Iranian Economic Review, 30(2), 449-479
DOI: https://doi.org/10.22059/ier.2024.373454.1007957

RESEARCH PAPER

The Interrelationships between Bank Leverage, Bank Stability, Credit Risk, and Liquidity Risk: Evidence from Asian-5 Countries

Handy Octavianus[a], **Isfenti Sadalia**[a,*], **Beby Kendida Hasibuan**[a], **Tona Aurora Lubis**[b], and **Yasmin Chairunisa Muchtar**[a]

a. Vocational Faculty, Universitas Sumatera Utara, Indonesia.
b. Department of Economics, Universitas Jambi, Jambi, Indonesia.
* Corresponding author.

Received: 03 March 2024, Revised: 25 May 2024, Accepted: 12 June 2024, Published: 30 June 2026
Publisher: The University of Tehran Press.

Abstract

This study investigates the interrelationships among bank leverage, bank stability, credit risk, and liquidity risk in 93 ASEAN-5 banks between 2010 and 2019, with 930 firm-year observations. The generalized method of moments (GMM) estimator is employed to examine the linkages between bank leverage, bank stability, credit risk, and liquidity risk. The test results show a negative reciprocal relationship between bank leverage and stability. Also, the findings show a negative reciprocal relationship between credit risk and bank leverage. Furthermore, an increase in asset liquidity concentration tends to increase the use of leverage and vice versa. The findings of this study confirm that bank capital decisions have implications for critical concepts in banking, i.e., bank stability, credit risk, and liquidity risk. Additionally, this study proposes a new measurement for determining liquidity concentration. The research will be valuable to banking management and regulators in identifying the interrelationships between essential banking concepts to create soundness in the banking environment.

Keywords: assets, capital, disbursement, finance, monetary.
JEL Classification: G21, G32.

Introduction

Banking is prominent in the economy. Failure in the banking sector will inevitably have a contagious effect on other sectors. Consequently, banks need to maintain their stability (Dang and Dang, 2021; Le and Pham, 2021). In both theoretical and empirical views, bank stability strongly affects the nature of banks' use of high leverage as a source of profit creation (Bleck, 2018). Banking is all about leverage (Ingves, 2014); all bank activities as financial intermediaries rely heavily on leverage. As a result, banks are naturally financially vulnerable (Ramlall, 2018;

Widarjono et al., 2022). Since the seminal study proposed by Modigliani and Miller (1958), various studies on optimal capital structure have been proposed, i.e., Baker and Wurgler (2002); Jensen and Meckling (1976); Kraus and Litzenberger (1973); Myers and Majluf (1984), but there is no consensus on the optimal capital structure for the firm. In particular, there are difficulties in applying capital structure theories to the banking sector (Miller, 1995). Moreover, Diamond and Rajan (2000) argue in "A Theory of Bank Capital" that banks do not suffer asymmetric information costs when increasing their leverage. Thus, the optimal capital structure for banks is a trade-off between liquidity, financial distress costs, and credit risk.

In performing its role as a financial intermediary, the bank always inherits at least two major financial risks, i.e., the risk of failure to return credit in time (credit risk) and the risk of bank failure to repay its liabilities (liquidity risk) (Dao and Kang, 2022; Ghenimi et al., 2017; Imbierowicz and Rauch, 2014). The effects posed by these risks will set the bank in a fragile condition and ultimately disrupt the bank's soundness (Sahyouni et al., 2021). The global financial crisis in 2008 pushed banking practitioners, regulators, and even academics to become aware of the importance of liquidity and stability for banks. Systematic risk becomes uncontrollable when banks cannot meet obligations to depositors while banks are in an illiquid state due to increased defaulting loans (Ananou et al., 2021; Golitsis et al., 2022; Obadire et al., 2022). Thus, financial intermediaries must ensure that the adequacy of funds for future needs can be met at a reasonable cost (Carsamer et al., 2021). Theoretically, the impact of asset liquidity conditions on bank stability and performance is still a debate. Low asset liquidity will drive insolvency risk problems (Berger and Bouwman, 2009), whereas at too high asset liquidity levels, paradoxically increase bank instability through the cost inefficiency in holding liquidity (Wagner, 2007). Furthermore, Acharya and Naqvi (2012) argue that when banks experience a flush of liquidity, moral hazard tends to increase, and lending rates decrease. Consequently, asset price bubbles and seeds of crisis are thus sown.

Loans are considered illiquid assets; an increase in loans tends to increase credit risk (Wagner, 2007). Consequently, the bank will sell the loans in the market instead of at their economic value, which will undoubtedly lead to a decrease in the bank's stability (Acharya et al., 2017; Acharya and Mora, 2015). During economic downturns, bank liquidity plays an essential role in triggering stability. However, too much liquidity in normal economic conditions is likely to trigger instability in banks through increased costs incurred due to holding high liquidity

(Almeshari et al., 2023; Durand and Le Quang, 2021; Kahn and Wagner, 2021; Wagner, 2007).

Discussions about the interrelationships of key concepts in the banking industry are always fascinating and contradictory. Researchers agree that bank stability is determined by the bank's ability to create profits, the strength of capital (equity), and the volatility of bank returns (Ali and Puah, 2019; Wang and Lin, 2021; Wang and Luo, 2022). While we acknowledge that using high leverage increases bank risk, we also realize that increasing leverage increases loans as a source of profit creation for banks (Ramlall, 2018). On the other hand, an excessive increase in profit can be an early indicator of financial distress due to an increase in loans, which also means an increase in credit risk. Pessarossi et al. (2020) demonstrated in their research that increasing profits decrease bank stability in lags 3–4. Moreover, according to some opinions, the increase in bank capital diminishes banks' ability to generate liquidity (Le and Pham, 2021). The financial fragility-crowding out hypothesis posits a negative relationship between bank capital and liquidity creation under this circumstance (Diamond and Rajan, 2000; Gorton and Winton, 2002). On the contrary, some researchers argue that increasing bank capital increases the bank's ability to create liquidity. This view is consistent with the risk absorption hypothesis, which states that an increase in bank capital positively impacts the creation of liquidity (Allen and Gale, 2004).

Consistent with the theoretical view, empirical tests also show contradictions in the relationship between these concepts. Previous research has shown that increased bank stability allows banks to use higher leverage levels (Hoque and Pour, 2018; Shahchera, 2013). These findings confirm that banks tend to follow the trade-off theory (Kraus and Litzenberger, 1973). In contrast, Gropp and Heider (2009) and Umar and Sun (2016) found that increasing bank stability causes banks to be more cautious when increasing leverage. This is part of the bank's efforts to maintain bank stability. Furthermore, in research conducted by Ghosh and Chatterjee (2018), Jouida and Hallara (2015), and Toumi (2019), an increase in credit risk forces banks to use more leverage in order to maintain bank solvency. This finding contradicts research conducted by Abbas et al. (2021), Dahir et al. (2018), Dang and Nguyen (2020), and Ghosh and Chatterjee (2018), that an increase in credit risk drives banks to be more careful about the possibility of additional risks as a result of using high leverage. Interestingly, Etudaiye-Muhtar and Abdul-Baki (2020) and Sarkar et al. (2019) did not find a significant relationship between credit risk and bank leverage. Still about the determinants of bank leverage, Bukair (2019), in his research on banks in developing countries,

shows that an increase in the liquidity of bank assets will increase the use of bank leverage, while Guizani and Ajmi (2021) on the contrary show that an increase in the liquidity of bank assets reduces the use of bank leverage. Etudaiye-Muhtar and Abdul-Baki (2020) show no significant relationship between bank asset liquidity and bank leverage. Furthermore, Dahir et al. (2018), Ghenimi et al. (2017), and Liu et al. (2020) show that an increase in bank asset liquidity tends to increase bank stability. Conversely, according to Abbas et al. (2021) and Ali and Puah (2019), an increase in bank asset liquidity creates cost inefficiencies and increases moral hazard, undermining bank stability.

There are apparent differences in the relationship between concepts in ASEAN and global banking. Figure 1 illustrates that ASEAN banks, since 2010, have tended to increase their equity in response to the crisis that occurred in 2008–2009 at an average level of 12.1 per cent. Consequently, there has been a significant decrease in the liquidity of bank assets. Credit risk tends to decrease to an average of 2.12 per cent. The response to the increase in equity in banks in the ASEAN region tends to increase bank stability.

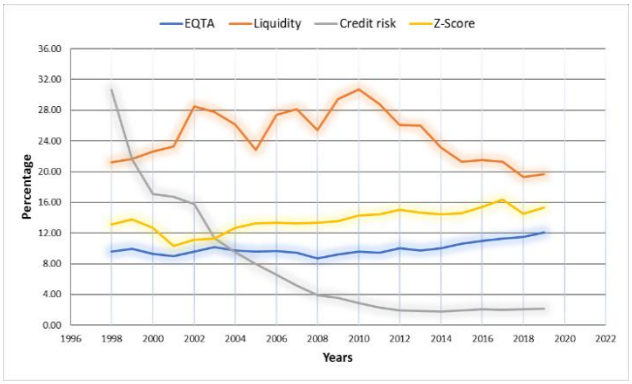

Figure 1. Average equity, liquidity, credit risk and stability of banks in the ASEAN region
Source: Le (2021).

