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**Article**

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## GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

# Funding liquidity, bank capital, and lending growth in a developing country

Yen Nguyen<sup>1,2</sup> and Liem Nguyen<sup>1,2\*</sup>

**Abstract:** The purpose of this paper is to examine the impacts of funding liquidity and bank capital on lending growth using panel data estimation techniques on a sample of banks in Vietnam from 2005 to 2021. The research shows that funding liquidity and capital have a positive impact on lending growth, confirming the important role of deposits and capital on bank lending activities. There is evidence that capital and funding liquidity can be substitutes to maintain growth in lending, and capital can help address agency problems associated with increased lending. Finally, we perform quantile regression to further investigate whether the above links hold across the distribution of lending growth, and find that the coefficients of funding liquidity, capital and their interaction term remain significant. Based on the research findings, we propose relevant implications for the maintenance of sustainable growth and stability of banks in this market.

**Subjects:** Finance; Banking; Credit & Credit Institutions

**Keywords:** Bank capital; funding liquidity; lending growth; quantile regression; Vietnam

## 1. Introduction

Credit provision is not only one of the traditional core activities of commercial banks, but also plays a critical role in stimulating economic activities (Kishan & Opiela, 2000). As a consequence, policy-makers and bank executives resort to various mechanisms to maintain credit supply of commercial banks. In turn, this necessitates the comprehension of factors determining bank lending in a specific market.

Basel guidelines have become the global standards that regulatory bodies aim to incorporate into their reform agendas to improve banking resilience. The latest Basel III accord puts enhanced emphasis on the minimum capital requirements and demands that banks hold adequate liquid assets and have stable funding. These requirements are meant to mitigate funding liquidity risks and consolidate the resilience and stability of banking systems (Smaoui et al., 2020). Unfortunately, it is empirically inconclusive as to how capital and liquidity can affect the stability and other aspects of bank operations.

To start with, liquidity risk is often cited as one crucial determinant, but its impact on bank lending growth is not universally agreed (Roulet, 2018). Funding liquidity is defined as the ability to meet the immediate obligations when due (Drehmann & Nikolaou, 2013). On the one hand, high funding liquidity is more conducive to lending expansion (Haddou, 2022; Neef & Schandlbauer, 2022). Lower funding liquidity risk (thus lower risk of bank runs) encourages banks to lend more aggressively, leading to higher potential insolvency risk (Abbas & Ali, 2021; Abbas et al., 2021; Acharya & Naqvi, 2012). In addition, banks need sufficient liquidity to maintain their intermediary role during external shocks (Kim & Sohn, 2017). Ivashina and Scharfstein (2010) also find that

deposit funding is more important than short-term debt financing in ensuring bank liquidity. For banks in developing and emerging markets, deposits have become a main source of funding. In fact, compared to developed markets, monetary policy changes that affect deposits in these countries can exert a more significant impact on bank lending.

On the other hand, Cornett et al. (2011) and Tran and McMillan (2020) suggest a negative link between funding liquidity and lending growth for U.S. banks. Cornett et al. (2011) argue that this is due to the effort to manage liquidity risk. High funding liquidity could indicate a stronger need for liquidity to comply with regulatory requirements, and banks might have to curb lending growth to meet those requirements effectively.

In terms of the relationship between bank capital and loan growth, there are contentious debates on the role of bank capital on risk-taking and stability of banks (Klomp & de Haan, 2015). On the one hand, there could be an equity-at-risk effect that curtails risky behavior (Furlong & Keeley, 1989). On the other hand, more stringent capital requirements might reduce banks' franchise values, encouraging banks to take on risky activities (Hellmann et al., 2000). Empirically, Louhichi and Boujelbene (2017) find that higher bank capital increases bank lending, while Vo (2018) shows the opposite.

Vietnam serves as an excellent research context. First, it is an emerging economy that has been witnessing strong yet stable economic growth. Its banking sector is a dominating player in the financial market, considerably contributing to economic development through lending businesses (Dang, 2019; Vo, 2018). Moreover, loans account for a larger share of total assets of banks in Vietnam, suggesting that lending is a major banking activity, compared to banks in more developed countries (Vo, 2018). Additionally, banks in Vietnam might be focusing on providing continued support for the economy; therefore, loan growth could be prioritized in Vietnam. Nevertheless, banks in Vietnam have lower capital and funding liquidity compared to the figures reported in Dahir et al. (2019) for BRICS countries. Currently, Vietnamese banks have not met Basel requirements, rendering them vulnerable to economic shocks (Dang, 2019). Studying the impacts of capital and liquidity in Vietnam is highly relevant since the country is aiming to adopt stricter regulations on these two factors while trying to maintain adequate lending growth to support the economy. However, there are limited studies on the role of the duet on bank lending growth in this country (Dang, 2019).

