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The impact of non-traditional activities on the technical efficiency of commercial banks: Evidence from Vietnam

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ABSTRACT

This study investigates the effect of non-traditional activities on the operational efficiency of Vietnamese commercial banks during the period 2016–2024. The data envelopment analysis (DEA) method is used to measure bank efficiency, while fixed effects, random effects, and system generalized method of moments (GMM) models are applied for estimation. The results indicate that non-traditional activities (NTAs) improve bank efficiency. In addition, the lagged value of bank efficiency and the ratio of loans to total assets have a positive influence on efficiency. In contrast, bank size and inflation reduce efficiency. The study does not find evidence of a relationship between return on assets, capital adequacy ratio, and economic growth rate with bank efficiency. These results provide useful insights for commercial banks in developing new non-traditional products and services to enhance operational efficiency.

1. Introduction

In-depth studies have shown that NTAs have an impact on the stability and efficiency of the banking system. Specifically, these NTAs contribute non-interest income to banks' profits and promote banks' operational strategies and risk management. However, scholars still face limitations in examining how changes in NTAs affect the efficiency of banks' operations.

Until now, there have been two perspectives on the impact of NTAs on the bank's technical efficiency. The first perspective suggests that NTAs positively impact the bank's technical efficiency (Gulati and Kumar, 2011; Lozano-Vivas and Pasiouras, 2010; Ahamed, 2017; Gueyié et al., 2019). According to DeYoung and Rice (2004) and Stiroh (2004), combining banking services and increasing the proportion of non-interest income can generate a stable income, optimize management costs, and therefore improve the bank's technical efficiency. On the other hand, some studies, such as Akhigbe and Stevenson (2010), Bian et al. (2015), and Pasiouras (2008), supported the second perspective that NTAs negatively impact a bank's technical efficiency. These studies explain that NTAs may reduce the effectiveness of commercial banks or have an insignificant impact on a bank's technical efficiency. Therefore, the current studies on the impact of NTAs on the bank's technical efficiency have not reached a unified conclusion.

In Vietnam, researchers on banking efficiency focus on measuring different types of banking efficiency and understanding the factors affecting efficiency. More specifically, efficiency measurement studies focus on cost-effectiveness categories such as those of Ngo and Tripe (2017) and Vu and Turnell (2010), studies measuring technical efficiency, scale efficiency, and allocative efficiency, such as Nguyen and Simioni (2015). Most studies use the input-oriented Data Envelopment Analysis (DEA) method with the intermediate approach in selecting input and output to measure efficiency (Noura et al., 2010), except Vu and Turnell (2010) and Ngo and Tripe (2017), who use the SFA method.

The second research direction on bank efficiency in Vietnam is to study the factors affecting bank efficiency. Specifically, the studies of Garrab and Yahyaoui (2025), Do et al. (2022), Minh et al. (2013), Stewart et al. (2016), and Vu and Nahm (2013) explored the internal (banking) and external (macroeconomic, industry) factors affecting the bank's efficiency. Nguyen et al. (2018) examined the impact of management reform in the banking sector on bank performance. Nguyen and Nghiem (2020)

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explored the effect of competition on bank performance. Besides, Le (2018) explored the impact of risk and capitalization on bank performance. Although previous studies have extensively investigated various factors influencing bank efficiency in Vietnam, such as competition, market concentration, risk management, capitalization, bad debts, and banking sector reforms, there remains a notable gap concerning the role of non-traditional activities (NTAs). Specifically, none of these studies has addressed how NTAs affect the performance and technical efficiency of Vietnamese commercial banks. Addressing this gap, this study aims to clarify empirical evidence on the impact of NTAs on the technical efficiency of commercial banks. The contributions of this paper will fill specific gaps in previously published research, such as the following: i) In Vietnam, there has been no research on the influence of NTAs on their technical efficiency during the 2016-2024 period; ii) The most distinct difference compared to prior studies is our examination of the impact on the technical efficiency of each non-traditional banking activity, such as the ratio of service income to total income (SER), the ratio of foreign exchange income to total income (FOREX), and the ratio of securities income to total income (SEC); (iii) Finally, by employing a range of estimation methods to obtain the best estimation results, our research proves more reliable than previous studies. Therefore, the findings in this study create a solid scientific basis for commercial banks to make decisions to implement plans to develop new, non-traditional products and services to promote operational efficiency.

The remaining sections are organized as follows: The second section provides a literature review of NTAs. The third section covers research methods and data. In Section 4, the empirical analysis and discussions are presented. Section 5 concludes with some concluding remarks and policy implications.

2. Literature review

2.1. An empirical study on banking efficiency in Vietnam

In Vietnam, researchers on banking efficiency focus on measuring different types of banking efficiency and understanding the factors affecting efficiency, but have not paid much attention to the impact of NTAs on bank efficiency. More specifically, efficiency measurement studies focus on cost-effectiveness categories such as those of Hung et al. (2018), Ngo and Tripe (2017), and Vu and Turnell (2010), studies measuring technical efficiency, scale efficiency, and allocative efficiency, such as Nguyen and Simioni (2015). Most studies use the input-oriented DEA method with the intermediate approach in selecting input and output to measure efficiency, except Vu and Turnell (2010) and Ngo and Tripe (2017), who used the SFA method.

The second research direction on bank efficiency in Vietnam is to study the factors affecting bank efficiency. Specifically, the study of Minh et al. (2013), Vu and Nahm (2013), and Stewart et al. (2016) explored the internal (banking) and external (macroeconomic, industry) factors affecting the bank's efficiency. Nguyen et al. (2018) explored the impact of management reform in the banking sector on bank performance. Nguyen and Nghiem (2020) explored the impact of competition on bank performance. Besides, Le (2018) explored the impact of risk and capitalization on bank performance.

Therefore, this study will add more empirical evidence as well as a theoretical basis to explain the impact of NTAs on bank performance and simultaneously explore the factors affecting NTAs in commercial banks from 2016 to 2024.

2.2. Non-traditional banking activities and their importance for commercial banks

Rogers and Sinkey (1999) argued that NTAs include all other fee-generating activities of banks, from financing and handling cash to storage services such as asset management, foreign currency exchange, and commercial accounts. DeYoung and Rice (2004) contend that the banking industry has capitalized on deregulation to earn substantial income from NTAs, including investment banking, stockbroking, reinsurance agencies, and mutual funds. Thus, NTAs include various financial services, and developing NTAs will bring many benefits to commercial banks.

