Pacific-Basin Finance Journal 47 (2018) 129–149

Contents lists available at ScienceDirect

Pacific-Basin Finance Journal

journal homepage: www.elsevier.com/locate/pacfin

Risk in Islamic banking and corporate governance☆

Md Safiullah*, Abul Shamsuddin

Newcastle Business School, The University of Newcastle, 409 Hunter Street, Newcastle, NSW 2300, Australia

ARTICLE INFO

JEL classification:
G21
G32
G34

Keywords:
Islamic banking
Shariah supervisory board
Ownership concentration
Risk

ABSTRACT

We examine the differences in risk between Islamic and conventional banks with specific attention to the role of Shariah supervisory board (SSB) composition on risk in Islamic banks. Using a sample of banks from 28 countries, we find that Islamic banks have a higher liquidity risk, lower credit risk, lower insolvency risk, but encounter similar operational risk in comparison with conventional banks. Operational and insolvency risks in Islamic banks decline with an increase in SSB size and SSB members' academic qualifications, but increase with an increase in the number of reputed Shariah scholars on the SSB. The SSB attributes do not have significant influence on liquidity and credit risks. The findings are robust to alternative risk measures, and the use of a system GMM estimator.

1. Introduction

The Islamic banking industry has grown rapidly since the early 2000s. Total assets in the Islamic banking industry grew from $195 billion in 2000 to $1451 billion in 2015 and this is expected to further increase to $2716 billion by 2021 (Thomson Reuters, 2016). The Islamic banking industry's rapid growth has spurred scholarly interest in investigating the issue of risk of Islamic banks in comparison to their conventional counterparts (Čihák and Hesse, 2010; Abedifar et al., 2013; Beck et al., 2013; Kabir et al., 2015; Mollah et al., 2017). Previous empirical research has examined accounting-based measures of insolvency risk and credit risk for Islamic and conventional banks. The findings are mixed. Abedifar et al. (2013) and Mollah et al. (2017) find that Islamic banks' insolvency risk does not differ from that of conventional banks. In contrast, Čihák and Hesse (2010) and Beck et al. (2013) find that Islamic banks face greater insolvency risk. With reference to credit risk, Abedifar et al. (2013) report less credit risk in Islamic banks while Kabir et al. (2015) show Islamic banks are at greater credit risk compared to their conventional counterparts. These diverse findings may be due to their use of an unmatched sample of banks, different samples[1] or different bank risk models. Also, these studies are limited to an examination of insolvency risk and credit risk. Our paper extends the literature in several ways.[2]

First, a key principle of Islamic finance is the prohibition of excessive risk-taking. The current regulatory infrastructure is tailored toward controlling risk exposures of conventional banks. Unlike conventional banks, Islamic banks operate under moral prohibitions set out in Islam with respect to excessive risk-taking, interest-based transactions, and transacting with firms whose core business are

☆ We thank Iftekhar Hasan, Paul Docherty and other discussants for their helpful comments at the Accounting and Finance discipline workshop, 13th–14th July 2016, University of Newcastle, Australia. We also acknowledge helpful comments from participants at the Applied Financial Modelling Conference, 2–3 February 2017, Melbourne, Australia.

* Corresponding author.
E-mail address: Md.Safiullah@uon.edu.au (M. Safiullah).

[1] For example, Chong and Liu (2009) show that Islamic banks in Malaysia do not strictly follow the profit-and-loss sharing paradigm and their deposit rates are highly correlated with conventional banks' deposit rates. Thus, the risk profile of such Islamic banks may be similar to their conventional counterparts.

[2] A summary of differences between our paper and the relevant previous studies is presented in Table A3 in the appendix.

https://doi.org/10.1016/j.pacfin.2017.12.008
Received 22 August 2017; Received in revised form 31 October 2017; Accepted 13 December 2017
Available online 17 December 2017
0927-538X/

deemed illicit in Islam.[3] These moral prohibitions along with lack of prudential regulations of Islamic banking can lead to differences in risk-taking between Islamic and conventional banks. Like our predecessors, we examine credit risk and insolvency risk of Islamic and conventional banks—but unlike them, we examine liquidity risk and operational risk. We measure these risks and investigate their determinants for both bank groups.[4] This line of investigation is important to depositors choosing between Islamic and conventional banks, bank managers identifying the key drivers of bank risk, regulators designing a coherent risk assessment framework for a dual-banking system that comprises Islamic and conventional banks, and policy-makers using interest-bearing financial instruments as conduits for monetary policy transmission.

