IJEM
International Journal of Economics and Management
Journal homepage: http://www.ijem.upm.edu.my

The Effects of Bank Size and Funding Liquidity on Financial Stability: Does Bank Regulation Matter? Evidence from BRICS

FAUZIAH MAHAT[a*] AND AHMED MOHAMED DAHIR[a]

[a]*Faculty of Economics and Management, Universiti Putra Malaysia, Malaysia*

ABSTRACT

This paper investigates whether the effect of funding liquidity on financial stability changes depending upon bank regulation and bank size, using bank-level data for 254 banks in BRICS over the period 2005-2014. The paper employs the system GMM techniques on dynamic panel analysis. The results show that the effect of funding liquidity on financial stability is positively and negatively associated with bank regulation and bank size, respectively, suggesting that bank regulation improves the financial stability, while the size hurts the stability. Moreover, the impact of funding liquidity on stability is strongly pronounced following the 2008 crisis. These findings provide further insights about bank regulation and bank size.

JEL Classification: M42, M41
Keywords: BRICS; Capital stringency; Funding liquidity; System GMM

Article history:
Received: 21 June 2018
Accepted: 23 November 2018

* Corresponding author: Email: f_mahat@upm.edu.my

INTRODUCTION

The worldwide financial crisis has re-opened a discussion among regulators and academics concerning the soundness and safety of the banking system. Again, it has been highlighted the critical importance of bank size and funding liquidity in the financial stability of the banking industry. There are a number of reasons why this heated discussion takes place. Firstly, bank size was a key determinant of risk since large banks, in particular, have been considered as the root of the financial crisis (Laeven et al., 2016). Secondly, funding liquidity is the risk factor. It increases substantially excessive risk-taking which leads to the banking fragility (Khan et al., 2017). Because funding liquidity, which denotes the bank's ability to pay the depositors' claims with immediacy, has a direct influence on the banking stability. The motive is that banks are the most leveraged institutions and managers' pay packages are much stronger at banks as compared to non-financial firms (Uhde, 2016). In fact, bank managers tend to take higher risks as their compensations are based on the loan volumes instead of their commitments. They are penalized because of their lack of efforts only in the case that banks encounter a severe liquidity shortfall (Acharya and Naqvi, 2012). Bank mangers can transfer risk to dispersed and unsophisticated borrowers (Uhde, 2016). It is worth noting that level of funding liquidity depends upon macroeconomic risk as the investors restrict direct investment and hold more bank deposits. As a result, the high level of funding liquidity motivates banks to take excessive credits and protect the potential decreases of their payoffs due to downside risks, leading to the financial fragility (Acharya and Naqvi, 2012). Thirdly, the merits of bank regulation and supervision have been underscored as a means to mitigate any potential economic instability (Klomp and De Haan, 2012).

Understanding how the effect of funding liquidity on financial stability varies depending upon bank regulation and supervision and bank size is central issue because a limited number of studies have investigated the impact of funding liquidity on financial stability and whether the effect of funding liquidity on financial stability differs depending on bank regulations and bank size. Banking theory posits that there is the strong association between the bank's assets and liabilities producing financial services which induce liquidity risk and credit risk simultaneously (Bryant, 1980; Diamond and Dybvig, 1983). Another theory, the too-big-to-fail hypothesis postulates that large banks tend to take excessive risks for two reasons: first, the regulators are not willing to put restrictions to a bank's activities that may lead to moral hazard and second banks may invest risky assets, expecting government bailouts in case they encounter failure (Farhi and Tirole, 2012). From empirics, interrelations between bank size and financial stability thus far reached few firm conclusions. Some studies argue that financial instability grows with bank size (Laeven et al., 2016). Bank size should be downsized for the avoidance of risk (De Jonghe et al., 2015). In contrast, bank size is positively associated with stability of banking system, suggesting that large banks exploit scale of economies that hence reduce excessive risk-taking and enhance more efficient intermediation improving bank stability (Moutsianas and Kosmidou, 2016).

Funding liquidity has been identified as a critical factor undermining a more resilient banking industry during the financial crisis (Khan et al., 2017). Studies that have focused on the interactions between bank size and financial stablitity.However, the interaction effect of funding liquidity and bank regulation on financial stability is significantly unclear. To our knowledge, this empirical investigation is the first study that accounts for effects of bank regulation and supervision and bank size when interacted with funding liquidity on financial stablity.

Therefore, this paper examines the interaction effects of funding liquidity, bank regulation and bank size on financial stablitity of banks in BRICS countries. The decision concerning research for BRICS countries is somewhat obvious because the BRICS countries are considered as key players in the world economy and their increasingly important role in the world economy is related to trade, growth, and population (Demir and Ersan, 2017; Mensi et al., 2014). For example, in last two decades, their shares of global trade and investment have grown at ferocious space, making the region to be more integrated with the rest of world (Mensi et al., 2014). In world trade, their exports and imports are accounted to be increased nearly in triple and double respectively. The population of the region which is estimated 41% of the world population live 28.4% of world territory and (Demir and Ersan, 2017; Mensi et al., 2014). The BRICS countries enjoy more than 1 billion labor people. Regarding share of global output, the region's economic growth has increased from approximately 7% to almost 22% in the last two decades, implying that the BRICS holds the second largest GDP of the global economic output after U.S (Demir and Ersan, 2017). Notably, the growth of BRICS is expected to surpass the U.S. after 2020 (Demir and Ersan, 2017). Moreover, investment, especially FDI has reached its peak with 294 in 2013

and BRICS will hold more than 40% of the capitalization of world stock by 2030 (Balcilar et al., 2018). To investigate these interactions, we use unbalanced panel data over the period between 2005 and 2014 of banks in Brazil, Russian Federation, India, China, and South Africa, known as BRICS countries to identify whether the effects of funding liquidity on financial stability change depending upon the bank regulations and bank size.