First, banking products are services, so they are intangible, unlike tangible goods. Therefore, bank products are easy to imitate, and it is difficult for customers without experience to tell the difference between these banks' products and other banks' products. However, commercial banks can research and launch many products to enrich their portfolio and improve their competitiveness while fully satisfying customers' financial needs. For example, banks can innovate traditional products such as deposit products by increasing differentiation in maturity, denomination, and type. Moreover, they can add non-traditional services to flagship products to meet the increasingly diverse needs of many customers, particularly the application of modern technology to products to improve the security level of transactions. At the same time, the additional services also bring in non-interest income, boosting revenue and increasing the bank's efficiency. Therefore, the expansion of the product mix towards traditional product differentiation and the addition of non-traditional products can be seen as a race to improve efficiency and competitiveness, with no goal of the commercial bank's goal.

Second, expanding online banking allows commercial banks to retain and attract new customers, especially in the current Technology 4.0 era. Advances in information, communication (Internet), smartphone, and Internet of Things (IoT) technologies have created favorable conditions for developing non-traditional banking services while improving the quality of traditional banking services.

Today's customers save a lot of time and effort and are willing to pay an extra fee for that convenience. In banking, many new technological advancements have been applied to internal processes (back office), notably artificial intelligence (advisory bots, contact mailboxes, chat boxes) or electronic devices. Modern banks can process banking transactions anytime, anywhere, which helps banks save on staff costs while ensuring they can respond quickly and quickly to customer needs.

According to Berger (2003), improvements in applied technology in banking - "back office" and the benefits consumers derive from the technology applied to customers in transactions - "front office" contribute to overall productivity as the quality and variety of banking services improve significantly increased services.

Third, the development of online banking has also helped improve the bank's competitive position against current and future competitors. Leading the trend, keeping up with market trends, meeting customer needs promptly, and providing a diversified product portfolio through traditional and non-traditional banking activities will be proactive ways of competing instead of passive reactions, such as offering similar products to competitors.

Passive competition will be so difficult as competitors increase, such as traditional commercial banks, non-bank financial institutions, digital banks, and technology companies. Manufacturing companies like Google, Apple, Samsung, and even motorcycle taxi companies, Grab Technology, or Starbucks Coffee offer services that compete with banks, such as payment services and e-wallets. Therefore, maintaining and expanding a competitive position is the most visible evidence of a bank's efficiency, which indicates an increasing concentration of commercial banking activities and has a significant impact on the efficiency of banks.

Notably, when expanding their online banking business, banks can make full use of input factors to save costs. Fixed costs are distributed equally among each production unit. This advantage stems from two factors: (i) fixed costs will be reduced per customer or unit of product or service when the scale of operations increases; (ii) variable costs are managed and used effectively and economically, which will contribute to reducing average costs in the long term and total costs in the short term. The theory of economies of scale provides a concrete and scientific explanation.

In addition, expanding the business scope to include the field of online banking will require the bank to invest in machinery, equipment, and technological progress. As a result, they can maintain contact with customers and respond to their needs continuously. Moreover, applying modern technology to its operation also helps banks extract and effectively manage cost items while providing products and services that customers can use. Achieve scale returns, make medium and long-term output growth rates higher than or equal to the input growth rate, improve service quality and customer satisfaction, and gradually improve efficiency and competitiveness.

3. Background theory and hypotheses

3.1. Background theory

The theoretical foundation for the need for commercial banks to develop non-traditional banking activities is demonstrated through three theories: the theory of financial intermediation, the modern portfolio theory, and the economies of scale.

The theory of Financial Intermediation was introduced in prestigious journals by such famous researchers as Allen and Santomero (1997) and Gurley and Shaw (1955) have shown that banks are essentially financial intermediaries, not different from non-banking financial institutions, because they both take in deposits and then lend out. Thus, commercial banks can ultimately provide all financial services like other financial intermediaries. In addition, with the distinct advantage of receiving deposits from both individual and institutional customers, banks can ultimately increase operational efficiency if they can provide a variety of financial services associated with the customer's existing deposit accounts and loans.

In the 1950s, Nobel Prize winner Harry M. Markowitz developed the modern portfolio theory, which states that financiers may reduce the risk of the market for a specified level of expected return by constructing a portfolio with a variety of assets. Applying this theory to the banking sector shows that the stronger development of commercial banks is the diversification of the bank's investment portfolio to increase benefits and reduce risks. Diversification in the banking sector has attracted the attention of scholars (Berger et al., 2010; Elsas et al., 2010; Lozano-Vivas and Pasiouras, 2010; Stiroh, 2004).

The theory of economies of scale developed by Panzar and Willig (1977) states that if two or more businesses share some common resources, the total cost of production will decrease, and hence, the total cost of production will increase efficiency. Therefore, when the bank expands into increasing its online banking activities, which is a related field, the bank will be able to use shared resources such as facilities, human resources, information, technology, and skills in risk management, control, and prevention, thereby reducing costs.

In summary, all three theories above have shown that the development of commercial banking activities by commercial banks will bring clear benefits to improve bank efficiency.

3.2. Development of hypotheses

In the face of increasingly fierce competition from non-bank financial institutions, causing interest income to decline, non-interest income is an additional source for commercial banks to maintain

and increase profits. Therefore, when non-interest income increases, bank efficiency increases, and this has been demonstrated by many previous studies, such as Gulati and Kumar (2011), Lozano-Vivas and Pasiouras (2010), Rogers and Sinkey (1999), and Tortosa-Ausina (2003). Our objective is to examine the effect of NTAs on bank technical efficiency. Non-traditional income includes all income from NTAs, such as service income, foreign exchange trading, securities trading, and other activities. Therefore, the first research hypothesis is proposed as follows:

H1: There is a positive relationship between non-interest income and the efficiency of commercial banks.

The size of a bank is an indicator showing the magnitude of all available factors and is used by a bank in the business process to improve efficiency and contribute to increasing the bank's value. The size is often determined based on total equity and total assets criteria, thereby demonstrating commercial banks' strengths or financial potential. According to Mertens and Urga (2001), the average cost curve of the banking industry is a U-shaped curve, so when scaling up, banks can make the most of the benefits based on economies of scale, in particular, such as saving some management costs, having conditions to diversify products and services to provide customers as well as access to more market segments. However, the benefits of economies of scale are easy to see when small and medium commercial banks expand their operations. The economic benefits of scale are not evident in the case of large commercial banks that continue to scale up and develop.

