International Journal of Economics, Management and Accounting 31, no. 1 (2023): 153-176

NET STABLE FUNDING AND LIQUIDITY COVERAGE INFLUENCE ON *ISLĀMIC* BANK FINANCIAL STABILITY: EVIDENCE FROM MALAYSIAN *ISLĀMIC* BANKING

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ABSTRACT

The Islamic Financial Services Board (IFSB) endorsed Basel III liquidity guidelines by modifying the criteria to cater to the unique aspects of the *Islāmic* banking industry. This paper adopted the IFSB-modified guidelines to calculate the Net Stable Funding Ratio (NSFR) and Liquidity Coverage Ratio (LCR) of 15 Malaysian *Islāmic* banks from 2009 to 2020. We examined the NSFR and LCR impact on financial stability (Z-score) and profitability (return on assets) of Malaysian *Islāmic* banks, after controlling for bank-specific and macro-level variables. The results from Panel Corrected Standard Errors (PCSE) estimation indicate that NSFR has a positive significant impact on stability and profitability, suggesting that NSFR not only achieves its desired objective of long-term liquidity management by reducing assets and liabilities mismatches but also improves *Islāmic* bank profitability. The impact of LCR, however, is negative both on financial stability (but insignificant) and profitability, implying that LCR requirements do not help financial stability and discourage *Islāmic* bank profitability. Given this finding, it can be claimed that because of liquidity constraints and a shortage of quality money market instruments, *Islāmic* banks are forced to keep an important share of their assets idle to satisfy liquidity requirements, which in turn reduces their profitability. Considering these findings, we recommend policy makers revise and reform existing LCR guidelines for *Islāmic* banks. We also encourage *Islāmic* banks to establish liquidity-

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resilient and sustainable plans as part of an overall strategic plan, to improve on liquidity and profitability.

JEL Classification: C52, E52

Keywords: Net stable funding ratio, Liquidity coverage ratio, Financial stability, Banks liquidity, *Islāmic* banks

Submitted: 04/05/2022 Accepted: 17/10/2022 Published: 28/06/2023

1. INTRODUCTION

Malaysia is a model of *Islāmic* finance especially *Islāmic* banking because of the regulated nature and tremendous growth of the country's *Islāmic* banking and finance industry. As of 2020, Malaysia holds 11.4% of the global *Islāmic* banking assets, making up the third-largest jurisdiction of *Islāmic* banking assets (IFSB, 2021a). Among Southeast Asian nations, Malaysia has the largest *Islāmic* banking industry worth $210 billion. The Malaysian *Islāmic* banking industry is supported by a friendly regulatory environment and strong governmental support (IFSB, 2017). The growth of Malaysia's *Islāmic* banking industry is also supported by a well-established infrastructure, deep customer penetration, and the startup of digital *Islāmic* banking (IFSB, 2021a). Moody's Investors Service report (2020) shows that apart from the GCC region, Malaysia will help to drive future growth in *Islāmic* financial products, although the Covid-19 shocks will disrupt the issuance of *sukūk* in the country.

The Malaysian *Islāmic* banking industry commenced in 1983 with introduction of the first Malaysian *Islāmic* bank "Bank Islam Malaysia Berhad". After a decade, commercial banks in the country were granted permission to open *Islāmic* window operations, allowing them to offer *Islāmic* banking products (Abdul-Rahman, Sulaiman, and Said, 2018). Since its inception, *Islāmic* banks (including *Islāmic* windows and subsidiaries) had been regulated by the Islamic Banking Act of 1983 and the Banking and Financial Institutions Act of 1989. Nonetheless, both acts were superseded by the latest Islamic Financial Services Act (IFSA 2013) and the Financial Services Act (FSA, 2013) to enhance the banking system governing efficiency.

In 2007-08, the financial crises highlighted extensive loopholes in the global financial system, particularly related to liquidity management, as banks failed to meet depositors' obligations. Brunnermeier and Pedersen (2009) argued that the global financial

crises uncovered shortcomings in the banking system's existing liquidity risk management guidelines and revealed weaknesses in the enforced Basel II guidelines. Following the financial crises and liquidity stress, various standard-setting bodies, such as the Financial Stability Board (FSB), International Organization of Securities Commission (IOSCO), Basel Committee on Banking Supervision (BCBS), and International Association of Insurance Supervisors (IAIS), issued numerous improvements in existing regulatory frameworks to reduce the possibility of future financial turmoil (IFSB, 2021b). Among these policy frameworks, the BCBS Basel III liquidity guidelines were the most impactful and received significant attention from policymakers and academics.

The Basel III regulatory accord introduced revised principles of liquidity risk management (2008) and two quantitative measures--Liquidity Coverage Ratio (LCR 2013) and Net Stable Funding Ratio (NSFR 2014) -- to tackle the liquidity risk and improve its management (Mennawi and Ahmed, 2020) **(1)**. These new frameworks were aimed at restricting banks' investment options and risk strategies to sort out issues in both short and long-term liquidity management (Abbas et al., 2022). Both measures intend to expand banks' liquidity support and financial stability. Specifically, LCR aims at ensuring banks have enough liquidity to ensure short-term, up to one-month, coping with liquidity problems. The NSFR intends to guarantee that banks have sufficient stable assets to solve long-term liquidity problems for one year. NSFR addresses more basic changes in the asset-liability liquidity mismatch.

