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The Efficiency and Returns to Scale of the Vietnam Banking Sector: New Evidence

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Abstract

The objective of the present research is to examine the efficiency of the Vietnamese banking sector throughout the period spanning from 2013 to 2021. This study used the Data Envelopment Analysis (DEA) approach to assess the relative efficiency of a sample of 43 banks across Vietnam for the period from 2013 to 2021.The analysis produced two key findings. First, the Vietnamese banking sector demonstrated the highest levels of technical efficiency in 2020, whereas it appeared to be at its lowest level in 2014. Second, state-owned commercial banks (SOCB) exhibit the highest mean technical efficiency (TE), whereas joint stock commercial banks (JSCB) exhibit the lowest average technical efficiency (TE). In addition, the technical efficiency of state-owned commercial banks (SOCB), joint-stock commercial banks (JSCB), and wholly foreign banks (WFB) has been enhanced due to improvements in scale efficiency (SE). Conversely, the technical efficiency of joint venture banks (JVB) has improved because of enhancements in the pure technical efficiency (PTE). As for the originality, there is a notable absence of comprehensive efficiency analyses of the Vietnamese banking sector, specifically focusing on the periods before and after the COVID-19 pandemic, ranging from 2013 to 2021. In addition, we considered four types of ownership in the Vietnamese banking sector. Therefore, this study makes a valuable contribution to the finance and banking fields by comprehensively examining the performance of Vietnamese banks. This study offers valuable insights for policymakers and bank management to formulate effective strategies for a country's financial institutions.

Keywords*:* Bank Efficiency, DEA, Vietnamese Banking Sector, Efficiency Level, Types of Ownership

Introduction

The banking industry has seen significant transformations globally in recent decades, characterized by several factors, such as deregulation, mergers and acquisitions, financial liberalization, and other reform and restructuring initiatives (Vu and Turnell, 2010). The efficiency of the banking sector's performance has consistently been a primary concern for policymakers and researchers globally, given the significant impact that banks have on the economic growth and progress of countries. The level of interest in this subject matter has increased significantly over the past 20 years, particularly during the global COVID-19 crisis. Researchers and managers use economic theories to evaluate and compare the efficiency of banks while analysing their potential for development.

Measuring efficiency is an important reference for policymakers and market participants. However, Bauer et al (1998), express concerns regarding the efficiency scores of banks across different studies. The Vietnamese banking system has undergone a comparable evolution, starting with its transition from a single-tier to a two-tier banking system. This was followed by initiatives aimed at restructuring domestic banks, implementing financial deregulation, and, more recently, integrating into the global financial system (Vu and Turnell, 2010).

Over the past decade, the State Bank of Vietnam (SBV) has implemented efficiency measures to guide the banking sector towards sustainable growth. The Vietnamese banking sector has significantly contributed to the country's thriving economy and is recognized by the World Bank as an emerging powerhouse in Southeast Asia. This can be attributed to the notable transformations in both the structure and operations of the sector following the implementation of the 'Doi Moi' policy, which aimed to revitalize the economy (Nguyen and Simioni, 2015). However, the rapid proliferation of banking operations during the transition and liberalization periods led to structural fragility. During the transition and liberalization periods, the rapid proliferation of banking operations led to structural fragility (Le et al., 2020).

During Global Financial Crisis (GFC), several issues posed significant challenges to the stability of the banking industry. This has led to issues such as bad debt proliferation, undercapitalization, and balance sheet degradation (Le et al., 2020). In 2012, the State Bank of Vietnam (SBV) implemented a restructuring plan to improve the banking sector's performance and long-term viability. This was in response to the ASEAN Economic Community and Trans-Pacific Partnership. The efficiency of the Vietnamese banking sector has gained attention in academic and policymaking circles, as it aims to enhance competitive capabilities and align the banking system with its regional counterparts.

This study offers a unique perspective on the Vietnamese banking industry and makes significant contributions to the literature, as outlined in the following sections. First, this study aims to evaluate the efficiency of the Vietnamese banking system from 2013 to 2021 using the data envelopment analysis (DEA) approach. This methodology differentiates between technical efficiency, pure technical efficiency, and scale efficiency measurements. Unlike conventional parametric techniques, such as regression analysis, DEA focuses on the annual observations of individual banks and optimizes performance measurements. This study

stands out from other studies on the Vietnamese banking industry and contributes significantly to the existing body of knowledge. It distinguishes itself from other studies and makes a significant contribution to the existing body of knowledge. The advantages of this study over regression analysis make it a valuable contribution to the field.

Second, this study investigates the effects of the COVID-19 pandemic on the efficiency of Vietnamese banks from 2013 to 2021. This period is significant not only because of the presence of the COVID-19 pandemic but also because it has brought about major structural transformations in the Vietnamese economy and financial sector. The integration process linked to Vietnam's accession to the World Trade Organization (WTO) and its efforts to enhance financial liberalization have significantly affected banking performance (Vu and Turnell, 2010). Finally, this study aims to analyse the returns to scale within Vietnam's banking industry, a topic not explored in previous research. Understanding scale efficiency (SE) is crucial for understanding the economic reasoning behind these initiatives and for recommending appropriate policies.

The study also compares the economies of scale of nationwide commercial banks and their regional counterparts, considering the significant size differences. Regional commercial banks primarily operate branch banking activities within their own regions, catering to small and medium-sized firms, households, and individual borrowers. By contrast, nationwide commercial banks can establish and operate branch banking networks across the country, participating in both short- and long-term financial activities (Sufian, 2011). This comprehensive analysis will help inform future policies and strategies for the Vietnamese banking sector.

The remainder of this paper is structured as follows. Section 2 presents a comprehensive review of Vietnam’s banking industry. Section 3 describes the methodology used in this study. Section 4 provides a detailed description of the model specifications used in the analysis including the selection of variables. Section 5 provides an in-depth analysis of the findings obtained from the research, and Section 6 provides the final conclusions drawn from the study.

Literature Review

As a generalisation of efficiency given by Farrell (1957), the Data Envelopment Analysis (DEA) was first introduced by Charnes et al (1978), and Banker et al (1984), has been widely embraced by researchers as a valuable tool for evaluating performance (Sufian, 2011). A vast body of literature is available on banking efficiency, for instance, in the United States (Berger et al., 1993; Berger and Humphrey, 1997; Berger, 2007) as well as on the banking systems of Western and developed countries (Sathye, 2001; Drake, 2001; Canhoto and Dermine, 2003; Fiordelisi, 2007; Pasiouras, 2008; Sturm and Williams, 2008; Siriopoulos and Tziogkidis, 2010).