Second, to ensure compliance with the moral prohibitions, Islamic banks are governed by an additional internal governance mechanism called the Shariah supervisory board (SSB), which develops guidelines for Shariah-compliant banking and ensures all banking products and transactions adhere to those guidelines (Safieddine, 2009; Mollah and Zaman, 2015). To our knowledge, there is no evidence to date on the effects of SSB composition on Islamic banks' liquidity risk, credit risk, operational risk and insolvency risk. We fill this research gap by investigating the effects of different SSB attributes, namely SSB size, and SSB members' academic qualifications and reputation on the risk of Islamic banks. Additionally, we examine the effectiveness of dual board structure in Islamic banks by evaluating the interactive effects of SSB and regular board of directors on Islamic banks' risk-taking behavior.[5]

Third, our paper also differs from prior literature on Islamic bank risk in that we use levels of ownership concentration as potential drivers of risk in Islamic vis-à-vis conventional banks. With concentrated ownership, large shareholders may have the incentive to reduce bank risk by monitoring bank managers' opportunistic risk-taking preferences (Shleifer and Vishny, 1986; Stulz, 2005; John et al., 2008). Conversely, they can exercise their controlling power to induce bank managers to engage in higher risk-taking, to maximize their own interests by expropriating the interests of minority shareholders (Shleifer and Vishny, 1986; John et al., 2008). Thus, the effect of ownership concentration on bank risk is a priori indeterminate. We empirically determine its effect on risk-taking behavior of conventional and Islamic banks.[6]

Fourth, previous literature on Islamic bank risk has used non-comparable or unmatched samples of Islamic and conventional banks. The use of an unmatched sample in a comparative research setting may cause sample selection bias (Schaeck et al., 2012), and hence the resulting evidence can be influenced by a confounding factor rather than the true underlying relationship between the variables of interest (Ho et al., 2007; Dunlap et al., 1996). We address this issue by examining the risk of Islamic banks in comparison with their matched conventional counterparts.

Fifth and finally, unlike previous studies on Islamic bank risk we examine variations in bank risk across six geographical regions. These are the following: Gulf Co-operation Council (GCC), non-GCC Middle East and North Africa (MENA), Europe and Central Asia, East Asia and Pacific, South Asia, and Sub-Saharan Africa. This allows us to discern whether the differences in cross-regional legal system, regulatory framework and the prevalence of Islamic banking practices result in differences in risk-taking behavior of Islamic and conventional banks. Additionally, the effect of the GFC on bank risk is examined to verify a commonly held view that Islamic banks are more resilient to a financial crisis than their conventional counterparts.

Our findings, using a matched-pair sample of 188 Islamic and conventional banks from 28 countries over 2003–2014, suggest that compared to conventional banks, Islamic banks generally have higher liquidity risk, but lower credit risk and lower insolvency risk. Islamic banks are indistinguishable from conventional banks in terms of operational risk. We find that the SSB attributes have no significant influence on liquidity and credit risks. However, the larger SSB size and higher academic qualifications of SSB members decrease Islamic banks' insolvency risk and operational risk, while the higher representation of reputed Shariah scholars on the SSB increases those risks.

The rest of this paper is organized as follows. Section 2 presents the hypotheses. Section 3 presents the sample selection process, data and descriptive statistics. Sections 4 and 5 present the empirical models of bank risk and discuss the results. These are followed by additional tests and conclusion, respectively, in Sections 6 and 7.

2. Do Islamic banks take more risk than conventional banks?

This section explains how Islamic principles-based banking practices and a dual board structure can influence the risk-taking behavior of Islamic banks compared to their conventional counterparts. Building on this explanation, we propose several testable hypotheses pertinent to risks of Islamic and conventional banks and their determinants.

2.1. Islamic banking and liquidity risk

Liquidity risk of a bank is the likelihood that customers' demand for cash withdrawals exceeds a bank's supply of cash. The risk

[3] These industries include alcoholic beverages, gambling, pork products, adult entertainment, tobacco, intoxicating drugs and defence products.

[4] The Basel Committee on Banking Supervision and the banking literature consider these four risks as major ones that banks encounter (BIS, 2001, 2008; Sun and Chang, 2011; Acharya and Mora, 2015).

[5] Balachandran and Faff (2015) interpret the corporate governance-risk nexus as an important first order linkage underlying the relationship between corporate governance and performance.

[6] Prior studies generally consider bank-level accounting variables and macroeconomic variables as determinants of Islamic banks' risk. An exception to this is Mollah et al. (2017), who use an index of regular board of directors' attributes as a determinant of insolvency risk and report that board governance increases Islamic banks' insolvency risk. An examination of the role of SSB attributes (e.g. size, academic qualifications and reputation of SSB members) and levels of ownership concentration as determinants of Islamic banks' liquidity risk, credit risk, operational risk and insolvency risk was beyond the scope of their study.

intensifies if banks face difficulties either in borrowing funds at a reasonable cost or selling an asset for its present value to meet liquidity needs (Diamond and Rajan, 2001). Compared to conventional banks, Islamic banks may incur more liquidity risk in times of market-wide liquidity stress due to the religious constraints on accessing interest-based funds from the money market or the central bank's lender of the last resort facility. In this context, what is also lacking is an Islamic money market and tradeable Shariah-compliant financial instruments to meet liquidity needs.[7] Furthermore, the Shariah restriction on securitization of an existing asset portfolio limits an Islamic bank's ability to transform its illiquid assets into liquid assets (Khan and Ahmed, 2001). Therefore the following hypothesis is proposed:

H_{1a}. Islamic banks' liquidity risk is higher than that of conventional banks.

