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Article

Analyze the impact of factors on Vietnam banks' net interest margin: A panel data approach

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Abstract: This study deals with the impact of Vietnam bank size, loans, credit risk, and liquidity on Vietnam banks' net interest margin, which are crucial for economic development. High profit margins result in a lower bad debt ratio due to timely loan collection and good liquidity. This study applies a panel data model to evaluate the relationship among bank size, loans, credit risk, liquidity, and marginal profitability, which are increasingly important in commercial bank growth. Data were collected from 2010 to 2022, and test methods were applied to select a good-fit model. Realizing that the factors that have a close correlation and affect the profit margin are 33.6% and 16.07%, 75.2%, 37.51%, 64.30%, and 41.11%, and R2 is 59.04%, respectively, this suggests that financial managers need to develop appropriate strategies and policies to adjust the factors that adversely affect commercial bank profitability.

Keywords: panel data; bad debt; credit risk; profitability; commercial banks
JEL Classification: G21; G32; O16

1. Introduction

Vietnam commercial banks are intermediary organizations that balance the economy and are the main source of capital financing. Therefore, they must operate smoothly, effectively, and safely to maintain funds and promote economic development. The main activities of Vietnam commercial banks are mobilizing capital and lending to generate profits, and these activities have many potential risks, causing unsafety in the banking system. However, commercial banks also benefit customers, including depositors and borrowers, as well as Vietnam commercial banks through the difference in interest earned.

Various factors affect the profitability of commercial banks in Vietnam. The primary factors that have a positive correlation with bank profitability are loans to total assets, credit risk provisions on loans, interest expenses on debt, and non-interest income on assets. Conversely, non-performing loans, operating expenses on revenue, and board size have a negative correlation with bank profitability. Hence, it is crucial for commercial banks in Vietnam to carefully consider these factors to enhance profitability. Vietnam's banking operations can be divided into two main categories: Credit activities, which generate marginal profits, and service activities, which generate service profits. This basic difference distinguishes banks from other businesses because credit activities constitute the foundation of commercial banking. Thus, the study's evaluation of the net interest margin (NIM) is reasonable and pertinent in the present banking context.

Vietnamese banks continue to maintain high net interest margins (NIM), especially when it comes to deposit mobilization. This places pressure on them to sustain their current NIM levels. According to an article on the Economy, the Q3/2021

profit of the entire banking industry, including 27 listed banks, decreased by 16% compared with the previous quarter. However, it increased by 19% compared to the same period last year, as per the most recent statistics from Yuanta securities. The rise in profit compared to the same period last year is mainly due to higher net interest income. However, the decline in profit compared to the previous quarter is due to a reduction in net interest income, fee income, and income from bad debt processing. In Q3/2021, net interest income recorded mixed results, decreasing by 7% compared with the previous quarter and increasing by 20% compared with the same period in the previous year. The decline in net interest income compared to the previous quarter is due to a slowdown in credit growth and a decrease in lending rates. To maintain high NIM levels, banks must carefully balance their deposit mobilization strategies and lending rates.

Risk management plays a crucial role in determining the success of banking activities. The unpredictable and ever-changing nature of the financial market makes it essential to establish a solid legal framework to ensure the banking system's safety and stability while protecting the economy. The Basel committee on banking supervision defines operational risk as the possibility of loss resulting from causes, such as human error, incomplete or improper operation of processes and systems, and external events. Credit and liquidity risks are associated with banking operations. To ensure operational efficiency and safety, effective risk management in commercial banks involves identifying, preventing, and promptly resolving risks to minimize losses. Vietnam has issued legal regulations to govern bank credit activities and facilitate effective risk management.

To minimize the financial risk of the banking system, this study explores the difference between total interest revenue and total interest expense paid on average total earning assets, called the net interest margin (NIM), which reflects each bank's efficiency and profitability, recently, the COVID-19 pandemic has negatively impacted the economy, which the banking industry is also affected. It is necessary to explore the factors that affect commercial banks' marginal interest income; thus, this study aims to determine the factors affecting the rate of their marginal profit, examine the influence of factors affecting the marginal interest rate, and propose recommendations based on the empirical results to increase commercial banks' marginal profit. In addition, the study examined whether these factors affect commercial banks' NIM, and the degree of influence of each factor on their marginal interest income is a problem that must be resolved; therefore, this study applied models such as the Pooled OLS (Ordinary Least Squares) Model, FEM Model (fixed-effects model), REM Model (Ram Effects Model), and tests of related hypotheses to select a goodness fit model. The remainder of the paper is structured as follows: Section 2 presents a literature review, section 3 explains the data and methodology of economics, section 4 summarizes the results, section 5 discusses the findings, and the final section presents the conclusions.

2. Review of literature

Previous studies have demonstrated that various factors, both inside and outside the bank, affect bank profitability such as size, credit risk, non-interest income, non-

interest expenses, and the equity-to-total-assets ratio are internal variables, while external influences include inflation and economic growth (Harding et al. 2013; Ghosh and Chatterjee, 2018).

