How Does Liquidity Risk Interact with Credit Risk? A Comparison Study of Indonesia and Malaysia Banking

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Abstract. This paper examines the effect of the interaction between liquidity and credit risk on bank stability in Indonesia and Malaysia. Annual data are analyzed for 24 Indonesian and 22 Malaysian commercial banks from 2010-2019. The generalized method of moments is used as a statistical analysis tool. The test results show that the increase in assets liquidity puts Indonesian Banks in a better stability condition, while in Malaysian Banks, it is the contrary. The interaction between liquidity and credit risk in Indonesian banks did not have a significant impact, while in banks in Malaysia, the interaction between the two led to a decrease in stability. This paper sheds more light on the relationship between bank risks on stability. This study proposes a different measurement of the level of bank liquidity by applying the effect of bank liquidity concentration which is measured using the Herfindahl Hirschman Index (HHI) method. This research is expected to be useful for banking management to identify the effect of joint occurrence between liquidity risk and credit risk.

Keywords: liquidity risk, credit risk, bank stability, GMM, HHI.

1 Introduction

Failure in the banking sector will significantly impact a country's economy, therefore it is essential to identify the sources of fragility in banks. Banks are particularly vulnerable to two risks, namely credit risk and liquidity risk (Ghenimi et al., 2017). Credit risk is caused by the failure of the loan refund in time, while liquidity risk is caused by suddenly fund withdrawals. These two risks have a strong interrelationship and lead to a decrease in bank stability. The interaction between the two would logically lead to a bank default (Imbierowicz & Rauch, 2014).

The global recession in 2007-2009 was a crisis that occurred due to the failure of banks as liquidity providers. Financial fragility in banks occurs as a result of the failure of banks to maintain their liquidity (Acharya & Mora, 2015; Thornton & Tommaso, 2020). The increase in insolvency risk will force banks to increase deposit interest, and this condition is a reflection of the level of stress experienced by banks. Paradoxically, deteriorating economic conditions will increase bank liquidity. When macroeconomic risks increase, investors tend to slow down the flow of investments in the capital markets and place their funds in banks. This situation resulted in banks experiencing a flush of liquidity and relaxing lending rates. The consequence of this condition is a massive absorption of funds by the community, which results in a bubble price that triggers an increase in credit risk (Acharya & Naqvi, 2012). This

argument is in line with the proposition by Wagner (2007) that an increase in the liquidity of bank assets can trigger an increase in bank instability.

Cheng et al. (2015) state that examining the determinants of bank liquidity has become an essential issue for financial stability and bank management. There are two views on liquidity's effect on banks' stability conditions. First, banks with too high liquidity tend to be less able to create profits. This view is based on the fact that holding liquidity requires high costs (Gafrej & Boujelbéne, 2021; Sahyouni et al., 2021). Furthermore, banks with high liquidity tend to make mistakes in lending (Ariefianto et al., 2021). Second, banks with low liquidity tend to be apt to solvency problems. This view is based on a situation that the bank must be ready when the depositor withdraws his funds at any time. Failure to repay the deposit funds will disrupt the entire bank mechanism (Ghenimi et al., 2020)

Various studies were conducted empirically to determine the correlation and interaction between credit risk and liquidity risk and their effect on bank stability. However, as is common in scientific studies, there are always pros and cons to the relationship between concepts. Some researchers found that increased bank liquidity provided better stability for the bank (Dahir et al., 2018; Ghenimi et al., 2017; Liu et al., 2020), while other researchers argue that an increase in bank liquidity will put banks in a less stable condition as a result of increasing liquidity costs and increasing the moral hazard (Abbas & Ali, 2021; Ali & Puah, 2019; Wagner, 2007). Meanwhile, increasing in credit risk should lead to a decrease in bank stability (Ghenimi et al., 2017; Riahi, 2019), whereas some researchers found that there was no significant influence on the relationship between credit risk on bank stability (Ali & Puah, 2019; Ayadi et al., 2019; Hsieh et al., 2013).