On the contrary, if large commercial banks continue expanding their operation scale beyond an allowable limit, they will incur additional costs due to economic disadvantages, reducing efficiency. In general, the effect of increasing scale efficiency is, to a certain extent, positive, according to Minh et al. (2013), Nguyen and Simioni (2015), Pasiouras (2008), Stewart et al. (2016), Sufian (2009), and Vu and Nahm (2013). Therefore, the research hypothesis is proposed as follows:

H2: There is a positive relationship between bank size and the efficiency of commercial banks.

Equity to Total Asset Ratio (ETA), also known as the Capital Adequacy Ratio, is used as a representation of financial well-being Fries and Taci (2005), Jiang et al. (2009), Kumbhakar and Wang (2007). A higher ratio is associated with a more vital ability to protect a bank against risks that could lead to loss of equity, reducing the risk of bankruptcy. In addition, the larger the bank's equity source, the less external funding will be needed and the lower the cost of capital. When there is a shortage of capital, the less pressure on the bank to pay interest. Therefore, banks with a high equity ratio have lower risks and higher business efficiency. Research by Pasiouras (2008), Bian et al. (2015), Nguyen and Nghiem (2020), and Le (2018) showed a positive correlation between equity / total assets and banking performance. Casu and Molyneux (2003) and Almumani (2013) found no relationship. Vu and Nahm (2013) again showed an inverse relationship. On a theoretical basis and based on previous studies, the author supports the view that a high capital adequacy ratio means lower risks and higher business performance. Therefore, the research hypothesis is proposed as follows:

H3: There is a positive relationship between capital structure and the efficiency of commercial banks.

Return on assets (ROA) is included in the model to represent banks' returns. Customers often prefer banks with higher profit margins, which attract the largest share of deposits and potential borrowers with the best credit. These circumstances create a favorable environment for banks to generate greater profits. A positive relationship between banks' returns and their performance is found in Ariff and Can (2008), Chortareas et al. (2013), Das and Ghosh (2006), Glass et al. (2014), Olson and Zoubi (2011), and Sufian (2009). Therefore, the research hypothesis is proposed as follows:

H4: There is a positive relationship between return on assets (ROA) and the business performance of commercial banks.

The loan-to-total assets ratio (LTA) represents the impact of a loan strategy on bank performance and recognizes differences in a bank's portfolio of assets. Banks with high loan-to-asset ratios indicate that their loan products are better appreciated by customers, perhaps because banks are more efficient, helping reduce production costs and offer reasonable loan terms to help them win large loan market share. Besides, previous research shows that net interest income is a stable source of revenue because clients are less likely to convert loan relationships frequently (DeYoung and Rice, 2004). Research by Casu and Molyneux (2003), Sufian (2009), and Chortareas et al. (2013) results in a positive relationship between the ratio of loans to total assets and bank performance. However, research by Ariff and Can (2008) showed a negative relationship with efficiency because banks that provide more loans are exposed to higher credit risk, especially in banking systems. In underdeveloped services like China, a high lending ratio to assets will increase banking efficiency and reduce risk for banks. The author supports the view that a high loan ratio means high business efficiency based on theoretical and empirical studies. Therefore, in this study, a positive relationship (+ sign) between LTA and banking performance is expected.

H5: There is a positive correlation between the ratio of loans to total assets and the efficiency of commercial banks.

Economic growth (GDP) provides environment-related information about macroeconomics, creating conditions for commercial banks to operate effectively. When the economy grows and develops stably, it will create conditions for actors to expand production and business activities, ensuring the ability to absorb capital and repay the capital of businesses. In such conditions, commercial banks' capital mobilization and lending activities took place smoothly, ensuring the ability to recover capital and bring profits to the bank. GDP growth has a positive impact on banking performance, as found in several studies by Barth et al. (2013), Maudos and de Guevara (2004), and Vu and Nahm (2013). Some studies found no relationship between economic growth and banking performance, such as Sufian (2009) and Nguyen and Nghiem (2020).

On the other hand, Thoraneenitiyan and Avkiran (2009) found a negative correlation between economic growth and business performance. The author believes that high economic growth will create conditions for banks to increase business efficiency based on theory and empirical studies. Therefore, in this study, it is expected that a positive relationship (+ sign) between the variable GDP and business performance will exist.

H6: There is a positive relationship between economic growth (GDP) and the technical efficiency of commercial banks.

The inflation rate (INF) is determined by calculating the percentage change in a price index (CPI). The inflation rate describes the percentage by which the price level changes from period to period. Inflation has direct and indirect effects on banking performance. The direct impact is the bank paying for inputs such as labor and equipment when prices rise, and the indirect effects through interest rates and asset changes. Inflation, whether high or low, indicates an upward trend in goods and services and asset prices when the local currency depreciates. This will damage the commercial banks, the leading lenders in the economy. When inflation is high, the capital mobilization of banks faces many difficulties, leading to competitive races to increase deposit interest rates, making capital mobilization costs increase, and reducing the efficiency of banks. Financial intermediaries will do less lending and less long-run financial activity. Therefore, the inflation rate, a measure of macroeconomic instability, is expected to affect banks' efficiency negatively. Inflation rates have positive effects on banking performance in some studies of Sufian (2009), Lozano-Vivas and Pasiouras (2010), and Vu and Nahm (2013). Research by Hermes and Nhung (2010) found no relationship between inflation and efficiency. Based on theory and empirical studies, the author supports the view that high inflation will hinder banks' business operations and reduce banking efficiency. Therefore, in this study, it is expected that an inverse relationship (the - sign) between the variable INF and banking performance will exist.

H7: There is a negative relationship between the inflation rate and the efficiency of commercial banks.

4. Data and methodology

4.1. Data and sample

The data utilized in this research are sourced from the Bankscope database. Our criteria for sample selection are as follows. Firstly, we concentrate solely on commercial banks to obtain a relatively homogeneous sample. Secondly, we refined the dataset by excluding listed commercial banks with fewer than four consecutive observations. This process reduces our sample size to thirteen commercial institutions. These banks are all listed on the Ho Chi Minh City Stock Exchange and the Hanoi Stock Exchange. According to statistics, by the end of 2024, the total assets of the 13 banks in the study sample accounted for 76% of the total assets of the Vietnamese commercial banking system. Therefore, the results of this group study represent the system of commercial banks in Vietnam. Regarding the period 2016 - 2024, this is when commercial banks in Vietnam revealed their difficulties and weaknesses after the 2008 financial crisis in the US and the COVID-19 pandemic. Hence, they had to change to overcome the difficulties and develop new business strategies to suit the period of economic growth in Vietnam and the general global economy. More specifically, the 2008 financial crisis and the COVID-19 pandemic made the weaknesses of Vietnamese commercial banks more severe and needed to be resolved quickly and decisively. The unresolved bad debts of commercial banks increased rapidly after the crisis. This threatens the safety of the whole system and significantly reduces the competitiveness of domestic commercial banks compared to joint venture banks and 100% foreign banks. The root cause of the bad debt problem is the "credit monoculture" business model and the slow development of NTAs. Recognizing this problem, commercial banks in Vietnam have also gradually developed non-traditional banking activities. However, only a few leading commercial banks have made significant progress. The leading banks have vigorously implemented changes in non-traditional banking activities from 2016 to 2024. Therefore, studying this period will provide more solid empirical literature to bank administrators, financial institution managers, and policymakers.

