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Article

Revolutionizing Banking: Neobanks' Digital Transformation for Enhanced Efficiency

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Abstract: The changing of banking customer preferences after Covid-19 pandemic encourages banking transformation. Neobanks emerges as innovation in banking that enter the market to compete with the incumbent banks by offering new digital experience for customer. This paper analyzes the neobanks which transformed from traditional bank, specifically its efficiency after they implement digital transformation. Efficiency is measured by using Stochastic Frontier Analysis (SFA). This study also uses Pooled Mean Group (PMG) of Panel ARDL (Autoregressive Distributed Lagged) to investigate digital transformation as one of determinants neobank's efficiency, as well as to examine the existence of short-term and long-term relationship between digital transformation and efficiency. The SFA results show that the efficiency of the neobanks increase after they carry out digital transformation. Furthermore, from PMG Panel ARDL, it can be concluded that digital transformation is one of determinant of efficiency and there is longevity relationship between digital transformation and efficiency. In the short run, digital transformation has a significant and negative correlation with efficiency and in the long run, it has a significant positive relationship because initially digital transformation cost for operational and risk management innovation decreases the profit efficiency, but afterwards it increases the profit efficiency.

Keywords: digital business; digital transformation; neobank; efficiency

1. Introduction

The massive digital technology development and Covid-19 pandemic had caused people entering digital era, and digital transformation become a common reality in every sector such as manufacture, transportation, healthcare, education, agriculture, as well as economy and finance. To response the digitalization phenomenon, since 2020, Indonesia has Digital Indonesia Roadmap with the long-term vision aims to support digital transformation in 4 (four) strategic sectors namely digital infrastructure, digital government, digital economy, and digital community (Indonesia Ministry of Communication and Information 2020).

The digital economy development requires banking digitalization, whereas bank as one of the financial system elements that accelerates the digital finance activities. Based on Indonesia Financial Services Authority (FSA)/Otoritas Jasa Keuangan (OJK), there are 3 (three) key factors support the digitalization in Indonesia banking sector: digital opportunity, digital behavior, and digital transaction. Digital opportunity involves demographic potency of Indonesian population which dominated by tech savvy millennial generation, digital economy and finance potency, internet penetration, and the increasing of potential customer in trading activities. Digital behavior includes the ownership of smartphone and mobile apps usage. Digital transaction indicated by increasing of online trading (*e-commerce*), digital banking transaction, electronic money transaction, and the declining of bank branch offices (OJK, 2021).

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The changing of customer preferences in banking services align with the needs on banking transformation as stated by King (2018) who mentioned that digital transformation in banking from the phase 1.0 in 1472-1980 with traditional bank office activities, then phase 2.0 (1980-2007) which started to use ATM technology, continued with phase 3.0 (2007-2017) which supported by smartphone mobile banking innovation, and currently phase 4.0 known as digital transformation with digital technology for real-time transaction and products or services based on artificial intelligence/machine learning. One of innovation in this 4.0 phase is the emergence of neobanks or challenger banks which focus only on digital banking product and services and delivered via digital channels (BaFin, 2021). Neobanks are new type of bank that enter the market to compete with the incumbent banks by offering new digital experience for customer. Neobanks have only limited branch offices or even have no branch, as it target is digital customers who visit banks rarely (Delgado, 2021).

This study comprehensively explores the implication of digital transformation of traditional banks which transform into neobanks and its efficiency, by using seven neobanks as the object of the study. Neobanks is one of this study's novelty, besides the discussion of digital transformation as the determinant of neobanks' efficiency and the longevity relationship between digital transformation and efficiency. The aim of this study is to analyzes the impact of digital transformation on neobanks' efficiency in the short run and in the long run with a wide-range analysis. The efficiency performance, central issue of the research, and digital transformation as determinant of efficiency, can cover the gap in this field as the existing study mostly discusses digital transformation, bank performance including efficiency, and determinant of efficiency, without mentioning digital transformation as one of independent variables.

Neobanks' digital transformation and efficiency are the focus of this study as it demonstrates its novelty which focuses on three analyzes. Firstly, the efficiency is analyzed by implementing the SFA to measure the alternative profit efficiency theory with Trans Log approach. Secondly, the digital transformation is investigated whether it is the determinant of bank efficiency. Thirdly, this study analyzes the relationship between digital transformation and bank efficiency in the short-term and long-term.

Initially, digital transformation is defined as organizational change or new investment in business model with digital infrastructure to scale up digital interaction of the customer on every single of their daily life (Bell 2011). Digital transformation is erudite and literate change (Bharadwaj et al. 2013), or strategic performance change (Rogers 2016). Other definition by Fitzgerald et al (2013) defined transformation of digital as "the use of new technology such as social media, mobile devices, and analytics tools to support significant business model improvement for example customer experience development and innovation for operational simplification".

In the other side, concept of efficiency for a firm according to Farrel (1957) and Porcelli (2009), consists of two components namely Allocative (or Price) Efficiency and Technical Efficiency. Allocative or Price Efficiency refers to firm capacity to incorporate inputs factors and outputs factors at optimum level measurements based on market prices, and valued by the objectives of production unit, for example assessing realized costs with the optimal costs or comparing realized earnings with optimal returns. On the other side, Technical Efficiency measures efficiency by assessing the realized number of outputs to the optimum number of outputs in the form of ratio, in assumption that inputs used is in fixed number, or by evaluating the minimum number of realized inputs with assumptions the fixed number of outputs. In measuring a financial institution's efficiency, Berger and Mester (1997) stated the three concepts of economic efficiency: Cost Efficiency, Standard Profit Efficiency, and Alternative Profit Efficiency. This research explored the Alternative Profit Efficiency approach to measure neobanks' efficiency.

The result of this analysis performs different view as it uses two methods to get complete results for two different objectives. The first method is Stochastic Frontier Analysis (SFA) which is used to analyze the efficiency of the banks, and the second is Panel of ARDL (Autoregressive Distributed Lagged) which is applied to analyze the short-term and long-term relationship (Agovino et al, 2022) between digital transformation and efficiency of the bank, as well as to lead toward the discussion of

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digital transformation as the determinant of neobanks' efficiency. The data selection focused on Indonesia's neobanks making it different from the existing literature.

Previous study on bank efficiency using kinds of variables and methodology. Barth et al (2013) mentioned that regulation on capital is positively associated with efficiency of the bank, while Sharma (2018) and Firdaus et al (2014) analyzed banking sector efficiency by using Data Envelopment Analysis (DEA), and Alber et al (2019) discussed about concept, drivers, and measurement of bank efficiency. Generally, the research using traditional bank (not neobank) as the research object (Ikhwan and Riani, 2022), which the banks classified by size of total assets (large banks and small banks), ownership (state-owned banks and private banks), certain period (before crises and after crises), and others point of view.

