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Market Competition and Liquidity Risk: Lessons from Malaysia

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ABSTRACT

This study investigates the influence of market competition (MC) on liquidity risk (LR) for conventional and Islamic banks in Malaysia. The research analyses two data sets comprising 17 Islamic and 27 conventional banks over the period of 1996–2015 using panel regression estimations. MC is measured using the Herfindahl–Hirschman index, concentration ratio, and entropy index. Meanwhile, LR is measured by the traditional and BASEL III measures using current asset to current liability ratio and net stable funding ratio, respectively. Market competition among Islamic banks has a significant positive relationship with liquidity risk. By contrast, results for conventional banks are inconclusive. This result indicates that Islamic banks need a certain degree of market power to manage liquidity risk. Thus, policy makers, regulators, and industry players should utilize a unique framework for Islamic and conventional banks when strategizing liquidity risk management. This study is the first comprehensive empirical research that compares the MC-LR relationship between Islamic and conventional banks using both traditional and BASEL III liquidity risk measures.

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INTRODUCTION

Instability in the banking system has intensified since the 2007 global financial crisis. The importance of effectively managing liquidity risk (LR) has been proven by the experience of several banks in developed countries facing liquidity pressures resulting from the financial market turmoil. From a risk management perspective, liquidity is similar to 'oxygen' that determines the survival and existence of a bank. Efficient LR management contributes to a consistent repayment of debt, constant balance of balance sheet, and an increased capability for banks to expand their intermediating role between surplus and deficit units (Ruozi and Ferrari, 2013). It is necessary, therefore, for banks to adequately substantiate liquidity position to boost performance whilst cushioning against failure due to unexpected financial panic.

Ironically, the concern on liquidity risk management has only been in the highlight in the aftermath of the global financial crisis, with the introduction of BASEL III liquidity requirements to remedy the banking sector. BASEL III has proposed the Liquidity Coverage Ratio (LCR) and Net Stable Funding ratio (NSFR) to ensure short-term and long-term sufficient liquidity in banking, respectively. While the notion of proposing these regulatory measures is to avoid excessive risk taking, yet the implementation incurs cost to the banks, leading to competitive environment. According to Mohammed et al. (2016), regulation plays a major role towards the change of market structure. They further added that the participation of Islamic banks in the banking industry also contribute to the change, as in the case of dual banking systems in Malaysia.

Since its inception, Islamic banking has gained its systematic importance in the Malaysian banking industry, making the market less concentrated throughout years (Ab-Rahim and Chiang, 2016). It has been documented that the growth of Islamic banking assets in Malaysia was approximately 23.8 percent in 2016 as compared to 23 percent in 2015 (IFSB, 2017). As at end 2017, Malaysia has total Islamic banking assets of US$204.4 billion and ranked third internationally after Iran and Saudi Arabia (The Malaysian Reserve, 2018). If this trend continues, Islamic banks will gain increasing market power and serve as a tough competition for conventional banks (Sahut et al., 2015). On the other side of the coin, the drastic growth of Islamic banking has raised doubts concerning whether Islamic banks will be capable of competing with conventional banking in the long run (Kabir and Worthington, 2017). This issue has raised the concern of market players, academicians, and policymakers on the bank performance, facing the current market structure of banking industry in the country.

Islamic banking, despites its different operations and risk profile (Abu Hussain and Al-Ajmi, 2012), is also exposed to liquidity risk like conventional banks but at a varying degree of exposure. As conventional banks have long benefited from variety options of liquidity instruments developed in money market, Islamic banks are restricted from such interest-based securities despites the availability of a small number of short-term Shariah compliant tools. Besides, Islamic banks further challenged by shallow secondary Islamic money market participants (Anam et al., 2012) to liquidate assets, rendering poor liquidity risk management. Consequently, Islamic banks faced difficult root to optimize the trade-off between being profitable and remaining liquid at a competitive playing field.

Given the distinct level of competition between Islamic banks and conventional banks (Ariss, 2010), the Relationship between market competition and liquidity risk (MC–LR relationship) for Islamic and conventional systems is expected to be different. Previous competition literature focus primarily on financial stability (Berger and Bouwman, 2009; Horvath et al., 2013), credit risk (Beck et al., 2006), and economic development (Claessens and Laeven, 2005). Little is known on how competition influence liquidity behavior in banking (Kim, 2012), especially after the 2007–2008 global financial crisis (Brunnermeier and Pedersen, 2009). Theory predicts that market competition (MC) may affect LR in two ways; either indirect or direct effect. For the former, MC may indirectly control the bank costs of holding reserves. A tradeoff exists between the banks' opportunity costs to forego returns from financing and the cost of obtaining funds that banks need to pay to the depositors. During high market competition, banks' profit margins are thinly spread, thereby often resulting in banks engaging in risky investment to compensate for low income and increase the LR among such banks. For the latter, MC may directly affect the income of banks from financing, thereby influencing banks' incentives to have excess reserves. If a bank holds reserves, then it influences the supply and demand of interbank market liquidity in terms of the prices of money market instruments. This scenario affects liquidity creation in money markets and LR faced by banks (Carletti and Leonello, 2018). While a number of documentation have been done on conventional banks (Kim, 2012, 2018; Nguyen et al., 2015; Jiang et al., 2016), it is remarkably scant on Islamic banks. Against this

background, the issue of MC-LR relationship among Islamic banks and conventional banks warrants further research.

The main objective of this study is to clarify the relationship between market competition (MC) and LR in the case of Malaysia. Thereafter, this research compares the risk behavior of conventional and Islamic banks. Malaysia is selected because it offers a dual banking system in the same financial landscape governed by a developed legal environment for both systems. That is, Islamic and conventional banks engage simultaneously and can compete fairly from a regulatory perspective. Nevertheless, conventional banks remain dominant in the Malaysian banking industry when compared with Islamic banks (Bank Negara Malaysia, 2015). Unlike conventional banks, the size of Islamic banks remains relatively small, although these banks experience increasing growth.