4.2. Research process

This study applies the procedure proposed by Akhigbe and Stevenson (2010), Bian et al. (2015), and Adesina (2019) to assess the impact of NTAs on the technical efficiency of Vietnamese commercial banks. The research process is shown in Fig. 1.

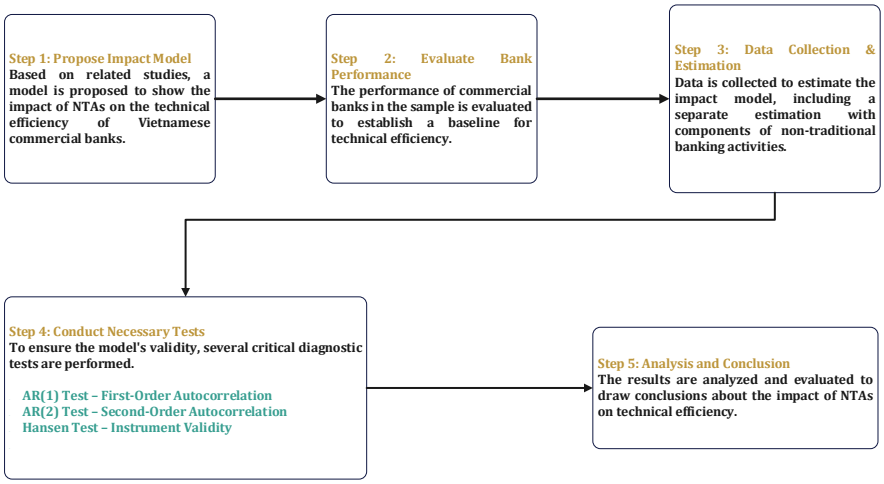

Fig. 1: Research process

- Step 1: Based on related studies, propose a model showing the impact of NTAs on the technical efficiency of Vietnamese commercial banks.
- Step 2: Evaluate the performance of commercial banks in the sample.
- Step 3: Collect data and estimate the impact model of NTAs on the technical efficiency of Vietnamese commercial banks. We also perform a model estimation with components of non-traditional banking activities.
- Step 4: Carry out necessary tests, including first-order autocorrelation (AR1), second-order autocorrelation (AR2), and the Hansen test.
- Step 5: Analyze, evaluate, and draw conclusions about the impact of NTAs on the technical efficiency of Vietnamese commercial banks.

4.3. Measuring bank technical efficiency: DEA approach

The technical efficiency of this bank will be calculated according to the following formula:

$$TE_s = \frac{\sum_{i=1}^{k} u_i y_{is}}{\sum_{j=1}^{h} v_j x_{js}} \quad (1)$$

where, y_{is} is the amount of output i of commercial bank s; x_{js} is the amount of input j used by this bank; u_i, v_j are the weights of the output and input, respectively. The DEA method calculates the TE values for each bank in the research sample annually during the period from 2016 to 2024. To utilize the DEA method, it is necessary to identify inputs and outputs for each bank. In this study, we choose inputs and outputs according to Adesina (2019). Specifically, the inputs include total deposits plus borrowed funds (X1), personnel expenses (X2), and fixed assets (X3). The outputs consist of total loans outstanding (Y1) and off-balance sheet items (Y2).

4.4. Determinants of bank technical efficiency

Based on the developed research hypotheses and relevant studies, we have developed the research model presented below. The rationale for selecting the variables in the model is outlined in Table 1.

$$EFF_{it} = \alpha_0 + \alpha_1 \times EFF_{it-1} + \theta_1 \times NII_{it} + \beta_1 \times SIZE_{it} + \beta_2 \times ETA_{it} + \beta_3 \times LTA_{it} + \beta_4 \times ROA_{it} + \beta_5 \times GDP_t + \beta_6 \times INF_t + u_{it} \quad (2)$$

where, i represents a bank ($i = 1, 2, \dots, 13$), t represents the period (t = 2016, 2017, ….,2024). EFF is the technical efficiency estimated via input-oriented DEA. EFE_{t-1} is the lagged dependent variable of bank technical efficiency. NII is the variable of interest, representing the non-traditional activities of Vietnamese commercial banks. $SIZE$ represents the scale of the bank. ETA is the total equity capital to total assets ratio. LTA is a loan-to-asset ratio. ROA, a return on banks' assets shows how efficiently a bank utilizes its assets. GDP is the annual GDP growth rate. INF is the inflation rate.

Table 1: Description of variables used in the model

Variable	Measurement	Reference
NII_{it}	The variable of interest, representing non-traditional activities of Vietnamese commercial banks	Gulati and Kumar (2011), Lozano-Vivas and Pasiouras (2010), Rogers and Sinkey (1999), and Tortosa-Ausina (2003)
$SIZE_{it}$	The natural logarithm of bank total assets	Minh et al. (2013), Nguyen and Simioni (2015), Pasiouras (2008), Stewart et al. (2016), Sufian (2009), and Vu and Nahm (2013)
ETA_{it}	The total equity capital to total assets ratio	Pasiouras (2008), Bian et al. (2015), Nguyen and Nghiem (2020), and Le (2018)
LTA_{it}	The loan to asset ratio	Casu and Molyneux (2003), Sufian (2009), and Chortareas et al. (2013)
ROA_{it}	The return on banks' assets	Ariff and Can (2008), Chortareas et al. (2013), Das and Ghosh (2006), Glass et al. (2014), Olson and Zoubi (2011), and Sufian (2009)
GDP_{it}	The annual GDP growth rate	Barth et al. (2013), Maudos and de Guevara (2004), and Vu and Nahm (2013)
INF_{it}	The inflation rate	Sufian (2009), Lozano-Vivas and Pasiouras (2010), and Vu and Nahm (2013)

To estimate model (2), we employ the following estimation methods: fixed effects, random effects, and system generalized method of moments (GMM). First, fixed effects and random effects methods are utilized to estimate the model (2). Subsequently, serial correlation and heteroscedasticity tests are applied to ensure that the estimates are reliable. In cases where these phenomena occur, we proceed to use the system GMM method to address them. The system GMM method also addresses the endogeneity issue, which is common in models with economic and financial variables.

