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Analysis of Mobile Banking Usage and Other Factors on Banking Productivity in Indonesia Using the Malmquist Productivity Index (MPI) Approach

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Abstract: *This study analyzes the impact of fintech technology on the productivity and efficiency of traditional banks in Indonesia that provide mobile banking services. While fintech has improved financial transactions and operational efficiency, previous research shows mixed results regarding the effect of fintech on bank productivity. This study fills the research gap by analyzing how fintech integration affects the efficiency of traditional banks using recent data. Using the Malmquist Productivity Index (MPI), this study evaluates the efficiency of nine traditional banks in Indonesia based on annual report data. The variables analyzed include Non-Perfoarming Loan (NPL), Capital Adequacy Ratio (CAR), Total asset (TA), 3rd Party Total Payments (PA), Market share of mobile transactin (PH). Variabel Gross Domestic Product (GDP), dan M2 Change Rate (MS). Descriptive analysis results show that the variables of CAR, TA, PA, GDP, and M2 have a significant influence on productivity. While the NPL variable does not have a significant influence on bank productivity.This study concludes that fintech is important to improve banking efficiency in Indonesia and banks should prioritize technological innovation to boost productivity. Further research is needed to explore additional variables in this relationship.*

Keyword: *Banking Efficiency, Fintech, Malmquist Productivity Index, Mobile Banking, Technological Innovation.*

Abstrak: Penelitian ini menganalisis dampak teknologi fintech terhadap produktivitas dan efisiensi bank konvensional di Indonesia yang menyediakan layanan mobile banking. Meskipun fintech telah meningkatkan transaksi keuangan dan efisiensi operasional, penelitian sebelumnya menunjukkan hasil yang beragam mengenai pengaruh fintech terhadap produktivitas bank. Penelitian ini mengisi kesenjangan penelitian dengan menganalisis bagaimana integrasi fintech memengaruhi efisiensi bank konvensional menggunakan data terkini. Dengan menggunakan Malmquist Productivity Index (MPI), penelitian ini mengevaluasi efisiensi sembilan bank konvensional di Indonesia berdasarkan data laporan

tahunan. Variabel yang dianalisis meliputi Non-Perfoarming Loan (NPL), Capital Adequacy Ratio (CAR), Total Assets (TA), 3rd Party Total Payments (PA), Market share of mobile transaction (PH). Variabel Gross Domestic Product (GDP) dan M2 Change Rate (MS). Hasil analisis deskriptif menunjukkan bahwa variabel CAR, TA, PA, GDP, dan M2 memiliki pengaruh signifikan terhadap produktivitas. Sementara variabel NPL tidak memiliki pengaruh signifikan terhadap produktivitas bank. Penelitian ini menyimpulkan bahwa fintech penting untuk meningkatkan efisiensi perbankan di Indonesia dan bank harus memprioritaskan inovasi teknologi untuk mendorong produktivitas. Penelitian lebih lanjut diperlukan untuk mengeksplorasi variabel tambahan dalam hubungan ini.

Kata Kunci: Efisiensi Perbankan, Fintech, Indeks Produktivitas Malmquist, Perbankan Seluler, Inovasi Teknologi.

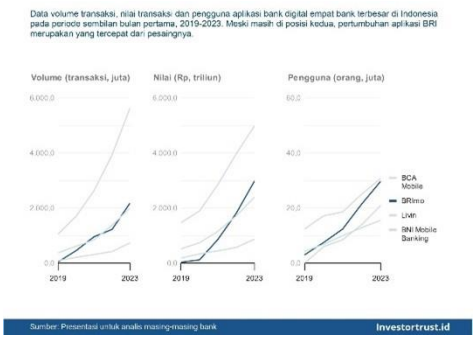
INTRODUCTION

In the digital era, information and communication technology advancements have significantly influenced many aspects of human life, including the financial sector. Innovations like financial technology (fintech) have made a substantial impact. One such innovation is mobile banking, which has become widely used for convenient financial transactions. This study uses the Malmquist Productivity Index (MPI) to examine how mobile banking affects banking productivity in Indonesia.

