FACTORS AFFECTING CREDIT RISK IN LENDING ACTIVITIES OF JOINT-STOCK COMMERCIAL BANKS IN VIETNAM

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ABSTRACT

This paper studies factors affecting credit risk in lending activities of joint-stock commercial banks in Vietnam. Data is collected from audited financial statements of 23 banks, and macroeconomic data from General Statistics Office of Vietnam in the period of 2009 – 2019. This paper uses GMM method which is carried out by using R programing language in Jupyter Notebook. The findings show that lagged credit risk, profitability and inflation have positive effects on credit risk, while bank capital, bank size, economic growth and loans to deposits ratio have negative ones. In addition, the findings also show that the nonlinear effects of loan growth on credit risk with U shape relationship, and this paper also calculates the relative importance of each variable.

Keywords: factors, credit risk, joint-stock commercial banks, R programing language.

DOI: http://dx.doi.org/10.15549/jeecar.v8i2.666

INTRODUCTION

Commercial banks are financial institutions providing services such as accepting deposits, making loans, offering payment methods and others financial services. Among those services, making loans is expected to help commercial banks to generate the most profits, Karim et al. (2010) pointed out that approximately 50% to 75% profits in commercial banks came from making loan. However, there are some risks accompany with this profitable service, in which the credit risk is considered to be the most significant one. Because of credit risk, making

loans does not always generate expected profits, that is the reason why commercial banks always pay special attention to this issue.

According to the State Bank of Vietnam, total non-performing loans ratio of the whole credit institutions were 1.89% in, to at the end of 2019, and it was up to 4.5% in Q3.2020. There is little doubt that it will continue to increase in the coming time because of the impact of pandemic and surpass the threshold of 3% set in 2021. This paper is to investigate the factors affecting credit risk in lending activities of joint-stock commercial banks in Vietnam using the R programing language in Jupyter Notebook. This use is expected to provide the trusted information for managing credit risk and controlling non-performing loans ratio in these banks.

LITERATURE REVIEWS

According to wrong choice theory, Pagano & Jappelli (1994) showed that information sharing can minimize adverse choices by providing information about borrowers. Richard (2011) stated that in a transaction parties which has more information about the goods can negotiate contract terms better than the others.

Moral hazard theory stated by Keeton & Morris (1987) stated that the low bank capital might encourage moral hazard by increasing risk level in their lending portfolio. Jimenez & Saurina (2007) supposed that competition in market would have banks' profitability decreased, therefore, they are willing to accept higher risk to generate more profits and scarify their clients.

Bad management theory by Berger & DeYoung (1997) supposed that commercial banks which have efficient management will monitor credit risk well, it is considered to be the bank's core ability. Otherwise, bad management will have credit risk increased. In addition, the writers also mentioned about Bad luck theory, commercial banks lend their customers money with a commitment to pay debts in the future, however, their customers might break that commitment, this not only make the banks loss but also bad rating by market and authorities.

Too Big to Fail theory supposed that, large banks usually tend to accept too much risk by increasing lending amount because market rules do not set apply for large banks, the government can protect them in bankruptcy situations (Stern & Feldman, 2004). According to Boyd & Gertler (1994), large banks in U.S. had higher risk of lending portfolio in 1980s because they were encouraged by the government, and this might lead to moral hazard.

A great number of empirical researches state that there are many factors affecting credit risk in lending activities of commercial banks. They can be divided into two groups: macro factors and bank specific factors. The factors are usually found from empirical evidences as following:

