The interrelationship between liquidity creation and bank capital in Vietnamese banking

Tu Le
Faculty of Business Government and Law, University of Canberra, Canberra, Australia and
Center for Economic and Financial Research, University of Economics and Law, Ho Chi Minh City, Vietnam

Received 7 September 2017
Revised 3 November 2017
26 December 2017
5 February 2018
Accepted 12 February 2018

Abstract

Purpose – The purpose of this paper is to investigate the interrelationship between liquidity creation (LC) and bank capital in Vietnamese banking between 2007 and 2015.

Design/methodology/approach – A three-step procedure is used to measure LC. Thereafter, a simultaneous equations model with a three-stage least squares estimator is employed to examine the links between LC and bank capital.

Findings – The findings show that large banks mainly contributed a strong growth in LC in Vietnam between 2007 and 2015. The findings also indicate that off-balance sheet activities only played a small role in LC. In addition, the findings indicate a negative two-way relationship between LC and bank capital in Vietnam. The results of the robust checks reinforce the main findings.

Practical implications – The evidence shows that the implementation of Basel III may reduce LC and greater LC may increase banks' insolvency. Consequently, this trade-off between the benefits of financial stability induced by tightening capital requirements and those of enhanced LC has important implications for Vietnamese authorities in strengthening the banking system.

Originality/value – This study is the first attempt to investigate the interrelationship between LC and bank capital in Vietnam, in which fat liquidity creation and non-fat liquidity creation are used and alternative measures of LC are also employed to provide robustness to the main findings.

Keywords Vietnam, Liquidity creation, Three-stage least squares, Bank capital

Paper type Research paper

1. Introduction

As per the financial intermediation theory, one of the banks' primary roles in any economy is liquidity creation (LC) (Allen and Carletti, 2009). Traditionally, banks' liquidity on-balance sheet is created by financing relatively long-term illiquid assets with relatively short-term liquid liabilities (Diamond and Dybvig, 1983). Banks also create liquidity off-balance sheets (OBSs) by providing loan commitments and generating same claims on liquid funds (Holmstrom and Tirole, 1998; Kashyap *et al.*, 2002). Subsequently, modern banks hold illiquid assets and loan commitments and supply liquidity to stimulate the economy.

Banks also face default risk if some liabilities invested in illiquid assets are claimed at short notice. The global financial crisis (GFC) (2008–2009) emphasised the function of such a LC by banks because illiquidity can affect macroeconomic stability. The GFC demonstrates how quickly and severely illiquidity can crystallise. As a result, banks' reliance on funding source[1] has changed significantly, which, in turn, raises more concerns about the valuation of assets and capital adequacy rules. In response, higher liquidity and capital standards are proposed by the Basel framework in order to enhance a more resilient banking sector (Bank for International Settlements, 2011). A positive relationship between bank capital and LC supports the view that an increase in capital requirements may lead to greater safety and a higher LC. Meanwhile, LC also impacts bank capital positively, implying that greater LC may enhance banks' solvency.

Managerial Finance

0307-4358
DOI 10.1108/MF-09-2017-0337

Together, this suggests the existence of the two-way linkage between LC and bank capital in favour of tightening capital requirements (Horváth *et al.*, 2014).

LC, however, may be impeded by the higher capital requirement. Accordingly, there exists a trade-off between the benefits of financial stability and the costs of lower LC to the economy. This trade-off may also strengthen when greater LC may be detrimental to banks' solvency (Fu *et al.*, 2015). Alternatively, reverse causality may also support the view that an optimal level of LC may, therefore, exist (Horváth *et al.*, 2014).

Several studies have examined the effect of bank capital on LC in individual countries such as the USA (Berger and Bouwman, 2009) and Russia (Fungáčová *et al.*, 2017). Other studies have investigated the two-way relationship between LC and bank capital such as Horváth *et al.*'s (2014) work in the Czech Republic also Distinguin *et al.*'s (2013) research in the USA and Europe. The empirical evidence documenting the relationship between bank capital and LC is primarily based on the US market and other developed countries, with much less insight and discussion on the banking industry in emerging economies, although Fu *et al.*'s (2015) study may be one of the few exceptions. When considering the size and impact of some emerging markets such as Vietnam on the world economy, it might be anticipated that there is a gap in the banking literature: there are no empirical studies that examine the interrelationship between LC and bank capital in Vietnam.

Since entering the World Trade Organisation in 2007, Vietnam boasts one of the fastest-growing economies in the world[2], experiencing an average of approximately 6 per cent gross domestic product (GDP) growth per year in real terms. Because of a relatively underdeveloped capital market[3], the Vietnamese banking system is a backbone of the economy as it contributes 16–18 per cent towards the GDP (Stewart *et al.*, 2016). In order to support sustainable growth, the financial regulation must be balanced with the requirement of the banking sector and economic growth. Given that a capital size of Vietnamese banks is modest compared to that of their regional counterparts, the State Bank of Vietnam (SBV) officially introduced new capital requirements in order to strengthen the banking system and increase LC. Accordingly, banks are now required to achieve the minimum charter capital requirement of VND3,000 bn (Vietcombank Securities Company, 2011) but SBV may further increase this requirement since this is still lower than what is suggested by the Basel III. Yet, SBV seems to neglect the possibility that a bank's solvency may constrain LC (Morgan and Pontines, 2013) as such, Vietnam offers a particularly interesting environment in which to investigate this critical issue.

Our paper contributes to the literature in several ways. First, we adopt the work of Berger and Bouwman (2009) to estimate how much liquidity Vietnamese banks create and whether the LC in Vietnam is similar to those reported for other countries in the Asia-Pacific region (Fu *et al.*, 2015), for the USA (Berger and Bouwman, 2009) and for the Czech Republic (Horváth *et al.*, 2014). Second, results obtained by the Granger causality framework as used in Horváth *et al.*'s (2014) research are sensitive to model specification and the number of lags. In our study, a three-stage least squares (3SLS) estimation is used to examine whether similar results are obtainable. Finally, this study is the first attempt to investigate the interrelationship between LC and bank capital in Vietnam. Thus, our study would help Vietnamese authorities assess the economic implications of the capital requirements in Basel III.

The findings indicate that large banks mainly contributed a strong growth in LC in Vietnam between 2007 and 2015. Our findings also show that OBS activities only played a small role in LC, thereby suggesting that Vietnamese banks were less engaged in OBS activities. Furthermore, our findings demonstrate a negative two-way link between LC and bank capital. This suggests a trade-off between the advantages of financial stability induced through tightening capital requirements and those of improved LC. The results of the robust checks reinforce these main findings.

The remainder of the study is organised as follows: Section 2 presents a literature review on the relationship between LC and bank capital. Then, Section 3 introduces the methodology. Section 4 describes data used in the tests and, Section 5 discusses the empirical findings while Section 6 concludes.