Research by Ho and Saunders (1981) is the issues that many studies consider the factors affecting the NIM of commercial banks. For example, Allen (1988) explored more types of loans with interdependent demand, concluding that NIM can be reduced when there is demand elasticity between the bank's products (Allen, 1988; Ho and Saunders, 1981). In addition, Angbazo (1997) added default risk factors to the model, and Saunders and Schumacher (2000) continued to develop research directions to determine the factors affecting NIM and applied the theoretical model from previous studies (Dinh, 2023; Angbazo, 1997; Saunders and Schumacher, 2000; Hauner and Peiris, 2008). Allen (1988) examined banking systems in the US and six European countries in the years 1988–1995 (Allen, 1988). Brock and Suarez (2000) also applied a theoretical model to Latin American countries (Brock and Suarez, 2000; Sufian and Habibullah, 2014). Maudos and de Guevara (2004) also extended the theoretical model by considering the importance of operating cost as a determinant of the interest margin rate and estimated it for the banking sector in Europe for the period 1992–2000. According to Mody and Peria (2004) and studies on the impact of foreign bank involvement and concentration on the marginal interest rate of banks in Latin America, foreign banks have lower costs than internal banks (Mody and Peria, 2004; Maudos and Solís, 2009; Wojewodzki et al., 2020). Islam and Nishiyama (2016) also studied the factors affecting NIM in South Asian countries in the period 1997–2012 and showed that they have a close relationship.

In the other studies, Garza-García (2010) also conducted research on the factors affecting profitability in developed and developing countries, including Canada, Colombia, Australia, Brazil, Slovakia, Spain, Hungary, Poland, Peru, Mexico, New Zealand, the USA, and the UK, for the period 2001–2008 (Garza-García, 2010; Maudos et al., 2002). In addition, Kasman et al. (2010) pointed out the effects of financial reform on the profitability of commercial banks of EU member states in the period 1995–2006 (Kasman et al., 2010; Diamond and Rajan, 2002). Besides, Gounder and Sharma (2012) analyzed the profitability of banks in Fiji in the period 2000–2010 by developing a panel data model (Garza-García, 2010; Gounder and Sharma, 2012), and according to Hamadi and Awdeh (2012), they pointed out the factors affecting the profitability of banks in Lebanon in the period 1996–2009 (Hamadi and Awdeh, 2012). In addition, studies have shown that having shown that loan-to-deposit ratios and management efficiency affect NIM, while factors such as bank size, credit risk, bank capital, and inflation have the opposite effect. and Akinlo and Oni (2015) and Lestari et al. (2021) also studied the factors affecting the credit growth of commercial banks in Nigeria from 1980 to 2010 (Lestari et al., 2021; Dawood et al., 2022). Banks' total assets are an important basis for not only financial stability but also credit growth; thus, Maudos and Solís (2009) developed a research model on the profitability of commercial banks by combining the original model of Doliente (2005) and several pre-existing studies covering the banking system in Mexico during 1993–2005 with 43 commercial banks (Maudos and Solís, 2009; Doliente, 2005; Ayalew and McMilla, 2021). From this, it can be seen that operating costs and interest rate risk have a positive influence on bank profits, while some variables represent governance quality.

Potential interest rates have also been studied to explore their impact on bank profits (Maudos and de Guevara 2004; Asaleye et al., 2018; Haqi and Suseno, 2019). According to (Abu-Alrop, 2020), the risk efficiency assessment of 85 Russian commercial banks and the application of data envelope analysis (DEA) with financial ratios were used to assess the risk efficiency of Russian banks; the results show that the impact of credit, operational, and liquidity risks on the performance indicators of Russian banks is positive and significant, which is similar to some studies (Alipour et al., 2015; Dinh, 2019c; Allen et al., 2015). However, the impact of leverage and risky interest rates on the performance indicators of Russian banks is limited and negative. Studies have also investigated the profitability of commercial banks and determined the factors that influence it (Aisen and Franken, 2010; Al-Homaidi et al., 2018; Dinh, 2020b; Ding and Sickles, 2018).

The difficulties demonstrate that there is considerable debate regarding the marginal profit of bank systems and the affecting factors, with each study focusing on a different topic. However, a literature analysis serves as the foundation for examining how these factors affect the marginal profit of bank systems, to help the government modify monetary policy, this study aims to ascertain how these factors affect the marginal profitability of commercial banks and develop a forecast model suitable for economic growth.

3. Methodology

Analyzing the impact of credit risk on the financial performance of commercial banks in Vietnam is the primary objective of this research. This study identifies several factors that affect bank profitability and credit risk such as credit growth, bank size, GDP, and inflation. Several solutions can be applied to increase a bank's NIM in a balanced way without affecting its liquidity, including increasing the loan ratio with higher interest rates, reducing capital mobilization costs, and increasing the demand deposit ratio.

The term "bank size" refers to the overall assets of a bank, which includes customer deposits, loans, and other investments. When banks lend money to customers, this is referred to as "loans". Credit risk arises from a borrower's failure to comply with credit contract terms. Liquidity margins refer to a bank's ability to convert assets into cash to pay debts and liabilities within a specific timeframe.