- Economic growth has a negative effect on credit risk, this is supported by Fofack (2005), Guy & Lowe (2011), Bofondi & Ropele (2011), Wapas et al. (2017), Tole et al. (2019), Kiet & Phu (2016) and Ameur (2016). However, Kharabsheh (2019) concluded that economic growth is not appropriate to explain credit risk.
- Inflation has a positive effect on credit risk, this is supported by Fofack (2005) and Bofondi (2011). However, there are some researchers that are Guy & Lowe (2011), Phong et al. (2015) and Ameur (2016) supposed that inflation has a negative effect on credit risk.
- Credit risk in the previous year has a positive effect on credit risk in the current year, this was supported by Binh & Anh (2013), Anh & Hung (2013), Quy & Toan (2014), Phong et al. (2015) and Koju et al. (2018)
- Loan growth has a positive effect on credit risk, this is supported by Anh & Hung (2013), Quy & Toan (2014), Kiet & Phu (2016), Diep & Kieu (2015) and Kharabsheh (2019). However, Tehulu & Olana (2014) and Tole et al. (2019) concluded that loans growth has a negative effect on credit risk.
- Bank size has a positive effect on credit risk, this is supported by Binh & Anh (2013), Anh & Hung (2013), Phong et al. (2015) and Koju et al. (2018). However, Tehulu & Olana (2014), Kiet & Phu (2016) concluded that bank size has a negative effect on credit risk, or Tole et al. (2019) and Ameur (2016)

supposed that bank size is not appropriate to explain credit risk.

- Bank capital has a negative effect on credit risk, this is supported by Tole et al. (2019), Phong et al. (2015) and Ameur (2016). However, Boudriga et al. (2010), Kharabsheh (2019) and Koju et al. (2018) supposed that capital has a positive effect on credit risk.
- Bank profitability has a possitive effect on credit risk, this is supported by Binh & Anh (2013), Kharabsheh (2019), Phong et al. (2015), Kiet & Phu (2016). However, Tole et al. (2019), Koju et al. (2018) supposed that bank profitability has a negative effect on credit risk.
- Other factors may have significant effect on credit risk, such as the positive effects of liquidity (Tole et al., 2019; Koju et al.,2018), financial leverage (Anh & Hung, 2013) and interest rate (Fofack, 2005; Bofondi & Ropele 2011; Waqas et el. 2017), a negative effect of income diversification (Koju et al., 2018), etc.

RESEARCH MODEL

According to empirical researches of Ameur (2016), Koju et al. (2018), Kharabsheh (2019), this paper uses a model for investigating the factors affecting credit risk in lending activities of joint-stock commercial banks in Vietnam as following:

$$CRISK_{i,t} = \beta_0 + \beta_1 * CRISKlag1_{i,t} + \beta_2 * CAP_{i,t} + \beta_3 * SIZE_{i,t} + \beta_4 * PROF_{i,t} + \beta_5 * LGR_{i,t} + \beta_6 * (LGR_{i,t})^2 + \beta_7 * LIQ_{i,t} + \beta_8 * GDP_t + \beta_9 * INF_t + \varepsilon_{i,t}$$

The research model includes the dependent variable, which is credit risk (CRISK), and the independent variables, which are credit risk of the previous period (CRISKlag1), bank capital (CAP), bank size (SIZE), bank profitability (PROF), loan growth (LGR), liquidity (LIQ), economic growth (GDP) and inflation (INF). In addition, β0 is the constant (intercept); β1, β2, β3, β4, β5, β6, β7, β8 are the coefficients; ε is the error term; i is used to index firms and t to index year.

Table 1 shows the way of calculating variables and the expectation about the effects of factors on credit risk, they are also research hypotheses in this paper.

Table 1: The way of calculating and expected effects

Variables	Calculating	Expectation	
		Expected effects	Related researches
Dependent variable			
CRISK	Credit risk provision in the current year / Loans in the current year		Tehulu & Olana (2014), Diep & Kieu (2015) and Quy & Toan (2014)
Independent variables			
CRISKlag1	Credit risk provision in the previous year / Loans in the previous year	+	Binh & Anh (2013), Anh & Hung (2013), Quy & Toan (2014), Phong et al. (2015) and Koju et al. (2018)
CAP	Owner's equity / Total assets	–	Boudriga et al. (2010), Kharabsheh (2019) and Koju et al. (2018)
SIZE	Logarit of average total assets	+	Binh & Anh (2013), Anh & Hung (2013), Phong et al. (2015) and Koju et al. (2018)