Banks are defined as commercial organizations under regulation UU No 10 of 1998 Article 1 that gather savings from the general public and offer credit or other services to the public to raise many people's standards of life. The number of commercial banks in Indonesia dropped from 109 in 2020 to 106 in 2023, according to data from the Financial Services Authority (OJK, 2023). According to Safari & Riyanti, (2024), mobile banking is an application that combines information technology and business applications. Currently, Indonesia is entering an era of modern industrialization, which has led banks in the country to strive to increase interest in mobile banking.

In the context of the development of fintech, the adoption of mobile banking services in Indonesian banks has positively impacted the national economy. This impact includes making transactions easier, providing easier access to financial products, and increasing financial knowledge among the populace. Global COVID-19 impact was demonstrated in Fu & Mishra, (2021) research on the acceleration of digital transformation in the banking industry. The study explained that the pandemic led to a significant increase in downloads of financial-related mobile applications, showing a growth rate between 21% and 26%. This growth is a phenomenon that may not have occurred without the Covid-19 pandemic.

According to research by Riady et al., (2022), there have been beneficial effects of the epidemic in Indonesia. Fintech provides digital financial solutions, making transactions easier and enabling people to meet their economic needs without being physically present. The surge in fintech transactions is a result of lifestyle changes caused by the pandemic.



Source: Investortrust. id

Figure 1. Mobile banking growth (2023)

Figure 1 above depicts the growth of transaction volume, transaction value, and the number of users for the four largest digital banking applications in Indonesia: BCA Mobile, BRImo, Livin by Mandiri, and BNI Mobile banking from 2019 to 2023. The graphs indicate that BCA Mobile leads in all categories with significant annual growth. This demonstrates how major banks are utilizing technology to expand services and drive increased transactions.

In their 2021 study, Novitasari et al., (2021) explain that customers can access their accounts without having to go to the bank directly, providing convenience and benefits such as transfers, transaction history, and payments, among others. As of 2023, Indonesia has 106 commercial banks registered with the OJK. The research focuses on 9 conventional commercial banks that consistently issued financial reports on mobile banking transactions from 2019 to 2023.

In a study by Khaksar & Malakoutian, (2020), the productivity of 30 banks from eight developing countries was compared from 2015 to 2019 using the DEA model and the Malmquist Productivity Index. Input variables included fixed assets and operational costs, while output variables were total savings, total loans, and total profits. The study found that banks with high management efficiency, stable asset structure, and operating in a stable market experienced an increase in productivity.

In a separate study, Jahan, (2019) analyzed 29 commercial banks in Bangladesh from 2011 to 2015. The study used the Malmquist Productivity Index (MPI) to assess changes in total factor productivity (TFP) in Bangladeshi commercial banks. The results indicated that Islamic banks, compared to conventional banks, demonstrated a higher average total factor productivity (TFP) change index. These increases were primarily attributed to improvements in efficiency rather than technological advances.

METHOD

This study utilizes quantitative research methods to analyze social phenomena and the relationships between variables using numerical data. The approach is descriptive and verification-based, focusing on presenting facts and testing hypotheses. Following a positive paradigm, the research examines observable phenomena and their causal relationships. Classified as causal-comparative research, these studies evaluate the impact of changing conditions over time. Data was collected from secondary reports and annual statements from banks and then analyzed using case study and panel data methodology. This research integrates cross-sectional and time data from 2020 to 2023 to offer a comprehensive view of mobile banking transactions at nine conventional banks in Indonesia.

Table 1. Sample List

NO.	Bank Name	Digital Service Application
1.	PT Bank Central Asia Tbk	BCA *Mobile*
2.	PT Bank Rakyat Indonesia Tbk	BRImo
3.	PT Bank Mandiri Tbk	Livin
4.	PT Bank Negara Indonesia Tbk	BNI *Mobile*
5.	PT Bank CIMB Niaga Tbk	OCTO *Mobile*
6.	PT Bank Tabungan Negara Indonesia Tbk	BTN *Mobile*
7.	PT Bank DBS Indonesia Tbk	Digibank
8.	PT Bank Maybank Indonesia Tbk	Maybank2u
9.	PT Bank Mrga Tbk	M-Smile

Source: Data processed by the author (2024)

According to Susanto et al., (2024) and Amin et al., (2023) the population of this study is made up of all pertinent units of analysis, such as organizations, people, or regions.. The sample is a part of the population that represents the whole, selected using a non-probability

purposive sampling method to ensure representativeness, as explained by (Sugiyono, 2020). Secondary data were obtained from annual Indonesian banking reports and official documents from OJK, Bank Indonesia, and BPS and were analyzed using descriptive analysis techniques with the DEAP 2.1 program to calculate productivity values through the Malmquist Productivity Index (MPI) Sugiyono, (2020) dan Kasmir, (2022). This method aims to provide a comprehensive picture of digital technology transactions in conventional commercial banks from 2019 to 2023.