This study fills in the literature gap in two distinct methods. First, this research contributes to the academic knowledge in terms of filling in the gap in the existing literature concerning the MC–LR relationships by providing empirical evidence for Islamic and conventional banks. Although previous research focuses on cross-country studies for conventional banks, the current study compares whether the MC–LR relationships hold for the Islamic and conventional banking systems. To investigate the MC–LR relationship for the case of conventional banks, Kim (2012) and Joh and Kim (2012) adopted a cross-country sampling of 25 Organization for Economic Co-operation and Development countries (OECD). Nguyen et al. (2012) tested 38 selected developed countries. Nguyen et al. (2015) analysed 63 developing countries. Unlike cross-country studies, the present study analyses a similar issue in the context of the Malaysian banking industry by enriching the existing LR literature in terms of comparing the MC–LR relationships between Islamic and conventional banks. Initially, this study investigates whether MC affects LR of Islamic banks. Thereafter, we analyse whether MC affects LR of conventional banks, in either a similar or different direction or magnitude from the Islamic banks. Lastly, this study determines whether the other determinants of LR differ between conventional and Islamic banks.

Second, the current study contributes to the current literature in terms of the LR and MC specifications. Although Nguyen et al. (2015) used two liquidity measures (i.e., funding liquidity raised from deposits and other purchased funds and bank investment in asset liquidity) and Kim (2012) adopted four measures (i.e., ratio of credit lines, short-term wholesale funds, liquid assets, and liquidity creation to total assets), the liquidity measures in the present study are enriched by comparing the traditional measure (current asset to current liability ratio- CR) and the recent liquidity measure established by BASEL III (NSFR). From the aforementioned liquidity measures, CR and NSFR are then inversely inferred toward LR exposure. In terms of the MC measures, the current study utilizes a comprehensive MC specification based on a structural approach that comprises Herfindahl index (HHI), Concentration ratio (ConR), and Entropy index (EI). Moreover, high HHI and ConR imply low MC, while high EI infers high MC.

The remainder of this paper is structured as follows. Section 2 presents the literature review. Section 3 presents the data and methodology employed in the present study. Section 4 presents the empirical findings of the results in both banking systems. Lastly, Section 5 concludes the study.

LITERATURE REVIEW

The literature review section is divided into four subsections that outline the fundamental components of the issue analysed before exploring the theoretical linkage between MC and LR.

LR measures

Bank LR is defined as the risk that banks may be unable to meet their obligations owing to their inability to convert assets to cash (Basel III, 2013). Previous studies have analysed the LR behavior using various specifications, including financial ratios and recently the Basel III liquidity requirement measures. Instances of financial ratios are cash to total asset ratio (Akhtar et al., 2011; Anam et al., 2012; Iqbal, 2012; Abdelkarim, 2013; Ramzan and Zafar, 2014); total deposit to total asset ratio (Sulaiman et al., 2013); capital to total asset ratio (Abdullah and Khan, 2012); current asset to total liability ratio (Sulaiman et al., 2013); liquid assets raised from deposits and other purchased funds (Nguyen et al, 2015); credit line to asset ratio, short-term wholesale fund to total asset ratio, and liquidity creation to total asset ratio (Kim, 2015); liquid asset to total asset ratio (Ghenimi and Brahim, 2015; Kim, 2015;), loan to deposit and short-term funding ratio (Amin et al., 2017) and cash and short-term securities to total

asset ratio (Waemustafa and Sukri, 2016). After the introduction new LR measures by Basel III in 2010, a few studies have tested those measures but in the context of different data sampling and research objectives. Angora and Roulet (2011) studied the factors influencing liquidity among US and European banks. Cucinelli (2013) investigated the determinants of liquidity among European countries. Horvath et al. (2012) analysed capital–liquidity relationships in the Czech Republic. Brůna and Blahová (2016) analysed the systemic liquidity shocks on banking liquidity in the Czech Republic. Abdul-Rahman et al. (2017) investigated the effect of financing structure on LR in the Malaysian context.

Determinants of LR

Previous studies include bank-specific and external factors when comparing the determinants of LR between conventional and Islamic banks. Ghenimi and Brahim (2015) compared the LR (liquid assets to total assets) determinants for Gulf countries. They demonstrated that return on equity (ROE), net interest margin (NIM), capital adequacy ratio (CAR), and inflation (INF) have positive relationships for both banks, with the additional positive relationship of size (SIZE) in the case of conventional banks. Similarly, return on assets (ROA) and non-performing financing (NPF) have negative relationships with both types of banks, as well as SIZE and growth of gross domestic product (GDP) in the case of Islamic banks. The negative influence of SIZE supports the argument that Islamic banks in the Gulf remain small, thereby resulting in high LR exposure.

In the context of Pakistan, Akhtar et al. (2011) highlighted the positive relationships between SIZE and net working capital on LR (measured by cash to total assets) for both types of banks, with the additional factors of capital adequacy ratio (CAR) and ROA for Islamic banks. The results contradict the findings of Ramzan and Zafar (2014), which suggested that only SIZE matters in relation to LR (measured by cash to total assets) in the case of Islamic banks. Abdullah and Khan (2012) studied the Pakistani context (but pooled Islamic and commercial banks together to compare the behaviour of foreign and domestic banks) and determined that SIZE is negatively related to LR (measured by capital to total asset) for domestic banks but not for foreign banks. Overall, these inconsistent results may be the result of the different LR measures, differing samplings of banks and time periods of study, and different research methodologies used by the aforementioned researchers.

Anam et al. (2012) adopted only bank-specific factors to investigate the determinants of LR (measured as cash to total assets) among conventional and Islamic banks in Bangladesh. CAR and ROA, have positive relationships with LR, whereas ROE has negative relationships with LR for both types of banks. In addition, SIZE has a negative relationship with LR for conventional banks but a positive relationship with LR for Islamic banks. By contrast, for similar sampling periods of the same country, Iqbal (2012) improved the model by adding non-performing financing (NPF) in the framework. The result shows that CAR, ROA, ROE, and SIZE have positive relationships with LR, whereas NPF has a negative relationship with LR for both banking systems. The inconclusive finding infers that the influence of SIZE on LR is not robust and sensitive toward the different choices and specifications of the variables included in the LR research framework.

