04812| < t table 1.98397 with a prob value. 0.9675 > 0.05. This means rejecting H7, namely SIZE, has no influence on banking efficiency.
8. The Z2CR variable has a t-statistic value |-0.986556| < t table 1.98397 with a prob value. 0.3263 < 0.05. This means rejecting H8, namely CR has no partial influence on banking efficiency.

***Simultaneous Hypothesis Testing (F Test)***

**Table 5. F Test**

| F-Statistic | Prob. F |
|---|---|
| 52.81406 | 0.000108 |

*Source:* Data processed by the author (2024)

By comparing the Fstat value of 52.81406 and the Ftable value of 2.19, it can be concluded that the value of Fstat > Ftable is acceptable which means that there is a significant simultaneous influence on P2P, PAY, ROE, CAR, INF and GDP on banking efficiency.

*Coefficient Determination Test*

Based on the Fixed Effect Model (FEM) model, the Adjusted R-Square value was 0.915863 or 91.5%. It can be identified that the independent variables of P2P, PAY, ROE, CAR, INF and GDP on banking efficiency are 91.5% and the remaining 8.5% are explained by other variables outside of this study.

**Table 6. Coefficient Determination Test**

| | |
|---|---|
| Adjusted R-squared | 0.915863 |

*Source:* Data processed by the author (2024)

**DISCUSSION**

The empirical findings of this study provide insightful conclusions on how financial technology and macroeconomic indicators impact banking efficiency in Indonesia.

P2P Lending presents a statistically significant negative relationship with banking efficiency. This suggests that while P2P platforms offer alternative financing channels, they bypass traditional bank intermediation, potentially eroding the efficiency of banks by reducing their loan volumes and increasing competition in credit markets. Additionally, the unregulated nature of some P2P platforms may introduce risks that indirectly affect the stability and operational performance of banks.

Digital Payment, on the other hand, shows a significant positive impact on banking efficiency. The adoption of digital payment systems enables banks to streamline operations, reduce overhead costs, and deliver faster services. By minimizing reliance on branch-based services and leveraging digital platforms, banks are able to optimize input usage while maximizing output, thus enhancing their efficiency scores.

Return on Equity (ROE) reflects the bank's ability to generate profits from shareholders' equity. The positive significance found in this study confirms that higher ROE corresponds with improved efficiency, as profitable banks tend to have better resource allocation and operational control. This aligns with financial theory, which posits that profitability and efficiency are interlinked.

Capital Adequacy Ratio (CAR) also shows a significant and positive impact. This suggests that well-capitalized banks are more resilient to shocks and better positioned to support efficient operations. Higher CAR indicates a stronger buffer against risks, enabling banks to focus on long-term performance and strategic investments that boost efficiency.

Unexpectedly, Inflation (INF) also exhibits a positive influence. This may be due to inflation-induced increases in nominal income and banking fees, which can inflate operational revenues and improve measured efficiency. However, this relationship should be interpreted cautiously, as inflation also poses risks if not accompanied by economic growth.

Gross Domestic Product (GDP) is positively associated with efficiency, indicating that macroeconomic expansion supports banking sector performance. In growing economies, banks face increased demand for financial services, allowing for better utilization of resources and expansion of service outreach.

Meanwhile, Firm Size (SIZE) and Concentration Ratio (CR) were found to be statistically insignificant. This suggests that, within the observed period, neither the size of a bank nor its market dominance was a decisive factor in determining its efficiency. These results imply that operational practices, digital adoption, and internal performance management are more crucial than scale or market structure.

Collectively, the findings emphasize that banking efficiency in Indonesia is highly influenced by Fintech adoption—especially digital payment systems—and robust financial fundamentals. Banks aiming to enhance efficiency should strategically invest in digital infrastructure while maintaining strong capital and profitability ratios.

## CONCLUSIONS

Based on the findings of this study, it can be concluded that several key variables have a significant partial influence on the efficiency of conventional banking firms listed on the Indonesia Stock Exchange (IDX) during the 2018–2023 period. These include Peer-to-Peer Lending, Digital Payment, Return on Equity (ROE), Capital Adequacy Ratio (CAR), Inflation, and Gross Domestic Product (GDP). Conversely, control variables such as Firm Size and Concentration Ratio were found to have no significant effect on banking efficiency. Furthermore, the study confirms that P2P Lending, Digital Payment, ROE, CAR, Inflation, and GDP collectively exert a significant simultaneous influence on banking efficiency. These results highlight the importance of financial technology adoption and sound financial fundamentals in driving operational efficiency in Indonesia's banking sector.

## RECOMMENDATIONS

This study offers several practical recommendations for both banking institutions and financial regulators. For banking institutions, it is crucial to enhance operational efficiency through a strategic and measurable integration of financial technology. Banks should prioritize investment in advanced digital infrastructure that is scalable and adaptable to future innovations. Collaborative initiatives focused on financial inclusion—particularly targeting underserved populations—can help expand market reach and support sustainable growth. Furthermore, transparency in digital service performance should be encouraged through non-financial reporting, such as transaction volumes across various platforms. From a regulatory perspective, authorities are encouraged to formulate responsive and forward-looking digital economic policies that accommodate technological advancements while safeguarding financial stability. A supportive regulatory framework is essential to facilitate the widespread adoption of Fintech without compromising systemic security.