As stated by Ulfa, (2020) variables are traits, characteristics, or values possessed by a person, object, or activity that can change and have at least two categories. Researchers use these variables to study and draw conclusions. Setting goals for analyzing, processing, and testing hypotheses is one of the objectives of determining variables. The description of the input and output variables used in this study is provided below:

Table 2. Description Variable

Independent Variable	Description	Source
Non-performing Loan (NPL)	Impaired loan/ gross loans	Annual Report
Capital Adequacy Ratio1(CAR)	Risk-weighted1assets/ equity capital	Annual Report
Total Asset (TA)	Total Asset	Annual Report
Bank market share of mobile transaction market (PH)	The financial market's total amount of mobile transactions divided by the volume of such transactions	Annual Report
3rd party total payments (PA)	The total number of transactions done by customers utilizing the third-party platform's account to pay for items	Annual Report
GDP	Annual real GDP of growth rate	BPS
MS	M2 change rate	BPS

BPS: Badan Pusat Statistik

Data analysis involves several techniques to ensure thorough examination and validation of the research hypotheses. The research model is as follows:

$$TFPCH = \alpha + \beta_1 NPL_{it} + \beta_2 CAR_{it} + \beta_3 TA_{it} + \beta_4 PA_{it} + \beta_5 PH_{it} + \beta_6 GDP_{it} + \beta_7 M2_{it} + \varepsilon_{it} \quad (2)$$

Where:

TFPCH (Y) = Productivity
$\beta_1 NPL_{it}$ = Non-performing Loan1(NPL)
$\beta_2 CAR_{it}$ = Capital Adequacy Ratio (CAR)
$\beta_3 TA_{it}$ = Total Asset (TA)
$\beta_4 PA_{it}$ = 3rd party total payments (PA)
$\beta_5 PH_{it}$ = Bank market share of mobile transaction market1(PH)
$\beta_6 GDP_{it}$ = Gross Domestic Product
$\beta_7 M2_{it}$ = Market Share
ε = Error

The primary analytical techniques used are:

1) Malmquist Productivity Index (MPI): This method measures changes in productivity over time by considering changes in technical efficiency and changes in scale. The MPI indicates how bank productivity changed between different periods, with higher values indicating increased productivity. This research utilizes DEAP 2.1 software for MPI analysis.
2) Descriptive Statistics: This process simplifies and visualizes research data through tabulation and graphical representation. Descriptive statistics help in summarizing and organizing data both numerically and graphically to understand the characteristics of the variables studied.

3) Classical Assumption Test: This test includes checks for multicollinearity, heteroscedasticity, and normality to ensure that the data meets the Best Linear Unbiased Estimator (BLUE) criteria. The purpose of this test is to verify the validity of the basic assumptions in regression analysis.
4) Panel Data Regression Analysis: This statistical technique evaluates the influence of independent variables on the dependent variable by considering individual and time dimensions. The three main models applied in this analysis are the Fixed Effects Model (FEM), the Random Effects Model (REM), and the Common Effects Model (CEM). This analysis process was carried out using EViews 13 software.
5) Hypothesis Testing: Using EViews 13 software, hypothesis testing is carried out to determine the acceptance or rejection of the proposed hypothesis. This test includes partial hypothesis testing (t-test) and simultaneous hypothesis testing (F-test).

Overall, the above technology allows for a deep understanding of bank productivity and data validity through comprehensive and appropriate analysis techniques.

RESULTS AND DISCUSSION

The Malmquist Productivity Index (MPI) approach was used to research commercial bank productivity. This involved measuring the overall relationship between input and output through Total Factor Productivity (TFPCH). The analysis assesses changes in bank productivity by comparing total output to total input, with productivity values indicating increases or decreases in efficiency over time.