The contributions of the paper are threefold. First, we extend the existing literature by identifying the determinants that influence the financial stability of intermediation system. This helps regulators and governments to determine key variables that enhance or undermine financial stability in emerging economies. Second, we investigate the effect of bank regulation on the association between funding liquidity and financial stability in BRICS countries. Such bank regulation encapsulates capital stringency, supervisory power, activity restrictions, and private monitoring and their essence widely discussed in the literature (J.R. Barth et al., 2013b). Finally, we employ system GMM techniques to reduce the potential bias affecting the results from the interrelationships among bank size, funding liquidity, and financial stability.

The remainder of the paper is organized as follows. Section 2 provides the related literature review, and Section 3 describes the empirical methodology and briefly presents data and variables. Section 4 shows the regression results and discussion of the baseline model and the extended model. Section 5 concludes.

LITERATURE REVIEW

Funding liquidity refers the ability of a bank to increase cash on short notice, while the funding liquidity risk is denoted as the banks' inability to obtain funds in case of need (Strahan, 2010). Several recent empirical and theoretical studies have elevated the comprehension of bank practices in funding liquidity. This research is related to the current literature on funding liquidity (Acharya and Naqvi, 2012; Khan et al., 2017; Mohamed et al., 2018; Umar et al., 2016). Unlike to this paper, many studies have investigated risk factors that undermine the stability of banking system and found bank size and funding liquidity as risk determinants that caused the financial instability (Acharya and Naqvi, 2012; Laeven et al., 2016). This paper adopts two theories, namely banking theory, and the too-big-to-fail theory. Firstly, banking theory posits that banks with the high level of funding liquidity tend to engage more in excessive risk-taking activities (Diamond and Dybvig, 1983). Banks generally attract funds from depositors and provide loans to borrowers. This increases funding liquidity which induces the bank to undertake activities which are inherent in risks, such as liquidity risk and credit risk (Broll et al., 2015). However, if banks are unable to settle the depositors' claims with immediacy, banks face funding liquidity risk. To this end, banks are more vulnerable to liquidity shortages which then causes fire sales resulting in banking instability (Gennaioli et al., 2013; Kashyap et al., 2002; Laeven et al., 2016; Shleifer and Vishny, 2010). Second, the too-big-to-fail theory postulates that the bank regulators are unwilling to downsize large and complex banks. Due to moral hazard, banks have incentives for more risks by expecting government bailouts (Laeven et al., 2016). Besides, large banks can get liquidity assistance from central banks when they face financial distress (Distinguin et al., 2013).

A number of studies have focused on the association between funding liquidity and bank risk-taking. Khan et al. (2017) use U.S bank holding companies to examine the effect of funding liquidity on bank risk-taking over the period 1986-2014, their results document that bank risk-taking is significantly and positively associated with funding liquidity, implying higher the funding liquidity risk, banks take more risk which results in financial instability. In the same vein, Mohamed et al. (2018) investigate the relationship between funding liquidity and bank risk-taking, using BRICS banks over the period 2006-2015, they find that the relationship is significantly positive. Besides, the theoretical model developed by Acharya and Naqvi (2012) has been employed in the current literature on funding liquidity-bank risk-taking relation argues that whenever funding liquidity increases, it encourage bank managers to take excessive risk, which results in financial stability. However, Vazquez and Federico (2015) focused on the relationship between funding liquidity and financial stability. Their results indicate that banks with less funding liquidity before the crisis have failed at the onset of the recent financial crisis. They highlighted the importance of funding liquidity that improves the safety and soundness of the banking sector. Notable banks with less funding liquidity have failed, while those with greater funds performed better during the crisis. More importantly, the findings show that large international banks were more than stable

than the domestic banks as they have many funds. The reason is attributed to that the foreign banks have more accessibility in funding liquidity.

From the market perspective, Drehmann and Nikolaou (2013) use insurance premium as a proxy for funding liquidity risk to study the association between funding liquidity risk and market liquidity. Using European countries and monthly data for the period from June 2005 to October 2008, the results indicate that the funding liquidity risk was stable and slightly low coupled with the temporal spikes. Furthermore, the results unveil that liquidity spirals have been declining. Boudt et al. (2017) use a theoretical model that posits interrelationship between funding liquidity and market liquidity concerning stabilization to investigate the determinants(i.e., market liquidity and volatility) of funding liquidity, and their results show that both market liquidity and volatility endogenize funding liquidity.

Other bank-specific variables that influence banking stability include bank size. However, the bank size and its relation with the financial stability of the banking industry is ambiguous. Large banks were cited as the root of the financial crisis because they generally tend to have excessive risk-taking behavior. To this end, the bank size undermines the stability of the banking sector. Laeven et al. (2016) find that large banks are positively correlated with risk, reducing financial stability. De Jonghe et al. (2015) suggest that bank size has a significant effect on increasing in potential systematic risk exposure. In contrast, Beccalli et al. (2015) find that size is positively associated with banking stability, suggesting that large banks have greater economies of scale. In fact, these banks enhance risk management by using diversification and franchise value.

Furthermore, various studies shed light on the role of bank regulation on bank risk-taking. Bank regulation and supervision have emerged as a flagship that emphasizes the importance of global capital and liquidity rules that mitigate the risk of bank fragility and its related adverse macroeconomic developments and improve a more resilient banking system (Deli and Hasan, 2016; Klomp and De Haan, 2012). Thus, we analyze the effects of bank regulations on the relationship between the funding liquidity and financial stability, using banks in BRICS countries over the period 2005 -2014. To identify the regulatory dimensions, we develop indices for capital stringency, activity restrictions, supervisory power, and private monitoring following the previous literature that focused on bank regulations (Ibrahim and Rizvi, 2017; Klomp and De Haan, 2012; Luo et al., 2016; Noman et al., 2018).

To sum up, the previous literature at both empirical and theoretical level indicate that funding liquidity may likely influence the financial stability of the banking system. However, the interaction funding liquidity, bank size, and bank regulation remain unclear.