This study collected panel data by observing the variables over time at a regular frequency. This data can be used to establish trends and correlations and guide further analysis. Panel data models provide information on bank size, loans, credit risk, and liquidity on the profit margins of individual commercial banks across time, with both cross-sectional and time-series dimensions. The data can be balanced when all individuals are observed in all periods or unbalanced when individuals are not observed in all periods. In addition, panel data analysis involves two types of modeling approaches: Linear and nonlinear, depending on the linearity of the regression parameters, which are applied based on the research question and nature of the data (Ba et al., 2021).

- What bank size, loans, credit risk, and liquidity affect marginal profits?
- Which model is suitable for exploring bank size, loans, credit risk, and liquidity?

- What are the solutions for commercial bank managers?

Commercial banks' business activities, the lending business, play a significant role and contribute to the economic growth of countries; however, whether the lending activity is as effective as its role depends entirely on the risk management capabilities of commercial banks. Commercial banks not only have the sole goal of profit but must also ensure safety and set the goal of maintaining the commercial bank's liquidity; therefore, they need to be subject to the principle of trade-off, while loans provided by commercial banks to customers are considered illiquid assets. This study applied seven independent variables and one dependent variable, which are calculated in **Table 1**.

Table 1. Description of variables.

Variables	Description	Calculation formula
NIM	The Net Interest Margin (NIM)	Net interest margin ratio = (Income − expenses)/average total profitable assets
SIZE	The size of a bank	Banks' Size = Logarithm (Total assets)
LOAN	A bank loan	Credit growth = Loan balance/total assets
CRISK	The term "risks"	CRISK = Provision expense for credit risk/total loan balance
LOAN × CRISK	The loan is multiplied by the risk	Interaction variable between loan size and credit risk
CAP	The size of a bank's equity	Equity size = Equity/Total assets
LIQ	Having liquidity is essential for a bank	Liquidity = Liquid assets/total assets
EFF	Effective bank management	Operating expenses/total operating income

With the goal mentioned above, the model can be written as follows:

$$\mathrm{NIM} = \propto_0 + \beta_1 \mathrm{SIZE} + \beta_2 \mathrm{LOAN} + \beta_3 \mathrm{CRISK} + \beta_4 (\mathrm{LOAN.CRISK}) + \beta_5 \mathrm{CAP} + \beta_6 \mathrm{EFF} + \beta_7 \mathrm{LIQ} + \varepsilon_i$$

3.1. Hypotheses

1) Using the Hausman test and the *F*-Test with a 1% significance level, 5% or 10% were used to identify statistically significant independent variables, explain the dependent variable, and choose between FEM and REM.
2) If hypothesis H_0 Select the REM model where there is no correlation between the independent variables and random components.
3) If hypothesis H_1: Select the FEM model where there is a correlation between the independent variables and random components.
4) If the test value *Prob* < α (5%): Reject H_0 and choose H_1; if test value *Prob* > α (5%): Accept H_0.
5) Applying the *F*-test to select the OLS and FEM models.
6) If hypotheses H_0: Select OLS models; H_1: Selection of FEM model. If the test value *Prob* < α (5%), H_0 and H_1 are rejected, and the FEM model is suitable for the research model.
7) If hypothesis the *Prob* test value > α (5%), the Accept H0 and OLS models are suitable.
8) The Hausman test is applied to choose between the FEM model and REM model with level $\alpha = 0.05$, and the following two hypotheses are applied:
9) If hypotheses H_0: There is no correlation between the independent variables and the random component to select REM.
10) If hypothesis H_1: There is a correlation between the independent variables and

random component to select the FEM.

11) The basis for accepting or rejecting the above pair of hypotheses is the result of the Hausman test; if the *P*-value of the Hausman test is less than 5%, hypothesis H_0 is rejected, and hypothesis H_1 is accepted. Conversely, if the *P*-value of the Hausman's test was greater than 5%, hypothesis H_1 was rejected, and hypothesis H0 was accepted. In addition, the *F*-test to choose between the OLS model and the FEM model: *F*-test by Likelihood Ratio method (LR test) to compare the two models: Pooled OLS and FEM at the 5% level:
12) If hypothesis H_0: The Pooled OLS model is more efficient than the FEM model.
13) If H_1: The FEM model is more efficient than the Pooled OLS model. To evaluate whether the REM model has variable variance, the study applied the Breusch-Pagan Lagrange multiplier test, with the level $\alpha = 0.05$, considering the following two hypotheses:
14) If hypotheses H_0: Has constant variance (*P*-value > 0.05)
15) If hypothesis H_1: There is heteroscedasticity.
16) To determine the variables and data collected using descriptive statistical modelling, descriptive statistics help describe and understand the properties of a particular dataset by providing short summaries of the data samples and parameters. Trend of the concentration of values, such as the mean, maximum, minimum, standard deviation, and observation coefficient. Multicollinearity and correlation matrix tests were applied to determine whether the model had multicollinearity, and whether the correlation test was closely related to the independent variables. Thus, this study could determine the linear relationship between the independent and dependent variables based on a given confidence interval, and a model correlation exists between the representative variables. The limited correlation coefficients from −1 to 1 indicate that these two variables have an absolute relationship and a value of 0 indicates that there is no relationship between the variables. The relationship of the correlation coefficient indicates a positive or negative relationship between variables; if the variables are positive, the two objects will increase, and vice versa, or the more one variable increases, the other decreases when there is a negative relationship, which is the correlation matrix model that reflects the linearity of the regression model. If the correlation coefficient was greater than 0.8, the model was considered to have multicollinearity, and multiple regression analysis (OLS), fixed effects analysis (FEM), and random effects (REM) were estimated and tested for model defects, including variable variance and autocorrelation. If there are defects, they are overcome by the FGLS random estimation method to obtain the final regression result.