Fukuyama (1993), was one of the earliest researchers to use the frontier estimation technique to analyse the performance of Asian banks in 1990, focusing on the 143 Japanese banks. The findings indicate that banks with varying organizational statuses exhibit varying levels of performance across all efficiency indicators. Additionally, it is shown that there is a positive but weak correlation between shareholder equity and bank size. Single-country

studies of Asian banking have mostly focused on the performance of foreign and local banks. In general, the available empirical evidence indicates that foreign banks have effectively used their advantages and demonstrated high performance compared to domestic banks.

According to Leightner and Lovell (1998), domestic Thai banks encountered a decline in total factor productivity (TFP) growth on average. Conversely, the average foreign bank exhibited an upward trend in TFP. Furthermore, according to Unite and Sullivan (2003), the presence of foreign banks in the Philippines leads to a decrease in interest rate spreads and bank profitability. Matthews and Ismail (2006) observed that foreign banks in the Malaysian banking sector demonstrate a greater degree of technical efficiency (TE). Additionally, local banks' productivity is suggested to be more vulnerable to macroeconomic shocks than their foreign bank counterparts.

Numerous studies have assessed banks' efficiency in Vietnam. In this study, Vu and Turnell (2010), investigated the correlation between ownership and cost efficiency throughout the period ranging from 2000 to 2006. State-owned commercial banks in Vietnam showed greater efficiency and lower cost inefficiencies than joint stock banks and foreign banks. Nguyen and Simioni (2015), used Fare-Primont indices to assess changes in the total factor productivity of banks in Vietnam. The researchers found a decline in scale efficiency between 2008 and 2012, indicating that efficiency decreases as banks increase in size.

Gardener et al (2011), conducted a study on the impact of ownership on bank performance in Malaysia, the Philippines, Thailand, Indonesia, and Vietnam using a conventional two-stage DEA methodology. The researchers in this study implemented measures to account for the influence of size and subsequently observed a detrimental effect of size on cost efficiency. According to Stewart et al (2016), an investigation conducted in Vietnam between 1999 and 2009 revealed that large banks demonstrate higher levels of efficiency than small banks. Pham and Zelenyuk (2017), use data from commercial banks in Vietnam to estimate a slack-based directional distance function. The findings of this study indicate that small banks demonstrate considerably higher efficiency levels than large banks. Moreover, large banks exhibit much greater levels of input waste, output shortages, and risk surplus.

Background of the Vietnamese Banking System

Vietnam is currently experiencing a period of economic emergence as it undergoes a shift towards full market orientation. This transition was initiated with the introduction of Doi Moi economic reforms in 1986. The 1986 implementation of Doi Moi led to a significant transformation in the banking industry, transitioning from a mono-to a two-tier system with each tier specializing in specific functions. The first tier encompasses the State Bank of Vietnam (SBV), which is responsible for managing monetary policy, maintaining currency stability, and overseeing commercial banks.

The second tier includes commercial and non-commercial banks that offer various banking services. The commercial banking sector is classified into four groups: state-owned commercial banks (SOCBs), joint-stock commercial banks (JSCBs), wholly-foreign banks (FOBs) and joint venture banks (JVBs) (see Table 1).

Table 1
Four different groups of commercial banks in Vietnam as at 30 September 2023

Ownership	No of Bank	List of Banks
SOCB	2	Agribank, OceanBank
JSCB	32	VietinBank, VCB, ACB, ABBANK, BAOVIET Bank, Viet Capital Bank, BacABank, LPB, VcomBank, EAB, SeABank, MSB, KLB, Techcombank, NAM A BANK, OCB, MB, VIB, NCB, SCB, SGB, SHB, Sacombank, TPB, VietABank, VPBank, Vietbank, PG Bank, Eximbank, HDBank, Mekong Bank,Southern Bank
FOB	7	ANZ Bank, Hong Leong Bank,Shinhan Bank, Standard Chartered Bank, Public Bank, Woori Bank, HSBC.
JVB	2	Indovina Bank, Vietnam-Russia Joint Venture Bank

Source: SBV Statistics (2023)
Abbreviations: state-owned commercial banks (SOCB), joint-stock commercial banks (JSCB), wholly-foreign banks (FOB) and joint venture banks (JVB).
**This list does not include five commercial banks due to data availability (GPBank, CB, CIMB, United Overseas, BIDV).
*** Mekong Bank was merged into MTB in 2015, Southern Bank was merged into Sacombank in 2015.

The country's macroeconomic performance has shown remarkable progress, with an annual GDP growth rate of 7 percent between 1990 and 2010. However, it is worth noting that this development rate has decelerated since 2010. Significant regulatory changes were initiated in the banking sector shortly after the 1997 Asian Financial Crisis. These reforms involved enhancing the autonomy and responsibilities of the State Bank of Vietnam and removing the direct political influence on interest rates. The banking system experienced significant expansion after its accession to the World Trade Organization (WTO) in 2007, resulting in a substantial inflow of money. Nevertheless, the financial sector was on the edge of collapse in late 2009 because of concealed risks stemming from financial asset booms and intrabank loan activity.

In 2012, the State Bank of Vietnam (SBV) made the decision to implement a comprehensive restructuring programme aimed at effectively addressing the significant level of non-performing loans (NPLs), extensive cross-ownership, and various structural issues within the banking sector. The primary objective is to boost the banking industry's overall efficiency and productivity. Financially unstable banks have had to choose between merging with other banks or having the SBV take over for a nominal amount of Vietnamese doing. Simultaneously, the financial regulatory system has been revised and has converged towards international standards. In addition to the aforementioned factors, domestic financial institutions were confronted with the need to increase their capital reserves to adhere to the stipulations set forth by the Basel II framework.

Data Methodology

As a generalisation of the efficiency concept given by Farrell (1957), the DEA was first presented by Charnes et al (1978), famously known as a CCR model after their names. However, the constant returns to scale (CRS) assumption are used to calculate the CCR model. This presumption is incorrect in markets with weak competition. By allowing variable returns to scale (VRS), the BCC model developed by Banker et al (1984), modifies the CCR model. This study achieves its objectives by employing estimates of efficiency based on the VRS assumption.