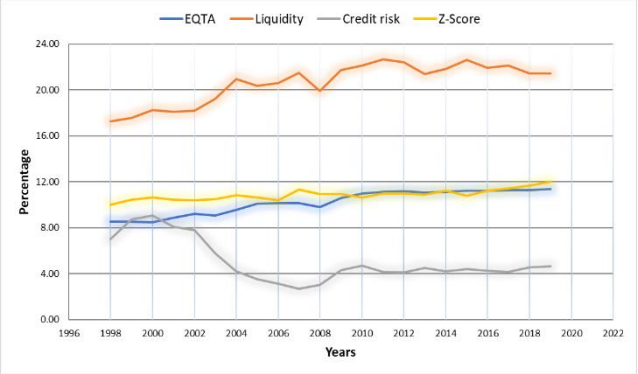

Figure 2. Average equity, liquidity, credit risk and stability of banks in the Global Bank
Source: Le (2021).

Interestingly, the findings of the phenomenon in ASEAN banks are not consistent with global banks. Since implementing BASEL III recommendations, global banks have been compliant enough to increase their equity to an average of 11.39 per cent. However, the increase in equity in global banks has increased the average liquidity of their assets, whereas the credit risk remains constant at 4.62 percent. In line with banks in the ASEAN region, bank stability increases along with equity (Figure 2). This study examines banks in five ASEAN countries (Indonesia, Malaysia, Thailand, Vietnam, and the Philippines) for the following reasons. First, ASEAN is the most dynamic region with rapid economic growth; the average GDP growth of the ASEAN region in 2019 was 5.1 per cent compared to the world average of around 3.6 per cent (Le, 2021). Second, increased capital market liberalization in the ASEAN region has led to substantial and significant market integration, resulting in massive foreign investment flows entering the ASEAN region (Wu, 2020). Third, the market has become more sensitive to global market movements, resulting in tightening banking regulations and policies to maintain the soundness of the banking sector in the ASEAN region (Huyghebaert and Wang, 2010; Nguyen and Le, 2022). Thus it can be concluded that the financial system in the ASEAN region is entirely dependent on banks as the primary source of financing (Ha et al., 2020).

This study's findings contribute to the banking literature in multiple ways. First, the results indicate an inverse relationship between credit risk, liquidity risk, bank stability, and bank leverage in the ASEAN-5 banks. This finding also confirms the theory proposed by Diamond and Rajan (2000), that bank capital decisions are a trade-off between credit risk, liquidity risk, and bank stability.

Second, this study proposes measuring the liquidity of bank assets using the Herfindahl-Hirschman Index (HHI) method in order to determine the effect of concentration on bank liquid assets. The remainder of this paper is structured as follows. Section 2 provides a literature review and hypothesis development. In Section 3, the data, variables, and methodology are introduced. In Section 4, empirical results and discussions are presented. Section 5 provides a summary and conclusion of the study.

Literature Review

Relationship between Bank Stability and Bank Leverage

According to "A Theory of Bank Capital" (Diamond and Rajan, 2000), the use of bank capital is determined by three main indicators: credit risk, liquidity risk, and bank stability. This theory contends that the optimal capital structure for banks is a trade-off between the return on loans granted to customers (credit risk) and the ability to return customer funds (liquidity risk). From the perspective of this theory, an increase in bank stability does not necessitate an increase in the bank's debt proportion (leverage). The bank must pay additional attention to liquidity and credit risk conditions. However, according to the trade-off theory proposed by Kraus and Litzenberger (1973), banks will continue to increase leverage until the marginal limit of the equilibrium between the benefits of using leverage and the costs incurred as a result of the use of leverage. If this theory is used to explain the relationship between bank stability and bank leverage, then an increase in bank stability should lead to a rise in bank leverage. In contrast, the pecking order theory (Myers and Majluf, 1984) suggests that banks with high stability should tend to reduce leverage to maintain their stability's sustainability.

Empirically, Gropp and Heider (2009), in their research on banks in the United States and Europe, show that increased stability reduces the use of bank leverage as a consequence of increased capitalization. Umar and Sun (2016) researched banks in BRICS countries in the observation years 2007–2014 and found that increasing bank stability tends to reduce bank leverage to maintain bank conditions from increased insolvency risks. However, in banks in developed countries or large banks that already have efficiency in risk management, increased stability tends to increase the use of leverage. In contrast, Hoque and Pour (2018), in their research on large global banks between 1998–2016 from 57 countries around the world, found that an increase in risk which means a decrease in stability, tends to reduce the use of bank leverage. Shahchera (2013) researched banks in Iran between 2009–2019, showing that banks with good stability will be more

accessible and flexible in managing high leverage. Furthermore, Dang and Nguyen (2020) researched 30 banks in Vietnam from 2007–2018, finding that banks with a high level of stability are more responsive to increasing leverage. Meanwhile, Haq et al. (2018) researched 1701 banks from 79 countries from 2000–2013, finding that increasing stability through reducing risk increases the use of leverage as a result of improving the bank's culture. Toumi (2019) researched 98 banks in MENA countries over the period 2006–2014, finding that increasing bank stability provides an opportunity for banks to increase leverage usage.

The ASEAN region is the basis for investment in developed nations and is highly susceptible to economic turmoil (Le, 2021). Failure in the banking sector in the ASEAN region would have enormous repercussions for global monetary instability; therefore, banks in the ASEAN region maintain capital adequacy rather than utilizing excessive leverage. Therefore, the increase in the stability of ASEAN banks indicates that leverage should be reduced to sustain the stability. Increased bank stability indicates the bank's capacity to generate enduring profits and preserve capital reserves. Thus, this study proposes the hypothesis that increased bank stability in the ASEAN region tends to encourage banks to maintain stability more carefully by reducing leverage.

Relationship between Credit Risk and Bank Leverage

Credit risk is one of the impacts that must be considered when a bank wants to determine its leverage decision (Diamond and Rajan, 2000). An increase in credit risk will put the bank at low liquidity (Dang and Nguyen, 2020; Shahchera, 2013), thus implicating the bank's stability (Ayadi et al., 2019). A decrease in bank stability characterized by an increase in insolvency risk will encourage banks to reduce their leverage levels (Ghosh and Chatterjee, 2018).

Some studies, such as those conducted by Ghosh and Chatterjee (2018) on banking in India between 1992 and 2012, found that credit risk negatively affects bank leverage. This indicates that a rise in credit risk will reduce banks' use of leverage. In addition, Dang and Nguyen (2020) researched banking in Vietnam between 2007 and 2018 and discovered that an increase in credit risk led to a significant reduction in leverage. In contrast, Kim Quoc Trung (2022), in his research on banking in Vietnam 2010-2020, found that increasing bank leverage tends to reduce credit risk. This result is consistent with the findings of Guizani and Ajmi (2021), who examined 54 banks in Malaysia from 2010 to 2018 and found that, in both conventional and Islamic banks, an increase in credit risk leads to a decrease in bank leverage. Jouida and Hallara (2015) found that a rise in credit

risk in 172 French banks during the observation period 2002-2012 compelled them to increase their equity and decrease their leverage usage. In contrast, Ghosh (2018) showed the positive effect of credit risk on bank leverage in his study of banks in 12 MENA countries during the observation period 2000-2012. Nonetheless, if there is regulatory pressure, MENA banks will reduce leverage and increase equity. This finding is consistent with research conducted by Toumi (2019), who also examined conventional and Islamic banking in MENA countries, indicating that an increase in credit risk prompts the use of higher leverage to counteract the possibility of an increase in insolvency risk. Etudaiye-Muhtar and Abdul-Baki (2020) tested 79 banks from 24 countries between 2000 and 2016 and found no correlation between credit risk and capital conditions. This study shows that an increase in credit risk in banks with less competitive markets does not necessitate extra capital. According to research conducted by Sarkar et al. (2019) on banking in India during the observation period of 2008-2016, an increase in credit risk does not significantly impact the use of bank capital as long as the bank is efficient and effective at cost management.

Given the high investment needs in the ASEAN region, ASEAN banks are typically more at ease utilizing leverage to create liquidity (Wu et al., 2020). However, when credit risk increases, the bank's stability is determined by its equity capital strength. In other words, when credit risk increases, banks in ASEAN will increase their capital reserves and decrease their use of leverage. As a result, this study proposes the hypothesis that an increase in credit risk tends to reduce the use of leverage in ASEAN banks in anticipation of an economic recession caused by massive global investment in the ASEAN region.

Relationship between liquidity risk and bank leverage

Liquidity and capital structure decisions determine bank stability (Ramlall, 2018). Under normal economic conditions, an increase in bank capital (equity) will make banks less effective in creating profits. This is because the cost of equity is higher than the cost of debt (leverage) (Gale and Gottardi, 2020). Therefore, increasing bank capital (decreasing leverage) has implications for reducing the bank's ability to create liquidity (Sahyouni et al., 2021; Umar and Sun, 2016). However, Ramlall (2018) argues that the resilience of a bank will be tested when an economic crisis occurs. Capital adequacy and liquidity levels are vital components that determine bank stability and become the paramount resilience of banks in crisis conditions. Banks tend to have low capital due to the characteristics of the bank's business, which is high leverage. The nature and business of banks and the role of banks as

financial intermediaries make banks require a high level of leverage in creating liquidity (Berger and Bouwman, 2009; Ingves, 2014; Umar et al., 2017).