5. Findings and discussion

The results of descriptive statistics measuring the specific quantities for the research variables are shown in Table 2. Descriptive statistics provide a summary of the attributes of a given data collection. From 2016 to 2024, the average technical efficiency of private commercial banks is determined to be 94.15%.

The 13 banks had a non-interest income to an average income ratio of 8.97% during this period. In the period 2016 - 2024, bank characteristics include return on assets, total equity capital to total assets ratio, bank loan ratio, and bank size, with an average value of 0.82%, 7.86%, 56.93%, and 19.19, respectively. Macro indicators such as average GDP growth during this period reached 6.55%; the inflation rate is 5.93%. The variables in the model correlate with one another, as shown in Fig. 2, which contains a correlation matrix.

The linear link between two variables can be measured using the correlation coefficient. Based on the findings, the correlation matrix between the variables in the model reveals that most of the correlation coefficients for pairs of independent variables contained within the model are lower than 60%. This suggests that the independent variables in the model do not have a strong correlation with one another. After that, to ensure that the model does not contain multicollinearity, we conduct a test to look for evidence of this phenomenon (Table 3).

Table 2: Descriptive statistics

Variables	Mean	Standard deviation	Minimum values	Maximum values
TE	0.9415	0.0677	0.7423	1.0000
NII	0.0897	0.0529	0.0019	0.2677
ROA	0.0082	0.0083	-0.0551	0.0267
ETA	0.0786	0.0268	0.0406	0.2195
LTA	0.5693	0.1200	0.1473	0.7538
GDP	0.0655	0.0093	0.0525	0.0846
INF	0.0593	0.0504	0.0063	0.1858
SIZE	19.1941	0.9634	16.5316	21.1220

The statistical values presented include the mean, standard deviation, minimum, and maximum values

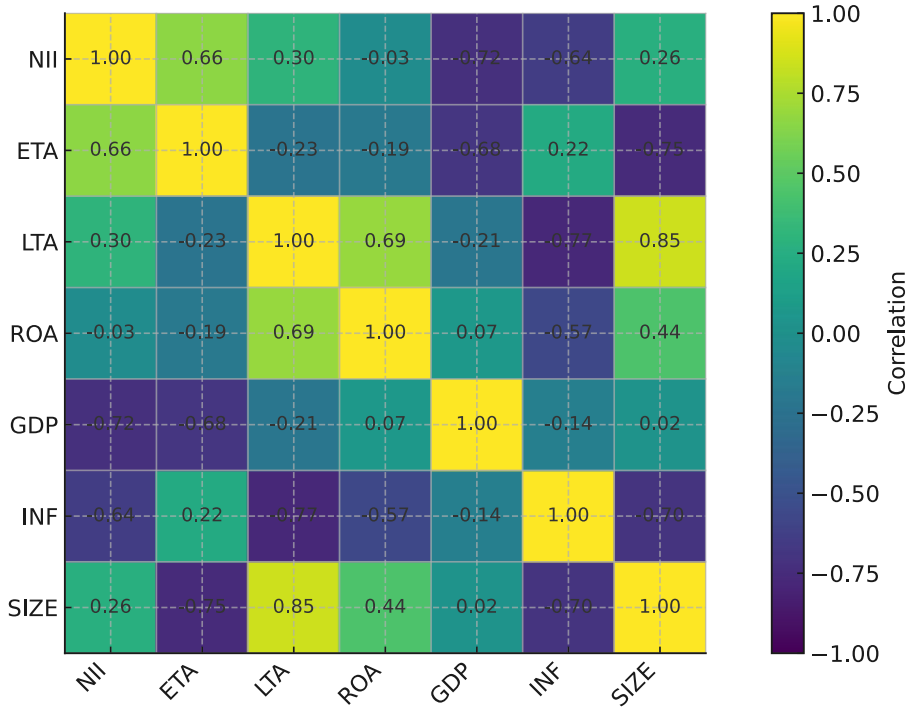

Fig. 2: Correlation matrix

Based on the results of the VIF test using Stata 16 software between the model's independent variables, there is no phenomenon of high multicollinearity among the independent variables. Therefore, we used these variables for regression analysis. The results of estimating the impact model of NTAs on the operational efficiency of banks are presented in Table 4.

Table 3: Variance inflation factor (VIF) test for multicollinearity

Variable	VIF
NII	2.21
ETA	2.40
LTA	2.27
ROA	2.88
SIZE	3.52
GDP	1.43
INF	1.82

The significance level for the Hausman test is set at 10%, however, the p-value for the test is 0.3422, which indicates that the model that was estimated to use the Random Effects Model (REM) is superior to the model that was estimated using the Fixed Effects Model (FEM). However, the model estimated with the REM method exhibits heteroskedasticity and serial correlation. Breusch and Pagan's test has a p-value of 0.0000, which is less than 1% significance level. Therefore, REM is more suitable than OLS.

The estimation results are presented in Table 4, indicating that the p-value of the AR(1) test is below the 10% significance level, while the p-value of the AR(2) test is above this level. Consequently, the model has a correlation in the first order but no correlation in the second order. Simultaneously, the Hansen test of the model shows a p-value greater than the 10% significance level, indicating that the instrumental variables employed in the model are sufficient. Conversely, the p-value of the F-test is less than the 5% significance level, indicating that the model is acceptable. When employing the System Generalized Method of Moments (SGMM), Table 5 illustrates a requirement that must be followed: the count of instrumental variables must not exceed the total count of observed groups. Consequently, the model ensures the reliability of our findings' analysis.

Table 4 shows that the regression coefficients of the variables TE (t-1), NII, LTA, INF, and SIZE are 0.6070, 1.0539, 0.3499, -1.1060, and -0.0671 are all statistically significant at 10%. Thus, TE (t-1), LTA, and NII all have positive effects on TE, while INF, SIZE have a negative impact on TE. More specifically, the performance of the previous year, the bank loan ratio, and non-interest income positively impact the efficiency of banking operations, while the inflation rate and bank size will have adverse effects on bank efficiency.

