Southeast Asian Journal of Economics Vol.12(3), December 2024: 37-70
Received: August 15, 2023
Revision: September 25, 2023
Accepted:January 8, 2024

Diversification Strategy and Bank Efficiency of Vietnamese Commercial Banks: Does Foreign Ownership and Bank Experience Matter?

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Abstract

This study aims to investigate the impact of diversification strategies on the efficiency of Vietnamese commercial banks from 2012 to 2022. It further explores the moderating roles of foreign ownership and bank experience in the nexus between diversification and efficiency. The study examines three dimensions of diversification strategy: asset diversification, income diversification, and funding diversification. The impact of diversification strategies varies depending on foreign ownership and bank age. The findings reveal that asset and funding diversification negatively impact bank efficiency. Additionally, both foreign ownership structure and bank age significantly influence bank efficiency. A comparison of foreign and domestic banks reveals that foreign-owned banks outperform their domestic counterparts. Surprisingly, even asset and funding-diversified domestic or foreign banks fail to improve bank efficiency, while large banks can mitigate the adverse effects of these strategies. These findings hold implications for researchers, policymakers, and bank managers in formulating more appropriate diversification strategies to ensure the stability of the entire banking system.

Keywords: bank efficiency, ownership structure, income diversification, asset diversification, funding diversification.

1. Introduction

Throughout the last decades, in response to changing competitive environments, consolidation, deregulation, and the innovation of managerial skills and technology, the Vietnamese banking system has experienced several major restructurings and changes. The Vietnamese banking system was transformed from a mono to a two-tier banking system in 1986, with the State Bank of Vietnam as the central bank (tier 1) and four specialized state-owned banks (tier 2). State-owned commercial banks have an advantage over their rivals in the banking services market thanks to extensive networks in practically all provinces and major cities. Currently, the largest four banks, the "big four," i.e., BIDV, Vietcombank, Agribank, and VietinBank, have gained more than 40% of the credit market share in the nation's banking sector, but over time, notably, these institutions have been a major factor in supporting the economy to get through the COVID-19 pandemic and other challenges.

State-owned banks always take the lead in implementing incentive policies of the central bank, such as lowering interest rates and profits to support businesses, but they are facing difficulties in terms of capital. Although the number of joint stock commercial banks expanded significantly (there are 31 in 2023), state-owned commercial banks continue to hold the top spots in the market. State-owned commercial banks were originally State Bank of Vietnam units with specified lending programs to state-owned enterprises based on government policies. Non-state-owned commercial banks diversified their type, consisting of joint stock commercial banks, branches of foreign banks, joint venture commercial banks, and foreign commercial banks. Unlike state-owned commercial banks, several joint-stock commercial banks are relatively young and experienced at the high competition level in this industry.

Vietnamese commercial banks compete not only with domestic banks but also with foreign banks when the regulations allow them to establish wholly foreign-owned banks with 100% foreign capital. The establishment of HSBC and Standard Chartered in 2008 is an important milestone that marked this trend. Because of increased competition, the marginal income from traditional banking operations (deposits and loans) is shrinking and shifting to non-traditional activities such as fee income, trading income, and service charges (Williams, 2016). As a result, commercial banks tend to implement diversification strategies to seek out new and flexible opportunities. Competition among commercial banks in Vietnam has also increased as the number of banks has increased dramatically, and banks' activities have shifted significantly to non-traditional sectors in recent decades. It is believed that the Vietnamese banking system will be an interesting case study for an investigation of the diversification–efficiency nexus.

Based on the literature, researchers have developed broad perspectives on whether banks should specialize instead of diversifying their assets, funding sources, and income sources (Berger et al., 2010). One of the most obvious reasons why diversification is beneficial to the banking business is that it provides the advantage of economies of scope, such as creating long-term customer relationships (Diamond, 1991; Rajan, 1992; Stein, 2002; Meslier et al., 2016), boosting profitability (DeYoung & Roland, 2001; Chiorazzo et al., 2008), lowering operating expenses (Drucker & Puri, 2009), reducing the risk by diversifying products and geographical regions (Goetz et al., 2016; Hunjra et al., 2021), and having greater capabilities to extend competitive advantages when entering new markets (Amidu et al., 2013). Eventually, as banks have grown, banks will see diversification as an improvement of professional skills

that can let them take advantage of potential chances to increase shareholder value.

Another body of literature argues that while diversification is important for a bank's efficiency, non-traditional activities are inherently unstable, and diversification may make banks more vulnerable. Notably, DeYoung and Roland (2001) conclude that a shift toward non-interest income is associated with increased leverage and income volatility, potentially increasing the volatility of bank earnings. Similarly, Acharya et al. (2006a) discovered that loan portfolio diversification in the Italian banking sector increases risk rather than being associated with improved performance. According to Stiroh and Rumble (2006), diversification benefits are offset by increased exposure to non-interest income businesses, which increases the volatility of equity market returns. Goddard et al. (2008) discovered a negative relationship between diversification and unadjusted and risk-adjusted profitability in a sample of small US credit unions.