MC measures

The growth of competition after the financial liberalization in the 1990s has reduced the bank profits (Demetriades, et al. 2001). Many banks are entering the new markets and providing new products to customers to boost their returns. The early research on bank competitive environment in the banking industry only focuses on conventional banking. Past MC studies on various issues using conventional bank sampling were conducted by Chan et al. (2007) in the case of New Zealand and Australia, Sharma and Bal (2010) for India, Tushaj (2010) for Albania, and Stavarek and Repkova (2011) for the Czech Republic. The MC measures employed in previous studies differ across different data samplings and most of these studies adopted a single MC measure in their research. Nevertheless, the MC measures can be categorised into structural and non-structural approaches (Bikker and Haaf, 2002). The most extensively used MC measure under the structural approach is ConR, followed by HHI and EI, respectively. By contrast, the most popular MC measures under the non-structural approach are Panzar–Rosse index (PR) and Lerner index (LI). These approaches are used extensively in the context of single-country studies (Cupian, 2017; Bod'a, 2014; Gajurel, 2012; Stavarek and Repkova, 2011) or cross-country studies (Hakim and Chikr, 2014; Iuga, 2013; Turk-Ariss, 2010).

Meanwhile, MC studies on Islamic banks remain extremely limited. Al-Muharrami et al. (2006) determined that Islamic banks in the Gulf Cooperation Council (GCC) countries are competitive using the PR technique, HHI,

and ConR. Abdul Majid and Sufian (2007) used the same MC measures and determined that Malaysian Islamic banks operate in a monopolistic competition market structure.

MC and LR: Theoretical and empirical evidence

Two contradictory philosophies are involved in the MC–LR relationship. On the one hand, an inverse MC–LR relationship occurs when an increase in MC contributes to low LR. An increase in MC reduces the profits received by banks from lending and reduces the opportunity costs for banks to hold reserves, thereby increasing the reserves held by banks and reducing the LR exposure of banks. In the opposite scenario, the high cost of holding reserve during periods of low MC likely prompts the banks to reduce reserves, thereby possibly enticing them to offer loans to risky borrowers, increase NPF, and increase their LR (Petersen and Rajan, 1995; Carletti and Leonello, 2016).

On the other hand, the high MC leads to high LR, which appears to indicate a positive relationship between MC and LR. During intense MC, banks have less incentive to behave prudently: they become involved in risky activities that indirectly increase LR (Keeley, 1990, Carletti, 2008, and Carletti and Vives, 2009). That is, banks with less market power (high MC) undertake high LR by offering other loans, promoting additional funding, and decreasing liquid reserves. The result of such activities is high LR exposure.[1] In a reverse situation, banks in less competitive markets (high market power) typically gain high liquidity creation, thereby eventually reducing LR of such banks (Petersen and Rajan 1995).

Empirical evidence concerning the two possible relationships between MC and LR in the theoretical literature is scarce. Nguyen et al. (2015) studied the influence of market competition using the LI on bank LR (measured as liquid assets to short-term liability ratio and the ratio of money lent to a bank customer to the money borrowed by the bank) for 101 developed and emerging countries from 1996 to 2013. The findings of the aforementioned research indicated that relationship between market power and LR are is U-shape for the developed and developing economies. When market power increases (MC decreases), banks tend to increase their liquid assets, become net lenders in the interbank markets, thereby eventually reducing their LR. Nevertheless, banks hold limited liquid assets and become net interbank borrowers once they exceed a certain threshold of market power, thereby increasing bank LR. Given that Nguyen et al. (2015) focused on market power, the interpretation of the MC–LR relationship is "u-shape." Before the threshold level, the relationship is positive but negative after the threshold.

Jiang et al. (2016) studied the competition and liquidity creation of 15,081 banks in the US during the period from 1984 to 2006. LR is measured using four Berger and Bouwman (2009) liquidity creation measures that capture the on and off-balance sheet categories of liquid, semiliquid, or illiquid. Using interstate deregulation competition measures, the increasing competition reduces liquidity creation and increases LR. This finding contradicts Kim (2018), who determined that reducing competition encourages banks to take further LR.

Thus, the current study addresses gaps in the existing literature by comparing the MC–LR relationships among conventional and Islamic banks in Malaysia. In addition, although previous studies concerning MC used a non-structural approach (i.e., the LI), the current study contributes to the competition literature by investigating the issue under a structural approach (i.e., Herfindahl index (HHI), Concentration ratio (ConR), and Entropy index (EI)) as a method of analysing the effect of MC on LR. The structural approach establishes a causal relationship between the structural characteristic of market (i.e. level of concentration, firm's market share, number of firms and condition of entry) of given industries on their performance (Scherer and Ross, 1990). In contrast, the non-structural approach measures competition in the market directly without using any structural information about the market such as using efficiency structure (ES) hypothesis. The ES states that efficiency helps firm in increasing its market share and realizing profits. This study adopts structural measures of concentration as it can link concentration to competition directly, where higher level of concentration signals lower market competition. Moreover, by using structural measures, we can examine the evolution in the market structure of an industry for each year in contrast to non-structural measures, which need many input variables of the banking institutions (Mohammed et al., 2016). Previous studies on structural approach have adopted different measures, but there is still no unanimous view as to which one is the best measure; hence, we analyse the most common structural measures (ConR, HHI and EI) in investigating the MC-LR relationship.

[1] This view is supported by the descriptive statistics of Keeley (1990), which demonstrates that numerous bank collapses precede the increasing market competition in the US banking industry. Banks tend to engage in high-risk activities to protect their franchise values, whereas excessive risk taking simultaneously increases the probability of bankruptcy in banking institutions.

DATA AND METHODOLOGY

The research analyses two data sets comprising 17 Islamic and 27 conventional banks over the period of 1996–2015.[2] The following sections provide details concerning the measurement of competition and explain the specifications of the model used in this study.

Measurement of Market Competition (MC)

The accurate measurement of MC has long been debated among researchers (Curry and George, 1983). A few MC measures are adopted to comprehensively capture different angles of MC. The current study employs the structural conduct paradigm (SCP) approach to measure MC. MC is calculated based on the model proposed by Sharma and Bal (2010), which utilized HHI, ConR, and EI. EI has been accepted as a straightforward measure of competition in economics studies (Nawrocki and Carter, 2010). Market share is calculated using the total assets for each year for both types of banking institutions. Table 1 presents the measures of MC used in the current study.

