Impact of credit risk (NPLs) and capital on liquidity risk of Malaysian banks

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Abstract

We investigate the relationship between bank liquidity risk and credit risk and the impact of bank capital on liquidity risk. Using 19 Malaysian commercial banks data over 2002-2011 and applying dynamic panel data GMM estimation after controlling for bank-specific and macroeconomic variables, empirical results document a positive relationship between liquidity and credit risk and a non-linear U-shaped relationship between bank capital and liquidity risk.

Keywords: liqudity risk; credit risk; bank capital; Malaysia banking risk.

1. INTRODUCTION

The aim of this paper is to answer the questions: what is the relationship between liquidity risk and credit risk in a commercial bank? And what is the impact of bank capital on liquidity risk. Traditional theory of banks, as in Diamond and Dybvig (1983), suggests that credit risk and liquidity risk are related in a close manner as the bank's asset and liability structures are connected. In banking theory, the banks' role is providing liquidity to the economy and to screen and monitor potential borrowers. Banks are thus engaged in the transformation of liquid deposits into illiquid loans (De Haan et al., 2009). In the bank's capital theory which is introduced by Diamond and Rajan (2000), "the optimal bank capital structure trades off the effects of bank capital on liquidity creation, the expected costs of bank distress, and the ease of forcing borrower repayment". However, the contrast between theory and reality is perhaps most apparent in the area of risk management (Allen & Santomero, 1997).

2. SELECTED LITERATURE

Few studies investigate the relationship between credit and liquidity risk in banks. Imbierowicz and Rauch (2014) study the relationship between liquidity risk and credit risk in U.S. commercial banks over 1998-2010 and find no relationship exists between them, they instead find that both (liquidity and credit) risks affect insolvency risk (probability of default Z-score). Distinguin et al. (2013) study the relationship between capital and liquidity risk in quoted US and European banks and find that small banks increase their capital when they face higher illiquidity. Berger and Bouwman (2009) find that the relationship between liquidity risk and capital in US banks is positive for large banks and negative for small banks.

However, Ratnovski (2013) studies liquidity and transparency in bank risk management and models a bank liquidity risk in which banks, in case of solvency problems, cannot refinance its short-term liabilities, the solution is that banks can aggregate buffer of liquid assets, or intensify transparency to communicate solvency.

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In the model, both liquidity buffers and bank transparency are important in bank liquidity risk management, and there are both a need for liquidity requirements to be complemented by measures, and a need for better corporate governance, to improve bank transparency (better communication that enhances access to external refinancing).

3. HYPOTHESES

We hypothesise the following two main hypotheses:
H1: *the relationship between credit risk and liquidity risk is positive*.
H2: *The relationship between bank capitalization and liquidity risk is a non-linear U-shaped relationship*. That is bank capital initially increases liquidity risk and then, with the bank build-ups, it decreases the bank liquidity risk.

4. SAMPLE, DATA, AND VARIABLES

4.1 Data

Bank-specific or bank-characteristics data are collected from *BankScope* database. The sample dataset consists of 19 commercial banks in Malaysia over the period 2002-2011[1]. The dataset compromises over 190 bank-year observations for each variable. We choose the year of 2002 as a beginning of the time series because at the beginning of 2001, 50 of the 54 banking institutions have been merged into 10 banking groups. Macroeconomic data are collected from World Bank database.

4.2 Variables

The dependent variable for this study is the liquidity risk (LR) which is measured by the sum of bank liquid assets divided by customer deposits and short term funding. The proxy of credit risk (CR) is the ratio of non-performing loans or impaired loans to gross loans. Bank capital (CA) is proxied by total equity to total assets. (CA^2) is the square term of capital (CA) which is included to test the existence of U-shaped (non-linearity) relationship between bank capitalization and liquidity risk. Macroeconomic control variables include inflation and sovereign (central government) debt which is represented by central government debt scaled to GDP in percentage.

Other bank-specific control variables include the net-interest income variable which is a product of net-interest income scaled to average earning assets, and the ratio of non-interest income scaled to total income as a proxy for income diversification. Bank size is peoxied by natural logarithm of total assets and return on equity as a proxy of bank's management performance equals the ratio of bank's pre-tax profits to total shareholders' equity. The last control variable is the bank inefficiency which is measured as the ratio of bank operating expenses (bank overheads or total non-interest expenses) scaled to the bank's operating income. The ratio measures how the bank is efficient in exploiting its resources. Less value of this ratio denotes more efficiency, and greater value marks higher inefficiency. In banking literature this ratio is called (cost-to-income ratio) and largely used. Table 1 presents the variable definition.