Table 1: Continued

PROF	Earnings after taxes / Average total assets	–	Binh & Anh (2013), Kharabsheh (2019), Phong et al. (2015), Kiet & Phu (2016)
LGR	(Opening loans – Closing loans) / Opening loans	+	Anh & Hung (2013), Quy & Toan (2014), Kiet & Phu (2015) and Kharabsheh (2019)
		+/– (Nonlinear)	-/-
LIQ	Loans / Deposits	+	Tole et al. (2019)
GDP	Increasing/Decreasing percentage of Gross domestic product	–	Boudriga et al. (2010), Tehulu & Olana (2014) and Tole et al. (2019)
INF	Increasing/Decreasing percentage of Consumer price index	+	Fofack (2005) and Bofondi (2011)

Source: Summary of authors from empirical researches

DATA AND METHODOLOGY

This paper uses the secondary data collected from audited financial statements of 23 joint-stock commercial banks in Vietnam from 2009 to 2019. The data is provided by FiinGroup, and is collected from Vietnamese General Statistics Office for macroeconomics data sector.

Table 2: List of joint-stock commercial banks

SEQ	Code	Full name
1	ABB	An Binh Commercial Joint-stock Bank
2	ACB	Asia Commercial Bank
3	BID	JSC Bank For Investment And Development Of Vietnam
4	CTG	Vietnam Joint-stock Commercial Bank for Industry and Trade
5	EIB	Vietnam Commercial Joint-stock Export Import Bank
6	GDB	Viet Capital Commercial Joint Stock Bank
7	HDB	Ho Chi Minh City Development Joint-stock Commercial Bank
8	KLB	Kien Long Commercial Joint-stock Bank
9	LPB	LienViet Post Joint-stock Commercial Bank
10	MBB	Military Commercial Joint-stock Bank
11	MSB	Vietnam Maritime Commercial Join Stock Bank
12	NAB	Nam A Commercial Joint-stock Bank
13	NVB	National Citizen Commercial Joint-stock Bank

Table 2: Continued

SEQ	Code	Full name
14	OCB	Orient Commercial Joint-stock Bank
15	PGB	Petrolimex Group Commercial Joint-stock Bank
16	SEA	Southeast Asia Commercial Joint-stock Bank
17	SGB	Saigon Bank For Industry And Trade
18	SHB	Saigon Hanoi Commercial Joint-stock Bank
19	STB	Sai Gon Thuong Tin Commercial Joint-stock Bank
20	TCB	Vietnam Technological and Commercial Joint-stock Bank
21	VCB	Bank for Foreign Trade of Vietnam
22	VIB	Vietnam International Commercial Joint-stock Bank
23	VPB	Vietnam Prosperity Joint-stock Commercial Bank

Source: Summary of authors

The study uses quantitative method including descriptive statistics, correlation analysis and panel data regression. In addition to the existing of lagged independent variable (CRISKlag1), the study will check the presence of heteroskedasticity and serial correlation to assure that the applying of Generalize Method of Moment (GMM) as gregression method is accurate and efficient.

FINDINGS AND DISCUSSIONS

Descriptive statistics

Descriptive statistics of CRISK in table 3 illustrate that banks accept the credit risks in lending activities in different levels, this is shown through the average credit risk provision ratio with 1.57% and standard deviation with 0.51%. The banks had minumum and maximum credit risk provision ratio were Viet Capital Joint-stock Commercial Bank with 0.33% in 2019 and Bank for Foreign Trade of Vietnam with 3.27% in 2009, respectively.

Table 3: Descriptive statistics result

Variables	Min	Mean	Max	SD	Observations
CRISK	0.0033	0.0157	0.0327	0.0051	253
CRISKlag1	0.0021	0.0129	0.0378	0.0053	253
CAP	0.0411	0.0991	0.3236	0.0457	253
SIZE	6.5240	7.9540	9.1470	0.5292	253
PROF	0.0000	0.0099	0.0435	0.0071	253
LGR	-0.7038	0.2590	1.6496	0.2653	253
LGR2	0.0000	0.1372	2.7211	0.2956	253
GDP	0.0503	0.0620	0.0708	0.0069	253
INF	0.0060	0.0601	0.1810	0.0479	253
LIQ	0.3956	0.8766	1.5271	0.1801	253