The diversification–efficiency nexus has been the subject of previous research in developed countries, but understanding this relationship in transition countries has received less attention. Only a small number of recent studies (Duho et al., 2020; M. Nguyen et al., 2012; Sanya & Wolfe, 2011) concentrate on emerging countries, and these studies provide contradictory results. This study contributes to the literature in several ways:

This study is, to the best of our knowledge, the first to examine the impact of asset, fund, and income diversification on Vietnamese commercial banks' efficiency. While there are many studies investigating the impact of income diversification on the performance of commercial banks (Adesina, 2021; Harimaya & Ozaki, 2021; Alhassan, 2015; Elyasiani & Wang, 2012a; Lee et al., 2014a), there are few studies that provide a comprehensive view of

three aspects of diversification strategies and make an in-depth analysis of asset, fund, and income diversification. The findings of this study, however, reveal the opposite; therefore, this study contributes to the research stream by examining the efficiency and its determinants of Vietnamese commercial banks.

Second, most studies in the banking literature use traditional financial ratios to assess bank performance, such as return on asset (ROA) and return on equity (ROE). The broad range of performance-related themes yielded a high level of diversity in the stream of banking research literature (Bonin et al., 2005; Liang et al., 2013; Berger & Bouwman, 2013; Lee et al., 2014; Bukair & Rahman, 2015; Talavera et al., 2018). Because of the complicated operating environment of the banking system, applying this measurement may reflect a part of the organization's activities. In this study, the frontier approach was used to measure bank efficiency, as it allows us to overcome this problem by handling different types of input and output together. This study focuses on measuring bank efficiency using a non-parametric frontier technique, i.e., data envelopment analysis (DEA). According to Fethi and Pasiouras (2010), out of the 179 research studies that employ DEA techniques to estimate various measures of bank efficiency and productivity growth, DEA is the most commonly used method to evaluate bank efficiency, with 136 studies using this method. More than 170 publications integrating DEA and banks are available in the Web of Science database (Avkiran, 2011). The findings obtained from this study contribute to understanding the evolution of bank efficiency in Vietnam and provide insights into the overall efficiency trends in the banking field. This is one of the initial studies that applied the DEA method on the bank efficiency in Vietnam over the period 2012–2022.

Third, an investigation was undertaken on the impact of diversification strategies on commercial bank efficiency in the Vietnamese banking system

from 2012 to 2022. It then offers additional analysis to investigate if the relationship between diversity and efficiency is dependent on bank expertise and ownership structure. Doan et al. (2018) highlight the significance of ownership structure in emerging market banking activities. The authors examined the relationship between income diversification and bank efficiency across 83 countries from 2003 to 2012 and discovered that while foreign-owned banks are less efficient in developed countries, increased foreign ownership improves diversification benefits in developing countries following the financial crisis. In a transition country, state-owned commercial banks are expected to receive more government incentives, e.g., government backing in terms of regulations and economies of scale, leading them to engage in riskier activities or have more "room" to operate in specific business activities. As a result, it is reasonable to expect that different forms of ownership will impact the relationship between diversification and efficiency. Based on the diversified ownership structure of the Vietnamese banking system, it is believed that ownership structure affects the relationship between diversification and bank efficiency.

The remainder of the paper is structured as follows. The research hypotheses are outlined in Section 2, along with a brief discussion of the prior literature review. In Section 3, the data and research methodology are presented, especially focusing on bank diversification and measuring efficiency. Section 4 provides empirical results and discussions. Discussions and empirical findings are presented in Section 4. Finally, an overview of the main findings and conclusions are offered in Section 5.

2. Literature Review and Hypothesis Development

2.1 Asset diversification

Most banks choose asset diversification as the top priority because assets are considered an integral part of banks. The results on the impact of asset diversification on bank returns and risk are also inconsistent. Using the sample of large Austrian commercial banks from the period 1997–2003, Rossi et al. (2009) found that while asset diversification decreases cost efficiency, it boosts profit efficiency and lowers bank risk. It appears that diversity boosts banks' capitalization. Moreover, asset diversification is shown to be positively correlated with the technical effectiveness of foreign banks operating in financial centers (Curi & Lozano-Vivas, 2013). According to several studies (Diamond, 1991; Rajan, 1992; Saunders & Walter, 1994; Stein, 2002), when granting loans, banks acquire information about their clients that they can use to effectively offer other financial services, such as securities underwriting. The same is true for operations like underwriting for securities and insurance, brokerage and mutual fund services, and other activities that could produce data that is useful for lending decisions. Therefore, banks that engage in a variety of operations may benefit from the scope of economies that boost performance and market values. Laeven and Levine (2007) studied 43 countries and observed that asset diversification has a positive impact on bank performance. Saunders et al. (2014) also studied US banks and suggested that diversification would lead to higher profits and a lower risk of bankruptcy. Harimaya and Ozaki (2021) studied a sample of Shinkin Banks, a representative cooperative financial institution in Japan. Shinkin banks need to change their current portfolios, which are heavily weighted toward mortgage loans and the real estate industry, as the findings support the notion that loan portfolio concentrations lead to increased inefficiencies.