The researchers agree that the impact of liquidity and credit risk on bank stability may vary at the location and period of the study, different economic conditions, and different types of banks (i.e. commercial banks or Islamic banks) (Ozili, 2018; Wang & Lin, 2021). Thus, this study seeks to fill the gaps in the study of banking stability by conducting comparative examinations on banks in Indonesia and Malaysia. Therefore, this research question can be drawn as follows: how does liquidity risk interact with credit risk on bank stability? Are there any differences in banking characteristics in Indonesia and Malaysia?

Indonesia and Malaysia were affected by the Asian financial crisis in 1997. At the time of the crisis, banks in those countries suffered a harsh impact. Banks are experiencing a shortage of liquidity, and deposit rates are rising very high, which results in banks experiencing conditions very close to default. As a lender of last resort, the central bank tried to help the banking conditions at that time, but the crisis persisted. Indonesia, like Malaysia, is a bank-based economy (Ariefianto et al., 2021), is on the identical geography, and has similar demographic conditions, but when the 1997 financial crisis occurred, banks in Malaysia allegedly recovered faster (Asutay & Othman, 2020); hence many vital lessons to be learned from this history. Thus this phenomenon became the basis of this study.

This study indicates that there are distinctions in characteristics between Indonesian banks and Malaysian banks. Liquidity conditions show different impacts on bank stability in each country, and the interaction between liquidity and credit risk affects bank stability differently. The similarity between Indonesian and Malaysian banks lies in the effect of equity resilience equally increasing bank stability. This study uses the generalized method of moments (GMM) as a statistical tool to identify potential endogeneity problems that occur between variables. The results of this study are expected to contribute to the body of knowledge, especially in the banking management literature. In this study, we proposed different measurements to determine bank liquidity by using the Herfindahl-Hirschman Index method to capture the level of liquidity concentration. Furthermore, in section 2, we discuss

the literature review. Section 3 discusses the data and methodology used in this study. Section 4 discusses the results of the test, section 5 is the discussion and finally, section 6 is the conclusion of the study.

2 Literature Review and Hypothesis Development

2.1 The Influence Credit Risk and Liquidity Risk on Bank Stability

Bank provides liquidity to other parties by making itself illiquid. In other words, banks finance illiquid assets using liquid liabilities; thus, at the same time, bank perform as a risk transformer, transforming riskless deposits into risky loans (Berger & Bouwman, 2009). Based on this argument, we can say that loans are a product of illiquid bank assets or also known as a category of high-risk investments. Failure to return a given loan is considered a credit risk (Wagner, 2007).

It is common sense that an increase in credit risk will lead to a decrease in the level of bank stability. Failure to repay credit puts the bank in short of liquidity. Thus, insolvency risk will increase and ultimately reduce the bank's stability(Ghenimi et al., 2017). On the other hand, according to the risk and returns view, it can be understood that an increase in insolvency risk should also increase banks' profitability (Ozili, 2018).

Based on the arguments outlined above, it can be concluded that there is a correlation between credit risk and bank liquidity (Diamond & Rajan, 2005). Furthermore, Diamond & Rajan, 2005 argues the reciprocal relationship between the two main risks of the bank. However, whenever it is connected to the effect on bank stability, it is necessary to distinguish its effect when normal or in crisis economic conditions. Increased liquidity under normal economic conditions may reduce bank stability (Abbas et al., 2021; Wagner, 2007) On the contrary, in times of crisis, bank liquidity is undoubtedly a lifesaver (Acharya & Mora, 2015; Diamond & Rajan, 2005; Imbierowicz & Rauch, 2014; Wang & Lin, 2021).