Specification of the model

The proposed model is developed to evaluate the relationship between MC and LR and includes other bank-specific and country-specific determinants of LR. The following model is estimated and modified based on previous studies by Kim (2012), Joh and Kim (2012), Nguyen et al. (2012), Yaacob et al. (2016), Lee et al. (2013), Mohammed et al. (2015), and Abdul-Rahman et al. (2018):

$$LQ_{it} = \beta_0 + \beta_* COMP_t + \beta_1 ROA_{i,t} + \beta_2 ROE_{i,t} + +\beta_3 SIZE_{i,t} + \beta_4 CAR_{i,t} + \beta_5 NPF_{i,t} + \beta_5 GDP_t + \beta_6 INF_t + \beta_7 AC_t + \beta_8 GC_t + \alpha_i + \mu_{it}$$

Table 1 Characteristic of competition measures

Measure	Formula	Ratio Range	Typical Characteristic
HHI	HHI= $\sum_{i=1}^{N} si^2$ where *si* is the market share of banks *i* in the market, and N is the number of banks. The HHI approach zero, the market perfectly competitive.	1/n = HHI = 1	Considers all banks; sensitive to entry of new banks
Concentration ratio ($ConR_n$)	$ConR_n = \sum_{i=1}^{n} si$ where *si* is the market share of ith bank in the market, and *n* defines the n^{th} banks. The ConR approach zero, the market perfectly competitive.	0 < $ConR_n$ =1	Takes only large banks into accounts
Entropy (EI)	EI= $-\sum_{i=1}^{N} s_i \ln s_i$ where s_i is the market share of banks *i* in the market, *In* is natural logarithm, and *N* is the number of banks. The higher of entropy, the higher the degree of competitiveness.tr	0 = EI = log n	Based on expected information content of a distribution.

Sources: Sharma and Bal (2010)

where $i = 1,2,\ldots N$ (number of banks); and $t = 1,2,\ldots T$ (years). The alternate LR (LQ_{it}) measures are the traditional measure, Current Ratio (*CR*), which is current asset to current liability (De Waal et al., 2013). While the weight for the *NSFR* based on Gobat et al. (2014). According to BASEL III, *NSFR* is determined by dividing available amount of stable funding (ASF) to required amount of stable funding (RSF). ASF is the share of a bank's funding structure that is trustworthy for one year, while the RSF is the share of a bank's assets and off balance sheet exposures that are perceived as illiquid for a year; thus, should be supported by stable funding sources. The alternate MC (COMP) variables are HHI ConR1, *ConR2*, *ConR4,* and *EI*. The bank-specific variables are profitability (*ROE, ROA)*, size of banks (*SIZE*), capital buffer (*CAR*), and non-performing financing (*NPF*). The macroeconomic variables are inflation (*INF*) and gross domestic product (*GDP*); while crisis dummies are the Asian crisis (*AC*) and global financial crisis (*GC*). Table 2 presents the detailed specifications of all variables.

With regard to the signs of the expected coefficients of bank- and country-specific variables, the predictions are based on the empirical findings and justifications from previous studies (Akhtar et al., 2011; Iqbal, 2011; Anam et al., 2012; Cucinelli, 2013; Sulaiman et al., 2013; Yaacob et al., 2016, Amin et al. (2017). For instance, based on the argument put forth by Amin et al. (2017), profitability (*ROA* and *ROE*) is expected to be positively related to

[2] In general, there have been 20 conventional banks in year 1996 and seven additional banks emerged in 2010-2012. For Islamic banks, around 12 Islamic banks (one full-fledge bank and 11 Islamic windows) in year 1996, followed by one additional full-fledge Islamic bank in 1999 before four new Islamic subsidiaries established in 2005-2006. The unbalance panel data are analysed using Stata data analysis package for both data sets.

liquidity due to the 'too big to fail' and 'gamble for resurrection', especially for large banks. Large banks, although during difficult time (low profit) tend to take riskier investment to rebound profit since there is always be a blanket guarantee by the government, which lead to less liquidity. In terms of size, there are two possibilities of outcomes. Positive relationship towards liquidity could be due to the benefits of economies of scale while the inverse relationship is in line with moral hazard theory of 'too big to fail'. With regards to capital buffer (*CAR*), is it expected to be negatively related with liquidity. This is consistent with the theory of risk absorption, high-capitalised firm are able to take more risk to bear unexpected shortfall, causing less liquidity. For asset quality (*NPF*), poor financing quality prevents banks to engage in riskier portfolio and increase liquidity. During good economic condition (*GDP*), the management is positive on the future prospect; thus spending more on financing portfolio rate than keeping liquidity. Finally, during high inflation (*INF*), banks prefer to hold liquidity due to decreasing profitability as a result from lower real rate of return.

This study adopts a static panel data approach where three models are estimated; namely; (i) pooled OLS, (ii) Random Effects and (iii) Fixed Effects model. Three tests are conducted in order to select the correct panel data model; (i) Poolability F-Test, (ii) Breusch-Pagan LM test and (iii) Hausman's specification test. Poolability F-Test is initially used to test whether the Fixed Effects model should be favoured instead of the pooled OLS model. Then the Breusch-Pagan LM test is used to determine if the Random Effects should be favoured instead of the pooled OLS. If the Fixed Effects and the Random Effects model both outperform the pooled OLS, then this study uses the Hausman's specification test to select which model is favoured. The null hypothesis in the LM test is that the variance across entities is zero. If Prob>chi2 is < 0.05 we reject the null and conclude that Random Effects is appropriate. The null hypothesis of Hausman test is that the preferred model is Random Effects vs. the alternative the Fixed Effects. If Prob>chi2 is < 0.05 (i.e. significant) use Fixed Effects. The diagnostic test for the Fixed Effect is robust standard errors. The null hypothesis is homoskedasticity (or constant variance). If Prob>chi2 is < 0.05 (i.e. significant), it shows the presence of heteroscedasticity, confirming that Fixed effect is the best model.