Numerous empirical studies have also demonstrated that commercial banks' profitability is negatively impacted by the diversity of their sources of income, which also raises risk. Diversification of revenue-generating industries raises risk and lowers commercial banks' profitability, as several empirical studies have also demonstrated (Klein & Saidenberg, 2000). The bank must deal with more competitive pressure from new areas as a result of its activities' diversification (Winton, 1999). Additionally, because the bank must recruit more staff to handle newly emerging business divisions, diversification raises agency costs in operations (Deng & Elyasiani, 2008). Specifically, Acharya et al. (2006b) discovered a positive correlation between the rise in non-interest income as a percentage of total income and the fall in commercial banks' profitability. The authors of the study contend that diversification of activities weakens the bank's capacity to oversee and manage loan items, which leads to loan items that are not guaranteed in quality and reduced profitability. Using the sample of European commercial banks from 1996 to 2002, Lepetit et al. (2008) found that commercial banks with high credit risk tend to increase the implementation of products and services outside of traditional lending activities. Using the sample of Bank Holding Companies (BHCs) from 1997–2007, Elyasiani & Wang (2012) applied DEA to calculate the total factor productivity. The authors presented the opposite findings: The degree of diversification is negatively connected with changes in technical efficiency but not with changes in total factor productivity. Adesina (2021) used a sample of 400 commercial banks that operated in 34 African nations between 2005 and 2015 and found that greater diversity lowers bank performance, whereas better levels of human capital efficiency are positively associated with bank performance. Meanwhile, Baele et al. (2007) argue that asset diversification does not significantly affect value in the long run. The same opinion is shared

by Edirisuriya et al. (2015), who argue that asset diversification does not raise the value of banks. Acharya et al. (2006) find no evidence that a more diverse loan portfolio is related to a greater rate of return or less risk.

Hypothesis H_{1a}: Asset diversification has a positive effect on bank efficiency.

Hypothesis H_{1b}: Asset diversification has a negative effect on bank efficiency.

2.2 Income diversification

The majority of studies in the literature demonstrated a positive relationship between income diversification and bank performance across different nations, such as in Italy (Chiorazzo et al., 2008), the US (Saunders et al., 2016), Malaysia (Brahmana et al., 2018), Turkey (Buyuran & Ekşi, 2020), and China (Liang et al., 2020). Notably, by using a global sample of commercial banks, Doumpos et al. (2016) stated that in comparison to banks in rich economies, banks operating in less developed nations may gain more from income diversification. They made this claim based on a global sample of commercial banks. The findings suggest that revenue and earning asset diversification may mitigate the financial crisis's detrimental effects on a bank's financial soundness.

Moreover, the empirical results of the prior authors varied with different ownership structures and sizes. According to Chiorazzo et al. (2008), income diversity boosts risk-adjusted returns. They offered evidence that was consistent with recent studies on EU banks but did not support conclusions about the US experience. They see the differences primarily in terms of the size of domestic banks, where the relationship is stronger at large banks.

Additionally, they discovered that the benefits of diversity are constrained as institutions get bigger. Only when small banks have a very small non-interest income share is the volume of non-interest income more crucial

than its source. Doan et al. (2018) also found a positive relationship between income diversification and bank efficiency across 83 countries over the period 2003-2012, but the benefits of diversification also led to risky non-interest activities.

Hypothesis H_2: Income diversification has a positive effect on bank efficiency.

2.3 Funding diversification

Regarding the significance of bank diversification, while a large body of literature focuses on asset and income diversification aspects, few papers have extended the funding diversification classification. By using an international sample of 1,334 banks from 101 countries leading up to the 2007 financial crisis, Demirgüç-Kunt & Huizinga (2010) found that although it can offer some risk reduction at typically observed low levels of non-deposit funding, wholesale non-deposit funding reduces the rate of return on assets. However, a sizable number of banks attract the majority of their short-term funding in the form of non-deposits, which leads to an increase in bank fragility. Additionally, Nguyen (2018) used the sample of 272 Shinkin banks from 2007 to 2014 and found that funding diversification significantly improves both residual and overall profit efficiency. Long- and short-term profit efficiency is higher for banks with higher funding diversification. Furthermore, the author concluded that funding-diversified banks owned mostly by the government had greater cost efficiency but lower profit efficiency than other banks. Lastly, foreign banks were found to be less profit-efficient due to both funding and asset diversification.