2.2. Islamic banking and credit risk

Credit risk refers to the possibility of a borrower's non-payment of a loan in accordance with the stipulated contract. Unlike conventional banks, the distinct modes of financing in Islamic banks may result in a different credit risk profile. Islamic banks may face higher credit risk in PLS (profit-and-loss sharing) financing modes due to the moral hazard incentives of borrowers associated with the opportunity to share loss with banks (El-Hawary et al., 2007). The religious restriction on the use of conventional credit risk mitigation tools such as credit derivatives is also likely to increase credit risk exposure of Islamic banks (Errico and Farahbaksh, 1998). However, the business partnership type of contracts between borrowers and banks can decrease credit risk because it reduces information asymmetry, improves the adverse selection problem, and facilitates better understanding of borrowers' creditworthiness (Errico and Farahbaksh, 1998). Islamic banks may also have lower credit risk exposure due to the religious beliefs of borrowers regarding the Islamic banking system, by inducing loyalty and discouraging default (Abedifar et al., 2013; Baele et al., 2014). Thus, it is a priori indeterminate whether an Islamic bank's credit risk is higher or lower than that of a conventional bank. So the following non-directional hypothesis is examined:

H_{1b}. There is a difference in credit risk between Islamic and conventional banks.

2.3. Islamic banking and operational risk

"Operational risk is defined as the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events" (BIS, 2011, p.3). Islamic banks can face additional operational risk arising from Shariah non-compliance, which can lead to the non-recognition of earnings and the resultant risk of losses (IFSB, 2005). The PLS financing mode can be a critical source of operational risk affecting Islamic banks due to the possibility of a higher asset return variability in a business-partnership type contract (Errico and Farahbaksh, 1998). The likelihood of operational risk is also high in non-PLS financing modes (e.g. leasing contracts) since Islamic banks assume ownership of assets or commodities and all risks associated with the ownership (e.g. price risk) until the end of the contract period (Sundararajan and Errico, 2002). Furthermore, a lack of a Shariah regulatory system and standardized accounting and control processes to govern Islamic banks may also impede their operational risk control (El-Hawary et al., 2007; Safieddine, 2009). For these reasons, we propose the following operational risk hypothesis:

H_{1c}. Islamic banks' operational risk is higher than that of conventional banks.

2.4. Islamic banking and insolvency risk

A bank is regarded as insolvent if value of its assets drops below the value of its liabilities. In Islamic banking, a profit-and-loss sharing relationship exist between banks and depositors, which provides Islamic banks with an opportunity to share realized losses with depositors. This feature reduces the volatility of cash flows and increases banks' capacity to absorb losses and thus mitigate insolvency risk. On the other hand, Shariah constraints on portfolio diversification,[8] interest-based wholesale funding and the use of conventional risk hedging instruments can make Islamic banks more risky and hence less financially stable (Beck et al., 2013; Abedifar et al., 2013; Sensoy, 2016). Additionally, Islamic banks' reliance on equity-based contracts does not give the debt market an opportunity to monitor their risk profile. This can compromise financial stability by reducing risk management incentives. The above two opposing considerations lead to the following hypothesis:

H_{1d}. There is a difference in insolvency risk between Islamic and conventional banks.

[7] The Islamic interbank money market is available only in Malaysia and Indonesia. UAE, Bahrain, Brunei and Sudan have established bilateral liquidity management facilities for Islamic banks only with their respective central bank but there are no market trading facilities (IFSB–IRTI, 2014).

[8] Islamic banks are not permitted to invest in alcoholic beverages, gambling, pork products, adult entertainment, tobacco, intoxicating drugs and defence industries as Islam deems them harmful to people's wellbeing.

2.5. Shariah supervisory board size and risk

From an agency theory perspective, board size determines the ability of the board to monitor and advise management. Coles et al. (2008) argue that larger board size is more effective in large and complex firms that are more diversified and require more specialized advice. Resource dependence theory also suggests that larger boards bring diverse knowledge and experience and consequently they are able to provide better quality advice and counsel to firms (Dalton et al., 1999). As the SSBs' decision involves an understanding of Islamic law, modern banking and finance, and legal issues, having more SSB members with diverse professional backgrounds may enable juristic Shariah decision-making and greater conformity to Shariah principles and as such influence the level of Islamic banks' risk.

A larger SSB may also influence the ability of that board to improve ex-ante Shariah screening of loan quality, policies, and strategies and to reduce managers' moral hazard problem of implementing less stringent monitoring of the borrowers' business. The stronger Shariah oversight ability of a larger SSB is also likely to restrain a manager's aggressive financing and lending practices, which in turn may lower Islamic banks' risk. Thus, the following hypothesis about the SSB size-risk relationship is proposed:

H_{2a}. Shariah supervisory board size is negatively associated with Islamic banks' risk.