The problem of asset liquidity in banking can be considered from two sides. First, the presence of highly liquid assets in banks indicates inadequate productivity due to increased costs in maintaining liquidity. Furthermore, banks with too high asset liquidity are prone to moral hazard (Acharya and Naqvi, 2012; Acharya, 2011; Wagner, 2007). Second, banks with high asset liquidity tend to be more stable and flexible in managing their leverage. This is possible because banks have low insolvency risk (Toumi, 2019). Empirically, Bukair (2019) showed in his research on 45 banks in the GCC region with the observation period 2009-2011 that an increase in bank asset liquidity triggers an increase in leverage usage. Thus, this study confirmed that banks in the GCC region tend to follow the trade-off theory (Kraus and Litzenberger, 1973). In contrast, Guizani and Ajmi (2021) tested 54 conventional and Islamic banks in Malaysia for the 2010-2018 period. They found that in both conventional and Islamic banks, an increase in asset liquidity tends to reduce the use of leverage. An increase in asset liquidity is seen as an increase in costs that can reduce bank efficiency. Meanwhile, Etudaiye-Muhtar and Abdul-Baki (2020), in their research on 79 banks in the period 2000-2016, found that the increase in bank liquid assets does not affect the character of banks in using leverage. The existence of high asset liquidity in ASEAN banking is a way to maintain insolvency risk problems that may occur due to ASEAN's strategic position as a global investment epicenter. Therefore, this study hypothesizes that ASEAN banks tend to increase leverage when their liquid assets increase as a state of caution against bank default.

Methodology

Data and Period of Study

This study uses panel data from 108 banks in the ASEAN-5 region (Indonesia, Malaysia, Thailand, Vietnam, and the Philippines) for ten years. This study intends to investigate banking conditions under normal economic conditions. Therefore, this study does not account for banking data during the global financial crisis of 2009-2010 and the economic crisis resulting from the COVID-19 pandemic. After applying the sample selection criteria, the statistical testing in this study is conducted using 930 firm-year observations. The financial statements of each bank from 2010 to 2019 provide all the data required to construct the variables. The structure of the panel data sampled for this study is presented in Table 1.

Table 1. The Structure of Panel Data

Country	Number of bank population	Excluded from population	Final sample	Number of observations
Indonesia	30	2	28	280
Malaysia	28	7	21	210
Thailand	20	2	18	180
Vietnam	19	4	15	150
Philippines	11	0	11	110
Total	108	15	93	930

Source: Research finding.

Note: The panel data structure shows a cross-section of 108 data with ten years of observation each (2010-2019). The sample selection criteria include (1) a conventional bank, (2) complete financial statements from 2010-2019, and (3) the bank's financial statements containing the information needed to construct research variables.

Measures of Liquidity Concentration

Almost any policy and decision a bank makes has consequences and an effect on its liquidity. This view was expressed by Berger and Bouwman (2009), who asserted that banks play two roles that ensure their continued existence and significance as economic drivers. The two roles are banks as liquidity creators and banks as a means of transforming risk. Banks provide liquidity through financing illiquid assets using liquid liabilities (Diamond and Dybvig, 1983). Furthermore, banks perform risk transformation by issuing riskless deposits to carry out risky financing (risky loans). Thus, it can be concluded that the level of bank liquidity plays a crucial role in providing funds to the market so that it becomes a trigger for the development of a country's economy (Tang et al., 2021). However, from the bank's side, liquidity also has a role in the sustainability of bank stability both in the short and long term (Berger and Bouwman, 2009). A decrease in the bank's liquidity level will force the bank to increase leverage by increasing deposit rates and vice versa. If the bank's liquidity level is excessive, it must maintain its stability by reducing deposit rates, thereby reducing its leverage. Therefore, banks must consider liquidity necessities in deciding the leverage level. The bank's liquidity need will affect the bank's stability and eventually reciprocally affect the bank's leverage. A liquidity level that is too low will lead to bank instability, but a liquidity level that is too high (flush of liquidity) will also increase bank instability (Acharya and Naqvi, 2012; Myers and Rajan, 1998; Wagner, 2007).

Berger and Bouwman (2009) argue that the ability of banks to create liquidity will be positively correlated with the value of the bank. However, liquidity issues make the bank susceptible to insolvency risk, resulting in a bank run or default conditions. Given the importance of liquidity in banking, various measurements are proposed to measure the level of bank liquidity, such as by Berger and Bouwman (2009), measuring liquidity creation based on a weighted measure according to the level of liquidity of assets. Ghenimi et al. (2020) and Imbierowicz and Rauch (2014) measure liquidity risk through the ratio of liquid asset categories to total assets. Meanwhile, Thornton and Tommaso (2020) measure bank liquidity with the ratio of liquid assets to total assets and deposits. Thus, it is essential to determine the classification of assets according to their liquidity level. Referring to Tang et al. (2021), who classify the condition of the liquidity level of banking assets, this study refers to the classification of asset liquidity as listed in Table 2.

Table 2. Assets Liquidity Classifications

Illiquid Assets	Semi-liquid Assets	Liquid Assets
Fixed assets	Loans to customers	Cash
Intangible assets	Loans to depository institutions	Due from banks
Corporate loans	Other due from banks	Financial instruments
Mortgage loans		Financial assets held to maturity
Loan loss reserves		Financial assets available for sale
Other long-term assets		Derivative financial assets

Source: Tang et al. (2021).

Several liquidity measures for banks are proposed to assess the liquidity of a bank's assets. In general, liquidity measurement uses the ratio of total liquid assets to total bank assets or total bank deposits (Abbas et al., 2021; Meriläinen and Junttila, 2020; Riahi, 2019; Sakouvogui and Shaik, 2020; Thornton and Tommaso, 2020). Meanwhile, Smaoui et al. (2020) measure bank liquidity by measuring the bank funding gap, which is the difference between loans and deposits (loan deposits) to total assets. Hunjra et al. (2020) measure liquidity with the ratio of current assets to current debt. Furthermore, Ghenimi et al. (2020) measure liquidity risk with 1/liquid assets to total assets. Meanwhile, Dang and Nguyen (2020) measure bank liquidity as total cash and deposits at interbank to total assets. ElMassah et al. (2019) determine bank liquidity by determining the ratio between

liquid assets to total short-term customer funds and other short-term funding minus hybrid capital and subordinated debt. Based on the existing liquidity formulations and given the urgency of this concept, this study proposes a concept of measuring bank liquidity by showing the concentrated effect of assets liquidity. This concept is constructed based on commonly used bank liquidity measurements (Abbas et al., 2021; Riahi, 2020; Sakouvogui, 2020; Thornton and Tommaso, 2020), which are written as follows,

$$\text{Bank Liquidity} = \frac{\text{Liquid Assets}}{\text{Total Assets}} \quad (1)$$

Consequently, this study proposes a concentrated effect of bank liquidity by employing the Herfindahl-Hirschman Index (HHI) method, such that Equation 1 can be modified to become Equation 2 below,

$$Liquidity\ Concentration = Z_{HHI} = 1 - \left[\left(\frac{Liquid\ Assets}{Total\ Assets}\right)^2 + \left(\frac{(Illiquid + semi\ likuid)}{Total\ Assets}\right)^2\right] \quad (2)$$

The classification of liquid assets is determined using the categories defined by Tang et al. (2021); (1) cash, (2) due to banks, (3) financial instruments, and (4) derivative financial assets. $\left[\left(\frac{Liquid\ Assets}{Total\ Assets}\right)^2 + \left(\frac{(Illiquid+semi\ likuid)}{Total\ Assets}\right)^2\right]$ will result in a concentration of illiquid assets. When 1 is subtracted from the illiquid assets concentration, the liquid assets concentration effect is obtained (Elsas et al., 2010; Wang and Lin, 2021). If the proportion of a bank's liquid assets is smaller than its illiquid assets, the ZHHI value will range from 0 to 0.5. When the value of ZHHI = 0.5, this condition indicates that the concentration of the bank's liquid assets is equal to its illiquid assets. When ZHHI = 0, it indicates that there are no liquid assets. When ZHHI > 0.5, it indicates that the proportion of the bank's liquid assets is greater than its illiquid assets.

The argument for the importance of the assets liquidity concentration concept is predicated on the notion that regulators should concentrate on a more straightforward measure to describe the circumstance of banks rather than using a variety of complex and confusing measures. A comprehensive measurement that can reveal banks' capital and liquidity conditions is required (Durand and Le Quang, 2021). In addition, since excessively high or low liquidity conditions can lead to bank instability (Acharya and Naqvi, 2012; Myers and Rajan, 1998; Wagner, 2007), banks should define asset liquidity requirements using the proper concepts and metrics.