Table 1. Variable Definition.

Variable	Definition
Liquidity risk	Bank liquid assets divided by customer deposits and short term funding
Credit risk	Ratio of non-performing loans to gross Loans
Capital	Total equity to total assets
Capital squared	Square term of (total equity to total assets)
Net-interest income	Net-interest income to average earning assets
Non-interest income	Non-interest income to total income
Size	Natural logarithm of bank's total assets
Inefficiency	Bank operating expenses to bank's operating income
Return on equity	Ratio of bank's pre-tax profits to total shareholders' equity
Inflation	
Sovereign debt	Central government debt over GDP

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[1] These 19 commercial banks are: Affin Bank Berhad, Alliance Bank Malaysia Berhad, AmBank (M) Berhad, CIMB Bank Berhad, Hong Leong Bank Berhad, Malayan Banking Berhad, Public Bank Berhad, RHB Bank Berhad, Bank of America Malaysia Berhad, Bank of Tokyo-Mitsubishi UFJ (Malaysia) Berhad, Citibank Berhad, Deutsche Bank (Malaysia) Berhad, HSBC Bank Malaysia Berhad, J.P. Morgan Chase Bank Berhad, OCBC Bank (Malaysia) Berhad, Standard Chartered Bank Malaysia Berhad, The Bank of Nova Scotia Berhad, The Royal Bank of Scotland Berhad, and United Overseas Bank (Malaysia) Berhad.

4.3 Descriptive Statistics

Fig. 1 depicts the graph for liquidity risk for each of the 19 banks in the sample during the period 2002-2011. Table 2 illustrates the descriptive statistics of this study's variables.

5. METHODLOGY

We use a dynamic panel data technique for the research's methodology in order to take into account the unobservable individual bank-specific effects, in addition to take under consideration and to control also for the 'time persistence' in the liquidity risk measure (i.e., the dependent variable) and in other variables as well. We use dynamic panel techniques, the Generalized Method of Moments (GMM) as suggested and introduces firstly by Arellano and Bond (1991) (the Difference GMM) and as Arellano and Bover (1995) and Blundell and Bond (1998) generalize it later (the System-GMM). The model for liquidity risk (LR) is taking the following form:

$$\textbf{LR}_{i,t} = \textbf{LR}_{i,t-1} + \textbf{CR}_{i,t} + \textbf{CA}_{i,t-1} + \textbf{CA}^2_{i,t-1} + \textbf{Control Variables} \qquad (1)$$

Table 2. Descriptive Statistics.