2.6. Shariah supervisory board members' academic qualifications and risk

Academic qualification is associated with cognitive ability, skill base, and risk attitude (Hambrick and Mason, 1984). A high academic qualification is likely to increase the capacity of directors to interpret and evaluate information (Bantel, 1993), to integrate a variety of proposed solutions to complex problems (Bantel and Jackson, 1989) and to undertake an in-depth assessment of the implications of decisions made (Chen, 2014). Berger et al. (2014) argue that the cognitive abilities of directors with advanced academic qualifications (e.g. PhD degrees) help to: firstly, increase the board of directors' effectiveness in decision-making; and secondly, lead to stronger monitoring of opportunistic risk-taking behavior of management should it occur.

SSB members with advanced academic qualifications could improve their ability to operationalize Islamic principles into banking practices, including enforcement of moral prohibition on excessive-risk taking. For example, advanced academic qualifications can enable SSB members to accurately evaluate the risk implications of Shariah-compliant banking and provide guidelines to develop internal techniques for hedging risk. Therefore, we propose the following hypothesis:

H_{2b}. Higher academic qualifications of SSB members reduces Islamic banks' risk.

2.7. Shariah supervisory board members' reputation and risk

The reputation of board members largely stems from their track record in improving firm performance. Directors with a good reputation can act as monitoring specialists (Fama and Jensen, 1983) and help the management attain effective board governance (Jiang et al., 2016). The appointment of reputable directors also enhances the firms' credibility and legitimacy to stakeholders (Deutsch and Ross, 2003). Diamond (1989) argues that when reputation becomes a valuable asset, it motivates decision-making agents to be self-disciplined and refrain from undertaking excessively risky projects to avoid reputational losses.

The presence of reputable Shariah scholars on an Islamic bank's SSB can be conducive for effective Shariah monitoring, which can in turn help mitigate risk. Due to their greater Shariah expertise, they are well-placed to bridge the gap between Shariah and finance skills of bank managers and hence reduce the operational risk resulting from Shariah non-compliance. Reputable Shariah members' extensive industry knowledge is more likely to improve the quality of ex-ante Shariah screening of lending policies, and also the quality of ex-post Shariah audit on the compliance with Shariah guidelines, which is likely to reduce possible credit and insolvency risks. The presence of reputed Shariah scholars on the SSB may also increase the bank's credibility to customers, which in turn reduces withdrawal risk and liquidity risk exposure. Finally, reputed SSB members' incentives to exert independent oversight of Shariah compliance to avoid their loss of reputation may also improve Islamic banks' asset quality and financial stability. The following hypothesis is suggested here:

H_{2c}. A higher representation of reputed SSB members reduces Islamic banks' risk.

3. Data and descriptive statistics

3.1. Sample selection

This study constructs a sample in two stages. In the first stage, 102 fully-fledged Islamic banks are selected from 28 countries where each country has at least one conventional and one Islamic bank. The sample selection is guided by the availability of relevant information on the Bankscope database.[9] In the second stage, we match selected Islamic banks with their conventional counterparts

[9] The Bankscope database categorizes 175 banks from 35 countries as Islamic banks. However, this category includes all Islamic banks, conventional banks with an Islamic window, and other types of non-bank Islamic financial institutions. We include only fully-fledged Islamic banks to ensure comparability with conventional banks and to maintain consistency across the sample. The GICS is initially used to identify Islamic and conventional banks, and then cross-checked against each country's central bank's categorization of banks. We exclude Iran from our sample because only Islamic banks operate in that country, while in other sample countries the dual-banking systems co-exist.

Table 1
Sample countries, banks and observations.

Region/country	Number of banks	Observations	Percentage of observations
Gulf Co-operation Council (GCC)			
Bahrain	18	164	12.91
Kuwait	10	78	6.14
Oman	4	8	0.63
Qatar	8	50	3.94
Saudi Arabia	8	50	3.94
United Arab Emirates	14	92	7.24
Non-GCC Middle East & North Africa			
Egypt	2	12	0.94
Iraq	6	24	1.89
Jordan	6	40	3.15
Lebanon	2	8	0.63
Palestine	2	12	0.94
Syrian Arab Republic	4	18	1.42
Tunisia	2	10	0.79
Yemen	2	18	1.42
Sub-Saharan Africa			
Kenya	4	20	1.57
Nigeria	2	6	0.47
South Africa	2	14	1.10
Sudan	10	46	3.62
Europe and Central Asia			
Turkey	8	74	5.83
United Kingdom	6	44	3.46
East Asia & Pacific			
Malaysia	26	202	15.91
Indonesia	6	40	3.15
Brunei Darussalam	2	10	0.79
Thailand	2	14	1.10
South Asia			
Bangladesh	14	94	7.40
Maldives	2	8	0.63
Pakistan	14	106	8.35
Sri Lanka	2	8	0.63
Total 28 countries (in six regions)	188	1270	100

Notes: This table presents the list of countries, number of banks and number of bank-year observations.
The sample includes an equal number of Islamic and conventional banks from each country.

using average bank size as the pair-matching criterion to mitigate sample selection bias resulting from the heterogeneity between bank types. Bank size is measured by total assets. Following Berger et al. (2014) and Schaeck et al. (2012), we allow a maximum of four closest-sized banks from which to select the best matched pair banks when an exact matching is unavailable. This approach results in a matched pair sample of 94 Islamic banks and 94 conventional banks, a total of 188 banks.