The DEA is a method of finding a non-parametric production frontier by looking at the sample's observed input-output data. This frontier serves as a benchmark for evaluating the efficiency of each bank in the sample (Coelli 1996). This method compares the efficiency of a decision-making unit (DMU) to other DMUs that are similar, assuming that all DMUs are on or below the efficient frontier. An efficient DMU is situated on the frontier. The data is structured in an order that can reduce radial distances to the frontier.

A brief overview of the DEA is presented below. Consider *K* inputs and *M* outputs for each *N* bank. For the *i*th bank, vectors *xi* and *yi.* Call the *K x N* input matrix *X* and the *M x N* output matrix *Y*. To quantify each bank's efficiency, we compute a ratio of all inputs, such as (*u'yi/v'xi*), where u is an *M x 1* vector of output weights and *v* is a *K x 1* vector of input weight. We present the following mathematical programming problem for choosing the optimum weights:

$$\min_{u,v} (u'y_i / v'x_i),$$
$$u'y / v'x_i \leq 1, \quad j = 1, 2, \ldots, N,$$
$$u, v \geq 0$$

To address the infinite solutions in the previous formulation, we confined $v'x_i$ to 1. This results in:

$$\min_{\mu,\varphi} (\mu'y_i),$$
$$\varphi'x_i = 1$$
$$\mu'y - \varphi'x_j \leq 0 \quad j = 1, 2, \ldots, N,$$
$$\mu, \varphi \geq 0$$

To represent transformations, we switch the notation from *u* and *v* to μ and φ. Linear programming duality can be used to develop a similar envelopment form for this problem:

$$\min_{\vartheta, \lambda} \square,$$
$$y_j \square Y \square \square 0$$
$$\square x_j \square X \square \square 0$$
$$\square \square 0$$

The efficiency score for the *i*th bank is represented by λ, which is a scalar ranging from 0 to 1. λ is a *N* x 1 constant vector. We solve the linear programming *N* times, one for each sample bank. To calculate efficiency under variable returns to scale, the convexity constraint ($N1'\lambda = 1$) is added to compare inefficient banks with similar banks, enabling economies of scale measurement in the DEA concept. The DEA approach focuses on assessing the performance of each DMUs in relative to the others, trying to identify inefficiency and improve overall efficiency; thus, it can compute the relative efficiency of each DMU by comparing its actual input and output values. it also identifies the inefficiency of DMUs in terms of sources and levels of both inputs and outputs. This method includes the constant returns to scale (CRS) and variable returns to scale (VRS) assumptions. Both assumptions allow estimation of the overall technical efficiency (TE), which can be divided into two components: pure technical efficiency (PTE) and scale efficiency (SE). PTE refers to managerial ability to use resources effectively. SE refers to taking advantage of economies of scale, in which the production frontier is at the position of constant returns to scale.

The DEA method has five advantages: First, it assigns a single efficiency to each DMU, which allows ranking among them in the sample. Second, each DMU can be improved. There is an area for improvement. For instance, since DMU can be compared to a set of efficient DMUs with similar input-output ratios, it can be determined whether there is excessive or underproduction input usage. Third, it allows inferences based on the DMU's general profile, with a reference set of efficient DMUs used to identify the global leader. This information is crucial for DMU owners, particularly when positioning their entities in the market.

Fourth, the DEA method does not require a predetermined framework to detect and establish efficient frontier, error, and inefficiency structures (Evanoff and Israelvich, 1991; Grifell-Tatje and Lovell, 1997; Bauer et al., 1998). Furthermore, DEA allows researchers to choose any input or output of managerial interest, regardless of the different measurement units, eliminating the need for standardization (Avkiran, 1999). The Data Envelopment Analysis (DEA) methodology has limitations because its assumes that the data used are free from measurement errors. Efficiency is evaluated based on a specific dataset, meaning that a proficient decision-making unit (DMU) cannot be directly compared to other DMUs that are not included in the sample.

Specification of Bank Inputs, Outputs, and Data

Variable selection significantly affects efficiency studies, however, the lack of data on relevant variables often hinders this process. The banking sector faces challenges in assessing costs and outputs due to the prevalence of jointly generated financial services and the common practice of assigning pricing to bundles. Commercial banks primarily aggregate savings from various entities, including households, to fund business investment needs and cater to individual consumption needs. The intermediation approach is the dominant strategy used in the literature. This method uses traditional microeconomic theory and maintains that financial institutions serve as intermediaries between individuals who save and those who borrow.

Table 2
Summary Statistics of the Input and Output Variables in Vietnamese Banking Sector (2013-2021) (USD Million)

Variables	Mean	Minimum	Maximum	Standard Deviation
Inputs				
Capital (x1)	1,364,891.73	9,279.00	10,144,856.00	1,914,090.89
Total Deposits (x2)	180,635,267.03	1,739,554.00	1,542,504,439.00	250,997,674.95
Labour (x3)	2,147,299.62	92,700.00	14,530,020.00	2,717,487.23
Outputs				
Loans (y1)	157,207,933.60	1,854,962.00	1,316,473,316.00	227,104,657.62
Investment (y2)	38,494,570.67	310,200.00	180,236,500.00	39,042,265.81
Non-Interest Income (y3)	1,609,032.99	100.00	11,896,700.00	2,116,452.94

Notes: x1: Capital (fixed assets), x2: Total Deposits (deposits and short-term funding), x3: Labour (personnel expenses), y1: Loans (gross loan), y2: Investment (total security), y3: Non-Interest Income.
Source: Author's own calculations.

According to Sealey and Lindley (1977), financial firms outputs comprise total loans and securities, whereas inputs consist of deposits, labour, and physical capital (Sealey and Lindley, 1977). In the context of the intermediation approach, we postulate that capital (X1), total deposits (X2), and labour (X3) serve as inputs to produce loans (Y1), investments (Y2), and non-interest income (Y3). Table 2 displays the summary statistics of the output and input variables used to construct the DEA model.