Our study contributes to the literature in a number of ways. First, it is important to investigate in more depth the effect of funding liquidity and capital as well as their interaction on lending growth due to the agenda of adopting stricter Basel III guidelines across the globe. However, even though there are many studies on the link between funding liquidity and capital on bank risk-taking (Dahir et al., 2019; Khan et al., 2017), little empirical evidence is provided on their effects on lending growth. Second, the investigation of the above links should bring more value for developing and emerging markets, while the empirical literature remains quite silent for this type of markets. Banks in less developed markets are generally more financially constrained and tend to rely on deposits and capital as main sources of financing, while their counterparts in more advanced countries have the luxury of more available sources and financial instruments. Vietnam is aiming to seriously engage in capital buildups and requires higher level of liquidity for banks, yet the empirical evidence for this country is highly limited.

Third, the most relevant study to ours is Dang (2021) with a dataset of Vietnamese banks from 2003 to 2017 and Dahir et al. (2019) for BRICS countries from 2006 to 2015. Compared to Dang (2021) and Dahir et al. (2019), we further consider the nonlinear effects of both capital and funding liquidity and use a more updated dataset, thus providing a more comprehensive and relevant evidence for policymakers and bank managers. Fourth, the study is the first to utilize quantile regression technique to investigate whether the (individual and joint) effects of funding liquidity and capital are the same across the distribution of lending growth in a developing country. This

study is important since it would help uncover the role of the two factors on enhancing loan growth at various growth rates. In other words, the study provides important evidence for the configuration of policies or strategies that support different credit growth targets.

The remaining of the article is structured as follows. Section 2 reviews the literature on the impact of funding liquidity and bank capital on loan growth and construct the testable hypotheses. Section 3 describes the sample and research methodology. Section 4 provides the estimation results and discussion. Finally, Section 5 summarizes the main points and provide implications.

## 2. Literature review and hypothesis development

Funding liquidity refers to the ability of banks to immediately fulfil depositors' withdrawal requests, and banks incur funding liquidity risk when they cannot settle the claims immediately (Drehmann & Nikolaou, 2013). There are multiple sources whereby banks can enhance funding liquidity; however, deposits maintain a critical source (Khan et al., 2017; Nguyen & Phan, 2018). Consistently, Khan et al. (2017) suggest that banks with higher deposit rates have sufficient funds to meet the obligations. Therefore, in line with the mentioned studies, funding liquidity is proxied by the ratio of deposits to total assets. Higher liquidity can also improve a bank's profitability (Abbas et al., 2019).

On the one hand, Acharya and Naqvi (2012) suggest that large deposits enhance funding liquidity, allowing managers to reduce lending interest rates in order to raise loan volumes and market shares. If managers are rewarded based on loan growth rates or loan volumes, a positive link between funding liquidity and loan growth is anticipated. Furthermore, short-term bank managers might ignore long-term consequences of such lending behavior. Importantly, this is likely to happen in countries where banks act as the prime financing channel that spurs the economy.

On the other hand, Cornett et al. (2011) find that high levels of funding liquidity might reflect needs to meet higher liquidity requirements. Maintaining sufficient liquidity helps limit risks of insolvency and lack of liquidity, so banks might choose to restrict lending activities. Additionally, if banks have to pay higher deposit rates to improve funding liquidity, these expenses would be passed on to borrowers through increased lending interest rates, lowering demand for borrowing (King, 2013). Dahir et al. (2019) find a negative relationship between funding liquidity and lending for banks in BRICS countries. Similarly, Tran and McMillan (2020) uses a sample of U.S. bank holding from 2000 to 2017, and shows the negative effects of funding liquidity on lending in the U.S. Interestingly, Tran and McMillan (2020) does not find any evidence of the relation between lending and funding liquidity after the global crisis. A speculative explanation for the insignificant relationship between lending and funding liquidity after the crisis is the offsetting effect of the precautionary behavior documented before the crisis and the increased moral hazard induced by the government intervention after the crisis. Ibrahim and Rizvi (2018) find no effect of deposits on bank lending during stress times for 114 banks across 10 countries.

Additionally, there are numerous studies focusing on the link between funding liquidity and risk-taking behavior of banks for different territories and time frames (Acharya & Naqvi, 2012; Ghenimi et al., 2017; Khan et al., 2017; Smaoui et al., 2020). Consistent with Acharya and Naqvi (2012), Khan et al. (2017) and Dahir et al., 2019) find a positive link between funding liquidity and bank risk-taking, implying the incidence of moral hazard problems. Smaoui et al. (2020) distinguish the impact of funding liquidity on risk taking behavior of conventional and Islamic banks of 18 countries from 2004 to 2016. The authors suggest funding liquidity is positively related to risk-taking which, in turn, increases insolvency risk, especially for conventional banks.

