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Article

Covid-19 and the factors affecting the performance of listed commercial banks in Vietnam: Utilizing the two-stage DEA method

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Abstract: This article measures the performance of listed commercial banks in Vietnam and identifies factors influencing their efficiency. The study follows a two-stage approach: (i) In the first stage, scale efficiency scores from 2016 to 2022 are assessed using the Data Envelopment Analysis (DEA) method; (ii) In the second stage, Tobit regression analyzes internal factors, macroeconomic conditions, and the impact of Covid-19. Key findings show that internal factors such as return on assets positively affect efficiency, while the ratio of equity to total capital has a negative and statistically significant impact. Bank size positively influences efficiency scores. Macroeconomic factors, including economic growth and inflation, were statistically insignificant. However, the Covid-19 pandemic had a significant negative effect on bank efficiency.

Keywords: Covid-19; DEA; intermediate approach; Tobit regression
JEL Classification: C33; G21; G20

1. Introduce

Banks play a crucial role in a country's economic development, making it essential to evaluate the ongoing performance of the banking industry (Henriques et al., 2018). There is considerable evidence that banks often exhibit inefficiencies, and that illiquidity can lead to systemic crises with adverse economic consequences (Fethi and Pasiouras, 2010). Evaluating bank performance scores within the banking system is important for several reasons (Ferrira et al., 2011): (i) First, research conducted within the banking system helps to identify inefficiencies in certain banks; (ii) Second, system-wide efficiency analysis allows banks to devise appropriate business strategies to achieve desired efficiency margins; (iii) Third, the analysis results provide valuable insights for governance; (iv) Fourth, a thorough review of business success at the system level can reveal redundant inputs and deficiencies in individual banks. Overall, evaluating bank performance offers insights and aids in the efficient allocation of resources to address inefficiencies.

In Vietnam, the commercial banking system, particularly listed commercial banks, plays a significant role in supplying and allocating capital to the economy. Vietnam's commercial banks have undergone various changes, including restructuring, mergers and acquisitions, special controls, and have been impacted by shifts in customer behavior, macroeconomic conditions, and the Covid-19 pandemic from 2016 to 2022. Given the strong link between banking activities and the economy, continuously evaluating banking efficiency is crucial for stakeholders to propose solutions that minimize negative impacts on banking performance and stabilize the economy.

The objective of this research is to evaluate the efficiency scores of listed banks in Vietnam from 2016 to 2022 and to examine the impact of the Covid-19 pandemic on their performance. This study employs a two-stage approach: (i) In the first phase, the bank's efficiency scores are measured, observing performance before, during, and after the Covid-19 pandemic; (ii) In the second phase, the impact of various factors, including the Covid-19 pandemic, on the efficiency scores is analyzed. The results indicate that the number of inefficient banks increased during and after the Covid-19 pandemic, with the pandemic having a negative impact on efficiency. Additionally, ROA, CAP, and BS were found to affect bank efficiency, while the economic growth rate and inflation rate were not statistically significant.

2. Analytical framework

2.1. Banking efficiency

According to Sherman and Zhu (2006), the overall productivity of a bank depends on four components of efficiency classification: technical efficiency, scale efficiency, price efficiency, and allocation efficiency. Scale efficiency measures how well a manufacturing unit is operating at optimal scale. According to Cooper, Seiford and Tone (2006), scale efficiency (SE) is calculated by comparing the general engineering efficiency under the assumption of constant returns to scale (CRS) and the technical efficiency of variation under the assumption of variable return to scale (VRS). A bank is considered technically inefficient when it wastes some inputs (Sherman and Zhu, 2006).

To measure the Technical Efficiency (TE) score, studies use a non-parametric approach in DEA, a non-parametric method that uses linear programming to measure the effectiveness of equivalent decision-making units (DMUs) using multiple inputs and outputs. The DEA was first developed by Farrel in 1957, later modified by Charnes, Cooper and Rhodes (CCR) in 1978 and Banker, Charnes and Cooper (BCC) in 1984.

2.2. Bank capital size and scale efficiency (SE)

The relationship between bank capital and SE is an important factor in evaluating the performance of banks. The theory of economies of scale shows that banks with large capital sizes are often able to reduce unit costs and enhance operational efficiency by taking advantage of scale. Specifically, with a large capital size, banks can diversify their portfolios and diversify risks, thereby enhancing their SE (Charnes et al., 1978). At the same time, the asset optimization theory emphasizes that effective capital management helps banks achieve higher SEs. Active capital management, which involves balancing equity and loans, helps maintain financial stability and improve SE (Jensen and Meckling, 1976).