Source: data is analized by using R programing language in Jupyter Notebook

The table 3 also details: (i) the obvious differences of bank capital and bank size, in which state owned banks are bigger than others; the banks set the lending rate higher than deposit rate to assure the profitability, (ii) the banks tend to expand their loan growth as a attempt to generate more profits, yet the growth percentages are not at the same patterm; (iii) economic growth remains stable over the period; (iv) except the significant inflation rate due to the sharp recession in 2011, at 18.1%, inflation were controlled well in other years.

Correlation analysis

Correlation matrix is summarized in table 4, it details the correlation coefficients of each pair of variables and visualizes their correlations on heat map format. The table 4 shows that while the credit risk has positive correlated with the credit risk in the previous year and bank size, it shows negative correlated with other variables.

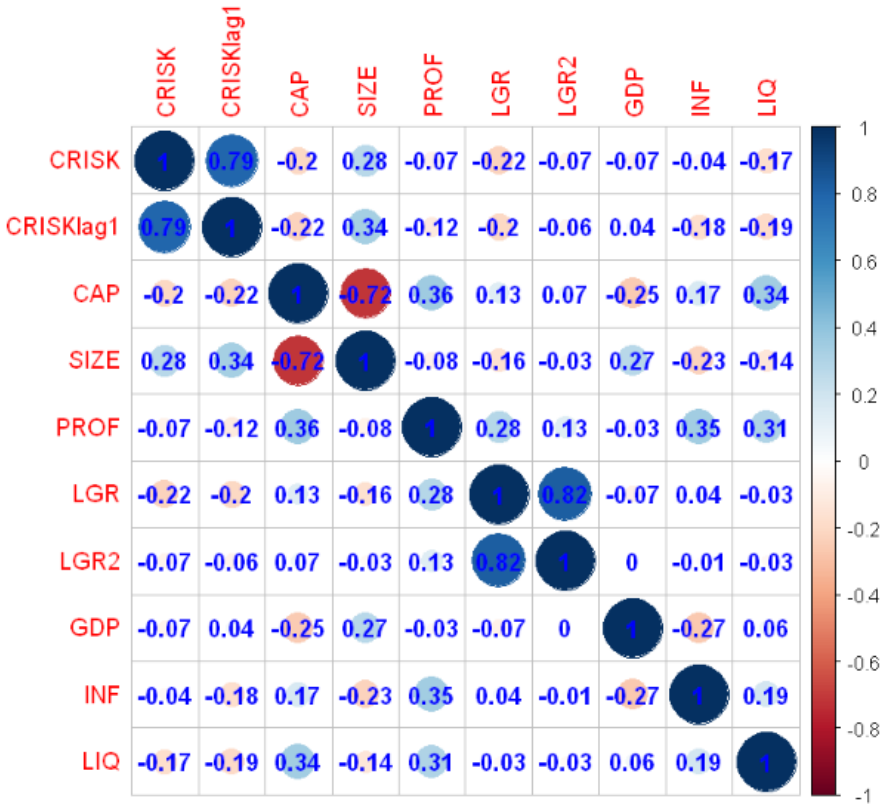

Figure 1: Correlation matrix

Source: data is analized by using R programing language in Jupyter Notebook

In addition, there are some significant correlations that are the correlation between CRISK and CRISKlag1 is 0.79, SIZE and CAP is -0.72, LGR2 and LGR is 0.82. In oder to assure there is no multi-collinearity the study carried out VIF (Variance inflating factor) test and the result reconfirm the absence of multi-collinearity.

```
CRISKlag1       CAP      SIZE      PROF       LGR      LGR2       GDP       INF
 1.239516  3.074841  2.835027  1.760651  4.069269  3.550473  1.214933  1.378026
      LIQ
 1.306893
```

Figure 2: Variance inflating factor (VIF)

Source: data is analized by using R programing language in Jupyter Notebook

Regression analysis

Firstly, Regression model

The study uses GMM as regression methos because of 4 main reasons:

