Analysis of Factors Affecting the Financial Capacity of Vietnam Commercial Banks After M&A by CAMEL Standards

Nguyen Thi Bich Vuong and Nguyen Phi Dat

Abstract After implementing the project on restructuring the credit institution system in period 1 (2011–2015) and period 2 (2016–2020), banking M&A activities in Vietnam as of 2020 have not been professional, small number, sometimes spontaneous, sometimes due to the pressure of mechanisms and regulations in legal documents, not yet derived from the economic interests of the bank and the economy, and thus lack of experience and information. Moreover, after restructuring, new commercial banks were formed, which is the result of M&A deals. But after a while, how these commercial banks develop and how effective they are, it is a difficult problem that bank administrators must continue to solve. Therefore, the question for commercial banks after M&A is how to improve financial capacity to maintain stability after M&A and the bank to still operate effectively. Therefore, the article used Probit binary regression model to analyze the factors affecting the financial capacity of commercial banks after M&A in Vietnam in the period 2012–2021 to see whether they meet CAMEL standards or not. This will be the basis for bank managers to come up with solutions to improve the financial capacity of commercial banks after M&A in Vietnam in the near future.

Keywords Financial capacity · Probit binary regression model · CAMEL standard · Commercial bank after M&A

1 Introduction

Probit binary regression model is a model in which the dependent variable is the predictor variable that receives only 2 values, 1 and 0. In this study on assessing the financial capacity of commercial banks after M&A in Vietnam, it is necessary to predict whether banks will meet CAMEL standards or not. Therefore, this study will

N. T. B. Vuong (✉)
Hanoi Technology Economics College, Hanoi, Vietnam
e-mail: Violet1072007@gmail.com

N. P. Dat
Banking Academy, Hanoi, Vietnam

A. T. Nguyen et al. (eds.), *Contemporary Economic Issues in Asian Countries: Proceeding of CEIAC 2022, Volume 1*,
https://doi.org/10.1007/978-981-19-9669-6_7

use the Probit binary regression model to predict the probability P in the interval (0, 1), where the value of $y = 1$ (meet CAMEL standard) or $y = 0$ (failure to meet CAMEL standard). Based on the collected data of 8 commercial banks after M&A in Vietnam, the calculation of criteria according to CAMEL standard includes 15 criteria, assessed according to CAMEL standard according to each criterion of passing (=1) or failing (=0), thereby assessing the financial capacity of commercial banks in each year after M&A by averaging and then performing Probit binary regression analysis with the dependent variable being Financial capacity (NLTC) with 2 values 0 and 1 and 15 independent variables in the model affecting the dependent variable.

2 Research Overview

The topic of financial capacity of commercial banks is a topic that has been studied a lot in the world, in which there have been many research works using Dupont, DEA, Capm, Probit, Logistic methods…to assess the financial capacity of a commercial bank, whether it meets CAMEL or Basel standards? Alton Gilbert et al. (2002) studied the financial capacity of US commercial banks according to CAMEL standard compared with SEER standard of commercial banks in the US in the period 1990–1998. The author's study used the Probit binary model to assess the financial capacity of US commercial banks according to the set of 5 criteria C, A, M, E, and L based on financial criteria such as capital size, financial leverage, profitability, asset quality, management quality, and liquidity of assets. Tatom (2011) studied the causes of the failure of commercial banks. The main reason is the financial capacity of these banks. The author's research also shows that the assessment of financial capacity of banks can be affected by C, A, M, E, and L, from which the author conducts regression according to Proxy to determine the influencing factors. The results show that the financial capacity of commercial banks is influenced by factors such as capital size, profitability, asset quality, management quality, and liquidity of assets. Then, the author uses downgrade method to predict the probability of future failure of commercial banks in the period 2003–2007. Nguyen Viet Hung (2008) has studied the performance of Vietnamese commercial banks in the period 2000–2005. In the study, the author has determined the factors affecting the financial capacity of banks according to CAMEL standards, then regression with Tobit. Research results show that factors such as bank's assets, loan/deposit ratio, ROA, and bad debt ratio have an influence on the financial capacity of the commercial banks during that period. Nga (2013) has deeply researched and assessed the financial capacity of 28 Vietnamese commercial banks according to CAMEL standards in the period 2003–2012. The author used Probit model to test 13 factors affecting the financial capacity of Vietnamese commercial banks, including size of equity; financial leverage; minimum capital adequacy ratio; outstanding debt/total assets; bad debt/ total outstanding debt (noxau_duno); ROA; ROE; NIM; operating cost index; asset liquidity ratio; deposit guarantee factor; short-term liquidity ratio; and loans/deposits. All of the above factors have a certain impact on the financial capacity