METHODOLOGY AND DATA

Empirical model

The paper estimates our empirical analysis, the first model considers the effect of funding liquidity on financial stability, while the other two accounts for interaction terms of bank regulation and bank size respectively. To this end, we specify the following equations:

$$STB_{it} = \alpha_0 + \rho STB_{it-1} + \beta_1 FLQ_{it-1} + \psi_i \mathrm{X}_{it} + \varepsilon_{it} \quad (1)$$

The paper extends the model by incorporating interactions to examine whether bank regulation and bank size affect the relationship between funding liquidity and financial stability. The interaction models are as follows:

$$\mathrm{STB}_{it} = \alpha_0 + \rho STB_{it-1} + \beta_1 FLQ_{it-1} + \beta_2 REG_{it-1} + \beta_3 FLQ \times REG_{it-1} + \psi_i \mathrm{X}_{it} + \lambda_i + \eta_t + \varepsilon_{it} \quad (2)$$

$$\mathrm{STB}_{it} = \alpha_0 + \rho STB_{it-1} + \beta_1 FLQ_{it-1} + \beta_2 LSZ_{it-1} + \beta_3 FLQ \times LSZ_{it-1} + \psi_i \mathrm{X}_{it} + \lambda_i + \eta_t + \varepsilon_{it} \quad (3)$$

Where STB_{it} represents bank stability, FLQ_{it} is funding liquidity, LSZ_{it} is bank size, REG_{it} is bank regulation, X_{it} is a set of bank-specific and country variables.

ε_{it} is the error term which is assumed to be uncorrelated over time and λ_i represents unobserved bank-specific effect and η_t is time-specific effect.

Bank stability (STB_{it})which serves as the dependent variable has a measure of z-score literature (Laeven et al., 2016; Lepetit and Strobel, 2013). It is calculated as the sum of return on assets and the capital to total assets divided by the standard deviation of returns [(ROA+ETA)/σROA]. The volatility of return (σROA) is calculated as a 3-year rolling window standard deviation of ROA. We employ the natural logarithm of z-score following Laeven and Levine (2009) to deal with upward bias which means the value of z-score is overestimated. In doing so, the log of z-score refers stability which is inversely proportional to the bank's insolvency and interpretation is more meaningful when it is used as a dependent variable in regression models. Funding liquidity(FLQ_{it}) has a measure of deposits to total assets. Bank size (LSZ_{it}) has a proxy of the natural logarithm of banks' total assets. The bank-specific variables include the loan composition(LTA_{it}) which is calculated as loans to total assets and profitability(ROA_{it}) which is a ratio of net income to total assets. The country control variables contain economic growth (ΔGDP_{it}) and inflation (ΔINF_{it}). FC_t is the dummy that represents the global financial crisis which takes the value of 1 for the year 2008 and 0 otherwise.

Turning to bank regulation, capital stringency(CAS_{it}) is an index that measures a country's aggregate laws and rules of bank capital. Initial capital investigates whether specific sources, such as borrowed funds and assets excluded government securities may be used as the initial capital and whether regulatory or supervisory authorities officially verified them. Conversely, overall capital examines whether the calculation of regulatory capital reflects risk elements and market value losses deducted. The capital stringency is sourced from data developed by J.R. Barth et al. (2013b). The construction of index takes the scores ranging from 1 to 10. Notably, a higher score shows greater capital stringency, implying a buffer that, therefore, reduces a bank's risk exposure, while a lower score reflects less capital stringency. The empirical literature examines the effect of capital stringency on financial stability provides positive results (Ibrahim and Rizvi, 2017; Noman et al., 2018). This implies that capital stringency induces banks to be prudent by raising their levels of monitoring and controlling. It also prevents banks from taking risky investment portfolio that may likely lead to bankruptcy (Noman et al., 2018). Therefore, we predict that there is a positive relationship between capital stringency and financial stability. Because the capital requirements that are mandated to banks imply the bank's equity is at risk, and any possible default costs are adjusted with the shareholders' equity.

Activity restrictions(ACR_{it}) measure bank activities that are restricted, and these include securities, insurance, real estate investment and ownership of non-financial companies. Banks tend to increase risk if they are permitted wide-ranging activities due to moral hazard(Klomp and De Haan, 2012). The index takes the score from 0 to 16, with a higher score reflects greater stringency activity restriction. J. Barth et al. (2004) indicate that activity restrictions are negatively associated with bank stability and raise the probability of bank failures. Similarly, the current empirical literature documents a negative relationship between bank stability and activity restrictions (Klomp and De Haan, 2012; Noman et al., 2018). Thus, the negative correlation between capital stringency and financial stability is to be expected.

Supervisory power(DSP_{it}) measures the power which supervisory authorities can exercise by taking corrective actions against bank management and declaring insolvency. Strong supervision can prevent bank managers from engaging in excessive risk-taking that undermines financial stability. However, the literature shows that strict supervisory may trigger corruption as supervisors exploit using their power (Luo et al., 2016). The index score varies from 1 to14; higher score reflects greater supervisory power while a lower score indicates less official supervisory power. Therefore, the expected relationship between financial stability and supervisory power is to be positive.

Private monitoring(PRM_{it}) measures the degree to which banks provide accurate and comprehensive information to public and officials and, in addition, requirements related to credit ratings as well as auditing. Overall the literature unveils a negative impact on moral hazard concerning asymmetric information and positive influence on financial stability (Ibrahim and Rizvi, 2017; Klomp and De Haan, 2012). Thus, we expect that the private monitoring is positively associated with financial stability.