Table 3. MTFPI (Malmquist Factor Productivity Index)

Firm	EFFCH	TECHCH	PECH	SECH	TFPCH	Productivity
BCA	0.834	0.824	0.911	0.916	0.687	Not Productive
BNI	1.000	0.874	1.000	1.000	0.874	Not Productive
Mandiri	0.972	0.958	1.000	0.972	0.931	Not Productive
BRI	0.983	0.888	1.000	0.983	0.874	Not Productive
CIMB	0.971	0.901	0.979	0.992	0.875	Not Productive
DBS	1.000	0.807	1.000	1.000	0.807	Not Productive
BTN	1.000	1.047	1.000	1.000	1.047	Productive*
Maybank	1.000	1.017	1.000	1.000	1.017	Productive*
MEGA	1.018	0.911	1.016	1.002	0.928	Not Productive
Mean	**0.974**	**0.911**	**0.989**	**0.985**	**0.887**	**Not Productive**

Source: Excel Processed Data (2024)

Notes:
1. EFFCH (Efficiency Change), TECHCH (Technology Change), PECH (Pure Efficiency Change), SECH (Scale Efficiency Change); TFPCH (Total Factor Productivity Change).
2. It is said to be productive if the TFPCH value is > 1

From the nine conventional commercial banks sampled in this study, average productivity data for each bank are presented in Table 4 Analysis using DEAP 21 reveals that between 2019 and 2023, several banks experienced declines in productivity. BCA (Bank Central Asia) saw significant reductions in technical efficiency (EFFCH = 0.834), technology (TECHCH = 0.824), and scale efficiency (SECH = 0.916), resulting1in a 31.3% decrease in total factor productivity (TFPCH = 0.687). BNI (Bank Negara Indonesia) maintained stable technical efficiency (EFFCH = 1.000) but experienced a decline in technology (TECHCH = 0.874), leading to a 12.6% decrease in total factor productivity (TFPCH = 0.874). Mandiri (Bank Mandiri) showed a slight decrease in technical efficiency (EFFCH = 0.972) and technology (TECHCH = 0.958), resulting in a 6.9% reduction in total factor productivity (TFPCH = 0.931). BRI (Bank Rakyat Indonesia) also experienced declines in technical efficiency (EFFCH = 0.983) and technology (TECHCH = 0.888), with an 11.6% drop in total factor productivity (TFPCH = 0.874). CIMB (CIMB Niaga) faced reductions across all

components, with technical efficiency (EFFCH = 0.971) and technology (TECHCH = 0.901), resulting1in a 12.5% decrease in total factor productivity (TFPCH = 0.875).

Overall, most banks showed a decline in total productivity, primarily due to reductions in technology adoption and scale efficiency. Only BTN and Maybank demonstrated productivity improvements, indicating their successful adaptation to technological changes and operational efficiency. In contrast, other banks, despite maintaining some stability in technical efficiency, struggled to leverage technology effectively, leading to decreased total productivity. This underscores the critical importance of technological innovation and optimal scale efficiency in sustaining and enhancing bank productivity.

Table 4. Descriptive Statistics Results of Conventional Commercial Bank Input and Output Variables

Variable	minimum	maximum	mean	st. deviate
labor input (x1)	2.797	91.620	23.667,86667	2.4419,5234
borrowed funds (x2)	398	57.931.877	18.654.820,36	18.800.636,73
physical capital (x3)	263.721	16.550.584	5.706.023,089	5.271.174,025
total loans (y1)	1.170.978	1.146.082.506	354.695.722	365.117.033,9
investment (y2)	13.813.909	392.596.227	1.1584.4613,5	106.940.421,3
non-interest investment (y3)	140.753	67.602.439	17.718.546,29	19.528.021,36

Source: Excel Processed Data (2024)

Table 5. Descriptive Statistics Results of Independent Variables for Conventional Commercial Banks (in million rupiah)

Variable	minimum	maximum	mean	st. deviate
Non-performing loan (NPL)	1,02	4,78	2,83	16.838,52
Capital Adequacy Ratio (CAR)	16,78	31,04	22,82	3,10
Total Asset (TA)	86.154.871	1.835.248.731	677.428.414,3	571.918.941,8
PA	98	87.030	8.959,85	16.838,52
PH	0,02	1,35	0,44	0,33
GDP	15.443,35	19.892,38	17.546,65	1.884,19
Market Share (M2)	6.136,78	8.826,53	7.648,34	1.011,52

