

Widarjono, Agus; Wijayanti, Diana; Suharto, Suharto

## Article

# Funding liquidity risk and asset risk of Indonesian Islamic rural banks

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\*Corresponding author: Agus  
Widarjono, Economics, Universitas  
Islam Indonesia Fakultas Ekonomi,  
Indonesia  
E-mail: [agus.widarjono@uii.ac.id](mailto:agus.widarjono@uii.ac.id)

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## FINANCIAL ECONOMICS | RESEARCH ARTICLE

# Funding liquidity risk and asset risk of Indonesian Islamic rural banks

Agus Widarjono\*, Diana Wijayanti and Suharto Suharto

**Abstract:** This study explores the influence of funding liquidity risk and several control variables on Islamic rural banks' asset risk in Indonesia. Our study analyzes Islamic rural banks comprising 142 Islamic banks with quarterly data from 2013: Q1 to 2018: Q4. Panel regression is then employed. We divide Islamic banks related to their size and location for further analysis. Our results confirm the funding liquidity risk increase Islamic banks' asset risk. Small Islamic banks encounter less asset risk than large Islamic banks, but large banks face a lower probability of bad financing than small Islamic banks. The influence of funding liquidity risk on asset risk is higher for Islamic banks in developed areas than in less developed areas. More interestingly, the results using an interaction term between funding liquidity risk and financial contracts show that Islamic banks providing profit-loss sharing contracts (PLS) and non-PLS face lower asset risk than those Islamic banks providing only non-PLS contracts. Results also highlight the importance of market power, size, financing, and efficiency in lowering asset risk. Our findings have two implications. First, policymakers can implement investment account product to reduce mismatch between liquidity risk and asset risk. Second, Islamic banks should provide both PLS and non-PLS contracts by optimizing both contracts to reduce Islamic banks' risk assets.

**Subjects:** banking; corporate finance; credit & credit institution

### ABOUT THE AUTHORS

Agus Widarjono Ph.D is an associate professor at the Department of Economics, Faculty of Business and Economics, Universitas Islam Indonesia (UII). His research interests are in Islamic banking and finance and Islamic Economics. He has published some papers in the *Journal of Islamic Marketing*, *Journal of Asian Finance*, *Economics*, and *Business and Asian Economic and Financial Review*.

Diana Wijayanti is a lecturer at the Department of Economics, Faculty of Business and Economics, Universitas Islam Indonesia (UII). Her research interests are Islamic banking, regional economics, and development economics.

Suharto Suharto is a lecturer at the Department of Economics, Faculty of Business and Economics, Universitas Islam Indonesia (UII). His research interests are Islamic banking, regional economics, and development economics.

### PUBLIC INTEREST STATEMENT

Indonesian Islamic banks comprise Islamic commercial banks (ICB) and Islamic rural banks (IRB). IBRs focus on small and medium firms, a major part of firms in Indonesia but face the high financing risk due to the profit-loss sharing contracts. So, it is interesting to investigate the effect of funding liquidity risk on IBRs' asset risk. Our results show that funding liquidity risk raises the IBRs' insolvency and increases the possibility of non-performing financing.

**Keywords:** Funding liquidity risk; asset risk; PLS and Non-PLS contracts; Islamic Rural Bank; Indonesia  
**JEL Classification:** Code: G21; G24; G28

## 1. Introduction

Commercial banks in Indonesia comprise large and small banks, both conventional and Islamic banks. Islamic commercial banks work throughout a whole nation while Islamic rural banks (IRBs) operate in regional areas. As a financial intermediary, IRBs must manage their funds properly to avoid financing and liquidity risks (Asrianti & Syamlan, 2021; Mongid, 2015). IRBs in Indonesia face high credit risk. The average non-performing financing (NPF) of IRBs was 8.59% which is above maximum NPF rate of 5% during 2010–2020, while the non-performing loan (NPL) of conventional rural banks (CRBs) as a competitor of IRBs was 5.94%.

Bank liquidity is an important aspect for banks as financial intermediaries. Therefore, it is recommended that banks always retain a liquidity buffer to reduce liquidity risk. Time deposits protect banks from financial risk, and banks with low deposits face more risk of funding liquidity. However, this condition sequentially reduces market discipline and generates more bank risk-taking behavior. Accordingly, a high level of asset liquidity can potentially increase bank risk (Acharya & Naqvi, 2012). The leading cause of the bank crisis in 2009–2010 was liquidity risk, which in turn can cause bank failure through systematic and unsystematic risks (Hong et al., 2014). Furthermore, deposit insurance leads to a moral hazard because deposit insurance causes too much bank risk-taking behavior in response to increased deposits in the deposit insurance fee.

