DOES RAISING BANK CAPITAL LIMIT BANK LIQUIDITY CREATION? EVIDENCE FROM COMMERCIAL BANKS IN VIETNAM

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ABSTRACT

Little is known about the trade-off mechanism underlying raising bank capital and enhancing bank liquidity creation, as empirical evidence is sparse. Pursuing Basel II target capital seems challenging and costly because it could generate unintended consequences, such as reducing liquidity creation. Thus, the aim of this study is to point out that the pursuit of raising capital to meet Basel II standards in recent years has limited the liquidity creation function of banks. This finding is reliable and consistent across different research methods, i.e. least absolute shrinkage and selection operator (LASSO regression) and the simultaneous equations model (SEM). We chose Vietnam's banking system for this study because applying Basel II in Vietnam has been topical in recent years and also more challenging than in the rest of the world. Our finding strengthens academically the financial fragility-crowding out hypothesis developed by Diamond & Rajan (2000).

INTRODUCTION

Banks' liquidity creation means banks' ability to meet all financial demands (Yeager & Seitz, 1982). Banks create liquidity by converting illiquid capital flows into highly liquid ones through their capital mobilization and lending activities. Banks' deposit services collect the small, fragile, and prone to run capital flows, forming a continuous, stable cash flow. These highly liquid sources of funds are available to meet many financial demands, even poor-liquidity investments (Bryant, 1980; Diamond & Dybvig, 1983). Along with the development of banks' deposit services and activities, the bank's ability to create liquidity has been expanded to off-balance sheet items like loan commitments (L/C) and lines of credit (Holmström & Tirole, 1998; Kashyap et al., 2002). That is how commercial banks perform their function of creating and providing liquidity to the economy.

Analyzing what affects liquidity in a bank is important because banks also help provide liquidity for the economy.

Banks hold illiquid assets in the form of loan commitments and offer liquidity to boost economic growth, and as a result of the diversity of bank deposit services, only commercial banks have promoted this function optimally. And according the theory of financial intermediaries, liquidity creation is one of the most significant preeminent functions of banks in any economy (Franklin Allen & Carletti, 2012; Berger & Bouwman, 2009; Bryant, 1980; Diamond & Dybvig, 1983). In other words, the function of creating and supplying liquidity to satisfy the financial needs of the economy is the reason for the inevitable and objective existence of the banking system. With respect to Central Banks, banks' liquidity creation is a valuable predictor of forecasting potential financial crises in the short and medium-term (Berger, 2017). Too much liquidity creation, i.e., when banks take on a large amount of risk to transform liquidity across different assets, often is followed by a financial crisis. Therefore, research on liquidity creation is valuable, with, high academic and practical value.

Recent studies, however, have raised concerns about the bank's liquidity-creation function being overwhelmed and limited by other banks' goals, such as meeting the continuously higher equity capital threshold as required by the Basel Committee. The significant increase in capital requirements from Basel came about following the global financial crisis in 2008-2009 in an effort to ensure the safety of the whole banking system, however the increase in capital requirements has put much pressure on banks' liquidity creation. Not surprisingly, banks that do not meet the new capital requirements are under higher pressure. In response, these banks have reduced their holdings of risky assets or shifted investors' funds from liquid deposits to relatively illiquid capital, thereby diminishing the liquidity-creation function (Tran et al., 2016). Greater bank capital decreases the likelihood of financial distress but also reduces the generation of liquidity. Therefore, optimal bank capital structure must eliminate the trade-off effects on liquidity creation. This negative effect is also observed by many researchers who support the financial fragility-crowding out hypothesis (Diamond & Rajan, 2000, 2001; Gorton & Winton, 2005). Notably, the risk absorption hypothesis shows an opposite view, arguing that greater capital ratios increase banks' risk-bearing capabilities, thus allowing them to produce more liquidity (Bhattacharya & Thakor, 1993; Coval & Thakor, 2005; Repullo, 2004; Von Thadden, 2004).