2.3. The relationship between financial efficiency and scale efficiency

Scale efficiency (SE) and financial performance are two important aspects in evaluating the performance of banks. Financial performance measures a bank's profitability relative to its assets, expressed through the ROA (Return on Assets) ratio.

And the relationship between these two concepts is quite complex and can be mutual. A bank with a high SE typically has lower operating costs, resulting in a higher ROA. However, a bank with a high ROA does not necessarily have to achieve maximum SE if it does not use resources optimally. The combination of SE and ROA provides a comprehensive view of performance, helping managers identify and improve core factors to improve overall efficiency.

2.4. Macro factors and scale efficiency

The bank's performance not only depends on internal factors but is also strongly affected by macro factors. According to macroeconomic theory, economic growth, interest rates, and inflation are important factors that affect banking operations. Economic growth drives demand for credit and financial services, while interest rates and inflation adjust the cost of capital and the real value of assets and liabilities (Mishkin, 2007). Economic cycle theory explains that the stages of the economic cycle—from growth to recession—directly affect banking efficiency. During the growth period, banks are often highly efficient with low NPL ratios. In contrast, during a recession, credit risk increases and demand for services decreases (Burns and Mitchell, 1946).

3. Related experimental studies

In order to measure the effectiveness score, studies have developed a variety of approaches, including the structured approach and the unstructured approach (Hughes and Mester, 2008). For banks, many studies have yet to reach a consensus on the most appropriate method for measuring performance scores. At the same time, in order to overcome the disadvantage of relying solely on index analysis (unstructured approach), efficiency measurement techniques using a marginal approach (structural approach) are preferred because they consider multiple inputs and outputs in effective point measurement (Titko et al., 2014). The participatory structure approach requires assumptions about the cost (or profit) function to estimate, and non-parametric does not require assumptions about the function form.

For the analysis of the impact on the banking efficiency score, Jesús Gustavo and Garza-García (2012) analyzed the main determinants of the banking performance of the Mexican banking industry in the period 2001–2009. DEA analysis is applied to achieve an efficiency estimate and then run the Tobit model to find out the key determinants. The results indicate that Mexico's banking industry has an average level of underperformance during the study period. Moreover, the main factors that determine the increased banking efficiency are the level of lending, GDP (Gross Domestic Product) and foreign ownership. Or research by Rishabh Goswami et al. (2019) also shows that liquidity risk, return on assets, credit risk, market concentration and GDP have a significant impact on technical efficiency, while bank size, interest rates and capitalization are said to be variables that are not statistically significant. Raphael (2013), a study using Tobit regression and finding that bank size, profitability, and liquidity are the main factors affecting bank efficiency, and the macro factor is only GDP affecting technical efficiency, while CPI (Consumer Price Index) has no

statistical significance. Research by Akin et al. (2009) on the Turkish banking system also shows that bank size has an inverse effect on banking efficiency.

Or Repkova (2015) studies the determinants of efficiency in the Czech banking sector in the period 2001–2012 and uses DEA in efficiency scoring. The results of the study for the level of capitalization, liquidity risk and risk of the portfolio have a positive impact on the bank's performance. ROA, interest rates, and GDP have a negative impact on the effectiveness of the CCR model. Ivana Marjanović et al. (2023) conducted in two periods from 2005 to 2022 of the Serbian banking system. The results indicate that when considering industry-specific factors, a greater level of market concentration will adversely affect the bank's efficiency. In terms of macroeconomic factors, the growth rate of gross domestic product, the inflation rate, and the global financial crisis have a significant impact on the level of banking efficiency achieved in the Republic of Serbia. The article measures the impact of Covid-19 on banking efficiency but has no statistical significance. In the study of Li et al. (2021) and Marjanovíc et al. (2023), Covid 19 has had the opposite impact on banking efficiency.

This study applies the two-stage Data Envelopment Analysis (DEA) method combined with Tobit regression to evaluate the performance of listed commercial banks in Vietnam. The DEA method has been extensively applied in international studies to assess the efficiency of financial institutions across various countries, such as the United States, China, and several European countries. More specifically, Li et al. (2021) primarily used regression models to analyze the impact of COVID-19 on operational efficiency, while Marjanović et al. (2023) applied the DEA method combined with Tobit regression to provide a deeper insight into the factors affecting banking efficiency. In this study, we will further strengthen the analysis of COVID-19's impact on banking efficiency using the two-stage DEA method.