Since the global financial crisis and the many bank failures, the banking system's stability and risk-taking behavior have begun crucial. Islamic banks are alternative financial intermediaries because they have a different risk model from conventional banks. Instead of financing contracts using interest rates, Islamic banks provide financing contracts, both profit-loss contracts (PLS) and non-PLS). PLS contracts comprise Mudharaba (profit-sharing contract) and Musyaraka (joint venture contract). Non-PLS contracts encompass Murabaha (margin scheme), Isthisna (manufacturing contract), Ijarah (leasing), Salam (forward contract), and Qardh (benevolence contract).

The business risk between Islamic banks (IBs) and conventional banks (CBs) is different, so risk-taking behavior is distinct between Islamic banks and conventional banks related to the impact of funding liquidity risk on asset risk. Research on the effect of funding risk on bank risk-taking behavior has been carried out for large Islamic banks. However, the existing empirical study on the financial risk and stability of IBs results in mixed findings. Hasan and Dridi (2011), Bourkhis and Nabi (2013), Abedifar, Molyneux and Tarazi (2013), and Smaoui et al. (2020) proved that IBs perform more pronounced than CBs during the gulf financial crisis, producing more financial stability. Čihák and Hesse (2010) documented that small CBs are riskier than small IBs. A study by Baele et al. (2014) also showed that IBs face likely low default risk because their financings are lower possible to failure to pay.

We explore the impact of funding liquidity risk on Indonesian IRB's asset risk as small IB. Indeed, several studies, such as Trinugroho et al. (2017), Widarjono et al. (2020), and Priyadi et al. (2021) investigated the risk-taking behavior of small IB but without addressing the effect of funding liquidity risk on asset risk. Furthermore, this study also investigates the risk-taking behavior of IRBs according to their size and location because behavior of IB is different between small and large banks (Čihák & Hesse, 2010) and between different geographical areas (Trinugroho et al., 2017).

Our study contributes to some existing literature. First, our paper enhances the existing empirical studies on the relationship between the Islamic bank's risk and financial stability. Particularly,

this study contributes to the risk channel to which the funding liquidity risk affects asset risk on the risk-taking behavior of Islamic banks in countries that apply dual-bank systems such as Indonesia. Second, it contributes to the literature about the impact of funding liquidity risk on small Islamic banks. Third, the last contribution examines the effect of financing contracts on bank risk by investigating how funding liquidity risk differs between Islamic banks that provide only non-PLS contracts and those that offer both PLS and non-PLS contracts.

## 2. Literature review and hypotheses development

### 2.1. Theoretical framework

The theoretical frameworks proposed by Wagner (2007) and Acharya and Naqvi (2012) are two fundamental theories that explain the relationship between liquidity and stability. Bank stability is related to asset liquidity, to which high asset liquidity leads to more financial stability (Wagner, 2007). Furthermore, Acharya and Naqvi (2012) propose that high liquidity increases the banks' risk-taking behavior because of aggressive loaning and asset price volatility. Based on two models, banks that have a high ratio of deposits to total assets and, in turn, have low funding liquidity risk do not hesitate to take more risks. Accordingly, the funding liquidity risk of banks protects banks from default risk. Accordingly, high deposits in the short term are implausible for banks to encounter a funding liquidity problem, so the bank is overconfident, and consequently, the bank manager is willing to take more risk in seeking higher managerial reward.

Some empirical studies show that banks' liquidity risks are a prominent factor in recent bank bankruptcy such as Hong et al. (2014). Funding stability, which is calculated by the net stable funding ratio, lessens the possibility of bank default according to the new Basel III (Vazquez & Federico, 2015). However, when a bank keeps a higher net stable funding ratio compensates for a higher interest rate payment due to having more long-term funds (King, 2013). For that reason, liquidity policy to protect against bank failure can unfavorably influence bank stability and decrease bank risk but the public party benefits due to the decrease in bank defaults across society. The liquidity risk also negatively affects the bank's risk-taking behavior, implying that low liquidity risk generates high risk-taking behavior (Dahir et al., 2018)