It is clear from the above discussion that there could be both positive and negative relationships between funding liquidity and lending growth. However, given Vietnam is a developing country whose economic growth relies heavily on bank financing, banks are more inclined to find sources to enable

expansion in lending. Also, from the literature on the link between funding liquidity and risk-taking, a positive link is more likely to dominate. Therefore, our first hypothesis is as follows:

***H1: funding liquidity is positively associated with lending growth.***

Bank capital is meant to mitigate insolvency risk, and banks that have risky portfolios from lending activities need to maintain adequate capital (Shim, 2013). Therefore, inadequate capital can result in banks curbing lending (Bernanke & Lown, 1991; Cornett et al., 2011; Furlong, 1992; Kim & Sohn, 2017). Importantly, Distinguin et al. (2013) suggest that sufficient capital enables banks to sustain losses from bad debts. Kim and Sohn (2017) and Carlson et al. (2013) also find a positive effect of bank capital on loan growth, especially during the financial crisis.

Nevertheless, there are also studies highlighting a negative association between bank capital and lending growth. Dahir et al. (2019) and Abbas et al. (2020) find a negative linkage between the two factors for commercial banks from BRICS countries and the U.S, respectively. Tabak et al. (2011) and Vo (2018) also find that higher bank capital reduces bank lending in Brazil and Vietnam, respectively. Interestingly, Tran and McMillan (2020) document an inverse relationship between capital and lending growth in U.S. in the pre-crisis period. However, this effect was not present during the crisis, while it becomes positive in the post-crisis period.

Even though there are two potential effects of bank capital on lending growth, we expect that in a less developed market like Vietnam, capital should act as a very important financing source that allows banks to keep financing the whole economy.

Our second testable hypothesis is as follows:

***H2: bank capital is positively related to lending growth***

As discussed earlier, funding liquidity is likely to increase bank risk-taking and lending growth (Acharya & Naqvi, 2012; Khan et al., 2017; Smaoui et al., 2020). With higher funding liquidity, there is less concern about liquidity risk and banks can focus on other aspects of operations. Bank capital is also conducive to lending growth (Bernanke & Lown, 1991; Cornett et al., 2011; Furlong, 1992; Kim & Sohn, 2017; Tran & McMillan, 2020). Given this background, there could be two possible joint effects of funding liquidity and bank capital on loan growth.

First, there could be a substitutive effect where banks with better funding liquidity will see a weaker dependence of loan growth on capital. The same relationship can occur when banks have stronger capital, i.e., banks would rely less on funding liquidity to facilitate loan growth. Furthermore, there is an equity-at-risk effect (Furlong & Keeley, 1989), where banks would have less risk-taking incentive if there is a high level of equity in place. As a result, if banks with more capital manage to raise deposits, they tend to refrain from making more loans to secure the capital. Furthermore, higher bank capital could effectively reduce the agency problem for banks (VanHoose, 2007), thus reducing the incentive to engage in overly risk-taking activities, including excessive lending growth, when there is abundant liquidity. Finally, if banks both increase funding liquidity and capital, this might reflect serious need to meet regulatory requirements. Therefore, banks should be reducing lending growth in this situation.

These arguments lead us to hypothesizing a negative joint effect of the two factors on lending growth.

**H3a: the interaction term of funding liquidity and capital has a negative association with lending growth.**

Second, more capital can result in more risk-taking from banks (Athanasoglou, 2011). If this occurs, when both sources of financing (deposits and capital) are abundantly available, banks can be more confident in making more loans, leading to a positive joint effect of the two factors on banks' lending growth.

**H3b: the interaction term of funding liquidity and capital has a positive association with lending growth.**

### 3. Data and research methodology

#### 3.1. Data

The research sample covers Vietnamese commercial banks from 2005 to 2021. The data were obtained from Refinitiv Eikon, which provides detailed audited financial reports of Vietnamese commercial banks. The data for GDP growth rates and inflation rate were obtained from the World Bank database. We select 2005 as the starting point of the period since Central Bank of Vietnam amended and supplemented a number of articles associated with debt classification, stricter lending process and supervision in this year. Consequently, the figures related to lending in previous years might not be consistent. We strive to have the latest data, so we collect the annual data until 2021.

We drop banks having less than 3-year worth of data, and bank-specific variables are winsorized at the 1st and 99th percentiles to address the effects of outliers. The ultimate research sample is an unbalanced panel of 35 banks. This could be considered as representative of commercial banks in Vietnam as the sampled banks account for a major percentage of all banks in Vietnam.