3.2. Data set

Secondary data of 13 banks listed on the stock market in Vietnam in 12 years from 2010 to 2022. Thus, the sample size of the study was 156 (13 samples × 12) (**Table 2**).

Table 2. List of 13 banks listed on the stock market in Vietnam.

Item	Stock code	Bank name
1	ACB	Asia Commercial Joint Stock Bank
2	BID	Joint Stock Commercial Bank for Investment and Development of Vietnam
3	EIB	Vietnam Export-Import Commercial Joint Stock Bank
4	HDB	Ho Chi Minh City Development Joint Stock Commercial Bank
5	LPB	Lien Viet Post Commercial Joint Stock Bank
6	MBB	Military Commercial Joint Stock Bank
7	MSB	Vietnam Maritime Commercial Joint Stock Bank
8	STB	Saigon Thuong Tin Commercial Joint Stock Bank
9	TCB	Vietnam Technological and Commercial Joint Stock Bank
10	VIB	Vietnam International Commercial Joint Stock Bank
11	VCB	Joint Stock Commercial Bank for Foreign Trade of Vietnam
12	CTG	Vietnam Joint Stock Commercial Bank for Industry and Trade
13	VPB	Vietnam Prosperity Joint Stock Commercial Bank

Recently, the banking industry in Vietnam has experienced significant growth. When choosing a Vietnamese bank, it is crucial to consider factors, such as financial stability and good customer service. Currently, thirty-one joint-stock commercial banks operate in Vietnam, with a focus on the thirteen largest banks for sample collection, as they have a significant impact on the country's economy.

4. Findings

Statistics aim to describe variables more clearly after collecting, synthesizing, and processing the data, thus, through descriptive statistics (see **Table 3**), the mean and standard deviation of the research variables.

Table 3. Statistical description.

Variables	Mean	Max	Min	Std. Dev.	Obs.
NIM	0.0662	0.1776	0.0087	0.0258	156
SIZE	8.3968	9.2459	7.5364	0.3739	156
LOAN	0.5677	0.8006	0.2252	0.1349	156
CRISK	0.0169	0.1915	0.0010	0.0243	156
CAP	0.0821	0.1697	0.0348	0.0251	156
LIQ	0.0470	0.1219	0.0125	0.0220	156
EFF	0.4789	0.8695	0.2419	0.1218	156

The results of the descriptive statistical analysis of the variables in the model are as follows:

Marginal interest income (NIM) is the dependent variable. NIM has an average value of 6.62%, indicating that commercial banks in Vietnam ensure effective profitability during their operations. Bank size (SIZE) is the independent variable, and SIZE ranges from the lowest level of 7.5364 to the highest level of 9.2459, showing that the analysis results show the diversity of the size of commercial banks in Vietnam.

Loan size (LOAN), with an average value of 56.77%, indicates that the asset structure of listed commercial banks mainly focuses on loans. This is an important basis for generating profit during the operation of commercial banks. Credit risk (CRISK): The research result is 1.6%, and it can be seen that, on average, commercial banks in Vietnam will lose 1.6 unit of 100 units of loans (Fungáčová and Poghosyan, 2011). Liquidity (LIQ): With an average value of 4.7% and a standard deviation of 2.2%, there is a large difference in the liquidity ratio among commercial banks in Vietnam.

Operational management efficiency of commercial banks (EFF): According to the statistical results, commercial banks listed on Vietnam's stock market have not been implemented effectively in terms of operational management. This is reflected in the mean of 47.89% (operating expenses are only approximately a quarter of the operating income of commercial banks), with a standard deviation of 12.18%. The correlation coefficient matrix shows the relationships between the variables in the model, and the study analyzed the correlation coefficients between the dependent and independent variables in the model (see **Table 4**).

Table 4. Correlation matrix between variables.

	NIM	**SIZE**	**LOAN**	**CRISK**	**CAP**	**EFF**	**LIQ**
NIM	1000	-	-	-	-	-	-
SIZE	0.3360	1000	-	-	-	-	-
LOAN	0.1607	0.6898	1000	-	-	-	-
CRISK	0.7520	−0.1119	−0.3453	1000	-	-	-
CAP	0.3751	−0.3410	−0.2643	0.2011	1000	-	-
EFF	0.6430	0.0064	0.0824	−0.1546	−0.0684	1000	-
LIQ	−0.4111	−0.4303	−0.1484	0.0966	−0.0898	−0.0986	1000

Source: Results on Stata 14 software.