2. Literature review

Existing literature suggests different causal relationships. The financial fragility-crowding out hypothesis suggests that bank capital impacts LC negatively. As a result, there are two following effects: financial fragility characterised by lower capital increases LC and a higher capital ratio crowds out deposits, thus reducing LC (Diamond and Rajan, 2000, 2001). As an intermediary in the economy, a bank collects funds from depositors and then lends them to borrowers. Once a loan is advanced, the bank must monitor the borrowers and obtain loan payments as predetermined. This allows the bank to collect private information from its borrowers, which provides the bank with an advantage in evaluating their profitability. Arguably, this may induce the bank to extract rents from its depositors by demanding a greater share of the loan income. It is so-called an agency problem in the literature (Horváth *et al.*, 2014). In order to secure stable funding, the bank is forced to make commitments to depositors by adopting a fragile financial structure with a large share of liquid deposits. Indeed, a fragile capital structure improves the bank's ability to generate more liquidity because depositors have the right to make a run on a bank if the bank limits its ability to raise financing (Diamond and Rajan, 2000, 2001); however, the situation is different for capital providers. Since deposits are more effective liquidity hedges than equity investments (Gorton and Winton, 2000) higher capital requirements may crowd-out deposits by shifting investor's funds from liquid deposits to illiquid equity, thus hampering LC.

In contrast, the risk absorption hypothesis posits that bank capital impacts LC positively (Berger and Bouwman, 2009). Accordingly, the higher liquidity banks generate the greater default risk they face because of the mismatched maturity of illiquid assets and liquid deposits (Allen and Gale, 2004). As a consequence, stronger capital requirements help banks absorb more risks, thus strengthening LC.

A counterargument is the capital cushion hypothesis that proposes a positive impact of LC on bank capital. Banks that create more liquidity are exposed to higher liquidity risk. Hence, banks may be required to hold more capital to strengthen their solvency (Matz and Neu, 2007). The liquidity substitution hypothesis, however, argues that LC impacts bank capital negatively (Distinguin *et al.*, 2013). Certain liquid liabilities are seen as stable sources of funding and therefore, banks may use them as a substitute for capital when they face higher illiquidity.

Several studies investigate the impact of bank capital on LC, while others examine the opposite causal relationship. Mixed results in the relationship between bank capital and liquidity are found: positive, negative, neutral and negative two-way linkage. Using US data, Berger and Bouwman (2009) found that there is a positive relationship between bank capital and LC for the large banks, while there is a negative relationship for the small banks. Meanwhile, Fungáčová *et al.* (2017) using Russian data indicated a neutral link between bank capital and LC for large, state-owned and foreign banks. Whereas studies conducted by Horváth *et al.* (2014) in the Czech Republic and Fu *et al.* (2015) in the Asia-Pacific region, both document a negative two-way relationship between capital and LC for banks of all sizes. This research uses Vietnam as an emerging market to understand whether the same mixed results hold. In addition, this study is the first attempt to investigate the interrelationship between LC and bank capital between 2007 and 2015 in Vietnam while utilising the GFC impact. Several measures are then used to confirm the main findings.

3. Methodology

3.1 The estimation of LC

Following Berger and Bouwman's (2009) study design, two measures of LC are constructed using a three-step procedure. Non-fat liquidity creation (NFLC) considers only on-balance sheet activities, whereas fat liquidity creation (FLC) includes both on-balance sheet and OBS activities, in which OBS activities functionally create liquidity in a similar way to on-balance sheet ones.

In the initial step, the assets, liabilities, equity and OBS activities are classified as liquid, semi-liquid or illiquid. Due to unavailable data on maturity, we continue to follow Berger and Bouwman's (2009) methods by classifying these items by different categories as presented in Table I. It is noted that the classification by category is better than by maturity based on the ease, cost and timeliness with which banks obtain liquid funds to facilitate their obligations that are more crucial than the time to self-liquidation. In the second step, all of the banks' activities are assigned differing weights according to the LC intuition[4]. The magnitudes of the weights are generated as follows: one dollar of liquidity is created by transferring one dollar of liquid liabilities into one dollar of illiquid assets or illiquid OBS activities. One dollar of liquidity, however, is destroyed by transferring one dollar of illiquid liabilities or equity into one dollar of liquid assets or liquid OBS activities. Accordingly, Berger and Bouwman (2009) assigned a weight of one-half for illiquid assets, liquid liabilities and illiquid OBS activities; a weight of 0 for semi-liquid assets, semi-liquid liabilities and semi-liquid OBS; and a weight of −1/2 for

Assets		
Illiquid assets (weight = 1/2)	Semi-liquid assets (weight = 0)	Liquid assets (weight = −1/2)
Corporate and commercial loans	Consumer/retail loans	Cash and due from other credit institutions
Other loans	Loans and advances to banks	Trading securities
Fixed assets		Derivatives
Other assets		Investment securities
		At-equity investments in associates
		Other securities
Liabilities plus equity		
Liquid liabilities (weight = 1/2)	Semi-liquid liabilities (weight = 0)	Illiquid liability plus equity (weight = −1/2)
Customer deposits-current	Customer deposits term	Senior debt maturing after 1 year
Customer deposits-saving	Term deposits from banks	Subordinated borrowing
Demand deposit from banks and other credit institutions	Other deposits	Other funding
Derivatives	Short-term borrowing from banks	Other liabilities
Discounts and rediscounts of valuable papers[a]	Certificates of deposit	
		Total equity
OBS activities		
Illiquid OBS (weight = 1/2)	Semi-liquid OBS (weight = 0)	Liquid OBS (weight = −1/2)
Acceptances and documentary credits reported OBS	Guarantees	
Committed credit lines		
Other contingent liabilities		

Table I. The construction of two liquidity creation measures

Note: [a]These items are classified as liquid liabilities in this study because Vietnamese commercial banks commit to repurchase these valuable papers within 91 days (SBV, 2008)
Sources: Adapted from Berger and Bouwman (2009) and Fu *et al.* (2015)

liquid assets, illiquid liabilities and liquid OBS activities. In the third step, the following FLC and NFLCs are estimated by combining the activities as determined and weighted in steps 1-2, respectively:

$$\begin{aligned}\text{FLC} = {} & 1/2 \times (\text{illiquid assets} + \text{liquid liabilities} + \text{illiquid OBS}) \\ & + 0 \times (\text{semiliquid assets} + \text{semiliquid liabilities} + \text{semiliquid OBS}) \\ & - 1/2 \times (\text{liquid assets} + \text{illiquid liabilities} + \text{equity} + \text{liquid OBS}), \end{aligned} \tag{1}$$

$$\begin{aligned}\text{NFLC} = {} & 1/2 \times (\text{illiquid assets} + \text{liquid liabilities}) \\ & + 0 \times (\text{semiliquid assets} + \text{semiliquid liabilities}) \\ & - 1/2 \times (\text{liquid assets} + \text{illiquid liabilities} + \text{equity}). \end{aligned} \tag{2}$$

3.2 The simultaneous equations model

A 3SLS estimator which combines 2SLS and SUR are used in our study due to the following reasons. The results obtained from the Granger causality are sensitive to model specification and the number of lags. Furthermore, the 3SLS are more efficient than 2SLS because this estimation can increase the strength of the interrelations among the error terms (Belsley, 1988).