(i) There is a lagged variable in one side of the equation that is CRISKlag1

(ii) The existing of liner realtion between CRISK and CRISKlag1

(iii) By applying Breush-Pagan test the study finds the presence of heteroskedasticity

```
        studentized Breusch-Pagan test

data:  model1
BP = 34.428, df = 9, p-value = 7.512e-05
```

Figure 3: Breusch-Pagan test

Source: data is analized by using R programing language in Jupyter Notebook

(iv) By applying Breusch-Godfrey/Wooldridge test the study find the the presence of serial correlation

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        Breusch-Godfrey/Wooldridge test for serial correlation in panel models

data:  CRISK ~ CRISKlag1 + CAP + SIZE + PROF + LGR + LGR2 + GDP + INF +     LIQ
chisq = 40.057, df = 11, p-value = 3.498e-05
alternative hypothesis: serial correlation in idiosyncratic errors
```

Figure 4: Breusch-Godfrey/Wooldridge test

Source: data is analized by using R programing language in Jupyter Notebook

Secondly, Regression result

Table 4 shows regression outputs of GMM and relative importance of variable.

Table 4: Regression result

Variables	Estimated β	P-value	Relative importance
(Intercept)	0.0142	0.0121	
CRISKlag1	0.6784	0.0000	82.77
CAP	-0.0115	0.1152	2.02
SIZE	-0.0003	0.4549	4.45

Table 4: Continued

Variables	Estimated β	P-value	Relative importance
PROF	0.0502	0.1451	0.38
LGR	-0.0033	0.0258	4.83
LGR2	0.0007	0.0293	1.47
GDP	-0.0844	0.0143	1.68
INF	0.0077	0.0444	0.62
LIQ	-0.0006	0.6302	1.78

Source: data is analized by using R programing language in Jupyter Notebook

The GMM regression result shows that CRISKlag1, LGR2 and INF are accepted to interpret the positive relation with CRISK. Besides, CRISK can also be interpreted by LGR in U-shape.

In addition, this study also applies "relaimpo" package provided in R programming language to calculate proportion of variance explained by model and the relative importance of each variable. The result shows that the proportion of variation explained by model is 65.86% and the most important variable is CRISKlag1 with 82.76%.

Figure 5: Relative importance of each variable

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Response variable: CRISK
Total response variance: 2.839742e-05
Analysis based on 253 observations

9 Regressors:
CRISKlag1 CAP SIZE PROF LGR LGR2 GDP INF LIQ
Proportion of variance explained by model: 65.86%
Metrics are normalized to sum to 100% (rela=TRUE).

Relative importance metrics:

                 lmg
CRISKlag1 0.827677578
CAP       0.020260783
SIZE      0.044555762
PROF      0.003804738
LGR       0.048321710
LGR2      0.014691925
GDP       0.016837022
INF       0.006150330
LIQ       0.017700152
```