#### 3.2. Empirical models

We follow Vo (2018), Dang (2019), Dahir et al. (2019), and Kim and Sohn (2017) to derive the following empirical models. Specifically, model (1) is used to examine hypotheses H1 and H2. Model (2) is used to examine hypotheses H3 and H4 on the joint effect of funding liquidity and bank capital.

$$LG_{it+1} = \alpha_0 + \alpha_1 FUL_{it} + \alpha_2 CAP_{it} + \alpha_3 X_{it} + \varepsilon_{it} \quad (1)$$

$$LG_{it+1} = \alpha_0 + \alpha_1 FUL_{it} + \alpha_2 CAP_{it} + \alpha_4 FUL * CAP_{it} + \alpha_3 X_{it} + \varepsilon_{it} \quad (2)$$

Where:  $i$  denotes bank  $i$ , and  $t$  represents time dimension.  $\varepsilon_{it}$  is the error term.  $LG_{it}$  is the growth rate of lending of bank  $i$  in period  $t$ ,  $FUL_{it}$  is funding liquidity, and  $CAP_{it}$  is bank capital.  $X_{it}$  is a vector of control variables including  $Size_{it}$ ,  $Profit_{it}$ ,  $Risk_{it}$  and  $Eff_{it}$ ,  $GDP_t$ ,  $INF_t$  (see detail in section 3.3).

To address possible simultaneity issues, we lag all explanatory variables by one year in all models compared to the period of the dependent variable (Dahir et al., 2019; Kim & Sohn, 2017).

#### 3.3. Variable construction

**Dependent variable:**  $LG_{it}$  is the growth rate of lending of bank  $i$  in period  $t$ , calculated as the ratio of the difference of loans made in year  $t$  and  $t-1$  to loans made in year  $t$  (Dahir et al., 2019; Kim & Sohn, 2017).

**Explanatory variables:** Two variables of interest are funding liquidity ( $FUL_{it}$ ) and bank capital ( $CAP_{it}$ ) respectively.  $CAP$  is defined as the ratio of total bank equity to total assets (Kim & Sohn, 2017; Dahir et al., 2019; Louhichi & Boujelbene, 2017).  $FUL_{it}$  is calculated as the ratio of total deposits to total assets (Dahir et al., 2019; Dang, 2019; Khan et al., 2017).



#### 4. Control variables

*Bank size* ( $SIZE_{it}$ ): size is calculated as the natural logarithm of total assets. We control for bank size because larger banks have more opportunities for lending growth (Diamond & Rajan, 2001; Kashyap & Stein, 1995).

*Profitability* ( $ROA_{it}$ ): profitability is measured by return on assets (Dahir et al., 2019; Vo, 2018). Kim and Sohn (2017) suppose that profitable banks tend to increase lending.

*Operating efficiency* ( $Eff_{it}$ ): This variable is calculated as the ratio of operating expense to total assets (Vo, 2018). Banks in Vietnam might allocate more costs to non-credit activities (Vo, 2018).

*Credit risk* ( $Risk_{it}$ ): credit risk is measured as the ratio of loan loss provisions to total loan (Vo, 2018). Banks with higher ratios might face high credit risk, and might choose to reduce lending growth.

*Macroeconomic variables*: macroeconomic variables include GDP growth (GDP) and inflation rate (INF; Dahir et al., 2019; Vo, 2018). GDP growth rate (GDP variable) is measured as the annual growth rate of GDP. INF is the annual inflation rate. Higher values of GDP and/or INF might reflect stronger economic growth, leading to an increase in loan demand (Kim & Sohn, 2017). Table 1 summarizes variables in the models:

##### 4.1. Estimation strategy

We employ fixed effects (within) regression to control for cross-sectional effects. This technique is able to address the endogeneity caused by variable omission associated with the individual bank effects. We further use System Generalized Method of Moments (System GMM) to deal with the endogeneity caused by the potential two-way relationship between dependent and independent variables through the use of instruments derived from lagged values of variables in the model (Arellano & Bond, 1991; Blundell & Bond, 1998; Roodman, 2009). Additionally, the robust System GMM estimator is able to tackle the issues of heteroskedasticity and autocorrelation, which are prevalent in panel data (Roodman, 2009). Finally, we use System GMM to allow for the dynamism since previous loan growth could affect the growth in the current period (Vo, 2018). The System GMM estimator is used to estimate the following models:

$$LG_{it+1} = \alpha_0 + \alpha_1 FUL_{it} + \alpha_2 CAP_{it} + \alpha_3 X_{it} + \beta LG_{it} + \varepsilon_{it} \quad (3)$$

$$LG_{it+1} = \alpha_0 + \alpha_1 FUL_{it} + \alpha_2 CAP_{it} + \alpha_4 FUL * CAP_{it} + \alpha_3 X_{it} + \beta LG_{it} + \varepsilon_{it} \quad (4)$$

The mentioned studies all share a common assumption that the impact of variables on lending growth is identical, regardless of loan growth distribution. Instead of focusing on a single measure of central tendency, quantile regression facilitates the estimation of the impact of variables at several quantiles along the distribution of loan growth. We argue that this is important since the growth rates in lending are quite diverse and have large range (see, Section 4.1). Rather than only relying on the traditional Ordinary Least Squares (OLS) or other panel data estimation approaches, we use quantile regression that allows us to report the full conditional distribution of loan growth (Koenker & Bassett, 1978). This regression technique is employed to examine whether the link between explanatory variables and the dependent variable is unchanged whether the loan growth rates are high or low.