Estimation model

We use two-step System GMM techniques proposed by Blundell and Bond (1998) to deal with potential endogeneity problems. We employ this dynamic panel approach because of its efficiency. This estimator is more suitable when panel data sample contains small T, and large N; the regressors are not exogeneous and the dependent variable is dynamic(persistent). Additionally, system GMM performs well even if there exist econometric issues, such as heteroscedasticity, autocorrelation, time invariant fixed-effect which are more common in bank data-level data. The system GMM model allows using the first differences to eliminate the potential correlation between lagged dependent variable and error terms while instrumenting the predetermined and endogenous variables to reduce endogeneity issues by using lags. System GMM estimation combines two sets of equations. For instance, variables are differenced in the first equation, and lags of independent and explanatory variables are used as instruments. In the second equation, independent and explanatory variables are expressed in levels. However, instrument proliferation may reduce the power of the overidentification validity. To overcome such issue, we limit the number of instruments to arrive a number of instruments which should be less than the number of banks (Roodman, 2009b).

Data description

We use bank accounting data which are sourced from Bureau van Dijk Bankscope database. Data regarding country control variables are extracted from World Development Indicators, and bank regulation is collected from a database developed by J.R. Barth et al. (2013b). After received the data, the paper deliberately omitted the banks with their data observations are missing or represent a history of fewer than three years. As a result, the data turn unbalanced panel data covering 254 individual banks in five emerging countries, namely Brazil, Russia Federation, India, China, and South Africa which are abbreviated by BRICS.

EMPIRICAL RESULTS AND DISCUSSION

Descriptive analysis

Table 1 presents definitions and the summary statistics of all variables. The Pearson correlation matrix between the variables is reported in Table 2.

Table 1 Descriptive statistics.

Variable	Definition	Expected Signs	Obs	Mean	Std. Dev.	Min	Max	VIF
STB_{it}	Financial stability		2004	3.40	1.21	-3.33	1.53	
FLQ_{it}	Funding liquidity (%)	-	2156	77.39	16.59	8.30	94.80	3.01
LSZ_{it}	Bank size (log)	+/-	1540	16.06	2.18	11.60	21.40	1.57
ETA_{it}	Capital (%)	+/-	2156	14.14	12.20	2.40	75.00	3.15
LTA_{it}	Loan composition (%)	-	2156	54.31	20.78	1.10	95.00	1.22
ROA_{it}	Profitability (%)	+/-	2156	1.76	2.91	-5.10	14.40	1.25
CAS_{it}	Capital stringency	+	2156	7.38	1.96	4.00	10.00	1.82
ACR_{it}	Activity restrictions	-	2156	7.00	2.17	4.00	11.00	3.31
DSP_{it}	Supervisory power	+	2156	9.98	2.55	6.00	14.00	1.91
PRM_{it}	Private monitoring	+	2156	8.19	1.34	6.00	11.00	2.34
ΔGDP_{it}	GDP growth (%)	+	2156	6.79	3.28	-7.80	12.70	1.74
ΔINF_{it}	Change in consumer price index (%)	-	2156	6.62	2.97	-0.70	15.50	1.68

Note: Banking stability (STB_{it}) with a measure of the natural logarithm of Z-score serves as the dependent variable. FLQ_{it} is funding liquidity; LSZ_{it} is bank size has a measure of the logarithm of total assets of banks and LTA_{it} represents loans-to-total assets. ROA_{it} is profitability with the proxy of net income divided by total assets. CAR_{it} is capital stringency, ACR_{it} is activity restrictions, DSP_{it} is a degree of supervisory power and PRM_{it} is private monitoring. ΔGDP_{it} is the growth of gross domestic product and ΔINF_{it} is the change of consumer price index.

Table 1 presents the descriptive statistics for the variables used in the empirical specification. On an average, the mean value of funding liquidity(FLQ_{it}) is 77.39%, while the overall mean scores of capital(ETA_{it}), loans-to-total assets (LTA_{it}), and profitability(ROA_{it}) are 14.14%, 54.31%, and 1.76% respectively. Also, their standard deviations are 16.59, 12.20, 20.78, and 2.91 accordingly. The mean values of bank stability (STB_{it}) and bank size (LSZ_{it}) represent 3.40 and 16.06 respectively, whereas the standard deviation of bank stability is 1.21, while bank size is 2.18. The mean values of capital stringency (CAS_{it}), activity restrictions (ACR_{it}), supervisory power (DSP_{it}), and private monitoring (PRM_{it}) are 7.38, 7.00, 9.98 and 8.19, respectively and their

corresponding standard deviations are 1.96, 2.17, 2.55 and 1.34. Finally, the average values of growth of gross domestic product (ΔGDP_{it}) and change of consumer price index (ΔINF_{it}) are 4.37% and 6.78%, respectively which correspond to standard deviations of 3.28 and 2.97 accordingly.

Table 2 Pairwise correlation analysis

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
STB_{it}	1.00											
FLQ_{it}	-0.10*	1.00										
ETA_{it}	0.03	-0.54*	1.00									
LSZ_{it}	-0.30*	0.29*	-0.51*	1.00								
LTA_{it}	-0.12*	0.33*	-0.25*	-0.01	1.00							
ROA_{it}	0.01	-0.46*	0.47*	-0.16*	-0.12*	1.00						
CAS_{it}	-0.19*	0.28*	-0.15*	0.31*	0.14*	-0.03	1.00					
ACR_{it}	-0.30*	0.16*	-0.12*	0.33*	0.04	0.04	0.55*	1.00				
DSP_{it}	-0.06*	-0.09*	-0.07*	0.10*	-0.30*	0.06*	-0.02	0.29*	1.00			
PRM_{it}	-0.26*	-0.04	-0.04	0.29*	-0.09*	0.06*	0.33*	0.53*	0.55*	1.00		
ΔGDP_{it}	-0.23*	0.13*	-0.11*	0.21*	0.02	0.06*	0.46*	0.50*	0.21*	0.49*	1.00	
ΔINF_{it}	0.17*	-0.03	0.04	-0.19*	0.17*	-0.05*	-0.16*	-0.45*	-0.39*	-0.53*	-0.43*	1.00

Note: * shows significance at the .05 level

Table 2 shows that the correlation coefficients amongst regressors are below 0.6, indicating that there is less of a concern of multicollinearity. In other words, Table 1 also represents the variance inflation factor (VIF) which is less than the threshold value (10). As a result, inflation factor (VIF) confirms no sign of multicollinearity. The correlation between funding liquidity (FLQ_{it}), bank size (LSZ_{it}) and loans (LTA_{it}) are negative and statistically significant at 5% significance level. However, the capital (ETA_{it}) and profitability (ROA_{it}) are positive but not statistically significant. The correlation coefficients of bank regulatory variables (i.e., CAS_{it} , ACR_{it}, SUP_{it}, and PRM_{it}) are negative and significant, suggesting that countries with more bank regulations may likely promote fragility of the banking system. Last but not least, economic growth (ΔGDP_{it}) and inflation (ΔINF_{it}) are statistically significant.