This opposite view of the causal link from bank capital to liquidity creation is also an ongoing debate, which initially motivates this study, especially in the real Vietnamese context. It is worth mentioning that for the past five years, starting from 2015, Vietnamese banks have been racing to apply solutions and campaigns to increase their capital to meet the Basel II requirement by 01/01/2020. This pressure is much higher when the State Bank of Vietnam (SBV) has emphasized that if banks violate the regulations on capital adequacy under Circular No. 41/2016/TT-NHNN from 01/01/2020, there will be a punishments response.

Therefore, this study has set out primarily to test whether pressure from increasing capital reduces the liquidity creation of the banks in the Vietnamese economy, finding evidence supporting the financial fragility-crowding out hypothesis. Extending previous studies, we check the two-way causality of capital requirements and liquidity creations.

Our study contributes to the banking literature and policy implementation in many ways. First, despite its urgent and clear research gap, prior to our study only the study of Le (2019) was carried

out in Vietnam. Our study revisits the effect of either capital or liquidity creation on each other, as Le (2019) pointed out, using Lasso regression as an additional data analysis tool to SEM. Second, the study depicts the bi-directional interactions between bank capital and liquidity creation, providing more insights into this relationship. Finally, we have updated Le's (2019) database, which is limited to 2015, extending the database up to 2019 to provide a closer look at the period, beginning in 2015, that caused the highest pressure caused by pursuing capital.

As expected, our results found reliable proof supporting the fragility crowding-out hypothesis, showing that a trade-off exists between raising equity capital and banks' liquidity creation. Remarkably, this finding is robust across LASSO and SEM regression, showing that an increase in bank capital reduces a bank's ability to produce liquidity, consistent with that of Le (2019). Therefore, a key policy priority should be to plan for the long-term care of raising equity capital to eliminate this trade-off effect.

This paper is broken into five parts. Section 2 gives a brief review of the relationship between liquidity creation and bank capital. Section 3 shows our model along with the choice of the data analysis methods. The fourth section presents the research findings, and managerial implications are highlighted in conclusion.

LITERATURE REVIEW

The causal relationship between bank capital and liquidity creation is examined in current theoretical and empirical research. are two basic mainstream hypotheses on bank capital and liquidity creation from the theoretical literature: the *financial fragility-crowding out* hypothesis and the *risk absorption* hypothesis (Berger & Bouwman, 2009). The former hypothesis implies a negative association between bank capital and liquidity creation. More specifically, when a bank's capital structure is weak, it will commit to more closely monitoring its borrowers, allowing it to extend loans and produce more liquidity. Meanwhile, increased equity capital makes it more difficult for the less-fragile bank to commit to monitoring, limiting its capacity to create liquidity (Diamond & Rajan, 2000, 2001).

Similarly, Gorton & Winton (2005) argued that a bank with higher regulatory capital may

experience lower liquidity creation because a higher capital standard could mitigate financial fragility, *crowding out* deposits in an unbranded capital market since deposits are more effective liquidity hedges than equity investments. In contrast, with regards to the *risk absorption* hypothesis, when banks have a higher risk tolerance, they can absorb more risk with more capital, and so they create more liquidity, indicating a positive link (Bhattacharya & Thakor, 1993; Coval & Thakor, 2005; Repullo, 2004; Von Thadden, 2004). Conversely, in playing a role of risk transformers, the higher the liquidity banks create, the greater the chance and severity of losses associated with having to sell illiquid assets to fulfill clients' liquidity requests (F. Allen & Gale, 2004; Berger & Bouwman, 2009; Diamond & Dybvig, 1983). The underlying reasoning of this hypothesis is that capital and the level of illiquidity risk are adjusted. As a result, there is a positive and bi-directional relationship between bank capital and liquidity creation (Tran et al., 2016).

