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Does Liquidity Risk Affect The Profitability Of Vietnamese Commercial Banks? Evidence From Panel Data Threshold Regression

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ABSTRACT

This article uses the Panel threshold regression model with a panel of 30 commercial banks in Vietnam over the 2009 – 2021 period to investigate the effect of liquidity risk on bank performance. The findings show that at a threshold of total assets of USD 27,28 billion, the impact of liquidity risk on bank performance proxied by ROA turns from negative to positive. In contrast, any size threshold in models where the dependent variable is ROE does not be found. The findings also show that the level of liquidity risk is more critical in determining the impact direction of liquidity risk on bank performance than state ownership. From the estimation and testing results, the authors propose several policy implications for banks with total

assets exceeding and below the threshold, as well as suggesting further research directions.

Keywords: Size threshold, Liquidity risk, Profitability, Commercial bank.

1. INTRODUCTION

After the 2008 global financial crisis, the impact of liquidity risk on the profitability of commercial banks is a topic of interest. Besides, studies building a method to measure Liquidity creation (LC) based on the modern liquidity theory show a difference in LC between large banks and smaller banks. Even though they only account for a small amount, large-scale banks generate more LCs, implying higher expected profits (Duan & Niu, 2020). In addition, large banks often receive better support from the government during a liquidity crisis (Dávila & Walther, 2020), implying that liquidity risk will have a more negative impact on small-sized banks (Berger & Bouwman, 2009; Berger & Bouwman, 2013). Many studies often group banks according to predetermined levels of total assets, while few studies use the approach to undefined thresholds of total assets (Le, 2019). Therefore, the objective of this study is to find an unspecified point of full asset size at which the impact of liquidity risk on bank profitability changes and estimate the effect of liquidity risk on profitability among mechanisms of thresholds.

With the above objective in mind, the structure of this study is divided into five parts, including: (1) introduce why we chose this study; (2) research overview and theoretical basis to answer the question posed; (3) the research method that we use in this article; (4) research findings and (5) conclusions and policy implications[1].

2. LITERATURE REVIEW AND THEORETICAL BASIS

2.1. Liquidity creation theory

The liquidity creation theory of banks was proposed by Bryant (1980); Diamond and Dybvig (1983). These early models focused on the Liabilities side of the balance sheet. The bank created liquidity by using deposits to invest in projects with a certain level of return or maturity given passively, allowing depositors to withdraw money on demand actively. The modern approach to liquidity generation emphasises the importance of both Assets and Liabilities in creating liquidity and argues that banks do not only generate liquidity through balance sheet entries but also off-balance sheet items (Holmstrom & Tirole, 1998).

A bank's liquidity creation occurs because of a difference in liquidity between what banks do with the money they hold and the source from which they finance their operations (Berger & Bouwman, 2013). For example, banks use demand deposits with high liquidity (allowing depositors to withdraw money whenever needed) to finance loans with low liquidity (loans have a term and are difficult to resell to investors in the financial markets). At this time, the bank's profitability will be equal to the interest rate difference (due to the difference in liquidity) between the two types of activities. When we extend the above analysis to all the items in the bank's financial statements, and at the same time determine the weights for liquidity, the direction of liquidity creation and the size of each type of activity, it can be seen that the more liquidity banks create, the larger their profits and thus positively affect the bank's profitability.

A bank's liquidity creation process creates liquidity risk (Diamond and Dybvig (1983). Liquidity risk refers to banks facing unexpected withdrawals, forcing them to find additional sources of capital with higher capital costs (Fungáčová et al, 2015). Thus, theoretically, liquidity risk positively impacts costs, negatively affecting bank profitability.

In summary, a bank's liquidity creation process can positively or negatively affect a bank's profitability, depending on which effect prevails. If a proxy for liquidity risk is created according to the method of determining LC and is consistent with market practices, it will simultaneously represent liquidity risk and LC. Then, it will represent well the liquidity risk to help the estimation results match the research objectives.