LC[5] and bank capital (CAP) represent the two endogenous variables in the following simultaneous equations system, with two right-hand side endogenous variables in each of the two equations. Adding exogenous variables[6] which have explanatory power for each of the above endogenous variables completes the model. See below:

$$\text{LC}_{i,t} = \alpha_0 + \alpha_1 \text{CAP}_{i,t} + \alpha_2 \text{MP}_{i,t} + \alpha_3 \text{NPL}_{i,t} + \alpha_4 \text{LNTA}_{i,t} + \alpha_5 \text{NIM}_{i,t} + \alpha_6 \text{GFC} + \varepsilon_{i,t} \tag{3}$$

$$\text{CAP}_{i,t} = \beta_0 + \beta_1 \text{LC}_{i,t} + \beta_2 \text{LA}_{i,t} + \beta_3 \text{NPL}_{i,t} + \beta_4 \text{LNTA}_{i,t} + \beta_5 \text{NIM}_{i,t} + \beta_6 \text{GFC} + \delta_{i,t} \tag{4}$$

3.2.1 Liquidity creation (LC). CAP. The risk absorption hypothesis (risk transformer) predicts that bank capital impacts LC positively by enhancing banks' risk-bearing abilities (Bhattacharya and Thakor, 1993; Repullo, 2004). Accordingly, banks that create more liquidity are exposed to higher default risk when they are forced to sell illiquid assets to meet the liquidity demands of their customers (Allen and Gale, 2004). Hence, more capital allows them to absorb greater risk. The financial fragility-crowding out hypothesis, however, suggests a negative impact of bank capital on LC. A higher capital ratio crowds out deposits, thus reduce LC. Also, financial fragility characterised by lower capital seems to increase LC (Diamond and Rajan, 2000, 2001).

Utilising existing literature, we use market power (MP), risk (NPL), bank size (LNTA), bank profitability (NIM) and the GFC as control variables for LC.

In Vietnam, two main sources of bank funding include core deposits and interbank loans as they accounted for 66 and 22 per cent, respectively, of banks' liabilities[7]. Therefore, MP, as measured by the ratio of deposits for each bank to total deposits in the banking industry, is used to control for MP (Demirgüç-Kunt *et al.*, 2004; Poghosyan, 2013; Viverita, 2014). Banks with greater MP may increase LC by locking in customers (Petersen and Rajan, 1995) but that may also reduce LC by offering a narrower service range (Berger and Hannan, 1989) along with charging higher interest rates on loans (Pilloff and Santomero, 1998). NPL, as measured by the ratio of non-performing loans to total loans, is used to control for risk. According to the moral hazard hypothesis, banks that face greater risk tend to increase their lending, thus improving LC (Umar and Sun, 2016). LNTA, as measured by the natural logarithm of total assets, is used to control for bank size (Berger and Bouwman, 2009; Distinguin *et al.*, 2013). Large banks may benefit from implicit guarantees such as

"too-big-to-fail", greater diversification opportunities and have easier access to the interbank market. NIM, as measured by the ratio of net interest income to total assets, is used to control for bank profitability[8]. Bank profitability results in higher equity, which ultimately enhances LC (Berger *et al.*, 2016; Hackethal *et al.*, 2010). GFC, a dummy variable that takes the value of 1 for the period of 2008–2009, and 0[9] otherwise, is included in the assessment of how bank LC responded during the GFC.

3.2.2 Bank capital (CAP). Liquidity creation. The illiquidity risk hypothesis postulates that LC impacts bank capital positively. Meanwhile, the more liquidity banks create, the greater their exposure to liquidity constraint because illiquid assets account for a larger share of their total balance sheets. As a result, banks have incentives to strengthen their solvency via increased capital. The greater capital would enhance their ability to raise external funds against risky LC since capital acts as a buffer. The liquidity substitution hypothesis, however, suggests a negative impact of LC on bank capital (Fu *et al.*, 2015). Banks may substitute certain liquid liabilities (demand and time deposits) for capital when they face higher illiquidity because these liabilities are seen as stable sources of funding.

Using existing literature, we use lending specialisation (LA), risk (NPL), bank size (LNTA), bank profitability (NIM) and the GFC as control variables for CAP. Following Le's (2017) research, LA, as measured by the ratio of total loans to total assets, is used to control for lending specialisation. Banks may tend to seize new lending opportunities, expand their businesses to new geographic markets or increase market share with existing products and markets. Increased loans may improve bank earnings—increasing lending interest rates while lowering deposit interest rates—thus, leading to higher bank capital. NPL, as measured by the ratio of non-performing loans to total loans, is used to control for bank risk. A bank that faces higher risk is required to have a greater capital ratio (Fu *et al.*, 2015). LNTA, as measured by the natural logarithm of total assets, is used to control for bank size. As per the franchise value hypothesis, higher earnings result in greater diversification, which offers banks more investment opportunities and therefore, this may lower the cost of capital, which provides incentives for large banks to raise more capital to avoid taking an extraordinary risk (Ahmad *et al.*, 2008). However, there is less restriction on access to the capital market by larger banks, so that they are able to raise external capital more easily. Subsequently, they may have greater financial flexibility, which induces them to hold lower capital ratio. NIM, as measured by the ratio of net interest income to total assets, is used to control for bank profitability[10]. The charter value hypothesis[11] posits that a profitable bank may increase capital ratios, all else being equal, to protect its charter value (Keeley, 1990). In addition, the pecking order theory of finance also suggests that increasing extra capital may be costly. All in all, it may be easier to accumulate capital via higher retained earnings. GFC, a dummy variable that takes the value of 1 for the period of 2008–2009, and 0 otherwise, is included to assess how bank capital varies during the GFC.

4. Data

This study focuses only on Vietnamese commercial banks between 2007 and 2015, where there were significant changes in banks' capital ratio and strong development of the economy, especially the banking sector. Furthermore, since 2007 Vietnamese banks have been required to publish their audited financial reports (SBV, 2007)[12], this allowed us to manually collect necessary information from the banks' financial statements. The exclusionary criteria for the banks were missing data on non-performing loans and missing data on loan classifications. As a result, we obtained an unbalanced panel data of 25 banks during the period of 2007–2015, which ultimately arrived at a total of 198 bank-yearly observations. All these data are deflated by their corresponding year

CPIs to the 2007 price level in order to control for inflation effects. The CPI data were extracted from the World Bank (2016) database. Table II provides descriptive statistics for all variables used in the regression.

5. Empirical results

5.1 An analysis of LC in Vietnamese banking system

Following Berger and Bouwman's (2009) work, large and small banks are defined as their total assets above and below the median, respectively. This decomposition allows for conclusions on the impact that different categories have on banks in relation to LC. The results of LC between 2007 and 2015 in Vietnamese banking system are presented in Table III.

