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COMMERCIAL BANKS' CAPITAL STRUCTURE AND PERFORMANCE IN VIETNAM: PANEL DATA MODEL APPROACH

Abstract

The study delves into the factors that influence the capital structure of commercial banks in Vietnam. Capital structure, measured by the net debt-to-asset ratio, is a key indicator of bank leverage. The study uses pooled OLS, fixed effects, and random effects models to analyze the impact of factors such as net interest-earning rate, Corporate Income Tax rate, and liquidity on commercial banks' profitability and their capital structure. Data from 26 banks during the 2010–2022 period in Vietnam was collected for the analysis. The results indicate that factors such as Tax, ROA, growth, and liquidity have significant impacts on the capital structure of the banks. Specifically, Tax has a beta coefficient of –0.05967, ROA has a beta of –0.01796, growth has a beta of 0.000509, and liquidity has a beta of –0.00045. The study found that ROA, Tax, and liquidity are negatively related to the capital structure of Vietnamese commercial banks, meaning that an increase in these factors leads to a decrease in the banks' total debt-to-total assets and vice versa. The empirical results suggest that commercial banks can manage their capital structure through these factors to reduce their debt-to-asset ratio, resulting in reduced credit risk, improved asset quality, and increased business efficiency. However, lowering the debt-to-asset ratio may also lead to reduced profits from lending activities, particularly when interest rates are high.

Keywords taxation policies, ROA, liquidity, performance, asset size, bad debt

JEL Classification G21, G32

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INTRODUCTION

Competition among businesses in the market economy is becoming increasingly fierce. Therefore, optimizing a company's capital structure is an essential task for financial managers; simultaneously, the banks' capital structure has a significant impact on their capacity to implement company plans, achieve economic efficiency, and promote sustainable growth. The issue of actively selecting a proper capital structure of equity and debt capital to optimize bank value has become increasingly pressing. This study examines the impact of various factors on a bank's capital structure using the GLS regression model. It identifies size, profitability (ROA), leverage, liquidity, risk, and net profit margin (NIM) as explanatory factors for banks. Additionally, macroeconomic variables such as economic growth, price inflation, real interest rates, equity market index volatility, deposit insurance, and governance index are incorporated into the model to regulate macroeconomic policies.

The data for this study were collected from 26 banks in the Vietnamese stock market from 2010 to 2022, with a focus on major banks that have a significant impact on the economy. The empirical results derived from this analysis can be used as a reference for

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banks to develop their business strategies and provide a basis for macroeconomic policymakers to formulate appropriate monetary policies for the economy.

The empirical research findings demonstrate that a bank's competitive strategies and effectiveness are significantly influenced by key factors, such as return on assets (ROA), leverage, liquidity, net profit margin, and risk. These factors play a crucial role in determining the competitive advantage of a bank and its ability to achieve strategic objectives. ROA is an important metric that measures how efficiently a bank utilizes its assets to generate profits. Similarly, leverage and liquidity ratios are vital indicators of a bank's financial health, whereas the net profit margin measures the profitability of a bank's operations. Lastly, risk is a critical consideration for banks, as it determines the likelihood of potential losses due to market fluctuations or other external factors. Understanding the impact of these factors on a bank's strategy is therefore essential for banks seeking to maintain their competitive edge in the financial industry (Jadah et al., 2020; Khan et al., 2021). Environmental factors such as the economic growth rate, Vietnam's volatility in the stock market index, deposit insurance ratio, and governance all significantly influence the economy's development and stability. Empirical data suggest that capital structure is now a key problem, not only in firms but also in banks. Empirical results also show that the banking system shows that banks face an imbalance in the structure of capital and assets when using short-term capital for long-term loans, increasing liquidity risk, leading to a high rate of bad debt, affecting the banking system in particular and the Vietnamese economy in general.

A well-crafted plan and a finely tuned capital structure are critical for ensuring a bank's profitability. This requires careful alignment and adjustment of the investment structure, which is essential for success. Investors must make educated judgments on capital investment plans, as mistakes can have a substantial influence on the overall balance of the investment structure.

1. LITERATURE REVIEW

Modigliani and Miller's (1958) paper introduced capital structure theory, also known as M&M theory. This theory has since evolved into other theories like equilibrium, pecking order, market regulation, and management structure (Modigliani & Miller, 1958; Aji & Adawiyah, 2021). Gropp and Heider (2010) show that between 1991 and 2004, deposits were the most important determinants of the capital structure and leverage of large US and European banks. There was a shift from deposits to non-deposit liabilities in the banks' liability structure. The impact of bank deposits on a bank's capital structure and leverage remained consistent over time.