Funding liquidity risk may have a negative impact on market liquidity (Drehmann & Nikolaou, 2013). As policymakers in conducting monetary policy through liquidity reserve requirement policy, the central bank requires every bank to preserve a given portion of deposits. Funding liquidity rates are upturn and downturn over time, depending on macroeconomic conditions. The increasing concerns about liquidity come up because a high liquidity rate can generate to bank's financial failure. Adrian and Shin (2010) indicate that banks try to capitalize on excess capacity by finding potential customers even customers do not have the resources to pay back their lending, and accordingly, a higher liquidity rate may generate the bank's default. Another model proposed by Wagner (2007) empirically tested the relationship between liquidity and stability. The model shows that high liquidity deteriorates a bank's stability during financial crises. Some empirical studies also documented that bank risk-taking behavior is related to funding liquidity, implying higher bank risk-taking behavior is stemmed from lower funding liquidity risk (Khan et al., 2017).

Berger et al. (2019) documented that the liquidity creation of IBs and CBs on financial stability is persistently different. Particularly, their study indicated that the impact of IBs' liquidity was positive on national stability in developing countries, but the effect of CB's liquidity was negative on national stability in advanced countries. Hassan et al. (2019) examined the response of on the stability of CBs and IBs to the liquidity and loan risk. They documented that liquidity risk and loan risk are linked to a negative relationship to stability, but the negative link between stability and liquidity risk exists just for IBs. Smaoui et al. (2020), employing bank and country-level data over

2004–2016 from 18 countries, found that higher risk-taking behavior is due to lower funding liquidity risk but less apparent for IBs. Furthermore, large banks involve less risk-taking as funding liquidity risk is low.

## 2.2. Hypothesis development

Certainly, IB asset risk depends on bank-specific conditions such as liquidity risk, market power, size, financing, equity, and efficiency and macroeconomic conditions. Islamic banks face less funding liquidity risk due to greater deposits because deposits protect Islamic banks from run risk. Consequently, this encourages the Islamic bank to involve more risk because banks are protected against the disadvantage of the risk (Smaoui et al., 2020). For this reason, higher deposits generate a lower Z-score as the measurement of bank stability due to greater risk-taking behavior. As a result, our study expects a negative relationship between funding liquidity risk and Z-score.

Market structure obviously links to profitability and stability of bank (Hamid, 2017; Mirzaei et al., 2013). Lerner Index is widely used to measure market structure. A high Lerner index represents imperfect market competition, and the bank can charge with its premium price over its cost to get higher profit (Trinugroho et al., 2018). Accordingly, this study expects the Lerner index will be positively related to lower risk-taking with a higher Z-score.

IB size is measured by total assets. Due to economies of scale and efficiency, large IB generates more benefits than small IB (Trad et al., 2017). However, the large IB may experience diseconomies of scale and inefficiency compared to the small IB (Pasiouras & Kosmidou, 2007). Consequently, our study expects that asset has a positive or negative effect on IB risk. Financing reveals the capability of an IB to offer more financing. High financing can generate higher profit and as a result, financing positively affects asset risk (Anisa & Sutrisno, 2020; Mirzaei et al., 2013).

Equity representing the ability of the bank to preserve capital may link to a positive relationship to profitability and stability. High equity causes IB to take more risk to generate more profit by expanding its financing (Hamid, 2017). The CIR is a ratio of operating cost to operating income. Low operating cost per unit income indicates that banks have good management quality and vice versa (Maudos & Solís, 2009). Therefore, CIR can represent the Islamic bank's operating efficiency. Higher CIR indicates lower efficiency and it is expected that CIR negatively links to less risk (Zarrouk et al., 2016). High economic growth indicates sound macroeconomic conditions so economic growth is expected to negatively linked to less risk (Trabelsi & Trad, 2017).

IB offers a distinct financial contract from a CB. Instead of the fixed cost from interest rate IB provides PLS and non-PLS contracts. Hence, it is interesting to explore the impact of PLS contracts on bank risk because many IRBs provide only non-PLS contracts. PLS contracts lead to asymmetric information, agency problems, and moral hazard and in turn cause higher financing risk (Kabir et al., 2015). In fact, PLS contracts lead to high risk for Islamic banks, but it may produce higher profit as long as the banks have more entrepreneurs to control for the financing of those contracts (Risfandy et al., 2020). Therefore, we expect that PLS has a positive or negative impact on IB risk.