Baseline regression results

We investigate the linear relationship between funding liquidity and financial stability of banks in BRICS over the period from 2005 to 2014. Table 3 reports the empirical results of the baseline model in column 1 and four different measures of bank regulations individually in columns 2 to 5 and jointly in column 6. Notably, we employ two-step system GMM technique to address any potential endogeneity from reverse causality between financial stability and funding liquidity and regressors in the right-hand side of the empirical models (i.e., Eq.(2) and Eq.(3)). We use two lags of both dependent and explanatory variables as instruments to reduce endogeneity issues that arise from bias in the estimation of control variables. Moreover,we checked whether the use of these instruments make our model consistent and, in doing so, the results confirm the validity of the model as Sargan test and AR2 reject the null hypotheses of invalid instruments and presence of second-order serial correlation followed by number of instruments are less than number of banks(i.e., no. of group).

The results show that lagged financial stability is statistically significant, confirming the persistence of lagged effects on financial stability. This ensures its dynamic effect suggesting that an increase in the past financial stability elevates the current financial stability level. In other words, the positive and significant coefficient of lagged financial stability of one year is to be carried forward to the following year, suggesting a bank's persistent financial stability.

Table 3 Funding liquidity and financial stability

	(1)	(2)	(3)	(4)	(5)	(6)
STB_{it-1}	0.452^{***}	0.461^{***}	0.597^{***}	0.481^{***}	0.476^{***}	0.472^{***}
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
FLQ_{it-1}	-0.021^{***}	-0.023^{***}	-0.031^{***}	-0.023^{***}	-0.022^{***}	-0.020^{***}
	[0.001]	[0.000]	[0.000]	[0.001]	[0.001]	[0.002]
LSZ_{it-1}	-0.302^{***}	-0.326^{***}	-0.152^{**}	-0.187^{***}	-0.202^{***}	-0.297^{***}
	[0.000]	[0.000]	[0.036]	[0.009]	[0.004]	[0.000]
ETA_{it-1}	-0.054^{***}	-0.051^{***}	-0.011	-0.012^{*}	-0.013^{*}	-0.051^{***}
	[0.000]	[0.000]	[0.147]	[0.093]	[0.081]	[0.000]
LTA_{it-1}	-0.001	0.001	0.005	0.004	0.005	0.002
	[0.893]	[0.816]	[0.155]	[0.359]	[0.268]	[0.604]
ROA_{it-1}	-0.176^{***}	-0.186^{***}	-0.188^{***}	-0.206^{***}	-0.210^{***}	-0.177^{***}
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]

Table 4 Cont.

ΔGDP_{it}	0.011*	0.012*	0.003	0.017**	0.019***	0.099***
	[0.075]	[0.058]	[0.717]	[0.028]	[0.008]	[0.008]
ΔINF_{it}	-0.051***	-0.049***	-0.010	-0.048***	-0.063***	-0.016**
	[0.000]	[0.000]	[0.492]	[0.000]	[0.000]	[0.041]
CAS_{it}		0.093***				0.051***
		[0.007]				[0.000]
ACR_{it}			0.134***			-0.074
			[0.001]			[0.188]
DSP_{it}				0.057**		0.048
				[0.037]		[0.138]
PRM_{it}					0.095**	0.131**
					[0.030]	[0.018]
Constant	4.804***	4.646***	2.251**	1.775*	1.622	2.817**
	[0.000]	[0.000]	[0.049]	[0.093]	[0.149]	[0.021]
No. of observations	1037	1037	1036	1037	1037	1037
No. of instruments	42	43	43	43	43	46
No. of groups	224	224	225	224	224	224
AR(1)test(p-value)	0.000	0.000	0.000	0.000	0.000	0.000
AR(2)test(p-value)	0.9845	0.996	0.783	0.7591	0.6361	0.8862
Sargan test(p-value)	0.1192	0.141	0.086	0.0719	0.0785	0.1237

Note: Banking stability (STB_{it}) with a proxy of the logarithm of z-score is used as the dependent variable. FLQ_{it} is funding liquidity with a measure of deposits to total assets; bank size (LSZ_{it}) has a measure with the logarithm of banks' total assets; loan composition (LTA_{it}) has the proxy of loans divided by total assets; profitability(ROA_{it}) has a measure of net income to total assets and capital(ETA_{it}) has a measure of equity to total assets. CAS is capital stringency, ACR_{it} is activity restrictions, DSP_{it} is supervisory power, and PRM_{it} is private monitoring. ΔGDP_{it} represents yearly economic growth rate, and ΔINF_{it} stands for the inflation rate. *, ** and *** represents statistical significance at 10, 5, and 1% level, respectively.

The coefficients of funding liquidity are found to be negative and statistically significant at the 5 % level in all specifications. This shows that the funding liquidity is negatively associated with financial stability, indicating that banks with higher funding liquidity are likely to be less stable. Regarding the magnitude of coefficients, the estimates which have minor differences range from low 0.020 to high 0.031, suggesting that an increase in the funding liquidity reduces financial stability by 0.020 and 0.031. The result is in concordance with the theoretical prediction (Bryant, 1980; Diamond and Dybvig, 1983). This finding implies that banks tend to take excessive risks. In fact, excessive risk-taking behavior per se is a risk determinant which hence leads to financial instability (Acharya and Naqvi, 2012).