Hypothesis H_3: Funding diversification has a positive effect on bank efficiency in Vietnam

3. Data and research methodology

3.1 Data

The quarterly dataset in this study covers 35 Vietnamese commercial banks over the period from 2012 to 2022, with 1356 observations for Q1/2012–Q2/2022. The financial information of each bank was obtained from banks' annual reports, financial reports, and websites from the State Bank of Vietnam. The bank-year observations that reported insufficient information over the entire period of 2012-2022 were then excluded.

3.2 Research Methodology

3.2.1 Diversification measurement

A modified Herfindahl-Hirschman Index (HHI) was employed, which is assessed by diversification of assets, diversification of funding, and diversification of income (Curi et al., 2015; Elsas et al., 2010). The diversification index is calculated by 1 minus HHI; the more degree of diversification, the more the diversification index increases.

Asset diversification (*ADIV*) includes customer loans (*LOAN*), interbank loans (*INTERBANKLOAN*), securities (*CKKD* + *CKDT*) such as trading securities (*CKKD*) and investment securities (*CKDT*), other assets (*DERA* + *LINVEST*) such as derivatives, and other financial assets (*DERA*) and long-term investment (*LINVEST*), where the sum of the six numerators is *EA*. As a consequence, *i* represents the bank, *t* represents time, and Equation (1) is used to generate the asset diversification index:

$$ADIV_{i,t} = 1 - [(\frac{LOAN}{EA})^2 + (\frac{INTERBANKLOAN}{EA})^2 + (\frac{CKKD + CKDT}{EA})^2 + (\frac{DERA + LINVEST}{EA})^2] \quad (1)$$

Funding diversification (*FDIV*) includes equity (*EQUITY*), interbank deposits and Government debt (*INTERBANKDEBT* + *NCP*), customers'

deposits (*DEPOSIT*), market funding such as derivatives, other financial assets and funding investment, and other debts (*NDERA + VUT + OTHERDEBT*), and certificates of deposit (*PHGTCG*), where the sum of the eight numerators is *FUND*. As a consequence, *i* represents the bank, *t* represents time, and Equation (2) is used to generate the funding diversification index:

$$FDIV_{i,t} = 1 - [(\frac{EQUITY}{FUND})^2 + (\frac{INTERBANKLOAN + NCP}{FUND})^2 + (\frac{DEPOSIT}{FUND})^2 + (\frac{NDERA + VUT + OTHERDEBT}{FUND})^2 + (\frac{PHGTCG}{FUND})^2] \quad (2)$$

For income diversification (*IDIV*), the methodology of Curi et al. (2015) was employed by taking net interest income (*NI*), non-interest income (*NDV+ NNH + NCKKD + NCKDT + NO + NMCP*) such as net profit/loss from service activities (*NDV*), net profit/loss from forex and gold trading (*NNH*), net profit/loss from trading securities (*NCKKD*), net profit/loss from trading investment securities (*NCKDT*), net profit from other activities (*NO*), and income from share purchase (*NMCP*), where the sum of the two numerators is *TOI*. As a consequence, *i* represents the bank, *t* represents time, and Equation (3) is used to generate the income diversification index:

$$IDIV_{i,t} = 1 - [(\frac{NI}{TOI})^2 + (\frac{NDV + NNH + NCKKD + NCKDT + NO + NMCP}{TOI})^2] \quad (3)$$

where *TOI* is the total of the seven numerators' absolute values. Contrary to assets and funds, the components of total income (*TOI*) may assume negative values, as noted by Elsas et al. (2010), which would result in negative shares for some revenue streams and a share larger than one for other income streams. To prevent this issue, TOI was computed using the absolute values of the four income components.

3.2.2 Bank efficiency measurement

Bank efficiency has rich literature that covers its causes or determinants, consequences or impacts, and metrics (Avkiran, 2006; Hassan & Hussein,

2003; Sathye, 2003; Shafiee et al., 2013). The choice of prospective model variables initiates the process of developing the DEA model.

Production and intermediation are the two common methods used to quantify bank efficiency. While banks were thought to meditate funds between savers and investors in the intermediation approach, the production method highlighted banks as businesses providing services in the form of transactions. Using capital, land, and labor as the conventional factors of production, banks were viewed as the makers of loans and deposits for borrowers and depositors in the production approach (Taufiq et al., 2009). When assessing the banking industry, the intermediation technique is more applicable because banks receive deposits and convert them into loans and other revenue-generating assets (Mokhtar et al., 2008). As a result, the intermediation method or the production approach was used in all of the banking literature cited in this work.

In this study, the intermediation technique was employed since it is based on the input-output relationship between bank functions. The intermediation concept regards banks as mediators, with banks changing and transferring financial assets from surplus to deficit units. Following in Thagunna and Poudel (2013), three input variables and three output variables were chosen. Each potential outcome was considered a dependent variable, whereas input factors were treated as predictors, as displayed in Table 1.