Definition and Measurement of Variables

This study examines the reciprocal effects between bank leverage (BLEV), bank stability (BSTAB), credit risk (CRISK), and bank asset liquidity concentration (ZHHI). In this study, bank leverage (BLEV) refers to the bank's total liabilities to total assets (Al-Hunnayan, 2020; Haq et al., 2018; Hoque and Pour, 2018). Meanwhile, credit risk is determined based on loan loss provision (LLP) to total loans (Dang and Nguyen, 2020; Defung and Yudaruddin, 2022; Nartey et al., 2019; Toumi, 2019). Bank stability (BSTAB) is proxied by the bank z-score, which shows the bank's position towards bankruptcy conditions. A decrease in the z-score indicates an increased risk of bankruptcy (Bakhouche et al., 2022; Tran et al., 2022; Wang and Lin, 2021; Wang and Luo, 2022; Widarjono et al., 2022). In this context, bank stability is assessed from three parameters; (1) the bank's ability to create profits, (2) the strength of bank equity, and (3) return volatility (Abbas et al., 2021; Gupta and Kashiramka, 2020). Thus, the bank z-score measurement can be written according to the following equation,

$$\text{Bank Stability (z-score)} = \frac{\text{ROA} + \frac{\text{Equity}}{\text{Assets}}}{\text{SDROA}} \tag{3}$$

where ROA is return on equity, SDROA is the standard deviation of ROA, Assets are the bank's total assets, and equity is the bank's total equity. The z-score measurement in this study follows that of Leaven and Levine (2005), Wang and Lin (2021) use the natural logarithm of the z-score for asymmetry reasons. Furthermore, this study proposes a new measurement of bank asset liquidity by measuring the concentration of bank liquid assets (liquidity concentrated). This measurement is expected to contribute to the need for a general system for measuring asset liquidity in the financial sector. As explained earlier, the concentration effect on bank liquid assets is determined using the Herfindahl-Hirschman Index (HHI) method (Equation 2). Table 3 shows the measurement of the variables used in this study.

Table 3. Variable Description and Measurement

Variable	Description	Measurement
Bank leverage (BLEV)	Bank leverage indicates the position of a bank's debts, which generally consist of short-term liabilities (third-party funds/deposits) and long-term liabilities (wholesale funds/bonds) against its total assets (Haq et al., 2018; Hoque and Pour, 2018)	$Bank\ Leverage = 1 - \left(\frac{Ekuitas}{Total\ Aset}\right)$
Bank stability (BSTAB)	Bank stability is an indication that shows the position of a bank against bankruptcy conditions (distance to default). An increase in Z-score indicates a decrease in bankruptcy risk (Abbas and Ali, 2021; Wang and Lin, 2021)	$Bank\ Stability\ (ZScore) = \frac{ROA + \frac{Equity}{Assets}}{SDROA}$
Liquidity concentration (Z_{HHI})	Liquidity concentration measures the concentration of liquid assets compared to illiquid assets regarding fulfilling the bank's short-term liabilities.	$1 - \left[\left(\frac{Liquid\ Assets}{Total\ Assets}\right)^2 + \left(\frac{(Semi + Illiquid)}{Total\ Assets}\right)^2\right]$
Credit risk (CRISK)	Credit risk is the risk of failure to return on loans granted by banks to their customers. This risk is generally proxied by loan loss provision (LLP) to total loans (Dang and Nguyen, 2020; Defung and Yudaruddin, 2022; Toumi, 2019).	$Credit\ Risk = \frac{Loan\ Lost\ Provision}{Total\ loans}$

Source: Research finding.

Model Specification and Econometric Method

This study analyses the relationship between concepts that influence bank capital decisions. The framework of this study is based on the theory proposed by Diamond and Rajan (2000) that the optimal capital structure of banks is a trade-off of credit risk, liquidity risk and bank stability. Thus, to analyze the relationship between these concepts, we propose the following test models:

$$BLEV_{it} = \beta_1 BLEV_{it-1} + \beta_2 BSTAB_{it} + \beta_3 CRISK_{it} + \beta_4 Z_{HHI_{it}} \quad (4)$$

$$BSTAB_{it} = \beta_1 BSTAB_{it-1} + \beta_2 BLEV_{it} + \beta_3 CRISK_{it} + \beta_4 Z_{HHI_{it}} \quad (5)$$

$$CRISK_{it} = \beta_1 CRISK_{it-1} + \beta_2 BLEV_{it} + \beta_3 BSTAB_{it} + \beta_4 Z_{HHI_{it}} \quad (6)$$

$$Z_{HHI_{it}} = \beta_1 Z_{HHI_{it-1}} + \beta_2 BLEV_{it} + \beta_3 BSTAB_{it} + \beta_4 CRISK_{it} \quad (7)$$

where *i* and *t* refer to bank and year, respectively. $BLEV_{it}$ represents bank leverage of bank i at time t. $BSTAB_{it}$, $CRISK_{it}$, $ZHHI_{it}$ represents bank stability, credit risk, and liquidity concentration of bank i at time t respectively.

The econometric model used in this study is the two-step generalized methods of moments (GMM). The consideration of using the GMM estimator is based on several reasons. First, the panel data sample structure used in this study has the characteristics of "large N, small T"; thus, the GMM estimator is appropriate. Secondly, the research model contains explanatory variables, some of which are strictly exogenous and others of which are predetermined (endogenous), meaning they are correlated with past and possibly current errors (Roodman, 2009). Therefore, it will be necessary to address endogeneity by employing the lags of certain variables as instruments (IV-Style). Individual-specific patterns of heteroscedasticity and serial correlation may also be present in the idiosyncratic disturbances. Thirdly, considering the purpose of this study is to examine the interrelationship between the variables BLEV, BSTAB, CRISK, and ZHHI, there is a high likelihood of a correlation with past occurrences (particularly at time t-1). Consequently, the panel data model possesses an autoregressive dynamic that must be taken into account even though the coefficient of the lagged dependent variable is not of direct interest.

Two specification tests determine the consistency of the GMM estimator: The Hansen/Sargan test for over-identifying restrictions and the serial correlation test in the error terms. The Hansen test of over-identification restrictions is utilized to determine whether or not the model is adequately specified by analyzing the overall validity of instruments that should not be correlated with the error term. Failure of the Hansen test to reject the null hypothesis would indicate that the instruments are not correlated with the disturbances and are, therefore, valid. This implies that the model's specification is accurate. In the serial correlation test, the null hypothesis that there is no first-order serial correlation [AR (1)] should be rejected. However, the null hypothesis that there is no second-order serial correlation [AR (2)] in the disturbances should not be rejected (Arellano and Bond, 1991).

Given the issues mentioned above and as outlined by Roodman (2009), it can be deduced that the generalized method of moments (GMM) is an appropriate model because it enables obtaining robust estimators with fewer assumptions. The Arellano-Bover/Blundell-Bond system estimator specifies a system of equations (the original and the transformed) that also permits the addition of additional instruments, thereby enhancing efficiency.

Researchers use an instrumental variable approach to address endogeneity in the model. These variables are correlated with the predictor variables, but not directly related to the dependent variable. Instrumental variable analysis allows researchers to isolate exogenous variation in predictor variables and obtain less biased estimates of their effect on the dependent variable. A technique that can help reduce endogeneity in biased samples is the Heckman correction.

Result and Discussion

Descriptive Statistics

Descriptive statistics for all research variables are presented in Table 4. The sample of this study is banking panel data in the ASEAN-5 region consisting of a total of 930 observations. BLEV ranges from 0.1114 to 0.9594, with an average BLEV of 0.8664, while the standard deviation is 0.0781. BSTAB has a minimum value of 0.4259 and a maximum of 228.6312, while the average BSTAB is 38.8817 with a standard deviation value of 28.4568. The average CRISK for ASEAN-5 banks is 0.0268, with the maximum value reaching 0.2313, while the minimum value is 0.0002 with a standard deviation of 0.0233. Finally, liquidity concentration (ZHHI) shows an average value of 0.4051, with a range of 0.0637 to 0.8798 with a standard deviation of 0.1014. A ZHHI value greater than 0.5 indicates that banks have a more significant portion of liquid than illiquid assets.

Table 4. Descriptive Statistics

	Mean	Median	Maximum	Minimum	Std. Dev.
BLEV	0.8664	0.8836	0.9594	0.1114	0.0781
BSTAB	38.8817	33.5752	228.6312	0.4259	28.4568
CRISK	0.0268	0.0206	0.2313	0.0002	0.0233
ZHHI	0.4051	0.4077	0.8798	0.0637	0.1014

Source: Research finding.

Table 5 shows the correlation matrix of the variables used in the study. The test results show that there is no high correlation between variables. In general, the correlation coefficient between variables is below 0.5. The highest correlation is the relationship between BSTAB and BLEV, which is -0.315. Thus, it can be concluded that there is no multicollinearity problem in the test model.

Table 5. Correlation Matrix

	BLEV	BSTAB	CRISK	ZHHI
BLEV	1.000			
BSTAB	-0.315	1.000		
CRISK	0.009	0.044	1.000	
ZHHI	-0.204	0.096	0.122	1.000

Source: Research finding.

Baseline Regression

The regression test results for the full sample of banks in the ASEAN-5 region are presented in Table 6. This study investigates the reciprocal relationship between bank leverage (BLEV), bank stability (BSTAB), credit risk (CRISK), and liquidity concentration (ZHHI). The generalized method of moments (GMM) estimator is utilized as a regression instrument. The results of the J-statistic test indicate that all models do not reject the null hypothesis; thus, over-identifying restrictions are valid, and model specifications are accurate (Arellano and Bond, 1991). Moreover, testing the AR(2) second-order serial correlation reveals that the ρ-value is insignificant at 0.05; consequently, all models are devoid of serial autocorrelation issues.

Table 6. Base Model Results (All samples ASEAN-5)

Variable	BLEV (1)	BSTAB (2)	CRISK (3)	ZHHI (4)
Lag(-1)	0.2474***	0.0884***	0.4374***	0.5859***
BLEV		-1.9690***	-3.6707***	0.7658**
BSTAB	-0.2362***		-0.3343***	0.0413
CRISK	-0.0467***	0.0124***		0.0825***
ZHHI	0.0536***	-0.1974	-0.2046*	
J-statistic	46.7172	44.2463	45.4722	34.0536
Prob. (J-statistic)	0.0890	0.1360	0.1107	0.3690
AR(1)	0.4027	0.1126	0.0046	0.0005
AR(2)	0.9648	0.9463	0.8798	0.5975

Source: Research finding.