The Islamic Financial Services Board (IFSB), the standard-setting body of the *Islāmic* banking industry, endorsed the Basel III regulatory framework in 2015 after necessary adjustments due to differences in *Islāmic* Bank assets and liabilities. The IFSB modified regulatory framework provided guidelines for calculating of LCR and NSFR for the *Islāmic* banking industry **(2)**. Ashraf, Rizwan, and Huillier (2016) noted that the main differences between the Basel III and IFSB regulatory guidelines are on the account of *Mushārakah*, *Ṣukūk*, *Istiṣnā'*, *Salam*, *Qarḍul-ḥasan*, Profit-Sharing Investment Accounts (PSIA), and Profit-Sharing Investment Accounts-Restricted (PSIA-R).

Bank Negara Malaysia (BNM) issued directives to banks operating in Malaysia to ensure that the Malaysian banking sector remains resilient, liquid, and solvent. BNM issued LCR and NSFR guidelines, which came into effect in June 2015 and July 2020,

respectively. Initially, the NSFR requirements were lowered to 80% and planned to increase to 100% from 30th September 2021 (Sundra and Low, 2021). These liquidity requirements are being phased in to give banks sufficient time to prepare for the new guidelines. In quarterly stability reports, BNM reported stable liquidity and funding conditions in the Malaysian banking system (BNM, March 2021 and June 2021). The aggregated levels of NSFR and LCR were 116% and 148 %, respectively, in the Malaysian banking industry by the end of 2020 (BNM, March 2021). Undoubtedly, after these reforms, the banking sector now has a stronger liquidity position, but such excess liquidity might lead to a reduction in banks' other performance indicators such as ROA and ROE.

Although the LCR and NSFR guidelines have been implemented, the net impact of these new regulatory requirements on banking performance remains unknown. A growing body of literature has focused on the impact of these new regulatory requirements on banking institutions' profitability and stability. This growing literature capitalizes on the argument that these newly enforced NSFR and LCR guidelines can be estimated from existing data, and their potential effects can be estimated on banking indicators retrospectively (Ashraf et al., 2016). Admati et al. (2013) documented that these new regulatory capital requirements (NSFR and LCR) diminish the chances of financial chaos and bank insolvency and prompt more capital and liquidity-proficient business plans and products. Likewise, Chalermchatvichien et al. (2014), using data from 68 banks in 11 East Asian economies, reported an inverse relationship between NSFR requirements and bank risk-taking behavior. Hence, higher LCR and NSFR requirements diminish banks' risk-taking abilities and chances of financial crises, leading to higher stability.

Yan, Hall and Turner (2012) used data from 11 UK banks and concluded that higher regulatory capital requirements lowered expected losses from banking crises but also reduced bank profitability. Using bank data from 15 countries, King (2013) reported the adverse effects of NSFR requirements on the economy because NSFR requirements shrink the bank balance sheet and change the composition of assets or their maturity. Similarly, Angelini et al. (2015) argued that implementing harder rules and regulations leads to high costs and may potentially reduce a country's GDP by increasing company and household borrowing costs. Specifically, the standards identifying with NSFR will restrict bank capacity to take on rewarding projects, as higher returns are associated with higher risk. Conforming to NSFR and LCR may potentially decrease bank profitability. Hence,

banks are confronted with a trade-off between risk and return resulting from higher regulatory capital requirements. Higher regulatory capital requirements improve bank stability; however, they may diminish profitability by reducing lending ability by imposing higher borrowing costs (Dolgun, Mirakhor, and Ng, 2019). Hence, it is important to strike a balance between liquidity and profitability to attain the maximum desired output.

Most past studies either examined the impact of the BCBS-NSFR on the stability of commercial banks (Giordana and Schumacher, 2017) or used BCBS-NSFR to examine its impact on *Islāmic* bank stability (Abbas et al., 2022). Unlike conventional banks, *Islāmic* banks are considerably different mainly because of the prohibition of riba (interest) in their operations (Qadri, Mustafa and Ali, 2021). The *Islāmic* bank business model is substantially different from commercial banks in terms of asset-liability structures and product offerings (Ashraf et al., 2016). Further, Mennawi and Ahmed (2020) advocated that *Islāmic* banks can reduce the assets-liabilities mismatch more easily as compared to their conventional counterparts by using saving and Mudarabah deposits to finance debt-based financing assets. Ashraf et al. (2016) argued that the equity-based and risk-sharing nature of *Islāmic* contracts helps diminish maturity mismatches of assets and liability, thus strengthening bank stability.

Accordingly, Abbas et al. (2022) proposed that *Islāmic* banking regulators should consider the different nature of the *Islāmic* banking industry and formulate a different set of guidelines that do not affect their profitability, as *Islāmic* banks have one more layer of supervision, the Sharia Advisory board, apart from the country's central bank. Dolgun et al. (2019) posited that a major growth challenge for *Islāmic* banking and finance is the lack of regulatory and supervisory standards. Qadri et al. (2021) argued that *Islāmic* banks face more short-term liquidity challenges given their limited access to Sharia-compliant money markets. Thus, we used IFSB-modified guidelines to measure LCR and NSFR and examined their impact on the financial stability and profitability of Malaysian *Islāmic* banks.