of Vietnamese commercial banks. Research "Applying CAMEL standards in financial analysis at Bank for Investment and Development of Vietnam" by Hoang Van Thang has focused on studying the financial capacity of Bank for Investment and Development of Vietnam through using the criteria system of CAMEL standards to analyze in the form of descriptive statistics the secondary data that the author collected in the period 2003–2008, including: Tier 1 Capital/Total Risky Assets, Equity/Total Assets, Equity/Risk Assets—CAR, BIS Ratio (Own Equity/Risk Assets), Financial leverage ratio (Total liabilities/equity), Internal capital generation ratio (Undivided profit/Tier 1 capital), NPLs/Total outstanding loans, Provision for credit risks/Debts bad, Provision expense ratio (Provision for debt loss/Average outstanding loans), Ability to cover bad debts (Provision for loss of debts/NPLs), ROA, ROE, Non-interest income/Total assets, Net Margin, Net Interest Income/Total Operating Income, Operating Expenses/Total Assets…. (Hoang Van Thang, 2009).

In summary, research overview shows that there have been many studies on the financial capacity of commercial banks, including the use of different evaluation analysis methods (Capm, DEA, Dupon, Probit, Proxy, Tobit, Logistic) and based on different standards (CAMEL, Basel1, Basel 2) but they are all commercial banks in general, not commercial banks after M&A. Therefore, the author directs his research to analyze the factors affecting the financial capacity of commercial banks after M&A in Vietnam according to CAMEL standards.

3 Research Model

The author builds the research model as follows:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \beta_{13} X_{13} + \beta_{14} X_{14} + \beta_{15} X_{15}$$

Dependent variable (Y): To forecast the probability that commercial banks after M&A meet CAMEL standards or fail to meet CAMEL standards, call the dependent variable y = NLTC (Financial capacity):

- NLTC = 1 if the bank meets CAMEL standard
- NLTC = 0 if the bank does not meet CAMEL standard.

Based on data collected from the annual report of commercial banks after M&A in Vietnam, analyzing the financial capacity of commercial banks after M&A according to CAMEL's standards based on 15 criteria. For each bank in each research year, evaluate each criterion according to CAMEL standards if rating 1 is achieved and if not rating 0 is achieved and then averaging 15 indicators.

- If the average of 15 indicators of each bank in each year is 0.5, it is CAMEL standard (NLTC = 1)

- If the average of 15 indicators of each bank in each year is <0.5, it is not CAMEL standard (NLTC = 0).

To forecast the probability P($y = 1$) while the variable NLTC only takes 2 values of 0 and 1, so the probability of not defaulting P($y = 0$) = 1 – P($y = 1$).

Independent variable (X) consists of 15 variables, which are 15 criteria to assess the financial capacity of banks according to CAMEL criteria as follows:

- X1: Size of equity
- X2: Financial leverage coefficient
- X3: Equity/Total Assets ratio
- X4: Minimum capital adequacy ratio (CAR)
- X5: Loan balance/Total assets
- X6: Bad debt ratio
- X7: Ratio of provision expenses
- X8: Profit growth rate
- X9: Credit growth rate
- X10: Return on Assets (ROA)
- X11: Return on Equity (ROE)
- X12: Net Interest Margin (NIM)
- X13: Non-net Interest Margin (NNIM)
- X14: Deposit/Total assets ratio
- X15: Loan/Deposit ratio.

From the above research model, the thesis also proposes research hypotheses including (Table 1).

Based on this model, the study was conducted to test the suitability of the model by the following tasks:

The first: Autocorrelation test is the phenomenon when the errors in the model have a relationship with each other, the cause of using time data, the delay of the data, and the inertia of the data. As a result, the estimate is biased. To test the phenomenon of autocorrelation, the thesis uses the Estat Dwatson function to calculate the coefficient d (Durbin-Watson), if $1 < d < 3d$ and d is close to 2, the model does not have autocorrelation.

The second: Testing for multicollinearity is a phenomenon where the independent variables in the model are correlated with each other, leading to no regression or incorrect model results. To test to determine the correlation coefficient (ri) between variables through the Corr function, if $ri < \pm 0.5$, it is considered that there is no multicollinearity phenomenon.

The third: Testing the phenomenon of variance is because the hypothesis of constant variance of the model is violated, due to the nature of economic quantities, or because of advances in measurement and data processing. It will affect the unbiased result of the estimate. To test the variable variance, the study uses the Hettest function from which to determine the P value, if the P value <5%, the phenomenon of variance does not occur and vice versa.