Note: ***, **, *, show significance at 1%, 5% and 10% respectively. The abbreviations are BLEV (bank leverage), BSTAB (bank stability), CRISK (credit risk), ZHHI (liquidity concentration).

In addition, all lag(-1) variables demonstrate significance at the 1% level, attesting to the dynamic characteristics of the model specification. Finally, the

selection of dynamic model specifications has been validated. The test results can therefore be further interpreted.

The test results in Table 6 are the primary tests in this study which consist of four models. In model (1), it can be seen that the coefficient of BSTAB has a negative and significant effect on BLEV. Interestingly, in model (2), BLEV has a negative and significant effect on BSTAB. This finding suggests that there is a reciprocal relationship between BSTAB and BLEV. An increase in stability tends to reduce the use of bank leverage, and conversely, an increase in bank leverage leads to a decrease in bank stability. Increased stability for banks in ASEAN signals that leverage should be lowered to maintain stability. Increased bank stability indicates that it can create sustainable profits and maintain its capital reserves. The results of this test are consistent and confirm the results of research conducted by Abbas and Ali (2021); Ayadi et al. (2019); Githaiga (2022); Haq et al. (2018); Umar and Sun (2016). Furthermore, the test results in model (1) show that CRISK has a negative and significant effect on BLEV, whereas, in model (3), BLEV also harms CRISK. This finding confirms a negative reciprocal relationship between CRISK and BLEV. The increase in credit risk in ASEAN-5 banks makes banks more cautious in increasing leverage due to the primacy of banks as significant capital and investment. ASEAN-5 banks realize that increasing leverage will increase loan growth. Loan growth tends to increase credit risk if there is no effective credit management system. The results of this test are in line with research conducted by Dang and Nguyen (2020); Ghosh and Chatterjee (2018); Guizani and Ajmi (2021); Hsieh et al. (2013).

ZHHI has a positive and significant effect on BLEV (model 1), while BLEV also has a positive and significant effect on ZHHI (model 4). This finding indicates that ZHHI and BLEV have a positive reciprocal relationship. There is a tradeoff between maximum lending and the cost of bankruptcy. When banks can overcome these costs, they tend to increase leverage. Furthermore, the ASEAN-5 banks maintain their liquidity by increasing leverage. Moreover, the enormous funding requirements in ASEAN compel ASEAN-5 banks to increase leverage. The findings of this test are in line with the findings of Al-Harbi (2017); Bukair (2019); Mazioud Chaabouni et al. (2018). In addition, testing in models (2) and (4) demonstrates that ZHHI has no significant effect on BSTAB and vice versa. BSTAB has no significant effect on ZHHI. In other words, ZHHI and BSTAB have no significant reciprocal relationship. This test's results are consistent with Grover and Sinha (2021).

Model (2) shows that CRISK has a positive and statistically significant effect on BSTAB, whereas Model (3) indicates that BSTAB has a negative and statistically significant effect on CRISK. Increased credit risk in the context of "high risk, high return" enhances the profitability of banks in ASEAN. Strong capital resiliency is the primary reason an increase in credit risk in ASEAN banks does not harm bank stability. In contrast, an increase in bank stability lowers credit risk. Credit risk reduction is made possible by the increased stability of ASEAN banks. This argument is supported by the results of research conducted by Kharabsheh and Gharaibeh (2022). In addition, Model (3) test results indicate that ZHHI has a negative but insignificant effect on CRISK at 5%. This result is consistent with research conducted by Ghenimi et al. (2017) on banking in MENA countries, which also found no significant correlation between liquidity risk and credit risk. In contrast, CRISK has a positive and statistically significant effect on ZHHI in model 4. This finding is fascinating: an increase in credit risk increases banks in the ASEAN region's liquidity concentration. The logical explanation for this result is that when credit risk increases in ASEAN banks, banks tend to increase asset liquidity to maintain insolvency risk (Abbas et al., 2021; Yang et al., 2020).

Further Investigations

This study continues to test the concepts of bank leverage, bank stability, credit risk, and liquidity concentration for each country in the ASEAN-5 region (Indonesia, Malaysia, Thailand, Vietnam, and the Philippines) to gain a more comprehensive understanding of the results of the baseline regression test. Table 7 shows the results of testing BSTAB, CRISK, and ZHHI against BLEV. There is no difference for all banks in the tested countries that BSTAB has a negative and significant effect on BLEV. Conversely, in Table 8, testing BLEV against BSTAB also shows a negative and significant effect. This finding is in line with the test conducted by Le et al. (2022), Chandramohan et al. (2022), and Githaiga (2022) on Indian banks, which showed that an increase in equity which means a decrease in leverage level, tends to increase bank stability. Thus, this finding confirms the reciprocal relationship between BSTAB and BLEV shown in the previous baseline regression.

Table 7. Country Level - Bank Leverage

Dependent Variable: BLEV	Indonesia	Malaysia	Thailand	Vietnam	Philippines
BLEV(-1)	0.0795***	0.0570***	0.2582***	0.2910***	-0.0415**
BSTAB	-0.1344***	-0.3364***	-0.3828***	-0.1095***	-0.1693***
CRISK	-0.0356***	-0.0185***	-0.0145***	-0.0198***	0.0094**
ZHHI	-0.0006	-0.2390***	0.0210***	0.0070	0.0013
J-statistic	23.6143	21.5310	17.0661	12.3842	8.4493
Prob. (J-statistic)	0.4838	0.2535	0.2527	0.2602	0.2946
AR(1)	0.1224	0.3216	0.3467	0.1723	0.0230
AR(2)	0.8910	0.2230	0.5345	0.1141	0.5469

Source: Research finding.

Note: ***, **, *, show significance at 1%, 5% and 10% respectively. The abbreviations are BLEV (bank leverage), BSTAB (bank stability), CRISK (credit risk), ZHHI (liquidity concentration).

Furthermore, CRISK negatively and significantly affects BLEV for each country tested. Conversely, the test results in Table 9 show that BLEV also has a negative and significant effect on CRISK for each country except for banks in the Philippines, which show a positive effect. Thus, there is also a reciprocal relationship between CRISK and BLEV with a negative direction. The negative relationship between these two concepts is demonstrated in a study conducted by Dang and Nguyen (2020) on banking in Vietnam. ZHHI in banks in Indonesia, Vietnam, and the Philippines does not show a significant relationship with BLEV, while in Malaysia, ZHHI harms BLEV and has a positive effect in Thailand. Table 10 shows that, on the contrary, the relationship between BLEV and ZHHI shows a different effect. In Indonesia and Malaysia, an increase in BLEV tends to increase the availability of asset liquidity, while in Vietnam, an increase in BLEV decreases asset liquidity. Banks in Thailand have no consequences of increasing leverage on their asset liquidity.

Table 8. Country level - Bank Stability

Dependent Variable: BSTAB	Indonesia	Malaysia	Thailand	Vietnam	Philippines
BSTAB(-1)	0.0424***	0.3612***	0.1204***	0.1298***	0.0557**
BLEV	-3.8485***	-1.9371***	-1.9288***	-6.7743***	-5.7500***
CRISK	-0.0538***	-0.0249**	0.1185***	-0.0338	0.0558***
ZHHI	0.0349***	-0.5192***	-0.1388	-0.3181*	0.0069
J-statistic	22.9929	19.0264	17.5680	11.4213	8.3069
Prob. (J-statistic)	0.5202	0.3902	0.2861	0.3257	0.3063
AR(1)	0.1643	0.1061	0.9999	0.3036	0.0150
AR(2)	0.8173	0.7388	0.9990	0.6238	0.3651

Source: Research finding.

Note: ***, **, *, show significance at 1%, 5% and 10% respectively. The abbreviations are BLEV (bank leverage), BSTAB (bank stability), CRISK (credit risk), ZHHI (liquidity concentration).

Table 8 shows that CRISK has a statistically significant negative effect on BSTAB in Indonesia and Malaysia but a positive and statistically significant effect in Thailand and the Philippines. Meanwhile, CRISK has no significant effect on BSTAB in Vietnam. Table 9 shows that the relationship between BSTAB and CRISK indicates that Indonesian and Malaysian banks have a negative relationship. Consequently, CRISK and BSTAB have a reciprocal relationship with Indonesian and Malaysian banks. This finding is supported by the test results of Chandramohan et al. (2022) and Riahi (2019). Similarly, the banks CRISK and BSTAB in Thailand and the Philippines have a reciprocal relationship. The test results consistently indicate no significant correlation between CRISK and BSTAB in Vietnamese banks. In addition, ZHHI has a positive effect on BSTAB for Indonesian banks but an adverse effect on Malaysian banks. CRISK does not significantly impact BSTAB for Thai, Vietnamese, and Philippine banks. Testing the effect of ZHHI on BSTAB shows varying results in banking in each country. ZHHI has a positive and significant effect on BSTAB in Indonesian banking but negatively in Malaysia. This finding is consistent with the test results conducted by Githaiga (2022) on banks in East African countries. While in banking in Thailand, Vietnam, and the Philippines, there is no significant effect. In contrast, the effect of BSTAB on ZHHI, as shown in Table 10, has a positive and significant effect on banking in Indonesia, Malaysia, and Thailand but has a negative effect on Vietnam and the Philippines. These findings are consistent with various test

results conducted by Abbas et al. (2021); Ali and Puah (2019); Dahir et al. (2018); Liu et al. (2020).