The independent variable SIZE has a positive correlation with the dependent variable NIM of 0.3360 at the 1% significance level, showing the fluctuation in commercial bank size with the fluctuation in profit margin for listed commercial banks. The Vietnamese stock market has a positive relationship and the independent variable LOAN has a positive correlation with the dependent variable NIM is 0.1607 at the 1% significance level, indicating that loan size volatility is positively correlated with the NIM volatility of commercial banks. The independent variable CRISK is positively correlated with the dependent variable NIM of 0.7520, indicating that volatility in credit risk is positively related to the volatility of commercial banks' marginal interest income. The independent variable CAP has a positive correlation with the dependent variable NIM (0.3751), indicating that the ratio of equity to total assets has a positive relationship with the marginal interest income of commercial banks. As the equity ratio increases, the banks' marginal interest income also increases. The EFF independent variable had a positive correlation with the NIM dependent variable of 0.6430, and the LIQ independent variable had a negative correlation with the NIM-dependent variable of −0.4111 at the 1% significance level. The results show that the correlation between the dependent and independent variables determines the phenomenon of multicollinearity in the research model, and all correlation coefficients have values

less than 0.8. Thus, it can be concluded that the research model does not have serious multicollinearity and that the variables are suitable for running the regression model. As the equity ratio increases, the banks' marginal interest income also increases, the EFF independent variable adds a positive correlation with the *NIM* dependent variable of 0.6430, and the *LIQ* independent variable has a negative correlation with the *NIM*-dependent variable of −0.4111 at the 1% significance level. The correlation between the dependent and independent variables to determine the phenomenon of multicollinearity in the research model shows that all the correlation coefficients have values less than 0.8. Therefore, it was concluded that the research model did not have a serious multicollinearity phenomenon, and the variables were suitable for running the regression model. As the equity ratio increases, banks' marginal interest income also increases; the EFF independent variable has a positive correlation with the *NIM* dependent variable of 0.6430, and the *LIQ* independent variable has a negative correlation with the *NIM*-dependent variable of −0.4111 at the 1% significance level. In addition, the correlation between the dependent and independent variables to determine the phenomenon of multicollinearity shows that all the correlation coefficients have values less than 0.8, indicating that the research model does not have a serious multicollinearity phenomenon, which is suitable for running the regression model (Leykun, 2016). The study will conduct regression according to Pooled OLS, FEM and REM methods, and the study will then use the Hausman test, *F*-test, and LM to choose which regression method is considered the most suitable.

The empirical results show that in the OLS model, with the observed variables, the dependent variable explains 62.36% (*R*-Squared) or 60.58% after adjusting (Adj *R*-squared), and the change in the independent variable occurs clearly (0.01622). The F index reached 35.02, and after testing the model again, we can see that the *R*-squared value in the OLS regression model is significant at $Prob > F = 0.0000 < 5\%$; thus, this regression model is satisfied according to the proposed independent variables with significance level $\alpha = 5\%$, all variables have *P*-value system with variable *LOAN* (0.477) > 0.05, so LOAN variable in OLS regression model does not affect NIM. In addition, the model results show that *LOAN*, *LOAN* × *CRISK*, *CAP*, and *LIQ* have positive regression coefficients, so these factors have a positive influence on the dependent variable *NIM*, and vice versa. The variables *SIZE*, *CRISK*, and *EFF* have a negative relationship; thus, these variables have a negative effect on the dependent variable NIM. The empirical results show that in the FEM model, with the observed variables, the dependent variable explains 56.77% (*R*-squared overall) of the change in the independent variable with the *F* index achieving 27.54, and the *R*-squared in this REM model is significant with $Prob > F = 0.0000 < 5\%$; this model is meaningful and exists with significance level $\alpha = 5\%$, all variables have *P*-value system < 0.05 with variables *SIZE* (0.403), *LOAN* (0.335), *LIQ* (0.132) greater than 0.05, so these variables in the FEM forecast model are not affecting the *NIM* variable. In addition, the variables *LOAN*, *LOANN* × *CRISK*, *CAP*, and *LIQ* have positive signs; therefore, these variables have a positive impact on the dependent variable NIM, and vice versa, the variables *SIZE* and *CRISK* (Obeid and Adeinat, 2017) (see **Table 5**).

Table 5. Synthetic Statistical tests.

Regression results according to Pooled OLS method			
source	*SS*	*DF*	*MS*
model	0.0645	7	0.0092
residual	0.0389	148	0.0002
total	0.1034	155	0.0006
Number of orbs = 156; *F* (7.148) = 35.02; *Prob* > *F* = 0.0000; *R*-squared = 0.6236; Adj *R*-squared = 0.6058; Root *MSE* = 0.01622			
Regression results by FEM method			
Targets		*R*-squared	
within		0.5863	
between		0.5556	
overall		0.5677	
Number of orbs = 156; Number of groups = 13; *F* (7.136) = 27.54; *Prob* > *F* = 0.0000			
Regression results according to the REM method			
Targets	*R*-squared	Number of orbs = 156 Number of groups = 13	
Within	0.5845	Wald chi2(7) = 208.53	
Between	0.6129	*Prob* > *F* = 0.0000	
Overall	0.5904	*Prob* > chi2 = 0.0000	

Source: Results on Stata 14 software.