The arrangement of this paper consists of the introduction and discussion on the literature review for theoretical analysis and research hypothesis in Section 2, continued with methodology of the research in Section 3, and elaboration on the results of the study in Section 4. The conclusion is explored in Section 5 and the recommendations are suggested in Section 6, while the limitations of this study discussed in Section 7.

2. Literature Review

According to Westerman et al (2017), digital transformation is a development and improvement of business model, activities, process, and capabilities to achieve benefit from digital technology which have strategic effects on public. Transformation of digital refers to excellent achievement by governing internal and external organizational elements comprehensively (Ismail 2018). Digital transformation is indicated by highly massive usage of digital technology in achieving performance enhancement and improvement, also significant position of the organization in the industry (Dahlstrom et al 2017). Digital innovation and information technology are massively used in the manufacturing sector (Shehadeh et al, 2023) such as the adoption of Mobile Information Technology for service innovation capabilities (SIC) and service innovation performance (SIP) as stated by Liu et al. 2022.

In banking, digitalization is defined as the usage of digital technology for making banking transaction easier (Bhutani and Paliwal 2015) and to reduce operating cost, thus digitalization also requires financial contexture transformation (Yoo et al 2010). The main objectives of digitalization are to increase consumer satisfaction and to make potential customer profile which is needed in the future (Valenduc and Vendramin 2017). Digitalization in banking encourages the presence of digital banks or neobanks with direct-branchless, that is banks which deliver their financial services to customers mainly via digital channels for example mobile apps (IMF, 2022). Neobanks emerge with some pro and contra argument as research on neobanks found several potential risks in its growth. First, there is higher potential credit risk trend in its loan originations due to underpricing credit risk and it is not covered with suitable provision; secondly, it has higher potential risk in the securities portfolio; and thirdly is inadequate liquidity risk management (IMF, 2022). In contrast, Pierri and Timmer (2022), stated that IT adoption promotes bank resiliency as it can help better risk management for debtor screening.

Digitalization is one of bank's resources to increase profitability and to differentiate their position in the market, also changes the bank's core business by reducing cost, increasing quality, and helping banks to develop new financial product. While previous researchers stated the relationship between bank performance and electronic banking services is positive, Dehnert (2020) analyzed 83 providers of financial service consists of electronic bank, fintech, and bigtech. He found a systematic connection between the dimension of digital transformation and the efficiency of financial service provider, as it can be identified from the digital configuration of the company which represents the company digital evolution.

Digital transformation is not just a simple implementation of information and communication technology because in the wide concept, digital transformation is commonly understood as compulsory expertise and capabilities for optimum operation (Kane et al. 2019). Over the time, as digital tools and techniques evolve, digital transformation definition has become more distinctive.

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Warner and Wager (2019) define digital transformation as a novel technology with digital attribute in example cloud, artificial intelligence, Internet of Things (IoT), and blockchain, in implementing operational model major changes, to provide customers a high-value experience, simplify the operation, or create new business model. Research on digital transformation and digital bank efficiency relationship are limited and most of it are theoretical and conceptual analysis. Researchers assure that digital transformation can immediately increase the bank efficiency and at the end increase bank profitability and financial capital.

Digital transformation commonly associated with innovation, specifically technological innovation. According to Ang (2010) the enterprises' technological innovation is supporting by capital as the endogenous variable and the technological innovation will increase if the financial capital improved. Banking sector has a huge amount of capital support and large financing capacity for their digital innovation, which will increase the impact of the innovation on their financial performance. Jusufi (2023) also found that innovation in marketing and process generate a moderate positive linear relationship with the financial performance, while organizational innovation and product innovation have weak but positive linear relationship with the financial performance.

Another focus in this study is efficiency which Berger and Mester (1997) found the differentiation of efficiency concept across Cost Efficiency, Standard Profit Efficiency, and Alternative Profit Efficiency. Cost efficiency assesses efficiency based on the cost of the bank compared to the benchmark cost in generating the similar output with the same situations. In this case, there is a cost comparison of a bank to the best operating costs bank who can generates the similar product under the similar technology. In Standard Profit Efficiency, the efficiency of the bank is measured by the maximum possible profit that can be achieved with a certain price of input and output. Standard Profit Efficiency assess the bank efficiency level by evaluating the capability of the bank to get profit at maximum level with a particular level output price, and this capability compared to another bank in the sample, with the best profit. In this situation, input-output factors' prices are defined by the market and generally associated with perfect market competition which means that no banks can define the input or output prices and thus, bank position just taking the price. The last, Alternative Profit Efficiency measures efficiency by comparing the projections of actual profits to the best practice bank's maximum profits projections as a reference. The Alternative Profit Efficiency commonly interpreted as a condition of imperfect market competition, with the assumption of bank has market power in setting the output price. Meanwhile, the bank does not have the power to determine the input price. This research adopts the Alternative Profit Efficiency methods to measure the efficiency of digital business bank as this approach provides a solution for controlling unmeasured differences of output quality such as higher service quality with higher charges to the customer, or differences in the nominal of total assets which different amongst the banks.

According to Bauer et al (1998), the measurement of financial institution performance more focus on x-efficiency or frontier efficiency which assesses the differentiation from "best practice" or from the efficient frontier. Financial institution's frontier efficiency calculated by comparing the relative performance of financial institution to the projection of "best" performance financial institution in the industry, in the similar market environment. Frontier efficiency is general standard of financial performance ratio from financial report such as Return on Asset (ROA) or Cost/Revenue Ratio which commonly used by regulator, financial institution manager, and consultant in financial sector, in evaluating the performance of financial institution. The more efficient bank, then the profitability will increase.

Frontier efficiency is divided into two categorizes namely parametric approach and non-parametric approach. The parametric approach is more detail compare with the non-parametric approach as it assumes a form with specific function which connects the input and output. It also assumes a particular probability distribution for error component of the function. On the other hand, those two conditions are not required in non-parametric approach. Basically, both approaches have the concept in estimating the level of efficiency, which is by using frontier curve as the reference. The banks on the frontier curve categorized as efficient banks, while banks outside the frontier are indicated as inefficient banks. The parametric approach measures efficiency by using stochastic

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econometric and attempts to omit the effect of inefficiency, while non-parametric approach using linier program (*Non-parametric Linear Programming Approach*) with non-stochastic approach and combining noise and inefficiency. Parametric econometric approach consists of three types of approach namely: 1) *Stochastic Frontier Approach* (SFA); 2) *Thick Frontier Approach* (TFA); and 3) *Distribution-free Approach* (DFA).