Regarding other bank-specific factors, most coefficients are statistically significant, with predicted signs. The bank size is negative and statistically significant at the 1 % significance level, implying that large banks are generally engaged in more risky investment, with the expectation of government bailout and liquidity assistance from the lender of last resort in the case of the financial stress (Distinguin et al., 2013). These findings are consistent with the too-big-to-fail theory (Farhi and Tirole, 2012) as well as the previous empirical studies (Ashraf et al., 2016; Laeven et al., 2016; Schwerter, 2011). The coefficients of bank capital and profitability enter significantly negative. The results indicate that financial stability is negatively correlated with profitability and is consistent with previous literature (Ibrahim and Rizvi, 2017). Moreover, higher capital castigates bank activities and decreases the financial stability of the banking system, and this result is in line with the existing literature (Noman et al., 2018). However, the coefficients of loan composition which turn positive are not statistically significant.

Turning to the bank regulation, coefficients are statistically significant in most specifications. Capital stringency(CAS) and private monitoring (PRM) are positively associated with financial stability in both individual and joint specifications, while the supervisory power(DSP) and activity restrictions(ACR) have positive effects on financial stability, but again the effects of latter are only significant for the individual specifications. On average, 1% increases in capital stringency and private monitoring improve financial stability by 0.093 and 0.095, respectively. Surprisingly, the joint model in column 6 shows the effect of private monitoring increases almost twice, while capital stringency decreases by approximately half as compared to individual specifications in columns 2 to 5. We also find that the supervisory power(DSP) and restrictions(ACR) are significantly positive in individual specifications, suggesting 1% increases in the supervisory power and activity restrictions enhance financial stability by 0.057 and 0.134 accordingly. Overall, the results indicate that the existence of regulations encourages banks to strengthen risk management. These are consistent with our previous predictions and, in addition, they support literature (Ben Bouheni, 2014; Klomp and De Haan, 2012; Noman et al., 2018).

Considering country control variables, the coefficients of GDP growth enter significantly positive, suggesting that a higher growth rate of GDP causes financial stability, while inflation estimates are negatively associated with financial stability. This implies that the stability of the banking system is expected to be more improved when banks work in less inflation and stronger economic growth environment. The results are in line with our previous expectations and existing literature as well (Ibrahim and Rizvi, 2017; Noman et al., 2018).

Interaction results

Table 4 reports the empirical results based on the use of interaction terms with bank size and regulations. The coefficients of bank size and bank regulations reflect the conditional influences of these factors on financial stability. Column 1 and 2 in Table 4 report the interaction effects of funding liquidity and bank size on financial stability. In columns 3 to 6, the four variables of bank regulations have interacted with funding liquidity. Column 7 presents financial crisis interacted with funding liquidity.

Table 5 Interaction effects of funding liquidity and financial stability

	Bank size		Bank regulations				Crisis
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
STB_{it-1}	0.418***	0.435***	0.522***	0.581***	0.490***	0.479***	0.428***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
FLQ_{it-1}	-0.026***	-0.025***	-0.019***	-0.016**	-0.022***	-0.021***	-0.017***
	[0.000]	[0.000]	[0.001]	[0.012]	[0.001]	[0.007]	[0.005]
LSZ_{it-1}	-0.232***	-0.229***	-0.352***	-0.283***	-0.197***	-0.281***	-0.327***
	[0.001]	[0.001]	[0.000]	[0.000]	[0.007]	[0.000]	[0.000]
ETA_{it-1}	-0.065***	-0.065***	-0.018**	-0.017**	-0.012	-0.019***	-0.056***
	[0.000]	[0.000]	[0.012]	[0.019]	[0.103]	[0.009]	[0.000]
LTA_{it-1}	-0.006	-0.005	-0.007	-0.006	0.003	-0.007	-0.008*
	[0.226]	[0.332]	[0.116]	[0.157]	[0.446]	[0.115]	[0.081]
ROA_{it-1}	-0.187***	-0.183***	-0.202***	-0.199***	-0.206***	-0.197***	-0.172***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
ΔGDP_{it}	0.021**	0.020**	0.017**	0.010	0.015*	0.018**	-0.002
	[0.014]	[0.023]	[0.025]	[0.172]	[0.057]	[0.014]	[0.734]
ΔINF_{it}	-0.066***	-0.066***	-0.028**	-0.026**	-0.047***	-0.025**	0.067***
	[0.000]	[0.000]	[0.025]	[0.041]	[0.000]	[0.036]	[0.000]
$FLQ \times LSZ_{it}$	-0.001**	-0.001**					
	[0.035]	[0.020]					
CAS_{it}		0.019	-0.133*				
		[0.755]	[0.081]				
$FLQ_{it} \times CAS_{it}$			0.003***				
			[0.001]				
ACR_{it}		0.016		-0.080			
		[0.744]		[0.317]			
$FLQ_{it} \times ACR_{it}$				0.002***			
				[0.009]			
SUP_{it}		0.009			0.009		
		[0.852]			[0.721]		
$FLQ_{it} \times SUP_{it}$					0.001**		
					[0.016]		
PRM_{it}		0.037				0.021	
		[0.545]				[0.680]	
$FLQ_{it} \times PRM_{it}$						0.001	
						[0.371]	
$FLQ_{it} \times Crisis_t$							-0.002**
							[0.030]
Constant	5.192***	4.567***	4.861***	3.833***	1.814	3.895***	5.067***
	[0.000]	[0.000]	[0.000]	[0.001]	[0.101]	[0.002]	[0.000]
No. of observations	999	999	1037	1037	1037	1037	1037
No. of instruments	43	47	44	44	44	44	43
No. of groups	219	219	224	224	224	224	224
AR(1):p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(2):p-value	0.784	0.762	0.746	0.860	0.800	0.492	0.701
Sargan test:p-value	0.082	0.102	0.135	0.118	0.078	0.074	0.211

Note: Banking stability (STB_{it}) with a proxy of the logarithm of z-score. FLQ_{it} is funding liquidity with a measure of deposits to total assets; bank size (LSZ_{it}) has a measure with the logarithm of banks' total assets; loan composition (LTA_{it}) has the proxy of loans divided by total assets; profitability(ROA) has a measure of net income to total assets, and capital (ETA_{it}) has a measure of equity to total assets. CAS_{it} is capital stringency, ACR_{it} is activity restrictions, DSP_{it} is supervisory power, and PRM_{it} is private monitoring. ΔGDP_{it} represents yearly economic growth rate, and ΔINF_{it} stands for the inflation rate. *, ** and *** represents statistical significance at 10, 5, and 1% level, respectively.