Variables	Mean	STD	Min.	Max.
FLC	12.95	18.41	−38.72	57.93
NFLC	9.54	17.03	−38.72	55.84
AFLC	19.09	16.78	−24.46	61.86
ANFLC	15.68	15.56	−24.46	59.76
CAP	12.28	9.16	2.91	66.08
LNTA	17.77	1.32	14.07	20.56
NPL	2.36	1.65	0.07	11.4
GFC	0.23	0.42	0	1
MP	3.16	4.05	0.04	15.93
NIM	2.71	1.41	0.24	9.61
LA	52.13	14.03	15.61	94.42

Notes: FLC, the ratio of liquidity creation—including on- and off-balance sheet activities—to total assets; NFLC, the ratio of liquidity creation—including only on-balance sheet activities—total assets; AFLC, the ratio of liquidity creation—including on- and off-balance sheet activities but excluding equity-to-total assets; ANFLC, the ratio of liquidity creation—including only on-balance sheet activities but excluding equity-to-total assets; CAP, the ratio of total equity-to-total assets; LNTA, the nature logarithm of total assets; NPL, the ratio of non-performing loans to total loans; GFC, a dummy variable that takes the value of 1 for years 2008–2009, and 0 otherwise; MP, the ratio of deposits for each bank to total deposits in the banking industry; NIM, the ratio of net interest income to total assets; LA, the ratio of total loans to total assets

Table II. Descriptive statistics for all variables

	Fat liquidity creation						Non-fat liquidity creation					
	Large banks (VND billion)	%[a]	Small banks (VND billion)	%	All banks (VND billion)	%	Large banks (VND billion)	%[b]	Small banks (VND billion)	%	All banks (VND billion)	%
2007	246,957	*19.97*	−6,878	−6.35	240,078	*6.81*	159,676	12.13	−7,456	−6.79	152,219	2.67
2008	186,227	20.09	3,854	3.69	190,081	11.89	137,089	14.82	3,764	3.57	140,854	9.2
2009	256,574	21	6,063	0.77	262,638	10.48	197,477	16.04	5,264	0.42	202,740	7.92
2010	260,281	15.73	2,472	−0.94	262,753	7.06	201,324	11.88	168	−2.12	201,492	4.6
2011	213,798	13.95	7,273	0.22	221,071	7.09	147,327	8.75	3,130	−1.59	150,457	3.58
2012	279,327	18.21	39,764	13.35	319,091	15.57	227,649	14.68	36,977	12.02	264,626	13.24
2013	291,339	21.45	49,650	13.78	340,989	17.45	241,027	17.84	46,055	12.32	287,083	14.96
2014	338,502	22.99	49,734	12.52	388,236	17.5	270,160	18.04	32,026	8.51	302,186	13.05
2015	402,877	*26.78*	59,458	23.5	462,335	*25.14*	291,947	18.52	38,154	17.53	330,101	18.02
2007–2015	275,098	*19.81*	23,488	6.49	298,586	*12.95*	208,186	14.64	17,565	4.74	225,751	*9.54*

Notes: [a,b]The ratio of liquidity creation to total assets. Fat liquidity creation includes on- and off-balance sheet activities, whereas non-fat liquidity creation considers only on-balance sheet activities. Large and small banks are classified as those with total assets above and below the median, respectively. All financial values are expressed in real 2007 bn of VND using the CPI price deflator

Table III. Bank liquidity creation in Vietnam, 2007–2015

The ratio of FLC to total assets appears to increase substantially from 6.81 per cent in 2007 to 25.14 per cent in 2015, suggesting the strong expansion of LC. In addition, the mean ratio of FLC to total assets over the period of 2007–2015 is approximately 13 per cent for Vietnamese banks. This is quite close to the 15 per cent in the Czech Republic reported by Horváth *et al.* (2014) but much lower than the 29 per cent in the USA documented by Berger and Bouwman (2009), the 27–30 per cent in Russia indicated by Fungáčová *et al.* (2017), and the 31 per cent in the Asia-Pacific region demonstrated by Fu *et al.* (2015). One of the main reasons for the lower level of LC in the Vietnamese banking system is that banks' size was modest compared to that of their regional counterparts—thus may limit their ability to create more liquidity.

In addition, large banks, on average, account for approximately 92 per cent of total LC in Vietnam between 2007 and 2015. This finding is comparable to the 95 per cent in the Asia-Pacific region reported by Fu *et al.* (2015), the 81 per cent in the USA documented by Berger and Bouwman (2009). The similar result can be found when observing LC by large banks in relative term. Accordingly, the mean ratios of FLC to total assets for Vietnamese large banks in years 2007 and 2015 are 19.97 and 26.78 per cent, respectively, as compared with those for all banks of 6.81 and 25.14 per cent, respectively. Furthermore, the data shown in Table III indicate that the mean ratio of NFLC to total asset in Vietnam during the period of 2007–2015 is 9.54 per cent, which is in line with the findings of Horváth *et al.* (2014) for Czech banks (10 per cent) but much lower than that estimated by Berger and Bouwman (2009) for US banks (50 per cent). This suggests that OBS activities play a small role in LC in Vietnam. In fact, the OBS activities of Vietnamese banks are quite limited and include financial guarantees, standby letters of credit, other guarantees and commitments, and foreign exchange transactions.

Furthermore, there is a strong growth of fat and NFLC (in the real term) between 2007 and 2015 as indicated in Figures 1 and 2. The expansion of LC (both measures) levelled off in years 2009–2010 and then reduced in the year 2011. But, there was a significant increase in LC in subsequent years. This fluctuation can be explained by the following reasons. Before the GFC, the Vietnamese banking system witnessed a substantial credit growth, especially towards the real estate industry. When the GFC (2008–2009) hit Vietnam, there appeared a significant decline in real estate prices and subsequent deep fall in the stock market index, which ultimately caused an increase in non-performing loans for banks. In response, banks were prudent to advance new lending which halted the expansion of LC during 2010–2011. The Vietnamese banking system, however, experienced a significant growth in LC during 2012–2015 because Vietnamese banks received benefits from the Government's stimulatory package.

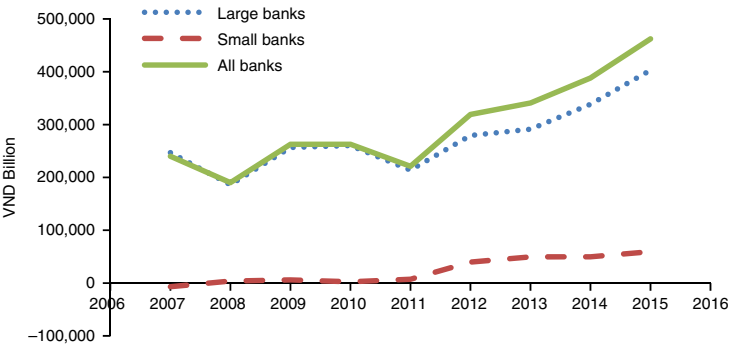

Figure 1.
Bank liquidity creation in Vietnam (fat liquidity creation includes on- and off-balance sheet activities), and the series are adjusted for inflation (2007 base) and are in VND billion

5.2 Regression results

Table IV presents the correlation matrix of the various variables used for this study. For the ease of exposition, we focus on the general interpretation of correlation between all measures of LC and CAP[13]. At the first glance, CAP is negatively correlated with all four measures of LC. Whether LC has an impact on CAP, however, can be only addressed by using the 3SLS estimation in a simultaneous equations model as indicated in the following sections.

5.2.1 Impact of bank capital on LC. The simultaneous equations system is fitted by pooled time-series cross-section observations using the 3SLS estimator. FLC and NFLC as discussed above are used as the main dependent variables. The results of the impact of CAP on LC are indicated in Table V.