EMPIRICAL FINDINGS

Table 3 summarizes the descriptive statistics of all variables in the contexts of conventional and Islamic banking. It shows that the mean values of the liquidity ratio, CR, and NSFR for conventional banks are higher than those among Islamic banks. As regards MC among conventional banks, Among Islamic banks, *EI* is recorded to have the highest mean value (1.2920), whereas *HHI* has the lowest mean value (0.5531), although both values are relatively higher than their conventional counterparts. Higher *HHI* and *ConR (ConR1, ConR4)* infer lower MC, whereas higher *EI* implies higher MC (Nawrocki and Carter, 2010). Both *EI* and *HHI* are higher among Islamic banks compared to conventional banks. It suggests that the Islamic banking industry can be more concentrated or more competitive than the conventional banking industry depending on the indicators we choose. This is consistent with the contestable market theory that market concentration and competition can coexist (Baumol, 1982). The findings also support the opposition of *HHI* as an absolute measure of competition but rather market concentration. Therefore, the use of various measures of competition is important to produce robust findings.

Tables 4 and 5 respectively present the panel regression results for conventional and Islamic banks using traditional liquidity measure (*CR*) and BASEL III liquidity measure (*NSFR*). Based on the findings of LM Breusch-Pagan Lagrange Multiplier (LM) and Hausman test in Table 4 and 5, the best model for conventional banks and Islamic banks are Fixed Effect and Random Effect models, respectively. The significant findings of Robust Standard Errors for the case of conventional banks in table 4 and 5 confirm that Fixed Effect is the best model as it shows the presence of heteroscedasticity. The high values of *CR* and *NSFR* mean that banks hold high liquidity ratios, which lead to low liquidity risk exposures. In other words, high *CR* and *NSFR* imply low liquidity risk. Given that we study the influence of market competition on liquidity risk instead of liquidity position, the inference toward liquidity risk exposure is inversely related to the sign of coefficients between independent variables and *CR* and *NSFR* in Tables 4 and 5.

Table 2 Definition and interpretation of variables

Variables	Mnemonic	Definition	Variable Interpretation
Dependent Variables			
Liquidity variables:			
Current Ratio	*CR*[1]	Current assets / Current liabilities. > 100%	High *CR* implies high liquidity position and low liquidity risk exposure
Net Stable Funding Ratio	*NSFR*	Available amount of stable funding / Required amount of stable funding > 100%	High *NSFR* implies high liquidity position and low liquidity risk exposure
Independent Variables:			
Market competition:			
Herfindahl-Hirschman index	*HHI*	Sum of the squares of the market shares of every bank in the industry.	High *HHI* implies low market competition
Concentration ratio of one bank	*ConR1*	Market share of the largest bank	High *ConR* implies low market competition
Concentration ratio of two bank	*ConR2*	Market share of the two largest banks	
Concentration ratio of four bank	*ConR4*	Market share of the four largest banks	
Entropy	*EI*	- Σ(Each (market share) x (logarithm market share))	High *EI* implies high market competition
Bank-specific variables:			
Return of asset	*ROA*	Ratio of net income to total assets	
Return of equity	*ROE*	Ratio of total equity to total assets	
Bank size	*SIZE*	The natural logarithm of total assets	
Non-performing financing	*NPF*	Total non-performing financing divided by total financing	
Capital adequacy ratio	*CAR*	Total capital to risk-weighted asset	
Country-specific variables:			
Gross domestic product	*GDP*	The annual growth rate of Gross Domestic Product (%)	
Inflation	*INF*	The annual rate of consumer price index (%)	
CRISIS:			
Asian Crisis	*AC*	Dummy variable, 1=year 1997 and 1998	
Global financial Crisis	*GC*	Dummy variable, 1=year 2007 and 2008	

Source: All variables are collected from Bankscope database with the exception of *GDP* and *INF*, which are collected from GMDI.

Table 3 Descriptive Statistics

	Conventional banks				Islamic banks			
Variables	**Mean**	**Std.dev.**	**Skewness**	**Kurtosis**	**Mean**	**Std.dev.**	**Skewness**	**Kurtosis**
CR	1.4932	3.8603	0.0000	0.0000	0.8635	1.3667	0.0000	0.0000
NSFR	1.1438	3.8190	0.0000	0.0000	1.0453	1.1998	0.0000	0.0000
HHI	0.4874	0.0152	0.0000	0.0001	0.5531	0.0334	0.0012	0.0000
ConR1	0.2318	0.0674	0.0000	0.0000	0.5930	0.2399	0.0706	0.0000
ConR2	0.3912	0.0867	0.0000	0.0000	0.7443	0.1884	0.0009	0.0000
ConR4	0.5820	0.0919	0.0000	0.0000	0.8689	0.1037	0.0000	0.1889
EI	0.3878	0.0364	0.0000	0.0004	1.2920	0.5678	0.3536	0.0000
ROA	0.0113	0.0165	0.3917	0.0000	0.0349	0.1528	0.0000	0.0000
ROE	0.1103	0.1331	0.0000	0.0000	0.0757	0.6216	0.0000	0.0000
SIZE	6.4499	0.7050	0.0016	0.0065	6.7906	1.0135	0.4008	0.0002
CAR	0.1443	1.1667	0.0000	0.0000	0.1394	0.2455	0.0000	0.0000
NPF	0.2587	1.0220	0.0000	0.0000	0.0344	0.0818	0.0000	0.0000
GDP	4.8450	3.7356	0.0000	0.0000	4.8650	3.7362	0.0000	0.0000
INF	2.5150	1.2440	0.0000	0.2210	2.5150	1.2445	0.0000	0.2680

Table 4 Regression Results for Conventional and Islamic banks using Traditional Liquidity Risk Measure (*CR*)