Source: Excel Processed Data (2024)

Table 6. Average Malmquist Productivity Index for Conventional Commercial Banks

Year	EFFCH	TECHCH	PECH	SECH	TFPCH
2019	0.908	1.283	0.997	0.911	1.165
2020	1.084	0.647	0.997	1.087	0.701
2021	1.009	0.784	1.015	0.994	0.791
2022	0.887	0.993	0.946	0.937	0.881
2023	0.994	0.972	0.992	1.002	0.967
Mean	**0.974**	**0.911**	**0.989**	**0.985**	**0.887**

Source: Data Processed by DEAP 21 (2024)

Table 7. Chow Test Results

Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	2.208707	(8,29)	0.0566
Cross-section Chi-square	21.410926	8	0.0061

Source: Data Processed by DEAP 21 (2024)

Table 8. Hausman Test Results

Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0.000000	7	1.0000

Source: Data Processed by DEAP 21 (2024)

Table 9. Lagrange Multiplier Test Results

	Test1Hypothesis Cross-section1	Time1	Both1
Breusch-Pagan	0.165880 (0.6838)	1.057645 (0.3038)	1.223526 (0.2687)

Source: Data Processed by DEAP 21 (2024)

Table 10. Common Effect Model Test Results

Variable	*Coefficient1*	*Std. Error1*	*t-Statistic*	*Prob.*
C	-0.232226	0.592984	-0.391622	0.6976
NPL	0.057329	0.047514	1.206581	0.2353
CAR	0.063837	0.018866	3.383605	0.0017
TA	5.45E-10	1.13E-10	4.808396	0.0000
PH	8.96E-16	4.39E-16	2.040053	0.0485
PA	-3.73E-11	1.05E-11	-3.560762	0.0010
GDP	0.037713	0.015334	2.459437	0.0187
M2	-1.28E-10	4.29E-11	-2.984636	0.0050

Root MSE	0.223687	R-squared	0.559330
Mean dependent var	0.956622	Adjusted R-squared	0.475961
S.D. dependent var	0.340773	S.E. of regression	0.246687
Akaike info criterion	0.198421	Sum squared resid	2.251621
Schwarz criterion	0.519605	Log likelihood	3.535534
Hannan-Quinn criter.	0.318155	F-statistic	6.709022
Durbin-Watson stat	1.970464	Prob(F-statistic)	0.000037

Source1: Data Processed by DEAP 21 (2024)

Table 10 above illustrates the equation's form when testing with the Common Effect Model:

$$TFPCH = -0.232226 + 0.057329NPL + 0.063837CAR + 5.45E\text{-}10TA - 3.73E\text{-}11PA + 8.96E16PH + 0.037713GDP + -1.28E\text{-}10\ M2 \quad (3)$$

Where:

1) TFPCH represented bank productivity
2) X_1 represented a Non-performing Loan (NPL)
3) X_2 represented a Capital Adequacy Ratio (CAR)
4) X_3 represented a Total Asset (TA)-
5) X_4 represented a 3rd party total payments (PA)
6) X_5 represented a Bank market share of the mobile transaction market (PH)
7) X_6 represented a Gross Domestic Product
8) X_7 represented a Market Share

The coefficient in the regression equation shows how each independent variable affects bank productivity. When all independent variables (NPL, CAR, TA, PH, PA, GDP, and M2) are zero, then bank productivity is 0.232226, as shown by the constant of -0.232226. The NPL variable with a T-statistic value (1.206581) is smaller than the T-table (2.0166922), and the probability value (0.2353) is much greater than 0.05, indicating that NPL has no significant effect on bank productivity. CAR, TA, and PH variables with probability values < 0.05 have a

significant influence on productivity. While the variables PA and M2 have a significant negative effect on productivity with a probability value < 0.05.

The Non-Performing Loans (NPL) variable has no significant effect while the Capital Adequacy Ratio (CAR), Total Assets (TA), Transaction Volume (PH), Number of Transactions (PA), GDP, and Market Share (M2) variables show a significant effect on productivity in the T-test regression analysis of Table 10 because the probability value is smaller than 0.05 and the T-statistic value is greater than the T-table. This finding indicates that although other factors do not significantly affect productivity, M2 and GDP do. Research conducted by Fajari & Sunarto, (2017) and published by Bank Indonesia shows that ineligible loans (NPL) and capital adequacy ratio (CAR) hurt bank performance. The study investigated 29 banks listed on the Indonesia Stock Exchange (IDX) from 2011 to 2015.