Table 9. Country Level – Credit risk

Dependent Variable: CRISK	Indonesia	Malaysia	Thailand	Vietnam	Philippines
CRISK(-1)	0.4833***	0.2749***	0.3055***	0.4023**	0.5874***
BLEV	-7.9797***	-4.6917***	2.2028***	-3.3345**	13.6953**
BSTAB	-0.7095***	-1.1119***	1.2476***	-0.1818	2.6944**
ZHHI	0.1023***	0.2025*	0.2204***	0.3569	0.3128
J-statistic	24.3415	18.9522	12.6892	10.7079	4.1859
Prob. (J-statistic)	0.4422	0.3948	0.5511	0.3807	0.7581
AR(1)	0.0011	0.9101	0.0095	0.5550	0.0782
AR(2)	0.6238	0.7390	0.5130	0.7325	0.9775

Source: Research finding.

Note: ***, **, *, show significance at 1%, 5% and 10% respectively. The abbreviations are BLEV (bank leverage), BSTAB (bank stability), CRISK (credit risk), ZHHI (liquidity concentration).

Testing the effect of ZHHI on credit risk in banks in Indonesia, Malaysia, and Thailand shows a consistency that an increase in asset liquidity tends to increase credit risk. Meanwhile, banks in Vietnam and the Philippines show no significant influence between the two concepts. Furthermore, Table 10 shows that an increase in CRISK positively affects ZHHI in banks in Indonesia, Malaysia, and Vietnam, while in Thailand and the Philippines, the relationship is not significant.

Table 10. Country level – ZHHI

Dependent Variable: ZHHI	Indonesia	Malaysia	Thailand	Vietnam	Philippines
ZHHI(-1)	0.3544***	0.6051***	0.2020***	0.4774***	0.2910***
BLEV	0.5573***	0.6704***	0.1735	-3.4304***	-0.9060
BSTAB	0.0783***	0.0873***	0.0942**	-0.4474***	-0.3760**
CRISK	0.0827***	0.1459***	0.0828	0.2513***	0.1576
J-statistic	26.64413	16.93439	14.5947	10.79237	6.119065
Prob. (J-statistic)	0.321312	0.52762	0.406409	0.373921	0.525918
AR(1)	0.0196	0.091	0.1041	0.9917	0.0523
AR(2)	0.7967	0.9704	0.0001	0.9277	0.1986

Source: Research finding.

Note: ***, **, *, show significance at 1%, 5% and 10% respectively. The abbreviations are BLEV (bank leverage), BSTAB (bank stability), CRISK (credit risk), ZHHI (liquidity concentration).

Conclusion

This study aims to demonstrate and analyze the relationship between bank leverage, bank stability, credit risk, and liquidity risk in banking. The test results confirm the theoretical view proposed by Diamond and Rajan (2000) that there is a close relationship between bank capital decisions and credit risk, liquidity risk, and bank stability. This study's results indicate a reciprocal relationship between the concept of bank leverage and bank stability. In ASEAN-5 banks, an increase in leverage will put the bank at lower stability and vice versa. When testing banks in each of the ASEAN-5 countries, there is no doubt that the concept of bank leverage and bank stability have a negative reciprocal relationship. Furthermore, an increase in credit risk in ASEAN-5 banks raises concerns about insolvency risks. Thus, ASEAN-5 banks tend to lower their leverage. Interestingly, an increase in leverage in ASEAN-5 banks sets banks at a lower credit risk, signaling that loan management in ASEAN-5 banks has been immensely efficient. An increase in asset liquidity concentration in ASEAN-5 banks tends to place banks at a higher leverage level. This suggests that ASEAN's regional position as a global investment center makes banks in ASEAN more productive in channeling capital. Conversely, an increase in leverage in ASEAN-5 banks gives banks a higher concentration of liquid assets. Thus, banks in ASEAN-5 effectively use leverage as a source of liquidity creation while maintaining insolvency risk issues.

The findings of the tests on banks in each of the ASEAN-5 countries are, in some relationships, consistent with the tests on the whole sample. Nevertheless,

each country's different demographic, political, social, cultural, and regulatory characteristics give different test results. Finally, this study has proven that bank leverage has a reciprocal relationship with bank stability, credit risk, and liquidity risk. Thus, it is a confirmation and contribution to banking theories that bank capital decisions will have a reciprocal effect on all the fundamental concepts that make up the life of a bank. This study has limitations that can be of concern to future researchers. Future researchers could conduct this test on banks in developed countries. Various empirical evidence shows that testing the influence of concepts on banking will have different results according to the characteristics of the country or region where the bank operates. Comparative studies between developed and developing countries will provide a much more comprehensive understanding of this research idea.

Statements and Declarations

- Funding: This work does not receive any funding.
- Conflict of interest: The authors declare that there is no conflict of interest.

References

Abbas, F., & Ali, S. (2021). Dynamics of diversification and banks' risk-taking and stability: Empirical analysis of commercial banks. *Managerial and Decision Economics*. Retrieved from https://doi.org/10.1002/mde.3434.

Abbas, F., Ali, S., & Ahmad, M. (2021). Does economic growth affect the relationship between banks' capital, liquidity and profitability: empirical evidence from emerging economies. *Journal of Economic and Administrative Sciences*, *ahead-of-print*(ahead-of-print). Retrieved from https://doi.org/10.1108/jeas-03-2021-0056.

Acharya, V., & Naqvi, H. (2012). The seeds of a crisis: A theory of bank liquidity and risk taking over the business cycle. *Journal of Financial Economics*, *106*(2), 349-366. Retrieved from https://doi.org/10.1016/j.jfineco.2012.05.014.

Acharya, V. V. (2011). Leverage, Moral Hazard, and Liquidity. *The Journal of Finance*, *LXVI*(1), 99-138. Retrieved from https://doi.org/10.1093/rfs/hhq073.

Acharya, V. V., Afonso, G., & Kovner, A. (2017). How do global banks scramble for liquidity? Evidence from the asset-backed commercial paper freeze of 2007. *Journal of Financial Intermediation*, *30*, 1-34. Retrieved from https://doi.org/10.1016/j.jfi.2016.02.002.

Acharya, V. V., & Mora, N. (2015). A Crisis of Banks as Liquidity Providers. *The Journal of Finance*, *70*(1), 1-43. Retrieved from https://doi.org/10.1111/jofi.12182.

Al-Harbi, A. (2017). Determinants of banks liquidity: evidence from OIC countries. *Journal of Economic and Administrative Sciences*, *33*(2), 164-177. Retrieved from https://doi.org/10.1108/jeas-02-2017-0004.

Al-Hunnayan, S. H. (2020). The capital structure decisions of Islamic banks in the GCC. *Journal of Islamic Accounting and Business Research*, *11*(3), 745-764. Retrieved from https://doi.org/10.1108/jiabr-02-2017-0026.

Ali, M., & Puah, C. H. (2019). The internal determinants of bank profitability and stability. *Management Research Review*, *42*(1), 49-67. Retrieved from https://doi.org/10.1108/mrr-04-2017-0103.

Allen, F., & Gale, D. (2004). Financial Intermediaries and Markets. *Econometrica*, *72*(4), 1023-1061. Retrieved from https://doi.org/10.1111/j.1468-0262.2004.00525.x.

Almeshari, A., Bin Dato Haji Yahya, M. H., Bin Kamarudin, F., & Abd Hamid, S. a. (2023). Liquidity Creation and Economic Growth: Are They Monotonically Related? Evidence from MENA Countries. *Economies*, *11*(1). Retrieved from https://doi.org/10.3390/economies11010024.

Ananou, F., Chronopoulos, D. K., Tarazi, A., & Wilson, J. O. S. (2021). Liquidity regulation and bank lending. *Journal of Corporate Finance*, *69*. Retrieved from https://doi.org/10.1016/j.jcorpfin.2021.101997.

Arellano, M., & Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application toEmployment Equations. *The Review of Economic Studies*, *58*, 277-297. Retrieved from http://www.jstor.org/stable/2297968.

Ayadi, M. A., Ayadi, N., & Trabelsi, S. (2019). Corporate governance, European bank performance and the financial crisis. *Managerial Auditing Journal*, *34*(3), 338-371. Retrieved from https://doi.org/10.1108/maj-11-2017-1704.

Baker, M., & Wurgler, J. (2002). Market Timing and Capital Structure. *The Journal of Finance*, *LVII, 1*.

Bakhouche, A., El Ghak, T., & Alshiab, M. (2022). Does Islamicity matter for the stability of Islamic banks in dual banking systems? *Heliyon*, *8*(4), e09245. Retrieved from https://doi.org/10.1016/j.heliyon.2022.e09245.

Berger, A. N., & Bouwman, C. H. S. (2009). Bank Liquidity Creation. *Review of Financial Studies*, *22*(9), 3779-3837. Retrieved from https://doi.org/10.1093/rfs/hhn104.

Bleck, A. (2018). Regulating bank leverage. *Journal of Financial Economic Policy*, *10*(2), 264-274. Retrieved from https://doi.org/10.1108/jfep-12-2017-0122.