Table 1 Summary of research hypotheses

Hypotheses	Content
H1	The larger the scale of equity, the stronger the financial capacity of Vietnamese commercial banks after M&A
H2	Using financial leverage as possible will make the financial capacity of Vietnamese commercial banks better after M&A
H3	The higher the equity/total assets ratio, the better the financial capacity of Vietnamese commercial banks after M&A
H4	The higher the minimum capital adequacy ratio (CAR), the better the financial capacity of Vietnamese commercial banks after M&A
H5	The higher the loan balance/total assets, the lower the financial capacity of Vietnamese commercial banks after M&A
H6	The higher the bad debt ratio, the lower the financial capacity of Vietnamese commercial banks after M&A
H7	The higher the ratio of provision expenses, the lower the financial capacity of Vietnamese commercial banks after M&A
H8	The higher the profit growth rate, the stronger the financial capacity of Vietnamese commercial banks after M&A
H9	The higher the credit growth rate, the stronger the financial capacity of Vietnamese commercial banks after M&A
H10	The higher the return on assets (ROA), the better the financial capacity of Vietnamese commercial banks after M&A
H11	The higher the return on equity (ROE), the better the financial capacity of Vietnamese commercial banks after M&A
H12	The higher the Net interest margin (NIM), the better the financial capacity of Vietnamese commercial banks after M&A
H13	The higher the Non-net interest margin (NIM), the better the financial capacity of Vietnamese commercial banks after M&A
H14	The larger the ratio of deposits/total assets, the higher the financial capacity of Vietnamese commercial banks after M&A will be improved
H15	The higher the loan/deposit ratio, the lower the financial capacity of Vietnamese commercial banks after M&A

Source Suggested by the author

The fourth: LR(chi2) test means testing the hypothesis that at least one regression coefficient of an independent variable in the model is different from 0.

4 Characteristics of the Analyzed Data

After collecting data, calculating the criteria to evaluate the financial capacity of commercial banks after M&A, assessing whether they pass or fail according to CAMEL standards in each bank, using the Stata16.0 software to perform the

Table 2 Characteristics of the analyzed data

Unweighted cases		N	Percent
Selected cases	Included in analysis	47	100.0
	Missing cases	0	0.00
	Total	47	100.0
Unselected cases		0	0.00
Total		47	100.0

Source Author's data analysis results

Table 3 Coding of dependent variable

Original value	Internal value
KhongdattieuchuanCAMEL	0
DattieuchuanCAMEL	1

Source Author's data analysis results

Probit binary analysis. Research data includes 8 commercial banks after M&A with data collected: LienVietPostBank, SCB (2012–2019); SHB (2013–2019), HDBank, PVcomBank (2014–2019); Sacombank, BIDV, and Maritimebank (2016–2019) include a total of 47 observations.

Table 2 shows the data characteristics included in the Probit binary analysis of this study, including 47 observations, none of which were missing data, and none of which were unselected.

Table 3 shows that the dependent variable has 2 values, "not meeting CAMEL standard" is coded as 0, and "meeting CAMEL standard" is encoded as 1.

5 Data Analysis Results

After checking the analysis data of the Probit binary regression model with no missing observations, no unselected observations, and coding the dependent variable, the next step is to test the phenomenon of autocorrelation, test the phenomenon of multicollinearity, test the phenomenon of variance, and test LR(chi2).

5.1 Test the Phenomenon of Autocorrelation

To test the autocorrelation phenomenon of residual variables in the model, the study uses the function Estat dwatson to determine the value of the coefficient d (Durbin-Watson). If $1 < d < 3$ and d is close to 2, then the variables are considered to have no autocorrelation. The results are as follows: Durbin-Watson coefficient d-statistic (8.72) = 1.384798; this value ranges from $1 < d < 3$. Therefore, it can be

Table 4 Calculation results of variance exaggeration factor VIF

Model variables	Coefficient VIF	1/VIF
Chovay/Tongtaisan	2.80	0.357751
Duno/Tiengui	2.20	0.453587
VonCSH/Tongtaisan	1.84	0.544303
VonCSH	1.57	0.635788
NNIM	1.47	0.681754
Noxau	1.35	0.738009
CAR	1.29	0.776560
Mean VIF	1.79	

Source Test results from Corr function on Stata 16.0

confirmed that the model does not have autocorrelation of residuals. This means that the regression model does not violate the assumption of error independence.