This study uses parametric approach of Stochastic Frontier Approach (SFA) in measuring efficiency level of the seven neobanks. It can estimates panel data as well as differentiates inefficiency and shocks of stochastic caused by error term more accurately in estimating the score of efficiency. The SFA approach has a better statistical control than the other generally used approach in the efficiency discussion, such as Data Envelope Analysis/DEA (Asmare & Begashaw, 2018; Huang & Wang, 2002, Sari & Saraswati, 2017). In investigating the efficiency scores, this study employes cost function model by Battese and Coelli (1995) which using translog profit function for each observation by utilizing three kinds of inputs and output.

In estimating bank efficiency by using parametric or non-parametric methods, Matthews and Thompson (2008) suggest to use Intermediation Approach because financial institutions intermediates, transforms, and transfers financial assets in the financial system. The inputs factors incorporate interest expense on deposits, labor costs, and operational cost, while output is measured by using interest income, operational income, and loan (Hadad et al, 2003).

Profit efficiency is one of the banks objectives in running their business. In recent years, banks management implement digital transformation to achieve the efficiency because banks as the financial services providers are technology-intensive business sector. Banks are exposed to utilize digital technology as the input to produce the financial product and services. Another input is high-quality talents with relevant knowledge reserves and advanced level of technical skill in the field of digital technology. Digital technology and tech talents of human capital are the elements of technological innovation (Schworer, 2012; Amiti, 2009) which also become part of digital transformation. In conclusion, the digital transformation is an important thing to support efficiency. According to this analysis, the first hypotheses for this paper is: Digital transformation will enhance neobank efficiency.

In testing the digital transformation as the determinant of bank efficiency, this study uses quantitative research methods to examine the influence of independent variables digital transformation, capital adequacy, liquidity, net interest margin, and economic growth, on response variable of profit efficiency of the bank. The variable of digital transformation in this study is using proxy of operational cost for digital transformation such as IT infrastructure investment and cost of digital services outsourcing, labor expenses including tech-talent (Bharadwaj et al. 2013), and cost of marketing and promotion for digital bank branding. Investment in IT encourages bank efficiency, but it requires some times from carrying out digital transformation up to achieving the efficiency (Kriebel and Debener 2021). Therefore, this study applies Panel ARDL to investigate digital transformation as determinant of bank efficiency and the short run and long run relationship between digital transformation and neobanks' efficiency. According to Peng and Zhou (2017), the technological innovation investment is impacting factors on digital transformation and he picked it as control variables in his study. Therefore, this paper takes the IT investment or IT cost as the independent variable.

Capital adequacy on banking industry is indicated by Capital Adequacy Ratio (CAR) is identified as determinant of efficiency (Widiarti et al, 2015). All neobanks in Indonesia has high level of CAR, above the minimum level of regulatory requirement 8%, as they strongly supported by the shareholder in their initial steps in doing digital transformation. The high-level capital represents the strong resilience in absorbing the credit risks. Therefore, bank should maintain their minimum level of equity as the reserve to support the main roles in mitigating operational and financial risks, as the primary financing to operate the bank before getting other source of financing, as guarantee to the depositors that bank owns sufficient equity as a bank, as source of financing to generate product, financial assistance and its infrastructure, and as the source of development to ensure long-range continuous growth (Rose and Hudgins, 2010).

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Another variable used in this study is the liquidity of the bank by using proxy of Loan Deposit Ratio (LDR). The liquidity of the bank is adequate if bank has sufficient cash or other liquid assets, able to escalate the fast financing from other financial assets, also can cover their obligations and financial commitments on schedule. Bank liquidity also indicated by the adequacy of funds to cover the instantaneous runs of money (Rose and Hudgins, 2010). Based on study by Sidhu et al (2023), as bank liquidity increases, then bank efficiency improves. But after achieving its maximum level, the efficiency is going down.

This study also uses Net Interest Margin (NIM) as the proxy for market power of the bank as banks in an imperfect competitive market enable their market control to set the price of their products and services without diminishing the demand (Sulaeman et al, 2019). Net Interest Margin measures the deviation between the interest income from loan also from other interest-bearing products, and the interest expenses for deposits, relative to the total of interest-earning assets. For majority of banking sector, price is represented by interest rates, both on funding side (customer deposits) and financing side (loan product). Market power also describes the competitiveness of the bank which also effects bank's efficiency (Case and Fair, 2012). Another study states that the production process efficiency will reduce output cost per unit, thus the output can be disposed at competitive prices in the market (Gaspersz, 2011). Based on the theoretical concept of the digital transformation implication on bank efficiency and the time lag of the impact, the hypotheses proposed are: Digital transformation is one of determinants for neobanks' efficiency and there is a time lag with long term relationship between digital transformation and banks' efficiency.

3. Methodology

All financial data employed in this study are data of the seven neobanks taken from the website of the Financial Services Authority-OJK (www.ojk.go.id) and website of the banks, which consists of monthly balance sheet also profit and loss from 2016 – 2023. To measure the efficiency, Stochastic Frontier Analysis (SFA) was used as it can estimate panel data and differentiate more precisely the inefficiency and the stochastic shocks from error to calculate the scores of efficiencies. Moreover, this study also analyzes digital transformation as the determinant of the efficiency and the relationship between digital transformation and efficiency in the short-term as well as in the long-term.

3.1. Stochastic Frontier Analysis

This study first analyses the efficiency of the banks by applying SFA to measure level of efficiency. The SFA method requires a parametric model construction for efficient frontier which shows a relationship between input factor and output factor. Current studies on efficiency measurement uses stochastic model function to show production frontier, in which the error term consists of two components. Aigner et al (1977) proposed stochastic model as follows:

$$q_1 = f(\beta x_i) + u_i + v_i \quad (1)$$

where q is maximum output can be produced using input factors xi, by firm i, and β is unknown parameters to be estimated, while ui is independent error component of non-positive disturbance which reflects any deviation as the impact of factors under control of the firm's management in example technical and economic inefficiency, and vi is symmetric error component as the effect of favorable and non-favorable outside environment events such as topography, climate, errors of observation/measurement, luck, or technology performance (Aigner et al, 1977). In SFA, measurement of inefficiency follows the production process which can be translated into production frontier function. In general, there are three commonly used production function forms in efficiency studies namely Cobb-Douglas production function, Trans-log production function and Transcendental production function. In this study, SFA method is used with Trans-log profit function as follows:

$$lnq_i = \beta_0 + \sum_j \beta_j \, lnx_j + {}^1/_2 \sum_j \sum_k \beta_{jk} \, lnx_j lnx_k \quad (2)$$

whereas $\beta_{jk} = \beta_{kj}$ and the function is homogenous if $\sum_k \beta_{jk} = 0$ for all j.