## 3. Methodology and data

### 3.1. Econometric specification

This study employs the regression method to empirically test the effect of funding liquidity risk on Islamic banks' asset risk, following the previous studies (Khan et al., 2017; Smaoui et al., 2020). Our study employs the panel regression model as follows:

$$\text{Risk}_{it} = \delta_0 + \delta_1 \text{Frisk}_{it} + \sum_{j=1}^n \vartheta_j \mathbf{X}_{jit} + \varphi_1 Y_{it} + e_{it} \quad (1)$$

Where Risk is Islamic bank's risk, Frisk is funding liquidity risk,  $\mathbf{X}_{jit}$  is a vector consisting of bank-specific variables and  $Y_{it}$  is macroeconomic variables. The Islamic rural banks' risk as the dependent variable is measured with two variables consisting of Z-score and loan loss provision (LLP). The Z-score is computed as the sum of the ROA (return on asset) and equity-to-asset ratio divided by the standard deviation of ROA (Čihák & Hesse, 2010) as follows:

$$\text{Z-score} = \frac{\text{ROA} + \left( \frac{\text{Equity}}{\text{Asset}} \right)}{\text{SDROA}} \quad (2)$$

Where ROA is the return on asset and SDROA is the standard deviation of ROA.

The second measure of Islamic banks' risk-taking is loan loss provision (LLP). LLP is measured by loan loss provision over total financing. Banks must preserve loan loss provisions as an impaired loan likely takes place. Loan loss provisions represent the banks' asset quality (Delis et al., 2014; Lee & Hsieh, 2013). Therefore, higher LLP shows that banks are facing more risky assets.

The independent variable consists of funding liquidity risk and control variables encompassing bank-specific and macroeconomic variables. Market power, total assets, financing, equity, operating efficiency, and a dummy variable for PLS contracts are bank-specific variables. Macroeconomic variable represents the province's business cycle ( $Y_{it}$ ) measured by economic growth.

Funding liquidity risk is calculated using the ratio of total deposits to total assets (Acharya & Naqvi, 2012; Qudah et al., 2021; Smaoui et al., 2020). IBs with high deposits face lower funding liquidity risk and then, in sequence, have a higher stimulus to make risky investments. Therefore, the insolvency bank risk is associated with lower funding liquidity risk. As a well-known measure of market power, Lerner Index is used to measure the bank's market power. It is the markup of the price of bank products over marginal cost. Our study calculates the Lerner index using the following formula:

$$\text{Lerner} = \left[ \frac{\text{Price} - \text{MC}}{\text{Price}} \right] \quad (3)$$

Where MC is marginal cost. Following Maudos and Solís (2009) for conventional banks and Risfandy et al. (2020) for Islamic banks, the price of bank products is proxied as ratio of total income over total assets. The marginal cost is obtained from the translog cost functions:

$$\begin{aligned} \text{TC}_{it} = & \theta_0 + \sum_{k=1}^3 \theta_1 \ln W_{k,it} + 0.5 \sum_{k=1}^3 \sum_{l=1}^3 \rho_{kl} \ln W_{k,it} \ln W_{l,it} + \rho_1 \ln \text{TA}_{it} + 0.5 \delta_2 (\ln \text{TA}_{it})^2 \\ & + \sum_{k=1}^3 \rho_{2k} \ln \text{TA}_{it} \ln W_{k,it} + e_{it} \end{aligned} \quad (4)$$

TC stands for the total cost that is the sum of interest and non-interest expenses. TA stands for the total assets. This study employs a translog cost function with three inputs (Fu et al., 2014; Risfandy et al., 2017): the funding cost (W1), the labor cost (W2) and physical capital (W3). W1 represents the ratio of total interest costs to customer deposits, and W2 shows the total personnel expense to total assets ratio, and W3 represents the capital-related expense to fixed asset ratio. Ln represents the natural logarithm. The marginal cost (MC) is the first derivative of TC with respect to the asset in equation (4) and is calculated using the following formula:



$$MC_{it} = \left( \rho_1 + \rho_2 \ln TA_{it} + \sum_{k=1}^3 \rho_{2k} \ln W_{k,it} \right) \frac{TC_{it}}{TA_{it}} \quad (5)$$

### 3.2. Data

The number of Islamic rural banks in Indonesia is 165, spanning from 2013 to 2018 with quarterly data. Of the existing 165 IRBs, this study selects 142 Indonesian IRB that have complete financial reports over period of study to explore the impact of funding risk on IRB's asset risk. This study employs balance panel with 3,408 observations. All financial data are sourced from the Financial Services Authority which is available online ([www.ojk.go.id](http://www.ojk.go.id)). The economic growth is obtained from the Central Bureau of Statistics that publishes online regional economic growth data ([www.bps.go.id](http://www.bps.go.id)).