Applying the spirit of liquidity theory, Berger and Bouwman (2009) developed the "Cat Fat" method and some customised versions to measure LC in a modern approach. The “Cat Fat” method builds on practice in the United States, valuing mortgage loans (whether they are long-term) into the semi-liquid category, as banks can easecuritisedtize them at low cost, so they are weighted with zero (i.e. do not create or absorb liquidity in the economy) and measure LC for off-balance sheet items. Le (2019) shows that off-balance-sheet activities play a small role in creating liquidity for the Vietnam market, as banks are less involved. Up to this point, in Vietnam, there has been no securitisation of loans and a market for buying and selling securitised loans. Hence, the study puts the entire loan portfolio of Vietnamese banks into the illiquid category. Based on the above analysis, this study uses the loan-to-deposit ratio (LDR) to represent the liquidity risk for Vietnamese banks according to practice in Vietnam. Some studies that have used this criterion to describe liquidity risk are Boussaada, Hakimi, and Karmani (2020) with MENA banks, Pop,

Cepoi, and Anghel (2018) with European banks, Saunders, Schmid, and Walter (2016) with banks in the US, Khan, Ahmad, and Chan (2018) with banks in 5 ASEAN countries.

2.2. Differences in the impact of liquidity risk on profitability of commercial banks across size groups

Since both LC and liquidity risk impacts a bank's profitability, when using a proxy for liquidity risk as measured by the LC approach (like LDR for Vietnam market), its impact on profitability will be influenced by the characteristics of the group of banks that have an effect on the amount of LC generated. One such characteristic that empirical studies have shown is the size of the total assets (referred to as size) of the bank. Specifically:

Using the US sample and the “Cat fat” method, Berger and Bouwman (2017) show that between 1984 and 2008, large banks of $3 billion or more generated about 80 % LC of the whole system even though it only accounts for less than 5% of the quantity. Also, with the "Cat fat" method and a sample of 25 banks in Vietnam from 2007 to 2015, Le (2019) shows that the group of banks larger than the sample median accounted for most (approximately 92%) of the LCs generated by banks in the sample.

Chronopoulos, Liu, McMillan, and Wilson (2015), using the criterion of total outstanding loans to total assets to represent liquidity risk, shows that the negative impact of this factor on ROA in large-scale banks in the US is only half that of a group of small or medium-sized banks in the sample. Kashyap, Rajan, and Stein (2002), using a large selection of US banks, also found a negative effect of size on holdings of highly liquid assets.

The above studies imply that the bank size factor influences the impact of liquidity risk on bank profitability. In other words, the

effect of liquidity risk on profitability varies across bank size groups.

3. METHODOLOGY

3.1. Research sample

This study uses a sample of balance sheet data collected from the annual audited financial statements of 30 banks in Vietnam from 2009 to 2021. The sample includes state-owned banks, domestic private joint-stock banks, foreign banks, or unlisted banks and listed banks, which helps reduce many risks of biased sampling. In addition, the statistical results from the research sample and data from the state bank show that: At the end of 2021, the total assets of the banks in the model accounted for 88.6% of the total assets of the Vietnamese banking system. Therefore, the research sample represents the entire Vietnamese banking system.

Macroeconomic data such as money supply growth rate, real GDP growth rate, annual inflation rate is collected and self-calculated from the Vietnam Key Indicator 2018 dataset of the Asian Development Bank Data is updated until the end of 2021.

3.2. Description of research variables

The research uses ROA and ROE as dependent variables representing bank profitability. Representing liquidity risk is the ratio of credit outstanding to customer deposits (LDR - Loan to Deposit ratio) presented in section 2.1. As for control variables, variables such as total asset size, equity, credit risk, and operating costs are often used to represent the bank's business characteristics that affect the bank's business performance (Athanasoglou, Brissimis, & Delis, 2008; Dietrich & Wanzenried, 2011). In addition, the study also controls for industry structural

factors and macroeconomic factors to reduce the risk that the model is severely missing variables.