Table 3
Four different types of commercial banks in Vietnam as at 30 September 2023

No	Name of Bank	Ownership
1	Vietnam Joint Stock Commercial Bank of Industry and Trade – VietinBank	JSCB
2	Joint Stock Commercial Bank for Foreign Trade of Vietnam - VCB	JSCB
3	Asia Commercial Joint Stock Bank - ACB	JSCB
4	AnBinh Commercial Joint Stock Bank - ABBANK	JSCB
5	BaoViet Joint Stock Commercial Bank – BAOVIET Bank	JSCB
6	Viet Capital Commercial Joint Stock Bank - Viet Capital Bank	JSCB
7	BAC A Commercial Joint Stock Bank -BacABank	JSCB
8	LienViet Post Joint Stock Commercial Bank – LienVietPostBank - LPB	JSCB
9	Vietnam Public Joint Stock Commercial Bank- PVcomBank	JSCB
10	DONG A Commercial Joint Stock Bank –EAB	JSCB
11	Southeast Asia Commercial Joint Stock Bank -SeABank	JSCB
12	Maritime Commercial Joint Stock Bank - MSB	JSCB
13	KienLong Commercial Joint Stock Bank - KLB	JSCB

14	Viet Nam Technological and Commercial Joint Stock Bank - Techcombank	JSCB
15	Nam A Commercial Joint Stock Bank - NAM A BANK	JSCB
16	Orient Commercial Joint Stock Bank - OCB	JSCB
17	Military Commercial Joint Stock Bank -MB	JSCB
18	Vietnam International Commercial Joint Stock Bank - VIB	JSCB
19	National Citizen Bank - NCB	JSCB
20	SaiGon Commercial Joint Stock Bank - SCB	JSCB
21	Saigon Bank for Industry & Trade - SGB	JSCB
22	Saigon-Hanoi Commercial Joint Stock Bank - SHB	JSCB
23	SaigonThuong Tin Commercial Joint Stock Bank - Sacombank	JSCB
24	TienPhongCommercial Joint Stock Bank - TPB	JSCB
25	Viet A Commercial Joint Stock Bank -VietABank	JSCB
26	Vietnam Prosperity Joint Stock Commercial Bank -VPBank	JSCB
27	VietnamThuong Tin Commercial Joint Stock Bank - Vietbank	JSCB
28	PetrolimexGroup Commercial Joint Stock Bank – PG Bank	JSCB
29	Viet Nam Export Import Commercial Joint Stock Bank - Eximbank	JSCB
30	Ho Chi MinhCity Development Joint Stock Commercial Bank – HDBank	JSCB
31	Mekong Development Joint Stock Commercial Bank	JSCB
32	Southern Commercial Joint Stock Bank	JSCB
33	ANZ Bank (Vietnam) Limited - ANZVL	FOB
34	Woori Bank Vietnam Limited -Woori Bank Vietnam	FOB
35	Public Bank Vietnam	FOB
36	Standard Chartered Bank (Vietnam) Limited - SCBVL	FOB
37	Shinhan Bank Vietnam Limited - SHBVN	FOB
38	Hong Leong Bank Vietnam Limited - HLBVN	FOB
39	HSBC Bank (Vietnam) Limited	FOB
40	Vietnam Bank for Agriculture and Rural Development - Agribank	SOCB
41	OceanCommercial One Member Limited Liability Bank - OceanBank	SOCB
42	Vietnam-Russia Joint Venture Bank	JVB
43	Indovina Bank	JVB

Sources: SBV Statistics (2023)

This study comprises annual bank-level data pertaining to 2 state-owned commercial banks (SOCBs), 32 joint-stock commercial banks (JSCBs), 7 wholly-foreign banks (FOBs) and 2 joint venture banks (JVBs) during the time span of 2013 to 2021. The data were collected from the Fitch Connect database. The final sample comprises 43 banks (see Table 3), representing almost 90 percent of the total assets of the banking system in Vietnam.

The selection of banks for this study was based on the methodology proposed by Dyson et al. (2001), which considers their shared market and nationwide competitive nature. In summary, Dyson et al. (2001) formulated a set of homogeneity assumptions, which suggest

that DMUs being compared in terms of performance should engage in similar activities and generate comparable products and services. This ensures the establishment of a shared set of outputs. When examining relative efficiency, it is imperative that decision-making units (DMUs) exhibit a sufficient degree of similarity to ensure meaningful comparisons may be made.

The next section examines the technical efficiency (TE) in the Vietnamese banking sector using the Data Envelopment Analysis (DEA) approach. Additionally, we will analyse the decomposition of TE into its distinct components of pure technical efficiency (PTE) and scale efficiency (SE). First, we analyse the efficiency of Vietnam's banking system using the DEA approach. To the assess technical efficiency (TE), pure technical efficiency (PTE), and scale efficiency (SE) of the banking sector in Vietnam, our study expands the analysis to include state-owned commercial banks (SOCBs), joint-stock commercial banks (JSCBs), wholly-foreign banks (FOBs), and joint venture banks (JVBs). This extension was achieved by using an alternative DEA model.

Empirical Results

Technical Efficiency of the Vietnamese Banking Sector: Evidence from Specific Year

It is important to understand that banks operate in a constantly changing business environment. According to Sufian (2011), among others, a bank might be very effective in one year but become inefficient in the next year(s) due to the rapidly changing financial environment. Thus, the DEA method may provide insights into the significant advancements in the Vietnamese banking sector. This study aims to address existing knowledge gaps by presenting fresh empirical information on the efficiency and returns to scale of Vietnamese banking sector.

Table 4

The Efficiency of the Vietnamese Banking Sector

Types of Banks	Mean	Minimum	Maximum	Std.Dev.
Panel A: All Banks 2013				
Technical Efficiency	0.876	0.630	1.000	0.117
Pure Technical Efficiency	0.938	0.693	1.000	0.096
Scale Efficiency	0.938	0.675	1.000	0.085
Panel B: All Banks 2014				
Technical Efficiency	0.711	0.394	1.000	0.248
Pure Technical Efficiency	0.891	0.394	1.000	0.188
Scale Efficiency	0.801	0.412	1.000	0.205
Panel C: All Banks 2015				
Technical Efficiency	0.912	0.665	1.000	0.100
Pure Technical Efficiency	0.962	0.735	1.000	0.079
Scale Efficiency	0.948	0.804	1.000	0.071
Panel D: All Banks 2016				
Technical Efficiency	0.732	0.331	1.000	0.230
Pure Technical Efficiency	0.870	0.403	1.000	0.171