In addition, there is literature mentioning capital structures, such as Khaki and Akin (2020) and Aulia (2020) identifying factors affecting capital structures; the results show that firm size, loan tangibles and opportunities, and loan growth positively impact financial leverage. They studied the correlation between capital structure parameters, such as profitability, business size, non-debt tax shield, growth, and business risk, and the financial leverage ratio (Kim & Berger, 2019; Cruijsen & Knoben, 2021; Kim et al., 2010; Park & Kim, 2003). Besides, Doliente (2006) showed the factors that influence the net profit margin (NIM) of banking institutions in four Southeast Asian nations using a linear regression model, and the results show that a bank's NIM depends on the structure of the bank, such as operating costs, capital, loan quality, collateral, and liquid assets. Although NIM exhibits sensitivity to fluctuations in interest rates for short-term loans, they are still major based on the insufficiently competitive organization of the banking system in the region. Allen et al. (2015), Horst et al. (2006), and Dinh (2020b) also showed that with the inappropriate use of capital, the business may go bankrupt, affecting the deposit and equity markets, they used the endogenous variable model to evaluate capital structure and costs and equity capital from bank deposit financing. The results show that capital structure affects expected returns and that equity generates higher returns than direct investment in risky assets. Dinh (2021) analyzed the relationship between risk and return and found that the higher the profit, the greater the risk by approaching the bias model, such as standards, variances, coefficients of various methods, and matrix functions to measure risk. Thus, banks must have a reasonable capital structure to generate profits and minimize risk.

Following these studies, the factors that determine companies' capital structure were analyzed. Although they are not banks, companies' capital structure is similar to that of banks (Neves et al., 2020; Shi et al., 2020; Liu et al., 2022). However, banks' capital is mainly mobilized from the outside, so it has a high risk. Thus, the empirical results show that capital structure plays an important role in deciding an appropriate investment policy to minimize risk. In addition, Dong and Robin (2018) and Teoh et al. (2013) investigate the possibility of effective capital allocation and risk management by analyzing the relationship between capital structure and portfolio risk level and consider the relationship between capital structure and portfolio risk by analyzing banks' ownership categories. The empirical results show that better-performing banks raise their capital holdings and take on more credit risk while lowering their riskier assets. Wojewodzki et al. (2020) examined the impact of the capital structure of banking enterprises and the adjustment of the capital structure according to the target to meet enterprise loan sources. The empirical findings show that credit ratings have a significant impact on economic growth based on banks' level of capital structure adjustment. The credit rating required for companies to adjust the appropriate capital structure of banks has affected the cash flow of the economy because commercial banks are financial intermediaries that regulate the economy and prompt economic development. Sheikh and Qureshi (2017) investigated how commercial banks analyzed the impact of the capital system on economic development by providing capital to the economy. The empirical results show that large commercial banks have more leverage than small intermediary financial institutions, as well as being more profitable and having a more secure income than small commercial banks; thus, profitability and structure of capital are closely related. It is well understood that saving an enterprise's capital structure is inextricably linked to the capital structure of banks, as banks' job is to mobilize capital and lend to companies. Kumar et al. (2017) examined enterprises' structure of capital using a theoretical model of capital organization and found that enterprises' capital organization affects commercial banks' capital organization, and evidence that the structure of capital is related to financial leverage, which also shows the advantage of the theory of capital organization in discussing commercial banks' profits both theoretically and statistically. Although the results of these studies have different scopes and objectives, they also have different meanings. The empirical findings indicate that the structure of capital has a detrimental impact on bank performance; that is, if the structure of capital is not appropriate, commercial banks' profits decrease (Siddik et al., 2017; Qayyum & Noreen, 2019; Jadah et al., 2020). The majority of the study's findings suggest that banks that achieve success through earnings from assets have a significant positive relationship with the ratio of equity to assets, percentage of liabilities to assets, and bank size (Ghosh & Chatterjee, 2018; Lama et al., 2014; Ayalew & McMilla, 2021). Furthermore, the ratios of short-term debt to property, longer-term obligations to total assets, and total liabilities to the total value of assets significantly and negatively affect bank profitability. The studies also aim to evaluate the impact of banking and environmental factors on the capital adequacy ratio of banks in Southeastern Europe (Schepens, 2016; Diamond & Rajan, 2002; Harding et al., 2013).

This study has reviewed the literature mentioned earlier and formulated hypotheses based on the information gathered from those sources. Additionally, the study has carefully analyzed previously conducted research and developed proposed hypotheses that align best with the findings and conclusions of the cited literature.