Imbierowicz and Rauch (2014) studied commercial banking operating in the USA from 1998-2010 and showed that higher liquidity risk and credit risk increase a bank's probability of default. Moreover, the interaction between these risks jointly contributes to bank default risk. Ghenimi et al. (2017) studied 49 banks operating in MENA from 2006-2013. They found that credit risk and liquidity risk did not have a meaningful mutual correlation but had a positive and significant effect on bank stability. Furthermore, the interaction between the two risks increased bank instability. The author argues that the inability of banks to manage credit risk can lead to the bank's failure to provide liquidity. Chettri (2022) studied 24 commercial banks in Nepal from 2013-2018 and found no relationship between credit risk and liquidity risk. However, in line with research conducted by Ghenimi et al. (2017), a decrease in credit risk and liquidity risk increased bank stability in Nepal. Riahi (2020) studied 39 Islamic and 64 commercial banks in six Gulf Cooperation Council countries from 2000-2014 and found that increasing credit risk decreased bank stability, especially in commercial banks. in contrast , Ali and Puah (2019) studied 24 commercial banks in Pakistan from 2007-2015, showing that liquidity risks lowered bank stability. Interestingly, the increase in credit risk did not significantly impact the bank's stability. Ayadi et al. (2019) studied commercial banks in Eurozone countries from 2004-2009, credit risk does not affect bank stability. Still, liquidity conditions convincingly have a positive effect on bank stability.

Based on the discussion in the literature review above, the hypotheses of the relationship between credit risk and liquidity risk to bank stability can be described as follows,

H_1: Liquidity risk have a positive and significant relationship to bank stability

H_2: Credit risk have a negative and significant relationship to bank stability

H_3: Liquidity risk and credit risk jointly contribute to bank stability

3 Data and Method

3.1 Data

This study used data from commercial banking located in Indonesia and Malaysia. There are 39 commercial banks listed on the Indonesia stock exchange and 27 commercial banks listed on the Malaysian stock exchange. The type of data used is secondary data, the unit of analysis used is the financial statements from 2010-2019 obtained from each bank's website. The sample collection method uses purposive sampling with the following sampling criteria (1) is a commercial bank, (2) has complete financial statements for 2010-2019, (3) is not delisted throughout the observation year, (4) has the financial parameters needed in the formation of research variables. Based on these criteria, a research sample of 24 banks in Indonesia and 22 banks in Malaysia with the observation period 2010-2019, so there were a total of 240 and 220 firm years of observation for Indonesia and Malaysia, respectively.

3.2 Definition of Operational and Measurement of Variables

The definition of variables is explained based on relevant concepts and theories to avoid different interpretations. The variables used in this study were bank stability (BSTAB) as a dependent variable. Meanwhile, credit risk (CRISK) and liquidity risk (LIQHHI) are independent variables. Bank capital (EQTA) and loan to deposit ratio (LDR) are the control variables of the study.

Bank Z-score is a proxy of bank stability (BSTAB), indicating the bank's position from the risk of bankruptcy. An increasing z-score indicates an improving level of bank stability. The interpretation of the bank z-score is the bank's ability to create profits, and the bank's capital condition against volatility returns is a characteristic of the bank's level of stability (Abuzayed et al., 2018; Ali et al., 2021; Gupta & Kashiramka, 2020; Imbierowicz & Rauch, 2014; Wang & Lin, 2021). Thus the bank z-score measurement in this study refers to previous studies stated in the following equation.

$$\text{Bank Stability} = \text{zscore} = \frac{\text{ROA} + \frac{\text{Equity}}{\text{Assets}}}{\text{SDROA}} \qquad (1)$$

Where ROA is the bank's return on assets, equity is the bank's total equity, assets are the bank's total assets, and SDROA is the standard deviation of ROA. For asymmetry reasons, this study follows Ghenimi et al. (2017); Leaven and Levine (2005); Wang and Lin (2021) and uses natural logarithms against the z-score.