Scale Efficiency	0.840	0.423	1.000	0.185
Panel E: All Banks 2017				
Technical Efficiency	0.880	0.568	1.000	0.121
Pure Technical Efficiency	0.915	0.599	1.000	0.108
Scale Efficiency	0.961	0.752	1.000	0.062
Panel F: All Banks 2018				
Technical Efficiency	0.907	0.668	1.000	0.099
Pure Technical Efficiency	0.957	0.774	1.000	0.069
Scale Efficiency	0.943	0.767	1.000	0.073
Panel G: All Banks 2019				
Technical Efficiency	0.897	0.563	1.000	0.123
Pure Technical Efficiency	0.947	0.707	1.000	0.090
Scale Efficiency	0.947	0.563	1.000	0.100
Panel H: All Banks 2020				
Technical Efficiency	0.923	0.710	1.000	0.098
Pure Technical Efficiency	0.948	0.710	1.000	0.091
Scale Efficiency	0.975	0.739	1.000	0.058
Panel I: All Banks 2021				
Technical Efficiency	0.896	0.609	1.000	0.113
Pure Technical Efficiency	0.923	0.609	1.000	0.116
Scale Efficiency	0.971	0.764	1.000	0.055
Panel J: State-Owned Commercial Banks				
Technical Efficiency	0.993	0.937	1.000	0.021
Pure Technical Efficiency	0.994	0.942	1.000	0.019
Scale Efficiency	0.999	0.995	1.000	0.002
Panel K: Joint Stock Commercial Banks				
Technical Efficiency	0.604	0.243	1.000	0.213
Pure Technical Efficiency	0.765	0.306	1.000	0.207
Scale Efficiency	0.792	0.378	1.000	0.165
Panel L: Wholly-Foreign Banks				
Technical Efficiency	0.954	0.618	1.000	0.094
Pure Technical Efficiency	0.970	0.622	1.000	0.085
Scale Efficiency	0.983	0.771	1.000	0.048
Panel M: Joint-Venture Banks				
Technical Efficiency	0.986	0.919	1.000	0.026
Pure Technical Efficiency	0.991	0.929	1.000	0.022
Scale Efficiency	0.995	0.970	1.000	0.010

Source: Author's own calculations.

Regarding the findings shown in Table 4, the average level of technical efficiency (TE) within the Vietnamese banking sector for each given year spans 2013 to 2021. The data presented in Panels A and Panel H of Table 4 suggests that the year 2020 witnessed the highest level of technical efficiency at 92.3 percent, while the lowest level was observed in 2014 at 71.1 percent. These figures reflect the extent to which productive resources were effectively utilized during the respective years. Accordingly, it has been observed that the Vietnamese banking sector has exhibited a lack of optimal utilization of inputs to achieve the

highest level of output or the ability to achieve a specific level of output with the least amount of inputs, thereby indicating the presence of technical inefficiency (TIE).

Possible explanations for the comparatively lower technical efficiency (TE) may include the fast growth of small and medium-sized banks and extensive investment in automation and computerization initiatives, leading to underutilized capacity for medium-sized banks. Consequently, banks may be required to collaborate and share their systems with other banks to reduce their unused capacity (Isik and Hassan, 2002). Excessive idle capacity may result in significant costs for banks, as they will be burdened with fixed expenses related to underused assets.

The results for the Vietnamese banking sector scale efficiency (SE) are shown in Table 4. From 2013 to 2016, scale inefficiency (SIE) was the dominant source of inefficiency in the Vietnamese banking sector rather than pure technical inefficiency (PTIE). Within that year, Vietnamese banks had not been operating at a relatively optimal or "wrong" scale of efficiency, even though they were managerially efficient enough to fully exploit their resources. The SIE was caused by an incorrect scale of bank operations, either too small (IRS) or too large (DRS).

From 2017 onwards, Vietnamese banks have been operating at a relatively optimal scale of efficiency, but have not been managerially efficient enough to exploit all their resources. One possible reason for this is that the enforcement of stringent laws and adherence to complex standards may lead to higher operational costs, thus impeding banks to function effectively.

Technical Efficiency of the Vietnamese Banking Sector: Evidence from Ownership

The efficiency of the banking system is closely related to bank ownership. The next section examines the efficiency of the Vietnamese banking sector based on ownership type. Table 4 presents the efficiency scores for specific types of banks, such as state-owned commercial banks (Panel J), joint-stock commercial banks (Panel K), wholly foreign banks (Panel L), and joint venture banks (Panel M). The findings from Panel J of Table 4 shows that the State-Owned Commercial Banks (SOCB) exhibits the highest mean TE of 99.3 percent where there is 0.7 percent waste in inputs., while the Joint Stock Commercial Banks (JSCB) exhibit the lowest average TE of 60.4 percent with 39.6 percent input waste.

The findings suggest that the SOCB have effectively fulfilled their role as intermediaries and have demonstrated efficient use of resources without any waste or inefficiencies, for example, transforming deposits collected from customers to loans and investments, relatively efficiently (Sufian and Habibullah, 2010). This results in an optimal technical efficiency.

We next turn our discussions on the Pure Technical Efficiency (PTE). Panel J of Table 4 shows that State-Owned Commercial Banks (SOCB) exhibit the highest mean PTE of at 99.4 percent. The empirical findings clearly show that the SOCB is more managerially efficient in the Vietnamese banking sector. In other words, during the study period, the management of banks in the SOCB efficiently allocated scarce resources to maximize outputs. This favourable

outcome could be attributed to the fact that SOCB has made better use of their resources to lower their running costs by building on the achievements of Industrial Revolution 4.0 (IR 4.0) and pushing digital banking apps.

Furthermore, the results given in Panel K of Table 4 shows that Joint Stock Commercial Banks (JSCB) have the lowest PTE of 76.5 percent. There are several plausible reasons why banks are required to comply with stringent laws, which may in turn result in increased administrative expenses. According to Sufian and Habibullah (2014), banks engaged in mergers tend to exhibit lower levels of cost efficiency than control groups consisting of non-merging banks.

Moreover, there is a correlation between increased agency costs and higher information asymmetry within the management, which subsequently leads to operational inefficiency (Le et al., 2020). Additionally, DeYoung and Roland (2001) demonstrated a strong association between management quality and efficiency. Thus, poor managers may also be poor in operations and passive in assuming higher risks and profits.

The results of the scale efficiency (SE) are shown in Panels J, K, L, and M of Table 4. As observed, the findings indicate a significant disparity in the level of inefficiency throughout the Vietnamese banking sectors, with State-Owned Commercial Banks (SOCB) exhibiting 1 percent inefficiency and Joint Stock Commercial Banks (JSCB) showing 20.8 percent inefficiency. This implies that these banks may not operate efficiently.

A possible explanation could be the presence of stringent government regulations that hinder the entry of De Novo banks, the complicated approval process for foreign banks to open new branches, and restrictions on business operations, such as limitations on foreign bank branches accepting retail deposits from customers. It has been argued that these limits have resulted in banks operating at a suboptimal level (Sufian, 2016), preventing them from benefiting from economies of scale.