We find that effect of funding liquidity and bank size is negatively associated with financial stability, with our previous expectation. A 1% increase in bank size raises the effect of funding liquidity on financial stability

by 0.001 in a year. In other words, a standard deviation rise in bank size elevates the impacts of the funding liquidity on financial stability by 0.00218 percentage points[1]. This implies that bank size weakens the financial stability. It is because banks engage in excessive risks, with expectation for a bailout in the case they face economic stress. The results are consistent with the literature (Laeven et al., 2016).

In contrast, the coefficients of other interaction terms(i.e., bank regulations) in columns 3 to 6 are significantly positive, except for private monitoring which is found to be nonsignificant. In terms of magnitude, the interaction effects of funding liquidity and capital stringency, supervisory power, and activity restrictions on financial stability are 0.003, 0.002, 0.001, respectively. The results suggest that bank regulations have a significant effect on the relationship between funding liquidity and financial stability. More specifically, stricter capital stringency and strong supervisory power strengthen the financial stability. The most striking result to emerge from the finding is that the effect of funding liquidity on financial stability is positively associated with activity restrictions, implying freeing bank activities improves financial stability. Activity restrictions are believed to increase risk-taking behavior if bank activities are not restricted. In doing so, they reduce financial stability. Thus, the overall results imply that funding liquidity is more sensitive to changes in bank regulations. Moreover, we find that the effect of funding liquidity on the financial crisis is negatively associated with the financial crisis, suggesting that the financial instability is more substantial during the recent financial crisis. We find significantly negative coefficients for capital, profitability, and inflation. Meanwhile, the coefficients of GDP enter positive.

CONCLUSION AND POLICY IMPLICATIONS

This paper investigates whether the effect of funding liquidity on financial stability differs depending on bank size and bank regulations, using bank-level data for BRICS countries. To the best of our knowledge, there has been little discussion about the direct and indirect effects of funding liquidity on financial stability. A better understanding of how funding liquidity affects the financial stability of the banking system is of paramount importance for policies related to, in particular, banks operating in emerging economies. In fact, the banking system is key players in economic development, especially in emerging economies. The paper uses a sample of 254 banks working in the BRICS countries from the period between 2005 and 2014. The paper applies two-step system GMM estimation techniques. It is worth noting that the empirical results show that coefficients of lagged financial stability are statistically significant and positive in all specifications, implying that financial stability lasts from one year to subsequent year and, again, there the dynamic effect of financial stability is observed.

The results reveal that liquidity funding and bank size are significant and negatively associated with financial stability at the 5% level of significance, while bank regulations are positively correlated with financial stability of the banking system, suggesting that strict capital regulation and supervisory control improve financial stability, while less supervisory controls on bank activities also have significant positive effects on the stability. However, in contrast, bank size weakens the stability of banks because the impact of liquidity funding on financial stability is negatively associated with the bank size. Moreover, the interaction action effect of funding liquidity and financial is more substantial during the recent global financial crisis.

The findings of this study have a number of policy implications. Firstly, it indicates that the interaction effects of funding liquidity, bank regulations and bank size on financial stability are significant, implying that bank funding liquidity and financial stability show intricate relationship instead of a linear relationship. Secondly, the results support the arguments favoring stricter bank capital requirement, and supervisory controls can help constrain the tendency of banks to take excessive risks and mitigate the adverse impacts of bank size on financial stability. Large bank size hurts the stability of the banking industry as it increases greater risk-taking behavior and leads to an increase in the probability of bank default. This paper underscores the importance of further research to examine funding liquidity and financial stability to draw a solid conclusion and more banks with similar characteristics.

[1] 0.00218=0.001×2.18(standard deviation of bank size)

REFERENCES

Acharya and Naqvi, Hassan. (2012) The seeds of a crisis: A theory of bank liquidity and risk taking over the business cycle. *Journal of Financial Economics*. 106(2), pp. 349-366.

Ashraf, Dawood, Rizwan, Muhammad Suhail and L'Huillier, Barbara. (2016) A net stable funding ratio for Islamic banks and its impact on financial stability: An international investigation. *Journal of Financial Stability*. 25, pp. 47-57.

Balcilar, Mehmet, Bonato, Matteo, Demirer, Riza and Gupta, Rangan. (2018) Geopolitical risks and stock market dynamics of the BRICS. *Economic Systems*. 42(2), pp. 295-306.

Barth, James, Caprio, Gerard and Levine, Ross. (2004) Bank regulation and supervision: what works best?. *Journal of Financial Intermediation*. 13(2), pp. 205-248.

Barth, James R, Lin, Chen, Ma, Yue, Seade, Jesús and Song, Frank M. (2013b) Do bank regulation, supervision and monitoring enhance or impede bank efficiency?. *Journal of Banking & Finance*. 37(8), pp. 2879-2892.

Beccalli, Elena, Anolli, Mario and Borello, Giuliana. (2015) Are European banks too big? Evidence on economies of scale. *Journal of Banking & Finance*. 58, pp. 232-246.

Ben Bouheni, Faten. (2014) Banking regulation and supervision: can it enhance stability in Europe?. *Journal of Financial Economic Policy*. 6(3), pp. 244-269.

Blundell, Richard and Bond, Stephen. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics*. 87(1), pp. 115-143.