The empirical results of the REM method show that, with the observed variables, the dependent variable explains 59.04% (*R*-squared overall) of the change in the independent variable, and Wald test chi2 achieved 208.53, indicating that the *R*-squared in the REM model is significant with *Prob* > *F* = 0.0000 < 5%; therefore, this model is meaningful and exists. Furthermore, at the significance level α = 5%, all variables have a *P*-value system with variable *SIZE* (0.132), *LOAN* (0.275) > 0.05, so these variables according to the REM model have no effect on the independent variable *NIM* and the variables *LOAN*, *LOAN* × *CRISK*, *CAP*, and *LIQ* have a positive relationship, so these variables have the same effect as the dependent variable NIM, and vice versa; *SIZE*, *CRISK*, and *EFF* have negative relationships, so they have a negative effect on the dependent variable *NIM* when considering the impact of factors on commercial banks' rate of marginal profit in the market (see **Table 6**).

The empirical results of the FEM show that all three models have the variables *SIZE*, *LOAN CRISK*, *LOAN* × *CRISK*, *CAP*, *LIQ*, and *EFF* are statistically significant at the 1% level, with statistical significance at 1%, while the variables *SIZE*, *LOAN*, *LIQ* that do not statistical significance, empirical results of *LOAN*, *CAP* is all accepted to explain the *NIM* variable with statistical significance at 1%, and the *LIQ* variable has a statistical significance at 10% and the other variables have statistical significance but *SIZE* and *LOAN* do not statistical significant. Thus, to select the appropriate model, the study compared the OLS model with FEM using the *F*-test and compared the FEM model with REM using the Hausman test. The empirical results also show that the *p*-value is 0.0000 < 0.05, which rejects the hypothesis H_0 that the OLS model is more efficient than the FEM model. Thus, the FEM model was more efficient than the

Pooled OLS model. Therefore, the FEM model was used for comparison with the REM model to decide which model would be the most effective of the three models. The value of Prob after the Hausman test is 0.4886, which is greater than 0.05. Therefore, we do not use hypothesis H_1 and choose hypothesis H_0, which shows that the REM model is more suitable than the FEM model for forecasting (see **Table 7**).

Table 6. Regression results by OLS, FEM, REM methods.

Independent variables	Targets	Pooled OLS	FEM	REM
SIZE	Coefficient β	−0.0213	−0.0059	−0.0099
	Standard deviation	0.0061	0.0070	0.0066
	Value *t*	−3.50	−0.84	-
	Value *P*	0.001(***)	0.403	0.132
LOAN	Coefficient β	0.0126	0.0167	0.0182
	Standard deviation	0.0177	0.0172	0.0167
	Value *t*	0.711	0.97	-
	Value *P*	0.477	0.335	0.275
CRISK	Coefficient β	−1.1579	−0.167	−0.7676
	Standard deviation	0.1591	0.1523	0.1486
	Value *t*	−7.27	−4.59	-
	Value *P*	0.000(***)	0.000(***)	0.0000(***)
LOAN × CRISK	Coefficient β	4.3066	−0.6987	3.1506
	Standard deviation	0.4613	0.4664	0.4519
	Value *t*	9.33	6.30	-
	Value *P*	0.000(***)	0.000(***)	0.000(***)
CAP	Coefficient β	0.2033	0.2365	0.2345
	Standard deviation	0.0598	0.0567	0.0552
	Value *t*	3.40	4.17	-
	Value *P*	0.001(***)	0.000(***)	0.000(***)
LIQ	Coefficient β	0.1595	0.0826	0.0966
	Standard deviation	0.0620	0.0544	0.0537
	Value *t*	2.57	1.52	-
	Value *P*	0.011(***)	0.132	0.072(*)
EFF	Coefficient β	0.2200	−0.0595	−0.0577
	Standard deviation	0.0145	0.0133	0.01311
	Value *t*	−3.26	−4.462	-
	Value *P*	0.001(***)	0.000(***)	0.000(***)

Note: (***) *P* Value coefficient less than 0.01, (**) *P*-value coefficient less than 0.05, (*) *P*-value coefficient less than 0.1. Source: Results on Stata 14 software.

There are many ways to evaluate the degree of multicollinearity, such as a high correlation coefficient between independent variables and sub-regression, based on the variance exaggeration factor (VIF); however, this study chooses the coefficient of variance exaggeration VIF method to check for multicollinearity of the model.

Table 7. Synthetic Statistical tests.

***F*-test results**	
F-Test	*Prob* > *F*
8.07	0.0000
Hausman-test results	
Spend 2	Prob > Expense 2
6.45	0.4886
Results of the series correlation test	
F (1,12)	*Prob* > *F*
64,108	0.0000
The results of the test of heteroskedasticity	
Chi2	*Prob* > Chi2
72.82	0.0000

Source: Results on Stata 14 software.