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In production function, there are two approach ini analyzing the efficiency. The equation for output-oriented production process, which views inefficiency exist when more quantity of output can be produced using given quantity of input, is obtained by simply adding the u_i term into the above equation, thus the equation is:

$$lnq_i = \beta_0 + \sum_j \beta_j \, lnx_j + {}^1/_2 \sum_j \sum_k \beta_{jk} \, lnx_j lnx_k + u_i \quad (3)$$

while the equation for input-oriented production process, which views a plan of production is technically inefficient if the observed output quantity can be generated with fewer input quantity, is derived from equation above by simply adding the u_i term to ln x_j term as follows:

$$lnq_i = \beta_0 + \sum_j \beta_j \, (lnx_j + u_i) + {}^1/_2 \sum_j \sum_k \beta_{jk} \, (lnx_j + u_i)(lnx_k + u_i) \quad (4)$$

SFA follows the regular approach that an input gives same function of derivative log cost in related to the equivalent log input price. The general situation was applied by determining the accumulative expense and all input expenses with the labor price. The cost function is applied out to estimate efficiency scores of each observation by using the stochastic frontier analysis. This study adopts a model by Kabir & Worthington (2017) which estimates marginal cost using trans-log cost function which consist of one output, Q_{it} (loans) and three prices of input, W_{hit} (h = deposits, capital, and labor), for the next variable of cost replaced with variable of profit. This study use SFA method with intermediation approach and define the input variables consists of Price of Deposits (w_{1it}), Price of Labor (w_{2it}), and Price of Capital (w_{3it}), while Loan as output variable (Q_{1it}), and control variables Equity (E_{1it}) and Trend (T_{2it}). The equation for the profit efficiency model is as follows:

$$\begin{aligned} Ln([(\pi) + |(\pi min) + 1|]_{it}/W_{3it}) = \beta_0 + \beta_1 LnQ_{it} + \sum_{h=1}^{2} \beta_h Ln(W_{hit}/W_{3it}) + \\ \frac{1}{2}\beta_{QQ}(LnQ_{it})^2 + \frac{1}{2}\beta_{12} Ln(W_{1it}/W_{3it}) Ln(W_{2it}/W_{3it}) + \sum_{h=1}^{2} \beta_{Qh} LnQ_{it} \, Ln(W_{hit}/W_{3it}) + \\ \beta_E LnE_{it} + \frac{1}{2}\beta_{EE}(LnE_{it})^2 + \sum_{h=1}^{2} \beta_{Eh} LnE_{it} \, Ln(W_{hit}/W_{3it}) + \beta_{EQ} LnE_{it} LnQ_{it} + \beta_T T + \\ \frac{1}{2}\beta_{TT} T^2 + \sum_{h=1}^{2} \beta_{Th} T \, Ln(W_{hit}/W_{3it}) + \beta_{TQ} T LnQ_{it} + \varepsilon_{it} \end{aligned} \quad (5)$$

whereas:

π = Profit
w_{1it} = Price of deposit (Interest Expense/Deposits)
w_{2it} = Price of capital (Other Operational Expense/Fixed Assets)
w_{3it} = Price of Labor (Labor Expense/Total Assets)
Q_{it} = Loans
E_{it} = Equity
T_{it} = Trend
v = Error term
u = Inefficiency term

The gap from the profit frontier can be determined as an error (eit) after the estimation process, and the error might be distinguished between random error (vit) and inefficiency term (uit). These two variables are domineering to be autonomous of one another and as objectives of the elements that cause profit inefficiency. The inefficiency terms can be calculated to be cost efficiency scores by using the estimation model used by Battese and Coelli (1995) in equation below:

$$EFF_{it} = - \exp(u_{it}) \quad (6)$$

where EFF_{it}= score of efficiency for banks i in period t; u_{it} = inefficiency score of bank i for periode t. The profit efficiency has a range from 0 to 1 for scoring which means that the higher the score, the higher the profit efficiency of a bank. The efficiency score might be interpreted inversely as the bank's inefficiency score. The efficiency score is then used as a response variable for the regression model to get the key factors of bank efficiency in Indonesia.

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3.2. Panel Autoregressive Distributed Lag (ARDL)

To further examine whether digital transformation has an important moderating role on efficiency of the bank and whether it has short run as well as long run relationship. Panel Autoregressive Distributed Lag (ARDL) model is constructed with the following equation:

$$Eff_{i,t} = \sum_{j=1}^{p} \lambda_{ij} Eff_{i,t-j} + \sum_{j=0}^{q} \gamma_{ij} X_{i,t-j} + \omega_i + \varepsilon_{i,t} \quad (7)$$

whereas:

$Eff_{i,t}$ = Profit Efficiency

$X_{i,t-j}$ = vector ($kx1$) of explanatory variable (Digital Transformation, CAR, LDR, NPL, NIM and Economic Growth as independent variables)

ω_i = fixed effect of bank specific

ε_{it} = *error term*

λ_{ij} = coefficient of previous lag dependent variable ($t-j$)

γ_{ij} = coefficient vector on current and previous lag of explanatory variable

Model of ARDL on equation below can be as alternative in representing error correction (EC):

$$\Delta Eff_{i,t} = \theta_i \left(Eff_{i,t-1} - \beta_i' X_{i,t-1} \right) + \sum_{j=1}^{p-1} \tilde{\lambda}_{ij} \Delta Eff_{i,t-j} + \sum_{j=0}^{q-1} \widetilde{\gamma_{ij}'} \Delta X_{i,t-j} + \omega_i + \varepsilon_{i,t} \quad (8)$$

whereas:

Δ = first difference

$Eff_{i,t-1} - \beta_i X_{i,t-1}$ = long-run relationship cointegration among variables

β_i = cointegration vector

θ_i = coefficient of error correction (EC) in measuring speed of adjustment on long-run equilibrium which measures long-run effect contribution of the explanatory variable on short-run dynamic of dependent variable bank efficiency (eff).

$\tilde{\lambda}_{ij} \Delta Eff_{i,t-j}$ and $\widetilde{\gamma_{ij}'} \Delta X_{i,t-j}$ = estimation of additional short-run effect on $Eff_{i,t}$

This study uses Panel ARDL method to appropriately ascertain the correlation between digital transformation and efficiency of the bank and simultaneously determining the short-term and long-term relationship, with the existence of nonlinearity and without non-stationarity problem among variables. The Panel ARDL assessment practice time series and cross-section dimensions as it boosts the observations' number and its variation. Furthermore, the estimation panel reduces the disturbance from estimation of individual time-series and increases the reliable inference.