Table 1: Description of research variables and hypotheses

Variable	Description	Hypothesis	Result	Sources
Return on Assets (ROA)	EBIT/Total Asset			
Return on Equity (ROE)	EAT/Equity			
Size (S)	Natural Logarithm of Total Assets (in billion VND)	+/-	Shehzad, De Haan, and Scholtens (2013) (+); Pasiouras and Kosmidou (2007) (-)	
Capital-Asset Ratio (CA)	Equity/Total Assets	+/-	Dietrich and Wanzenried (2011) complied	
Loan-Deposit Ratio (LDR)	Loan balance/Capital mobilisation balance	+/-	Pasiouras and Kosmidou (2007) (+/-depending on bank group); Saunders et al. (2016) (-); Abdelaziz, Rim, and Helmi (2020); Boussaada et al. (2020); Pop et al. (2018); Khan et al. (2018).	Financial reports
Net Interest Margin (NIM)	Net interest income/Total assets	+	Khan et al. (2018)	
Diversification-Asset Ratio (DIA)	Net non-interest income/Total assets	+	Tan and Floros (2012)	

Loan Provision Cost-Loan Ratio (LPCLR)	Provision expense for credit risk/Total outstanding balance	-	Chen, Shen, Kao, and Yeh (2018)	
Operation Expense-Assets Ratio (OEAR)	Operating expenses/Total assets	-	Athanasoglou et al. (2008); Khan et al. (2018)	
Concentration Ratio (CON)	Total assets of 04 banks with the most significant total assets/Total assets of banks in the sample	+/-	Tan and Floros (2012) (+); Pasiouras and Kosmidou (2007) (+/- depending on bank size group)	
Money Supply Growth Rate (MSG)	Annual M2 money supply growth rate	+	Sufian, Chong, and Finance (2008)	ADB Key Indicator 2018
GDP Growth Rate (GDPG)	Annual real GDP growth rate	+	Dietrich and Wanzenried (2011); Chronopoulos et al. (2015)	
Inflation Rate (INF)	Annual inflation rate	+/-	Caporale, Lodh, and Nandy (2017) (+); Chen et al. (2018) (+); Chronopoulos et al. (2015) (-)	

Source: Compiled by the author

3.3. Research models

If the LDR variable changes in impact according to thresholds, it plays the role of a regime-dependent variable delimited by

thresholds, where the scale variable is the threshold variable. The threshold model with the assumption that two-scale thresholds exist has the form:

$$\begin{cases} Y_{it} = \beta_0 + \beta_1^{'} LDR_{it}\, U(S_{it} \le \omega_1) + \beta_2^{'} LDR_{it}\, U(\omega_1 < S_{it} \le \omega_2) \\ +\beta_3^{'} LDR_{it}\, U(\omega_2 < S_{it}) + \sum_{m=1}^{6} \beta_m X_{mit} + \sum_{n=1}^{4} \beta_n Z_{nt} + \mu_i + \varepsilon_{it} \end{cases} \quad (1.1)$$

$$\begin{cases} Y_{it} = \beta_0 + \beta_1^{'} LDR_{it}\, U(S_{it} \le \omega_1) + \beta_2^{'} LDR_{it}\, U(\omega_1 < S_{it} \le \omega_2) \\ +\beta_3^{'} LDR_{it}\, U(\omega_2 < S_{it}) + \sum_{m=1}^{6} \beta_m X_{mit} + \sum_{t=2010}^{2017} \beta_t\, D.Year_t + \mu_i + \varepsilon_{it} \end{cases} \quad (1.2)$$

Model 1.1 uses the collected macroeconomic variables while Model 1.2 uses dummy year variables to control. The model that gives the test results of threshold existence with higher statistical significance will be selected for analysis.