Table 8. VIF test results.

Independent variables	**VIF**	**1/VIF**
SIZE	8.86	0.1128
LOAN	8.04	0.1244
CRISK	3.38	0.2959
LOAN*CRISK	3.07	0.3253
CAP	1.86	0.5367
LIQ	1.34	0.7489
EFF	1.11	0.9034
Mean VIF	3.95	

Source: Results on Stata 14 software.

The results (**Table 8**) show that the variance exaggeration coefficient VIF of the above variables are all less than 10, so the model can be concluded that it has not had the phenomenon of multicollinearity, so it is affected by series correlation; thus, the study applied the Woolridge test, with the level $\alpha = 0.05$, to consider a pair of hypotheses, and the results show that the dependent variable model has *P*-value = 0.000 < 0.05 (with a significance level of 5%), therefore, this is the basis for concluding that the hypotheses H_1 is accepted. The results of the Breusch-Pagan LM test for the model have *P*-value = 0.000 < 0.05, with a significance level of 5%, hypothesis H_0 is rejected, and hypothesis H_1 is accepted. After testing for defects, the model was entangled with multicollinearity and series correlation and heteroscedasticity was observed, causing error variance in the model. After assessing the multicollinearity and heteroskedasticity tests, the empirical result shows that the phenomenon of heteroskedasticity has occurred. Thus, to overcome this phenomenon, the study applied Feasible Generalized Least Squares (FGLS) to select the goodness fit model (**Table 9**).

The forecast regression model is applied using the REM model in the following form: $NIM = 0.1508573 - 0.0123987 \times SIZE + 0.002928 \times LOAN - 0.6907247 \times CRISK + 32.773547 \times (LOAN \times CRISK) + 0.2455527 \times CAP + 0.0534824 \times LIQ -$

0.0377698 × *EFF*.

Table 9. Model estimation results by feasible generalized least squares method (FGLS).

NIM	Regression coefficient	*P* > |z|
SIZE	−0.0123987	0.037
LOAN	0.002928	0.859
CRISK	−0.6907247	0.000
LOAN CRISK	2.773547	0.000
CAP	0.2455527	0.000
LIQ	0.0534824	0.124
EFF	−0.0377698	0.002
CONS	0.1508573	0.002

Source: Results on Stata 14 software.

The empirical results show that factors such as *SIZE*, *CRISK*, *LOAN* × *CRISK*, *CAP*, and *EFF* affect the *NIM* variable with 5% significance, while the remaining two factors have no statistical significance: The *LOAN* × *CRISK*, *CAP*, and *LIQ* variables have a positive influence on the marginal income ratio, while the *SIZE*, *CRISK*, and *EFF* factors have a negative relationship.

The efficiency in this study was measured by factors, specifically *NIM* = 0.1508573 − 0.0123987 × *SIZE* + 0.002928 × *LOAN* − 0.6907247 × *CRISK* + 32.773547 × (*LOAN* × *CRISK*) + 0.2455527 × *CAP* + 0.0534824 × *LIQ* − 0.0377698 × *EFF*. Thus, if the study wants to know which factor affects efficiency (MIN) by allowing that factor to fluctuate, other factors remaining unchanged, the assumption that risk impact analysis (CRISK) increases to 3%, the level of impact on profitability is: *NIM* = 0.1508573 − 0.6907247 × 0.03 = 0.13, this shows that when risk increases by 3%, profitability (NIM) decreases by 13%, To analyze other factors, they are analyzed similarly.

5. Discussion

The third quarter of 2022 witnessed a sharp increase in the net profit margin (NIM) of banks in Vietnam, which has been consistently high. According to the FiinGroup data, the NIM of 19 listed banks rose by 0.097% compared to the previous quarter, reaching 0.89%. This indicates an all-time high quarterly NIM level and a significant jump since the first quarter of 2022, which had seen strong growth in the banking industry. However, the lending interest rate reduction to support customers during the pandemic period had a negative impact on banks' interest income in the third quarter. By 2022, the on-balance sheet bad debt ratio of Vietnam's entire banking system was 1.89%. Unfortunately, the bad debt of banks in Vietnam increased by around 30% after nine months of 2022 due to the effect of the COVID-19 pandemic.

The empirical results helped to explore the factors affecting the NIM of commercial banks, based on inheriting what has been done in previous literature, which has built a model and identified the factors affecting the NIM of 13 commercial banks in Vietnam from 2010 to 2022. In the initial research model, the study identified

seven factors affecting the *NIM* of commercial banks: *SIZE*, *LOAN*, *CRISK*, *LOANCRISK*, *CAP*, *LIQ*, and *EFF*. The empirical results show that the factors affecting the marginal income ratio of commercial banks are *SIZE* with a Beta coefficient of −0.0123987, *LOAN* is 0.002928, *CRISK* is −0.6907247, *LOANCRISK* is 2.773547, *CAP* is 0.2455527, *LIQ* is 0.0534824, and the final *EFF* is −0.0377698. Based on the research results, this study proposes recommendations to help Vietnamese commercial banks develop appropriate policies and strategies to increase their revenue marginal interest income ratio (Dinh, 2019b; Nourani et al., 2019).