5.2 Test the Phenomenon of Multicollinearity

The phenomenon of multicollinearity occurs when the independent variables are strongly correlated and expressed as a function, and this affects the results of the regression function. Therefore, testing whether or not multicollinearity contributes significantly to the conclusion that the regression results are appropriate or not. In this study, the author uses the Corr function on Stata 16.0 software to analyze the correlation between the independent variables of the model. The results show that the variables with correlation coefficients all reach statistical significance ($-0.5 < r < 0.5$). However, to ensure that the variables do not have multicollinearity, the author also uses the variance exaggeration factor VIF to overcome. The result is as follows:

The results of Table 4 show that the variance exaggeration coefficient VIF of all variables is lower than 10 and the average value is 1.79, so it can be concluded that the model does not have multicollinearity; this means that the variables in the model are closely correlated with each other.

5.3 Test the Phenomenon of Variance

To test the phenomenon of variance, the author uses the Hettest function on Stata 16.0 software with results as follows:

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
Ho: Constant variance
Variables: fitted values of NLTC
chi2(1) = 1.75
Prob > chi2 = 0.1853

Source Test results from Hettest function on Stata 16.0

The results show: Prob > Chi2 = 0.1853 > 0.05, so the hypothesis that the variance is fixed, in other words, can reject the hypothesis that the variance varies.

5.4 Test LR (Chi2)

Another test that needs to be done is to test the hypothesis that at least one regression coefficient of an independent variable in the model is different from 0, where the test is done through the LR (chi2) statistic with degrees of freedom is 7. The test results are as follows:

LR chi2 (7) = 42.60

Prob > chi2 = 0.0000.

The results show that the coefficient Prob > chi2 = 0.0000 < 0.05, so it can be confirmed that the model does not occur at the same time, and the regression coefficients are zero.

In short, after testing the fit of the model with the results obtained, the research can answer: The built regression model is suitable, there is no autocorrelation and no multicollinearity, variance does not change, and there is no case where the regression coefficients are equal to 0.

5.5 The Results of the Regression Analysis

The results of the regression analysis show that the variables with statistical significance show the impact on the bank's financial capacity, including the following variables: size of equity; equity/total assets ratio; minimum capital adequacy ratio (CAR); loan balance/total assets; bad debt ratio; loan/deposit ratio; and non-net interest margin (NNIM). Probit regression has no equivalent to R squared found in OLS regression, but Pseudo R2 values close to 1 are still considered good for the model. The result Pseudo R2 = 0.5253 > 0.5, thus also showing the model, has high reliability.

The results of Table 5 show that all variables in the model show a statistically significant impact, here the author chooses an error of less than 10% to be accepted, because the research sample size is limited in number. Checking the model's marginal

effects, it can be seen that the difference is not large between the coefficients of the variables in the model when keeping the remaining variables unchanged. In addition, the correctly classified level of the model also has a high rate of 86.11%, and they show that the model can correctly explain 86.11% of the cases of the dependent variable, which is a high percentage. Then, the regression model is written as follows:

$$\begin{aligned} Y = & -9.9307340 + 0.0005101 * \text{VonCSH} + 0.1761097 * \text{VonCSH/Tongtaisan} \\ & + 0.4686083 * \text{CAR} - 0.1062785 * \text{Chovay/Tongtaisan} \\ & - 0.5944837 * \text{Noxau} + 0.5051688 * \text{NNIM} - 0.0495970 * \text{Duno/Tiengui} \end{aligned}$$

According to the regression results, it can be seen that because of the Probit function, the impact results of the factors are measured by probability and the level of impact is determined in Table 5; therefore, the factors that really affect the financial capacity of Vietnamese commercial banks after M&A include:

Size of equity: If the size of a bank's equity is larger, the financial capacity of the bank will be stronger with the impact that when equity increases by 1 unit, the probability that the bank's financial capacity will reach CAMEL standard increased to 3.86E−06%. This result is consistent with the studies of previous authors such as Johnston (2009), Alton Gilbert et al. (2002), Tatom (2011), Wirnkar and Tanko (2007), and Godfrey Cadogan (2011), and this is also consistent with the reality in Vietnam when a bank with large equity will help them be financially self-sufficient; at the same time, there are many opportunities to implement big projects and also easily withstand when there are risks. Indeed, among the 8 Vietnamese commercial banks after M&A, BIDV is the bank before and after the M&A implementation that always has the largest scale of equity and is ranked as one of the 4 commercial banks with strong financial capacity in banking system in Vietnam.