Table 4: Estimation results of the impact of non-traditional banking activities on performance

TE	Model (1)	Model (2)	Model (3)
TE(t-1)			0.6070**
NII	-0.02292	0.0088	1.0539**
ETA	0.5309*	0.4887*	-0.0592
ROA	0.7325	0.8476	-0.3832
LTA	-0.1411*	-0.1694**	0.3499*
GDP	-0.5702	-0.5244	-1.9461
INF	-0.0151	-0.0456	-1.1060*
SIZE	0.0326*	0.0305**	-0.0671*
_CONS	0.3888	0.4438	1.5317
Breusch and Pagan Lagrangian multiplier p-value	0.0000		
Wooldridge p-value	0.0967		
Hausman p-value	0.3422		
AR (1) p-value			0.043
AR (2) p-value			0.497
Hansen p-value			0.969
Number of groups			13
Number of instruments			10
Second stage F-test p-value			0.000

This table summarizes regression results: $EFF_{it} = \alpha_0 + \alpha_1 EFE_{it-1} + \Theta_1 NII_{it} + \beta_1 SIZE_{it} + \beta_2 ETA_{it} + \beta_3 LTA_{it} + \beta_4 ROA_{it} + \beta_5 GDP_{it} + \beta_6 INF_{it} + u_{it}$; In column 2, the results are based on fixed effects; In column 3, the results are from random effects; Column 4 shows the results from the two-step system GMM estimator; The dependent variables are TE(t-1), ROA, LTA, ETA, SIZE, GDP, INF; ***, **, *: Statistical significance levels of 1%, 5%, 10%

The regression coefficient of the variable NII is 1.0539, which is positive and statistically significant at 5%. Thus, non-interest income positively impacts the bank's operational efficiency. At the same time, when non-interest income increases by 1%, the bank's efficiency will increase by 1.0539%. Thus, hypothesis H1 is supported. This study result is consistent with the study of Akhigbe and Stevenson (2010) and like the initial expectation of the study. This result shows that when banks increase their operations, non-interest banks will bring a source of non-interest income, increasing the bank's total income, so that the banking efficiency will increase. This can be explained entirely because, along with the rapid development of information and communication technology and the 4.0 revolution, it has created favorable conditions for the NHRI to upgrade and apply public science innovations. Thus, technology can provide more banking products and services. Specifically, Vietnam SOCBs have used e-banking solutions to transfer money via social networks and withdraw money by testing digital banking services and transforming the business model towards modernization and digitalization. Money at ATMs without using cards, electronic banking applications, and data analysis technology (VPBank). Alternatively, some banks have tried to present digital business models such as digital technology transaction space Digital Lab (Vietcombank); Project of Timo Digital Banking (VPBank); TPBank's LiveBank automatic banking service, E-Zone modern electronic banking experience zone (BIDV); multiplexing platform (Omni Chanel -OCB). This study also shows that the case of the development of CPB activities of Vietnam SOCBs is consistent with modern portfolio

diversification theory and economic benefit theory by scale.

The lagged independent variable of bank efficiency positively impacts the banking efficiency at the 5% level. This means that the effect of a bank impacts each other and a positive correlation between periods. This can be explained because the banking business takes place continuously; the business results of this period will depend on the business results of the previous period.

The regression coefficient of LTA is 0.3499, which is positive and statistically significant at the 10% level. Thus, the bank's lending rate positively impacts bank efficiency, particularly when the bank's lending rate increases by 1%, the bank's efficiency will increase by 0.3499%. Therefore, hypothesis H5 is supported. This result is consistent with the research of Sufian (2009). In the context of Vietnam, the SOCBs are banks with good business results, reputable and well-trained staff, so they can attract more customers to use the loan products. Moreover, when banks increase lending, customers will attract more new customers and retain old customers that already have credit relationships with the bank, and help cross-sell products and services. Therefore, it is possible to increase non-traditional operations, increase interest income, and reduce costs, leading to increased efficiency. This result is consistent with the theory of economies of scale.

The regression coefficient of INF is -1.1060, a negative value and statistically significant at the 10% level. Thus, inflation has a negative impact on the bank's operational efficiency, particularly when inflation increases by 1%, bank efficiency decreases by 1.106%. Therefore, hypothesis H7 is supported. This result is consistent with the results of previous studies of Lozano-Vivas and Pasiouras (2010), Hermes and Nhung (2010), Vu and Nahm (2013), and like the initial expectation of the study. When inflation occurs, it will significantly impact people's lives. With a developing economy like Vietnam, the average income of the people is low. With anxiety, people will convert their reserves, such as savings, to safer assets such as gold, strong foreign currencies, so mobilized capital, and cheap capital of banks will decrease. Banks must find other sources of capital at higher prices to meet the borrowing needs during the difficult times of the economy. This increases the bank's operating costs. In addition, due to inflation, the bank's borrowers also fell into difficulties, so there is a risk of not paying their debts on time, making interest income decline. Because of these two factors, in Vietnam, commercial banks, inflation has reduced the bank's efficiency.

However, for the SIZE factor, the results of this study are different from previous studies such as Minh et al. (2013), Nguyen and Simioni (2015), Pasiouras (2008), Stewart et al. (2016), Sufian (2009), and Vu and Nahm (2013) when it was pointed out that the size of the bank would have a negative impact on banking performance. With the coefficient -0.0671, when the bank size increases by 1%, it will decrease banking efficiency by 0.0671%. Therefore, hypothesis H2 is not supported. This can be explained by the fact that commercial banks only take advantage of the economic advantages due to the expansion of the operation scale within a permitted limit, associated with each bank's specific characteristics and conditions in each period of economic development. Therefore, when expanding their operations, not all banks can save costs and improve and improve efficiency. According to economic theory, thanks to the scale, increasing scale will help banks reduce costs if they take advantage of input resources. However, in Vietnam, the SOCBs in the research period have constantly expanded their operation scale, but maybe because they have not attracted the necessary number of customers or have not exploited the input resources, which makes the average costs per customer increase, not decrease. In addition, the expansion of the product scale is still focusing on traditional activities, as credit also increases costs, especially human costs. Moreover, this has resulted in increased scale has had a negative impact on banking performance.

According to our research findings, hypotheses H3, H4, and H6 are not supported. Specifically, the ratio of equity to total assets (ETA), return on assets (ROA), and economic growth (GDP) do not have a significant impact on bank technical efficiency. The actual operations of commercial banks in Vietnam during the 2016 - 2024 period indicate that the equity to total assets ratio is not a decisive factor in bank operational efficiency. More specifically, banks with small amounts of equity, such as HDB, TPB, MBB, and VPB, have good operational efficiency due to the efficient allocation of resources by their leadership. Additionally, banks are reducing their reliance on income from lending. Therefore, the return on assets ratio does not have a statistically significant impact on bank technical efficiency. Finally, the technical efficiency of Vietnamese banks is more affected by the input resource allocation capability of their leadership than by external macroeconomic factors.