The study found that, based on the F test results, the Non-Performing Loans (NPL) variable had no significant effect on productivity. However, the Capital Adequacy Ratio (CAR), Total Assets (TA), Transaction Volume (PH), Number of Transactions (PA), GDP, and Market Share (M2) variables did have a significant effect on productivity when considered together. The F test statistical value of 6.709022, which was greater than the t-table value of 2.34902747, and the F test probability value of 0.000037, which was smaller than 0.05, supported this finding. In other words, when the independent variables were taken into account collectively, they had a significant impact on productivity. The F test is a statistical test that assesses the overall significance of a regression model by determining whether the independent variables make a significant contribution to the dependent variable at the same time (Wooldridge, 2019).

There is a possibility that NPL, CAR, TA, PA, PH, GDP, and M2 can be responsible for the dependent variable, namely productivity, as shown in Table 10, where the results of the coefficient of determination (R2) test show an adjusted R-squared value of 0.475961, or 47.5961%. While other variables outside the study affect 0.52403 or 52.403% of the total, which indicates that bank-specific variables such as NPL, CAR, TA PA, PH, GDP, and M2 can affect productivity.

Based on this finding, it is explained that the value of 0.559330 indicates that about 55.9330% of the variability in banking productivity can be explained by the independent variables on productivity. The value of 0.475961 indicates that after adjustment for the number of variables in the model, only about 47.59330% of the variability in banking productivity is explained by the independent variables. The F-statistic value of 6.709022 and Prob (F-statistic) of 0.000037 indicate that the independent variables have a significant influence on banking productivity in the MPI (Malquist Index Productivity) method. Based on the significant R-squared and F-statistic values, the results show that variables such as NPL (Non-Performing Loans), CAR (Capital Adequacy Ratio), TA (Total Assets), PA (3rd party total payments), PH (market share of mobile transaction market), GDP (Annual real GDP growth rate), and MS (M2 Change Rate) have a significant influence on changes in bank efficiency and productivity.

Discussion

This study uses the Malmquist Productivity Index (MPI) to assess the impact of independent factors on the productivity of traditional banks in Indonesia. The results show that non-performing loan ratio (NPL), capital adequacy ratio (CAP), total assets (TA), total third-party payments (PA), and mobile transaction market share (PH) are examples of independent factors that have a significant impact on bank productivity. On the other hand, fintech technology shows a strong influence in improving bank productivity in Indonesia.

In this model, it is found that Non-Performing Loans (NPL) do not significantly affect bank productivity, but they do hurt profitability. High NPLs can lead to a reduction in interest income and affect a bank's financial performance. However, in the short term, the impact on productivity may be small if the bank effectively manages operational and management cost

risks. This finding aligns with the research by Çollaku & Aliu, (2021) which indicates that while NPLs negatively affect bank profits, they may not always have a significant impact on productivity.

CAR has a significant positive influence on CAR and Productivity. Capital adequacy ratio, also known as CAR, is a ratio used to ensure that banks have sufficient capital to cover unexpected losses, maintain financial stability, and protect depositors. CAR is the percentage of capital a bank has compared to assets that are considered the most risky. A high CAR indicates that the bank has sufficient capital to cover the risk of its assets. This is in line with research conducted on 48 conventional banks and 28 Islamic banks in GCC countries. Miah & Uddin, (2017) explained that banks with higher CAR, both Islamic and conventional banks, tend to be more efficient in managing risk, which in turn increases productivity.

The third hypothesis is that there is a significant influence between Total Assets (TA) on bank productivity in this model. This is in line with research conducted by Rashid et al., (2020) on 30 banks listed in Bangladesh from 2013 to 2017 where bank productivity is related to the amount of Total Asset owned. Total Asset acts as an important measure to see how banks can manage Total Asset well so that it can be said to be productive. However, this is not in line with research conducted by Ghosh & Maji, (2019) on the relationship between bank productivity performance in India with a sample of 40 commercial banks listed in India during the period 2002 to 2016. This study shows that various factors, such as management efficiency, asset composition, and market conditions, can cause the correlation between bank performance and total assets to not always be significant. Although banks have a lot of assets, ineffective management in implementing mobile banking may hinder productivity.