Based on the literature review, this study will test and evaluate the hypotheses to gain insights and draw forecast models. The hypotheses of the model were constructed as follows:

H1: *The relationship between return on assets (ROA) and bank capital structure in the Vietnam Stock Market.*

H2: *The connection between the net interest income rate (GROW) and bank capital structure in the Vietnam Stock Market.*

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H3: *The influence of the corporate income tax rate (TAX) on the capital structure of banks in the Vietnam Stock Market.*

H4: *The role of liquidity (LIQ) in determining the capital structure of banks in the Vietnam Stock Market.*

2. METHODOLOGY

The study used Pooled OLS, FEM, and REM models and tested the data using the Likelihood Ratio and Housman methods to eliminate redundant variables (Qian, 1999), which is also consistent with previous studies such as the model of Myers and Majluf (1984) with investors, managerial rationality, and adverse selection costs varying between firms and from time to time. Rajan and Zingales (1995) found that firms tend to issue shares after disclosure, which can reduce information asymmetry. Simultaneously, capital organization theories are used to test the factors that influence capital structure (Alipour et al., 2015). Temporary fluctuations in the market-to-book ratio measure changes in adverse selection, a fixed-effects panel regression model analyzes ten-year data to explore the relationship between leverage and business success while adjusting for characteristics, including a bank's size, age, tangibleness and growth, and liquidity. This model is applied in the literature to examine banks' or entities' capital structure and profitability (Dawar, 2014; Ukaegbu & Oino, 2014; Nourani et al., 2019). A literature review related to the structure and profitability of commercial banks shows that the research model is built based on independent variables and dependent variables such as ROA (banks' profitability), Net Interest Earning Rate (GROW), Corporate Income Tax Rate (TAX), and (Illiquidity and the dependent variable is TLEV – reflecting banks' capital structure.

1. Dependent variable

1.1 *TLEV*: Reflecting banks' capital structure. The total debt-to-total assets is a ratio that helps to determine the amount of debt a company has in relation to its assets. This metric allows analysts to make comparisons between the leverage of a commercial bank and other commercial banks in the same industry. It is useful in assessing the financial stability of a company.

$$TLEV = \frac{Total\ Debt}{Total\ assets}, \tag{1}$$

In which. *Total Debt* includes all short-term and long-term debt, including short-term loan payables and long-term debt due to borrowing or issuing long-term bonds. *Total assets:* all assets of the bank.

2. Independents variables

2.1 *ROA*: Bank profitability and it is calculated by Return on Assets.

2.2 *GROW*: Net Interest Margin (NIM) reflects the growth rate of interest income relative to the growth rate of expenses (%), (Next year's net interest income minus that of the previous year's net interest income) divided by the previous year's net interest income multiplied by 100 percent.

2.3 *TAX*: Corporate income tax rate (%), It is important to consider the calculation of corporate income tax on profits. Corporate income tax directly affects and reflects the bank's business situation. In addition, the bank's performance and the overall state of the economy also have a significant impact on corporate income tax.

2.4 *LIQ*: Liquidity, customer's account outstanding (before provision) divided by the customer's deposit.

Data were collected from 26 banks in the Vietnamese stock market on financial statements from 2010 to 2022. These banks were selected as the research sample because they are the largest in Vietnam and have a significant influence on economic growth.

The FEM and REM models are commonly applied models for panel data, and the FEM model does not ignore time-series effects and cross-units. In other words, a regression model with fixed cross-effects builds on the assumption of different origins between diagonal units, but the slope is constant, the REM model is:

$$TLEV = \beta_0 + \beta_1 ROA + \beta_2 GROW + \beta_3 TAX + \beta_4 LIQ + \mu_{it}, \quad (2)$$

where $\mu_{it} = \varepsilon_{i} + u_{it}$; ε_i – Random error with mean 0 and variance ∂^2; u_{it} – Error in the combined evaluation of individual qualities based on the object being evaluated or over a certain period.

The random-effects model assumes that the error component μ_{it} is not connected with any of the explanatory factors. Unobserved time constant qualities provide random effects that are corrected for serial correlation.

A fixed-effects model is a type of statistical model where the model parameters are considered non-random or fixed. In contrast, random- and mixed-effects models include some or all of their parameters as random variables. The fixed-effects model can be symbolized as:

$$TLEV = \beta_0 + \beta_1 ROA + \beta_2 GROW + \beta_3 TAX + \beta_4 LIQ + u_{it}. \quad (3)$$

The pooled OLS model is a regression method used to estimate the coefficients of the selected variables based on the data. Determining variable correlation is essential to selecting the appropriate model for panel data analysis and eliminating multicollinearity. Tests such as the F-test, Breusch-Pagan Lagrangian, and Hausman were used to select the best-fit model.