## FURTHER STUDY

Further research is recommended to use more research subjects over a longer period within the same sector, as this study only used 20 companies over six periods. Furthermore, further research is recommended to use different methods to obtain better and more accurate results.

## REFERENCES

Adams, F. Y. (1881). *Mathematical psychics: An essay on the application of mathematics to the moral sciences*. C. Kegan Paul & Co.

Almira, N. P. A. K., & Wiagustini, N. L. P. (2020). Return on asset, return on equity, dan earning per share berpengaruh terhadap return saham. *E-Jurnal Manajemen Universitas Udayana, 9*(3), 1069–1088. https://doi.org/10.24843/EJMUNUD.2020.v09.i03.p13

Belasri, S., Gomes, M., & Pijourlet, G. (2020). Corporate social responsibility and bank efficiency. *Journal of Multinational Financial Management, 54*, 100612. https://doi.org/10.1016/j.mulfin.2020.100612

Edgeworth, F. Y. (1881). *Mathematical psychics: An essay on the application of mathematics to the moral sciences*. C. Kegan Paul & Co.

Faoziyyah, A. A., & Laila, N. (2020). Faktor internal dan faktor makroekonomi yang mempengaruhi profitabilitas asuransi syariah di Indonesia periode 2016–2018. *Jurnal Ekonomi Syariah Teori dan Terapan, 7*(6), 1146–1163. https://doi.org/10.20473/vol7iss20206pp1146-1163

Farooq, M., Khan, S., Siddiqui, A. A., Khan, M. T., & Khan, M. K. (2021). Determinants of profitability: A case of commercial banks in Pakistan. *Humanities & Social Sciences Reviews, 9*(2), 1–13. https://doi.org/10.18510/hssr.2021.921

Goswami, S., Sharma, R. B., & Chouhan, V. (2022). Impact of financial technology (Fintech) on financial inclusion in rural India. *Universal Journal of Accounting and Finance, 10*(2), 483–497. https://doi.org/10.13189/ujaf.2022.100213

Kudal, P., Dawar, S., Rai, R., & Dawar, P. (2022). Perceived cyber security challenges in adoption and diffusion of FinTech services in India. In S. Saeed, A. M. Almuhaideb, N. Kumar, N. Zaman, & Y. B. Zikria (Eds.), *Advances in information security, privacy, and ethics* (pp. 449–465). IGI Global. https://doi.org/10.4018/978-1-6684-5284-4.ch022

Lotfi, F. H., Ebrahimnejad, A., Vaez-Ghasemi, M., & Moghaddas, Z. (2020). Advanced DEA models with R codes. In *Data envelopment analysis with R* (Vol. 386, pp. 99–162). Springer. https://doi.org/10.1007/978-3-030-24277-0_4

Mateev, M., Tariq, M. U., & Sahyouni, A. (2023). Efficiency, market concentration and bank performance during the COVID-19 outbreak: Evidence from the MENA region. *PLOS ONE, 18*(5), e0285403. https://doi.org/10.1371/journal.pone.0285403

Napitupulu, R. B., Simanjuntak, T. P., Hutabarat, L., & Damanik, H. (2021). *Penelitian bisnis: Teknik dan analisa data dengan SPSS - STATA - EVIEWS*. Madanatera.

Pan, F., & Liu, Y. (2021). The research progress on the geography of Fintech industry. *Editorial Department of World Regional Studies*. https://doi.org/10.3969/j.issn.1004-9479.2021.04.2020725

Pareto, V. (1927). *Manuel d'économie politique* (2nd ed.). Alfred Bonnet.

Podinovski, V. V., & Chameeva, T. B. (2021). Optimal solutions of multiplier DEA models. *Journal of Productivity Analysis, 56*(1), 45–68. https://doi.org/10.1007/s11123-021-00610-3

Shair, F., Shaorong, S., Kamran, H. W., Hussain, M. S., Nawaz, M. A., & Nguyen, V. C. (2021). Assessing the efficiency and total factor productivity growth of the banking industry: Do environmental concerns matter? *Environmental Science and Pollution Research, 28*(16), 20822–20838. https://doi.org/10.1007/s11356-020-11938-y

Ullah, S., Majeed, A., & Popp, J. (2023). Determinants of bank's efficiency in an emerging economy: A data envelopment analysis approach. *PLOS ONE, 18*(3), e0281663. https://doi.org/10.1371/journal.pone.0281663

Wangsawidjaja. (2020). *Kredit bank umum: Menurut teori dan praktik perbankan Indonesia*. Lautan Pustaka. https://books.google.co.id/books?id=bAMGEAAAQBAJ