There is a significant negative effect of 3rd Party Total Payments (PA) on bank productivity in this model. Mobile banking allows customers to make third-party payments easily through banking applications. This is in line with research conducted by Kamboj et al., (2022) on 338 respondents who are customers of banks that have mobile banking in India. The results of this study state that the number of mobile banking transactions or 3rd party total payments can have a significant negative impact on the productivity of banks. Research by Zavolokina et al., (2016) explained in their research that the perception of financial innovation, including third-party payments, and found that the adoption of these technologies by banks does not always result in increased productivity unless accompanied by changes in business processes and risk management. From the above studies, it can be concluded that although 3rd Party Total Payments (PA) services through fintech and mobile banking improve efficiency and convenience for customers, the impact on overall bank productivity is not always significant.

PH has a significant impact or influence on productivity in the context of this study.

This is in line with research conducted by Fitriyani et al., (2023) on 90 customers of Bank Aceh Syariah, where the number of mobile banking transactions from the bank can increase bank productivity because with the increase in the number of transactions it is concluded that customers will continue to grow because they are able to give trust to the bank. Supported by research conducted by Efendi, (2024) at the BSI KCP Medan bank which states that an increase in the number of mobile banking transactions can increase bank productivity because the trust given by customers can encourage the growth of the bank.

The sixth hypothesis showed a significant positive relationship between GDP and bank productivity. The findings of this study are consistent with a macroeconomic perspective, as an increase in GDP signals an increase in economic activity which generally leads to greater demand for banking services such as loans, investments, and other financial products. This is related to research conducted by Ayuningtyas & Sufina, (2023) on the conventional bank sector listed on the Indonesia Stock Exchange from 2017 to 2021.

The seventh hypothesis shows a significant negative relationship between M2 and bank productivity. An increasing growth rate of money supply (M2) will increase liquidity in the

economic system, allowing banks to extend credit and other financial services. AlHarbi et al., (2024) explained in their study that Market Share (MS) is basically the total amount of money circulating in a country's financial system, which includes bank deposits and cash. This amount has an important impact on inflation and overall economic activity.

Simultaneously and partially from the results of the F Test and T Test on the variables NPL, CAR, TA, PA, PH, GDP, and M2 show a significant effect on bank productivity simultaneously. Judging from the probability value of 0.000037 <0.05, so it is concluded that simultaneously the independent variables have a significant effect on productivity, fintech technology also plays an important role in improving efficiency. This research emphasizes how important it is for the banking industry to embrace technology, especially through mobile banking, which can increase customer trust and improve transaction efficiency.

Banking is an institution that accepts deposits from the public and channels them to other members of the community to improve their standard of living, as stipulated in Law No. 10 of 1998 on Banking. According to Dewi & Octrina, (2022), banks play a crucial role in Indonesia's financial system development. Banks provide credit and various services that support the economic and trade sectors, hence holding a1significant role in the monetary system of a country.

Productivity is the ratio of output to input. According to Octrina et al., (2020),Total Factor Productivity (TFPCH) takes into account all aspects of production by calculating the change in output relative to all inputs. The Malmquist Index measures shifts in productivity and innovation by examining economic variables and production technology. According to Ralević et al., (2020), the Malmquist Productivity Index (MPI) consists of two components: Efficiency Change (EC) and Technological Change (TC). Efficiency Change (EC) measures an organization's efficiency changes over time, while Technological Change (TC) assesses the organization's technology improvements over time. To measure MPI, the approach outlined by Färe & Grosskopf, (1994) can be used.

$$M_{t,t+1}(y^{t+1}, x^{t+1}, y^t, x^t) = \left[\frac{D^t(y^{t+1}, x^{t+1})}{D^t(y^t, x^t)} \times \frac{D^t(y^{t+1}, x^{t+1})}{D^{t+1}(y^t, x^t)}\right]^{1/2}$$

M represents productivity in the context of the production function y^{t+1}, x^{t+1}, while the production function for the technology period is t+1. For the observation distance function, we can use $D_0^t(x^{t+1}, y^{t+1})$. Used on the MPI (Malmquist Productivity Index) values, there are three possible scenarios: If MPI >11, it indicates an upward trend in productivity; if MPI = 1, it signifies that productivity remains unchanged; and if MPI <11, it suggests a downward trend in productivity.