#### 5. Results and discussion

##### 5.1. Descriptive statistics

Table 2 provides descriptive statistics for variables in the models. The average lending growth (LG) is healthy at 34.1 per cent per annum during the research period. In addition, the standard deviation and range of lending growth are quite considerable, suggesting diverse loan growth



**Table 1. Measurement of variables in the models**

Variables	Description	Measure	Source
LG	Lending growth	The annual growth in total loans	Refinitiv Eikon
FUL	Funding liquidity	The ratio of total deposits on total assets	Refinitiv Eikon
CAP	Bank capital	The ratio of bank equity to total assets	Refinitiv Eikon
Size	Size of bank	Logarithm of total assets	Refinitiv Eikon
Profit	Bank profitability	Return on total assets	Refinitiv Eikon
Risk	Credit risk	The ratio of loan loss provisions to total loan	Refinitiv Eikon
Eff	Efficiency	The ratio of operating cost to total assets	Refinitiv Eikon
GDP	Growth of GDP	Annual GDP growth rate	World Bank database
INF	Inflation rate	Annual inflation rate	World Bank database

**Table 2. Descriptive statistics**

Variable	Obs	Mean	Std. Dev.	Min	Max
LG	502	0.341	0.558	−0.313	7.486
FUL	502	0.627	0.140	0.001	0.912
CAP	502	0.103	0.069	0.000	0.712
Size	502	18.113	1.560	11.884	27.003
Profit	502	0.009	0.007	−0.004	0.060
Risk	502	0.010	0.008	−0.010	0.054
Eff	502	0.504	0.153	0.162	1.115
GDP	502	0.059	0.013	0.026	0.075
INF	502	0.070	0.059	0.006	0.231

Note: LG, lending growth; FUL, funding liquidity; CAP, bank capital; Profit, bank profit; Risk, credit risk; Eff, Efficiency; INF, inflation rate; GDP, GDP growth rate. Source: Author's calculation from research sample.

rates. Importantly, the mean figure is much higher than that in Dahir et al. (2019) for BRICS banks during the period 2006–2015 and in Kim and Sohn (2017) for US banks from 2010 to 2013. The strong rate confirms the dominating role of the commercial banks in providing financing to different sectors in a developing market like Vietnam. The mean value of FUL is 62.7% and that of CAP is 10.3%. Meanwhile, the average values of FUL and CAL reported by Dahir et al. (2019) were 70% and 14.1%, respectively, which suggests higher risks for Vietnamese banks.

The correlation matrix presented in Table 3 presents the pairwise correlation coefficients for variables in the models. Most correlation coefficients are quite low, which suggests that multicollinearity should not be a major concern. Lending growth is positively related to bank capital, while negatively correlates with funding liquidity. However, it is clear that pairwise correlation coefficients only indicate the association between two variables without the consideration of other covariates. Multiple regression should be conducted so that the results are appropriate for statistical inferences.

## 5.2. Effect of funding liquidity and capital on lending growth

Table 4 presents the fixed effects regression (Columns 1 and 2) and System GMM (Columns 3 and 4). Funding liquidity is significantly (both economically and statistically) and positively

**Table 3. Correlation matrix**

	F.LG	FUL	CAP	Size	Risk	Eff	Profit	GDP	INF
F.LG	1.000								
FUL	-0.282	1.000							
CAP	0.510	-0.432	1.000						
Size	-0.452	0.484	-0.672	1.000					
Risk	-0.074	0.169	-0.065	0.293	1.000				
Eff	-0.083	0.226	-0.116	0.007	-0.242	1.000			
Profit	0.186	-0.291	0.429	-0.217	-0.017	-0.653	1.000		
GDP	0.115	-0.072	0.029	-0.167	-0.002	-0.097	0.040	1.000	
INF	0.167	-0.395	0.255	-0.319	-0.155	-0.187	0.246	-0.037	1.000

Note: LG, lending growth; FUL, funding liquidity; CAP, bank capital; Profit, bank profit; Risk, credit risk; Eff, Efficiency; INF, inflation rate; GDP, GDP growth rate. Source: Author's calculation from research sample.

associated with lending growth, consistent with hypothesis H1. This result is in line with the theory of Acharya and Naqvi (2012) as well as most previous studies including Dahir et al. (2019), Tran and McMillan (2020), Lee and Hsieh (2013) and Cornett et al. (2011). Deposits are a critical source in enhancing bank liquidity (Khan et al., 2017). Acharya and Naqvi (2012) suggest that large deposits enhance funding liquidity, enabling managers to reduce lending interest rates to raise loan volumes and market shares. Furthermore, short-term bank managers might ignore long-term consequences of such lending behavior. Importantly, in Vietnam, this relationship is highly likely to happen in countries where banks act as the prime financing channel that spurs the economy (Vo, 2018).