Besides, two opposite hypotheses have been developed under the inverse link from liquidity creation to bank capital. Matz & Neu (2007) stated that when banks create more liquidity, they are becoming increasingly vulnerable to the risk of not being able to satisfy unexpected customer withdrawals. Consequently, banks may be required to hold more capital in order to enhance their solvency, raise external funds more readily, and bear the losses associated with selling illiquid assets at fire-sale prices. They suggested a positive link between bank capital and liquidity creation by hypothesizing *liquidity constraint*. Contrarily, an alternative view suggested by Distinguin et al. (2013) argues that when banks confront increasing illiquidity, they may swap these illiquid liabilities for capital. At the end, the *liquidity substitution hypothesis* explains a negative effect of liquidity creation on bank capital.

While theories imply a causal link between capital and liquidity creation, the issue is more complicated in practice, and both might be determined simultaneously. Recently, this relationship has been investigated through several studies (Berger et al., 2014; Berger & Bouwman, 2009; Fungacova et al., 2015; Fungáčová et al., 2017; Li & Malone, 2016; Ozturk Danisman, 2018; Tran et al., 2016; Tu, 2015). Initially, according to the main results of Berger

& Bouwman (2009), there is an effect of liquidity on banks' capital, and this effect is clearly different between the two groups of small and large banks. For larger banks, this effect is favorable, but for small ones, the results show a negative effect. This is explained by the two respective theories (as mentioned above): (1) the risk absorption effect and (2) the financial fragility-crowding out effect. Furthermore, for medium-sized banks, the relationship is not really clear. The study of each sized group was also carried out by Fungacova et al. (2015), based on the inheritance of Berger & Bouwman's (2009) method, to develop a measure of the liquidity creation of Russian banks. Their findings point out that the top liquidity-creating banks have less liquid assets than total assets but significantly higher liabilities per total assets than other banks. These studies of Berger & Bouwman (2009) and Fungacova et al. (2015), however, both find that the association between liquidity creation and bank capital is only one way.

Later studies have investigated two-way causality tests between these variables. At first, Distinguin et al. (2013), Anis and Rashid (2017) claimed that Basel III's illiquidity measure and liquidity creation are both adversely associated with Tier-1 and Tier-2 capital ratios. Nevertheless, capital appears to be favorably related to liquidity creation for small banks when stable deposits are replaced with core deposits for liquidity measures. Regarding a sample of Czech banks, Horvath et al. (2014) found that liquidity creation reduces capital in a sample of Czech banks, and that capital has a negative impact on liquidity creation for small banks. To date, Tran et al. (2016) proved that capital has a positive effect on liquidity, while Le (2019) stated the opposite, the larger the capital, the lower the ability to create liquidity. Inversely, the impact of liquidity on capital is negative, in which banks creating more liquidity are usually banks with low capital. Though the findings of Le (2019) brought many scientific and informative values, they did not clarify the relationship between these two variables in the Vietnamese economy.

On the other hand, due to the mixed results from their pre-studies, Berger et al. (2016) made more in-depth studies, considering additional policies and regulations that can reduce the liquidity-creation function. Interestingly, they found that regulatory interventions (i.e., capital adequacy regulation) do not affect the liquidity created by assets but that of liabilities and off-balance-sheet accounts. In contrast, capital support does not affect the liquidity created by off-balance-sheet items, but it does negatively impact the liquidity created by assets and has a positive impact on the liquidity created by liabilities on the balance sheet. As a way to clarify the relationship, Ozturk Danisman (2018) also added a number of control variables such as bank size, equity to total assets, Z-score, or non-performing loan ratio, alongside two macro variables, real GDP growth rate and the inflation rate. The results are similar to those of Berger et al. (2014), in which there exists a positive relationship between capital and liquidity. A new feature of Ozturk Danisman (2018) found that the "risk-absorbing" hypothesis prevails for small banks and the "financial fragility" hypothesis is more common in large banks in Turkey.