In this study, we propose a new measurement of bank liquidity by providing a concentration effect on the bank's liquid assets compared to its overall assets. To acquire the effect of concentration, we use the Herfindahl-Hirschman Index (HHI) method by classifying

the categories of liquid assets. The classification of liquid assets of banks follows the opinion of Tang et al. (2021), who performed the category as shown in Table 1 below,

Table 1. Definition of Operational Variables

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

Researchers generally measure bank assets' liquidity level using a general formulation, i.e. the comparison between liquid assets and their total assets (Abbas et al., 2021; Liu et al., 2020; Thornton & Tommaso, 2020). Based on the general formulation, we made modifications with the HHI method so that an equation of bank liquidity concentration can be formed as follows,

$$\text{HHI}_{\text{liquidity}} = 1 - \left[\left(\frac{\text{Liquid Assets}}{\text{Total Assets}} \right)^2 + \left(\frac{(\text{Illiquid Assets} + \text{Semi-liquid Assets})}{\text{Total Assets}} \right)^2 \right] \qquad (2)$$

The value of HHIliquidity ranges from 0 to 0.5. If HHIliquidity = 0, this indicates there are no liquid assets in the bank, while if HHIliquidity = 0.5 indicates the number of liquid assets is equal to illiquid assets.

The standard credit risk measurement (CRISK) is the ratio of non-performing loans (NPL), but not all banks provide NPL data on their financial statements. Thus, this study measured using the ratio of loan loss provisions (LLP) to gross loans (Abbas et al., 2021; Dang & Dang, 2021; Duho et al., 2021; Gafrej & Boujelbéne, 2021). Meanwhile, the control variables in this study are the capital ratio (EQTA) and the loan-to-deposit ratio (LDR) (Abbas & Ali, 2021; Durand & Le Quang, 2021). In short, Table 2 presents the different variables and their measurements.

Table 2. Definition of Operational and Measurement of Variables

Variable	Measurement
Dependent Variable	
Bank Stability (BSTAB)	Natural logarithm of the Z-score
Independent Variables	
Credit risk (CRISK)	$\dfrac{\text{Loan lost provision}}{\text{Gross loan}}$
Liquidity HHI (LIQHHI)	$1 - \left[\left(\dfrac{\text{Liquid Assets}}{\text{Total Assets}} \right)^2 + \left(\dfrac{(\text{Illiquid Assets} + \text{Semi-liquid Assets})}{\text{Total Assets}} \right)^2 \right]$
Bank specific variables/control variables	
Loan to deposit ratio (LDR)	$\dfrac{\text{Gross loan}}{\text{Deposit}}$

	Equity
Bank Capital (EQTA)	Total assets

3.3 Method

This study used the generalized method of moments (GMM) as a statistical testing tool (Arellano & Bond, 1991). The reason for the selection of the GMM estimator is because of its advantages when there is a possible reciprocal influence between liquidity and credit risk on bank stability. Furthermore, GMM estimators can handle lagging dependent variables, unobserved fixed effects, independent endogenous regressors, heteroskedasticity and autocorrelation in regression models (Dang & Nguyen, 2020; Wang & Lin, 2021). According to Wu et al. (2020) GMM estimators are highly recommended as an econometric method for research with panel data characteristics with a small time series but more cross sections.

For the testing of research hypotheses, the research models built for the two respective countries are as follows.

$$BSTAB_{it}=\beta_1 BSTAB_{it\text{-}1}+\beta_2 CRISK_{it}+\beta_3 LIQHHI_{it}+\beta_4 CRISK_{it}*LIQHHI_{it}+\sum_{j=1}^{J}\beta_j Bank_{it}^{j} \quad (3)$$

Where i = 1,…N denotes the bank and t = 1,…T denotes the period. BSTABit represents bank stability of bank i at time t. CRISKit dan LIQHHIit represents, respectively, the credit risk and liquidity risk using HHI method of bank i at time t, and Bankit represents the bank-specific control variables, namely the bank capital (EQTA) and loan to deposit ratio (LDR) of bank i at time t.

4   Result

Descriptive statistical results for a sample of Indonesian banks are shown in Table 3. In comparison, Malaysian banks are shown in Table 4. The mean value of bank stability for banks in Indonesia is 33.72, while for Malaysia, it is 52.93. This value indicates that banks in Malaysia look more stable than banks in Indonesia. The mean value of credit risk in Indonesian banks is higher than that of Malaysian banks (2.2 per cent and 1.9 per cent). Furthermore, liquidity concentration in Malaysian banks is higher (0.446) than liquidity concentration in Indonesian banks (0.333).