To take a closer look at the impact of NTAs on bank performance, we continue to regress each component of non-interest income, the representative variable of non-traditional banking activities. The estimated results of the models are presented in Table 5.

As seen in Table 5, the SGMM model estimates show first-order residual autocorrelation but not second-order. Hansen tests indicate that model instrumental variables are appropriate. The F-test shows the models are suitable, and the number of instrumental variables is less than the observed groups. Thus, all models guarantee reliability.

Table 5 shows that the coefficient of SER is 1.8923, which has a positive value and is statistically significant at the 10% level. Thus, the service income to total income (SER) ratio positively impacts the bank's performance. This result is consistent with the study of Akhigbe and Stevenson (2010). Specifically, when the income ratio from services

increases by 1%, the bank's operational efficiency will increase by 1.8923%.

The results show that non-credit services such as payment services, treasury, trust and agency, consulting, business and insurance services, discounting, asset preservation, rental of safes, and other revenues (currency brokerage and other services) are non-traditional banking activities that bring high non-interest income for state-owned commercial banks. In fact, from 2016 to 2024, state-owned commercial banks and Vietnamese commercial banks, in general, have made significant changes in the payment services segment with the implementation of e-banking activities.

Table 5: Model estimation results of the impact of components of non-interest income on bank performance

TE	SER			FOREX			SEC		
	FEM	REM	SGMM	FEM	REM	SGMM	FEM	REM	SGMM
TE(t-1)			0.4894**			0.3659*			0.8097**
ETA	0.4286	0.4214*	2.1335***	0.3972	0.4576*	0.0541	0.3706	0.3902	0.1890
ROA	1.1655	1.5004**	-5.7414	1.3592*	1.2161*	-1.1195	2.2990**	1.9741**	-5.5979
LTA	-0.1123	-0.1480**	-0.0182	-0.12713*	-0.1572**	-0.4463	-0.1344*	-0.1765**	-0.2411
GDP	-0.5088	-0.4011	-1.8290	-0.2253	-0.3702	2.9042	-0.9852	-0.7601	1.2021
INF	-0.0241	-0.0795	-0.7810*	-0.1907	-0.1452	0.2769	-0.0397	-0.0882	-1.2110*
SIZE	0.0325*	0.0331***	0.0223	0.0199	0.0289**	0.0283	0.0288	0.0276**	0.0377*
SER	-0.4902	-0.6741**	1.8923*						
FOREX				-1.0096***	-0.8288***	0.6889**			
SEC							-0.5615**	-0.3919*	3.0054*
_CONS	0.3904	0.3983	0.0388	0.6222	0.4693	0.1209	0.4879	0.5234	-0.4458
Breusch and Pagan Lagrangian multiplier p-value	0.0000			0.0000			0.0000		
Wooldridge p-value	0.1176			0.2208			0.1256		
Hausman p-value	0.9999			0.9473			0.9999		
AR (1) p-value			0.019			0.008			0.064
AR (2) p-value			0.275			0.241			0.875
Hansen p-value			0.549			0.334			0.144
Number of groups			13			13			13
Number of instruments			13			13			11
Second stage F-test p-value			0.000			0.000			0.000

***, **, *: Statistical significance levels of 1%, 5%, 10%

In addition, banks also cooperate with insurance companies with strategic cooperation contracts to distribute life insurance products that help bring in sizeable non-interest income. Specifically, SCB, SHB, and HDB signed an exclusive distribution contract with Dai-ichi Life VN. CTG, TCB, SCB, and TPBank are also cooperating with Manulife Vietnam. VPB, ACB signed with AIA. They are generally signed with EIB. NCB signed with Prévoir. FWD signed with VCB.

MBB, in collaboration with Ageas Insurance Group (AGEAS) of the Kingdom of Belgium and Muang Thai Life Insurance Company Limited (MTL) of Thailand, officially signed a joint venture contract to establish a new life insurance company in Vietnam. Moreover, BIDV entered a joint venture with MetLife USA Co., Ltd to establish BIDV MetLife Insurance Company.

Thus, payment services, business, and insurance services are the commercial banks' activities that bring high non-interest income for Vietnam's state-owned commercial banks.

Besides, the estimated results in Table 5 show that the coefficient of FOREX is 0.6889 with a positive value and statistical significance at 5%. Thus, the ratio of income from forex trading to total income (FOREX) positively affects the performance of a particular bank. The bank's operating results will increase by 0.69%. This result is consistent with the study of Akhigbe and Stevenson (2010). This result also shows that Vietnamese state-owned commercial banks need to pay more attention to foreign exchange business to increase non-interest income from this activity further.

For the SEC variable, the estimated results in Table 5 show that the coefficient of SEC is 3.0054, which has a positive value and is statistically significant at 10%. Thus, the ratio of income from securities trading to total income (SEC) positively impacts the bank's performance. When the ratio of income from securities trading increases by 1%, the efficiency of securities trading increases by 1%. The bank's operating results will increase by 3.0054%. This result is consistent with the study of Akhigbe and Stevenson (2010). This result shows that income from securities trading and trading has been a non-traditional banking activity that has contributed a great deal of non-interest income, helping to increase efficiency for state-owned commercial banks during the period 2016 – 2024. This result is due to the increasingly stable development of Vietnam's stock market. The appearance of more stocks of large, reputable enterprises with good business performance has attracted the attention of many domestic and foreign investors. Of course, it is impossible not to mention the appearance of these banks on the two official stock exchanges, HOSE and HNX. In the future, when all Vietnamese commercial banks must officially list all of them according to the regulations of the State Bank, this will probably still be a non-traditional banking activity that brings high

non-interest income to the family and then increase the efficiency of banks.

6. Conclusion

This study aims to evaluate the impact of NTAs on the technical efficiency of commercial banks in Vietnam. The summary of the impact results is visualized in Fig. 3. In this study, we provide an overview of financial intermediation theory, portfolio diversification theory, modern investment theory, and scale economies theory.

The model is built based on previous studies. In addition to presenting theoretical foundations, we also provide a review of domestic and foreign research related to the impact of NTAs on bank efficiency. Based on the results of previous studies, we use the DEA method to measure the technical efficiency of commercial banks in Vietnam. Then, technical efficiency is used as a dependent variable in the model to evaluate the impact of NTAs on the efficiency of banking operations in commercial banks in Vietnam. Then, we use panel data and a two-step SGMM method to estimate the model.