| Variable	Mean	Max.	Min.	Sd.	Skewness
Liquidity risk LR	44.60	155.40	9.50	34.89	1.54
Credit risk CR	6.54	57.33	0.08	7.47	3.18
Capital CA	10.18	35.34	3.57	6.44	2.11
Capital squared CA^2	144.88	1248	12.74	224.43	3.02
Net-interest income	3.21	13.87	0.27	1.69	3.86
Non-interest income	85.21	1425	-1219	163.18	1.09
Size (log TA)	10.11	12.93	6.81	1.49	-0.42
Inefficiency	41.64	102.87	-199	21.03	-7.82
Return on equity ROE	17.73	55.43	-23.5	10.45	-0.10
Inflation	4.43	10.39	-5.99	4.17	-1.17
Sovereign debt	44.99	51.57	39.80	4.48	0.38
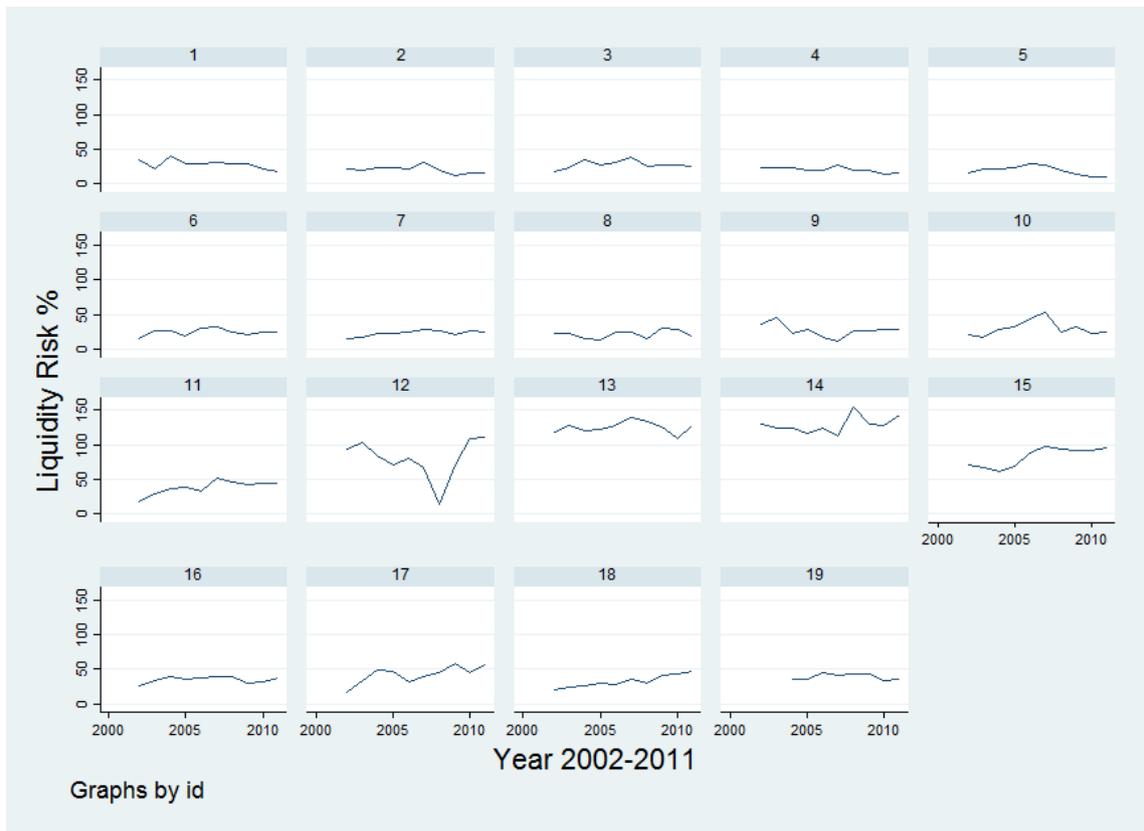
Fig. 1. Banks Liquidity Risk % 2002-2011.

In Eq. (1), we use two-step GMM estimation method and lagged values of liquidity risk (LR), capital (CA), capital squared (CA^2), return on equity (ROE), and sovereign debt; and current (contemporaneous) values of

credit risk (CR), net-interest income, non-interest income, bank size (Log TA), inefficiency, and inflation; are used as an explanatory variables.

The estimated standard errors in the two-step GMM estimation are utilized in order to produce a consistency in the "variance–covariance matrix of the moment conditions" errors of the model (Louzis et al., 2012). However, the two-step estimator of standards errors may impose a downward biased tendency during the estimation (Arellano and Bond, 1995; Blundell and Bond, 1998), yet, Windmeijer (2005) states that "Monte Carlo studies have shown that estimated asymptotic standard errors of the efficient two-step generalized method of moments (GMM) estimator can be severely downward biased in small samples". In this case to face this problem, we use the finite-sample correction of covariance matrix (corrected estimate of the variance) resulting from the two-step method, the correction method proposed by Windmeijer (2005) in order to lead to more accurate statistical inference. Moreover, we use 'robust standard errors' option in STATA software in the two-step GMM estimators to get more efficient and consistent results.

We use Sragan specification test which attests the total validity of the variables instruments used in the model estimation, that is to test the null hypothesis of Sargan test which is "asymptotically distributed moment conditions as chi-square", in other words the null hypothesis of valid moment conditions (Arellano and Bond, 1995; Blundell and Bond, 1998). Sargan test (it is called also Hansen specification test) is used to ensure that the errors (residuals) are not second-order auto correlated, i.e., to test the hypothesis that no second-order serial autocorrelation in errors (m_2 test). As a rule of thumb in GMM estimation, the number of instruments used should not exceeds the number of groups of cross section units, i.e., the number of banks in the research. This issue is also being under consideration during the GMM estimation.