In Vietnam, the research on liquidity creation and the link between the liquidity-creation function and bank capital is relatively new. Currently, only Le (2019) has carried out the research design of Berger et al. (2014) to calculate liquidity creation for the banking system from 2007 to 2015. Le (2019) noticed a substantial increase in liquidity, in which the proportion of fat liquidity creation (FLC) on total assets increased significantly from 6.81% in 2007 to 25.14% in 2015. In addition, the average proportion of FLC to total assets for Vietnamese banks throughout 2007-2015 is approximately 13%. This figure is much lower than that of the US (at 29%, Berger et al. (2014)), Russia (from 27% to 30%, Rauch et al. (2010)), and the Asia-Pacific region (at 31%, Fu et al. (2016)). One of the main causes for the Vietnamese banking system's reduced liquidity supply is that bank sizes are pretty modest compared to those in the same region, thus limiting their potential to create additional liquidity. Moreover, on average, large banks accounted for roughly 92% of the total liquidity supply in Vietnam during 2007-2015, compared to 95% in the Asia-Pacific region (Fu et al., 2016), and 81% in the US (Berger et al, 2016) The study also concluded that the liquidity creation of Vietnamese banks has increased over time.

Hitherto, the interrelationship between liquidity and bank capital is still questionable,

and there are differences between groups of banks across countries. For Vietnamese banks, Le (2019) covered the period of 2007-2015, and the model, despite reliability, is not convincing due to the lack of control variables as macro variables.

Drawing upon this research strand, this study attempts to test the following hypothesis in the case of Vietnam.

- *Hypothesis H1: Bank capital has a negative effect on bank liquidity creation.*
- *Hypothesis H2: Bank liquidity creation has a negative effect on bank capital.*

METHODOLOGY

A balanced panel data is collected for this study, including eight variables extracted from the annual audited financial statements of 29 commercial banks in Vietnam from 2007 to 2019. This research period is optimal because it recorded a significant reform in the banks' capital structure due to the 2008 financial crisis and the high pressure of raising the capital required by Basel II in the Vietnamese banking system in the past five years.

The following models express the potential bi-directional relationship between bank's liquidity creation ($LIQCREATION_{i,t}$) and bank equity capital ($CAPITAL_{i,t}$) in mathematical language:

Equation (1) presents the regression of bank capital on bank liquidity creation as a central explanatory variable:

$CAPITAL_{i,t} = \beta_0 + \beta_1 LIQCREATION_{i,t} + \beta_2 PROVISION_{it} + \beta_3 CIR_{i,t} + \beta_4 INFLATION_{i,t} + \beta_5 LNTA_{i,t} + \delta_{i,t}$ (1)

Equation (2) presents the regression of bank liquidity creation on bank capital as a central explanatory variable:

$LIQCREATION_{i,t} = \alpha_0 + \alpha_1 CAPITAL_{i,t} + \alpha_2 LOAN_{i,t} + \alpha_3 LONGSEC_{i,t} + \alpha_4 INFLATION_{i,t} + \alpha_5 LNTA_{i,t} + \varepsilon_{i,t}$ (2)

Where:

- CAPITAL: capital of bank i at time t, proxied by bank equity/total assets
- LIQCREATION: bank i's ability to create liquidity at time t, calculated by the authors using Berger & Bouwman's (2009) measurement, proxied by CatNonFat/total assets

- CIR: cost to income ratio of bank i at time t, proxied by operating cost/operating income
- LOAN: total loans of bank i at time t
- LONGSEC: long-term investments of bank i at time t
- PROVISION: total provisions for credit losses of bank i at time t
- INF: inflation rate at time t
- LNTA: bank i's size at time t, proxied by the natural logarithm of the bank's total assets
  - Subscripts *i* and *t* denote bank and period, respectively.

In the above model, CAPITAL and LIQCREATION are the two variables of main interest, one of which is the explanatory variable for the other, respectively. Notably, the most crucial point in designing these models is the choice of the optimal set of exogenous variables.