For studies on banking efficiency in Vietnam, the studies are mainly analyzed through an unstructured, structured approach, through parametric methods, or evaluating factors affecting banking efficiency through a set of indicators or efficiency scores measured through parametric approaches (Ngo Dang Thanh, 2012; Nguyen Minh Sang, 2015; Vu Thi Thanh Thuy and Vu Thi Anh Tuyet, 2023). The study by Vu Ha and Nahm (2013) conducted an analysis of the profitability of Vietnamese banks in the period 2000–2006 and found that the efficiency of profits improved due to the larger scale, while being hampered by low asset quality and high capitalization. Current studies in Vietnam have not yet addressed the determinants of technical efficiency and considered all internal and macro factors affecting the technical efficiency of Vietnam's banking system, especially in the period 2016 to 2022. In addition, many other related studies have not analyzed and measured the impact of the Covid-19 epidemic on banking efficiency, but only stopped at observing, comparing and drawing conclusions. Specifically, the research by Nguyen Minh Sang (2022) analyzed the impact of Covid-19 on the operational efficiency of 26 Vietnamese commercial banks using the DEA method, and the research results show that banks have effectively taken advantage of the positive impacts of the COVID-19 pandemic. due to the improved average performance in 2020 compared to the pre-pandemic period in 2019 on the same models for comparison and estimation.

4. Research methodology

4.1. DEA method

DEA is a widely used method in the banking sector to measure operational efficiency. The term "data bag" was first coined by a team of researchers (Charnes, Cooper and Rhodes, 1978) based on earlier work by Farrell (1957). DEA is built in two approaches: an input-oriented approach and an output-oriented approach. In terms of an input-oriented approach, the focus is on optimizing the input level while maintaining a constant output level. On the other hand, the output-oriented model aims to optimize the output level while maintaining a constant input level. The majority of banking efficiency studies use an input-oriented approach (Eyceyurt Batir et al., 2017). Another important issue is that there is still a lack of consensus among researchers on the selection of the type of efficiency at scale. DEA – CCR, built on the assumption of CRS by Charnes and ctg (1978). CRS is the assumption that a proportional increase in input will cause the output to increase proportionally (Titko and ctg, 2014). Further modifications of the model by Banker, Charnes and Cooper (1984) make assumptions about VRS. The scale efficiency (SE) is calculated by comparing CCR – CRS and BCC – VRS (**Table 1**).

Table 1. Description of input-oriented CCR—CRS model, Input-oriented BCC—VRS model, and Scale efficiency.

Input-oriented CCR— CRS model	**Input-oriented BCC—VRS model**
$$Min\ \theta_0 - \varepsilon(\sum_{i=1}^{m} s_i^- + \sum_{i=1}^{s} s_r^+)$$ $$\theta, \lambda, s_i^-, s_r^+$$ Subject to: $$\begin{cases} \sum_{j=1}^{n} \lambda_j y_{rj} - s_r^+ = y_{r0}\ ; r = 1, 2, \dots, s \\ \sum_{j=1}^{n} \lambda_j x_{ij} + s_{\bar{i}} \geq \theta_0 x_{i0}\ ; i = 1, 2, \dots, m \\ \lambda_j, s_i^-, s_r^+ \geq 0\ ; j = 1, 2, \dots, n \end{cases}$$	$$\min g_o\ (\theta^{BCC}, s^+, s^-) = \theta_o^{BCC} - \varepsilon(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+)$$ Subject to: $$\sum_{j=1}^{n} \lambda_j\, x_{ij} + s_i^- = \theta_o^{BCC} x_{io}$$ $$\sum_{j=1}^{n} \lambda_j\, y_{rj} - s_r^+ = y_{ro}$$ $$\sum_{j=1}^{n} \lambda_j = 1$$ $$\lambda_j, s_i^-, s_r^+ \geq 0$$
Scale Efficiency (SE): SE = $\frac{CCR-CRS}{BCC-VRS}$	

The value $\theta_0$represents the level of technical efficiency of DMU_0.

λ_j is the vector (λ_1...,λ_n) is the weight of the bank.

x_{i0}, y_{r0} is the input and output of DMU.