To avoid biased estimations, we estimate both the stability (Model 1) and profitability (Model 2) models using the Panel Corrected Standard Error (PCSE) technique. The PCSE method developed by Beck and Katz (1995) is more efficient in providing estimates that are less sensitive to outliers, free from serial correlations, and have more accurate standard errors (Ikpesu et al., 2019). Nsanyan Sandow, Duodu, and Oteng-Abayie (2021) claimed

that most existing studies examining the effect of regulatory capital requirements on bank performance suffer from methodological weaknesses. For instance, Abakah (2020) examined the capital adequacy effect on the performance of listed banks in Ghana using fixed- and random-effect models. But these models do not account for the cross-sectional dependencies among cross-sectional units. Failure to address cross-sectional dependencies in panel data leads to the estimation of biased estimates (Pesaran, 2007). Further, Doku, Kpekpena, and Boateng (2019) used the ordinary least squares to examine capital requirements effect on bank performance. The authors, however, failed to account for cross-sectional dependencies, panel heteroskedasticity, and serial correlation which are features of panel data. The PCSE estimator considers the dispersion from spherical errors besides allowing for more suitable inferences from the linear models estimated from panel data (Sundjo and Aziseh, 2018). Therefore, the current study used the PCSE method to examine the LCR and NSFR effects on Malaysian *Islāmic* bank financial stability and profitability.

The current study contributes to the literature on two fronts. First, we addressed methodological flaws and contributed to the literature by employing the PCSE framework. The PCSE approach simultaneously corrects cross-sectional dependence, serial correlation, and panel heteroskedasticity to improve parameter efficiency. Second, we used the IFSB-modified regulatory capital requirements, to examine the LCR and NSFR effects on Malaysian *Islāmic* bank financial stability and profitability. The aim is to determine whether the NSFR and LCR capital requirements are optimal for attaining higher stability and retaining profitability. The current study investigates the LCR and NSFR impacts on the financial stability (Z-score) and profitability (ROA) of Malaysian *Islāmic* banks. To estimate the impact of these liquidity ratios, we performed a comprehensive analysis of 15 Malaysian Shariah-compliant *Islāmic* banks using data for the period 2009–2020.

2. LITERATURE REVIEW

For containing liquidity risk, the main regulatory guidelines in the Basel III accord include two minimum standards for funding liquidity to complete the sound principles previously published in 2008 (BCBS, 2014). To manage liquidity risk, banks are required to maintain two liquidity ratios: liquidity coverage ratio (LCR) and net stable funding ratio (NSFR). In line with commercial bank regulatory guidelines, the

IFSB modified these two conventional liquidity ratios to consider Sharia-compliant assets (IFSB, 2015). Further, IFSB-12, published in March 2012, aimed at strengthening the internationally recognized guidelines and sound practices for liquidity risk management, specifically for *Islāmic* financial services. In April 2015, the IFSB issued guidance note 6 (GN-6) intended to provide a level playing field to institutions offering *Islāmic* financial services (IIFS) and their supervisory authorities for implementing liquidity standards (IFSB, 2015) [(3)]. The IFSB's proposed liquidity guidelines have led to the popularity of this topic (Ayed, Lamouchi, and Alawi, 2021). According to surveys by IFSB member authorities, the implementation of IFSB-led regulatory guidelines has significantly increased from 28% in 2015 to 38% in 2016 (IFSB, 2017).

Giordana and Schumacher (2017) investigate the impact of Basel III regulations (CAR, NSFR, and LCR) and Luxembourg's bank capital levels on bank default chances. They found that liquidity regulations, especially the NSFR, tend to significantly diminish Luxembourg banks' chances of default. But they did not find a significant effect of liquidity regulations on bank profitability. So far, past studies focusing on commercial banks in developed countries have found a significantly positive effect of NSFR on bank profitability and stability (Abbas et al., 2022). Hence, it implies that NSFR and LCR cause increase in banking sector profitability and stability. In contrast, BCBS guidelines have also highlighted that NSFR LCR regulations may have unintended consequences (King, 2013), meaning that higher regulations may hurt bank stability and profitability (King, 2013). But these studies have used BCBS guidelines to measure LCR and NSFR and examined their impact on conventional bank stability and profitability, while we used IFSB regulatory guidelines for the LCR and NSFR measurements and examined their impact on the *Islāmic* bank stability and profitability.

Abdul-Rahman et al. (2018) tested the financial structure and liquidity risk relationship in Malaysian *Islāmic* and conventional banks using data from 1994 to 2014. The authors used the BCBS-developed guidelines to quantify the LCR and NSFR. They recommend that regulators set up separate regulatory frameworks for *Islāmic* and commercial banks, which justifies our use of IFSB-modified liquidity guidelines (rather than Basel III) which are solely made for *Islāmic* financial institutions. Dolgun et al. (2019) also raised concerns regarding the effect of Basel III liquidity guidelines on *Islāmic* bank portfolio selection. They argue that under Basel III

guidelines, *Islāmic* banks may face implementation challenges given the limited availability of high-quality liquid assets and adjustment issues to suit *Islāmic* banking practices. Hence, we applied the IFSB modified guidelines to quantify LCR and NSFR and examined their impact on Malaysian *Islāmic* bank financial stability and profitability.