The dependent variable Yit is the ROA or ROE of the banks each year. The indices i, t represent cross units and years; μi is an unobservable component that does not change over time, meaning the internal characteristics of the bank; εit is the characteristic error of the model. U(.) is a binary instruction function that takes the value one if the expression in brackets is satisfied and 0 if it is not. ω1 and ω2 are threshold values (ω1< ω2), respectively.

Xmit represents independent variables on bank characteristics (S, CA, NIM, DIA, LPCLR, OEAR) while, Znt represents variables on industry and macroeconomic factors (CON, MSG, GDPG, INF), D.Yeart represents the dummy year, minus the base year (2009). The hypothesis is:

Hypothesis 1: The model has one or more scale thresholds at which the impact of the loan-to-customer deposit ratio on profitability changes. The basis of this hypothesis was presented in section 2.2.

Hypothesis 2: Experiences in Vietnam show that the four state-owned banks in the sample and some large-scale private joint-stock banks have a more significant number of customers and a more comprehensive network of operations than other banks, so they have a better ability to mobilise capital, thereby easily balancing and keeping the LDR ratio stable than small-sized banks. Therefore, hypothesis 2 suggests that at the most extensive scale mechanisms, the impact of the LDR ratio on bank profitability will be more positive than in the previous regimes.

3.4. Estimation method

To evaluate the heterogeneity of each data group, studies can use methods such as using dummy variables for groups, analysing differences indifference, quantile regression. However, the disadvantage of these methods is that the groups of data are defined in advance. The above techniques will help to estimate the relationships according to each group, so the model is built in a more rigid way than using statistical methods to find the difference between groups of observations. The panel threshold regression (PTR) method proposed by Hansen (1999) applied to balanced panel data has advantages over the above methods because it allows nonlinear mining relationships according to undefined thresholds. To deal with outliers, since the sample size is not significant (270 observations), the threshold estimation and the effects in the threshold model were performed simultaneously with the trimming of 1% of total comments at each end by bank size.

All tables and figures must be centred and title should be on top. Number all tables and figures with Arabic numerals in the order in which the tables are first mentioned in text. Use font size 9 pt for contents in tables and figures and 8pt for notes and source. All illustrations (charts, figures and graphs) in the text will be printed in black and white coloured.

4. RESULTS

4.1. Multicollinearity test

Research practice suggests that if the correlation coefficient is greater than 0.8, the model has high multicollinearity. However, the pair correlation coefficient only considers the correlation between two variables. In comparison, multicollinearity can occur when more than two variables are highly correlated, so the study continues to estimate the variance inflation factor (VIF) of the independent variables. If the VIF coefficient is greater than 5, the model has high multicollinearity with that independent variable.

Table 2: Correlation matrix of variables

	ROA	**ROE**	**S**	**CA**	**LDR**	**NIM**	**DIA**	**LPCLR**	**OEAR**	**CON**	**MSG**	**GDPG**	**INF**
ROE	0.674	1											
S	-0.216	0.318	1										
CA	0.512	-0.184	-0.715	1									

LDR	0.278	0.094	-0.207	0.366	1								
NIM	0.592	0.387	-0.055	0.334	0.229	1							
DIA	0.472	0.34	0.073	0.203	0.046	0.04	1						
LPC	-0.075	-0.02	0.26	-0.077	-0.142	0.391	0.255	1					
LR	0.105	-0.003	-0.04	0.139	0.003	0.606	0.094	0.43	1				
OE AR	-0.04	0.01	-0.072	-0.001	0.031	-0.14	0.169	-0.055	-0.128	1			
CON	0.276	0.22	-0.249	0.171	0.206	-0.099	0.046	-0.227	-0.238	0.432	1		
MSG	-0.076	0.012	0.211	-0.215	0.003	-0.083	-0.039	0.075	0.119	-0.209	-0.216	1	
GDPG	0.111	0.044	-0.187	0.186	0.028	0.177	-0.022	-0.142	0.049	-0.641	-0.04	-0.23	1
INF	0.357	0.244	-0.187	0.186	0.028	0.177	-0.022	-0.142	0.049	-0.641	-0.04	-0.23	1

Source: Calculation from STATA 15.1

Table 2 shows that the largest value (in terms of magnitude) is the correlation coefficient between the size variable (S) and the equity ratio (CA), with a value of 0.715. However, this value is still less than 0.8. Therefore, preliminary shows that the phenomenon of high multicollinearity appears.