The steps in this empirical approach initially begin with identifying the order of data cointegration in the regression ARDL model, as it is integrated at level I(0) or integrated at first difference I(1), while variables of I(2) must be omitted from the data set. The IPS and LLC are used to investigate the unit root in the panel series group whether the variables are non-stationary. Also, ADF – Fisher and PP – Fisher is used as foundation framework to test the null hypothesis of the non-existence co-integration among all independent variables with the alternative hypothesis of co-integration existence. The latter is to complete the order of vector autoregression which shows the total of lags that will be applied by using Akaike Information Criterion (AIC). Then the regression of panel ARDL is measured by using a Pooled Mean Group (PMG) estimation which shows the result of short-term and long-term correlation of dependent variable and the regressors.

4. Result

Based on the financial data of the seven neobanks in Table 1, majority of the banks have low efficiency as described by high level of ratio operating expense to operational income. Profitability which indicated by ROA and ROE also in low level, even negative. The CAR of neobanks in Indonesia in December 2023 at the range of 27,86% - 118,21%, while LDR show a variety of liquidity level with the level LDR of 51,72% - 150,77% which indicate that some banks have higher level of loan than the deposits they have collected, while other bank only generate about half of the deposits.

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Table 1. Financial performance of neobank as of December 2023.

No	Bank	CAR	NPL	ROA	ROE	NIM	OC/OI	LDR
1	Bank A	27.86	3.73	-2.99	-17.56	18.39	112.27	77.73
2	Bank B	43.84	4.40	1.05	4.03	3.91	90.51	84.21
3	Bank C	71.48	1.10	0.18	1.16	5.36	97.66	51.72
4	Bank D	38.73	1.94	1.20	5.62	18.75	95.30	67.72
5	Bank E	61.77	0.84	0.49	1.02	9.45	95.83	107.77
6	Bank F	79.53	0.08	4.76	6.70	9.01	59.87	150.77
7	Bank G	118.21	0.00	-3.89	-4.86	4.83	157.59	87.93

Source: Financial Report on bank's website, where: CAR: Capital Adequacy Ratio; NPL: Non-Performing Loan; ROA: Return on Asset; ROE: Return on Equity; NIM: Net Interest Margin; OC/OI: Operational Cost to Operational Income; LDR: Loan to Deposit Ratio.

4.1. Profit Efficiency and SFA Results Analysis

The results of SFA show that the profit efficiency of all neobanks in this study are increase after they carry out digital transformation. The digital transformation improved bank efficiency, as stated by Zhu and Jin (2023) based on their study with A-share listed bank in China from 2011 to 2021. Another study by Shehadeh et al (2023) also found the significant effect of digital transformation on Islamic bank's efficiency and competitive advantage in Jordan. Table 2 describes detailed data on profit efficiency of each neobank in Indonesia during 2016 - 2023. The annual profit efficiency of each bank is the monthly average of efficiency in every year. Based on the results, the efficiency of most neobanks is increase after they carry out digital transformation, although the efficiency goes down when the digital transformation process in 2019-2021. Bank B previously is the biggest bank of the sample banks in terms of total assets, and it is affiliated with a state-owned bank, thus the digital transformation process is more complex than the other bank which more agile thus they can settle digital transformation process faster and improve their efficiency sooner.

Table 2. Profit Efficiency of neobank Year 2016 – 2023.

Bank	2016	2017	2018	2019	2020	2021	2022	2023
Bank A	0.524	0.460	0.389	0.325	0.330	**0.184**	0.405	0.572
Bank B	0.607	0.526	0.454	0.387	**0.237**	0.290	0.430	0.401
Bank C	0.481	0.404	0.394	0.319	0.349	**0.303**	0.310	0.386
Bank D	0.461	0.267	0.186	**0.142**	0.329	0.407	0.524	0.587
Bank E	0.473	0.366	0.323	0.239	**0.177**	0.256	0.406	0.527
Bank F	0.528	0.464	0.363	0.245	**0.241**	0.321	0.412	0.517
Bank G	0.505	0.356	0.246	0.180	0.229	**0.127**	0.218	0.391

Source: Data Processed from the bank's financial report.

Table 2 presents the profit efficiency trend of the seven neobanks in Indonesia before and after doing the digital transformation (the bold one is efficiency at the time they transformed). All of them show the lowest point of efficiency is at the time of digital transformation process. The bank's profit efficiency shows that even though these profit efficiencies decrease when they began to implement digital transformation, afterward the profit efficiency of majority digital business banks increases. The deterioration of the banks' efficiency is aligned with the large amount of investment required in digital transformation for example digital infrastructure, change management and culture, tech talent, and marketing promotional expense for the new business model branding.

This finding support Kriebel and Debener (2021) who found that IT investment, or in this study is the digital transformation, increase bank's efficiency but there is time lag to achieve the targeted efficiency. The decreasing of banks' efficiency aligns with the high cost of digital transformation which covers huge investment on IT infrastructure, digital-tech talent expense, organizational change management expense, and marketing promotional expense for the new branding. This finding also

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relevant with Zhu and Jin (2023) who found that efficiency of the Chinese commercial bank improves because of digital transformation and executives' technical background as well as their innovation consciousness.

4.2. Digital Transformation and Determinant of Efficiency

The next stage in this study is to investigate whether digital transformation is the determinant of neobank efficiency and to analyze the relationship of digital transformation and efficiency in the short run and in the long run, as described in the following steps.

Multicollinearity Test

First, the test is begun with multicollinearity analysis which focuses on identifying the existence of strong correlations between independent variables in the regression model, that can complicate or distort the interpretation of regression coefficients. In this context, examining the correlation matrix between the variables Digital Transformation (DT), capital adequacy (CAR), liquidity (LDR), interest margin (NIM) and economic growth, provides an initial identification of relationship between variables in a linear model. As described in Table 3, the variables correlation ranges from -0.317 (between capital adequacy and interest margin) to 0.408 (between digital transformation and net interest margin), indicating that there is no strong relationship or high correlation which is usually indicated by a correlation value close to 1 or -1. Hence it can be concluded that there was no striking evidence of multicollinearity problems in this study.

Table 3. Multicollinearity Test Result.

	DT	CAR	LDR	NIM	GDP
DT	1				
CAR	-0.091	1			
LDR	-0.127	0.071	1		
NIM	0.408	-0.317	-0.157	1	
GDP	0.074	-0.243	0.040	0.169	1

Source: Data Processed from the bank's financial report.