Ashraf et al. (2016) examined potential impact of NSFR on stability of 133 *Islāmic* banks, operating in 30 different jurisdictions. Using the IFSB-modified NSFR measure and dataset from 2000 to 2013, the authors reported a significant and positive NSFR impact on *Islāmic* bank stability. Our study, however, differs from theirs because we are using both LCR and NSFR liquidity guidelines (rather than only NSFR) to consider short-term and long-term liquidity management in Malaysian *Islāmic* banks. Second, they only examined *Islāmic* bank stability while we examined both stability and profitability of Malaysian *Islāmic* banks. Besides, we used the latest dataset, and a different context of study.

Abbas et al. (2022) explored the NSFR impact on profitability and stability of 89 Asian *Islāmic* banks by utilizing the two steps generalized method of moment (GMM) approach and dataset from 2011 to 2017. The authors found those *Islāmic* banks in the Asian region to be stable and did not find any effect of NSFR on bank profitability. Our study differs from theirs on two main grounds. First, they adopted BCBS guidelines to measure NSFR, while we used IFSB-modified guidelines. Second, they only focused on long-term liquidity management (NSFR) while we considered both short- and long-term liquidity management.

3. DATA AND METHODS

3.1 DATA

The sample of the current study consists of 15 Malaysian *Islāmic* banks in business from 2009 to 2020 (N = 15, T = 12; N > T). The choice of period was based on the post-crisis era, where concerns were raised about the bank liquidity position. Subsequently, NSFR and LCR guidelines were introduced and modified by the IFSB for *Islāmic* financial institutions. Bank-specific data were gleaned from the Bankscope Database and the respective banks' financial reports. Macroeconomic data were retrieved from the World Development Indicators (WDI) database.

3.2 VARIABLE IN ESTIMATIONS

3.2.1 NET STABLE FUNDING RATIO (NSFR):

NSFR of Malaysian *Islāmic* banks is calculated using the IFSB modified guidelines. As in the Basel III, in IFSB regulations NSFR is the ratio of Available Stable Funding (ASF) divided by Required Stable Funding (RSF). The ASF and RSF computations, however, are significantly different in both the guidelines (Basel III and IFSB). Ashraf et al. (2016) argued that the main difference between the Basel III NSFR and IFSB NSFR is the different nature of assets and liabilities in both banking systems. For instance, in *Islāmic* banks, the Profit-sharing investment account (PSIA) has two categories, namely restricted PSIA and unrestricted PSIA. In the unrestricted PSIA, a bank has full discretion over the investor fund to invest in any sharia-compliant business. While in the restricted PISA, the investment is made according to account holder instructions and therefore is quasi-equity. The IFSB requires *Islāmic* banks a haircut between 90% to 95% for unrestricted PSIA and 95% for restricted PSIA. Whereas commercial banks under the BCBS guidelines do not differentiate between saving deposits and require a 95% haircut in NSFR estimation. Most of the differences in both guidelines are concerning asset treatment. For example, some *Islāmic* bank product offerings are unique in that they have no direct substitute for conventional banks. One example is the *Mushārakah* product, which is based on the concept of partnership and has no direct substitute in conventional banks. BCBS guidelines require commercial banks 85% stable funding against all loans and advances, while IFSB only requires 50% stable funding for *Mushārakah* products because of its partnership nature **(4)**.

As for the RSF calculation under IFSB regulations, assets and liabilities are categorized under different 'buckets' depending upon liquidity position. The haircut for highly liquid assets is 0% (i.e., cash) and 100% for highly illiquid assets (i.e., fixed assets). While the ASF calculation also requires haircuts on funding sources, ranging from 0% for Shariah-compliant hedging to 100% for regulatory capital.

The calculation of the NSFR presents several challenges. These challenges are mainly related to the regulatory guidelines and data availability. Because of certain regulatory ambiguities, one must exercise judgment in estimating NSFR which might lead to some inconsistencies (Abbas et al., 2022). In data availability, the common

problems are related to format, categorization, and so forth, which may create inconsistencies (Hong, Huang and Wu, 2014). The International Monetary Fund (IMF) report on Financial Stability (2011) also highlighted such practical data limitations in calculating NSFR. Studies that have calculated NSFR using the Basel III guidelines have applied an approximation approach, thereby applying haircuts to various balance sheet components (Abbas et al., 2022; King, 2013). Ashraf et al. (2016) claimed that although the IFSB guidelines for NSFR calculation are comprehensive enough they still face some data limitations.

We followed Ashraf et al. (2016) in calculating NSFR and made several assumptions regarding haircut applications on different balance sheet items. To calculate NSFR, first, ASF is calculated:

$$ASF_{it} = \{(tcap_{it} + Minv_{it}) + 0.5(Mdsav_{it} + Csav_{it} + Osav_{it})\} \quad (1)$$

In Equation (1), ASF_{it} is the available stable funding of a Malaysian *Islāmic* bank i at time t. This ASF is the sum of 100% of total shareholders' capital ($tcap_{it}$), *Muḍārabah* investment account ($Minv_{it}$); and 50% of the *Muḍārabah* savings ($Mdsav_{it}$), current savings ($Csav_{it}$) and other accounts that are not profit and loss sharing ($Osav_{it}$). Second, the RSF is calculated as:

$$RSF_{it} = \{(FixA_{it} + Bbi_{it}) + 0.085(Musp_{it} + Istn_{it} + Aof_{it}) + 0.65(Cinv_{it} + Binv_{it}) + 0.5(Msh_{it} + Ijra_{it})\} \quad (2)$$