First, each exogenous variable is closely linked to its endogenous variable, as has been proven by previous studies. CIR and PROVISION are typically the determinants of bank capital. The loan loss provisions, known as the bank's cost of the risk, further decrease bank profits, deplete bank capital and reinforce the existing recession (if any) (Krüger et al., 2018; Ozili & Outa, 2017). Similarly, the cost to income (CIR) is inversely related to bank profitability, resulting in a depletion of bank capital (Ghosh et al., 2003; Hess & Francis, 2004). Bank liquidity creation (LIQCREATION) is strongly determined by the size of credit activity (LOAN) and long-term investments (LONGSEC), the two main financing activities from banks. In Vietnamese banks, these activities account for an average of 76% and 17% of a bank's total assets, respectively. These two are the most illiquid assets of a bank's activities, then growth in lending and long-term security investment negatively influence bank liquidity creation for the economy (Roy et al., 2019).

Second, the exogenous variables for equation (1) have to be well correlated with the endogenous variable of equation (1) than with the endogenous variable of equation (2) and vice versa. This fact helps to eliminate the multicollinearity and reduce the bias estimation during regression. In this study, CIR and PROVISION have significant correlations to CAPITAL but not to LIQCREATION. Similarly, in equation (2), LOAN and LONGSEC are highly correlated to LIQCREATION but not with CAPITAL. This fact is observable by the bolded

correlations coefficients shown in Table 2.

Finally, the control variables must be chosen so that explanatory significance in both models occurs simultaneously. LNTA and INF are the two variables that satisfy this requirement, show a significant impact on both LIQCREATION and CAPITAL. LNTA is bank size, measured by the natural logarithm of total assets, and is integrated into the model to control bank's characteristics that may confound liquidity creation or equity raising. Berger & Bouwman (2009) argued that large banks, considered *too big to fail*, do not create as much liquidity to the economy as small banks, especially in emerging economies. On the other hand, for capital, according to Ahmad et al. (2008), large banks have higher incomes and more investment opportunities (and thus can reduce the cost of capital), and their ability to access the capital market is less restrictive than those of small banks. As a result, large banks can more easily mobilize external funds, allowing large banks to hold a lower capital ratio. INF as a proxy for the macro-control variable inherited from the study of Bunda & Desquilbet (2009). A high inflation rate is one of the reasons why banks tend to hold a lot of liquid assets. When the inflation rate rises, banks become more vulnerable, especially those focusing on long-term loans. On the contrary, it would be more difficult for banks to raise capital during a high inflation period.

Designing the above model for balanced panel data for Vietnamese banks is an art. As usual, all the financial variables of the bank have a multi-directional correlation with each other. To build the model, the variable selection that satisfies the very high technical requirements mentioned above is vital, creating a unique value for this study.

The simultaneous equation model (SEM) is chosen primarily to estimate the above equations as suggested by Distinguin et al. (2013); Le (2019); Ozturk Danisman (2018); Tran et al. (2016). First, using the same methodology as Distinguin et al. (2013); Le (2019); Ozturk Danisman (2018); Tran et al. (2016) facilitates the comparison across empirical studies. Second, SEM is the most appropriate to test the bi-directional causal link existing in bank capital and bank liquidity creation, as pointed out in the literature review and in the design of our model.

Umar (2018) emphasized that using SEM with a highly structured model has the advantage of integrating many endogenous variables without endogeneity and autocorrelation in the model's residuals.

Apart from SEM, LASSO is chosen as an additional analysis tool for this study to find additional evidence on the relationship between liquidity creation and bank capital. We chose LASSO because it is developed based on linear regression like SEM but is more advanced. In nature, LASSO is the standard least-squares linear regression incorporating the L1-norm, known as the sum of the absolute values rather than the squares (Hastie et al., 2009). LASSO stands for least absolute shrinkage and selection operator. So, one obvious advantage of LASSO regression over linear regression is that it eliminates the multi-directional correlation problem among exogenous variables through its feature selection operator (Xu et al., 2012). Moreover, LASSO allows working on data with extreme values while standard regression is not because standard regression is limited to normally distributed data, while almost all financial databases are not normally distributed. As shown in Table 1, all variables are not entirely normally distributed.