Development in the Return to Scale (RTS) of the Vietnamese Banking Sectors

Table 5 (see below) displays the structure of banks within the Vietnamese banking sector, which forms efficiency frontiers. Panel A of Table 5 shows significant fluctuations in the percentage of bank observations that representing the efficiency frontier, ranging from 18.60% in 2016 to 55.80% in 2020. In Panel A of Table 5, most the time on the efficiency frontier is in 2020, with 24 bank observations. However, it is clear that a smaller number of banks were able to achieve the efficiency frontier status in 2016 (i.e., eight bank observations).

Table 5, Panel B, displays the composition of banks in the Vietnamese banking sector that form efficiency boundaries based on ownership. It is evident that joint venture banks (10 bank observations, or 90.91% of total bank observations) and foreign banks (18 bank observations, or 81.82% of total bank observations) form the highest percentage of the efficiency frontier among Vietnamese banks. Empirical data indicate that state-owned commercial banks were the least frequent on the efficiency frontier over the research period, accounting for only 11.10% of all bank observations.

Table 5
Developments in the Returns to Scale of the Vietnamese Banking Sector

Panel A: Returns to Scale by Year										
	CRS			**DRS**			**IRS**			
Year	**No of Bank**	**% Share**		**No of Bank**	**% Share**		**No of Bank**	**% Share**		**No of Banks**
	Observations	r%	c%	**Observations**	r%	c%	**Observations**	r%	c%	
2013	14	32.56	11.11	29	67.44	11.15	-	-	-	**43**
2014	10	23.26	7.94	33	76.74	12.69	-	-	-	**43**
2015	13	30.23	10.32	30	69.77	11.54	-	-	-	**43**
2016	8	18.60	6.35	35	81.40	13.46	-	-	-	**43**
2017	13	30.23	10.32	30	69.77	11.54	-	-	-	**43**
2018	12	27.91	9.52	31	72.09	11.92	-	-	-	**43**
2019	12	27.91	9.52	31	72.09	11.92	-	-	-	**43**
2020	24	55.81	19.05	19	44.19	7.31	-	-	-	**43**
2021	20	46.51	15.87	22	51.16	8.46	1	2.33	100.00	**43**
Total	**126**		**100.0**	**260**		**100.0**	**1**		**100.0**	**387**
Panel B: Returns to Scale by Ownership										
	CRS			**DRS**			**IRS**			
Ownership	**No of Bank**	**% Share**		**No of Bank**	**% Share**		**No of Bank**	**% Share**		**No of Banks**
	Observations	r%	c%	**Observations**	r%	c%	**Observations**	r%	c%	
Joint Stock Commercial Banks	97	45.33	76.98	117	54.67	90.70	-	-	-	**214**
Foreign Banks	18	81.82	14.29	4	18.18	3.10	-	-	-	**22**
State-Owned	1	11.11	0.79	8	88.89	6.20	-	-	-	**9**

Commercial Banks Joint Venture Banks	10	90.91	7.94	0	0.00	0.00	1.00	9.09	100.00	**11**
Total	**126**		**100.0**	**129**		**100.0**	**1**		**100.0**	**256**

r% indicates row wise (relative to the same group i.e. year and ownership)
c% indicates column wise (relative to the other groups i.e. year and ownership)
Source: Author's own calculations

The data suggest variations in production costs across banks of different sizes over time. The empirical data suggest that the scale inefficiency caused by DRS may be a result of larger banks adjusting their size to meet the high market demand for financial services. It is plausible that big banks in Vietnamese economies likely faced surplus capacity both before and during the post COVID-19 pandemic crisis period. Moreover, since big banks operate under DRS and CRS, the findings suggest that additional size growth will result in a diminishing marginal gain in outputs relative to inputs for these large banks. To improve efficiency, large banks may need to reduce their activities and regulatory bodies should be cautious when promoting mergers among the largest banks.

New and small Vietnamese banks may have caused inefficiencies in the IRS scale. The likely cause may be the smaller banks' intention to grow to the appropriate size of operations rapidly, but they fail to do so. However, empirical data suggests that Vietnamese banks have been achieved better output levels by efficiently implementing innovative ideas and concepts through their production. This situation might prompt governments to increase their investment in research and development (R&D), which would be seen as a wise decision to promote skilled workers and improve human capital development.

Essentially, empirical data indicates that small banks could benefit from increasing inputs or extending their scale of operations. Expanding operations allow small banks to lower their average operating costs by distributing fixed expenses over a larger client base, which leads to increased efficiency. In other words, significant operational benefits can be achieved by altering the scale of operations through growth and/or consolidation in the banking industry.

To achieve a cost advantage and capitalize on the benefits of economies of scale, it is useful to encourage smaller banks to consolidate or merge with other banks of a similar size. In a competitive market, banks experiencing IRS should either enhance their efficiency or risk being acquired by other banks capable of streamlining procedures and eliminating inefficiencies (Evanoff & Israelvich, 1991).

It is evident that the primary cause of inefficiency in the banking sector of the Vietnamese economy is the incorrect production scale rather than inefficient resource utilization. Most banks operate on a less-than-ideal scale because of scale inefficiency. Because their size is smaller than optimal, they either increase the IRS or decrease the DRS because of being larger than the optimal. Therefore, adjusting the production scale could help

banks take advantage of the cost reductions resulting from increased efficiency or higher output.

Robustness Tests for Efficiency Scores in the Vietnamese Banking Sector based on the Ownership (2013-2021)

After reviewing the DEA method findings, the question is whether the technical, pure technical, and scale efficiency of joint stock commercial banks, state-owned commercial banks, wholly foreign banks, and joint venture banks differ statistically. Two independent samples from populations with the same distribution were tested using the Mann-Whitney and Kolmogorov-Smirnov tests. The primary issue is that the data does not meet the strict t-test assumptions of the independent group. To achieve more robust findings, we ran the parametric (t-test) and non-parametric (Mann-Whitney test and Kolmogorov-Smirnov test).