Multicollinearity occurs when independent variables in a regression model are highly correlated, which can lead to unstable and unreliable estimates of the regression coefficients. The Variance Inflation Factor (VIF) is used to test for multicollinearity by calculating the ratio of the variance of estimated regression coefficients and the following hypothesis:

- If the variance exaggeration factor VIF is more than two, the model has multicollinearity.
- If the variance exaggeration factor VIF is less than two, it can be proven that the model does not have multicollinearity.

Additionally, this study employed the Hausman test and F-test to determine the best-fit model among the three research models. The hypotheses tested are as follows F-test with the two hypotheses:

H_0: *Pooled OLS model is selected;*

H_1: *FEM model is selected.*

To decide between H_1 or H_0 based on the probability value test as: If the Prob test value is < α (5%), H_0 is rejected, and H_1 is accepted, the FEM model is goodness of fit. If the Prob test value is > α (5%), accepting H_0 means that there is no evidence that idiosyncrasies are different; therefore, the model is fit.

The Hausman test is a statistical method used to determine the best-fitting model for regression analysis. It involves comparing two models – a fixed effects model and a random effects model – and testing two hypotheses. The first hypothesis states that the random effects model is consistent and efficient, whereas the fixed effects model is inconsistent. The second hypothesis is that both models are consistent but that the random effects model is less powerful than the fixed effects model. The study tested these hypotheses against the following probability values:

H_0: *Select an REM model with no connection between the variables that are independent and random components.*

H_1: *Select an FEM model that has a relationship between the variables that are independent and random components.*

To decide between H_1 or H_0, use a probability value test as: If the test value Prob < α (5%), H_0 is rejected, and H_1 is accepted. If the test value was Prob > α (5%), H_0 is accepted.

Variance and autocorrelation tests: This test helps detect whether the research model is subject to variance. With this test, two hypotheses were proposed: H_0: The model has a homoscedasticity. H_1: The model has a heteroskedasticity. To select these hypotheses, it is essential to depend on the probability value mentioned below.

- If the test value was Prob < α (5%), H_0 is rejected, H_1 is accepted H_1, and the model has a heteroskedasticity.

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- If the test value Prob > α (5%), H_0 is accepted, and the model has homoscedasticity.

Autocorrelation test: The autocorrelation test helps to detect whether the research model is autocorrelated. For the autocorrelation test, there will also be two hypotheses: H_0: The model has no autocorrelation, and H_1: The model has autocorrelation. To select these two hypotheses, they are based on probability value as follows:

- If the test Prob value < α (5%), H_0 is rejected, H_1 is accepted, and the model has autocorrelation.

- If the test Prob value > α (5%), H_0 is accepted, the model has no autocorrelation.

Further, the FGLS stochastic estimation method was used in this study to control variable variance and autocorrelation, so these models estimate the model randomly and correct errors that may arise from the OLS method. The objective was to test the factor's impact on the capital structure of banks, with statistical significance levels set at 1%, 5%, and 10% to consider whether the pooled OLS model is more efficient than the FEM or REM model and vice versa.

This study aims to explore the influence of commercial banks' capital structure in Vietnam and determine the relationship between macro and endogenous factors of commercial banks on capital structure. The study proposes fiscal policies suitable for Vietnam's economic conditions and long-term strategies and investigates the correlation between profitability and capital structures.

3. RESULTS

Descriptive statistics summarize data samples and parameters. The most common types are mean, median, and mode. They provide statistical indices like standard deviation.

The results of the descriptive statistical analysis indicate that the average value of the capital structure of enterprises (TLEV) is 90.8%, with a minimum value of 71.3% and a maximum value of 95.9%. The average profitability (ROA) is 0.705 times, with a minimum value of 0.01 times and a maximum value of 2.64 times. The average growth opportunity (GROW) is 19.989%, with a minimum value of –28.88% and a maximum value of 88.3%. The average TAX is 23.8%, with a minimum value of 77.7%. Additionally, the liquidity (LIQ) index has an average value of 87,923, with a minimum value of 60.66 times and a maximum value of 139.4 times (see Table 1).

The coefficient of the correlation matrix represents the link between the two variables in the model, so this shows the correlation coefficients between the dependent and independent variables in the model (Dinh, 2020a). To test whether there was a correlation between the variables, the data were tested using a correlation coefficient matrix (Table 2).

Table 2. Correlation variables analysis

Source: Stata software.