The relationship between bank capital and lending growth is significantly positive. This result is consistent with hypothesis H2 and previous studies such as Kim and Sohn (2017) and Dahir et al. (2019). According to Shim (2013), bank capital could help mitigate insolvency risk, and adequate capital can facilitate lending expansion (Bernanke & Lown, 1991; Cornett et al., 2011; Kim & Sohn, 2017). Distinguin et al. (2013) also find that sufficient capital allows banks to absorb losses from bad debts, and this role is more pronounced in the financial crisis period (Kim & Sohn, 2017).

The regression results suggest that the increase in liquidity and capital individually does not necessarily reflect the desire to be safer in terms of liquidity. Instead, commercial banks in Vietnam seem to take advantage of the available deposits and capital to expand credit activities, which is a major role of banking system in this developing market. This is interesting, since both the funding liquidity ratio and capital ratio of Vietnamese banks are quite low compared to those of developed countries.

We further investigate the joint effect of funding liquidity and capital on lending growth. The interaction term has a negative sign and significant, providing evidence in support of hypothesis H3a. Both funding liquidity and capital might individually increase lending growth; therefore, there could be a positive joint effect which implies that the duet can supplement each other to boost lending growth in Vietnam. Nonetheless, this does not happen, and this could imply the substitution effect between the two funding sources. Importantly, a bank that increases both capital and funding liquidity might have strong desire to meet regulatory requirements, so reducing lending growth in this case could be expected. There could be an equity-at-risk effect, meaning that banks would have less risk-taking incentive if there is a high level of equity in place. In other words, even when banks with high capital are capable of raising deposits, they might still refrain from making more loans to secure capital, which is an expensive source of financing to raise.

**Table 4. Impacts of funding liquidity and bank capital on lending growth**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
FUL	0.031	0.641*	0.325**	1.503***
	[0.14]	[1.88]	[2.12]	[6.24]
CAP	3.468***	5.611***	5.413***	9.218***
	[6.80]	[5.47]	[10.95]	[6.49]
FUL*CAP		−5.398**		−10.36***
		[−2.40]		[−4.13]
Size	−0.259***	−0.263***	−0.0162	−0.0563***
	[−9.02]	[−9.17]	[−0.86]	[−4.03]
Profit	−2.714	−2.252	−7.700**	−6.774***
	[−0.49]	[−0.41]	[−2.31]	[−3.07]
Risk	1.436	1.372	1.046	0.618
	[0.44]	[0.42]	[0.59]	[0.29]
Eff	0.277	0.256	−0.561***	−0.337**
	[1.12]	[1.04]	[−4.87]	[−2.63]
GDP	−1.057	−1.475	1.410***	0.818*
	[−0.53]	[−0.74]	[2.82]	[1.97]
INF	−1.349***	−1.098**	0.480**	0.894***
	[−3.24]	[−2.57]	[2.48]	[5.21]
LG			0.0836***	0.0976***
			[7.77]	[4.68]
_cons	4.664***	4.459***	0.0787	0.162
	[7.73]	[7.36]	[0.19]	[0.60]
No of obs	464	464	464	464
R-sq	0.452	0.459		
AR1 test p-value			0.005	0.011
AR2 test p-value			0.309	0.390
Hansen test p-value			0.325	0.239

Note: Column 1 and 2 present fixed effects regression. Column 3 and 4 present system GMM. There are six control variables: bank size (Size), bank profitability (Profit), credit risk (Risk), bank efficiency (Eff), GDP growth rate (GDP), inflation rate (INF). Numbers in brackets are test statistics. \*, \*\* and \*\*\* indicate significance at 10%, 5% and 1%, respectively.

### 5.3. Non-linear effect of funding liquidity and capital on lending growth

In order to provide a more comprehensive understanding of the effects of the two factors, we add quadratic terms of funding liquidity (FUL\*FUL) and capital (CAP\*CAP). The inclusion of squared terms allows the detection of nonlinear relationship of U-shaped or inverted U-shaped patterns. Table 5 provides the estimation results. It is clear that funding liquidity does not have a nonlinear relationship with lending growth, as the squared term is not significant for both fixed effects and System GMM estimation techniques.

The results from columns 3 and 4 (Table 5) confirm that there is a nonlinear relationship between capital and bank lending growth in Vietnam, evident through a significant and positive coefficient of squared CAP variable. This suggests that at high levels, bank capital is more conducive to lending expansion. This evidence is consistent with the result from Dias, (2020) which indicates a significant risk-taking attitude when banks have high levels of capital. At low levels though, Dias, (2020) show a negative effect of capital on bank risk taking, which implies that banks with low capital could have more incentive to protect their capital.