We use annual data over the period 2003–2014. For each year, we match financial data with SSB composition and corporate governance data, which provides us with a panel of 1270 bank-year observations with equal numbers of observations from Islamic and conventional banks (see Table 1). A sub-sample of publicly traded banks from the matched full sample is also formed to estimate market-based risk measures. This sub-sample consists of 76 Islamic and conventional banks from 14 countries and a total of 486 bank-year observations.[10] We further form a geographical region-wise sub-sample of banks.[11]

Financial and ownership concentration data for banks are obtained from the Bankscope database. Data for the attributes of the SSB and board of directors are hand-collected from the annual reports published on the websites of respective banks. Data for country-level governance and macroeconomic variables are collected from the World Bank (http://data.worldbank.org/data-catalog/world-development-indicators). Stock price, number of shares outstanding, trading volume and market value of equity are obtained from Datastream.

[10] We follow Griffin et al. (2010) by requiring a stock to have daily volume data, and at least 30% trading days of non-zero price changes in a year to be included in the sub-sample of publicly traded banks.

[11] Our region classification is similar to that of the World Bank except for the MENA region. We divided it into GCC and non-GCC MENA regions to separate out results for GCC countries. This is because in terms of market share, they constitute the largest Islamic banking market compared to other regions (Ernst and Young, 2016).

3.2. Risk measures

This study considers liquidity risk, credit risk, operational risk and insolvency risk of banks. The loan-to-deposit ratio is used as a measure for liquidity risk. This variable measures the extent to which banks use liquid deposits to finance illiquid loans. A large loan-to-deposit ratio indicates a greater reliance on non-deposit funds to support lending growth and liquidity demand, which in turn implies higher liquidity risk (DeYoung and Jang, 2016; Acharya and Mora, 2015). Credit risk is measured by the ratio of loan-loss reserves to gross loans. This ratio indicates the amount of reserves banks maintain to allow for credit losses. The higher the ratio, the greater the credit risk. We also use the ratio of non-performing loans to gross loans as an alternative measure. These two credit risk measures are widely used in the banking literature (e.g. Abedifar et al., 2013).

Operational risk is proxied by asset return volatility, following John et al. (2008) and Sun and Chang (2011). This is measured as the three-year rolling standard deviation of net income after tax to total assets. For the sub-sample of publicly traded banks, we use stock return volatility as an additional measure for operational risk following Sun and Chang (2011), which is computed as the standard deviation of the daily stock return times the square root of the number of trading days in a particular year. A higher asset return volatility or stock return volatility is indicative of a greater frequency and severity of operational risk losses.

Three alternative measures of insolvency risk are considered. The first measure is the Z-score, which is defined as follows: $Z-\text{score}_{i,\,t} = (\text{ROA}_{i,\,t} + \text{CAR}_{i,\,t})/\text{SDROA}_{i,\,t}$, where ROA is the return on assets; CAR is the capital-to-asset ratio; and SDROA is the standard deviation of ROA for bank *i* at time *t*. The Z-score is the number of standard deviations that a bank's ROA would have to drop below its anticipated value to exhaust equity. Thus, Z-score is an inverse proxy of insolvency risk. Following Laeven and Levine (2009), we use the natural logarithm of the Z-scores to mitigate the effects of outliers and skewness. For our sub-sample of publicly traded banks, we estimate Bharath and Shumway's (2008) naïve distance to default (naïve DD) model[12] and use it as an alternative measure of insolvency risk. A higher naïve DD indicates a lower insolvency risk. The naïve DD is estimated as follows:

$$\text{naïve DD} = \frac{\text{In}\left(\frac{E+F}{F}\right) + (r_{it-1} - 0.5\ \text{naïve}\ \sigma_v{}^2)T}{\text{naïve}\ \sigma_v\sqrt{T}}$$

where, E is the market value of equity; F is the face value of debts measured by total liabilities; $r_{it\,-\,1}$ is the annual stock return estimated as the average daily stock return of the previous year times the number of trading days; T is the forecast horizon of 1 year; and naïve σ_v is the volatility of firms' assets. This is calculated as:

$$\text{naïve}\ \sigma_v = \frac{E}{E+F}\sigma_E + \frac{F}{E+F}\text{naïve}\ \sigma_D$$

where, σ_E is the annual stock returns volatility estimated as the standard deviation of daily stock return times the square root of the number of trading days in a year, and naïve σ_D is the volatility of a firm's debt, which is computed as, naïve $\sigma_D = 0.05 + 0.25 \times \sigma_E$.

As a direct measure of insolvency risk, we also use the naïve probability of default: naïve PD = N(− naïve DD), where N is the cumulative density function of the standard normal distribution. Insolvency risk increases monotonically with naïve PD.

3.3. Measurement of bank risk determinants

The next section presents the empirical models of bank risk that are used to test the hypotheses. Before turning to those models, we focus on the measurement of the risk determinants of our interest and the control variables.