All variables used for Panel ARDL are shown on descriptive statistics in Table 4 which presents the variables at natural level and exposes the independent variables' minimal correlation, and it means that there is no problem of multi-collinearity in the models.

Table 4. Descriptive Statistics.

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
Eff	24.574	24.571	27.296	22.534	1.100	223
DT	96.877	31.998	1165.500	12.299	164.652	224
CAR	4560.734	90.955	429824.900	0.000	41104.100	224
LDR	5.053	4.636	19.570	-12.229	4.535	224
NIM	4.047	5.030	7.080	-5.320	2.773	224
GDP	24.574	24.571	27.296	22.534	1.100	223

Unit Root Test

Secondly, the LLC test and the IPS test, which implements in this study to investigate variables unit root whether applicable to the same root and applicable to no root respectively, as described in Table 5. This test is conducted to avoid the pseudo-regression phenomenon in analysis of empiric model by testing each variable stationarity, because panel data consists of both cross-sectional data and time-series data. The LLC test presumes the equal parameters are tested across all the panels. In the meantime, the IPS test is less oppose as it allows the parameters to vary across panels than the LLC test and it is obtained as the mean of the ADF statistic. The unit root test describes the stationary

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at levels of some variables and other variables are at first difference stationarity, regardless of the test is using a constant with or without trend. The result of unit root test shows that aside from LDR and GDP which stationary at level, the other variables (DT, CAR, NIM, and GDP) are stationary at the first difference. The unit root test determines the I(0) and I(1) integration existence among the variables. The assessment performs the presence of a long-run equilibrium in stable relationship between variables, thus the Panel of ARDL is chosen for this analysis.

Table 5. Results of stationarity test.

	LLC		IPS	
	Level	**Δ (*first diff*)**	**Level**	**Δ (*first diff*)**
EFF	0.3652	0.0000***	0.1919	0.0000***
DT	0.9463	0.0000***	0.9959	0.0000***
CAR	0.3029	0.0000***	0.3632	0.0000***
LDR	0.0537*	0.0000***	0.0248**	0.0000***
NIM	0.9768	0.0006***	0.9203	0.0000***
GDP	0.5908	0.0000***	0.0179**	0.0000***

Notes: ***), **), and *) Stationarity at 1%, 5%, and 10% levels, respectively.

Thirdly, after stationarity test, then the Akaike Information Criterion (AIC) model test conducts to define the vector autoregression (VAR) order which shows the lags number to be applied. Table 6 describes the AIC optimum lags which automatically selected based on which choose the smallest value of AIC as the optimum lags ARDL (2, 2, 2, 2, 2, 2, 2).

Table 6. Results of Optimum Lag.

LogL	AIC*	BIC	HQ	Specification
449.791	-3.318	-1.372	-2.530	ARDL(2, 2, 2, 2, 2, 2, 2)
411.914	-3.009	-1.179	-2.268	ARDL(1, 2, 2, 2, 2, 2, 2)
358.512	-2.895	-1.757	-2.435	ARDL(1, 1, 1, 1, 1, 1, 1)
364.944	-2.889	-1.636	-2.382	ARDL(2, 1, 1, 1, 1, 1, 1)

Cointegration Test

The fourth, another test conducted in this study is the test of co-integration as reported in Table 7. After all variables across all panels getting stationer at first difference, the next step is the cointegration test for efficiency as dependent variable and the independent variables by applying the Pedroni (1999) Cointegration Test. This cointegration test use to check the hypothesis of no existence of cointegration for all six variables of Digital Transformation (DT), CAR, LDR, NIM, NPL and Economic Growth (GDP). The results indicate that no cointegration as the null hypothesis is rejected, which indicates the evidence that dependent variables and the explanatory variables are in a long-run relationship. The analysis suggests a reliable short and long-run estimate which means that digital transformation and other explanatory variables are statistically significant and positive relationship with profit efficiency in the long-run.

Table 7. Results of Cointegration Test.

Cointegration Test		Statistic	Prob
Kao Residual Cointegration test	ADF	-4.210759	0.0000***
Pedroni Cointegration Test			
	Panel v-Statistic	-0.651922	0.7428
	Panel rho-Statistic	-1.071797	0.1419
	Panel PP-Statistic	-8.431710	0.0000***

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Panel ADF-Statistic	-2.823261	0.0024***

Notes: ***), **), and *) are cointegrated at 1%, 5%, and 10% levels, respectively.

The final stage is using Pooled Mean Group (PMG) to estimate the panel ARDL regression by incorporating the optimum lag which had been selected based on the AIC lag selection criteria. Table 8 presents the short-run and the long-run ARDL Panel regression results of digital transformation and other explanatory variables of the full panel of sample banks from 2016 – 2023.

Table 8. Results of ARDL Estimation (Short-run and Long-run).

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Long Run Equation				
DT^2	0.1251	0.0246	5.0794	0.0000***
DT	-6.0158	1.1783	-5.1055	0.0000***
CAR	0.0006	0.0002	3.6362	0.0004***
LDR	0.0017	0.0007	2.3284	0.0219**
NIM	0.0094	0.0093	1.0098	0.3150
GDP	0.0643	0.0232	2.7789	0.0065***
Short Run Equation				
COINTEQ01	-0.2063	0.0669	-3.0852	0.0026***
D(EFF(-1))	-0.1812	0.2434	-0.7443	0.4584
D(DT^2)	-0.0423	0.0531	-0.7961	0.4279
D(DT(-1)^2)	-0.0004	0.0633	-0.0065	0.9949
D(DT)	2.2109	2.6681	0.8287	0.4093
D(DT(-1))	0.0809	3.0369	0.0266	0.9788
D(CAR)	0.0008	0.0017	0.4676	0.6411
D(CAR(-1))	0.0013	0.0030	0.4349	0.6646
D(LDR)	0.0020	0.0011	1.8353	0.0694*
D(LDR(-1))	0.0015	0.0020	0.7452	0.4579
D(NIM)	0.0417	0.0199	2.0927	0.0389**
D(NIM(-1))	-0.0132	0.0252	-0.5257	0.6002
D(GDP)	0.0051	0.0153	0.3353	0.7381
D(GDP(-1))	-0.0015	0.0041	-0.3716	0.7109
COVID	0.0130	0.0223	0.5822	0.5617
C	14.8409	4.8164	3.0813	0.0027***

Note: * 10% ** 5%, *** 1% and are represent significance level.