Table 3: VIF coefficients of independent variables

Independent variables	S	CA	LDR	NIM	DIA	LPCLR	OEAR	CON	MSG	GDPG	INF	Mean VIF
VIF	3.11	3.6	1.44	2.35	1.61	1.66	1.98	3.38	1.64	1.6	3.2	2.32

Source: Calculation from STATA 15.1

Table 3 shows that all VIF values are less than 5. Therefore, this result shows no high multicollinearity appears and allows the estimation to continue.

4.2 Results of testing the existence of scale thresholds and threshold model estimation

First, this study tests the existence of a threshold using the Bootstrap method 300 times and grid search on 400 percentiles. Suppose the results exist a threshold that is statistically significant at the 10% level of significance. In that case, this study continues to test the existence of two thresholds based on the previous first threshold estimation results. If the hypothesis exists, two thresholds are accepted, the study continues to test the existence of the next thresholds. This research also uses the improved standard error method (robust std. err.) and bank-clustering to overcome the heteroscedasticity and autocorrelation (if any) for estimates in threshold models.

Table 4: Results of testing the existence of S-scale thresholds (Bootstrap 300 times)

Dependent variable	Model Selection	Independent variable changes the impact	Test for existence of a threshold		Test for the existence of two thresholds	
			Threshold value	F-stat	Threshold value	F-stat
ROA	MH 1.1	LDR	13.2290**	19.72	13.2290	5.45

				12.0233	
	MH 1.2	13.3391***	23.21	13.3391	6.43
				12.9135	
ROE	MH 1.1	12.5638	14.95		
	MH 1.2	12.5638	14.52		

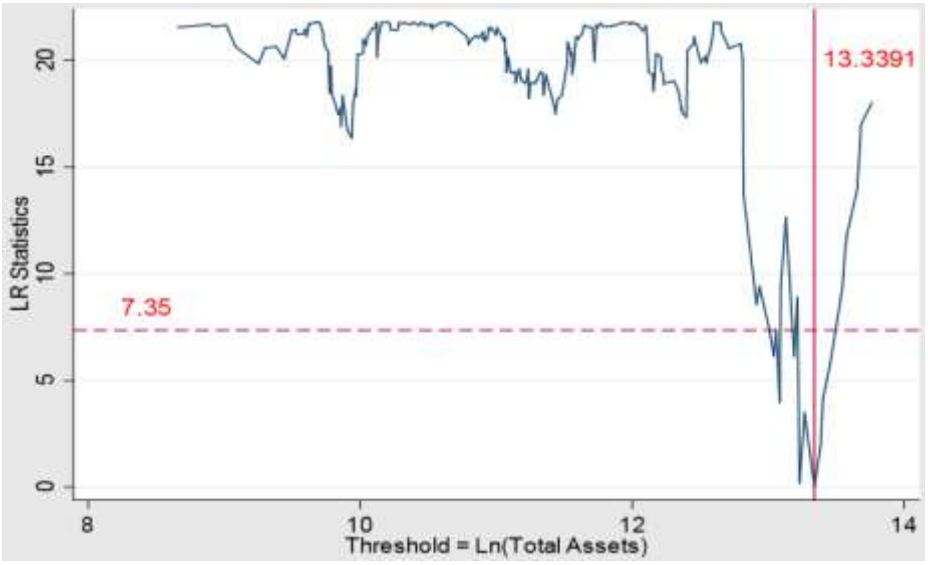
Notes: *, ** and *** are the symbols of significance levels at 10%, 5% and 1%, respectively.
Source: Calculation from STATA 15.1

The results in Table 4 show that the models with ROA as the dependent variable exist threshold, while the models with ROE do not exist threshold at 10% significance level. Therefore, the study will use the model's results with ROA as the dependent variable for analysis.