The key risk determinants of our interest are bank type and attributes of the SSB. To assess the effect of bank type on bank risk, we include a dummy variable for Islamic banks in the bank risk models, which is equal to one if a bank is an Islamic bank, and zero if otherwise. The measures for SSB characteristics are SSB size, and SSB members' academic qualifications and SSB members' reputation. SSB size is the total number of SSB members of an Islamic bank at the end of each year. The academic qualifications among SSB members refer to the number of SSB members with doctorate degrees, as a percentage of the total SSB members.[13] SSB members' reputation is proxied by the number of reputable Shariah scholars on the SSB of a bank, as a percentage of the total SSB members. Reputable Shariah scholars are those who have had or currently hold a Shariah directorship position in both or one of the following two international Shariah standard-setting organizations: the Islamic Financial Service Board (IFSB) and the Accounting and Auditing Organizations for Islamic Financial Institutions (AAOIFI).

To determine the partial effect of each key risk determinant of our interest, we consider a number of control variables. First, a board governance index is constructed with eight individual attributes of board of directors. The index comprises board of directors' size, board independence, CEO duality, board members' financial expertise, board members' multiple directorships position, audit committee size, audit committee chairman independence and risk management committee size. Following Aggarwal et al. (2010), we assign a value of one to a board attribute if the bank meets the threshold level of that attribute (see Table A1) and zero if otherwise. We express the index on a 0–100 scale. If a bank fulfils the threshold standards for all individual board attributes, its board governance index value would equal to 100. On the one hand, better board governance can help align the risk-taking behavior of

[12] Bharath and Shumway (2008) propose the naïve DD model to compute distance to default (DD) based on Merton's (1974) DD model. The use of market value of equity in naïve DD calculation allows this measure to reflect default information faster than an accounting data-based insolvency risk measure.

[13] This study follows Berger et al. (2014) by including doctorate degrees as a measure of academic qualifications since other undergraduate and postgraduate qualifications are typically nested within a doctorate degree.

managers with that of shareholders with less aversion to risk (Jensen and Meckling, 1976; Boyd et al., 2011). In such a scenario, good governance may lead to taking more risk. On the other hand, bank managers may sometimes take excessive risk solely to maximize their performance-linked remuneration instead of maximizing shareholders' wealth (Diamond and Rajan, 2009; Laeven, 2013). Better board governance may be able to control such excessive risk-taking behavior through its monitoring role as well as the provision of additional resources (e.g. advice, counsel, networking) to bank managers (Minton et al., 2014).

Second, to measure ownership concentration, we follow Laeven and Levine (2009) by adopting 10% or more ownership by a shareholder (e.g. any individual or any legal entity) as a threshold point for ownership concentration. In line with Shehzad et al. (2010), the ownership concentration level is measured in terms of dummy variables OCL10, OCL20, OCL40, and OCL51. Each of these takes a value of 1 if one shareholder holds at least 10%, 20%, 40%, and 51% of all shares, respectively, and zero if otherwise. We use different levels of ownership concentration instead of a fixed cut-off level of ownership concentration measure, as the former is a better measure of the degree of ownership concentration in a bank. The higher level of ownership concentration may motivate shareholders to rigorously monitor managers and control their risk-taking (Shehzad et al., 2010; John et al., 2008). However, increased ownership concentration can also increase insider expropriation risk, which in turn leads to higher bank risk and less managerial motivation to engage in risk-management (Shleifer and Vishny, 1986; Burkart et al., 1997). Thus, ownership concentration may either increase or decrease bank risk.

Following Abedifar et al. (2013), we also control for capital-to-asset ratio,[14] total assets growth, cost-to-income ratio, income diversity and bank size as bank-specific variables. Country-level control variables are bank concentration ratio, national governance and annual growth rate of per capita GDP. Further details of the measurement of risk determinants are provided in Table A2.

3.4. Descriptive statistics

In Table 2, Panel A presents descriptive statistics for the risk variables. The liquidity risk is measured in terms of the loan-to-deposit ratio. The mean loan-to-deposit ratio is 98.68% for Islamic banks and 84.29% for conventional banks. The difference in means is statistically significant at the 1% level, implying that Islamic banks have a greater liquidity risk than conventional banks. Concerning credit risk, Islamic and conventional banks have on average, loan-loss reserves ratio of 4.46% and 4.99%, respectively. The average non-performing loan ratio is 6.29% for Islamic banks and 6.52% for conventional banks. Thus, the difference in credit risk is negligible in magnitude and also statistically insignificant.

Asset return volatility and stock return volatility are used respectively as accounting and market-based proxies of operational risk. The mean of asset return volatility is 1.11 for Islamic banks and 0.85 for conventional banks. The average stock return volatility is 0.217 and 0.16 for Islamic and conventional banks, respectively. Both of these differences are significant at the 5% level, indicating that Islamic banks have higher operational risk than conventional banks. The accounting-based measure of insolvency risk is Z-score while the market-based measures of insolvency risk are naïve distance-to-default, and the corresponding naïve probability of default. The Z-score has a mean of 1.47 for Islamic banks and 1.60 for conventional banks. The mean value of distance-to-default is 0.51 and 0.18 on Islamic and conventional banks, respectively. Furthermore, the mean probability of default is 0.38 for Islamic banks and 0.46 for conventional banks. The differences in means are statistically significant at the 5% level, indicating that Islamic banks are less exposed to insolvency risk compared to conventional banks as measured by naïve DD and PD.