First, the most important components of the balance sheets and income statements of the banks were chosen. Customers' deposits, interbank debt, and interest payments, which are usually converted into loans, are the Vietnamese commercial banks' main sources of funding. Additionally, they lend money to consumers, and the majority of their income comes from interest on those loans. To measure the capacity of the intermediation function of banks to generate income, total operational income and loans were added as an output variable.

Table 1. Combination of inputs and outputs employed in DEA models

No.	Inputs	No.	Outputs
(I1)	Interest expense	(O1)	Total Loans
(I2)	Deposits	(O2)	Interest Income
(I3)	Operating non-interest expense	(O3)	Operating Non-Interest Income

4. Model specification

The effect of bank diversity on efficiency was investigated using fixed-effects panel regression. The diversification index measures the dependent variable (ADIV, IDIV, and FDIV). Then, DEA was used to determine the amount of efficiency. The approach for each decision-making unit (DMU) is to employ the fewest types of inputs required to generate a specific set of outputs. This is a non-parametric frontier model that employs a linear model. The DEA method has two approach models: CRS (Constant Return to Scale) and VRS (Variable Returns to Scale).

According to CRS, if an input is multiplied by *n*, the output will also be multiplied by *n*. This means that output will fluctuate in proportion to changes in input. The VRS model is another option. The addition of input and output is not the same, which means that increasing the input by *n* times will not result in an increase in output by *n* times. Depending on the value, the output may rise or fall. VRS captures production technology's growing, steady, or sliding returns to scale. The VRS model was employed in this study because the sample is a bank with multiple hurdles and financial constraints. We also employed the CRS approach for robustness check and had similar results.

Given the considerations of the theoretical and empirical studies described above, the following basic model is specified in Equation (4):

$$Effieciency_{it} = \beta_0 + \beta_1 DIV_{it} + \beta_2 DIV_{it} * FOWN_{it} + \beta_3 AGE_{it} + \beta_4 DIV_{it} * AGE_{it} + \beta_5 Control_{it} + \varepsilon_{it} \quad (4)$$

where the dependent variable is bank efficiency (i) at the time (t) measured by VRS and CRS approaches for robustness. The independent variables are DIV_{it}, with three measures of bank diversification, i.e., asset diversification (ADIV), funding diversification (FDIV), and income diversification (IDIV), of the bank (i) at the time (t); $DIV_{it} * FOWN_{it}$, the interaction of bank diversification and the bank's foreign ownership of bank (i) at the time (t); and $DIV_{it} * AGE_{it}$, the interaction of bank diversification and age of bank (i) at the time (t). The control variables are *FOWN*, foreign ownership of the bank (i) at the time (t); AGE_{it}, age of the bank (i) at the time (t); $SIZE_{it}$, total assets of the bank (i) at the time (t); $AGROWTH_{it}$, asset growth of the bank (i) at the time (t); CAR_{it}, capital adequacy ratio of the bank (i) at the time (t); $NPLR_{it}$, non-performance loan ratio of the bank (i) at the time (t); $MARKETPOWER_{it}$, local market power of the bank (i) at the time (t); and ε_{it}, error term (Table 2).

Table 2. Variable construction

Classification	**Variables**	**Description**	**Measurement**
Dependent Variables	VRS_EF CRS_EF	Bank Efficiency	Apply DEA to measure bank efficiency with the input, and output following Thagunna et al. (2013).
Independent Variables	ADIV	Asset diversification	As displayed in Section 3.2.1
	FDIV	Funding diversification	As displayed in Section 3.2.1
	IDIV	Income diversification	As displayed in Section 3.2.1
Control Variables	SIZE	Bank size	Total assets in natural logarithm
	AGROWTH	The growth rate of total assets	(Total Asset$_t$ – Total Asset$_{t-1}$) / Total Asset$_{-1}$
	NPLR	Non-performance loan ratio	The ratio of non-performing loans to equity.
	CAR	Capital adequacy ratio	Collected in the bank's annual report.
	MARKETPOWER	Deposit market shares	Deposit market shares / Total deposit in the industry
	FOWN	Foreign ownership is the total value of the shares held	Collected in the bank's annual report.

		by foreign owners.	
	AGE	Bank age	Current year – Bank established year.

Table 3. Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
Efficiency	0.758	0.243	0.012	1
ADIV	0.494	0.089	0.070	0.726
FDIV	0.470	0.119	0.079	0.760
IDIV	0.254	0.205	-0.872	0.498
SIZE	18.789	1.108	15.819	23.036
Asset growth	0.118	1.648	-0.979	50.176
NPLR	0.034	0.108	0.001	2.002
CAR	12.434	3.353	1	23.59
Market power	0.039	0.046	0.0002	0.195
FOWN	15.444	10.892	0	30
Age	25.925	10.712	1	65

Notes: This table reports the result of the descriptive statistics; all variables are provided in Table 1.
Source: Authors' calculation.