In Equation (2), RSF_{it} is the required stable funding from Malaysian *Islāmic* banks (i's) at time t. RSF is the sum of 100% fixed assets ($FixA_{it}$), balances with financial institutions (Bbi_{it}); 85% of *Murābaḥah*, deferred sales and *Murābaḥah* for purchase orders ($Musp_{it}$), *Istiṣnā'* and parallel *Istiṣnā'* ($Istn_{it}$), all other financing (Aof_{it}); and 50% of the value of financing from *Mushārakah* and diminishing *Mushārakah* contracts (Msh_{it}), hire purchase and *Ijārah Muntahiya Bit-Tamlīk* (Ijr_{it}).

$$NSFR_{it} = \frac{Available\ Stable\ Funding_{it}}{Required\ Stable\ Funding_{it}} \quad (3)$$

In short, Equation (3) is our final NSFR measure which is the ratio of ASF to RSF of an *Islāmic* bank i at time t. The higher $NSFR_{it}$ implies better funding conditions and therefore is expected to positively affect the *Islāmic* bank's financial stability and profitability.

3.2.2 LIQUIDITY COVERAGE RATIO (LCR)

The aim of the IFSB modified liquidity coverage ratio (LCR) is to ensure that *Islāmic* banks endure short-term liquidity shocks (IFSB, 2015). To meet this requirement, the IFSB requires *Islāmic* banks to keep adequate unpledged stock of high-quality liquid assets (HQLA), which can be easily liquidated in times of liquidity stress scenario, to meet short-term obligations of up to 30 days (Yaacob, Rahman and Karim, 2016). The formula for LCR computation under IFSB regulations is:

$$(4)\quad LCR_{it} = \frac{Stock\ of\ Sharia\ Compliant\ HQLA_i}{Total\ Net\ Cash\ Outflows\ over\ the\ next\ 30\ days_{it}} \geq 100\%$$

In Equation (4), LCR is the liquidity coverage ratio of *Islāmic* bank i at time t, which equals the stock of the Sharia-compliant HQLA to total net cash outflows over the next 30 days. The total net cash outflows are estimated as a total of 30 days of gross expected cash outflows minus a total of 30 days of expected cash inflows or 75% of total expected cash outflows. IFSB requires all *Islāmic* banks to maintain an LCR ratio equal to or greater than 100% [(5)].

3.2.3 BANK'S FINANCIAL STABILITY (Z-SCORE)

The stability of the sample Malaysian *Islāmic* banks is measured with a Z-score, which is a function of ROA plus the level of capitalization (equity/total assets) divided by the ROA standard deviation. The ratio shows the number of standard deviations below the mean value profit must fall to deplete bank equity capital (Houston et al. 2010). Z-score calculates the distance from bank insolvency since a higher Z-score value means a higher level of bank stability and vice versa. Mathematically, Z-score is calculated as:

$$Z - score_{it} = \frac{ROA_{it} + \frac{Equity_{it}}{Total\ Assets_{it}}}{\sigma ROA_{it}} \quad (5)$$

In Equation (5), $Z - score_{it}$ denotes *Islāmic* banks' financial stability and σROA_{it} represents the deviation of Return on Assets.

3.2.4 BANK PROFITABILITY (ROA)

Higher LCR and NSFR are expected to positively influence *Islāmic* bank profitability. In literature, various proxies have been considered for measuring bank profitability (Abbas et al., 2022). We used ROA to measure Malaysian *Islāmic* bank profitability. According to Ayed et al. (2021), our measure of ROA is the profit after tax and Zakat to total assets.

3.2.5 CONTROL VARIABLES

In our estimation, we control for bank and country characteristics, which may potentially influence bank stability and profitability. In bank-specific variables, we used bank size (too big to fail) and capital structure (Equity/total assets). Bank size has been a widely used control in the banking literature (Ashraf et al., 2016). Capital structure is defined as regulatory capital to risk-weighted total assets (also used by Nsanyan Sandow et al., 2021). It exhibits a bank's ability to absorb losses before becoming insolvent. While in the macroeconomic context, we included GDP and Interest rate (INT). The former captures country productivity, and the latter is a measurement of borrowing cost, since changes in the macroeconomic environment can influence demand for bank products and services (Doku et al., 2019). Finally, to avoid the possibility of spurious outliers, all control variables were winsorized at the 1 and 99% levels.

3.3 ECONOMETRIC TECHNIQUE

Panel data estimators can deal with complex error compositions, but to be efficient and unbiased. It is important to consider cross-sectional dependency (CSD), contemporaneous correlation, heteroscedasticity, and panel autocorrelation (Reed and Ye, 2011) for coefficients and standard errors. Marques and Fuinhas (2012) stated that commonly used panel data estimators, such as fixed effects and random effects models, often fail to perform well.