Panel B of Table 2 contains descriptive statistics for the potential determinants of risk. The mean SSB size is 4.15 with a maximum size of 14. On average, 57.66% of SSB members have a doctorate degree and 19.25% of SSB members are reputed Shariah scholars. The mean board governance index is 58.44 for Islamic banks and 60.41 for conventional banks. This difference is statistically significant at the 10% level. Ownership concentration in Islamic banks is not significantly different from that in conventional banks when the level of concentration is defined by either the 10% or 40% threshold level of ownership. However, the mean ownership concentration becomes higher in Islamic banks compared to conventional banks when the ownership concentration threshold is set at either 20% or 51%. The descriptive statistics for bank-specific accounting variables show that Islamic banks have a higher capital-to-asset ratio, higher total assets growth and higher cost-to-income ratio in comparison to conventional banks. A typical Islamic bank is smaller, and its non-interest income is less than that of a typical conventional bank. Next, we focus on descriptive statistics of country-level control variables. The average concentration ratio in the banking sector shows that 69.63% of banking assets are held by the three largest banks. The national governance index is measured on a -2.5 to $+2.5$ scale by the World Bank. The average value of this index is -0.156 with a standard deviation of 0.701, indicating a large variation in governance across countries. The growth rate of per capita GDP shows considerable variation with a standard deviation almost 2.5 times larger than the mean.

4. Risk-taking behavior of Islamic and conventional banks

4.1. Model of bank risk

We first examine the determinants of bank risk using the full sample of Islamic and conventional banks. The model includes bank type, bank–level corporate governance, financial characteristics, and country-level governance and macroeconomic variables as determinants of bank risk. For each risk measure (liquidity risk, credit risk, operational risk and insolvency risk), the following model is estimated:

[14] All but insolvency risk regression models are controlled for the capital-to-asset ratio since the insolvency risk measure itself accounts for the capital-to-asset ratio.

Table 2
Summary statistics.

	Islamic banks		Conventional banks		t-Statistics
	Mean	Std. Dev.	Mean	Std. Dev.	
Panel A: Risk measures					
Liquidity risk measure:					
Loan-to-deposit ratio	98.689	78.730	84.299	44.062	3.757[a]
Credit risk proxies:					
Ratio of loan loss reserves to gross loans	4.463	7.271	4.999	6.248	− 1.287
Ratio of non-performing loans to gross loans	6.297	10.058	6.525	7.679	− 0.379
Operational risk proxies:					
Asset return volatility	1.117	1.999	0.859	2.262	2.129[b]
Stock return volatility	0.217	0.230	0.161	0.154	3.108[a]
Insolvency risk proxies:					
Z-score	1.479	0.504	1.600	0.578	− 3.881[a]
naïve distance to default	0.511	1.581	0.181	1.656	2.180[b]
naïve probability of default	0.387	0.346	0.464	0.369	− 2.334[b]
Panel B: Determinants of risk					
Shariah supervisory board (SSB) characteristics:					
SSB size	4.151	2.107			
SSB academic qualifications	57.666	34.762			
SSB members' reputation	19.253	28.908			
Corporate governance variables:					
Board governance index	58.445	20.810	60.413	19.152	− 1.753[c]
Ownership concentration:					
OCL10	0.243	0.429	0.272	0.446	− 1.334
OCL20	0.309	0.462	0.208	0.406	4.032[a]
OCL40	0.077	0.267	0.099	0.299	− 1.401
OCL51	0.416	0.493	0.351	0.478	2.482[b]
Bank-level accounting variables:					
Capital-to-asset ratio	17.537	18.974	13.507	9.510	5.275[a]
Assets growth	27.091	50.931	15.270	23.627	5.722[a]
Cost-to-income ratio	64.724	57.892	50.226	41.512	5.623[a]
Bank size	3.270	0.729	3.608	0.828	− 11.105[a]
Non-interest income ratio	22.004	15.477	23.793	11.622	− 2.329[b]
Country-level control variables:					
Bank concentration	69.633	22.212			
National governance	− 0.156	0.701			
Growth rate of per capita GDP (in %)	1.670	4.038			

Notes: This table presents the summary statistics of risk measures in Panel A and determinants of risk in Panel B. Descriptive statistics of the country-level control variables are presented under the Islamic bank columns, as these are invariant to bank-types. Superscripts a, b and c indicate statistical significance at the 1%, 5% and 10% levels, respectively.