Table 3 presents descriptive statistics of variables used in this study, including four essential measures, namely the mean, standard deviation (Std. Dev.), minimum value (Min), and maximum value (Max). The average efficiency of the banks analyzed is 0.758, with a standard deviation of 0.243. The minimum observed efficiency is 0.012, while the maximum is 1. ADIV had a mean of 0.494, a standard deviation of 0.089, a minimum value of 0.070, and a maximum value of 0.726. In terms of FDIV, 1,128 data points were observed, with a mean of 0.470 and a standard deviation of 0.119. Interestingly, the minimum value of IDIV was -0.872, while the maximum value was 0.498. Similar patterns were found for the other variables, where variations were observed in means, standard deviations, and ranges. These descriptive statistics

lay the foundation for further analysis and provide a comprehensive understanding of the data's central tendency and dispersion, as well as the minimum and maximum values observed for each variable. The asset and income diversification were 1.120 and 1.128, respectively, and the average funding diversification was 1.121. Market power is the share of each bank deposit on the aggregated bank deposits. In addition, the mean value of the market power is 3.9%, corresponding to a standard deviation of 4.6%. On average, the foreign ownership is 15.44%. The FOWN variable has a broader range from 0% to 30%. Age is constructed as the banks' operational years. The average value and standard deviation of the bank age were found to be 26 years and 11 years, respectively.

Table 4. Correlation matrix

No.	Variable	1	2	3	4	5	6	7	8	9	10	11
1	Efficiency	1										
2	ADIV	-0.192	1									
3	IDIV	0.159	-0.055	1								
4	FDIV	-0.258	0.327	0.147	1							
5	SIZE	-0.510	0.126	0.082	0.387	1						
6	AGROWTH	-0.037	0.123	0.036	0.055	0.020	1					
7	NPLR	0.089	-0.052	0.109	0.159	-0.067	-0.056	1				
8	CAR	0.249	-0.191	-0.013	-0.180	-0.433	-0.011	0.093	1			
9	MARKETPOWER	-0.804	-0.064	-0.044	0.240	0.728	-0.018	-0.060	-0.173	1		
10	FOWN	-0.242	0.232	0.079	-0.005	0.501	0.075	-0.035	0.130	0.427	1	
11	AGE	0.098	-0.517	0.038	-0.229	0.016	-0.070	-0.013	0.383	0.108	0.069	1

Notes: Table 4 presents the summary statistics for both the dependent and independent variables, including the mean, standard deviation, minimum, and maximum values, as well as a correlation matrix. Source: Authors' calculation.

5. Empirical results

First, for the panel data model, the regression methods were the pooled ordinary least square (POLS) regression model, fixed effect model (FEM), and random effect model (REM). Second, a Hausman test was performed to find an appropriate model between FEM and REM. Next, tests of autocorrelation and heteroskedasticity were performed to assess the reliability of the model. If the selected model satisfied the tests, it would be included in the analysis of the final results. Conversely, if the model had autocorrelation or heteroskedasticity, it would be corrected through generalized least squares (GLS) models. GLS models were used to estimate the impact of bank diversification on efficiency. The dependent variables were efficiency scores (VRS_EF and CRS_EF) of Vietnamese commercial banks, including three aspects: asset, income, and funding diversification, measured by both VRS (Models 1, 2, 3) and CRS (Models 4, 5, 6) approaches for robustness check.

As shown below in Table 5, asset diversification has a negative impact on bank efficiency at a 5% significant level. This negative effect is in line with many studies in the literature about asset diversification (Elyasiani & Wang, 2012; Rossi et al., 2009; Lepetit et al., 2008; Deng & Elyasiani, 2008; Acharya et al., 2006b). Hypothesis H_{1b} is accepted, and Hypothesis H_{1a} is rejected. The bank must deal with more competitive pressure from new areas as a result of its activities' diversification instead of the traditional loan activities. Additionally, because the bank must recruit more staff to handle newly emerging business divisions, diversification raises agency costs in operations. Diversification of activities weakens the bank's capacity to oversee and manage loan items, leading to loan items that are not guaranteed in quality and reduce profitability. On the other hand, no significant relationship is found between income diversification and bank efficiency.