**Table 5. Non-linear impacts of funding liquidity and bank capital on lending growth**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
FUL	0.879	3.294	0.0504	0.287**
	[0.77]	[1.32]	[0.22]	[2.29]
FUL*FUL	−0.726	−2.265		
	[−0.76]	[−1.07]		
CAP	3.599***	5.426***	0.142	1.416
	[6.68]	[3.46]	[0.14]	[0.92]
CAP*CAP			6.416***	8.056**
			[3.84]	[2.47]
Size	−0.259***	−0.011	−0.263***	−0.0425**
	[−8.99]	[−0.32]	[−9.30]	[−2.38]
Profit	−3.88	0.76	−2.948	−4.082
	[−0.67]	[0.12]	[−0.54]	[−1.66]
RISK	1.157	−0.424	0.725	1.333
	[0.35]	[−0.13]	[0.23]	[0.82]
Eff	0.244	−0.32	0.183	−0.315**
	[0.97]	[−1.15]	[0.75]	[−2.21]
GDP	−0.986	1.201*	−1.808	0.704*
	[−0.49]	[1.71]	[−0.92]	[1.95]
INF	−1.383***	0.681*	−1.067**	0.598***
	[−3.30]	[1.97]	[−2.56]	[2.97]
LG		0.136***		0.100***
		[3.40]		[10.07]
_cons	4.435***	−1.16	5.051***	0.725*
	[6.57]	[−0.91]	[8.39]	[1.87]
No of obs	464	464	464	464
R-sq	0.452		0.47	
AR1 test p-value		0.002		0.003
AR2 test p-value		0.387		0.394
Hansen test p-value		0.119		0.276

Note: Column 1 and 2 present fixed effects regression. Column 3 and 4 present system GMM. There are six control variables: bank size (Size), bank profitability (Profit), credit risk (Risk), bank efficiency (Eff), GDP growth rate (GDP), inflation rate (INF). Numbers in brackets are test statistics. \*, \*\* and \*\*\* indicate significance at 10%, 5% and 1%, respectively.

#### 5.4. Quantile regression estimates

We investigate whether the impact of funding liquidity and bank capital changes depending on the distribution of lending growth (Table 6). This would supplement our understanding of the role of the two funding sources on the ability to expand lending of banks in a developing country.

First of all, the association between funding liquidity and bank lending growth is increasing as lending growth is stronger (quantile 75 has the highest value, 1.260). As we investigate the characteristics of banks with different lending growth (not tabulated here), we find that banks that have slow growth tend to have more bad debts. At higher lending growth rates (thus lower bad debts), banks might feel safer to increase lending knowing that there are adequate deposits to fund the growth. The higher association between liquidity and credit growth at higher lending growth rates implies banks rely more on deposits to fund loans at high expansion rates.

**Table 6. Quantile regression of the impact of funding liquidity and bank capital on lending growth**

	Q25	Q50	Q75
FUL	0.650*** [6.02]	0.660** [2.15]	1.260*** [6.61]
CAP	3.317*** [4.60]	3.507 [1.48]	9.954*** [9.02]
FUL*CAP	-6.448*** [-5.89]	-7.281** [-2.03]	-15.71*** [-7.69]
Size	-0.0287*** [-3.43]	-0.0578*** [-6.72]	-0.110*** [-6.43]
Profit	6.823*** [3.60]	8.344*** [4.79]	2.926 [0.92]
Risk	-0.446 [-0.54]	-0.116 [-0.13]	-1.468 [-1.63]
Eff	0.00189 [0.03]	0.0476 [0.68]	-0.307*** [-3.15]
GDP	0.769* [1.78]	0.922** [2.48]	1.089 [1.39]
INF	-0.104 [-0.39]	0.213 [1.11]	0.756 [1.64]
cons	0.203 [1.16]	0.778*** [3.11]	1.596*** [4.52]
No of obs	464	464	464

Note: There are six control variables, including bank size (Size), bank profitability (Profit), credit risk (Risk), bank efficiency (Eff), GDP growth rate (GDP), inflation rate (INF). Numbers in brackets are test statistics. \*, \*\* and \*\*\* indicate significance at 10%, 5% and 1%, respectively. We performed test of differences in coefficients across quantiles, and confirm that the coefficients of FUL, CAP and FUL\*CAP are significantly different from each other in the three quantiles.

With regard to capital, as loan growth rates become higher, more capital facilitates more effectively lending growth. We can see that the coefficient change of capital variable is quite dramatic (3-fold increase), compared to that of funding liquidity (2-fold increase), from quantile 25 to quantile 75. This could partly confirm the nonlinear relationship between capital and lending growth found in 4.3. At low rates of loan growth (thus higher bad debts), banks might have more interest in protecting capital. Therefore, more capital is associated with weaker growth in loans, compared to high rates of loan expansion.

The interaction between funding liquidity and capital exerts a negative impact on lending growth, and this effect is more pronounced as lending growth is faster. As the growth rates are better (thus lower credit risk), the relationship between funding liquidity and capital seems more substitutive. With higher credit growth, equity-at-risk effect might be more relevant, so if banks can arrange higher rates of deposits (thus better funding liquidity), they may wish to secure the capital, thus the reliance of lending growth on capital is reduced. Furthermore, banks with increases in both capital and funding liquidity might actually be in the dire situation to meet regulatory requirements. As higher credit growth might impose more risk for any bank, such banks are more likely to reduce credit expansion.