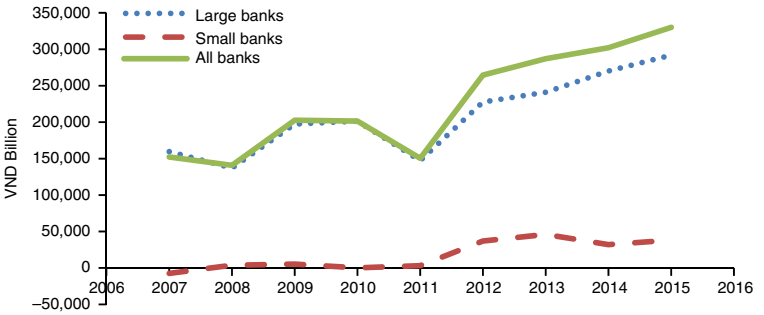

Figure 2. Bank liquidity creation in Vietnam (non-fat liquidity creation considers only on-balance sheet activities), and the series are adjusted for inflation (2007 base) and are in VND billion

	FLC	NFLC	AFLC	ANFLC	CAP	LNTA	NPL	LA	NIM	GFC	MP
CAP	−0.47***	−0.44***	−0.24***	−0.19***	1						
	(−7.37)	(−6.88)	(−3.44)	(−2.69)							
LNTA	0.5***	0.43***	0.37***	0.28***	−0.64***	1					
	(8.05)	(6.6)	(5.61)	(4.05)	(−11.72)						
NPL	0.12*	0.13*	0.15**	0.16**	0.07	−0.02	1				
	(1.68)	(1.83)	(2.11)	(2.29)	(0.93)	(−0.32)					
LA	0.48***	0.52***	0.53***	0.58***	0.042	0.07	0	1			
	(7.59)	(8.51)	(8.85)	(9.99)	(0.58)	(0.95)	(0)				
NIM	−0.22***	−0.25***	−0.06	−0.08	0.65***	−0.19	0.019	0.26	1		
	(−3.1)	(−3.54)	(−0.85)	(−1.09)	(11.92)	(−2.72)	(0.27)	(3.76)			
GFC	−0.05	−0.03	−0.03	−0	0.13*	−0.28	−0.05	0.18	−0.04	1	
	(−0.76)	(−0.47)	(−0.36)	(−0)	(1.76)	(−4.15)	(−0.66)	(2.61)	(−0.54)		
MP	0.39***	0.33***	0.33***	0.25***	−0.38***	0.79	−0.04	0.29	−0.06	−0.07	1
	(5.95)	(4.91)	(4.84)	(3.65)	(−5.66)	(18.18)	(−0.5)	(4.16)	(−0.78)	(−0.98)	

Notes: FLC, the ratio of liquidity creation—including on- and off-balance sheet activities—to total assets; NFLC, the ratio of liquidity creation—including only on-balance sheet activities—total assets; AFLC, the ratio of liquidity creation—including on- and off-balance sheet activities but excluding equity-to-total assets; ANFLC, the ratio of liquidity creation—including only on-balance sheet activities but excluding equity-to-total assets; CAP, the ratio of total equity-to-total assets; LNTA, the nature logarithm of total assets; NPL, the ratio of non-performing loans to total loans; LA, the ratio of total loans to total assets; NIM, the ratio of net interest income to total assets; GFC, a dummy variable that takes the value of 1 for years 2008–2009, and 0 otherwise; MP, the ratio of deposits for each bank to total deposits in the industry. The table reports the correlation matrix of key considerable variables. Accordingly, the correlation matrix among LC variables is not presented due to space constraint. *t*-Statistics are indicated in parentheses. *,**,***Significant at 10, 5 and 1 per cent levels, respectively

Table IV. Correlation matrix of key variables

	FLC	NFLC
CAP	−8.91*** (−3.14)	−−9.31*** (−3.14)
MP	4.99** (2.41	5.25** (2.43)
NPL	3.78* (1.91)	3.86* (1.87)
LNTA	−0.4** (−2.55)	−0.43*** (−2.68)
NIM	28.23*** (2.89)	29.14*** (2.86)
GFC	−0.06 (−0.66)	−0.07 (−0.73)
Constant	7.25*** (2.61)	7.91*** (2.72)
Adjusted R^2	−4.6	−6.13
No. of observations	198	198

Notes: FLC, the ratio of liquidity creation—including on- and off-balance sheet activities—to total assets; NFLC, the ratio of liquidity creation—including on-balance sheet activities—to total assets; CAP, the ratio of total equity-to-total assets; MP, measured by the ratio of deposits for each bank to total deposits in the industry; NPL, the ratio of non-performing loans to total loans; LNTA, the natural logarithm of total assets; NIM, the ratio of net interest income to total assets; GFC, a dummy variable that takes the value of 1 for 2008–2009, and 0 otherwise. The table contains the results estimated using a simultaneous equations model with the 3SLS estimator. *t*-Statistics are indicated in parentheses. *,**,***Significant at 10, 5 and 1 per cent levels, respectively

Table V.
The determinants of liquidity creation

Table V shows that the coefficient of CAP is significant and negative in all versions, suggesting that the greater the bank capital LC is reduced—thus, confirming the financial fragility-crowding out hypothesis. Diamond and Rajan (2000, 2001) suggested that if deposit insurance is complete, depositors have no incentive to make run on the bank. The bank may withhold efforts which curtail its ability to create liquidity. This could be the case for the Vietnamese banking system, where the deposit insurance is quite complete. In addition to it, since 2010 the SBV implemented several measures to prevent unfair competition on deposit interest rates. All in all, this would reduce the likelihood of a bank run by depositors in Vietnam.

Furthermore, Gorton and Winton (2000) proposed a model on the crowding out effect that assumed a single and unsegmented capital market. Such an assumption is appropriate to our case. Due to a relatively undeveloped capital market in Vietnam, where investors may not have many options of equity vs debt instruments, increased demand for capital may induce banks to shift out of their deposits.

The coefficient of MP is significant and positive, suggesting banks that have greater MP tend to increase LC[14]. These findings are in line with those of Fu *et al.* (2015) in the Asia-Pacific region. NPL is significantly and positively related to LC, implying banks that face greater risk create more liquidity—thus, a moral hazard hypothesis may exist. Managers tend to increase banks' lending in the presence of high NPLs in order to maximise their utility. Also, shareholders prefer risky portfolios by ultimately transferring the risk to depositors (Acharya *et al.*, 2016). Nonetheless, our findings do not support the earlier findings of Umar and Sun (2016) who found that there was no evidence of a moral hazard problem in Chinese banks. Furthermore, the coefficient of LNTA is significant and negative, suggesting that large banks create less liquidity per total assets. These findings are comparable to those of Berger and Bouwman's (2009) research in the USA, or Fu *et al.*'s (2015) work in the Asia-Pacific region as well as Horváth *et al.*'s (2014) study in the Czech Republic. NIM is significantly and positively associated with LC, suggesting that profitable banks create more liquidity. Increased profitability leads to the higher amount of available funds, which enhances LC. These findings are similar to those by Umar and Sun (2016). The coefficient of GFC is negative but statistically not significant in either equation, suggesting that the GFC had no impact on LC in Vietnam.