The efficiency score θ_0 takes a value in the range [0,1] and a DMU is considered inefficient if $\theta_0 < 1$. To achieve the optimal level of $\theta_0 = 1$, the DMU must either reduce excess input costs or expand insufficient outputs.

At the same time, the most controversial question when using DEA is the choice of input and output variables (Henriques and ctg, 2020). In previous studies, three approaches were commonly used (Milenković and ctg, 2022): the production approach, the intermediary approach, and the profit approach. Berger and Humphrey (1997)

argue that the intermediary method is the most suitable for measuring the bank's performance score compared to other methods.

4.2. Tobit regression

The efficiency score measurement primarily focuses on the bank's internal inputs and outputs, without accounting for macroeconomic factors such as economic growth, inflation, and the impact of Covid-19. Additionally, DEA analysis does not address how various factors impact the efficiency score. Therefore, in the second stage, a regression method is employed, where the efficiency score serves as the dependent variable, and other variables act as independent variables. These independent variables mainly reflect the macro environment and unique characteristics of each bank. Developed by Tobin (1958), the Tobit model addresses the issue of limited dependent variables and is often combined with DEA efficiency scores.

4.3. Research data

The banking industry in Vietnam has undergone significant changes over the years due to restructuring, mergers, and international integration. These changes have improved average liquidity, reduced bad debts, and addressed the issues of many weak banks. However, the effectiveness of Vietnam's banking system also needs a more comprehensive evaluation following these changes, especially considering the impact of the Covid-19 pandemic.

The process of measuring efficiency scores involves researching and using audited financial statements of 26 banks listed on three Vietnamese stock exchanges: HSX, HNX, and Upcom, during the period from 2016 to 2022. Data on macroeconomic factors, such as GDP and CPI, are collected from the General Statistics Office of Vietnam; in particular, the Covid-19 variable is a binary variable, assigned a value of 0 or 1.

4.4. Proposed model

In the first stage, the intermediary method is used to calculate the efficiency score with the selected input variables are: employee costs (payments for staff and management activities in the cash flow statement), deposit costs (interest expenses and similar costs in the income statement), customer deposits (customer deposits in the balance sheet), equity (total equity in the balance sheet); and output variables include: customer loans (customer loans in the balance sheet), interest income (interest income and similar earnings in the income statement), non-interest income (total of net interest from services, plus net interest from foreign exchange activities, plus gains/ losses from trading securities, plus net interest from investment securities, plus net interest from other activities, plus income from capital contributions and share purchases in the income statement). The input and output variables are obtained from audited financial statements publicly available on the banks' websites.

In the second stage, the study will analyze the factors that affect the effectiveness score. Previous studies have often used Tobit regression in combination with DEA (Eyceyurt Batir and ctg, 2017; Milenković and ctg 2022). Several studies look at the impact of: (i) Bank-specific factors such as profitability (Akin and ctg, 2009; Jesús

Gustavo and Garza-García, 2012; Rishabh Goswami and ctg, 2019) or the size of the bank (Vu Ha and Nahm, 2013; Repkova (2015); (ii) Industry-specific factors such as ownership, concentration in competition (Gulati, 2022; Henriques and ctg, 2018); (iii) Macro cities such as CPI, GDP and the Covid-19 epidemic (Ivana Marjanović and ctg, 2023; Li et al., 2021; Raphael, 2013; Repkova, 2015; Rishabh Goswami and ctg, 2019).

In this study, only the internal variables of the bank are focused including profit (through ROA), size of equity (through CAP), size of bank (through BS); and macro factors including GDP, CPI (througt Inflation Index – INF), and the Covid-19 epidemic (through Cov). Additionally, **Table 2** provides a detailed description of the dependent, independent variables and the expectations of the impact on SE.

Table 2. Description of the dependent and independence variables.

Dependent variable	**Description**	**Expectations**
SE	Scale Efficiency	
Independent variable		
ROA	Return on total assets	+
CAP	Equity size (ratio of equity to total capital)	+/-
BS	Bank size (total assets of a bank)	+
GDP	Economic growth	+/-
INF	Inflation Index	+/-
Cov	Covid-19 pandemic	-

Source: Compiled by the authors.