Table 3. Descriptive statistic Indonesia banks

Variables	Observation	Mean	Median	Maximum	Minimum	SD
BSTAB	240	33.7241	30.8208	79.2407	1.1235	18.7520
CRISK	240	0.0227	0.0189	0.1233	0.0002	0.0173
LIQHHI	240	0.3331	0.3339	0.5264	0.1572	0.0737
LDR	240	0.8796	0.8703	1.7913	0.4263	0.1428
EQTA	240	0.1471	0.1410	0.2902	0.0602	0.0518

The loan-to-deposit ratio (LDR) in banks in Indonesia is 87.96 per cent, while in Malaysia, it is 92 per cent. These findings indicate that banks in Malaysia are more productive in distributing loans to customers. Equity is one of the indicators of bank soundness (Durand & Le Quang, 2021; Sahyouni et al., 2021), It can be noticed that bank equity in Indonesia is higher (14.71 per cent) than bank equity in Malaysia (12.61 per cent).

Table 4. Descriptive statistic Malaysia banks

Variables	Observation	Mean	Median	Maximum	Minimum	SD
BSTAB	220	52.9370	42.6812	188.3508	11.0819	36.1262
CRISK	220	0.0196	0.0167	0.0560	0.0009	0.0115
LIQHHI	220	0.4464	0.4339	0.8099	0.0637	0.0865
LDR	220	0.9200	0.9057	3.7660	0.1181	0.3511
EQTA	220	0.1261	0.1002	0.7555	0.0513	0.0832

From the descriptive statistics between banks in Indonesia and Malaysia, it can be concluded that, on average, banks in Malaysia are more stable, have more negligible credit risks and have a higher concentration of liquidity than Indonesian banks.

Table 5. Correlation matrix Indonesia banks

Variables	CRISK	LIQHHI	LDR	EQTA
CRISK	1.0000			
LIQHHI	0.2743	1.0000		
LDR	0.1393	-0.5213	1.0000	
EQTA	-0.0003	0.0793	0.2421	1.0000

Table 5. and 6 shows the relationship between independent variables in a sample of banks in Indonesia and Malaysia. Generally, the correlation between variables is insignificant, and no correlation above 0.7. Thus, the research model does not indicate multicollinearity problems in variables.

Table 6. Correlation matrix Malaysia banks.

Variables	CRISK	LIQHHI	LDR	EQTA
CRISK	1.0000			
LIQHHI	-0.3857	1.0000		
LDR	0.3884	-0.3742	1.0000	
EQTA	-0.2671	0.3698	-0.1056	1.0000

Table 7. shows the testing result using bank samples in Indonesia and Malaysia. J-statistics with a p-value above 0.05 or accepting the null hypothesis indicate that the instrument used is appropriate. Meanwhile, the p-values of AR(1) and AR(2) are under the

condition of accepting the null hypothesis. Therefore, the residual consistency is maintained (Arellano & Bond, 1991).

Table 7. The impact of liquidity and credit risk on bank stability

Country	Indonesia			Malaysia		
Variable	**Coefficient**	**t-Statistic**	**Prob.**	**Coefficient**	**t-Statistic**	**Prob.**
BSTAB(-1)	0.0376**	2.2659	0.0332	0.0143*	2.0349	0.0547
CRISK	-0.0736***	-2.8222	0.0097	-0.0404***	-6.7881	0.0000
LIQHHI	0.2449**	2.3177	0.0297	-0.2984***	-4.4181	0.0002
CRISK*LIQHHI	0.0330	1.6310	0.1165	-0.0793***	-5.7751	0.0000
LDR	0.0349	0.9857	0.3345	0.0089	1.5823	0.1285
EQTA	0.9483***	42.5744	0.0000	0.9635***	206.3554	0.0000
Observations	192			176		
S.E. of regression	0.260137			0.030254		
J-statistic	24.70311			20.11687		
Prob(J-statistic)	0.311482			0.215003		
AR(1) test (p-value)	0.2082			0.7152		
AR(2) test (p-value)	0.5129			0.6162		

Notes: ***, **, * show significance at 1%, 5% and 10% respectively. The abbreviations are BSTAB (bank stability), CRISK (credit risk), LIQHHI (Liquidity HHI), LDR (loan to deposit ratio), EQTA (equity to total assets).