Equity/Total Assets: The larger the equity/total assets ratio, the better the financial capacity of Vietnamese commercial banks after M&A, with the increase in the equity/total assets ratio by 1 unit, and they can increase the probability that the bank meets the CAMEL standard to 0.1331%. This result is consistent with the studies of previous authors such as Frank Heid (2007) and Hoang Van Thang (2009), and this is also consistent with the reality in Vietnam when a bank with only owning capital and large assets will help the bank to have good financial autonomy to implement large projects and easily support when the risk occurs.

Bad debt ratio: If the bad debt ratio of any bank is higher, the financial capacity of that bank will decrease. When the bad debt ratio increases by 1 unit, the probability that the financial capacity meets the CAMEL standard will decrease by 0.449%. This result is consistent with the studies of previous authors such as Berger et al. (1997), Alton Gilbert et al. (2002), and Nguyen Viet Hung (2008), and this is also consistent with the reality in Vietnam when a bank has a high bad debt ratio; the possibility of capital loss will be greater, especially in the current period when many businesses have difficulty doing business. With a lot of difficulties and losses, the increasing number of bankrupt enterprises will make it more difficult to collect debts of the

Table 5 Results of regression analysis

Variable	Coef	Std. Err	z	P > |z|	[95% conf. interval]
VonCSH	0.0005101	0.0001407	3.62	0.000	0.0002343 0.0007860
VonCSH/TongTS	0.1761097	0.1036263	1.70	0.089	−0.0269941 0.3792135
CAR	0.4686083	0.2314109	2.03	0.043	0.0150513 0.9221653
Chovay/TongTS	−0.1062785	0.0413386	−2.57	0.010	−0.1873006 − 0.0252563
Noxau	−0.5944837	0.1927318	−3.08	0.002	−0.9722310 − 0.2167363
NNIM	0.5051688	0.2178985	2.32	0.020	0.0780956 0.9322420
Duno/Tiengui	−0.0495970	0.0287323	−1.73	0.084	−0.0067168 0.1059119
_cons	−9.9307340	4.0047090	−2.48	0.013	−17.779820 − 2.0816470

Variable	dy/dx	Std. err	z	P > |z|	[95% C.I.]	X
VonCSH	3.86E-06	0.00001	0.46	0.644	−1.2E-05 0.00002	16,924.70
VonCSH/TongTS	0.001331	0.00297	0.45	0.654	−0.00449 0.007150	7.565570
CAR	0.003542	0.00746	0.47	0.635	−0.01107 0.018156	10.77420
Chovay/TongTS	−0.00080	0.00173	−0.47	0.642	−0.00419 0.002578	55.16680
Noxau	−0.00449	0.00984	−0.46	0.648	−0.02378 0.014795	2.708750
NNIM	0.003818	0.00814	0.47	0.639	−0.01214 0.019780	2.619220
Duno/Tiengui	−0.00037	0.00081	0.46	0.645	−0.00122 0.001970	78.28090

Sensitivity	Pr(+|D)	88.64%
Specificity	Pr(−|~D)	82.14%
Positive predictive value	Pr(D|+)	88.64%
Negative predictive value	Pr(~D|−)	82.14%
False + rate for true ~D	Pr(+|~D)	17.86%
False − rate for true D	Pr(−|D)	11.36%
False + rate for classified	Pr(~D|+)	11.36%
False − rate for classified	Pr(D|−)	17.86%
Correctly classified		86.11%

Source Probit regression results for independent and dependent variables from Stata 16.0

bank, leading to adverse effects on the financial situation of the bank. Therefore, banks are increasingly showing their efforts in thoroughly solving outstanding bad debts and minimizing the arising of new bad debts with stricter regulations in lending activities.

Non-net interest margin (NNIM): If Non-net interest margin of bank is larger, the financial capacity of that bank will be more likely to meet the CAMEL standard, with the ratio when NNIM increases by 1 unit, the probability of achieving CAMEL increases to 0.3818%. This result is consistent with the studies of Barnes and Lopez (2005) and Nga (2013), and this is also consistent with reality in Vietnam when a bank has a larger difference between non-interest income and non-interest expenses, the more it contributes to increasing profits and increasing business efficiency and increase the financial potential of the bank.

Loan balance/total assets: The higher the loan balance/assets of any bank, the lower the financial capacity of that bank. When loan balance/assets increase by 1 unit, the probability of achieving CAMEL decreases by 0.08%. This result is consistent with the study of Wagner (2007) and Tatom (2011), and this is also consistent with the reality of business at commercial banks because when the loan balance is too high compared to the total assets of the bank, it is easy for banks to use borrowed funds at high cost to cover the difference, or it will cause the possibility of an imbalance in payments, causing strong risks to the bank's operations.