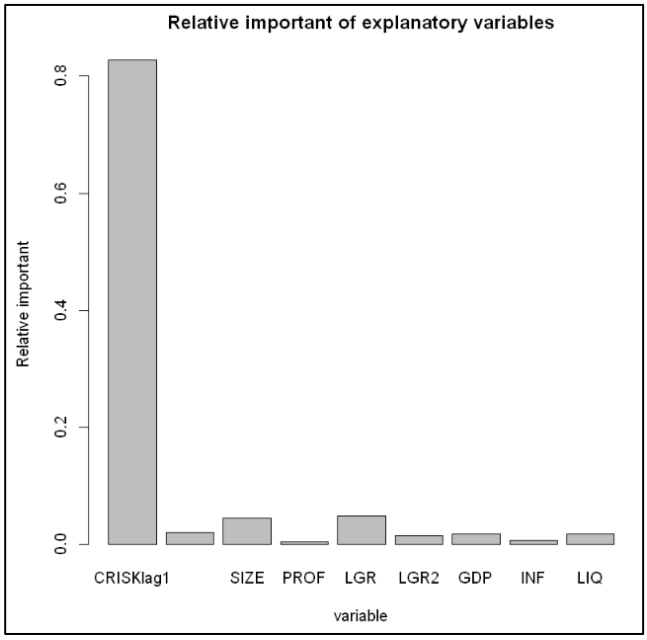

Source: data is analized by using R programing language in Jupyter Notebook

Discussions

Firstly, the possitive effect of CRISKlag1 to CRISK

According to the GMM regression result, coefficient of CRISKlag1 is 0.6784, this shows a positive effect of credit risks in the previous year on the credit risk in the current year. This result is appropriate with the expectation and support the findings of Binh & Anh (2013), Anh & Hung (2013), Quy & Toan (2014), Phong et al. (2015) and Koju et al. (2018). This result illustrates that credit risk in the previous year

was not completely eliminated, it can affect the current year. It means that commercial banks might suffer a long-term shock when credit risk occurs. This can also be interpreted by the banks' structures of long-term and short-term financing or by bad management theory. The consequence of bad management in the previous year can affect the current situation of credit risk.

Secondly, the negative effect of CAP to CRISK

According to the GMM regression result, coefficient of CAP is -0.0115, this shows a negative effect of capital to credit risk. This result does not support the findings of Boudriga et al. (2010), Kharabsheh (2019) and Koju et al. (2018). The result shows that the higher capital banks have, the safer they are, because this is a crucial source which can provide financial strength to banks. Commercial banks with higher capital are usually strong banks, they always have strict standard for making loans. This result can also be interpreted by agency theory.

Thirdly, the negative effect of SIZE to CRISK

According to the GMM regression result, coefficient of SIZE is -0.0004, this shows a negative effect of bank size on credit risk. This result does not support the findings of Binh & Anh (2013), Anh & Hung (2013), Phong et al. (2015) and Koju et al. (2018); however, it supports the results of Tehulu & Olana (2014), Kiet & Phu (2016). As for larger banks, it is easier for them to attract customer's attention, so they have opportunities to decide which kind of customers they should make loans. In addition, the staff's quality and technology are also highly demanded so their first line of defense also works better.

Fourth, the possitive effect of PROF to CRISK

According to the GMM regression result, coefficient of PROF is 0.0502, this shows a positive effect of bank profitability on credit risk. This result does not support the findings of Binh & Anh (2013), Kharabsheh (2019), Phong et al. (2015), Kiet & Phu (2016). In order to generate more profits, commercial banks tend to accept much business including higher risk transactions. It can also be explained that commercial banks are confident to accept high risk transaction because they believe in their risk management.

Fifth, the non-linear effect of LGR to CRISK

According to the GMM regression result, coefficient of LGR is -0.0033 but coefficient of LGR2 is 0.0007, this shows a non-linear effect of loan growth on credit risk with U-shape. When loans growth increases, credit risk will decrease, however, it will not follow that pattern when loan growth exceeds the certain percentage.

The U-shaped relationship between credit risk and loan growth meet the expectation. This relationship indicates that only the suitable increasing of loan can help to dercrease credit risk. This relationship can be explained by risk and return trade off theory, commercial banks usually prefer making loan to low risk clients, this will help them to decrease credit risk. This result is suported by Boudriga et al. (2010), Tehulu & Olana (2014) and Tole et al. (2019). When the low risk clients become scarce, commercial banks have to make loan to higher risk client to achive their business target and credit risk will start increasing. This result is suported by Anh & Hung (2013), Quy & Toan (2014), Kiet & Phu (2015) and Kharabsheh (2019). Besides, the U shape relationship can also be explained that when clients' demand of borowing money increases, commercial banks tend to increase their interest rate, lending conditions, client's using money plan. However, when loan growth exceeds the limit, these borrows might not be used for actual business and it will increase the credit risk.