## 4. Estimation results and discussion

### 4.1. Descriptive statistics

The descriptive statistics of all variables being studied are presented in Table 2. Our sample contains 3804 observations. The Z-score ranges from -4.5945 to 5.4421 with an average Z-score of 1.0307 and a standard deviation of 1.4151. LLP varies from 0 to 64.6943 with an average LLP of 2.6830. Zero LLP means that some IRBs do not encounter impaired financing in the given period. The average funding liquidity risk (Frisk) is 34.87%, with a standard deviation of 0.1873, varying from zero to 93.60%. Interestingly, some IRBs provide only Wadiah savings without a Mudarabah deposit. The mean asset of IRBs was IDR 49.42 billion, but the standard deviation was high, indicating that a high disparity among IRBs is found. Average financing rate (Fin) was 74.05% but the financing rate varies across IRB due to high standard deviation (41.42). The average equity is 18.49%, ranging from 2.06% to 136.71%. The efficiency level (CIR) of IRB was 66.64%, below the threshold of 94%. DPLS is a dummy variable, 1 for those Islamic banks offering PLS contracts and 0 for those providing only non-PLS contracts. Interestingly, some IRB provide only non-PLS contracts like CB products because IB consumers are accustomed to interest rate scheme (Utomo et al., 2021) and non-PLS financing are riskier (Widarjono et al., 2020). Economic growth was 5.25% and was relatively the same across provinces because of low standard deviation.

We first check correlation to guarantee that correlation among the independent variables is not high before estimating panel regression. The correlation matrix among the independent variables is presented in Table 3. Generally, the correlation coefficients between independent variables are

**Table 2. Descriptive statistics**

	Mean	Minimum	Maximum	Std. Dev.
Z-score	1.0307	-4.5945	5.4421	1.4151
LLP	2.6830	0.0000	64.6943	4.3690
Frisk	0.3487	0.0000	0.9360	0.1873
Lerner	0.1226	-11.8466	8.1675	0.8745
Asset (billion IDR)	49.4200	0.570	1220.0000	89.5900
Fin	0.7405	0.0167	23.3926	0.4142
Equity	0.1849	0.0206	1.3671	0.1673
CIR	66.6401	15.5177	1947.6560	55.5463
DPLS	0.6690	0.0000	1.0000	0.4706
GGRDP	5.2530	-13.8800	34.0800	1.8733



**Table 3. Correlation matrix**

	Z-score	LLP	Frisk	Lerner	Lasset	Fin	Equity	DPLS	GGRDP
Z-score	1.000								
LLP	-0.285	1.000							
Frisk	-0.011	-0.019	1.000						
Lerner	0.161	-0.193	0.000	1.000					
LAsset	0.404	-0.235	0.192	0.020	1.000				
Fin	-0.017	0.059	-0.010	0.018	-0.014	1.000			
Equity	-0.320	0.320	-0.283	-0.090	-0.531	0.048	1.000		
DPLS	0.080	-0.041	0.240	-0.006	0.238	-0.032	-0.236	1.000	
GGRDP	0.094	-0.014	0.076	0.044	0.145	-0.001	-0.115	0.131	1.000

less than 0.5, which is the highest correlation between the asset and equity (−0.531). These correlation matrixes obviously warrant no perfect multicollinearity problem in our model and accordingly generate efficient estimators.

#### 4.2. Baseline regression

Table 4 exhibits a baseline regression estimation for all IRBs to explore the effect of funding liquidity risk on asset risk of IRBs. The baseline regression in columns (1) and (2) is the basic model to investigate the effect of funding liquidity risk on Islamic rural banks' asset risk consisting of Z-score and LLP. Regression results in columns (3) and (4) include interaction variables between Frisk and dummy PLS (dpls). The interaction is important to examine the impact of the PLS contract on Islamic banks taking behavior through funding liquidity risk. The pooled regression, fixed effect (FE), and random effect (FE) are widely applied to estimate static panel regression. F test indicates that the FE model is better than the pooled model and Hausman tests evidently show that the FE model is more pronounced than RE.