Loan/deposit: The larger the loan/deposit balance of any bank, the lower the financial capacity of that bank. When the loan/deposit balance increases by 1 unit, the probability of achieving CAMEL decreases by 0.037%. This result is consistent with the study of Wagner (2007), Tatom (2011), and Nga (2013). This is also consistent with the reality in Vietnam when a bank with a higher loan/deposit balance means that the bank has made a larger loan than the amount of customer deposits that the bank has mobilized. In fact, the loan is a loan that the bank will periodically collect according to the agreed credit contract. Banks do not arbitrarily collect early unless the customer voluntarily repays the loan before the due date and the deposit can be withdrawn at any time. Therefore, if the bank lends more than the mobilized amount, it will lead to liquidity risk, especially in the current period, which can make the bank insolvent if this ratio is too high.

Minimum capital adequacy ratio (CAR): The higher the minimum capital adequacy ratio (CAR), the better the financial capacity of Vietnamese commercial banks after M&A. When CAR increases by 1 unit, the probability of achieving CAMEL increases to 0.3542%. This result is consistent with the studies of previous authors such as Heid (2007), Brown and Kevin Davis (2009), Barnesa and Lopez (2005), Wirnkar and Tanko (2007), Cadogan (2011), and Nga (2013). This result is also confirmed in practice not only in Vietnam but also around the world, that is, the higher the capital adequacy ratio of banks, the higher their financial capacity is.

Table 6 Individual regression coefficients of each factor

Factors	Code	z	Sig
X1: size of equity	VonCSH	3.62	0.000
X2: financial leverage coefficient	DonbayTC	No impact	0.314
X3: equity/total assets ratio	VonCSH/Taisan	1.70	0.089
X4: minimum capital adequacy ratio	CAR	2.03	0.043
X5: loan balance/total assets	DunoCV/Taisan	−2.57	0.010
X6: bad debt ratio	Noxau	−3.08	0.002
X7: ratio of provision expenses	ChiphiDP	No impact	0.322
X8: profit growth rate	TangtruongLN	No impact	0.964
X9: credit growth rate	TangtruongTD	No impact	0.829
X10: return on assets	ROA	No impact	0.878
X11: return on equity	ROE	No impact	0.890
X12: net interest margin	NIM	No impact	0.280
X13: non-net interest margin	NNIM	2.32	0.020
X14: deposit/total assets ratio	Tiengui/Taisan	No impact	0.298
X15: loan/deposit ratio	DunoCV/Tiengui	−1.73	0.084

Source Summary of separate regression results on Stata 16.0 with each factor

5.6 The Result of Hypothesis Testing

To test the research hypothesis, the study conducted a separate regression of each independent variable affecting the financial capacity of Vietnamese commercial banks after M&A, and the results are summarized as follows (Table 6).

Hypothesis 1 (H1):

Does the size of equity have a positive effect on the financial capacity of Vietnamese commercial banks after M&A?

The test results in $z = 3.62$ and the P value (Sig) of VonCSH (X1) $= 0.000 <$ 10%. From that, it can be concluded that the hypothesis H1 is accepted with high confidence (X1 is statistically significant) and equity has a positive influence on the financial capacity of the bank. In other words, the larger the scale of equity, the stronger the financial capacity of Vietnamese commercial banks after M&A.

Hypothesis 2 (H2):

Does Financial leverage coefficient have a positive effect on the financial capacity of Vietnamese commercial banks after M&A?

The test gives the result P value (Sig) of DonbayTC (X2) $= 0.314 > 10\%$. From that, it can be concluded that hypothesis H2 is not accepted. Therefore, it is not possible to confirm the impact relationship between the financial leverage coefficient and the financial capacity of Vietnamese commercial banks after M&A.

Hypothesis 3 (H3):

Does the equity/total assets ratio positively affect the financial capacity of Vietnamese commercial banks after M&A?

The test results in $z = 1.7$ and P value (Sig) of VonCSH/Taisan $= 0.089 < 10\%$. From that, it can be concluded that the hypothesis H3 is accepted with high confidence (X3 is statistically significant) and the equity/total assets ratio has a positive influence on the bank's financial capacity. In other words, the larger the equity/total assets ratio, the better the financial capacity of Vietnamese commercial banks after M&A.

Hypothesis 4 (H4):

Does the minimum capital adequacy ratio (CAR) positively affect the financial capacity of Vietnamese commercial banks after M&A?