5.2.2 Impact of LC on bank capital. The results of the impact of LC on CAP are indicated in Table VI.

As can be seen in Table VI, the coefficient of LC is significant and negative in all versions, suggesting that higher LC reduces bank capital—thus, supporting the liquidity substitution hypothesis. Accordingly, Vietnamese banks may substitute their stable liabilities for capital when facing liquidity constraints because they have better access to deposit base while poorer access to the capital markets. These findings are similar to those of Fu *et al.*'s (2015) work on banks in the Asia-Pacific region. LA is significantly and positively related to CAP, suggesting that banks with the higher level of lending specialisation could obtain higher earnings, thus increasing the level of capital. In the context of Vietnam, bank loans are more highly valued than alternative bank outputs (security investments) (Le, 2016). The coefficient of NPL is significant and positive, suggesting banks that face greater risk have higher capital ratios because they are required to set aside more capital as a buffer against losses. The coefficient of LNTA is generally negative and significant in one version, suggesting that smaller banks maintain the higher level of bank capital. NIM is significantly and positively related to CAP, suggesting that banks accumulate capital via higher retained earnings (Fu *et al.*, 2015). In addition, GFC is found to have no impact on bank capital.

In sum, the findings for Vietnam indicate a negative two-way relationship between LC and bank capital. These findings are comparable to those of Horváth *et al.*'s (2014) research in the Czech Republic and Fu *et al.*'s (2015) work in the Asia-Pacific region. In addition, a significantly negative coefficient of bank size in both models as discussed above implies that the relationship between bank capital and LC may differ for both large and small banks.

5.3 Robust checks

In order to provide robust checks for the main findings, we also use a simultaneous equations model with a generalised method of moments (GMM) estimator[15]. In addition, we further investigate the interrelationship between LC and bank capital using alternative measures of LC. Finally, the interrelationship between them is investigated in subsamples.

5.3.1 GMM regression. In order to mitigate potential endogeneity with bank-level control variables, we follow Berger and Bouwman (2009) and Distinguin *et al.* (2013) by replacing all bank-level explanatory variables with their one-year lagged value in all regressions.

	FLC	NFLC
LC	−0.52*** (−2.92)	−0.51*** (−3.11)
LA	0.31** (2.40)	0.33** (2.58)
NPL	1.01** (2.39)	0.98** (2.52)
LNTA	−0.01 (−0.68)	−0.02** (−2.12)
NIM	1.77** (2.28)	1.53* (1.94)
GFC	−0.01 (−0.47)	−0.01 (−0.75)
Constant	0.09 (0.39)	0.23 (1.38)
Adjusted R^2	0.28	0.37
No. of observations	198	198

Notes: FLC, the ratio of liquidity creation—including on- and off-balance sheet activities—to total assets; NFLC, the ratio of liquidity creation—including on-balance sheet activities—to total assets; CAP, the ratio of total equity-to-total assets; LA, the ratio of total loans to total assets; NPL, the ratio of non-performing loans to total loans; LNTA, the natural logarithm of total assets; NIM, the ratio of net interest income to total assets; GFC, a dummy variable that takes the value of 1 for 2008–2009, and 0 otherwise. The table contains the results estimated using a simultaneous equations model with the 3SLS estimator. *t*-Statistics are indicated in parentheses. *,**,***Significant at 10, 5 and 1 per cent levels, respectively

Table VI. The determinants of bank capital

Therefore, the one-year lagged values of the presumably endogenous variables will be used as instruments[16]. The results of using a simultaneous equations model with a GMM estimator are presented in Table VII.

Table VII shows that bank capital impacts LC negatively, while there is no evidence of the impact of LC (FLC and NFLC) on bank capital. Nonetheless, these findings support these above main results.

5.3.2 Alternative measures of LC. As shown in Table I, equity was assigned the weight of (−1/2). LC theories, however, suggest that banks create liquidity when illiquid assets are transformed into liquid liabilities, rather than illiquid claims such as equity (Fu *et al.*, 2015). In order to address this potential concern, equity should be excluded from these measures (Berger and Bouwman, 2009). Two alternative measures, AFLC (as measured by the ratio LC-including on-balance sheet and OBS activities but excluding equity-to-total assets) and ANFLC (as measured by the ratio LC, including on-balance sheet activities but excluding equity-to-total assets) are used in our study. Table VIII demonstrates the negative two-way relationship between LC and bank capital, suggesting that the main findings are robust to the exclusion of equity from the LC measures.

	FLC	CAP	NFLC	CAP
CAP	−2.36** (−2.10)			
FLC		0.03 (0.09)		
CAP			−2.19 (−1.48)	
NFLC				−0.12 (−0.81)
Constant	−0.97 (−0.83)	0.57* (1.94)	−1.77 (−1.57)	0.4*** (3.03)
No. of observations	189			

Notes: FLC, the ratio of liquidity creation—including on- and off-balance sheet activities—to total assets; NFLC, the ratio of liquidity creation—including on-balance sheet activities—to total assets; CAP, the ratio of total equity-to-total assets. The table contains the results estimated using a simultaneous equations model with a GMM estimator. The same set of control variables for liquidity creation and bank capital is used as indicated in Equations (3) and (4). However, the coefficients on other control variables are not presented in the table due to space constraints. *t*-Statistics are indicated in parentheses. *,**,***Significant at 10, 5 and 1 per cent levels, respectively

Table VII.
The interrelationship between liquidity creation and bank capital using a GMM estimator

	AFLC	CAP	ANFLC	CAP
CAP	−8.41*** (−2.96)			
AFLC		−0.7** (−2.16)		
CAP			−8.81*** (−2.97)	
ANFLC				−0.69*** (−2.32)
Constant	7.25*** (2.61)	0.12 (0.41)	7.91*** (2.72)	0.31 (1.59)
Adjusted R^2	−5.75	−0.31	−7.54	−0.14
No. of observations	198	198	198	198

Notes: AFLC, the ratio of liquidity creation—including on- and off-balance sheet activities but excluding equity-to-total assets; ANFLC, the ratio of liquidity creation—including on-balance sheet activities but excluding equity-to-total assets; CAP, the ratio of equity-to-total assets. The table contains the results estimated using a simultaneous equations model with the 3SLS estimator. AFLC and ANFLC are used to replace FLC and NFLC in the regressions, respectively. The same set of control variables for liquidity creation and bank capital is used as indicated in Equations (3) and (4). However, the coefficients on other control variables are not presented in the table due to space constraints. *t*-Statistics are indicated in parentheses. **,***Significant at 5 and 1 per cent levels, respectively

Table VIII.
The interrelationship between liquidity creation (excluding equity) and bank capital

5.3.3 Subsample issues. Berger and Bouwman (2009) using US data showed a negative effect of bank capital on LC for small banks but a positive effect for large banks. Thus, we further examine whether the links between LC and capital in Vietnam differ between small and large banks. Large and small banks are defined as those with total assets above and below than the median, respectively (Berger and Bouwman, 2009). FLC and NFLC are used as a measure of LC. The results of the interrelationship between LC and capital for small banks are indicated in Table IX.

Table IX shows that the coefficient of CAP is significant and negative in both measures of LC, while there is no evidence of the impact of LC (FLC and NFLC) on bank capital for small banks.

The results for the interrelationship between LC and capital for large banks are presented in Table X. As can be seen in Table X, there is no significant correlation between bank capital (CAP) and liquidity creation (FLC and NFLC) for large banks. These findings, however, should be interpreted with caution because the small sample size is used in the 3SLS estimator. Ultimately, the results from the subsample corroborate the findings of Berger and Bouwman (2009).