Bukair, A. A. A. (2019). Factors influencing Islamic banks' capital structure in developing economies. *Journal of Islamic Accounting and Business Research*, *10*(1), 2-20. Retrieved from https://doi.org/10.1108/jiabr-02-2014-0008.

Carsamer, E., Abbam, A., & Queku, Y. N. (2021). Bank capital, liquidity and risk in Ghana. *Journal of Financial Regulation and Compliance*, *ahead-of-print* (ahead-of-print). Retrieved from https://doi.org/10.1108/jfrc-12-2020-0117.

Chandramohan, K., Lunawat, C. A. D., & Lunawat, C. A. A. (2022). The impact of diversification on bank stability in India. *Cogent Business & Management*, *9*(1). Retrieved from https://doi.org/10.1080/23311975.2022.2094590.

Dahir, A. M., Mahat, F. B., & Ali, N. A. B. (2018). Funding liquidity risk and bank risk-taking in BRICS countries. *International Journal of Emerging Markets*, *13*(1), 231-248. Retrieved from https://doi.org/10.1108/IJoEM-03-2017-0086.

Dang, V. D., & Dang, V. C. (2021). Liquidity injection, bank lending, and security holdings: The asymmetric effects in Vietnam. *The Journal of Economic Asymmetries*, *24*. Retrieved from https://doi.org/10.1016/j.jeca.2021.e00212.

Dang, V. D., & Nguyen, K. Q. B. (2020). Monetary policy, bank leverage and liquidity. *International Journal of Managerial Finance*, *ahead-of-print* (ahead-of-print). Retrieved from https://doi.org/10.1108/ijmf-06-2020-0284.

Dao, H. T., & Kang, T. (2022). Non-performing loans and the lending channel of shock transmission across countries. *Cogent Business & Management*, *9*(1). Retrieved from https://doi.org/10.1080/23311975.2022.2046239.

Defung, F., & Yudaruddin, R. (2022). Economic freedom on bank stability and risk-taking in emerging economy: Indonesian case study. *Cogent Business & Management*, *9*(1). Retrieved from https://doi.org/10.1080/23311975.2022.2112816.

Diamond, D. W., & Dybvig, P. H. (1983). Bank Runs, Deposit Insurance, and Liquidity. *Journal of Political Economy*, *91*(3), 401-419. Retrieved from http://www.jstor.org/stable/1837095.

Diamond, D. W., & Rajan, R. G. (2000). A Theory of Bank Capital. *The Journal of Finance*, *LV*(6), 2431-2465.

Durand, P., & Le Quang, G. (2021). Banks to basics! Why banking regulation should focus on equity. *European Journal of Operational Research*. Retrieved from https://doi.org/10.1016/j.ejor.2021.10.057.

ElMassah, S., AlSayed, O., & Bacheer, S. M. (2019). Liquidity in the UAE Islamic banks. *Journal of Islamic Accounting and Business Research*, *10*(5), 679-694. Retrieved from https://doi.org/10.1108/jiabr-02-2017-0018.

Elsas, R., Hackethal, A., & Holzhäuser, M. (2010). The anatomy of bank diversification. *Journal of Banking & Finance*, *34*(6), 1274-1287. Retrieved from https://doi.org/10.1016/j.jbankfin.2009.11.024.

Etudaiye-Muhtar, O. F., & Abdul-Baki, Z. (2020). Market structure, institutional quality and bank capital ratios: evidence from developing countries. *European Journal of Management and Business Economics*, *30*(1), 92-107. Retrieved from https://doi.org/10.1108/ejmbe-09-2019-0158.

Gale, D., & Gottardi, P. (2020). A general equilibrium theory of banks' capital structure. *Journal of Economic Theory*, *186*. Retrieved from https://doi.org/10.1016/j.jet.2020.104995.

Ghenimi, A., Chaibi, H., & Omri, M. A. B. (2017). The effects of liquidity risk and credit risk on bank stability: Evidence from the MENA region. *Borsa Istanbul Review*, *17*(4), 238-248. Retrieved from https://doi.org/10.1016/j.bir.2017.05.002.

Ghenimi, A., Chaibi, H., & Omri, M. A. B. (2020). Liquidity risk determinants: Islamic vs conventional banks. *International Journal of Law and Management*, *63*(1), 65-95. Retrieved from https://doi.org/10.1108/ijlma-03-2018-0060.

Ghosh, S. (2018). Capital structure, ownership and crisis: evidence from Middle East and North African banks. *Accounting Research Journal*, *31*(2), 284-300. Retrieved from https://doi.org/10.1108/arj-09-2015-0121.

Ghosh, S., & Chatterjee, G. (2018). Capital structure, ownership and crisis: how different are banks? *Journal of Financial Regulation and Compliance*, *26*(2), 300-330. Retrieved from https://doi.org/10.1108/jfrc-09-2016-0085.

Githaiga, P. N. (2022). Income diversification and bank risk-taking: The moderating role of intellectual capital. *Cogent Business & Management*, *9*(1). Retrieved from https://doi.org/10.1080/23311975.2022.2149142.

Golitsis, P., Khudoykulov, K., & Palanov, S. (2022). Determinants of non-performing loans in North Macedonia. *Cogent Business & Management*, *9*(1). Retrieved from https://doi.org/10.1080/23311975.2022.2140488.

Gorton, G., & Winton, A. (2002). Financial Intermediation. *NBER Working Paper Series*, *8928*(May). Retrieved from http://www.nber.org/papers/w8928.

Gropp, R., & Heider, F. (2009). The Determinants of Bank Capital Structure. *European Central Bank*, *September*.

Grover, N., & Sinha, P. (2021). Determinants, persistence and value implications of liquidity creation: an evidence from Indian banks. *Journal of Asia Business Studies*, *15*(2), 384-400. Retrieved from https://doi.org/10.1108/jabs-06-2019-0192.

Guizani, M., & Ajmi, A. N. (2021). The capital structure decision of Islamic and conventional banks: empirical evidence from Malaysia. *Asia-Pacific Journal of Business Administration*, *ahead-of-print*(ahead-of-print). Retrieved from https://doi.org/10.1108/apjba-06-2020-0218.

Gupta, J., & Kashiramka, S. (2020). Financial stability of banks in India: Does liquidity creation matter? *Pacific-Basin Finance Journal*, *64*. Retrieved from https://doi.org/10.1016/j.pacfin.2020.101439.

Ha, D., Gillet, P., Le, P., & Vo, D.-T. (2020). Banking integration in ASEAN-6: An empirical investigation. *Economic Modelling*, *91*, 705-719. Retrieved from https://doi.org/10.1016/j.econmod.2019.09.017.

Haq, M., Hu, D., Faff, R., & Pathan, S. (2018). New evidence on national culture and bank capital structure. *Pacific-Basin Finance Journal*, *50*, 41-64. Retrieved from https://doi.org/10.1016/j.pacfin.2017.09.005.

Hoque, H., & Pour, E. K. (2018). Bank-level and country-level determinants of bank capital structure and funding sources. *International Journal of Finance & Economics*, *23*(4), 504-532. Retrieved from https://doi.org/10.1002/ijfe.1635.

Hsieh, M.-F., Chen, P.-F., Lee, C.-C., & Yang, S.-J. (2013). How Does Diversification Impact Bank Stability? The Role of Globalization, Regulations, and Governance Environments. *Asia-Pacific Journal of Financial Studies*, *42*(5), 813-844. Retrieved from https://doi.org/10.1111/ajfs.12032.

Hunjra, A. I., Mehmood, A., Nguyen, H. P., & Tayachi, T. (2020). Do firm-specific risks affect bank performance? *International Journal of Emerging Markets*, *ahead-of-print*(ahead-of-print). Retrieved from https://doi.org/10.1108/ijoem-04-2020-0329.

Huyghebaert, N., & Wang, L. (2010). The co-movement of stock markets in East Asia. *China Economic Review*, *21*(1), 98-112. Retrieved from https://doi.org/10.1016/j.chieco.2009.11.001.

Imbierowicz, B., & Rauch, C. (2014). The relationship between liquidity risk and credit risk in banks. *Journal of Banking & Finance*, *40*, 242-256. Retrieved from https://doi.org/10.1016/j.jbankfin.2013.11.030.

Ingves, S. (2014). Banking on Leverage. *10th Asia-Pasific High-Level Meeting on Banking Supervision*.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: managerial behavior, agency costs and ownership structure. *Journal of Financial Economic*, *3*(4), 305-360.

Jouida, S., & Hallara, S. (2015). Capital Structure and Regulatory Capital of French Banks. *Procedia Economics and Finance*, *26*, 892-902. Retrieved from https://doi.org/10.1016/s2212-5671(15)00901-6.

Kahn, C. M., & Wagner, W. (2021). Sources of Liquidity and Liquidity Shortages. *Journal of Financial Intermediation*, *46*. Retrieved from https://doi.org/10.1016/j.jfi.2020.100869.

Kharabsheh, B., & Gharaibeh, O. K. (2022). Determinants of Banks' Stability in Jordan. *Economies*, *10*(12). Retrieved from https://doi.org/10.3390/economies10120311.

Kim Quoc Trung, N. (2022). Does leverage fit non-performing loans in the COVID-19 pandemic – evidence from the Vietnamese banking system. *Cogent Business & Management*, *9*(1). Retrieved from https://doi.org/10.1080/23311975.2022.2119675.