The estimated coefficient for funding diversification (FDIV) is also negative and statistically significant at a 1% level. This indicates that banks with greater funding diversification perform worse. Hypothesis H_3 is rejected. This new finding is the main highlight that fills the gap in the literature because the funding aspect receives little concern from scholars, especially in the Vietnamese banking sector. Due to the similarity in the features of the fundraising products as well as the inevitable fierce competition between 32 commercial banks in the Vietnamese banking sector, there is a situation where customers easily transfer their deposit balances from one bank to another, leading to the source of deposit capital of banks lacking sustainability in terms of scale and cost, thereby affecting the business efficiency of banks in the system. Thus, commercial banks can only conduct strategies that may be very costly compared to the efficiency received. For example, a mixed marketing strategy with departmental strategies for rebranding, promotion, advertising, internal communication, comprehensive cooperation, and customer care helps the branch to fully exploit the strengths of the bank in the competition for mobilizing capital, which is a traditional mobilization model applied at all transaction points of banks. In implementing the pricing strategy, it can be seen that interest rates are the key to attracting mobilized capital and affect the types of fees and accompanying services in the competition for mobilized capital between banks.

There is no evidence from these results that income diversification has an impact on bank efficiency. Banks create a variety of products and services from traditional interest- or non-interest-generating activities or from combining the two at the same time as part of an income-generating strategy known as revenue diversification. Our finding is not similar to Sang (2017), who used a sample of 34 Vietnamese commercial banks from 2007 to 2015 and

found that income diversification had a positive impact on operational efficiency. This study also demonstrated that, in comparison to the group of small-scale commercial banks, the large-scale banks' level of income diversification had a greater impact on operational efficiency.

This point of view is also supported by the evidence that the estimated coefficient for the market power variable is negative and statistically significant. Bank deposits can be identified as a key financial indicator that determines the profitability of a commercial bank. However, the literature provided conflicting findings about the relationship between deposits and bank efficiency. Combined previous empirical data indicates commercial banks that rely primarily on deposits for lending are less profitable due to low-interest costs, but it is costly in terms of the required branching network and other expenses (Demirgüç-Kunt & Huizinga, 1999). Vong and Chan (2009) concluded that banks with large deposit networks in Macau do not achieve as high a level of profitability as banks with narrower deposit networks. In line with the above discussion, the negative coefficient of the market power variable stated that the increase in the bank deposit worsens the bank's efficiency at a 1% significant level.

The impact of bank size on bank efficiency is positive and is significant at the level of 1%, implying that bigger banks tend to be more efficient in pricing and utilizing inputs for certain outputs. The positive coefficient indicates large banks benefit from economies of scale, diversification benefits, capital access, and the systematic effect. With a long history in the banking industry, they may be able to capitalize by investing in cutting-edge technology and developing competitive goods. Furthermore, major banks may have greater access to capital markets, stronger investment and diversification alternatives, and hence be less vulnerable to negative capital shock. This result is consistent

with Thi Thanh Tran and Phan (2020), who studied 20 Vietnamese commercial banks from 2012 to 2016 and stated that due to economies of scale and scope, larger banks could spread fixed costs over a broader customer base and effectively manage diverse product offerings.

Positive impacts are also found for foreign ownership (FOWN) on bank efficiency, indicating that an increase in foreign ownership is positively associated with bank efficiency. This finding is supported by previous studies (Nguyen et al., 2016; Detragiache et al., 2008; Havrylchyk, 2006; Weill, 2003; Grigorian & Manole, 2002). These studies suggest that bank efficiency is positively correlated with the percentage of its capital structure allocated to foreign investors. As the foreign share increases, domestic banks with foreign stakeholders will likewise perform better, as foreign banks already do. Foreign players' involvement in the banking sector has steadily expanded in emerging countries like Vietnam. The financial market is expected to become more competitive due to the involvement of foreigners. Consequently, in the long run, it can strengthen and consolidate the market. Regarding partially foreign banks, the benefit of funding from foreign strategic investors could boost bank efficiency since it provides local banks with human capital in addition to cutting-edge technology and managerial capabilities.

Considering the relationship between interaction variables (DIV x FOWN) and bank efficiency, the results are highly interesting. The negative coefficient of interaction variables implies that, while foreign-owned banks perform better than domestic banks, foreign-owned banks with more asset and funding diversification are less profit-efficient.

Bank experience can mitigate the adverse impact of asset and funding diversification on the bank's efficiency. This conclusion is supported by the positive coefficient of the interaction term between DIV x AGE. This finding

could provide an interesting implication for bank managers. Due to the different stages of development, they must consider whether they will apply diversification strategies or concentrate on their strength to gain the best advantage.