The results in column (1), where the dependent variable is Z-score, show that the coefficient of funding liquidity risk is negative and statistically significant, meaning that funding liquidity risk increases the insolvency bank risk. Islamic banks have more the stimulus to make risky investments because of lower funding liquidity risk and obviously supports the bank lending theory proposed by Acharya and Naqvi (2012). The theory of bank lending stems from the stylized reality that high deposits protect from bank's failure. Banks experiencing low funding liquidity risk, which is indicated by the high ratio of deposits to total assets, tend to take more risk. Our findings support the previous results such as Khan et al. (2017), Dahir et al. (2018), and Smaoui et al. (2020).

Some other explanatory variables, as control variables, are significant. The market power using the Lerner Index positively affects the Z-score. The results imply that banks with high market power lead to higher profits because they can set high margins. A study by Trinugroho et al. (2018) documented that the Lerner index is positively associated with bank margins at Indonesian Islamic rural banks. The effect of the bank's size on the Z-score is positive and statistically significant for all samples. Large Islamic banks benefit from economies of scale and efficiency than smaller IB and accordingly, our results reject the too big to fail theory (Trad et al., 2017). Operating inefficiency (CIR) lowers Z-score similar to Sutrisno and Widarjono (2018) for large IBs in Indonesia. Our findings imply an apparent relationship between the Z-scores and the operating efficiency. The good macroeconomic condition is also positive and statistically significant.

**Table 4. Islamic bank's asset risk: baseline regression**

Variable	Z-score	LLP	Z-score	LLP
	(1)	(2)	(3)	(4)
Cons	−2.9852*** (0.8850)	12.4713*** (2.7609)	−3.1563*** (0.8883)	15.4661*** (2.7130)
Frisk	−0.3836** (0.2137)	6.0977*** (0.6667)	−0.9505*** (0.3439)	16.0238*** (1.0502)
Frisk*dpls	- (0.4344)	- (0.4344)	0.9140** (0.4344)	−16.0023*** (1.3268)
Lerner	0.0688*** (0.0211)	−0.3239*** (0.0658)	0.0685*** (0.0211)	−0.3176*** (0.0645)
Lasset	0.2560*** (0.0506)	−0.8260*** (0.1577)	0.2636*** (0.0507)	−0.9593*** (0.1547)
Fin	−0.0367 (0.0424)	0.2339** (0.1323)	−0.0389 (0.0424)	0.2724** (0.1296)
Equity	−0.1845 (0.2373)	0.1909 (0.7401)	−0.1116 (0.2396)	−1.0863* (0.7319)
CIR	−0.0049*** (0.0004)	0.0313*** (0.0016)	−0.0050*** (0.0004)	0.0327*** (0.0011)
GGRDP	0.0322*** (0.0103)	−0.0183 (0.0322)	0.0323*** (0.0103)	−0.0202 (0.0315)
R <sup>2</sup>	0.2549	0.2245	0.2278	0.1028
F Statistic	16.64	15.46	16.69	17.18
Bruesch Pagan	5518.35	4854.61	5520.46	3872.31
Hausman	75.42	51.83	17.24	118.11

Note: \*, \*\*, and \*\*\* are significant at 10%, 5%, and 1%, respectively. The standard error is presented in parentheses.

To further warrant the robustness of our findings, this study also estimates the model using the loan loss provisions (LLP) as the alternate measurement of bank risk-taking. Funding liquidity risk is positive and significant on LLP, representing that Islamic banks prefer to take more risk because of lower funding liquidity risk. This result is in line with the existing empirical study such as Khan et al. (2017) and Smaoui et al. (2020). Lerner index negatively affects LLP as expected. According to the theory of market structure (Smirlock, 1985), the high Lerner index represents high market power and then in turn generates more profit and stability, meaning that higher market power increases banks' financial value and lowers risk-taking behavior.

Bank size also negatively affects LLP, implying that large banks can create operating efficiency due to economics of scale. However, financing and equity are positive and statistically significant. Higher financing and equity lead to higher impaired financing. LLP is positively related to operating inefficiency, implying that there is an obvious positive relationship between the inefficiency and LLP.