EMPIRICAL RESULTS

This section shows the empirical evidence of the trade-off from capital raising to liquidity creation in Vietnamese commercial banks. The descriptive statistics and the correlation matrix of eight variables are presented in Table 1, 2. LASSO and SEM results are shown in Table 3.

Table 2 presents the correlation matrix between the dependent and explanatory variables. The two variables, capital (CAPITAL) and liquidity creation (LIQCREATION), are negatively correlated at -0.281, reaching statistical significance at 1%. This is virtual proof as a premise for testing the trade-off relationship between these two variables.

Table 1. Descriptive statistics

Variable	Obs.	Mean	Std.	Min	Max
CAPITAL	290	0.0932395	0.0422221	0.0293141	0.2564247
LIQCREATION	290	0.0835861	0.1372139	-0.3868528	0.4094463
PROVISION	290	0.5503881	0.5184588	-1.693503	3.480835
CIR	290	83.31754	503.8986	0.4530923	8630.244
LOAN	290	53.69655	14.0108	0.6352305	81.86418
LONGSEC	290	0.1740489	0.0784437	0.0054246	0.4688021
LNTA	290	32.30446	1.179811	29.73825	34.93752
INF	290	6.080647	4.978262	.6312009	18.67773
Source: Calculated by the authors					

Two control variables, including inflation (INF) and bank size (LNTA), are all correlated with both capital dependent variables (CAPITAL) and liquidity generating capacity (LIQCREATION), at the 1% level of statistical significance. Moreover, the correlation of these two variables with the two dependent variables is higher than the correlation of these two variables with the explanatory variables in each model. This is a piece of empirical evidence that reinforces that the selection of these three variables as control variables is entirely appropriate. The pair of variables of credit activity size (LOAN) and size of long-term investment securities (LONGSEC) are highly significant with the variable LIQCREATION and do not correlate with the variable (CAPITAL). This is in line with expectations and meets the technical requirements of the SEM - simultaneous equation system model. Similar to the pair of performance variables (CIR) and risk provision size (PROVISION) as the explanatory variable for CAPITAL. One more thing to note is that the pair of the size of credit activity (LOAN) and the size of long-term securities investment (LONGSEC) are not correlated. The same is true for the pair of performance variables (CIR) and the size of the loan loss provision (PROVISION). The absence of correlation between the explanatory variables in the same model shows that the explanatory variables are independent of each other, meeting the requirements of the regression technique. It shows that the multicollinearity is not a problem in the research figure. At this point, there is a basis to confirm that the selected combination of variables to build this research model completely meets the technical requirements and is consistent with the research hypothesis.

Table 2. Correlation matrix

	CAPITAL	LIQCREATION	PROVISION	CIR	LOAN	LONGSEC	LNTA	INF
CAPITAL	1							
LIQCREATION	-0.2807**	1						
PROVISION	0.0933*	0.044	1					
CIR	0.1721**	-0.0645	-0.0262	1				
LOAN	-0.0109	0.4243**	0.4683**	-0.1627	1			
LONGSEC	-0.0914	-0.1934*	-0.0118	0.1155	-0.5453	1		
LNTA	-0.7159**	0.2883*	0.1731	-0.1043	0.1964	-0.0067	1	
INF	0.2481**	-0.5664*	-0.1745	0.0233	-0.1852	-0.1381	-0.2303	1
Source: Calculated by the authors								

Overall, the estimated results of all four   equations in Table 3 show the stability of the

relationships between the variables. Most variables are statistically significant across models. The variables all have the sign of the expected agreement and are constant from the

base model to the matching model. The explanatory level of the models is above 60%.