The Tobit regression pattern looks like:

$$TE_{it} = \beta_0 + \beta_1 ROA_{it} + \beta_2 CAP_{it} + \beta_3 BS_{it} + \beta_3 INF_{it} + \beta_4 GDP_{it} + \beta_5 Cov_{it} + \varepsilon_{it}$$

5. Research results

In the first stage of analysis, the year-on-year performance score was calculated. **Table 3**, showing the average effectiveness score from 2016 to 2022. The overall efficiency of the 26 listed banks for the years 2016 to 2022 was 53.8%, 42.3%, 50%, 57.7%, 65.4%, 57.7%, and 46.1%, respectively. Observing that the effectiveness score during and after Covid-19 has decreased markedly in the number of effective banks from 17 (2020) to 15 (2021) and 12 (2022).

Table 3. The bank's scale efficiency score from 2016 to 2022.

Year	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Number of DMUs	26	26	26	26	26	26	26
Effective number of DMUs	14 53.8%	11 42.3%	13 50%	15 57.7%	17 65.4%	15 57.7%	12 46.1%
The number of DMUs is inefficient	12	15	13	11	9	11	14
Average value	0.9695	0.9689	0.98005	0.9743	0.9743	0.9779	0.9695
SD	0.0458	0.04408	0.0582	0.0399	0.0541	0.0498	0.06202
Highest Efficiency Score	1	1	1.09166	1	1	1	1
Low Effectiveness Score Click	0.8624	0.8515	0.8533	0.8772	0.7924	0.7729	0.77843

Source: Calculation of the author team with DEA_Solver Pro 5.0 software.

The measurement also indicates that inefficient banks can improve by reducing excess input while maintaining output levels. Specifically, inefficient banks should consider reducing employee costs, interest expenses, customer deposits and equity, while keeping customer loans, interest income, and non-interest income unchanged to get closer to the effective border. While this can't be done immediately, reducing equity or total customer deposits will help improve the efficiency score. In the second step, Tobit regression is used to analyze on a set of balance sheet data. When analyzing the table data, it is necessary to check the stability of the time series by the Levin–Lin–Chu test, and the test results show that the variables are all stopped at a meaningful level of 1%. The estimation results of the model are described in **Table 4**:

Table 4. Tobit regression results.

Interpretive variables	**Estimated value**
ROA	1.834329***
CAP	−0.4209414***
BS	0.0192128***
INF	0.2431907
GDP	−0.2480317
Cov	−0.0206725***
Contanst	0.642641
Prob > chi2	0.0000
Number of observations	182
Number of Banks (DMUs)	26

*** $p < 0.01$,** $p < 0.05$, *$p < 0.1$
Source: Calculation of the author's team with Stata 14 software.

Regarding the impact of ROA on banking efficiency, it shows that the relationship in the same direction is statistically significant. The higher the profit, the greater the possibility of increasing inputs and outputs. Therefore, banks that improve inputs such as deposits, reduce employee costs, and reduce interest costs through increasing low-cost deposits will greatly improve their efficiency scores. The results of this study are similar to those of Rishabh Goswami and ctg (2019), but contrary to the study of Repkova (2015).

For CAP, it shows an inverse relationship, which is statistically significant. The higher the equity, the better the bank's financial strength will be and help it grow sustainably, but it will not help increase the efficiency score. Therefore, banks should increase the size of equity but at the same time must increase the size of deposits, use staff costs and manage more effectively, diversify deposits to help banks meet legal requirements and improve efficiency scores. The results of Rishabh Goswami and ctg's (2019) study on the level of capitalization are not statistically significant, and Repkova (2015) shows that the level of capitalization has the same impact on banking efficiency.

The scale of banks has the same impact on banking efficiency in the period 2016–2022, which is statistically significant. Therefore, the larger the size of the bank, as

shown by the total value of capital, or the total value of assets will help the bank have a higher efficiency score, so banks need to increase the size of deposits and increase the size of customer loans. The results of this study are similar to those of Wu and Nahm (2013) and contrary to those of Akin et al. (2009).

GDP has the opposite impact on the effectiveness point but has no statistical significance. This finding also indicates that the inverse relationship may be due to banks choosing to invest in riskier assets during periods of growth (Repkova, 2015), although there is no statistical significance in this result. Such a strategy puts them at a higher risk of losing capital if borrowers do not fulfill their debt repayment obligations. More specifically, banks do not benefit from periods of economic growth due to higher default rates, which in turn reduces efficiency (Ofori-Sasu and ctg 2019).