Sixth, the negative effect of LIQ to CRISK

According to the GMM regression result, coefficient of LIQ is -0.0006, showing that loans to deposits ratio has a negative effect on credit risk, or it also means that having a positive effect of bank liquidity on credit risk. This result supports the finding of Tole et al. (2019). When commercial banks make use of as much deposit amount as they can in order to make loans, they must pay high attention into the possibility paying debts from their customers. To make sure their customer can pay the debts,

commercial banks are required to set up after making loans management and monitors. This will help to decrease credit risk.

Seventh, the negative effect of GDP to CRISK

According to the GMM regression result, coefficient of GDP is -0.0845, this shows a negative effect of economic growth on credit risk. This result supports the researching results of Boudriga et al. (2010), Tehulu & Olana (2014) and Tole et al. (2019). As a general rule, during seasons of economic growth, consumer confidence is high, companies and individuals can do more business and they have greater their income, so they are able to pay debts.

Finally, the possitive effect of INF to CRISK

According to the GMM regression result, coefficient of INF is 0.0077, this shows a positive effect of inflation on credit risk. This result supports the findings of Fofack (2005) and Bofondi (2011). When inflation increases, customer's real income might not increase or even decrease but prices will increase significantly, this will influence their ability of paying debts. In that situation commercial banks tends to increase their lending interest to make sure they can have real profits. This kind of action put more pressure to their customers.

CONCLUSIONS AND RECOMMENDATIONS

From literature reviews and empirical researches, this paper has suggested an appropriate researching model and method. Researching result points out that both of macroeconomics and microeconomic factors affect credit risk in lending activities of joint-stock commercial banks in Vietnam. In which, credit risks in the previous year, bank size, liquidity and inflation have positive effects on credit risk; while bank capital, profitability and economic growth have negative ones. In addition, loan growth shows its non-linear effect on credit risk with U-shape. In order to control and minimize credit risk in lending activities, the research result suggests that:

Firstly, commercial banks should pay attention to manage and monitor credit risk at the moment, they also should focus on analyze and strengthen risk management ability for medium and long-term loan. Find out solutions for solving bad debts, actively remind customer to pay their debts; build up bank's credit risk early warning system for all kind of risk especially for medium and long-term loan.

Secondly, commercial banks should calculate a suitable loan growth policy which is suitable to their risk management ability. After making loans, they must monitor customer's using lending money purposes to assure the profits and manage credit risks. When commercial bank's want to open their credit policy, they must strengthen their management policy too. They are required to pay more attention to monitor lending conditions and underwriting process for making loans. To enhance their ability of preventing risks, they should first improve staff's underwriting ability.

Thirdly, commercial banks can issue more stocks to increase their capital. They can sell their stocks to strategic partners, clients and current shareholders or make decision on keep profits after tax. Commercial banks must consider which is the best way to increase their capital and when is the most suitable time to do it, this will help the banks to increase and also assure the benefits and rights of current shareholders.

Fourth, commercial banks should set up a lending policy in which profitability and credit risk are balance. They must consider their management ability to set up lending policy appropriately. They also have to find out in which kind of business and clients they can make loans and they can also manage these clients. When they want to set a higher lending interest rate, this can bring them more benefits, yet they must consider whether their clients are able to pay the debts.

Fifth, aggressively control bank size. When commercial banks want to increase their size they must calculate their current resources, financial ability, staff's quality to find out at which size they can both operate well and minimize all kind of risks.

Sixth, when commercial banks want to make use of client's deposit for lending purposes they must calculate which is the most suitable percentage to achieve both profit target and safety purpose. They also have to make sure

their lending policy compliant with inside policy and related regulations from the government.

Finally, commercial banks should take the advantages of economic growth to set up their business target for each period. In addition, they also should find out where is the potential market to open their new business or they also can have some special policy to making loans for some specific business which can help the nation to increase GDP. They also must forecast the inflation rate and time to make sure their lending policy will be changed flexibly to minimized credit risk when the economy plumps.

The research results can be seen to give important clues about factors affecting credit risk in lending activities of joint-stock commercial banks in Vietnam. Nevertheless, the research data does not include all banks, and it may be possible to identify differences in the factors among the groups of banks with different bank age, corporate governance or ownership structure, etc. According to that, future studies can consider these factors as moderating variables in research model.

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