5   Discussion

This study focuses on the impact of credit risk and bank liquidity risk on bank stability. Comparing banks in Indonesia and Malaysia should provide a deeper insight into how the two risks affect bank stability. Furthermore, this study examines the interaction between the risks to bank stability in Indonesian and Malaysian banking. The empirical testing of banks in both countries (Table 7.) showed an increase in credit risk, lowering bank stability. This finding is in line with research conducted by Ghenimi et al. (2017) on banking in MENA countries and Riahi (2019) on banking in GCC countries.

The increase in bank liquidity concentration in Indonesia also increased bank stability (significantly at 5 per cent), while in Malaysia, the increase in liquidity concentration decreased bank stability (significantly at 1 per cent). Dahir et al. (2018), in their research of 57 banks operating in MENA countries, showed that the increase in bank liquidity convincingly helped improve its stability. Likewise Liu et al. (2020) conducted a study on banks in the USA, showing that increasing bank liquidity also increased bank stability, while Abbas et al. (2021) on commercial banking in Asian countries showed the contrasting result. As well as Ali and Puah (2019) in their research on banks in Pakistan, show that increases in bank liquidity decrease its stability. The interaction between credit risk and liquidity risk had no significant effect on banks in Indonesia. On the contrary, the interaction between the two risks

convincingly lowered the stability of banks in Malaysia (significantly at 1 per cent). These findings indeed open up space for researchers to conduct more in-depth research into the causes of the interaction of credit risk and liquidity risk, not significantly affecting bank stability in Indonesia. It is essential to consider that Indonesia and Malaysia are neighbouring countries with similar cultural, geographical and demographic characteristics. The LDR did not significantly impact bank stability in Indonesia and Malaysia, while EQTA had a positive and significant effect of 1 per cent on bank stability in both countries.

6 Conclusion

This study has examined how the two most significant risks in banking affect and interact with bank stability in Indonesia and Malaysia from 2010 to 2019. This study separately analyzed the impact of credit risk and liquidity risk on bank stability in Indonesia and Malaysia. There is no difference between banks in Indonesia and Malaysia regarding the effect of credit risk on bank stability, as logical reasoning suggests that increased credit risk undoubtedly damages bank stability. This study shows the negative impact of credit risk on bank stability in both countries. The increasing concentration of asset liquidity in Indonesian banks increases bank stability, and this shows that the existence of bank liquid assets provides space for banks in Indonesia to create profits through efficient liquidity management. On the contrary, the increase in asset liquidity concentration in Malaysian banks decreased bank stability. Acharya and Naqvi (2012) agree with Wagner (2007) that increasing assets liquidity paradoxically increases bank instability due to raised costs and the risk of misconduct in financing.

Interestingly, the interaction between credit risk and liquidity risk turned out to have a different impact on both countries. Banks in Indonesia are not affected when these two risks interact together, while banks in Malaysia reassure that the effects of credit risk and liquidity risk interactions convincingly reduce bank stability. When there is an increase in credit risk in Indonesian banks, bank stability decreases, but when there is an interaction of increased liquidity concentration, the impact of such instability has no significant effect. This condition shows that when there is an increase in credit risk in Indonesian banks, banks in Indonesia slow down in disbursing loans. These findings confirm that credit risk exposure can be minimized by the highly concentrated of a bank's liquid assets to the extent that the bank can perform good liquidity management. The interaction between credit risk and liquidity in Malaysian banks has further reduced bank stability. This situation indicates that banks in Malaysia are more aggressive in financing when credit risk increases.

This research has limitations that require attention for subsequent research. This research period is assumed in normal economic conditions (2010 – 2019). It will be more comprehensive if this study compares the conditions of the economic crisis. Further research can use the 2007-2009 (crisis) and compare it with the period of 2010-2019 and continue on the crisis conditions caused by the Covid-19 pandemic (2020-2021).

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