Table 3. LASSO results vs. SEM results

	SEM regression		LASSO regression	
	Equation 1	**Equation 2**	**Equation 1**	**Equation 2**
Dependent variables	CAPITAL	LIQCREATION	CAPITAL	LIQCREATION
Explanatory variables				
CAPITAL		- 0.7707308***		-0.511564
LIQCREATION	- 0.0922695***		0.000000	
PROVISION	0.0147113		0.000000	
CIR	0.0000132		0.000000	
LOAN		0.0024784***		0.002465
LONGSEC		-0.2203863***		-0.224667
Control variables				
INF	0.0012974**	-0.012849**	0.000000	-0.013459
LNTA	0.0001959***	0.0042865***	-0.017231	0.000339
RMSE	0.0415346	0.1012167		
L1 Norm			0.667096	0.861408
R-squared	0.8352	0.6021	0.457559	0.462992

Note:

Equation 1: $CAPITAL_{i,t} = \beta_0 + \beta_1 LIQCREATION_{i,t} + \beta_2 INFLATION_{i,t} + \beta_3 LNTA_{i,t} + \beta_4 PROVISION_{it} + \beta_5 CIR_{i,t} + \delta_{i,t}$

Equation 2: $LIQCREATION_{i,t} = \alpha_0 + \alpha_1 CAPITAL_{i,t} + \alpha_2 INFLATION_{i,t} + \alpha_3 LNTA_{i,t} + \alpha_4 LOAN_{i,t} + \alpha_5 LONGSEC_{i,t} + \varepsilon_{i,t}$

*, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively.

The choice of λ is frequently made by employing an automated 10-fold cross-validation approach. For this method, the dataset is randomly partitioned into k equal-sized sub-samples. The training dataset makes up 80% of the total, while the testing dataset makes up the remaining 20%.

Source: Calculated by the authors

What stands out in Table 3 is the significant negative effect of CAPITAL on LIQCREATION in both SEM and LASSO results. In econometric language, the trade-off from raising capital to bank liquidity creation is clear and very strong, represented by the significant and negative coefficients of **-0.7707308***** and **-0.511564**, respectively. In short, banks with higher capital create less liquidity. The results strongly support

the financial fragility-crowding out hypothesis, as expected. They are not only in line with mentioned theories but also many previous studies (Berger et al., 2016; Berger & Bouwman, 2009; Fu et al., 2016; Fungacova et al., 2015; Le, 2019; Li & Malone, 2016; Ozturk Danisman, 2018; Tran et al., 2016). This result also confirms that our first hypothesis is entirely appropriate for the Vietnamese banking system during the

research period, when racing to increase bank equity was observable. The time and money cost of raising equity are always greater than that of calling deposits. Therefore, pursuing the goal of increasing capital reduces financial resources for other activities, including deposit mobilization and credit activities. Not to mention, to attract an increase in capital, banks must apply preferential pricing policies to attract capital from strategic investors, unintentionally creating a comparison with deposit interest rates. The better the cost price policy, the less competitive the deposit interest rate, creating a crowding effect. An increase in crowdfunding reduces deposits to banks and reduces financial resources for liquidity creation. This argument is completely consistent with the context that Vietnamese banks are mainly small and medium-sized compared to the rest of the world, plus the market share is very limited; capital primarily depends on a limited number of sources, such as enterprises or strategic investors in the domestic market. Thus, the crowding-out effect between capital and deposits becomes very clear and significant, consistent with the findings of Gorton and Winton (2000). This result is also consistent with the conclusions of many other studies (Berger and Udell, 1994; Hancock, Laing and Wilcox, 1995). Based on research results published by Lei and Song (2013), Vietnam's banking system has the same characteristics as China's, that is, the ability to create liquidity is overwhelmed by pressure to increase capital, as is explained through the the financial fragility-crowding out hypothesis. It is also worth noting that our findings contradict the risk absorptive hypothesis, in which banks can absorb more risk with more capital, thereby being able to accept higher risks and thus generate more capital with high liquidity (Allen and Gale, 2004; Allen and Santomero, 1997; Bhattacharya and Thakor, 1993; Coval and Thakor, 2005; Repullo, 2004; Von Thaised, 2004).