In fact, some IRBs provide only non-PLS contracts since PLS contracts generate riskier financing. The existing studies have not tested the effect of PLS contracts on risk-taking behavior. Therefore, our study controls for discrepancies in risk-taking behavior between the two kinds of Islamic banks using the interaction variable (frisk\*dpls) by multiplying between the funding liquidity risk variable

**Table 5. Islamic bank's asset risk: the Islamic bank's size**

Variable	Large		Small	
	Z-score	LLR	Z-score	LLR
	(1)	(2)	(3)	(4)
Constant	2.0117*	-10.1851***	-5.3977***	30.8010***
	(1.1771)	(2.3635)	(1.1728)	(5.1851)
Frisk	-1.0882***	1.3191**	-0.1515	9.4690***
	(0.2878)	(0.5913)	(0.2397)	(1.0760)
Lerner	-0.0010	0.1707***	0.0860***	-0.5476***
	(0.0325)	(0.0546)	(0.0267)	(0.1106)
Lasset	0.0780*	0.5325***	0.3763***	-1.9334***
	(0.0592)	(0.1199)	(0.0703)	(0.3132)
Fin	-0.0133	-1.3512***	-0.0361	0.1804
	(0.2940)	(0.5125)	(0.0424)	(0.1765)
Equity	-0.1636	13.3184***	-0.1112	-2.4464**
	(0.5767)	(1.1520)	(0.2386)	(1.0526)
CIR	-0.0297**	0.0259***	-0.0040***	0.0294***
	(0.0017)	(0.0029)	(0.0004)	(0.0016)
GGRDP	0.0168*	-0.0014	0.0595**	-0.0858
	(0.0107)	(0.0179)	(0.0250)	(0.1095)
R <sup>2</sup>	0.2682	0.1056	0.2230	0.223
F test	13.29	15.95	18.26	16.37
Bruesch Pagan test	2148.38	2557.76	2903.01	2244.00
Hausman	6.26	19.87	202.40	37.00

Note: \*, \*\*, and \*\*\* are significant at 10%, 5%, and 1%, respectively. The standard error is presented in parentheses.

(frisk) and PLS (dpls) as a dummy variable. This interaction variable shows the differential effect in asset risk between IRBs with PLS contracts and without PLS contracts. Interestingly, this interactive variable is positive and statistically significant to Z-score and is negative and statistically significant to LLP. Our results show that IRBs providing both PLS and non-PLS contracts display less risk-taking than those who provide only non-PLS contracts, meaning that PLS contracts can lessen bank risk-taking behavior. Overall, the impact of control variables is similar to basic regression.

#### 4.3. Further investigation

Čihák and Hesse (2010) documented that the financial performance of Islamic banks depends on the Islamic bank's size. Consequently, our study particularly explores the impact of funding liquidity risk on Islam bank risk-taking behavior based on Islamic bank's size. Bank's size is grouped according to the total asset. Islamic banks whose assets above the average are considered large Islamic banks and, otherwise, it is small Islamic banks. Table 5 exhibits the impact of funding risk based on a bank's size. The diagnostic test indicates that random effect fit for model (1) for large banks and the fixed effect is appropriate for other models.

Funding liquidity risk negatively affects the Z-score for large banks, but this variable does not affect small banks. These results denote that large IB face higher asset risk than small IB. Our findings also indicate that large IBs have a higher default risk than small IB to support 'the too big

**Table 6. Islamic bank's asset risk: Islamic bank's location**

Variable	Java		Off Java	
	Z-score	LLR	Z-score	LLR
	(1)	(2)	(3)	(4)
Constant	−2.3775** (0.9456)	−3.6311 (2.6782)	−5.1171*** (1.6776)	46.5939*** (5.8525)
Frisk	−0.6523*** (0.2429)	0.5655 (0.6852)	−0.4332* (0.3348)	16.4092*** (1.1681)
Lerner	0.0651** (0.0301)	−0.0555 (0.0834)	0.0438* (0.0287)	−0.5494*** (0.1001)
Lasset	0.2203*** (0.0483)	0.0255 (0.1369)	0.3746*** (0.0981)	−2.8188*** (0.3424)
Fin	0.5947** (0.2383)	2.7060*** (0.6629)	−0.0675* (0.0449)	0.2551* (0.1568)
Equity	−0.1230 (0.2979)	6.7863*** (0.8338)	0.1261 (0.3526)	−10.8925*** (1.2303)
CIR	−0.0142*** (0.0008)	0.0313*** (0.0022)	−0.0027*** (0.0004)	0.0290*** (0.0015)
GGRDP	0.0681** (0.0403)	0.0376 (0.1115)	0.0281** (0.0107)	−0.0635** (0.0374)
R <sup>2</sup>	0.3189	0.1350	0.2488	0.1201
F test	15.75	17.53	17.70	20.70
Bruesch Pagan test	3350.85	3966.88	2009.95	1226.34
Hausman test	18.69	11.63	77.13	166.40

Note: \*, \*\*, and \*\*\* are significant at 10%, 5% and 1%, respectively. The standard error is presented in parentheses.

to fail” theory. Our results confirm the previous results such as Dahir et al. (2018), Hassan et al. (2019), and Smaoui et al. (2020).