Kraus, A., & Litzenberger, R. H. (1973). A state-preference model of optimal financial leverage. *The Journal of Finance*, *28*, 911-922.

Le, T. D. Q., & Pham, X. T. T. (2021). The inter-relationships among liquidity creation, bank capital and credit risk: evidence from emerging Asia–Pacific economies. *Managerial Finance*, *47*(8), 1149-1167. Retrieved from https://doi.org/10.1108/mf-04-2020-0189.

Le, T. H. (2021). Systemic risk in ASEAN-6: a new empirical investigation. *International Journal of Emerging Markets*, *ahead-of-print*(ahead-of-print). Retrieved from https://doi.org/10.1108/ijoem-05-2020-0567.

Le, T. T., Nguyen, Q. A., Vu, T. M. N., Do, M. P., & Tran, M. D. (2022). Impact of income diversification on the default risk of Vietnamese commercial banks in the context of the COVID-19 pandemic. *Cogent Business & Management*, *9*(1). Retrieved from https://doi.org/10.1080/23311975.2022.2119679.

Leaven, L., & Levine, R. (2005). Is there a diversification discount in financial conglomerates? *NBER Working Paper, 11499*.

Liu, F. H., Norden, L., & Spargoli, F. (2020). Does uniqueness in banking matter? *Journal of Banking & Finance*, *120*. Retrieved from https://doi.org/10.1016/j.jbankfin.2020.105941.

Mazioud Chaabouni, M., Zouaoui, H., & Ellouz, N. Z. (2018). Bank capital and liquidity creation: new evidence from a quantile regression approach. *Managerial Finance*, *44*(12), 1382-1400. Retrieved from https://doi.org/10.1108/mf-11-2017-0478.

Meriläinen, J.-M., & Junttila, J. (2020). The relationship between credit ratings and asset liquidity: Evidence from Western European banks. *Journal of International Money and Finance*, *108*. Retrieved from https://doi.org/10.1016/j.jimonfin.2020.102224.

Miller, M. H. (1995). Do the M & M propositions apply to banks? *Journal of Banking & Finance*, *19*, 483-789.

Modigliani, F., & Miller, M. H. (1958). The cost of capital, corporation finance and the theory of investment. *The American Economic Review*, *48*, 261-280.

Myers, S., & Majluf, N. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economic*, *13*(2), 187-220.

Myers, S. C., & Rajan, R. G. (1998). The Paradox of Liquidity. *The Quarterly Journal of Economics*, *113*(3), 733-771. Retrieved from https://doi.org/10.1162/003355398555739.

Nartey, S. B., Osei, K. A., & Sarpong-Kumankoma, E. (2019). Bank productivity in Africa. *International Journal of Productivity and Performance Management*, *69*(9), 1973-1997. Retrieved from https://doi.org/10.1108/ijppm-09-2018-0328.

Nguyen, D. T., & Le, T. D. Q. (2022). The interrelationships between bank profitability, bank stability and loan growth in Southeast Asia. *Cogent Business & Management*, *9*(1). Retrieved from https://doi.org/10.1080/23311975.2022.2084977.

Obadire, A. M., Moyo, V., & Munzhelele, N. F. (2022). Basel III Capital Regulations and Bank Efficiency: Evidence from Selected African Countries. *International Journal of Financial Studies*, *10*(3). Retrieved from https://doi.org/10.3390/ijfs10030057.

Pessarossi, P., Thevenon, J.-L., & Weill, L. (2020). Does high profitability improve stability for European banks? *Research in International Business and Finance*, *53*. Retrieved from https://doi.org/10.1016/j.ribaf.2020.101220.

Ramlall, I. (2018). Banking Sector and Financial Stability. In *The Banking Sector Under Financial Stability* (13-27). Retrieved from https://doi.org/10.1108/978-1-78769-681-520181002.

Riahi, Y. (2020). Examining the relationship between bank stability and earnings quality in Islamic and conventional banks. *International Journal of Islamic and Middle Eastern Finance and Management*, *13*(5), 803-826. Retrieved from https://doi.org/10.1108/imefm-10-2018-0328.

Riahi, Y. M. (2019). How to explain the liquidity risk by the dynamics of discretionary loan loss provisions and non-performing loans? The impact of the global crisis. *Managerial Finance*, *45*(2), 244-262. Retrieved from https://doi.org/10.1108/mf-12-2017-0520.

Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *The Stata Journal*, *9(1)*, 86-136.

Sahyouni, A., Zaid, M. A. A., & Adib, M. (2021). Bank soundness and liquidity creation. *EuroMed Journal of Business*, *16*(1), 86-107. Retrieved from https://doi.org/10.1108/emjb-04-2019-0061.

Sakouvogui, K. (2020). Impact of liquidity and solvency risk factors on variations in efficiency of US banks. *Managerial Finance*, *46*(7), 883-895. Retrieved from https://doi.org/10.1108/mf-05-2019-0241.

Sakouvogui, K., & Shaik, S. (2020). Impact of financial liquidity and solvency on cost efficiency: evidence from US banking system. *Studies in Economics and Finance*, *37*(2), 391-410. Retrieved from https://doi.org/10.1108/sef-04-2019-0155.

Sarkar, S., Sensarma, R., & Sharma, D. (2019). The relationship between risk, capital and efficiency in Indian banking: Does ownership matter? *Journal of Financial Economic Policy*, *11*(2), 218-231. Retrieved from https://doi.org/10.1108/jfep-05-2018-0074.

Shahchera, M. (2013). The Determinants of Banks' Capital Structure: The Case in Iran. *JOurnal of Money and Economy*, *8*(1), 141-167.

Smaoui, H., Mimouni, K., Miniaoui, H., & Temimi, A. (2020). Funding liquidity risk and banks' risk-taking: Evidence from Islamic and conventional banks. *Pacific-Basin Finance Journal*, *64*. Retrieved from https://doi.org/10.1016/j.pacfin.2020.101436.

Tang, Y., Li, Z., Chen, J., & Deng, C. (2021). Liquidity creation cyclicality, capital regulation and interbank credit: Evidence from Chinese commercial banks. *Pacific-Basin Finance Journal*, *67*. Retrieved from https://doi.org/10.1016/j.pacfin.2021.101523.

Thornton, J., & Tommaso, C. d. (2020). Liquidity and capital in bank lending: Evidence from European banks. *Finance Research Letters*, *34*. Retrieved from https://doi.org/10.1016/j.frl.2019.08.021.

Toumi, K. (2019). Islamic ethics, capital structure and profitability of banks; what makes Islamic banks different? *International Journal of Islamic and Middle Eastern Finance and Management*, *13*(1), 116-134. Retrieved from https://doi.org/10.1108/imefm-05-2016-0061.

Tran, S., Nguyen, D., & Nguyen, L. (2022). Concentration, capital, and bank stability in emerging and developing countries. *Borsa Istanbul Review*. Retrieved from https://doi.org/10.1016/j.bir.2022.08.012.

Umar, M., & Sun, G. (2016). Bank leverage and stock liquidity: evidence from BRICS countries. *Journal of Financial Economic Policy*, *8*(3), 298-315. Retrieved from https://doi.org/10.1108/jfep-07-2015-0040.

Umar, M., Sun, G., & Majeed, M. A. (2017). Bank capital and liquidity creation: evidence of relation from India. *Journal of Asia Business Studies*, *11*(2), 152-166. Retrieved from https://doi.org/10.1108/jabs-12-2015-0208.

Wagner, W. (2007). The liquidity of bank assets and banking stability. *Journal of Banking & Finance*, *31*(1), 121-139. Retrieved from https://doi.org/10.1016/j.jbankfin.2005.07.019.

Wang, C., & Lin, Y. (2021). Income diversification and bank risk in Asia Pacific. *The North American Journal of Economics and Finance*, *57*. Retrieved from https://doi.org/10.1016/j.najef.2021.101448.

Wang, R., & Luo, H. (2022). How does financial inclusion affect bank stability in emerging economies? *Emerging Markets Review*, *51*. Retrieved from https://doi.org/10.1016/j.ememar.2021.100876.

Widarjono, A., Wijayanti, D., Suharto, S., & McMillan, D. (2022). Funding liquidity risk and asset risk of Indonesian Islamic rural banks. *Cogent Economics & Finance*, *10*(1). Retrieved from https://doi.org/10.1080/23322039.2022.2059911.

Wu, F. (2020). Stock market integration in East and Southeast Asia: The role of global factors. *International Review of Financial Analysis*, *67*. Retrieved from https://doi.org/10.1016/j.irfa.2019.101416.

Wu, J., Chen, L., Chen, M., & Jeon, B. N. (2020). Diversification, efficiency and risk of banks: Evidence from emerging economies. *Emerging Markets Review*, *45*. Retrieved from https://doi.org/10.1016/j.ememar.2020.100720.

Yang, H.-F., Liu, C.-L., & Yeutien Chou, R. (2020). Bank diversification and systemic risk. *The Quarterly Review of Economics and Finance*, *77*, 311-326. Retrieved from https://doi.org/10.1016/j.qref.2019.11.003.

Cite this article: Octavianus, H., Sadalia, I., Hasibuan, B. K., Lubis, T. A., & Muchtar, Y. Ch. (2026). The Interrelationships between Bank Leverage, Bank Stability, Credit Risk, and Liquidity Risk: Evidence from Asian-5 Countries. *Iranian Economic Review, 30*(2), 449-479.