Boudt, Kris, Paulus, Ellen C.S. and Rosenthal, Dale W.R. (2017) Funding liquidity, market liquidity and TED spread: A two-regime model. *Journal of Empirical Finance*. 43, pp. 143-158.

Broll, Udo, Guo, Xu, Welzel, Peter and Wong, Wing-Keung. (2015) The banking firm and risk taking in a two-moment decision model. *Economic* Modelling. 50, pp. 275-280.

Bryant, John. (1980) A model of reserves, bank runs, and deposit insurance. *Journal of banking & finance*. 4(4), pp. 335-344.

De Jonghe, Olivier, Diepstraten, Maaike and Schepens, Glenn. (2015) Banks' size, scope and systemic risk: What role for conflicts of interest?. *Journal of Banking & Finance*. 61, pp. S3-S13.

Deli, Yota D and Hasan, Iftekhar. (2016) Real effects of bank capital regulations: Global evidence. *Journal of Banking & Finance*.

Demir, Ender and Ersan, Oguz. (2017) Economic policy uncertainty and cash holdings: Evidence from BRIC countries. *Emerging Markets Review*. 33, pp. 189-200.

Diamond, Douglas W and Dybvig, Philip H. (1983) Bank runs, deposit insurance, and liquidity. *Journal of political economy*. 91(3), pp. 401-419.

Distinguin, Isabelle, Roulet, Caroline and Tarazi, Amine. (2013) Bank regulatory capital and liquidity: Evidence from US and European publicly traded banks. *Journal of Banking & Finance*. 37(9), pp. 3295-3317.

Drehmann, Mathias and Nikolaou, Kleopatra. (2013) Funding liquidity risk: definition and measurement. *Journal of Banking & Finance*. 37(7), pp. 2173-2182.

Farhi, Emmanuel and Tirole, Jean. (2012) Collective moral hazard, maturity mismatch, and systemic bailouts. *The American Economic Review*. 102(1), pp. 60-93.

Gennaioli, Nicola, Shleifer, Andrei and Vishny, Robert W. (2013) A model of shadow banking. *The Journal of Finance*. 68(4), pp. 1331-1363.

Ibrahim, Mansor H and Rizvi, Syed Aun R. (2017) Do we need bigger Islamic banks? An assessment of bank stability. *Journal of Multinational Financial Management*. 40, pp. 77-91.

Kashyap, Anil K, Rajan, Raghuram and Stein, Jeremy C. (2002) Banks as liquidity providers: An explanation for the coexistence of lending and deposit- taking. *The Journal of Finance*. 57(1), pp. 33-73.

Khan, Muhammad Saifuddin, Scheule, Harald and Wu, Eliza. (2017) Funding liquidity and bank risk taking. *Journal of Banking & Finance*. 82, pp. 203-216.

Klomp, Jeroen and De Haan, Jakob. (2012) Banking risk and regulation: Does one size fit all? *Journal of Banking & Finance*. 36(12), pp. 3197-3212.

Laeven, Luc and Levine, Ross. (2009) Bank governance, regulation and risk taking. *Journal of Financial Economics*. 93(2), pp. 259-275.

Laeven, Luc, Ratnovski, Lev and Tong, Hui. (2016) Bank size, capital, and systemic risk: Some international evidence. *Journal of Banking &* Finance. 69(1), pp. S25-S34.

Lepetit, Laetitia and Strobel, Frank. (2013) Bank insolvency risk and time-varying Z-score measures. *Journal of International Financial Markets, Institutions and Money*. 25(3), pp. 73-87.

Luo, Yun, Tanna, Sailesh and De Vita, Glauco. (2016) Financial openness, risk and bank efficiency: Cross-country evidence. *Journal of Financial Stability*. 24, pp. 132-148.

Mensi, Walid, Hammoudeh, Shawkat, Reboredo, Juan Carlos and Nguyen, Duc Khuong. (2014) Do global factors impact BRICS stock markets? A quantile regression approach. *Emerging Markets Review*. 19, pp. 1-17.

Mohamed, Dahir Ahmed, Binti, Mahat Fauziah and Bin, Ali Noor Azman. (2018) Funding liquidity risk and bank risk-taking in BRICS countries: An application of system GMM approach. *International Journal of Emerging Markets*. 13(1), pp. 231-248. doi: doi:10.1108/IJoEM-03-2017-0086

Moutsianas, Konstantinos A and Kosmidou, Kyriaki. (2016) Bank earnings volatility in the UK: Does size matter? A comparison between commercial and investment banks. *Research in International Business and Finance*. 38, pp. 137-150.

Noman, Abu Hanifa Md, Gee, Chan Sok and Isa, Che Ruhana. (2018) Does bank regulation matter on the relationship between competition and financial stability? Evidence from Southeast Asian countries. *Pacific-Basin Finance* Journal. 48, pp. 144-161.

Roodman, David. (2009b) A note on the theme of too many instruments. *Oxford Bulletin of Economics and statistics*. 71(1), pp. 135-158.

Schwerter, Stefan. (2011) Basel III's ability to mitigate systemic risk. *Journal of financial regulation and compliance*. 19(4), pp. 337-354.

Shleifer, Andrei and Vishny, Robert W. (2010) Unstable banking. *Journal of financial economics*. 97(3), pp. 306-318.

Strahan, Philip. (2010) Liquidity production in 21st century banking: National Bureau of Economic Research.

Uhde, Andr é. (2016) Risk-taking incentives through excess variable compensation: Evidence from European banks. *The Quarterly Review of Economics and* Finance. 60, pp. 12-28.

Umar, Muhammad, Sun, Gang, Ashton, JohnKevin and Ashton, JohnKevin. (2016) Interaction among funding liquidity, liquidity creation & stock liquidity of banks: evidence from BRICS countries. *Journal of Financial Regulation and* Compliance. 24(4).

Vazquez, Francisco and Federico, Pablo. (2015) Bank funding structures and risk: Evidence from the global financial crisis. *Journal of banking & finance*. 61(6), pp. 1-14.