Table 6
Robustness Tests based on Parametric and Non-Parametric Tests on Joint Stock Commercial Banks and State-Owned

Commercial Banks (2013- 2021)

Test Statistic	Parametric Test		Non-parametric test			
	t-test		Mann Whitney Test		Kolmogorov-Smirnov Test	
	t (Prb > t)		*Z (Prb > z)*		*Z (Prb > z)*	
	Mean	*t*	Mean Rank	*z*	Mean Rank	*z*
Technical Efficiency						
Joint Stock Commercial Banks	0.616	2.629	157.01	-2.823***	0.378	1.558**
State-Owned Commercial Banks	0.359		97.39			
Pure Technical Efficiency						
Joint Stock Commercial Banks	0.668	1.923**	155.13	-1.364	0.281	1.158
State-Owned Commercial Banks	0.468		127.36			
Scale Efficiency						
Joint Stock Commercial Banks	0.672	2.728	156.79	-3.081***	0.440	1.809***
State-Owned Commercial Banks	0.390		92.53			

Note: ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.
Source: Author's own calculations.

Table 7
Robustness Tests based on Parametric and Non-Parametric Tests on Joint Stock Commercial Banks and Wholly-Foreign Banks (2013- 2021)

Test Statistic	Parametric Test		Non-parametric test			
	t-test		Mann Whitney Test		Kolmogorov-Smirnov Test	
	t (Prb > t)		*Z (Prb > z)*		*Z (Prb > z)*	
	Mean	*t*	Mean Rank	*z*	Mean Rank	*z*
Technical Efficiency						
Joint Stock Commercial Banks	0.616	3.050***	179.91	-1.583	0.265	1.908***
Wholly-Foreign Banks	0.438		158.13			
Pure Technical Efficiency						
Joint Stock Commercial Banks	0.668	3.987***	183.14	-2.979***	0.281	2.022***
Wholly-Foreign Banks	0.426		143.37			
Scale Efficiency						
Joint Stock Commercial Banks	0.672	4.045***	180.65	-2.109**	0.300	2.154***
Wholly-Foreign Banks	0.425		152.04			

Note: ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.
Source: Author's own calculations.

Table 8
Robustness Tests based on Parametric and Non-Parametric Tests on Joint Stock Commercial Banks and Joint-Venture Banks (2013- 2021)

Test Statistic	Parametric Test		Non-parametric test			
	t-test		Mann Whitney Test		Kolmogorov-Smirnov Test	
	t (Prb > t)		*Z (Prb > z)*		*Z (Prb > z)*	
	Mean	*t*	Mean Rank	*z*	Mean Rank	*z*
Technical Efficiency						
Joint Stock Commercial Banks	0.616	0.081**	152.02	-1.190	0.319	1.315*

Joint-Venture Banks	0.608		177.11			
Pure Technical Efficiency						
Joint Stock Commercial Banks	0.668	0.545**	152.91	-0.496	0.181	0.743
Joint-Venture Banks	0.611		162.97			
Scale Efficiency						
Joint Stock Commercial Banks	0.672	0.607**	152.13	-0.713	0.232	0.953
Joint-Venture Banks	0.608		166.94			

Note: ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.
Source: Author's own calculations.

Table 9
Robustness Tests based on Parametric and Non-Parametric Tests on State-Owned Commercial Banks and Wholly-Foreign Banks (2013- 2021)

Test Statistic	**Parametric Test**		**Non-parametric test**			
	t-test		**Mann Whitney Test**		**Kolmogorov-Smirnov Test**	
	t (Prb > t)		***Z (Prb > z)***		***Z (Prb > z)***	
	Mean	***t***	**Mean Rank**	***z***	**Mean Rank**	***z***
Technical Efficiency						
State-Owned Commercial Banks	0.438	-0.642***	36.11	-1.094	0.397	1.485**
Wholly-Foreign Banks	0.359		42.40			
Pure Technical Efficiency						
State-Owned Commercial Banks	0.426	0.320	42.67	-0.381	0.071	0.267
Wholly-Foreign Banks	0.468		40.52			
Scale Efficiency						
State-Owned Commercial Banks	0.425	-0.272***	37.58	-0.780	0.325	1.218
Wholly-Foreign Banks	0.390		41.98			

Note: ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.
Source: Author's own calculations.

Table 10
Robustness Tests based on Parametric and Non-Parametric Tests on State-Owned Commercial Banks and Joint-Venture Banks (2013- 2021)

Test Statistic	Parametric Test		Non-parametric test			
	t-test		Mann Whitney Test		Kolmogorov-Smirnov Test	
	t (Prb > t)		*Z (Prb > z)*		*Z (Prb > z)*	
	Mean	*t*	Mean Rank	*z*	Mean Rank	*z*
Technical Efficiency						
State-Owned Commercial Banks	0.359	-1.674***	14.75	-2.262**	0.611	1.833***
Joint-Venture Banks	0.608		22.25			
Pure Technical Efficiency						
State-Owned Commercial Banks	0.468	-0.869	16.89	-1.034	0.222	0.667
Joint-Venture Banks	0.611		20.11			
Scale Efficiency						
State-Owned Commercial Banks	0.390	-1.407*	15.08	-2.069*	0.556	1.667***
Joint-Venture Banks	0.608		21.92			

Note: ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.
Source: Author's own calculations.

Table 11
Robustness Tests based on Parametric and Non-Parametric Tests on Joint-Venture Banks and Wholly-Foreign Banks

(2013- 2021)

Test Statistic	Parametric Test		Non-parametric test			
	t-test		Mann Whitney Test		Kolmogorov-Smirnov Test	
	t (Prb > t)		*Z (Prb > z)*		*Z (Prb > z)*	
	Mean	*t*	Mean Rank	*z*	Mean Rank	*z*
Technical Efficiency						
Wholly-Foreign Banks	0.438	-1.305	39.06	-1.531	0.246	0.921
Joint-Venture Banks	0.608		47.78			

Pure Technical Efficiency						
Wholly-Foreign Banks	0.426	-1.417	38.89	-1.690*	0.278	1.039
Joint-Venture Banks	0.611		48.39			
Scale Efficiency						
Wholly-Foreign Banks	0.425	-1.381	39.21	-1.451	0.230	0.861
Joint-Venture Banks	0.601		47.28			

Note: ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.
Source: Author's own calculations.

The results in Table 6 show that joint-stock commercial banks were more efficient than state-owned commercial banks were during the study period. This was supported by the parametric t-test, which showed that technical efficiency (0.616 > 0.359), pure technical efficiency (0.668 > 0.468), and scale efficiency (0.672 > 0.390) were statistically significant at the 5% level (except for technical and scale efficiency). This finding indicates that joint-stock commercial banks are more efficient in terms of management. The Non-parametric Mann-Whitney and Kolmogorov-Smirnov tests confirmed the parametric t-test findings, where all tests were statistically significant at the 1% and 5% levels, except for pure technical efficiency.