Variables	TLEV	ROA	GROW	TAX	LIQ
TLEV	1	–	–	–	–
P-value	–	–	–	–	–
ROA	–0.5115	1	–	–	–
P-value	0.0001	–	–	–	–
GROW	0.6724	–0.0786	1	–	–
P-value	0.0006	0.3296	–	–	–
TAX	–0.6881	–0.1621	0.0551	1	–
P-value	0.0187	0.0432	0.4944	–	–
LIQ	–0.5888	0.4514	–0.0282	0.0319	1
P-value	0.000	0.000	0.7272	0.693	–

Table 2 results indicate that if the significance (sig) test is less than 0.05, the pair of variables is linearly correlated. If the significance is greater than 0.05, the pair of variables does not have a linear correlation (assuming a significance level of 5% = 0.05). Therefore, all P-values with a significance less than

Table 1. Descriptive statistics

Source: Stata software.

Variables	N	Minimum	Maximum	Mean	Std. Deviation
TLEV	156	0.713	0.959	0.908	0.046
ROA	156	0.01	2.64	0.705	0.510
GROW	156	–28.88	88.3	19.989	17.390
TAX	156	0.146	0.777	0.238	0.125
LIQ	156	60.66	139.4	87.923	15.665

0.05 indicate that the independent variables have a statistically significant relationship with the dependent variable (TLEV).

Additionally, the value (r) demonstrates that the independent variables have a relatively close correlation with the dependent variable. The closer r gets to +1 or -1, the stronger the correlation; conversely, if r is close to 0, the correlation is weak. Specifically, the variables ROA, GROW, TAX, and LIQ have relationships with the variable TLEV of 51.15%, 67.24%, 68.81%, and 58.88%, respectively.

Furthermore, the variables ROA, TAX, and LIQ exhibit a negative correlation with the TLEV variable. This means that when these variables increase, the TLEV variable decreases, and vice versa.

To determine the best-fit regression method among OLS, FEM, and REM models, the study used the LM, Hausman test, and F test and applied regression models based on pooled OLS, REM, and FEM techniques (Jubilee et al., 2022; Dinh, 2020c).

The Pooled Ordinary Least Squares (OLS) regression results indicate that the independent variables have a 58.61% relationship (R-squared) or 56.72% after adjusting for R-squared (Adj R-squared) with a bank's profitability. The results indicate that the sums of squares between treatments/conditions (SS) are 0.0974 with 4 degrees of freedom (df) and 0.2431 with 151 degrees of freedom (df). The mean square for between conditions (MS) is 0.0243 and 0.0016. These values are used to calculate the F-test value, which is 0.0243 divided by 0.0016, resulting in 15.1375. Therefore, the F-test result is F(4, 151) = 15.13. The F index is 15.13, which shows that the R-square in the Poole OLS model is statistically significant. With a prob > F of 0.0000 < 5%, it can be concluded that this regression model is reliable. All variables with a P-value < 0.05 were considered statistically significant, with an alpha significance level of 5%. Besides, the mean squared error (MSE) of an estimate is calculated as the average of the squared errors, which is the difference between the estimate and the actual value being evaluated. MSE is a risk function that corresponds to the expected value of the squared error loss or quadratic loss. The difference can occur due to chance or because the estimates do not take into account information that could lead to a more accurate estimate (see Table 3).

Furthermore, the results show that the ROA, TAX, and LIQ variables have a negative relationship with the TLEV variable. This means that as these factors increase, the TLEV decreases. On the other hand, the GROW variable has a positive relationship with the TLEV variable. Therefore, when the GROW variable decreases, it leads to a decreased TLEV variable, so these results are consistent (see Table 4) (Siddik et al., 2014; Liu et al., 2012; Dinh, 2023c).

The fixed effects model applied to panel data is assumed to vary non-randomly, ε_{it} is compared with i or t, making the fixed effects model like a dummy variable model in one way, which is a popular type of panel data model, in addition to the random effects model REM (Maudos et al., 2002; Fadzlan, 2012).

Table 3. Pooled OLS model's regression results

Source: Stata software.

Source	SS	df	MS	Number of obs = 156	
Model Residual	0.0974 0.2431	4 151	0.0243 0.0016	F (4, 151) = 15.13 Prob > F = 0.0000 R-squared = 0.5861 Adj R-squared =0.5672	
Total	0.3406	156	0.00219	Root MSE = 0.04013	

TLEV	Coef.	Std. err.	t	P> |t|	[95% Con. Interval]	
ROA	–0.01828	0.007228	–2.53	0.012	–0.03256	–0.004
GROW	0.000704	0.000186	3.78	0.000	0.000336	0.001072
TAX	–0.08413	0.026185	–3.21	0.002	–0.13586	–0.03239
LIQ	–0.00085	0.000232	–3.66	0.000	–0.00131	–0.00039
Constant	1.002469	0.019798	50.63	0.000	0.963351	1.041586

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Table 4. Regression results according to the FEM model

Source: Stata software.