In case ROA is the dependent variable, model 1.2 helps determine the threshold with higher statistical significance (1% significance level) than model 1.1 (5% significance level). This implies that the use of dummy variables helps control the model better than the group of macroeconomic variables from the collected data. The reason is that the use of dummy variables helps control for the aggregate effect of all factors that have a common impact on banks, including macroeconomic factors in model 1.2.

Figure 1 illustrates the results of the threshold existence test at the 5% significance level, corresponding to the Likelihood ratio (LR) statistic value of 7.35 (Wang & Shao, 2019), showing that the LR statistical values 13.3391 are quite far from 7.35.l. Therefore, the results will be stable at the 5% significance level even if the threshold existence test is performed according to the Bootstrap method with a more significant number of iterations (e.g., 500 times).

Figure 1: LR statistics and defined threshold values



Source: Calculation from STATA 15.1

Table 5: Estimation results of threshold models ROA as the dependent variable

Dependent variable: ROA	**Estimated results Model 1.2**	
Dependent variable	**Estimated coefficient**	**Robust S.E**
LDR if S<=13.3391	-0.0021**	0.001
LDR if S>13.3391	0.0016	0.002
S	0.0035**	0.001
CA	0.0142*	0.007
NIM	0.5637***	0.086
DIA	0.8243***	0.079
LPCLR	-0.3202***	0.047
OEAR	-0.1920	0.205
_cons	-0.0363**	0.015

Notes: *, ** and *** are the symbols of significance levels at 10%, 5% and 1%, respectively

Source: Calculation from STATA 15.1

Table 5 shows that for observations below the threshold of 13.3391 (corresponding to total assets equal to 27.28 billion USD), liquidity risk (LDR) has a negative impact on ROA at the 5% level of statistical significance, however, when the bank size exceeds the upper threshold, this effect turns positive and is not statistically significant. Therefore, the observation group with the largest size (total assets exceeding the threshold of 27.28 billion USD) is less affected by liquidity risk than the other observations when increasing LDR. To explain this, the research applies the spirit of liquidity theory and compares the data in the sample simultaneously. Noticeably, the group of observations that exceed the threshold only includes observations belonging to four state-owned banks holding over 50%.

The theory of liquidity creation implies that an increase in LC has two effects on the bank: (i) increased profitability and (ii) increased cost of capital. If the LDR is too high, the negative impact of increased capital costs on profitability may outweigh the positive effect of credit growth. In addition, banks in Vietnam are often subject to credit growth limits; high LDR values often leave banks with little room for credit growth, so it is unlikely to increase much profit.

Compared to the sample, Table 6 shows that the group of banks with more than 50% state capital holdings has an average LDR of over 12.61%, and the volatility of LDR (standard deviation) is lower than the other group of banks.

Table 6: Average loan-to-deposit ratio of groups of banks in the sample

Bank groups	Group average LDR	Standard deviation
Private joint-stock bank	86.03%	24.82%
Banks with state capital holding more than 50%	96.88%	13.45%
Below the threshold of USD 27.28 billion	101.21%	14.13%
Above the threshold of USD 27.28 billion	92.04%	11.14%

Source: Calculation from STATA 15.1

However, when the scale exceeds the threshold of USD 27,28 billion, the average LDR of the four banks above is lower than the group observed under the scale mechanism below 9.06%, and the volatility (LDR standard deviation) lower than the group of observations with scale below the threshold and the lowest in table 6. This shows that the observation group with over-threshold size has a lower liquidity risk than the observation group with the below-threshold size. At the same time, they also have a better capacity to maintain this. Therefore, according to the theory of liquidity creation, with this research, the impact of LDR on profitability will turn more positive when the bank's size exceeds the threshold of USD 27.28 billion. This result is consistent with Chronopoulos et al. (2015).