The Panel Corrected Standard Error (PCSE) technique is more efficient in providing estimates which are less sensitive to outliers, free from serial correlation, and have more accurate standard errors (Ikpesu et al., 2019). Doku et al. (2019) asserted that the PCSE approach simultaneously corrects CSD, heteroskedasticity, and serial correlation to improve parameter efficiency. This estimator also accommodates the deviations arising from spherical errors and helps improve linear model inferences (Sundjo and Aziseh, 2018). Besides, the PCSE method is relatively more appropriate when dealing with dynamic heterogeneous panels (Reed and Webb, 2010) and finite samples (Beck and Katz, 1995). It is worth mentioning that Feasible Generalized Least Squares (FGLS) is also a panel data estimator that corrects for CSD, autocorrelation, and heteroskedasticity (Reed and Ye, 2011). FGLS, however, is more appropriate when time either exceeds or equals cross sections (T ≥ N). In the current study cross-sections (banks, 15) exceed the time dimension (12, from 2009-2020). Nsanyan Sandow et al. (2021) also highlighted that the PCSE estimator performs better than FGLS, especially when N > T. Thus, considering the data properties we estimated both of our models (1 and 2) with the PCSE estimator.

3.4 ECONOMETRIC MODELS

To examine the effect of LCR and NSFR on the financial stability (Model 1) and profitability (Model 2) of Malaysian *Islāmic* banks, we specified both generalized models in Equation (6) and Equation (7), respectively.

$$Z\_Score_{i,t} = \Omega_i + \Omega_1 NSFR_{i,t} + \Omega_2 LCR_{i,t} + \Theta_i Z_{i,t} + \varepsilon_{i,t} \quad (6)$$

$$ROA_{i,t} = \gamma_i + \gamma_1 NSFR_{i,t} + \gamma_2 LCR_{i,t} + \Theta_i Z_{i,t} + \varepsilon_{i,t} \quad (7)$$

Where $Z\_Score_{i,t}$ and $ROA_{i,t}$ are the measures of stability and profitability, respectively. In both equations, $Z_{i,t}$ is a vector of control variables namely, bank size (size), capital adequacy ratio (CAR), Interest rate (INT), and Gross domestic product (GDP). γ_1, γ_2, Ω_1, Ω_2, Θ_i are the parameters to be estimated; Ω_i and γ_i are capturing bank-specific effects, and $\varepsilon_{i,t}$ is the white noise term.

4. EMPIRICAL RESULTS

To begin with empirical results, the series properties were first examined with descriptive statistics as presented in Table 1. The results exhibit no such outliers in the data; therefore, further analysis can be performed safely. Second, before the empirical estimation, we examined stationarity properties using the Im-Pesaran-Shin (IPS) and Levin-Lin-Chu (LLC) unit root tests. As shown in Table 1, at first difference all the variables are stationary, thus, the null hypothesis that the variables have a unit root is rejected. Afterwards, long-term cointegration among the variables was examined through Kao's (1999) residual cointegration and Pedroni's (1999) modified Philip Perron tests. The results in Table 3 reveal that the variables are cointegrated, indicating the presence of a long-term relationship. This long-term cointegration shows that NSFR and LCR have a long-run relationship with the stability (Z-score) and profitability (ROA) of Malaysian *Islāmic* banks. The simultaneous use of various explanatory variables in an equation may lead to the possibility of collinearity; therefore, we examined multicollinearity using the Variance Inflation Factor (VIF) and correlation matrix. As presented in Table 2, the correlation coefficients and VIF exhibit no such case of multicollinearity.

TABLE 1
Descriptive Statistics and Unit Root Testing

Variables	Descriptive Statistics						Unit Root Test-1st Diff	
	Mean	Std.	Min.	Max.	Skw.	Kurt.	IPS	LLC
Z_Score	3.98	1.16	-0.02	6.33	0.06	0.22	-11.47	-15.95
ROA	0.02	0.15	-0.23	1.04	0.07	0.02	-7.79	-10.48
NSFR	1.12	0.32	0.06	1.96	0.20	0.02	-8.98	-8.60
LCR	1.01	0.36	0.01	1.66	0.01	0.06	-11.78	-13.85
LnSize	10.18	1.67	0.02	13.79	0.02	0.01	-6.03	-9.32
CAR	0.09	0.10	0.02	0.99	0.07	0.09	-40.59	-80.54
GDP	4.75	2.03	-1.51	7.42	0.04	0.07	-11.88	-20.90
INT	2.36	3.63	-3.90	11.78	0.00	0.77	-9.06	-10.58

Im-Pesaran-Shin (IPS) and Lin-Lin-Chu (LLC) are unit root tests. 1st Diff. = first difference stationary, Std. = standard deviation, Skw=skewness, Kurt=Kurtosis, NSFR=net stable funding ratio, LCR=liquidity coverage ratio, CAR=capital adequacy ratio, INT =interest rate.

TABLE 2
Correlation Matrix

Variables	VIF	Z-Score	ROA	NSFR	LCR	Size	CAR	GDP
Z-Score	-	1.00						
ROA	-	0.01	1.00					
NSFR	1.36	0.18	0.21	1.00				
LCR	1.07	0.03	0.07	-0.23	1.00			
LnSize	1.51	0.01	-0.14	-0.39	0.02	1.00		
CAR	1.28	0.01	-0.03	-0.07	0.08	-0.40	1.00	
GDP	2.65	0.09	-0.01	-0.08	0.04	-0.03	0.05	1.00
INT	2.64	0.03	0.00	-0.01	-0.02	0.08	-0.01	-0.78

VIF=Variance Inflation factor

Next, the presence of cross-sectional dependency is tested via the Breusch Pagan LM and Pesaran CD tests. Both tests reject the alternate hypothesis of no long-run cross-sectional interdependence, implying that the output is not spatially independent. In our case, it indicates the existence of contemporaneous correlation across banks. Continuing with the diagnostics, the presence of serial correlation is examined via the Wooldridge test, where the null hypothesis is supported by assuming the existence of autocorrelation. Similar to Baum (2001), group-wise heteroscedasticity in the residuals was examined through a modified Wald test.