	FLC	CAP	NFLC	CAP
CAP	−4.53*** (−4.25)			
FLC		0.63 (1.04)		
CAP			−4.58*** (−4.33)	
NFLC				0.97 (0.78)
Constant	4.85*** (3.07)	2.48* (1.95)	5.04*** (3.21)	2.94 (1.28)
Adjusted R^2	−0.84	0.33	−1.05	−0.19
No. of observations	102	102	102	102

Notes: FLC, the ratio of liquidity creation—including on- and off-balance sheet activities—to total assets; NFLC, the ratio of liquidity creation—including on-balance sheet activities—to total assets; CAP, the ratio of equity-to-total assets. The table contains the results estimated using a simultaneous equations model with the 3SLS estimator. The same set of control variables for liquidity creation and bank capital is used as indicated in Equations (3) and (4). However, the coefficients on other control variables are not presented in the table due to space constraints. *t*-Statistics are indicated in parentheses. *,***Significant at 10 and 1 per cent levels, respectively

Table IX.
The interrelationship between liquidity creation and capital for small banks

	FLC	CAP	NFLC	CAP
CAP	45.08 (0.64)			
FLC		0.23 (0.29)		
CAP			49.28 (0.63)	
NFLC				0.07 (0.39)
Constant	−14.89 (−0.62)	0.43* (1.75)	−16.62 (−0.63)	0.38*** (4.35)
Adjusted R^2	−75.1	−0.59	−96.82	0.11
No. of observations	96	96	96	96

Notes: FLC is the ratio of liquidity creation—including on- and off-balance sheet activities—to total assets. NFLC is the ratio of liquidity creation—including on-balance sheet activities—to total assets. CAP is the ratio of equity-to-total assets. The table contains the results estimated using a simultaneous equations model with the 3SLS estimator. The same set of control variables for liquidity creation and bank capital is used as indicated in Equations (3) and (4). However, the coefficients on other control variables are not presented in the table due to space constraints. *t*-Statistics are indicated in parentheses. *,***Significant at 10 and 1 per cent levels, respectively

Table X.
The interrelationship between liquidity creation and capital for large banks

6. Conclusion

This study examined the interrelationship amid LC and bank capital in Vietnam between 2007 and 2015. The findings show that a strong growth of LC in Vietnam was primarily driven by large banks. In addition, the findings also indicate that OBS activities only played a small role in LC, suggesting that Vietnamese banks were less engaged in OBS activities.

Furthermore, our findings demonstrate a negative two-way relationship between LC and capital. These findings confirm the financial fragility-crowding out hypothesis according to which greater bank capital hampers LC. Our findings also support the liquidity substitution hypothesis, which suggests that banks can substitute liquid liabilities for capital when they encounter higher illiquidity. In addition, several robust checks indicate consistent results.

Our results have several policy implications. The trade-off between the benefits of financial stability induced by stronger capital requirement as suggested by Basel III and those of higher LC is applicable to Vietnamese banks. Accordingly, tightening capital requirement may reduce LC, thus hampering economic growth. However, higher LC may reduce bank capital and lead to higher risk. Consequently, any action in favour of one objective might deteriorate the other. Vietnamese authorities should consider this antagonistic relation when further increasing the minimum charter capital requirement.

The study has some limitations. The alternative measures of regulatory capital may be used to confirm our main findings. Furthermore, our study covers one emerging market and a limited period of study, suggesting that the need for future research in other emerging nations which have similar banking structure for robustness of the results.

Notes

1. Banks tend to shift away from short-term wholesale debt funding and securitisation and towards retail deposits and long-term wholesale debt funding because they are considered stickier and more stable source of funding (Wong, 2012).
2. Just behind China within Asia with an average of approximately 9% GDP growth per year over the same period.
3. The stock market has been only serving a limited number of companies in the favour of the government.
4. Berger and Bouwman (2009, pp. 3794) highlighted that the intuition for liquidity creation is that "banks create liquidity because they hold illiquid items in place of the non-bank public and give the public liquid items".
5. Two measures of liquidity creations (FLC and NFLC) as outlined above are used.
6. In order to detect the potential endogeneity of considered variables in each equation, the Durbin-Wu-Hausman test is used. Due to the length restrictions, the table of results cannot be presented but is available upon request. Nonetheless, the results of Durbin-Wu-Hausman test show that CAP is justified as an endogenous factor of LC and vice-versa. For other control variables in each equation, the results also demonstrate that there is not enough evidence to reject the null hypothesis that the regressor is an exogenous variable. Therefore, our SEM results using 3SLS are consistent.
7. The author's calculation is based on the available data of Vietnamese banks between 2007 and 2015. In addition, Tran *et al.* (2015) also suggested that Vietnamese banks, in the long run, tend to fund their banking activities via the growing core deposits because the implementation of Circular No. 21/2012/TT-NHNN further restricts banks from the use of interbank loans.
8. We also use returns on average total assets (ROAA) to control for bank profitability. The findings show that the coefficient of ROAA is positive but statistically not significant.
9. The Bank for International Settlements (2010) identified the pre-crisis period as from 2003 to June 2007 and the acute crisis period as from July 2007 to March 2009. Since only yearly data are

available, we consider years 2008–2009 as the crisis period in Vietnam. This crisis period is also considered in several studies such as Fu *et al.* (2015).

10. We also use returns on average total assets (ROAA) to control for bank profitability. The coefficient of ROAA is positive but statistically not significant.
11. Under the charter value hypothesis, greater profitable and efficient banks encourage their managers to hold extra capital from earnings to protect against the possibility of liquidation (Berger and Bonaccorsi di Patti, 2006).
12. According to Article 14 under Decision No. 16/2007/QD-NHNN, all financial institutions must announce their annual financial statements which must be audited by independent accounting companies.
13. The correlations of other control variables in both equations are also reported. Table IV shows that the highest correlation is between LNTA and MP. However, LNTA does not necessarily distort the sign of MP when both variables are considered in Equation (3) when running the 3SLS estimation as presented in Table V.
14. We also use HHI to control for the degree of bank competition. The coefficient of HHI is positive but not statistically significant. Nonetheless, this confirms our main findings. The results are not presented due to space constraints but are available upon request.
15. We thank an anonymous referee for this suggestion.
16. More lags of these variables are not introduced in the regressions because they are weak instruments.

References

Acharya, V.V., Mehran, H. and Thakor, A.V. (2016), "Caught between Scylla and Charybdis? Regulating bank leverage when there is rent seeking and risk shifting", *Review of Corporate Finance Studies*, Vol. 5 No. 1, pp. 36-75.

Ahmad, R., Ariff, M. and Skully, M.J. (2008), "The determinants of bank capital ratios in a developing economy", *Asia-Pacific Financial Markets*, Vol. 15 No. 3, pp. 255-272.

Allen, F. and Carletti, E. (2009), "The roles of banks in financial systems", in Berger, A.N., Molyneux, P. and Wilson, J.O.S. (Eds), *The Oxford Handbook of Banking*, Oxford University Press, Oxford, pp. 1-23.

Allen, F. and Gale, D. (2004), "Financial intermediaries and markets", *Econometrica*, Vol. 72 No. 4, pp. 1023-1061.