The above results also show that even the above four large state-owned banks, once they maintain a high level of liquidity risk (high LDR value), such as when their size is below 27.28 billion USD, LDR also affects negatively affect their profitability like other banks. This result implies that the degree of LDR that banks have is a key feature determining their positive or negative impact on bank profitability rather than whether they are "state-owned". This may be because, in Vietnam, banks rarely experience liquidity shortages so severe that the government needs to relieve liquidity, so the impact of “state ownership” or “too big to fail” on

the relationship between liquidity risk and profitability of banks is not clear.

Scale (S) represents economies of scale as implied by financial intermediation theory. This variable has a positive effect on ROA; on average, a 1% growth scale only helps ROA to grow by 0.0035 percentage points. This implies that banks will benefit from scale growth, although not significant.

The equity ratio (CA) has a significant positive impact of 10% on ROA. Raising the equity ratio helps increase the tolerance for losses arising from business risks, especially credit risks, thereby promoting credit growth to earn higher profits. In addition, the cost perspective holds that raising the equity ratio helps increase creditworthiness, thereby helping banks reduce capital costs (Molyneux, 1993), increasing profits.

Net interest margin (NIM), as well as Diversification-Asset Ratio (DIA), have a positive effect, and credit risk (LPCLR) has a negative impact on ROA and are statistically significant. This is in line with common sense.

Operating cost (OEAR) has a negative but not statistically significant effect on ROA. This result implies that banks in Vietnam generally manage operating costs (including labour costs and other operating costs) quite well.

5. CONCLUSION AND IMPLICATION

5.1. For banks whose total assets exceed the threshold

The results in section 4.2 show that, in Vietnam, the largest group of banks operating with a moderate level of liquidity risk

(represented by the LDR value) has room for credit growth without being adversely affected by liquidity risk. The study recommends that with the advantages of large network size and good access to capital from wholesale capital markets, these banks should maintain liquidity risk and liquidity stability. Then liquidity risk from traditional operations is not a concern for them.

5.2. For banks with total assets below the threshold

In addition, the shift of business to non-interest service activities such as digital banking, bancassurance, and cards also creates an alternative source of income from interest, reduces pressure on credit growth and thereby facilitates the reduction of LDR.

Banks below the upper threshold focus on reducing the LDR ratio in the process of growing their scale by increasing the sources of capital mobilised from retail. Retail funding is often more stable than wholesale funding and is suitable for small-scale banks, which are valued for their ability to exploit soft-information more than other banks. Large banks (Berger & Black, 2011; Berger, Miller, Petersen, Rajan, & Stein, 2005) are better able to mitigate asymmetric information (Barros, Ferreira, & Williams, 2007), allowing them to build and maintain long-term relationships with individual customers and small and medium-sized enterprise customers. In addition, the shift of business to non-interest service activities such as digital banking, bancassurance, and cards also creates an alternative source of income from interest, reduces credit growth pressure and thereby facilitates the reduction of the LDR rate.

To conclusion, the analysis has shown that liquidity risk plays an important role when considering the impact of liquidity risk on bank profitability. Therefore, it is possible to conduct further

studies to estimate the liquidity risk threshold, under which the effect of this factor on profitability changes.

Similar to the fixed effects method, the PTR allows the correlation between the unobserved and time-invariant components of each bank with the independent variables in the model, thereby minimising the endogeneity problem in the model. In addition, controlling annual dummy variables helps control the combined effects of factors that have a common influence on the bank's yearly performance, and endogenous risks continue to be minimised. However, the problem of endogeneity may not be completely resolved either because the model does not control enough important independent variables or because of a two-way relationship between the dependent and independent variables. This is a proposal to continue to work to improve the quality of research

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