The test results in $z = 2.03$ and P value (Sig) of CAR $= 0.043 < 10\%$. From that, it can be concluded that the hypothesis H4 is accepted with high confidence (X4 is statistically significant) and the minimum capital adequacy ratio (CAR) has a positive effect on the financial capacity of the bank. In other words, the higher the minimum capital adequacy ratio (CAR), the better the financial capacity of Vietnamese commercial banks after M&A.

Hypothesis 5 (H5):

Does loan balance/total assets have a negative effect on the financial capacity of Vietnamese commercial banks after M&A?

The test results in $z = -2.57$ and P value (Sig) of DunoCV/Taisan $= 0.010 < 10\%$. From that, it can be concluded that the hypothesis H5 is accepted (X5 is statistically significant) and the loan balance/total assets have a negative effect on the financial capacity of the bank. In other words, the higher the loan balance/total assets, the lower the financial capacity of Vietnamese commercial banks after M&A.

Hypothesis 6 (H6):

Does the bad debt ratio have a negative effect on the financial capacity of Vietnamese commercial banks after M&A?

The test results in $z = -3.08$ and Noxau's P value (Sig) $= 0.002 < 10\%$. From that, it can be concluded that the hypothesis H6 is accepted with high confidence (X6 is statistically significant) and the bad debt ratio has a negative effect on the financial capacity of the bank. In other words, the higher the bad debt ratio, the lower the financial capacity of Vietnamese commercial banks after M&A.

Hypothesis 7 (H7):

Does the ratio of provision expenses have a negative effect on the financial capacity of Vietnamese commercial banks after M&A?

The test gives the results P value (Sig) of ChiphiDP $= 0.322 > 10\%$. From that, it can be concluded that hypothesis H7 is not accepted. Therefore, it is not possible to confirm the impact relationship between ratio of provision expenses and financial capacity of Vietnamese commercial banks after M&A.

Hypothesis 8 (H8):

Profit growth rate has a positive influence on the financial capacity of Vietnamese commercial banks after M&A.

Test results in P value (Sig) of TangtruongLN = 0.964 > 10%. From that, it can be concluded that hypothesis H8 is not accepted. Therefore, it is not possible to confirm the impact relationship between the profit growth rate and the financial capacity of Vietnamese commercial banks after M&A.

Hypothesis 9 (H9):

Credit growth rate has a positive influence on the financial capacity of Vietnamese commercial banks after M&A.

Test results in P value (Sig) of TangtruongTD = 0.829 > 10%. From that, it can be concluded that hypothesis H9 is not accepted. Therefore, it is not possible to confirm the impact relationship between credit growth rate and financial capacity of Vietnamese commercial banks after M&A.

Hypothesis 10 (H10):

Return on Assets (ROA) has a positive influence on the financial capacity of Vietnamese commercial banks after M&A.

The test results in P value (Sig) of ROA = 0.878 > 10%. From that, it can be concluded that hypothesis H10 is not accepted. Therefore, it is not possible to confirm the impact relationship between ROA and financial capacity of Vietnamese commercial banks after M&A.

Hypothesis 11 (H11):

Return on Equity (ROE) has a positive influence on the financial capacity of Vietnamese commercial banks after M&A.

The test results in P value(Sig) of ROE = 0.890 > 10%. From that, it can be concluded that hypothesis H11 is not accepted. Therefore, it is not possible to confirm the impact relationship between ROE and financial capacity of Vietnamese commercial banks after M&A.

Hypothesis 12 (H12):

Net Interest Margin (NIM) has a positive effect on the financial capacity of Vietnamese commercial banks after M&A.

The test results in P value (Sig) of NIM = 0.280 > 10%. From that, it can be concluded that hypothesis H12 is not accepted. Therefore, it is not possible to confirm the impact relationship between NIM and the financial capacity of Vietnamese commercial banks after M&A.

Hypothesis 13 (H13):

Non-net Interest Margin (NIM) has a positive effect on the financial capacity of Vietnamese commercial banks after M&A.

The test results in $z = 2.32$ and P value (Sig) of NNIM $= 0.020 < 10\%$. From that, it can be concluded that the hypothesis H13 is accepted with high confidence (X13 is statistically significant) and the Non-net Interest Margin (NNIM) has a positive influence on the financial capacity of the bank. In other words, the larger the NNIM, the better the financial capacity of Vietnamese commercial banks after M&A.

Hypothesis 14 (H14):

Deposit/Total assets ratio has a positive effect on the financial capacity of Vietnamese commercial banks after M&A.

The test results in P value (Sig) of Tiengui/Taisan $= 0.298 > 10\%$. From that, it can be concluded that hypothesis H14 is not accepted. Therefore, it is not possible to confirm the impact relationship between the deposit/Total assets ratio and the financial capacity of Vietnamese commercial banks after M&A.