Items	R-squared			Number of obs= 156 Number of groups = 26 F (4, 126) = 5.84 Prob > F = 0.0002 Prob > F= 0.0000		
	0.5650					
F test	F(25,126) = 3.45					
TLEV	**Coef.**	**Std. err.**	**t**	**P> |t|**	**[95% Con. Interval]**	
ROA	0.016926	0.009059	1.87	0.064	–0.001	0.034854
GROW	0.000632	0.000207	3.05	0.003	0.000222	0.001042
TAX	–0.06326	0.026138	–2.42	0.017	–0.11498	–0.01153
LIQ	–0.00055	0.000245	–2.25	0.026	–0.00103	–6.6E–05
Constant	0.94764	0.022086	42.91	0.000	0.903932	0.991348

The results in Table 4 indicate that the sample consists of 156 observations divided into 26 groups. Additionally, the F-index is 5.84, indicating that the R-squared in the FEM model is statistically significant. With a prob > F of 0.0000 < 5%, it is concluded that this regression model is reliable. All variables with a p-value < 0.05 are considered statistically significant, with an alpha significance level of 5%. The FEM regression results indicate that 56.5% of the independent explanatory variables are closely related to the dependent variable. The regression model is fit for the research objectives with a statistically significant R-squared value. The ROA variable has no statistical significance, while other variables have a significant influence on the TLEV variable. TAX and LIQ have negative regression coefficients, and GROW has a positive regression coefficient, similar to previous studies (Al-Homaidi et al., 2018; Hauner & Peiris, 2008).

REM and random effects models are two approaches for data analysis. In REM, differences between units relate to explanatory variables. In random effects, differences between units are random. REM assumes that the cutoff value of cross-units is randomly drawn from a larger total sample, expressed as a deviation from the mean (Bollen & Brand, 2010; Dinh, 2022).

The REM regression analysis shows that independent variables have a close relationship with the dependent variable (R-squared = 62.34%). The model fits well with Prob > F = 0.0000 < 5%. ROA is not statistically significant (P-value = 0.290 > 0.05), while the remaining variables are significant (P-value < 0.05). TAX and LIQ have negative coefficients, while GROW has a positive coefficient, implying that an increase in profitability leads to an increase in capital structure (see Table 5). This empirical result is similar to the literature (Sufian & Habibullah, 2014; Agusman et al., 2014).

To analyze the impact of factors on the capital structure of 26 Vietnamese banks listed from 2010 to 2022, the study used panel data analysis with pooled OLS, FEM, and REM.

This study used statistical tests to compare different models and evaluate multicollinearity. The F-test and Hausman test were used to compare OLS and FEM models, while VIF was used to check for multicollinearity (see table 6). Additionally, the study applied FGLS estimates to the model with heteroskedasticity.

After conducting the Hausman test, it was found that the probability value was less than 0.05, spe-

Table 5. Regression results by the REM model

Source: Stata software.

Items	R-squared		Number of obs = 156 Number of groups = 26 Wald chi2(4) = 38.93 Prob. > chi2 = 0.0000			
	0.6234					
TLEV	**Coef.**	**Std. err.**	**t**	**P > |t|**	**[95% Con. Interval]**	
ROA	–0.00809	0.007644	–1.06	0.290	–0.02307	0.006893
GROW	0.000657	0.000191	3.43	0.001	0.000282	0.001032
TAX	–0.06961	0.02568	–2.71	0.007	–0.11994	–0.01928
LIQ	–0.00077	0.000233	–3.33	0.001	–0.00123	–0.00032
Constant	0.986043	0.020419	48.29	0.000	0.946023	1.026063

Table 6. Regression results of models, including Pooled OLS, FEM, and REM

Source: Stata software.

Independent variables	TLEV	Pooled OLS	FEM	REM
ROA	Beta coefficient	–0.01828	0.01693	–0.00809
	Std. Err	0.00723	0.00906	0.00764
	Value: t	–2.53	1.87	–1.06
	Prob. P	0.012(**)	0.064(*)	0.29
GROW	Beta coefficient	0.0007704	0.000632	0.000657
	Std. Err	0.00019	0.00021	0.00019
	Value: t	3.78	3.05	3.43
	Prob. P	0.000 (***)	0.003(***)	0.001(***)
TAX	Beta coefficient	–0.08413	–0.06326	–0.06961
	Std. Err	0.02619	0.02614	0.02568
	Value: t	–3.21	–2.42	–2.71
	Prob. P	0.002(***)	0.017(**)	0.007(***)
LIQ	Beta coefficient	–0.00085	–0.00055	–0.00077
	Std. Err	0.00023	0.00025	0.00023
	Value: t	–3.66	–2.25	–3.33
	Prob. P	0.000 (***)	0.026(**)	0.001(***)
Constant		1.002469	0.94764	0.986043

Note: (***) P-value coefficient < 0.01, (**) the significance level coefficient < 0.05, and (*) the p-value coefficient < 0.1.