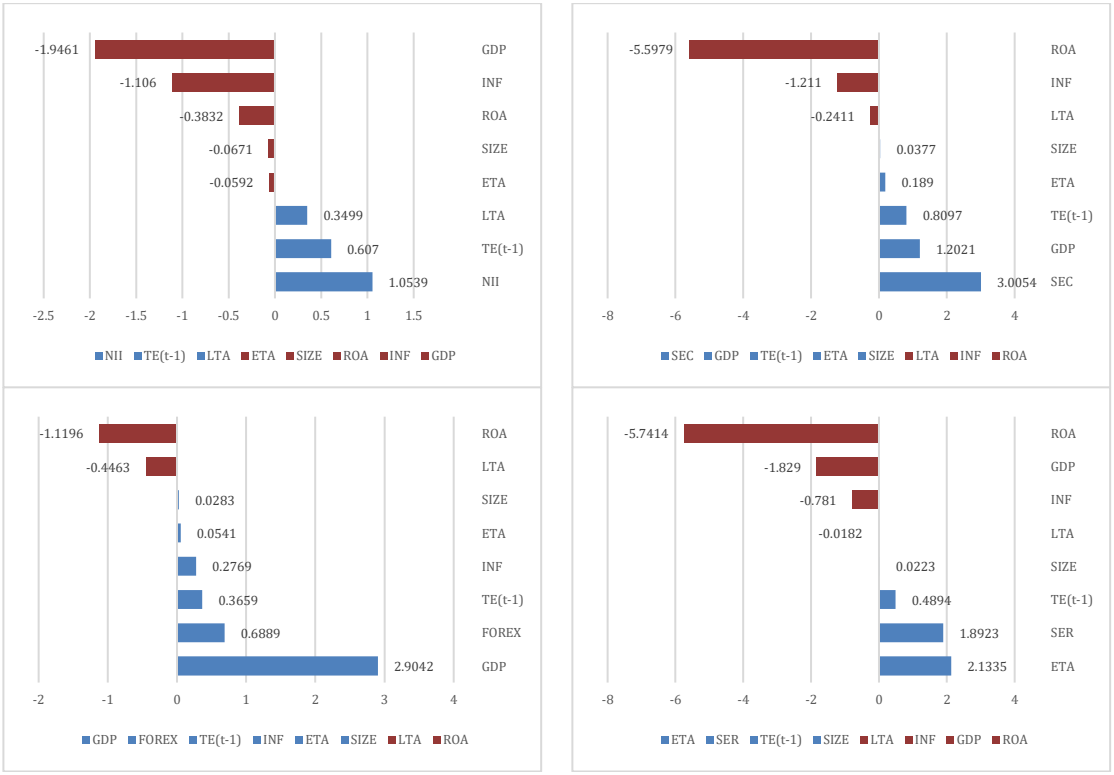

Fig. 3: Visualization of the impact of NII, SEC, FOREX, and SER on TE

The estimation results show that NTAs positively affect the bank efficiency of State-owned banks in Vietnam in the period 2016 - 2024. This is consistent with modern portfolio theory and the research results of Akhigbe and Stevenson (2010). When the bank develops activities, the NTAs will bring a variety of products and services, which will bring a source of non-interest income to increase profits and thus increase the technical efficiency of the bank. In addition, the study results also show that the bank efficiency of the previous year, the ratio of loans to total assets, has a positive impact on banking performance, while inflation and scale have negative effects on bank efficiency.

The study has not found a relationship between the variables of return on assets, capital adequacy ratio, and economic growth rate with bank efficiency. For variables belonging to internal factors of banks, the customer loan ratio has a positive impact, while bank size has a negative impact on bank efficiency. For external environmental variables, the inflation rate has a negative impact on bank efficiency.

These findings create a solid scientific basis for commercial banks to make decisions to implement plans to develop new, non-traditional products and services to promote operational efficiency. Specifically, based on the research findings presented above, the policy implications suggested by the author include:

1. Promoting the development of NTAs by diversifying products and services to increase the effectiveness of banks. Banks need to implement strategies to diversify their product and service offerings, focusing on each group of non-traditional banking activities, including non-credit services, securities trading, foreign exchange trading, and other activities that banks are legally permitted to undertake.
2. Improving the quality of traditional banking operations is also an issue that banks need to focus on. The quality of traditional banking operations, especially lending and credit activities, needs to be continuously improved because research results

show that increasing the lending ratio also increases the effectiveness of banks.

3. In addition, banks need to develop a diversified distribution channel system. Banks need to continue to develop their branch network systems together with various forms of transactions and diversified channels for distributing banking products and services. Increasing the number of branches and transaction points will increase non-interest income and, as a result, increase the effectiveness of banks.

Although the research objective has been achieved, this study is still limited and needs to be expanded and improved in the future. Firstly, this study only measures non-traditional banking through the non-interest income ratio. In the future, follow-up studies need to use both measures to compare, analyze, and evaluate NTAs more fully on NTAs. Second, for banking efficiency, it is possible to measure various types of efficiency, such as cost-effectiveness, profitability, and alternative profitability, but this study only measures the technical efficiency. Therefore, the following research direction is to measure banking efficiency through cost-effectiveness, profitability, and alternative profitability to have a more comprehensive study of the impact of NTAs on banking efficiency. Third, many internal and external factors can affect banking performance and credit card operations, but in this study, the author cannot consider all. Lastly, the data of this study of limited years have been taken due to the time constraint, and only state-owned banks in Vietnam. Therefore, future studies may broaden the impact factors as well as learn more about the factors that have been considered in this study but have not found an impact on efficiency (return on financial assets). assets, capital adequacy ratio, and economic growth) as well as factors that are not found to impact PBB operations (marginal interest income and deposit ratio).

List of abbreviations

AR(1)	First-order autocorrelation
AR(2)	Second-order autocorrelation
CPI	Consumer price index
DEA	Data envelopment analysis
ETA	Equity to total assets ratio
FEM	Fixed effects model
FOREX	Ratio of foreign exchange income to total income
GDP	Gross domestic product
GMM	Generalized method of moments
INF	Inflation rate
IoT	Internet of Things
LTA	Loan to total assets ratio
NII	Non-interest income
NTAs	Non-traditional activities
REM	Random effects model
ROA	Return on assets
SEC	Ratio of securities income to total income
SER	Ratio of service income to total income
SGMM	System generalized method of moments
SFA	Stochastic frontier analysis
TE	Technical efficiency
VIF	Variance inflation factor

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Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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