Hypothesis 15 (H15):

The Loan/Deposit ratio has a negative effect on the financial capacity of Vietnamese commercial banks after M&A.

The test results in $z = -1.73$ and P value (Sig) of DunoCV/Tiengui $= 0.084 < 10\%$. From that, it can be concluded that the hypothesis H15 is accepted with high confidence (X15 is statistically significant) and the loan/deposit ratio has a negative effect on the financial capacity of the bank. In other words, the higher the loan/deposit ratio, the lower the financial capacity of Vietnamese commercial banks after M&A.

6 Conclusion

Probit regression analysis results for each factor show that there are 11 factors that positively affect the financial capacity of Vietnamese commercial banks after M&A and 4 factors are bad debt ratio, Ratio of provision expenses, loan balance/total assets, Loan/deposit ratio which have the opposite effect. These results are consistent with previous studies of authors such as Wagner (2007), Tatom (2011), Barnes and Lopez (2005), Nguyen Viet Hung (2008), Van Thang (2009), and Nga (2013) as well as in line with the actual operation and financial capacity of Vietnamese commercial banks in general and Vietnamese commercial banks after M&A in particular.

However, according to the standardized estimation results of the theoretical model, out of 15 factors, only 7 factors are statistically significant, showing the influence on the bank's financial capacity, including size of equity, equity/total assets ratio, minimum capital adequacy ratio (CAR), loan balance/total assets, bad debt ratio, Non-net Interest Margin (NNIM), and loan/deposit ratio. The remaining 8 factors that are not statistically significant are excluded from the model. The results of testing the causal relationship between concepts in the standardized model show that the importance of factors affecting the financial capacity of Vietnamese commercial banks after M&A is very different. However, 15 factors also reflect 86.11% of the

problem of the bank's financial capacity whether or not it meets the CAMEL standards. Therefore, there will be other factors that may affect the financial capacity of Vietnamese commercial banks after M&A but have not been covered by this study in the current research model. The regression results show that the role of factors in contributing to improving the financial capacity of the bank is clearly hierarchically defined through the regression equation.

References

Alton Gilbert, R., Meyer, A. P., & Vaughan, M. D. (2002, January/February). Could a CAMELS downgrade model improve off-site surveillance? *Federal Reserve Bank of St. Louis Review, 84*(1).

Annual reports of banks LPB, SCB, SHB, HDBank, Pvcombank, Sacombank, BIDV, Maritimebank in the years 2012–2021.

Berger, A. N., Saunders, A., Scalise, J. M., & Udell, G. F. (1997). The effects of bank mergers and acquisitions on small business lending. *Finance and Economics Discussion Series 1997–1928*. Board of Governors of the Federal Reserve System (US).

Barnes, M. L., Lopez, J. A. (2005, September 23). Alternative measures of the Federal Reserve Banks cost of equity capital. *FRB of Boston Public Policy Discussion*, Paper No. 05-2.

Brown, C., & Davis, K. (2009). Capital management in mutual financial institutions. *Journal of Banking & Finance, 33*(3), 443–455.

Cadogan, G. (2011). *A theory of asset pricing and performance evaluation for minority banks with implications for bank failure prediction, compensating risk, and CAMELS rating.* Working Paper.

Heid, F. (2007). The cyclical effects of the Basel II capital requirements. *Journal of Banking & Finance, 31*(12), 3885–3900.

Hung, N. V. (2008). *Operational efficiency of Vietnam commercial bank in the period 2000–2005*. Doctoral Thesis in Economics, Banking Academy.

Johnston, M. (2009). Extending the Basel II approach to estimate capital requirements for equity investments. *Journal of Banking & Finance, 33*(6), 1177–1185.

Nga, P. T. H. (2013). *Financial capacity of Vietnamese commercial banks.* Doctoral Thesis in Economics. Banking University City. Ho Chi Minh.

Tatom, J. (2011, December 6). Predicting failure in the commercial banking industry. Networks Financial Institute at Indiana State University. Working Paper, No. 2011-WP-27.

Van Thang, H. (2009). *Applying CAMEL model in financial analysis at bank for investment and development of Vietnam.* Foreign Trade University, Hanoi.

Wagner, W. (2007). The liquidity of bank assets and banking stability. *Journal of Banking & Finance, 31*(1), 121–139.

Wirnkar, A., & Tanko, M. (2007). Camel(s) and banks performance, evaluation: the way forward. *SSRN Electronic Journal.*