The results in Table 3 show that the errors have group-wise heteroscedasticity. The results from the specification tests show that the panel dataset has cross-sectional dependency, autocorrelation, and group-wise heteroscedasticity. Indeed, the findings are suggesting the existence of significant variances across the liquidity management (NSFR and LCR) of *Islāmic* banks. The PCSE estimator can efficiently handle such data features. The beauty of PCSE is that when calculating the variance-covariance metrics and standard errors, PCSE (with the Stata XTPCSE command) by default assumes that the disturbances are contemporaneously correlated and heteroscedastic.

TABLE 3
Long-term Cointegration and Diagnostic Statistics

	Model 1 (Z-Score)		Model 2 (ROA)	
Tests	Statistic	Prob.	Statistic	Prob.
Long-term Cointegration				
MDF (*t*-stat.)	7.021	0.003	6.033	0.001
MPP (*t*-stat.)	5.249	0.000	4.638	0.000
			Diagnostic Statistics	
Breusch-Pagan LM	72.126	0.061	203.473	0.000
Pesaran CD	10.775	0.009	58.446	0.000
Wooldridge test (*F*-stat.)	4.202	0.068	406.794	0.000
Modified Wald test (chi − squared)	46.590	0.000	6542.740	0.000

Modified Dicky Fuller (MDF) is Kao's (1999) residual cointegration test; Modified Phillip Perron's (MPP) is Pedroni's (1999) long-term cointegration test. Breusch-Pagan (LM) and Pesaran (CD) are cross-sectional dependence tests. The Wooldridge test is a panel serial correlation test, and the Modified Wald test is a panel heteroscedasticity test.

The empirical results, reported in Table 4, meet theoretical expectations. In Model 1, the alternate hypothesis of a positive association between the NSFR and bank stability is significant at the 1% significance level, demonstrating that NSFR maintenance increases Islāmic bank stability. Similarly, Chalermchatvichien et al. (2014) argue that implementing NSFR guidelines increases banking stability. Likewise, Ashraf et al. (2016) found a positive significant impact of NSFR on stability of *Islāmic* banks operating in 30 different jurisdictions from 2000 to 2013. Moreover, Abbas et al. (2022) also reported, calculated using Basel III guidelines, a positive significant impact of NSFR on the stability of 89 *Islāmic* banks. The results in Model 2 show a positive and significant relationship between NSFR and profitability, suggesting that long-term liquidity management (NSFR) increases *Islāmic* bank profitability. Contrary to the latter finding, Abbas et al. (2022) did not find any significant impact of Basel III NSFR on profitability of *Islāmic* banks operating in the Asian region. In a nutshell, we found a positive significant impact of IFSB's

modified NSFR on the financial stability and profitability of Malaysian *Islāmic* banks.

TABLE 4
Panel Corrected Standard Errors Estimation Results

	Model 1 (Z-score)		Model 2 (ROA)	
Variables	Coefficient	Standard Errors	Coefficient	Standard Error
Constant	9.278***	2.785	0.988***	0.246
NSFR	0.976***	0.353	0.092**	0.042
LCR	-0.207	0.322	-0.064**	0.042
Ln_Size	-3.382	2.083	-0.416**	0.189
CAR	-0.518	1.209	-0.102	0.109
GDP	2.854***	1.054	0.585***	0.138
INT	-0.833**	0.328	-0.087**	0.044

NSFR = Net Stable Funding; LCR = Liquidity Coverage Ratio; CAR = Capital Adequacy Ratio INT = interest rate.
Note: ***significant at 1% level, **significant at 5% level

Next, the LCR coefficient is not statistically significant albeit negative. This can be interpreted as LCR maintenance not helping improve *Islāmic* bank stability. However, the coefficient of LCR in Model 2 is negative and significant, implying that LCR maintenance discourages profitability of *Islāmic* banks operating in Malaysia. So, the findings exhibit that LCR regulations do not achieve the desired objective of bank stability but reduce bank profitability. This finding is in accordance with Barth et al.'s (2013) findings that banking restrictions are negatively related to banking efficiency (i.e., profitability). Mennawi and Ahmed (2020) also claimed that *Islāmic* banks mainly depend on depositors' funds rather than equity funds; therefore, maintaining a high level of cash buffers and liquid assets will mitigate depositors' withdrawals. Such liquidity buffers, however, have potential to discourage *Islāmic* banks' profitability. Likewise, Dolgun et al. (2019) raised concerns about *Islāmic* banks' higher cash buffers and asked for liquidity calibrations. When *Islāmic* banks follow strict liquidity regulations and maintain higher liquidity buffers, they reduce their lending ability and subsequent profitability. Thus, the challenges in *Islāmic* banks' short-term liquidity management necessitate revising existing LCR guidelines.