Bank for International Settlements (2010), "80th Annual Report", Bank for International Settlements, Basel.

Bank for International Settlements (2011), *International Regulatory Framework for Banks (Basel Iii)*, Bank for International Settlements, Basel.

Belsley, D.A. (1988), "Two- or three-stage least squares?", *Computer Science in Economics and Management*, Vol. 1 No. 1, pp. 21-30.

Berger, A.N. and Bonaccorsi di Patti, E. (2006), "Capital structure and firm performance: a new approach to testing agency theory and an application to the banking industry", *Journal of Banking & Finance*, Vol. 30 No. 4, pp. 1065-1102.

Berger, A.N. and Bouwman, C.H. (2009), "Bank liquidity creation", *Review of Financial Studies*, Vol. 22 No. 9, pp. 3779-3837.

Berger, A.N. and Hannan, T.H. (1989), "The price-concentration relationship in banking", *The Review of Economics and Statistics*, Vol. 71 No. 2, pp. 291-299.

Berger, A.N., Bouwman, C.H., Kick, T. and Schaeck, K. (2016), "Bank liquidity creation following regulatory interventions and capital support", *Journal of Financial Intermediation*, Vol. 26, pp. 115-141.

Bhattacharya, S. and Thakor, A.V. (1993), "Contemporary banking theory", *Journal of Financial Intermediation*, Vol. 3 No. 1, pp. 2-50.

Demirgüç-Kunt, A., Laeven, L. and Levine, R. (2004), "Regulations, market structure, institutions, and the cost of financial intermediation", *Journal of Money, Credit and Banking*, Vol. 36 No. 3, pp. 593-622.

Diamond, D.W. and Dybvig, P.H. (1983), "Bank runs, deposit insurance, and liquidity", *Journal of Political Economy*, Vol. 91 No. 3, pp. 401-419.

Diamond, D.W. and Rajan, R.G. (2000), "A theory of bank capital", *The Journal of Finance*, Vol. 55 No. 6, pp. 2431-2465.

Diamond, D.W. and Rajan, R.G. (2001), "Liquidity risk, liquidity creation, and financial fragility: a theory of banking", *Journal of Political Economy*, Vol. 109 No. 2, pp. 287-327.

Distinguin, I., Roulet, C. and Tarazi, A. (2013), "Bank regulatory capital and liquidity: evidence from US and European publicly traded banks", *Journal of Banking & Finance*, Vol. 37 No. 9, pp. 3295-3317.

Fu, X.M., Lin, Y.R. and Molyneux, P. (2015), "Bank capital and liquidity creation in Asia Pacific", *Economic Inquiry*, Vol. 54 No. 2, pp. 966-993.

Fungáčová, Z., Weill, L. and Zhou, M. (2017), "Bank capital, liquidity creation and deposit insurance", *Journal of Financial Services Research*, Vol. 51 No. 1, pp. 97-123.

Gorton, G.B. and Winton, A. (2000), "Liquidity provision, bank capital, and the macroeconomy", working paper, University of Minnesota, MN.

Hackethal, A., Rauch, C., Steffen, S. and Tyrell, M. (2010), "Determinants of bank liquidity creation", working paper, Goethe University Frankfurt, Frankfurt.

Holmstrom, B. and Tirole, J. (1998), "Private and public supply of liquidity", *Journal of Political Economy*, Vol. 106 No. 1, pp. 1-40.

Horváth, R., Seidler, J. and Weill, L. (2014), "Bank capital and liquidity creation: granger-causality evidence", *Journal of Financial Services Research*, Vol. 45 No. 3, pp. 341-361.

Kashyap, A.K., Rajan, R. and Stein, J.C. (2002), "Banks as liquidity providers: an explanation for the coexistence of lending and deposit-taking", *The Journal of Finance*, Vol. 57 No. 1, pp. 33-73.

Keeley, M.C. (1990), "Deposit insurance, risk, and market power in banking", *The American Economic Review*, Vol. 80 No. 5, pp. 1183-1200.

Le, T.D. (2016), "Bank risk, capitalisation and technical efficiency in Vietnamese banking", paper presented at 2016 Symposium in Banking and Finance, Hanoi.

Le, T.D. (2017), "The interrelationship between net interest margin and non-interest income: evidence from Vietnam", *International Journal of Managerial Finance*, Vol. 13 No. 5, pp. 521-540.

Matz, L. and Neu, P. (2007), *Liquidity Risk Measurement and Management: A Practitioner's Guide to Global Best Practices*, John Wiley & Sons, Singapore.

Morgan, P. and Pontines, V. (2013), "An Asian perspective on global financial reforms", ADBI Working Paper No. 433, Asian Development Bank Institute, Tokyo.

Petersen, M.A. and Rajan, R.G. (1995), "The effect of credit market competition on lending relationships", *The Quarterly Journal of Economics*, Vol. 110 No. 2, pp. 407-443.

Pilloff, S.J. and Santomero, A.M. (1998), "The value effects of bank mergers and acquisitions", in Amihud, Y. and Miller, G. (Eds), *Bank Mergers & Acquisitions*, Springer, Boston, MA, pp. 59-78.

Poghosyan, T. (2013), "Financial intermediation costs in low income countries: the role of regulatory, institutional, and macroeconomic factors", *Economic Systems*, Vol. 37 No. 1, pp. 92-110.

Repullo, R. (2004), "Capital requirements, market power, and risk-taking in banking", *Journal of Financial Intermediation*, Vol. 13 No. 2, pp. 156-182.

SBV (2007), "Decision of the governor of the State Bank of Vietnam on financial reporting standards for credit institutions", Ministry of Justice, Hanoi.

SBV (2008), "Decision No. 12/2008/QD-NHNN: regulation on discount and rediscount of valuable papers", the State Bank of Vietnam, Hanoi.

Stewart, C., Matousek, R. and Nguyen, T.N. (2016), "Efficiency in the Vietnamese banking system: a DEA double bootstrap approach", *Research in International Business and Finance*, Vol. 36, pp. 96-111.

Tran, B.T., Ong, B. and Weldon, S. (2015), "Vietnam banking industry report", Duxton Asset Management, Singapore.

Umar, M. and Sun, G. (2016), "Non-performing loans (NPLs), liquidity creation, and moral hazard: case of Chinese banks", *China Finance and Economic Review*, Vol. 4 No. 1, pp. 1-23.

Vietcombank Securities Company (2011), "Banking sector report", Vietcombank Securities Company, Hanoi.

Viverita (2014), "Cost efficiency and market power: a test of quiet life and related hypotheses in Indonesian banking industry", in Emrouznejad, A. and Cabanda, E. (Eds), *Managing Service Productivity: Using Frontier Efficiency Methodologies and Multicriteria Decision Making for Improving Service Performance*, Springer, Berlin and Heidelberg, pp. 167-190.

Wong, J. (2012), "Bank funding–the change in composition and pricing", *Reserve Bank of New Zealand: Bulletin*, Vol. 75 No. 2, pp. 15-24.

World Bank (2016), *World Development Indicators: GDP Growth (Annual %)*, World Bank, Washington, DC.

Corresponding author
Tu Le can be contacted at: tu.le@canberra.edu.au