On the other hand, the CPI has the same impact on the bank's performance. The impact of CPI is closely tied to the interest rate structure. If bank administrations correctly predict inflation, they can adjust interest rates in a way that does not harm net interest margins (Ofori-Sasu and ctg, 2019). In this case, the results of the study show that banks have been able to predict inflation effectively and bring the same impact to their effectiveness. However, the variable explaining inflation is not statistically significant.

At the time of the Covid-19 epidemic in 2020, banks had an efficiency score of up to 17, accounting for 65.4%, but then the number dropped rapidly in 2021 and 2022. With the table data, the Cov variable (Covid-19) receives a value of 1 if it belongs to the epidemic year, and a value of 0 if it is the opposite, indicating a meaningful inverse relationship. This result is also consistent with previous research by Li et al. (2021), while the study by Marjanović and ctg (2023) is not statistically significant. Particularly, Sang's research (2022) has only stopped at comparing the effectiveness score in 2020 with 2019, so the effectiveness score has increased, and the results of that study are similar to the observation of the effectiveness score of this study. However, in the following years, the Covid-19 epidemic had a negative impact on the efficiency of Vietnamese banks and this impact was reduced due to a series of timely policies from the government and the State Bank.

6. Conclusion

Banks play a big role in economic development by controlling and rationally allocating the money supply, so the efficiency of the banking system is a very important indicator to assess the health of the economy. By effectively intermediating between depositors and borrowers, banks contribute to efficient capital allocation, facilitating capital flows into areas with growth potential and promoting economic development. Using the two-stage DEA study method, the results show that there is room to improve the efficiency position, as the number of banks with the highest efficiency is 65.4%, and gradually decreases after the impact of Covid-19. For factors affecting bank efficiency, ROA, BS show the same impact, CAP and the Covid-19 epidemic (Cov) have the opposite impact, which is statistically significant. At the same time, there is no evidence that inflation and economic growth have an impact on banking efficiency.

Therefore, listed commercial banks should have an orientation in their business strategies to improve their efficiency points, including: (i) First, promoting non-profit collection activities from services, investment, and other revenues in order to increase after-tax profits that are competitive and sustainable. In addition, banks must also save on staff costs and management costs, which can be the same salary fund but will be redistributed appropriately to increase productivity. This will help the bank to sustainably increase ROA; (ii) Second, banks need to have a strategy to increase total assets and total capital in a reasonable way, and take into account sustainable growth and proactive risk management; (iii) Third, increasing equity is the right action to increase financial strength and meet capital adequacy standards from the State Bank, but banks also need to have a strategy and roadmap to achieve both, including: efficiency score and capital adequacy; (iv) Fourth, banks also need to develop business response action scenarios when another pandemic occurs to minimize the negative impact on banking efficiency and other consequences.

This article contributes to existing studies on banking efficiency in Vietnam and considers the impact factors of the Covid-19 pandemic. Theoretical contributions include providing a comprehensive overview of the models used to measure the effectiveness score and identify the influencing factors. Empirically, this study shows that the number of effective banks declined during and after the Covid-19 pandemic, and Covid-19 had the opposite effect on the effectiveness score. The results indicate that the Covid-19 pandemic negatively impacted the operational efficiency of Vietnamese commercial banks from 2020 onward. Specifically, the pandemic led to an increase in non-performing loans and a decrease in credit demand due to economic downturns. Social distancing policies further disrupted bank operations, reducing the ability to deliver in-person services. This impact mechanism involves rising credit risk due to the financial strain on customers, diminished profitability as credit demand wanes, and additional costs arising from support measures for affected clients. The pandemic's effects are not merely short-term but also impose long-lasting repercussions on bank efficiency, emphasizing the need for risk management strategy adjustments and restructuring to adapt to similar future disruptions.

In addition, the study also shows the influence of ROA, CAP, BS on the effectiveness score and has not found evidence for the influence of GDP and INF on banking efficiency. However, the study also has certain limitations such as: (i) First, adding independent variables inherent in a bank such as credit risk ratio, liquidity ratio; (ii) Second, supplementing variations showing the level of competition of the industry; (iii) Third, consider the effects of these factors on the bank's performance score taking into account the assumption of profit change (Banker and ctg, 1984), because the banking industry is dominated by government regulation and imperfect competition, it tends to deviate from optimal scale. The above is also the next research direction in the future.

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