## 6. Conclusion

With increased adoption of Basel III guidelines across the globe following financial crises, it is important to examine the effect of funding liquidity and capital as well as their interaction on

lending growth in more depth. Meanwhile, little empirical evidence is provided on these relationships, especially for developing and emerging countries. Vietnam is a developing country where banks tend to have low capital and restricted funding opportunities, while banks have a highly important role in providing financing to support the economy. The regulatory bodies are encouraging banks' engagement in raising capital and liquidity levels for banks, yet the empirical evidence for this country is highly limited.

This paper seeks to provide evidence on the mentioned links for Vietnam, using a sample of 35 banks during a period from 2005 to 2021. First, we find that funding liquidity and capital are positively related to credit growth, highlighting the role of these two financing sources in Vietnam. Importantly, even though Vietnam banks tend to have low capital, the banks still follow credit expansion strategies in general, rather than keeping the capital safe. It is also worth noting that the interaction term between funding liquidity and capital exerts a negative effect on lending growth. Therefore, instead of boosting lending growth as there are increases in both capital and funding liquidity, there appears substitution effect and equity-at-risk effect that deals with the agency problems in expanding lending so fast. Second, we also find that these effects are enhanced when lending growth is stronger. Third, the nonlinear relationship only occurs between bank capital and lending growth.

The research offers several important implications. We provide quite comprehensive understanding on the impact of funding liquidity and bank capital on lending growth in Vietnam. At low rates of lending growth, it could be more important to focus on improving banks' credit risk management since there tends to be higher rates of nonperforming loans here. Also, it is worth noting that even though either fund liquidity or capital can enhance risk-taking by boosting lending growth, their interaction reduces it. This is an important implication for shareholders and regulatory bodies with regard to how to address agency problems. Another point is that even though individually capital and funding liquidity raise lending growth, there is evidence that a bank that increases both capital and liquidity might be in a dire situation to meet regulatory requirements.

Future studies could focus more on other mechanisms that can moderate the relationship between funding liquidity, capital and lending growth, in both developed and developing countries. This would bring relevant implications as, again, there is a trend to adopt stricter Basel requirements on liquidity and capital for banks all over the world.

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## Appendix A

List of Vietnamese Commercial Banks		
No.	Abbr.	Name of bank
1	ABB	An Binh Commercial Joint Stock Bank
2	ACB	Asia Commercial Joint Stock Bank
3	AGR	Vietnam Bank for Agriculture and Rural Development
4	BAB	Bac A Commercial Joint Stock Bank
5	Bao Viet	Bao Viet Commercial Joint Stock Bank
6	BID	Joint Stock Commercial Bank for Investment and Development of Vietnam
7	BVB	Viet Capital Commercial Joint Stock Bank
8	CTG	Vietnam Joint Stock Commercial Bank for Industry and Trade
9	EAB	Southeast Asia Commercial Joint Stock Bank
10	EIB	Vietnam Commercial Joint Stock Export Import Bank
11	GPB	Global Petro Sole Member Limited Commercial Bank
12	HDB	Ho Chi Minh City Development Joint Stock Commercial Bank
13	KLB	Kien Long Commercial Joint Stock Bank
14	LPB	Lien Viet Post Joint Stock Commercial Bank
15	MBB	Military Commercial Joint Stock Bank
16	MSB	Vietnam Maritime Commercial Joint Stock Bank
17	NAB	Nam A Commercial Joint Stock Bank
18	NVB	National Citizen Commercial Joint Stock Bank
19	OCB	Orient Commercial Joint Stock Bank
20	OJB	Ocean Commercial One Member Limited Liability Bank
21	PGB	Petrolimex Group Commercial Joint Stock Bank

(Continued)

<b>List of Vietnamese Commercial Banks</b>		
<b>No.</b>	<b>Abbr.</b>	<b>Name of bank</b>
22	PVC	Vietnam Public Joint Stock Commercial Bank
23	SCB	Saigon Commercial Joint Stock Bank
24	SGB	Saigon Bank for Industry and Trade
25	SHB	Saigon Hanoi Commercial Joint Stock Bank
26	SSB	Southeast Asia Commercial Joint Stock Bank
27	STB	Sai Gon Thuong Tin Commercial Joint Stock Bank
28	TCB	Vietnam Technological and Commercial Joint Stock Bank
29	TPB	Tien Phong Commercial Joint Stock Bank
30	VAB	Vietnam—Asia Commercial Joint Stock Bank
31	VBB	Vietnam Thuong Tin Commercial Joint Stock Bank
32	VCB	Bank for Foreign Trade of Vietnam
33	VIB	Vietnam International Commercial Joint Stock Bank
34	VNCB	Construction Bank
35	VPB	Vietnam Prosperity Joint Stock Commercial Bank



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