In bank-specific factors, Bank size (Ln_Size) has a negative and significant impact on Z-score and ROA, implying that small

Islāmic banks have better stability and profitability compared to larger *Islāmic* banks. This finding is in line with past studies that reported that small *Islāmic* banks are more stable (for instance, Ashraf et al., 2016, Čihák and Hesse, 2010) and profitable (Akhtar, Ali and Sadaqat, 2011). Contrary to our expectations, the results do not support that capital adequacy enhances *Islāmic* banks' stability and profitability, although prior studies found that capital adequacy enhances bank stability because a higher ratio of equity to total assets decreases a bank's cost of funding and demand for external funding, which in turn can lower bankruptcy costs (Abbas et al., 2022). Similarly, capital adequacy significantly leads to banks' profitability (i.e., Said, 2014). Past studies, however, reported that minimum capital requirements expose banks to undue liquidity risk through increased cost of funding and, consequently, diminish bank profitability (Le, Nasir and Huynh, 2020). Finally, the insignificant impact of equity on total assets might be because *Islāmic* banks depend mainly on depositors' funds rather than shareholders' equity funds (Mennawi and Ahmed, 2020).

As for macroeconomic factors, the impact of GDP is highly significant and positive in both models, suggesting that rising economic activity in Malaysia increases *Islāmic* bank stability and profitability. Theoretically, a higher GDP increases bank stability and profitability because more money circulates in the financial market, thus decreasing the default risk and increasing profitability. Past studies also found that GDP is positively related to Malaysian *Islāmic* bank liquidity (i.e., Sulaiman, Mohamad and Muhamad, 2013) and profitability (i.e., Wasiuzzaman and Tarmizi, 2010), reinforcing that the Malaysian economy (GDP) assists in maintaining *Islāmic* bank financial stability and profitability. As for the interest rate, its impact on *Islāmic* bank stability and profitability is negatively significant, explaining that the rising cost of capital adversely affects bank stability and profitability. Although *Islāmic* bank transactions are free from interest rates, changes in interest rates significantly influence their performance (Zainol and Kassim, 2012) because *Islāmic* bank products are usually benchmarked against a conventional interest rate. For instance, in Ijarah and *Murābaḥah* contracts, the markup rate is determined by the benchmark rate plus the risk premium (Ayub, 2007).

5. CONCLUSION AND SUMMARY

This paper investigated the impact of NSFR and LCR on *Islāmic* banks' financial stability and profitability, using a sample of 15

Malaysian *Islāmic* banks operating from 2009 to 2020. The IFSB modified guidelines for Islamic Financial Institutions were used to measure NSFR and LCR, whereas the Z-score and ROA were used as measures of bank stability and profitability, respectively. The Panel Corrected Standard Error (PCSE) estimation approach was applied for the analysis due to the presence of cross-sectional dependency, autocorrelation, and panel heteroskedasticity in the data.

The results indicate that NSFR has a significant and positive impact on both financial stability and profitability, suggesting that NSFR maintenance enhances *Islāmic* bank stability (Z-score) and profitability (ROA). Our findings suggest that NSFR has the potential to achieve its desired objective of banking stability by reducing asset-liability mismatches. The NSFR's impact on bank financial stability and profitability is a double-edged sword; it improves bank financial stability, but when it rises after a certain limit, it might worsen bank profitability. Therefore, NSFR maintenance should be optimized to attain the maximum desired output.

The impact of LCR is negative on both banking stability (but insignificant) and profitability; such a negative impact explains that LCR requirements do not help bank stability and discourage bank profitability. Considering these findings, it can be claimed that due to the given regulatory constraints and shortage of high-quality liquid assets, *Islāmic* banks are required to keep an important share of their assets idle to satisfy LCR liquidity requirements (Dolgun et al., 2019), which in turn diminishes their profitability. Hence, challenges for liquidity risk management necessitate revising and reforming the existing LCR regulatory requirements for *Islāmic* banks.

Given the insignificant role of LCR in financial stability and its negative role in profitability of Malaysian *Islāmic* banks, we advise policymakers to reconsider LCR requirements because the enforced guidelines are not helping *Islāmic* banks in financial stability but discouraging their profitability. We recommend that policymakers fill the shortage of *Islāmic* money markets and introduce new shariah-compliant instruments so that *Islāmic* banks can use them to meet short-term liquidity requirements without any loss to profitability. In the presence of short-term liquidity requirements and limited access to *Islāmic* money market instruments, *Islāmic* banks are forced to hold high liquidity buffers (to meet depositor demands) which in turn affects their profitability. We also encourage *Islāmic* banks to establish liquidity-resilient and sustainable plans as part of their overall strategic plan. Such a comprehensive plan will not only

improve *Islāmic* bank short- and long-term liquidity management but will also help in attaining other performance objectives such as profitability. In future research, our study can be extended by conducting a comparative study between *Islāmic* and conventional banks on NSFR and LCR to provide further insights into the possible improvements and future implementation of liquidity regulations.

ENDNOTES

1. On the liquidity side, the BASEL III framework refined the capital ratio and increased its minimum requirement from 8% to 10.5%, in addition to the introduction of LR, LCR, and NSFR.
2. On the liquidity side, the BASEL III framework refined the capital ratio and increased its minimum requirement from 8% to 10.5%, in addition to the introduction of LR, LCR, and NSFR.
3. IFSB-issued Guidance Note No. 12 provides guidelines for calculating the NSFR for *Islāmic* banks.
4. Ashraf et al. (2016) can be visited for the detailed differences and treatment of assets and liabilities.
5. Visit IFSB (2015) for details. https://www.ifsb.org/download.php?id=4391&lang=English&pg=/index.php

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