Table 8 shows that there is a relationship between variables in the short-run and long-run as the result of Panel ARDL regression with Cointeq (1) represents for Error Correction Term coefficient (*ECTt*−1) is -0.206 which implies that efficiency adjusts towards its long-run equilibrium by about 20,6% in each period. It means that if there is a deviation from the long-run equilibrium, the speed of adjustment of efficiency will adjust towards it, is around 5 times of the quarterly period (around 15 months). The high significant and negative value of ECT coefficient also provides strong evidence of a stable level of long-run relationship between the regressors and the dependent variable. In the short run, only CAR as independent variables, have a significant but negative relationship with the efficiency as the higher CAR implies more idle capacity, which is not utilized, and it means inefficient capital management. Digital Transformation (DT) have insignificant negative impact on bank efficiency because of the huge investment for digital transformation.

In the long run, Digital Transformation (DT) with quadratic function, has a U-shape relationship with profit efficiency in 1% significance level. Other variables namely CAR, LDR, and GDP have a significant positive relationship with banks' profit efficiency in 1% (CAR, GDP) and 5% (LDR) significance level, while NIM has not significant relationship as the higher NIM contribute to

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profitability. Hence, it can be concluded that DT can boost bank efficiency after certain period of implementation as discussed by Qehaja-Keka et al., (2023) and Yang et.al., (2018).

Impulse Response Function (IRF)

This study empirically analyzes the impact of the digital transformation on neobanks' efficiency. The empirical results are shown in Impulse Response Function in Figure 1, which describes that the impact of digital transformation as independent variable on neobanks' efficiency as dependent variables are consistent, with negative coefficient of digital transformation in the short-run relationship and positive coefficient of digital transformation in the long-run relationship.

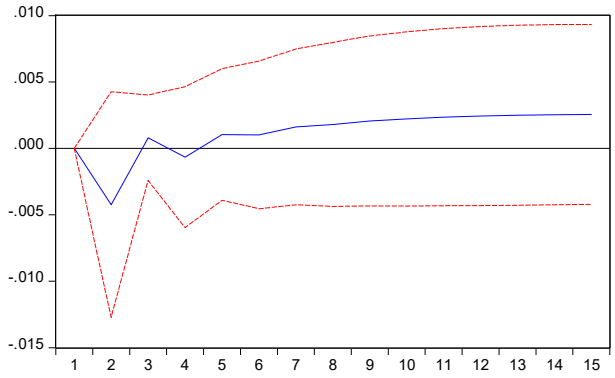
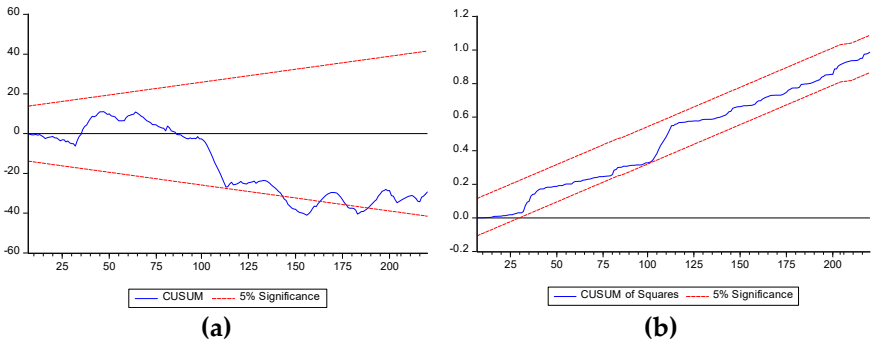


Figure 1. Response of Efficiency to Digital Transformation.

CUSUM Test Heterogeneity test

Even though the cointegration had been tested, it does not absolutely mean a stable estimated coefficients to get a reliable result (Bahmani-Oskooee and Chomsisengphet, 2002). Therefore, testing the stability of long-run parameter is important. This study using Pesaran and Pesaran (1997) suggestion by adopting the cumulative sum of recursive residuals (CUSUM) and using Brown et al. (1975) of cumulative sum of recursive residuals squared (CUSUM squared) to test the proposed residuals of the ECMs and to test for parameter constancy.

Assuming when the statistics plot lies inside the 5% significance critical bounds, the estimated coefficients are stable. These tests are commonly interpreted by a graphic visualization, which allow over time stability evaluation. Figure 2a,b describes the cumulative sums plot with the 5% critical lines. The parameters stability indicates by movement inside the critical lines. Based on the figures, it can be summarized that out of an imperceptible instability in 2020–2021, the CUSUM squared (Figure 2) suggesting that the residuals variance can be defined quite stable with 5% significance lines.



(a) **(b)**

Figure 2. (a) CUSUM; (b) CUSUM Square.

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5. Discussion

Digital transformation has an impact on efficiency of the organization, both negative impact at the beginning of the transformation process or directly positive impact but then decrease for certain period and back to increase afterward. As stated by Sadigh et al (2021), digital transformation is an organizations collective action in adopting disruptive digital technology to achieve organization goal and significantly changes organization performance and efficiency. One of the reasons for bank doing digital transformation is to reduce operational cost, other reasons are for differentiation from competitors (Indriasari, 2019). This profit efficiency study supports previous study by Kriebel and Debener (2021) who found that IT investment will affect banking efficiency in the long run, there is time lag up to 5 years from the beginning of digital transformation up to the achievement of the efficiency.

Each management has their own path in achieving efficiency as the goals of their digital transformation process. The magnitude of the impact on bank efficiency depends on digital transformation strategy which developed by the bank. As stated by Hadi and Hmood (2020), digital transformation combines information technology and works of the banks to address future challenges in business. The more massive digital transformation means the more technology revolution applied and the higher cost for IT investment required. Krasonikolakis et al (2020) found that digitalization in banking as a technology revolution with massive usage of technology and digital services innovation that changes banking product and services exponentially and replace conventional banking practice.

In implementing digital transformation, some banks' management have a significant movement, both when the efficiency is decreasing and increasing. Other banks have smooth gradual process in managing the investment cost and consequently in achieving the efficiency target. Problem arises if bank thought that digital transformation is just about workflow and system, rather than customer experience (Indriasari, 2019). In last several years, companies around the globe started to transform and improve their competitive advantage, even though not all companies confirmed with the business value of digital transformation due to the high cost and long time required to get expected performance impact, including in efficiency (McKinsey, 2020). Based on McKinsey's survey, 92% of the company executives stated that their business model will no longer survive in the era of digitalization if they do not transform their business to neo.