In productivity analysis, MPI helps identify ways organizations can improve efficiency and technology to increase productivity. It can also be used to assess changes in performance. According to Octrina et al., (2020), this index consists of several components, including Efficiency Change (EFFCH), Technological Change (TECHCH), Pure Efficiency Change (PECH), Scale Efficiency Change (SECH), and Total Factor Productivity Change (TFPCH). TFPCH can be divided into two components: Technical Efficiency Change (EFFCH) and Technological Change (TECHCH). To measure bank productivity in this research, the input variables used in this study are :

1. Total loans or total credit refers to the amount of loans provided by commercial banks to individuals or customers at the end of the year (Octrina & Pratidina, 2021).
2. Total investments in securities, as defined by, comprise tradable financial products such as exchange-traded funds (ETFs), mutual funds, equities, and bonds. We can add together the components listed by Cho & Chen, (2021) to compute investments.
3. Non-Interest Revenues, according to Octrina & Pratidina, (2021) non-interest income refers to the additional income generated by commercial banks that is unrelated to their

main operations. This includes income from sources such as interest, rent, dividends, and profits from the sale of fixed assets, and is not included in operating income.

The output variables used in this study are:

1. Labor Input According to Cho & Chen, (2021) labor input pertains to the amount of labor utilized by banks in producing output and is quantified in terms of the number of individuals. Labor input can be gauged either by the number of people employed or by the number of paid working hours by employees.
2. Borrowed Funds **t**he borrowed funds or total deposits represent the amount of money clients have entrusted to the bank in the form of an account at the end of the year, as stated in the balance sheet of the commercial bank (Octrina & Pratidina, 2021).
3. Physical capital is also called total assets or total net fixed assets, referring to all assets owned by a bank to support its business operations at the end of the year as listed in the Dewi & Octrina, (2022) balance sheet.

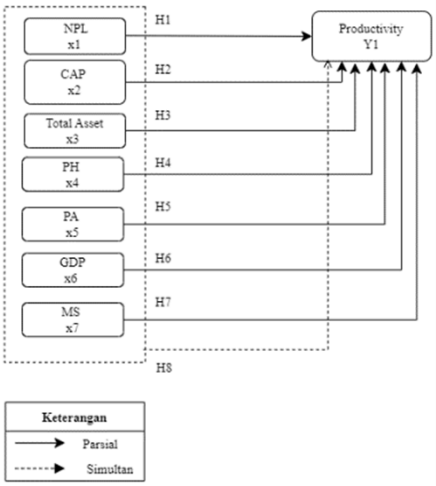


Figure 2. Conceptual Framework

In Figure 2, the relationship between several independent variables (NPL, CAR, TA, PA, PH, GDP, and M2) and productivity (Y1) is depicted. Each independent variable is assumed to have a partial relationship with productivity (Y1), as indicated by the solid line with an arrow. Additionally, there is a simultaneous relationship, denoted by the dotted line, which shows the combined impact of these variables on productivity.

CONCLUSION

Based on the analysis and discussion of the research findings regarding the Malquist Productivity Index (MPI)-based study of the productivity of conventional commercial banks in Indonesia, the average results show that, as indicated by the TFPCH value > 1, conventional commercial banks have not achieved full productivity during the 2019-2023 study period. The fact that the TECHCH figure is the highest and indicates that conventional commercial banks using mobile banking have not fully optimized their technology may have an impact on this. Independent bank factors including CAR, TA, PA, and PH significantly affect productivity, according to this study. However, the NPL variable had an insignificant relationship. Meanwhile, the study findings show that NPL, CAR, TA, PA, PH, GDP, and MS variables have a noticeable impact on productivity.

This study contributes to the literature by highlighting how fintech adoption, reflected in the independent variables, is a key factor in driving productivity. These findings guide the banking industry to focus more on technological innovation to achieve higher efficiency and

sustainable growth. Therefore, this study provides significant insights into the role of technology in improving banking productivity in Indonesia.

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