6. RESULTS

Table 3 depicts the empirical results of Arellano-Bond dynamic panel-data two-step GMM estimation for liquidity risk model. m_2 test revealed that there are no second-order serial autocorrelation in errors and consequently a valid moments conditions. The model constant is significant at 0.1% with high coefficients of -148.5049 and the lagged dependent variable is found to be statistically not significant.

The relationship between credit risk and liquidity risk is significantly positive at 0.1% confidence level. That denotes that more credit risk (more non-performing loans) leads to more liquidity risk and vice versa, i.e., less credit risk tends to decrease liquidity risk.

The sign of the lagged capital coefficient is significantly positive at 5% level in respect to its effect on liquidity risk. However, the sign of the lagged capital squared is significantly negative at 5% level, and that suggests that the relationship between bank capital and liquidity risk is non-linear and takes a convex shape or U-shaped relationship. This non-linear U-shaped relationship that exists between capital and liquidity suggests that bank capital is initially increasing the bank liquidity risk and then with the bank capital build-ups it helps decreasing the liquidity risk of the bank.

Coefficient of lagged return on equity variable (ROE) is not statistically significant, implying that bank profitability has nothing to do empirically (or significantly) with the bank liquidity risk. The relationship between bank inefficiency and liquidity risk is significantly negative at 0.1% level suggestive of that the less inefficiency, the more liquidity risk.

The impact of bank size on liquidity risk is significantly positive at 0.1% implying that larger banks tend to be more risky (in terms of liquidity risk) and to realize 'too-big-to-fail' argument in terms of liquidity risk as well.

Net-interest income is affecting liquidity risk positively at 5% level, and non-interest income is affecting liquidity risk negatively at 5% level. This denotes that more interest based income results in more liquidity risk, and more non-interest income (more income diversification) results in less liquidity risk.

For macroeconomic variables, the relationship between inflation and liquidity risk is significantly negative at 5% level, and the relationship between (lagged) sovereign debt and liquidity risk is also negative at 5% confidence level. Macroeconomics variables results may imply that the expansionary phase of the economy (high rates of inflation and sovereign debt) lead to less liquidity risk in the banking system.

Table 3. Arellano-Bond dynamic panel-data two-step GMM estimation results for liquidity risk model.

Dependent variable: liquidity risk$_{i,t}$	Coefficients and standard errors
Constant	- 148.5049***
	(45.2207)
Liquidity risk$_{i,t-1}$	0.3219362
	(0.2599124)
Credit risk$_{i,t}$	0.9073271***
	(0.283484)
Capital $_{i,t-1}$	2.345811*
	(1.195199)
Capital squared $_{i,t-1}$	- 0.0550705*
	(0.0218499)
Net-interest income$_{i,t}$	2.035359*
	(0.9265308)
Non-interest income$_{i,t}$	- 0.0026929*
	(0.0011303)
Size$_{i,t}$ (Log total assets)	14.82638***
	(3.057642)
Inefficiency$_{i,t}$	- 0.0801915***
	(0.0150265)
Return on equity$_{i,t-1}$	0.0611842
	(0.0340537)
Inflation$_{i,t}$	-0.6412711*
	(0.2602978)
Sovereign debt $_{i,t-1}$	- 0.4874895*
	(0.2281709)
First order Sargan test (m_1)	-1.4476
m_1 P-value	[0.1477]
Second order Sargan test (m_2)	- 0.69165
m_2 P-value	[0.4892]
Wald chi-square X^2	239.92
Prob. $> X^2$	[0.0000]
Number of observations	149
Number of groups	19
Number of instruments	19

Notes: t-statistics are reported in parenthesis. The p-values for the Sargan test m2 and chi-square X2 are reported in brackets. ***significant at 0.1%, ** significant at 1%, and * significant at 5%.

7. CONCLUSION

This paper studies the relationship between the most two important factors for bank survival. We find that the relationship between bank credit risk and bank liquidity risk is positive. The paper also finds that bank capital is an important factor of bank liquidity risk as it initially increases the liquidity risk and with more capital buffers and build-ups it decreases the liquidity risk. Larger banks tend to have more liquidity risk; more net-interest income leads to more liquidity risk, and more non-interest income leads to less liquidity risk. Bank inefficiency is related to liquidity risk and macroeconomic environment (inflation and sovereign debt) are affecting liquidity risk negatively.

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