		Panel A: Conventional Banks					Panel B: Islamic Banks				
	Exp. coeff. sign	Model 1	Model 2(a)	Model 2 (b)	Model 2 (c)	Model 3	Model 1	Model 2 (a)	Model 2 (b)	Model 2 (c)	Model 3
C		-10.647*** (1.630)	-6.309*** (1.300)	-5.708*** (1.331)	-6.519*** (1.354)	-2.128 (1.730)	7.615* (4.495)	4.151 (3.860)	4.538 (3.830)	2.51 (3.809)	1.544 (3.752)
HHI		-8.704*** (2.127)					7.361** (0.075)				
ConR1			-1.031*** (0.092)					1.042** (0.378)			
ConR2				-1.179*** (0.322)					2.030*** (0.652)		
ConR4					-0.129 (0.261)					2.416* (1.383)	
EI						2.614*** (0.662)					-0.296 (0.185)
ROA	+	0.361 (0.093)	0.008 (0.092)	0.011 (0.322)	-0.010 (0.095)	0.049 (0.093)	-0.062 (0.075)	-0.068 (0.074)	-0.067 (0.073)	-0.063 (0.076)	-0.054 (0.077)
ROE	+	-0.059 (0.0924)	-0.536 (0.919)	-0.041 (0.0924)	-0.011 (0.065)	-0.059 (0.092)	0.238** (0.116)	0.236** (0.115)	0.228** (0.114)	0.266** (0.117)	0.253** (0.119)
SIZE	+/-	2.218*** (0.728)	2.340*** (0.714)	2.301*** (0.7344)	3.199*** (0.719)	2.331*** (0.722)	-1.824 (1.793)	-1.932 (1.795)	-2.083 (1.783)	-1.346 (1.774)	-1.174 (1.786)
CAR	-	0.082 (0.055)	0.735 (0.054)	0.0707 (0.054)	0.063 (0.056)	0.086 (0.055)	0.068 (0.291)	0.060 (0.290)	0.051 (0.288)	0.084 (0.293)	0.113 (0.294)
NPF	+	-0.045 (0.036)	-0.059* (0.035)	-0.053 (0.036)	-0.083** (0.036)	-0.046 (0.036)	0108 (0.114)	0.118 (0.114)	0.147 (0.115)	0.071 (0.117)	0.025 (0.108)
GDP	-	0.104 (0.099)	0.084 (0.098)	0.052 (0.100	0.095 (0.101)	0.143 (0.099)	-0.095 (0.382)	-0.123 (0.382)	-0.148 (0.378)	-0.020 (0.391)	0.067 (0.382)
INF	+	-0.119 (0.109)	-0.113 (0.109)	-0.121 (0.109)	-0.122 (0.114)	-0.094 (0.109)	0.419 (0.265)	0.382 (0.266)	0.442 (0.260)	0.1794 (0.285)	0.227 (0.299)
AC		0.118 (0.270)	0.088 (0.268)	0.037 (0.271)	-0.333 (0.251)	0.049 (0.263)	-1.311 (1.090)	-1.340 (1.084)	-1341 (1.069)	-1.393 (1.100)	-1.283 (1.104)
GC		0.231* (0.138)	0.161 (0.139)	0.206 (0.139)	0.247* (0.141)	0.257* (0.138)	0.841** (0.314)	0.830** (0.309)	0.8255** (0.300)	0.923*** (0.307)	0.947*** (0.315)
R-squared		0.197	0.196	0.186	0.157	0.196	0.212	0.219	0.239	0.206	0.198
F-stats		6.81	6.74	6.33	5.17	6.74					
Prob (F)		0.000	0.000	0.000	0.000	0.000					
Wald Chi							32.16	33.36	36.32	30.40	29.31
Prob Chi							0.0004	0.0002	0.0001	0.0007	0.0011
Obs		312	312	312	312	312	128	128	128	128	128
LM test		chibar2(01) = 56.84 Prob > chibar2 = 0.0000	chibar2(01) = 56.96 Prob > chibar2 = 0.0000	chibar2(01) = 53.68 Prob > chibar2 = 0.0000	chibar2(01) = 38.82 Prob > chibar2 = 0.0000	chibar2(01) = 55.53 Prob > chibar2 = 0.0000	chibar2(01)= 5.09 Prob > chibar2 = 0.0120	chibar2(01) = 4.94 Prob > chibar2 = 0.0131	chibar2(01) = 6.18 Prob > chibar2 = 0.0065	chibar2(01) = 7.04 Prob > chibar2 = 0.0040	chibar2(01) = 5.46 Prob > chibar2 = 0.0097
Hausman test		chi2(8) = 22.54 Prob>chi2 = 0.0040	chi2(8)=30.31 Prob>chi2 =0.0002	chi2(8)= 24.46 Prob>chi2 = 0.0019	chi2(8) = 18.66 Prob>chi2 =0.0168	chi2(8) = 21.38 Prob>chi2 =0.0062	chi2(8)= 12.06 Prob>chi2 = 0.1487	chi2(8) =11.99 Prob>chi2 = 0.1548	chi2(8)=13.21 Prob>chi2 = 0.1050	chi2(8)= 13.34 Prob>chi2 = 0.1007	chi2(8) = 11.75 Prob>chi2 = 0.1629
Robust stand errors (hetero)		chi2 (26) = 1200.60 Prob>chi2 = 0.0000	chi2 (26) = 1580.90 Prob>chi2 = 0.0000	chi2 (26) = 1580.90 Prob>chi2 = 0.0000	chi2 (26)= 2172.83 Prob>chi2 = 0.0000	chi2 (26)= 1036.30 Prob>chi2 = 0.0000					

Note: Since CR implies liquidity creation, a higher value indicates lower liquidity risk. Robust standard errors in parentheses. ***, ** and * denotes significance at 1 %, 5% and 10% level respectively.