The results show that commercial bank size has a negative relationship with the marginal income ratio of commercial banks, which is different from the expectation that when commercial banks expand their scale through forms such as expanding market share to reach more customers and brand identity, they improve the image and reputation of the bank for customers, thereby making the most of the advantages and resources to develop NIM. However, the results are contrary and show that banks need to reduce their growth in scale to reduce costs and loan size, control risks favorably, and advance governance to ensure sustainable development (Dinh, 2020a; Islam and Nishiyama, 2016).

The empirical results show that the lending size of commercial banks has a positive effect on the marginal rate of income, indicating that commercial banks need to expand and strengthen their lending activities, such as by expanding lending in areas with growth potential, bringing new loan products suitable for each customer, and being in line with the country's economy. In addition to the development of loan size, banks must strengthen measures to strictly control the risks of loans, such as introducing more lending conditions, regulations on approval authority, assessing the debt repayment capacity of customers, and building a credit rating system (Dinh, 2021; Zhou and Wong, 2008).

Based on these results, the marginal income ratio of commercial banks is negatively affected by credit risk, which shows that if commercial banks control credit risk well, bad debts will be limited, so provisions will be less than guaranteed in terms of banks' profits. To control credit risk effectively, commercial banks need to establish reasonable credit policies, including policies on asset size, customers, interest rates, rating systems, and customer credit ratings. In addition, it is necessary to reasonably value collateral assets with market value to ensure risks, creating a basis for commercial banks to recover the debt that they have lent to customers (Dinh, 2019a; Gropp and Heider, 2010). If credit risks occur, banks should conduct early debt collection with positive measures, when customers face financial difficulties due to unfavorable business situations, especially since the COVID-19 epidemic season has passed through our country, the bank can apply measures such as: advising customers to help customers, borrowed to restore the business situation based on the understanding of customers and the market, debt extensions for customers, and restructuring loans for customers (Mishkin, 2013). For unrecoverable debts, it is necessary to apply flexible and liquidate assets through measures such as banks persuading customers to sell collateral by themselves and reach agreements with authorized customers, in addition to selling the property to recover the debt and using legal measures to recover the loan (Dinh, 2022; Akinlo and Oni, 2015). The empirical results show that equity has a positive impact on the marginal income ratio; the higher

the equity, the higher is the marginal income ratio of commercial banks. trade increases. The increase in CAP has many directions: issuing more shares, attracting foreign investors by selling shares, paying dividends in stock, and using additional surplus to equity (Dinh, 2023). Measures must be taken to increase the size of equity capital, especially the strengths of each commercial bank and the economic circumstances. This ensures that the bank's capital is stable and creates a foundation for long-term development. The research results show that liquidity has a positive impact on the NIM of commercial banks, which explains why the income from commercial banks' business activities must go hand in hand while maintaining high liquidity, thereby building customer confidence. Hence, the business will be easier to implement in business activities. The fact that the research results show that bank management has a negative relationship with the marginal rate of income is contrary to the expectations of this study. Commercial banks need to focus on developing and improving the level of leadership, improving the quality and professionalism of employees by opening quality training classes, and fostering and sharing management experience. Review the operation of the systems, costs, and annual expenditures so that they are reasonable, such as capital restructuring, rearranging the operating apparatus, and arranging departments so that they can reduce employee costs and upgrade automation systems to limit hiring too many personnel.

6. Conclusion

The empirical results reveal that a bank's net interest margin (NIM) is a critical factor in boosting profits. NIM is a profitability measure that compares lending interest rates to savings interest rates. A higher NIM level indicates higher profitability. However, NIM is impacted by various factors such as capital costs, operating costs, bad debt ratio, and other economic factors. Furthermore, experimental findings demonstrate that risk management is a scientific process that enables banks to identify, control, and prevent risks. It also reduces losses and negative impacts that can harm banks. The forecasting models' outcomes are utilized to transform risks into profitable opportunities for banks. Therefore, risk management is crucial for banks as it directly affects their business operations.

This is based on the literature and has selected and inherited empirical studies in the world and studies in Vietnam as a basis for this study to build a research model that identifies seven factors affecting the rate of interest income. These results can provide useful theories for managers of joint-stock commercial banks in Vietnam, and the empirical evidence of this study has important implications for bank managers in making appropriate policies and strategies to increase banks' NIM. To do so, managers should expand their lending scale, increase equity, and simultaneously control credit risks, focusing on management and development. The professional quality of employees has also been mentioned above, and the empirical evidence of the study has important implications for bank managers in making appropriate policies and strategies to increase banks' NIM. To do so, managers should expand the lending scale, increase equity, control credit risks well, and focus on management and development and the professional quality of employees. The empirical evidence of this study has important implications for bank managers in making appropriate policies and

strategies to increase banks' NIM. To do this, managers should expand the lending scale, increase equity, and at the same time control credit risks well, focus on management and development, and the professional quality of employees was also mentioned by some previous authors in their studies.

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