The LASSO and SEM results also provide other valuable information, helping to identify the main factors affecting liquidity creation. Liquidity creation is an increasing function of the size of a bank's credit activities (LOAN), and a descending function of the size of long-term securities investment (LONGSEC). Credit activities help improve the ability to create liquidity for the economy. The regression coefficient of the variable LOAN in both the LASSO and SEM models has a positive value with

high (1%) statistical significance, 0.0024784. In contrast, long-term securities investment limits the liquidity creation function for the economy. The regression coefficient of the variable LONGSEC in both models has a negative value with 5% statistical significance, - 0.2203863. These findings, while preliminary, are valuable as insights into bank liquidity creation.

Notably, the impact of inflation is very different on capital growth and the supply of liquidity for the economy. The increased capital at the introduction of the equity requirements of Basel II is the proactive purpose of banks, trying to apply necessary actions to acquire more equity in accordance with the roadmap set out by the Central Bank. Therefore, this capital increase is relatively independent of the impact of inflation; the variable INF of the SEM model has weak statistical significance. Meanwhile, the ability to create liquidity in the economy is strongly and negatively affected by inflation, with a negative value and statistical significance. Hence, the higher the inflation, the lower the liquidity creation function. This result is very consistent with the theory and the results of many previous studies (Berger and Bouwman, 2009, 2017; Berger, Bouwman and Berger, 2014; Fungacova, Turk and Weill, 2015; Fu, Lin et al. Molyneux, 2016; Li and Malone, 2016; Tran, Lin and Nguyen, 2016; Ozturk Danisman, 2018; Le, 2019).

The variable bank size (LNTA) is statistically significant in all models, confirming a difference in capital and in liquidity creation according to the size of the bank. Specifically, the larger the bank, the higher the liquidity and capital creation capacity.

On the question of whether the causality between bank liquidity creation and bank capital is bi-directional, this study found rebutting evidence. Although the SEM estimate shows that liquidity creation affects capital, the LASSO estimation completely rejects this, with the regression coefficient shrinkage down to zero. This result has not been found in other similar studies. Tran, Lin, and Nguyen (2016) demonstrated that capital positively affects liquidity, while Le (2019) proved the opposite. Our study completely rejects the impact of capital on the ability to create accounts. Therefore, our second hypothesis is rejected, and this is an important issue for future research.

CONCLUSIONS

This study adds to the existing literature by providing a detailed examination of the correlation between bank capital and liquidity creation in the Vietnamese banking sector from 2007 to 2019. After many robust checks in LASSO and SEM regression, the study indicates only a one-way relationship between bank capital and liquidity creation, i.e., banks with higher capital may reduce their ability to supply liquidity to the economy. Moreover, an inverse relationship is absolutely rejected due to the LASSO estimation, with the coefficients shrinking down to zero. These findings comply with the reality of Vietnam and many pre-studies and confirm the financial fragility-crowding out hypothesis.

Our findings have significant implications for Vietnam's present regulatory and financial reforms. First, the State Bank of Vietnam (SBV) should reconsider its roadmap to meet Basel II in the short term and Basel III standards in the medium term, especially the capital adequacy ratio requirement (CAR). Namely, SBV should consider designing a longer roadmap instead of a short-term one, which is enough to help banks reinforce capital adequacy and resilience when risk arises while not reducing the liquidity supply for the economy. Second, SBV also should think about setting a limit on the long-term security investment of Vietnamese commercial banks. This also opens up a need for a more in-depth study to determine the optimal investment structure, helping to balance banks' primary functions that provide liquidity for the economy and invest for profits. And finally, the impact of liquidity creation on bank capital is still controversial and should get more attention in further studies.

DECLARATION

The authors declare that they have no competing interests.

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AUTHORS' CONTRIBUTION

Xuan, T.T.P. conceptualized the manuscript analyzed and interpreted the data. Tin, H.H. performed the logic of the writing. Thanh, N.P. edited and reviewed the manuscript. Van, T.T.V. reviewed the manuscript. Nguyen, T.T.H. formatted, edited, and revised the manuscript. All authors read and approved the final manuscript.

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