Furthermore, the results in Table 7 show that the parametric t-test indicates that joint-stock commercial banks have higher technical efficiency (0.616 > 0.438), pure technical efficiency (0.668 > 0.426), and scale efficiency (0.672 > 0.425) than wholly foreign banks (all statistically significant at the 1% level). The parametric t-test results were confirmed using non-parametric Mann-Whitney and Kolmogorov-Smirnov tests. All tests were statistically significant at the 1% and 5% levels, except for the Mann-Whitney test, which is the most technically efficient.

Additionally, Table 8 shows that joint-stock commercial banks have better technical efficiency (0.616 > 0.608), pure technical efficiency (0.668 > 0.611), and scale efficiency (0.672 > 0.608) than joint-venture banks (all significant at the 5% level). However, the results from the non-parametric Mann-Whitney and Kolmogorov-Smirnov tests should to be interpreted with caution, as there is a significant difference between the parametric and non-parametric test results.

Table 9 shows that the results of the parametric t-test suggest that the technical and scale efficiencies of state-owned commercial banks are higher than the technical efficiency of wholly foreign banks (where TE 0.438 > 0.359 and SE 0.425 > 0.390), except for pure technical efficiency (PTE 0.426 < 0.468), and statistically significant at the 1% level. The non-parametric Mann-Whitney and Kolmogorov-Smirnov tests further supported the results of the parametric t-test. However, there was no statistically significant difference for both non-parametric tests, except for technical efficiency (significant at the 5% level).

Moreover, compared to the other types of banks shown in Table 10, the results of the parametric t-test show that the technical efficiency of the joint venture banks is higher than the technical efficiency (TE 0.608 > 0.359), pure technical efficiency (PTE 0.611 > 0.468), and scale efficiency (SE 0.837 > 0.659) of state-owned commercial banks. All efficiency results are significant at the 1% and 10% levels, except for pure technical efficiency. The results of the parametric t-test were confirmed using the non-parametric Mann-Whitney and Kolmogorov-Smirnov tests. All tests are statistically significant at the 1%, 5%, and 10% levels, except for pure technical efficiency.

As shown in Table 11, the joint venture banks had higher technical efficiency (0.608 > 0.438), pure technical efficiency (0.611 > 0.426), and scale efficiency (0.601 > 0.425) than wholly foreign banks. The only area that was statistically significant at the 10% level was pure technical efficiency. However, the non-parametric Mann-Whitney and Kolmogorov-Smirnov tests should be interpreted with caution because there is a significant difference between the parametric and non-parametric test results.

Briefly, the study concludes that joint-stock commercial banks are more efficient than state-owned commercial banks, wholly foreign banks, and joint venture banks because the results on efficiencies are significant at the 1%, 5%, and 10% levels. As for joint venture banks are more efficient than state-owned commercial banks and wholly foreign banks, and significant at the 1%, 5%, and 10% levels.

Conclusion

Numerous studies examine bank efficiency and most of this research has focused on western and established banking sectors. However, empirical research in developing countries, notably Vietnam, is lacking. To address this gap, this study provides new empirical information on the Vietnamese banking sector's technical, pure technical, and scale efficiency of different types of Vietnamese banks. Data Envelopment Analysis (DEA) is used to calculate the technical efficiency of Vietnamese banks from 2013 to 2021. This study covered the recent COVID-19 pandemic in this data.

Empirical evidence suggests that the Vietnamese banking system demonstrated the highest levels of technical efficiency in 2020, whereas it seemed to be at its lowest level in 2014. State-owned commercial banks (SOCB) have the highest mean technical efficiency (TE), whereas joint-stock commercial banks (JSCB) have the lowest average technical efficiency (TE). Furthermore, the scale efficiency (SE) improvements have led to greater technical efficiency in state-owned commercial banks (SOCB), joint-stock commercial banks (JSCB), and wholly foreign banks (WFB). By contrast, the technical efficiency of joint venture banks (JVB) has increased owing to improvements in pure technical efficiency (PTE).

The empirical results indicate that scale is the primary factor contributing to the decline in the efficiency of Vietnamese banks. The findings suggest that banks operating within the Vietnamese banking system exhibit a lack of optimal scale efficiency because they are either too small to take advantage of economies of scale or too large to effectively achieve scale efficiency. Therefore, from a policy-making standpoint, the findings suggest that smaller

banks have the potential to enhance their efficiency by pursuing expansion strategies, but larger banks may need to downsize their operations to achieve scale efficiency.

Second, larger banks are less efficient than smaller ones are. An ideal company size achieves a constant return to scale (CRS). A DMU with rising returns to scale (IRS) must grow, whereas one with declining returns to scale (DRS) must be downsized. Perhaps larger banks are underperforming because their scale has become a burden rather than an opportunity. It is crucial to balance the significant benefits with the substantial costs of managing a large organization.

Moreover, when it comes to ownership, most banks are pure technical inefficiencies, surpassing scale inefficiency in determining the technical efficiency of Vietnam's banking sectors. This suggests that the banking sector in Vietnam has shown inefficiency in effectively utilizing resources due to managerial factors. The findings indicate that the technical efficiency of state-owned commercial banks, joint-stock commercial banks, and wholly foreign banks has been enhanced by improvements in scale efficiency. Conversely, the technical efficiency of joint venture banks has improved because of enhancements in pure technical efficiency.

Additionally, this study provides valuable insights for policymakers in terms of achieving the maximum utilization of capacities, enhancing managerial ability, effectively allocating limited resources, and determining the most efficient scale of operation for commercial banks operating within the banking sector of Vietnam. This may also contribute to the establishment of strategies to ensure the long-term competitiveness of Vietnam’s banking industry. Efficiency statistics provide valuable insights for bank managers, allowing them to assess the performance of their organizations within the area. This may provide guidance for the implementation of suitable policies aimed at improving the operational efficiency of banks. Furthermore, efficiency findings serve as a valuable tool for investors, government entities, and policymakers, enabling them to effectively assess bank performance of banks and maintain competitiveness over an extended period.

Owing to these restrictions, this study can be expanded in many ways. First, future research on the efficiency of the Vietnamese banking sector could include an analysis of the production function in conjunction with an intermediation function. Second, the use of nonparametric frontier analysis in this study has the potential to be integrated with the stochastic frontier analysis approach to estimate the frontier. This should serve as evidence for the resilience of the findings when subjected to other estimation methodologies.

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