Funding liquidity risk has a higher impact on LLP for small banks than for large banks. These findings indicate that small banks face more impaired financing than large banks. Widarjono et al. (2020) document that non-performing financing of Islamic banks are more prevalent for small IRBs than large IRBs. Interestingly, market power is very important for small banks because it can increase the Z-score and reduce the risk of impaired financing. The level of operational efficiency reduces the Z-score and increase the financing risk of both small and large banks.

Further analysis also examines banking risk behavior based on the geographical area due to the evidence of the distinct gap between outside Java as the less developed areas and Java as the developed areas (Trinugroho et al., 2015; Widarjono et al., 2020). Indeed, it is interesting to particularly examine the effect of funding liquidity on Islamic bank risk-taking related to an economic concentration between IRBs in Java and outside Java. Table 6 displays the findings for IRBs in Java. The Hausman test shows that the FE model is appropriate for models 1 and 3 but the RE model is valid for model 2.

Funding liquidity risk negatively influences the Z-score for banks located in Java and off Java. However, banks in Java have a higher coefficient than outside Java, implying that banks face more insolvency in

the advanced economy than in the less developed economy. Market power has a greater influence on the Z-score in the Java region than outside Java. Trinugroho et al. (2018) and Widarjono et al. (2020) found that IRBs in Java can generate high margins to capitalize on higher profit. Bank's size has a positive effect in both areas. The amount of financing has a positive effect on the Z-score for banks located in Java and the financing reduces the Z-score for banks located outside Java. Operating inefficient increases bank risk in all regions. Macroeconomic conditions positively affect the Z-score, but the impact is greater in Java than outside Java.

Funding liquidity risk positively affects LLP for Islamic banks outside Java, while frisk does not affect banks in Java. The Lerner Index has a negative effect on LLP only for banks outside Java. Bank's size has a negative effect on banks located outside Java. IRBs outside Java can generate efficient management due to large size and imperfect market (Widarjono et al., 2020), meaning that the larger the bank size, the less likely there is impaired financing. Financing has a positive effect on banks in both locations, but the impact of financing is greater for IRBs in Java than for IRBs outside Java. Operating inefficiency had a positive effect on LLP, but the impact was lower for IRBs outside Java than in Java. Economic growth negatively affects LLP for IRBs outside Java.

## 5. Conclusion

Our study explores the impact of funding liquidity risk and some control variables on IRBs' asset risk. Our study clearly indicates that funding liquidity risk increases the insolvency bank risk and increases the possibility of financing impairments. Funding liquidity risk reduces Z-score for large IRBs than small IRBs but small banks face more impaired financing than large banks. The impact of funding liquidity on a bank's asset risk is lower for the banks in less developed areas than developed areas. More interestingly, the Islamic bank providing both PLS and non-PLS contracts display less risk-taking than those who do not provide PLS contracts.

In summary, as funding liquidity is high, IRB involves more risk-taking but as funding liquidity is low, IRB faces a liquidity shortage. Our results have policy implications for policymakers and IRB to manage asset risk. First, Indonesian Financial Service Authority (Otoritas Jasa Keuangan) as policymakers enforces regulations that prevent liquidity mismatch between asset risk and liquidity risk. One possibility is regulation about investment account product, which may balance the credit and liquidity risk (Asrianti & Syamlan, 2021). Second, Islamic banks that provide only non-PLS contracts face high asset risk. Therefore, the Islamic bank must try to balance financing both PLS and non-PLS contracts by optimizing both contracts to reduce Islamic bank's risk assets

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### Author details

Agus Widarjono  
 E-mail: [agus.widarjono@uii.ac.id](mailto:agus.widarjono@uii.ac.id)  
 Diana Wijayanti  
 Suharto Suharto  
 Department of Economics, Faculty of Business and Economics, Universitas Islam Indonesia, Yogyakarta, Indonesia.

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