This study supports previous studies about the digital transformation impact on bank efficiency and shows that digital transformation is one of determinant for bank efficiency. Digital transformation has direct continuous impact on operational performance rather than financial performance because the expected efficiency in operational activities and innovation environment for operating performance are easier to be seen. Digital technology is the enabling factor in transforming bank into a different kind of bank, not only in terms of time and cost efficiency, but also providing customer a high-level quality services with security guarantee, efficient, and easier personal relationship (Filotto et al., 2020). Another study by Busaidi and Muharrami (2020) also discussed the significant finding as the impact of Information and Communication Technology (ICT) investment on non-financial performance such as customer, internal process, and learning model on bank and on financial performance indicator.

According to this research, factors which become determinant of bank efficiency is DT, CAR, LDR, and GDP. CAR is the proxy for capital. The higher capital will support the more massive digital transformation and support bank efficiency. So do LDR which implies the bank's capability in managing their portfolio efficiently. The higher LDR means bank can manage the loan and get higher profit. On the macroeconomic level, higher GDP or economic growth encourages more financial transaction in the economy through the financial system, including digital bank as one of the financial system elements. Another independent variable of bank specific factor is LDR as the proxy of liquidity. This variable is significantly positive impacting the banks' efficiency as the higher LDR means of higher interest income, and it will directly impact to bank efficiency. In contrast, NIM as the proxy of net interest income, are not significantly affecting the efficiency as the NIM will directly impact on competitiveness and profitability.

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6. Conclusions

Based on the study results and discussions, it can be summarized that digital transformation enhances neobanks' efficiency as indicated by the increasing efficiency score. Based on the efficiency measurement by using SFA approach, the overall neobanks' efficiency can be improved further align with their digital capacity development in delivering the relevant product and services in digital era. The profit efficiency trend show that the efficiency deteriorates when digital transformation starts to be implemented as this deterioration aligned with the huge cost required in digital transformation which involves IT infrastructure investment, change management and culture, tech talent, and marketing promotional expense for the branding of new neobank.

Each neobank has their own path in achieving efficiency as the goals of digital transformation process. The magnitude of digital transformation impact on banks' efficiency depends on neobank's digital transformation which developed by the banks because transformation combines information technology and strategy of the bank. The more massive digital transformation, the higher investment or higher cost for digital transformation, and consequently the longer time for bank in achieving the efficiency, specifically if bank does not have sufficient strategy in adopting digital transformation.

Regarding the determinants of neo bank's efficiency, the analysis on all variables used in this study concludes that digital transformation, capital, liquidity, and economic growth, are significant determinants of profit efficiency. Furthermore, in the short term, digital transformation has negative effect on profit efficiency of the banks due to digital transformation cost. Afterwards, in the long term, digital transformation has positive implication on profit efficiency of the bank, as well as the higher capital will support digital transformation for bank efficiency and liquidity generates profit which positively impact the banks' efficiency. The economic growth also significantly affects the banks' efficiency by encouraging higher financial transaction. On the other side, net interest margin has not significantly impacted the efficiency because higher net interest margin will impact to competitiveness and profitability. This study also confirms the "U" shape relationship between the digital transformation and banks' efficiency as describes by non-linear function, which means in the beginning, digital transformation will cause the deterioration of banks' efficiency because of digital transformation expenses. Afterwards, banks' efficiency will increase.

7. Recommendations & Limitations

Digital transformation is associated with digital technological innovation in banking activities. This research has verified that the digital transformation can increase the bank efficiency, particularly in this study, is neobanks. Studies in this research which analyzed the digital transformation effects on efficiency, confirmed that digital transformation will be advantageous for neobanks' operational performance and enhancing neobanks' efficiency.

The improvement of bank efficiency by implementing digital transformation will also potentially encourages micro lending as this lending is critical to support micro-scale enterprises growth (Farida et al., 2015). For Indonesia as an archipelago emerging country and dominated by Micro, Small, Medium, Enterprises (MSMEs) in business sector, this benefit of bank efficiency from digital transformation will increase MSMEs activities and the prosperity of low-level income people, specifically to provide financial support for MSMEs' digital transformation and inclusive growth (Fauzi et al, 2023). This support from neobanks is part of intervention to boost digital transformation of MSMEs', particularly from the financing and organization aspects.

The number of Indonesia's neobanks are still limited compared with the hundred banks in Indonesia which operates in their existing operational activities. Some banks build their digital banking services in separated line of business. Related scholars state that the business strategy of digital transformation is not fully adopted by most banks because of limited information regarded to the adoption of digital transformation and much money required for digital transformation investment. Hence, it is important to empower the study in promoting digital transformation to enhance banks' efficiency.

Digital technology input on traditional banking product and services has little influence in improving the output of banks, while the high-end input of digital technology, knowledge, and tech

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talent can bring enormous financial services, which become catalyst to achieve the efficiency. In the end, banking industry should prioritize the quality and efficiency of their traditional services and focus on the digital transformation process and expenses. More concern should be discussed as the input, such as digital infrastructure, investment, and tech talent, for the best results of digital transformation elements, which leads to bank profit efficiency.

Consumer engagement is a substantial element of banking service-oriented transformation. The relationship between consumer and bankers will create valuable information for innovation. Hence, neobanks should transform the innovation strategy and put more focus to customer experience. Specifically, neobanks are suggested to evaluate the information from consumers, meaning the consumers as the innovation partners to establish and improve the process in generating banking product and services.

Other aspects to be concerned are focus on capturing the valuable insight provided by customer, scaling up the information acquisition capability, and appointing related officer in collecting important knowledge from consumer comprehensively, to provide relevant innovation for consumer satisfaction. Large-scale peripheral interconnections are the essential of banking activities. In digital transformation process, neobanks should focus on establishes collaboration instead of competing with bigger and smaller banks and other financial services providers, governments, and universities.

Moreover, digital business banks should manage long run and harmonious synergy with colleagues and determine the requested technology and capability from banks with advanced level of digital technology to get corresponding benefit. In contrary, with ambiguity in the external surroundings, setting collaborations with related banks enable it to distribute risks, decrease losses, and improve the capability of neobanks to manage risks and adapting responses, but still maintaining prudential aspect in data protection and risk management of cyber security. Bolster the coordination and correspondence between colleagues, establish the production and propagation of innovative capability, and increase the impact of digital technology innovation.

As commonly studies do, this study has some limitations. The determinants of digital bank efficiency are limited to test five independent variables namely digital transformation, capital adequacy, liquidity, net interest margin, and economic growth, while there are many other factors that can influence bank's profit efficiency. The object of this study was limited to the seven neobanks in Indonesia, future research might be added with next newcomer of neobanks. Furthermore, the next research can be completed with the optimum strategy in implementing digital transformation to accelerate the efficiency goal achievement.

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