Table 7. Test results

Source: Stata software.

F-test	Prob > F	
3.45	0.000	
Hausman test results		
Chi2	Prob > Chi2	
24.26	0.0001	
Heteroskedasticity error test results		
Chi2	Prob > Chi2	
7432.89	0.000	
The Wooldridge test	Prob: 0.1103	
VIF test results		
Independent variables	**VIF**	**1/VIF**
ROA	1.31	0.761951
LIQ	1.27	0.784929
TAX	1.04	0.958159
GROW	1.01	0.991974
Mean VIF	1.16	–
The result of a model defect was corrected by FGLS		
Index	**Regression coefficient**	**Significance**
Prob > chi2	0.000(***)	–
ROA	–0.01796	0.002(***)
GROW	0.000509	0.000(***)
TAX	–0.05967	0.001(***)
LIQ	–0.00045	0.005(***)
Constant	0.972328	0.000(***)

Note: (***) P-value coefficient < 0.01, (**) the significance level coefficient < 0.05, and (*) the p-value coefficient < 0.1.

cifically 0.0001. Therefore, the null hypothesis H_0 was rejected. This implies that the FEM model fits the data sample better than the REM model. Additionally, the FEM model was tested for homogeneity, autocorrelation between residuals, and multicollinearity, and it was found to be a good fit model. Hence, the FEM model was selected as the goodness-of-fit model.

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The Wooldridge test showed a P-value of 0.1103 > 0.05 (significant level 5%), which means that hypothesis H_0 cannot be rejected. Therefore, it can be concluded that the model does not have serial autocorrelation. The study then tested for variable variance based on the results of the F-test (see Table 7), which showed a p-value of 0.000 < 0.05. This means that H_0 should be rejected, and the FEM model is more efficient than the OLS Poole model.

The Breusch-Pagan LM test showed that the model had a P-value of 0.000 < 0.05 (significant level 5%), which means that H_0 was rejected, and H_1 was accepted, so this indicates that the model has the variable variance phenomenon.

The outcome of the Breusch-Pagan LM test showed that the model has P-value = 0.000 < 0.05 (significant level 5%), thus rejecting hypothesis H_0 and accepting hypothesis H_1, which means that the model has the phenomenon of variable variance, selecting the FEM forecast model (see Table 7).

When testing for multicollinearity, the results indicate that all independent variables have VIF values less than 2. Specifically, the variables ROA, LIQ, TAX, and GROW have VIF values of 1.31, 1.27, 1.04, and 1.01, respectively, all of which are less than 2. Therefore, the model shows no multicollinearity.

The study employed the Wooldridge and Breusch-Pagan LM tests to analyze the series correlation and variable variance in the FEM model. Thus, the Wooldridge test showed no serial autocorrelation, and the F-test revealed that the FEM model is more efficient than the OLS Poole model. The Breusch-Pagan LM test showed that the FEM model has a variable variance. Hence, the FEM forecast model can be represented as follows:

$$\begin{aligned} FEM(TLEV) &= 0.94764 + 0.01693\,ROA \\ &+ 0.000632\,GROW - 0.06326\,TAX \\ &- 0.00055\,LIQ. \end{aligned} \tag{4}$$

Empirical findings show that the TAX variable, which has a beta coefficient of –0.05967, has a negative relationship with a bank's capital structure, so the tax index helps banks avoid tax costs, but, on the contrary, reduces banks' profits and capital structure. Therefore, the manager considers taxation cost, which affects the bank's profitability and capital structure. The GROW variable has a beta coefficient of 0.000509, which has a positive relationship with banks' capital structure; thus, when banks' revenue increases, the banks' profits and capital structure increase. The LIQ variable, which has a beta coefficient of –0.00045, has a negative relationship with banks' capital structure; thus, when banks' debt increases, their capital structure decreases. Therefore, bank managers need to increase their current assets and reduce their debt to improve their capital structures. The ROA variable, which has a negative relationship with a commercial bank's capital structure, has a beta coefficient of –0.01796, so, the higher the bank's profit, the higher its profitability.