Table 5 Regression Results for Conventional and Islamic banks using BASEL III Liquidity Risk Measure - (*NSFR*)

		Conventional					Islamic				
	Exp. coeff. sign	Model 1	Model 2(a)	Model 2 (b)	Model 2 (c)	Model 3	Model 1	Model 2(a)	Model 2(b)	Model 2 (c)	Model 3
C		0.123 (0.82)	-1.352* (0.784)	-1.867** (0.825)	-1.258 (0.791)	-4.370*** (1.206)	1.593 (1.744)	0.537 (1521)	0.508 (1.520)	0.206 (1.512)	-0.360 (1.504)
HHI		3.711*** (1.127)					2.156** (0.971)				
ConR1			0.233** (0.115)					0.484** (0.224)			
ConR2				0.427** (0.154)					0.484** (0.224)		
ConR4					0.197* (0.118)					0.662 (0.160)	
EI						-1.356*** (1.206)					-0.078 (0.064)
ROA	+	0.0748 (0.060)	0.061 (0.061)	0.066 (0.060)	0.054 (0.0611)	0.077 (0.060)	-0.132*** (0.025)	-0.134*** (0.025)	-0.134*** (0.025)	-0.131*** (0.026)	-0.131*** (0.026)
ROE	+	-0.0839 (0.057)	-0.069 (0.058)	-0.075 (0.057)	-0.0706 (0.058)	-0.092 (0.057)	0.0532 (0.039)	0.055 (0.039)	0.055 (0.039)	0.060 (0.039)	0.056 (0.040)
SIZE	+/-	1.808*** (0.532)	1.192** (0.484)	1.498*** (0.505)	0.979** (0.456)	1.982*** (0.538)	-0.562 (0.715)	-0.573 (0.713)	-0.573 (0.713)	-0.450 (0.711)	-0.315 (0.727)

Table 5 Cont.

CAR	-	0.249***	0.240***	0.247***	0.230***	0.248***	-0.180*	-0.177*	-0.177*	-0.177*	-0.186*
		(0.053)	(0.054)	(0.054)	(0.054)	(0.053)	(0.105)	(0.105)	(0.105)	(0.106)	(0.108)
NPF	+	-0.057***	-0.053***	-0.057***	-0.056***	-0.058***	0.0594	0.612	0.063	0.0634	0.041
		(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.040)	(0.040)	(0.040)	(0.041)	(0.038)
GDP	-	-0.011	-0.005	0.008	-0.009	0.033	-0.020	-0.021	-0.021	-0.007	0.030
		(0.039)	(0.040)	(0.040)	(0.040)	(0.040)	(0.132)	(0.133)	(0.133)	(0.133)	(0.131)
INF	+	-0.056	-0.060	-0.058	-0.070	-0.066	0.040	0.049	0.049	0.071	0.102
		(0.044)	(0.044)	(0.044)	(0.045)	(0.043)	(0.091)	(0.091)	(0.091)	(0.090)	(0.092)
AC		-0.145	-0.045	-0.089	0.012	-0.159	-0.217	-0.228	-0.224	-0.242	-0.185
		(0.111)	(0.110)	(0.109)	(0.101)	(0.114)	(0.386)	(0.387)	(0.388)	(0.390)	(0.390)
GC		-0.889	-0.638	-0.708	-0.088	-0.902	0.111	0.113	0.127	0.139	0.153
		(0.057)	(0.057)	(0.056)	(0.056)	(0.058)	(0.112)	(0.111)	(0.109)	(0.109)	(0.111)
R-squared		0.20	0.174	0.187	0.172	0.214	0.355	0.356	0.354	0.349	0.344
F-stats		6.48	5.37	5.88	5.30	6.95					
Prob (F)		0.000	0.000	0.000	0.000	0.000					
Wald Chi							57.24	57.58	57.16	55.70	50.40
Prob Chi							0.0000	0.0000	0.0000	0.0000	0.0000
Obs		290	290	290	290	290	131	131	131	131	131
LM test		chibar2(01) = 214.43 Prob > chibar2 = 0.0000	chibar2(01) = 208.36 Prob > chibar2 = 0.0000	chibar2(01) = 211.43 Prob > chibar2 = 0.0000	chibar2(01) = 203.94 Prob > chibar2 = 0.0000	chibar2(01) = 216.65 Prob > chibar2 = 0.0000	chibar2(01) = 7.71 Prob > chibar2 = 0.0028	chibar2(01) = 7.79 Prob > chibar2 = 0.0026	chibar2(01) = 7.49 Prob > chibar2 = 0.0031	chibar2(01) = 6.51 Prob > chibar2 = 0.0054	chibar2(01) = 7.49 Prob > chibar2 = 0.0031
Hausman test		chi2(8) = 32.32 Prob>chi2 = 0.0001	chi2(8)= 29.95 Prob>chi2 = 0.0002	chi2(8)= 31.17 Prob>chi2 =0.0001	chi2(8) = 30.15 Prob>chi2 = 0.0002	chi2(8)= 33.23 Prob>chi2 =0.0001	chi2(8)=1 0.76 Prob>chi2 = 0.2157	chi2(8)=1 0.89 Prob>chi2 = 0.2079	chi2(8)=1 1.04 Prob>chi2 = 0.1995	chi2(8)=1 0.76 Prob>chi2 = 0.2158	chi2(8)=9. 85 Prob>chi2 = 0.2760
Robust stand errors(hetero)		chi2 (25) = 1.1e+32 Prob>chi2 = 0.0000	chi2 (25) = 3816.31 Prob>chi2 = 0.0000	chi2 (25) = 3908.06 Prob>chi2 = 0.0000	chi2 (25) = 5275.79 Prob>chi2 = 0.0000	chi2 (25) = 3874.08 Prob>chi2 = 0.0000					

Note: Since NSFR implies liquidity creation, a higher value indicates lower liquidity risk. Robust standard errors in parentheses. ***, ** and * denotes significance at 1 %, 5% and 10% level respectively.

For the traditional liquidity measure, Table 4 of Panel A demonstrates that *HHI* (Model 1) and *ConR* (Models 2(a) and 2(b)) are negatively related with CR. As concentration (*HHI* and *ConR*) increases, liquidity position (CR) decreases. An increase in concentration (*HHI* and *ConR*) infers a decrease in the level of competition (MC). Thus, the findings imply that when MC is reduced, conventional banks have a low liquidity position (*CR*), which results in high short-term LR exposure in the case of conventional banks. That is, reduced MC or increased concentration (inferred by increasing value of *ConR* and *HHI*) creates low *CR*, thereby inferring high LR exposure for conventional banks. The results are consistent with Carletti and Leonello (2018), who concluded that significant competition is more lucrative as it increases the opportunity cost of detaining liquid assets to provide financing that causes the banks to embark in risky activities and subsequently lead to increases in LR exposure. The results of Model 3 confirm the existence of an inverse relationship between MC and LR. The positive sign of *EI* implies that as MC increases (owing to increases in *EI*), *CR* increases, thereby leading to a decrease in LR. In summary, our findings for all models except Model 2(c) demonstrate that MC has an inverse relationship with LR for Malaysian conventional banks using traditional liquidity measure.