Table 5. Effects of asset, income, and funding diversification on bank efficiency

	VRS approach			**CRS approach**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	ADIV	**IDIV**	**FDIV**	**ADIV**	**IDIV**	**FDIV**
	Coefficient (.Std err)	Coefficient (.Std err)	Coefficient (.Std err)	Coefficient (.Std err)	Coefficient (.Std err)	Coefficient (.Std err)
DIV	-0.900**	0.258	-1.826***	-2.148**	0.355	-0.616
	(0.345)	(0.295)	(0.459)	(0.661)	(0.191)	(0.740)
SIZE	0.061***	0.060***	0.049***	0.072***	0.099***	0.054**
	(0.011)	(0.012)	(0.014)	(0.017)	(0.016)	(0.017)
AGROWTH	-0.007	-0.015	-0.011	-0.003	-0.018	-0.007
	(0.007)	(0.009)	(0.008)	(0.007)	(0.008)	(0.006)
NPLR	-0.026	-0.014	0.072	0.126	0.083	0.119
	(0.085)	(0.079)	(0.111)	(0.140)	(0.113)	(0.106)
CAR	0.007***	0.004	0.003	0.012***	0.008*	-0.002
	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)
MARKET POWER	-5.649***	-5.566***	-5.268***	-6.338***	-6.076***	-5.952***
	(0.492)	(0.502)	(0.384)	(0.552)	(0.584)	(0.401)
FOWN	0.012***	0.001	0.019***	0.028***	0.004*	0.023***
	(0.003)	(0.001)	(0.002)	(0.005)	(0.002)	(0.003)
AGE	-0.008	0.008	-0.030***	-0.039**	-0.018***	-0.004
	(0.007)	(0.004)	(0.008)	(0.015)	(0.003)	(0.013)
DIV*FOWN	-0.020**	-0.003	-0.027***	-0.046***	-0.003	-0.041***
	(0.007)	(0.003)	(0.004)	(0.010)	(0.005)	(0.006)
DIV*AGE	0.008	-0.007	0.078***	0.086**	-0.007	0.052
	(0.015)	(0.011)	(0.018)	(0.029)	(0.008)	(0.029)
Intercept	0.264	0.450	0.695*	0.353	-1.604***	-0.389
	(0.299)	(0.257)	(0.325)	(0.525)	(0.313)	(0.453)
Number of observations						

Notes: DIV is a diversification index including 3 classifications: ADIV (asset diversification), FDIV (funding diversification), and IDIV (income diversification), as displayed in Columns (1, 4), (2, 5), and (3, 6). DIV × FOWN displays the interaction terms between the diversification index and banks' foreign ownership structures. DIV x AGE displays the interaction terms between the diversification index and the bank age. Other control variables include SIZE, AGROWTH, NPLR, CAR, market power, FOWN, and AGE, as described in Table 1. ***, **, and * indicate a significance level of 1%, 5%, and 10%, respectively. Source: Authors' calculation.

6. Conclusion

This study analyzes the nexus between diversification strategies and the efficiency of Vietnamese commercial banks using panel data from 2012 to 2022.

It applies the more advanced method, a conditional nonparametric frontier analysis (DEA), to measure bank efficiency. For the robustness check, bank efficiency was assessed using both VRS and CRS approaches. There is a lack of studies that examine such a relationship that takes into account foreign ownership structure in detail or the degree of ownership in the bank's capital structure, especially the foreign share in the domestic bank, as the study does. Therefore, the study contributes to the literature by providing a deeper understanding of the effect of diversification strategies in three aspects: asset, income, and funding diversification. By investigating different aspects of diversification, the findings provide an optimal model that is essential for the managers of commercial banks and policymakers in the current context in Vietnam. The study's findings provide useful guidance not only for bank management but also for regulators in assisting the Vietnam restructuring program's success.

In addition, according to the regression results, diverse banks with asset and financing dimensions have worse bank efficiency, while income diversification did not affect bank efficiency. This insight has implications for bank executives and policymakers because bank managers believe that the best model is one that diversifies assets to improve the bank's efficiency. Nonetheless, this study reveals that asset and funding diversification has significant negative impacts. Instead of focusing on the traditional activities and sources for mobilization, diversification can lead to an increase in cost operation, and these strategies may be more costly than the benefits from

diversification. The bank should ascertain its strengths and competitive advantage in a fierce industry with a high level of competition rather than spend too many resources and capital on new activities. Expanding the scope while the human capital or staff do not have enough expertise or management skills to control could be a dangerous step for quality control and risk management.

Subsequently, the findings indicate that foreign ownership enhances bank efficiency. More specifically, a higher proportion of foreign investors in the capital structure corresponds to a higher degree of operational efficiency. This report then recommends that, by current legislation, the Vietnamese government should raise the maximum percentage of foreign ownership in any local bank to more than 30 percent. The role of ownership is one noteworthy result connected to the relationship between diversification and bank efficiency. While international banks outperform local banks in terms of efficiency, asset and funding-diversified banks with foreign ownership have poorer efficiency.

Finally, size positively affects the efficiency of banks. Among the control variables, large banks were found to be less efficient than small and medium-sized banks, even if they achieved a large market share, e.g., the proportion of customer deposits in the banking sector. Thus, this study supports policies toward increasing the size of banks and encouraging banks to diversify their businesses rather than only focus on traditional credit activities. Large banks may benefit from the economy of scale to mitigate the adverse impact of diversification on bank efficiency.

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