Empirical results show that the factors affect commercial banks' capital structure according to the following hypothesis: If the tax increases by 10% and other factors remain constant, the capital structure will decrease by 0.01693 + 0.000632 + (–0.06326 · 0.1) + (–0.00055) = 1.07%; If the liquidity factor is increased by 10%, other factors remain constant, and the decreased capital structure is 0.01693 + 0.000632 + (–0.06326) + (–0.00055 · 10%) = 4.58%. Based on the forecast model results, it is necessary to adjust the factors such that capital structure is the most appropriate. Commercial banks' income tax has a negative relationship with banks' capital structure, showing that the higher the income tax, the more detrimental its effect on their capital structure. Therefore, commercial banks need to constantly improve their internal control systems to identify risks, including financial ones. When promptly identifying risks, commercial banks take many measures to adjust operations and develop short-, medium-, and long-term financial planning goals for their capital source policies.

Commercial banks should improve their business performance because the ROA factor has a strong impact on capital structure and a positive relationship with capital structure (beta = 0.01693). Therefore, commercial banks can enhance their strengths and seek capital to achieve high business performance. However, commercial banks that need to mobilize capital must have specific plans to minimize bad debt. When commercial banks perform well, instead of making loans, they can utilize financial and capital resources from retained earnings, which are less expensive than debt charges, to issue new shares. However, commercial bank financial management must assess the dividend payment ratio and retained earnings to guarantee that shareholders' interests are balanced with optimal capital usage. Furthermore, when commercial banks do well in business, they can improve their credit ratings in the financial market, allowing them to raise cash from creditors and investors at a cheaper cost.

The empirical results also show that the net interest income rate (GROW) has a positive relationship with commercial banks' capital structure, meaning that commercial banks' growth is mainly based on the net interest income from lending to individuals and economic organizations. Therefore, commercial banks that want to grow quickly must increase their lending to individuals and economic entities.

Liquidity is negatively related to capital structure, although its impact on capital structure is very small, with a beta coefficient of –0.00055, indicating that commercial banks need to improve their liquidity and ensure debt from funding sources and short-term capital sources, avoiding the situation in which commercial banks are insolvent, which adversely affects capital structure. Risk managers need to manage liquidity well and simultaneously have measures to coordinate the liquidity management of assets and liabilities and asset liquidity management to take advantage of cash in the treasury and ensure mobilized capital in the economy to increase liquidity. Managers should be aware of liquidity safety risks, especially credit risk. Loan risk and liquidity risk are interconnected, as are loan growth rates. Banks have recently paid more attention to liquidity risk management. Empirical results show that three factors, GROW, TAX, and LIQ, are statistically significant in the OLS, REM, and FEM models for the ROA factor. The FEM model has some defects, such as multicollinearity, series correlations, and heteroskedasticity errors, which are difficult to overcome (see Table 7).

CONCLUSION

In the realm of commercial banking, there is a significant focus on capital structure and efficiency. The primary objective of this study is to identify ways to optimize capital use and maximize profits. This involves a range of considerations, such as determining the ideal capital size to ensure stability and control capital mobilization costs. Additionally, the study aims to increase operational efficiency, which can lead to enhanced profitability and ensure the safety of investments. By analyzing and optimizing the capital structure of commercial banks, this study identifies ways to improve long-term financial stability and growth. Empirical results based on factors affecting twenty-six commercial banks' capital structure in the 2010–2022 period, with a total of 156 observations, show that the sample size is appropriate and reliable and that the empirical results can be applied to all domestic and foreign commercial banks for reference. Although many other factors can affect capital structure, this study selected basic factors that have a major influence on capital structure. In addition, the models were also applied to choose the best model with the most accurate forecast results, and through the above-mentioned criteria, the FEM model was selected for forecasting.

Based on the capital structure methodology and empirical research in the globe and Vietnam as a foundation for building a model suitable for the research objectives, four factors affecting capital structure were identified. Bank capital in Vietnam's stock market includes tax rate (TAX), bank profitability (ROA), net interest income (GROW), and liquidity (LIQ). The empirical results suggest policies on risk management, profit growth, etc., and the study has clarified the methodology of capital structure in general, its general influencing factors, and the factors that influence commercial banks' capital structure in the Vietnamese stock market.

The empirical results are particularly useful for bank managers in Vietnam's stock market, and this study's empirical findings have significant consequences for bank managers in building an optimum capital structure. Banks in Vietnam's stock market should prioritize retained earnings or equity overborrowing. On the other hand, the experimental results show that, in addition to the above factors,

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other factors affect a banks' structure of capital in the Vietnamese stock market, such as managers' behavior, management policies, risk management, other policies, and macro policies related to the bank's development stage. In addition, several studies have also analyzed and compared the reliability of the predictive model; therefore, the experimental results mentioned above are the basis for reliable references for interested managers, readers, and investors.

AUTHOR CONTRIBUTIONS

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