Interestingly, among Islamic banks, the results in Panel B demonstrate a positive relationship between concentration (*HHI* and *ConR*) measures and CR, leading to a decrease in LR exposure. When MC reduces, Islamic banks have a substantial liquidity position (*CR*), which results in low LR exposure. The findings support the results by Keeley (1990) and consistent with Mohammed et al. (2017). Keeley (1990) suggests that low competition increases bank charter values, which discourages Islamic banks from taking excessive risks that lead to low LR exposure. Meanwhile, Mohammed et al. (2017) show that both conventional banks and Islamic banks in Malaysia operate in the monopolistic competition structure. Against this view, the findings in this study affirm that the Islamic banks require market power to reduce LR exposure. The finding concerning *EI* also supports this inverse MC–LR relationship, though not statistically significant.

With regard to MC and LR using the BASEL III liquidity measure, the findings of *NSFR* for Islamic banks support our earlier findings concerning *CR*, but the result does not hold for the case of conventional banks. Instead, the results of conventional banks show that MC is positively related with *NSFR*, which is consistent with the

findings for Islamic banks. This finding implies that reducing MC among both conventional and Islamic banks could reduce LR exposure, thereby enhancing the stability of Islamic banks. The BASEL III liquidity measure promotes the existence of market power among conventional and Islamic banks to enable the efficient management of their LR exposure. The contradicting results for conventional banks for traditional and BASEL III measures reaffirm that it is relevant to revisit the LR literature by adopting the latest measure of liquidity.

For the other LR determinants, findings also show inconsistent results between the traditional and BASEL III measures. As BASEL III measure is deemed more accurate, the following discussion is based on findings from table 5. As regards bank-specific variables, *ROA* and *CAR* demonstrate an inverse relationship with *NSFR* in the case of Islamic banks, leading to an increase in LR exposure. Thus, a significant *ROA* and *CAR* could decrease the liquidity position, thus increasing LR exposure. The negative relationships of *ROA* and *CAR* with *NSFR* prove that increasing the profitability and capital buffers for Islamic banks decreases the liquidity ratio; thus, increasing LR exposure. The findings are consistent with Anam et al. (2012), but contradict with Amin et al. (2017). The rationale for the positive relationship between *ROA* and LR for both types of banks is that banks normally offer medium- to long-term investments (mortgage and vehicle financing), which may require time to gain returns. However, the sources of funds are mainly from deposits, which are liquid in nature. This maturity mismatch has caused the LR of banks to increase. Although *CAR* is negatively related to *NSFR* in the case of Islamic banks, it is positively related to *NSFR* in the case of conventional banks. The present findings imply that as *CAR* increases, long-term LR increases among Islamic banks. However, LR decreases in the case of conventional banks. Another two additional determinants for the case of conventional banks are *SIZE* and *NPF*. *SIZE* shows positive relationship with *NSFR*, indicating that bigger conventional banks have higher liquidity, hence, lower LR, conjecturing that the benefits of the economies of scale dominates in the industry. Meanwhile, *NPF* is inversely related to *NSFR*, inferring that poor credit quality does not prevent conventional banks to embark into risky portfolio that finally end up having higher LR. With respect to the macroeconomic variables, none of the indicators is a significant determinant of LR, showing that bank-specific variables play a major role in managing the liquidity risk management framework.

CONCLUSION

The present study aims to investigate the relationship between market competition and liquidity risk exposure using traditional (*CR*) and BASEL III liquidity measures (*NSFR*). In particular, the study compares the MC-LR relationship of Islamic banks with those of conventional peers in Malaysia while simultaneously validating the results using different liquidity risk measures. The findings show some evidences that market competition has a positive relationship with *NSFR* in the context of conventional and Islamic banking. Considering that *NSFR* measure liquidity levels, the interpretation of *NSFR* in relation to liquidity risk exposure is the opposite. That is, when market competition decreases (owing to an increase in *HHI* and *ConR* or a decrease in *EI*), banks provide more liquidity (via an increase in *NSFR*), which results in low liquidity risk exposure. These findings can be considered robust as majority of relationships hold, regardless of the different measures of market competition. Besides, the inconsistent findings between traditional and BASEL III measures acknowledge the relevancy of revisiting the liquidity studies using the latest measure.

A dual financial system that operates in the same financial landscape has influenced both conventional and Islamic banks in Malaysia to behave in a similar way with respect to market competition structure, though the other determinants may differ. The findings imply that the Islamic banking system has been enjoying revolutionary levels of growth over the last decade despite their current state of liquidity and market power. Due to a limited number of *Shariah* compliant money market instruments in a shallow market, Islamic banks need to have some degree of market power to enhance profitability and to survive against any adverse liquidity circumstances. In addition, in a less competitive market, Islamic banks can attain more information of their customers. If customers are considered as risky market segments (especially in equity-based financings or profit sharing contracts), then banks may offer a higher profit sharing rate to potential clients with high repayment rates as a way to prudential banking practice. Having high returns from partnership financing enables Islamic banks to have high liquidity creations and low liquidity risk.

One of the lessons learned from the findings is that policy makers and regulators like the central bank of Malaysia should promote the existing banking market with an ideal level of concentration and competition to allow

effective liquidity risk for both conventional and Islamic banking. In other words, both conventional and Islamic banks can better manage their liquidity risk when they operate in the monopolistic competition market structure environment, hence merger and acquisition program introduced by the central banks a few years ago suits well with the Malaysian banking industry. The second lesson is that the regulators should avoid a 'one-size-fits-all' approach because the behaviour of the liquidity risk exposure may differ between conventional and Islamic banking systems. As the determinants for both Islamic and conventional banks vary, the central bank of Malaysia may consider establishing a separate liquidity risk management framework for them. For future research, similar studies can be conducted to include cross-country analysis and different measures of market competition.

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