$$Risk_{i,t} = \alpha + \beta IB_{i,t} + \gamma BG_{i,t} + \delta OWCL_{i,t} + \varphi X_{i,t} + \omega M_t + \varepsilon_{i,t} \quad (1)$$

where $Risk_{i,\ t}$ refers to a risk measure for bank i at time t; $IB_{i,\ t}$ is the Islamic bank dummy that is equal to 1 if the bank is an Islamic bank, and 0 if otherwise; $BG_{i,\ t}$ is the board governance index constructed with the eight individual attributes relating to board composition, and characteristics of the audit and risk management committees; $OWCL_{i,\ t}$ is the dummy variable for ownership concentration measured at the threshold level of 10%, 20%, 40% and 51% ownership of all shares in a given year; $X_{i,\ t}$ is the vector of bank-specific accounting variables; M_t is the vector of country-level control variables; $\varepsilon_{i,\ t}$ is the random error term; α is the constant; and β, γ, δ, φ and ω are the parameters to be estimated. We also control for year effects and country effects.[15] The coefficient β measures the difference in risk between Islamic and conventional banks conditional on other drivers of risk. This model differs from those of prior studies on Islamic banks' risk (Čihák and Hesse, 2010; Beck et al., 2013; Abedifar et al., 2013; Kabir et al., 2015) in that it considers additional measures of bank risk, and adds board governance and ownership concentration as risk determinants to our predecessors' model. See Table A3 in the Appendix for details concerning the distinguishing features of our model and research design.

Eq. (1) is estimated using the GLS random-effects estimator, which has also been employed in recent studies on bank risk and governance (see Pathan, 2009; Abedifar et al., 2013). A random-effects model is preferable over a fixed-effects model in our context because the latter requires time variation and cross-firm variation of variables. However, the bank-level corporate governance variables of our study do not considerably vary over time and the country-level macroeconomic variables have no variation across banks. Furthermore, the random-effects model is more appropriate given the presence of several dummy variables in our empirical models, as the fixed effects model wipes out the effects of individual dummy variables (Wooldridge, 2010; Baltagi, 2008).

[15] Specifically, 11-year dummies and 27-country dummies are used for our 12-years data from 28 countries.

Table 3
Liquidity risk and credit risk.

	Panel A: Liquidity risk				Panel B: Credit risk			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Islamic bank dummy	19.752[b]	19.357[b]	19.953[b]	18.654[b]	− 2.109[b]	− 2.147[b]	− 2.054[c]	− 1.979[c]
Corporate governance variables:								
Board governance		0.242	0.272[c]	0.312[c]		0.019	0.017	0.021[c]
OCL10			19.962[a]	22.579[a]			0.236	0.174
OCL20			− 9.413	− 10.187[b]			− 1.002[b]	− 0.992[b]
OCL40			− 5.194	− 4.252			0.352	0.368
OCL51			− 1.841	− 4.669			0.009	− 0.015
Bank-level accounting variables:								
Capital-to-asset ratio	1.394[a]	1.400[a]	1.383[a]	1.313[a]	− 0.080[a]	− 0.079[a]	− 0.075[a]	− 0.073[a]
Assets growth	− 0.015	− 0.011	− 0.010	− 0.044	− 0.019[a]	− 0.019[a]	− 0.018[a]	− 0.018[a]
Cost -to-income ratio	0.041	0.033	0.030	0.042	0.046[a]	0.046[a]	0.045[a]	0.045[a]
Income diversity	− 0.021	− 0.021	− 0.022	− 0.023	− 0.006[a]	− 0.006[a]	− 0.006[a]	− 0.007[a]
Bank size	7.604	5.671	3.862	− 1.686	− 2.755[a]	− 2.935[a]	− 2.944[a]	− 2.694[a]
Country-level control variables:								
Bank concentration				− 0.331[a]				0.005
National governance				17.795[a]				− 1.079
Growth rate of per capita GDP				0.271				− 0.090[a]
Constant	36.881[c]	29.865		58.564[b]	14.593[a]	14.141[a]	14.300[a]	12.843[a]
Overall R-square	0.055	0.057	0.076	0.112	0.131	0.1267	0.131	0.1404
Wald chi2	40.78[a]	43.26[a]	56.34[a]	92.21[a]	180.81[a]	183.1 [a]	189.07[a]	199.71[a]

Notes: This table presents the GLS random effect estimation results of Eq. (1) for liquidity risk and credit risk in Panels A and B, respectively. The loan-to-deposit ratio is the measure for liquidity risk, and the ratio of loan-loss reserves to gross loans is the measure for credit risk. Model 1 includes an Islamic bank dummy and bank-specific accounting variables as regressors. Model 1 is cumulatively augmented by board governance, ownership concentration and country-level control variables to obtain Model 2, Model 3 and Model 4, respectively. Note that in addition to country-level control variables, Model 4 includes year and country dummies. Superscripts a, b and c indicate statistical significance at the 1%, 5% and 10% levels, respectively.

4.2. Results on the determinants of bank risk

We present the results for four alternative specifications of Eq. (1) in Tables 3–5. The base model (Model 1) regresses a risk measure on the Islamic bank dummy variable and bank-specific accounting variables, omitting the board governance, ownership concentration, and country-level control variables. This model is then cumulatively augmented by board governance measures, dummy variables for ownership concentration, and country-level control variables to obtain Model 2, Model 3 and Model 4, respectively.

Panel A of Table 3 presents the results of liquidity risk models. The loan-to-deposit ratio serves as the measure for liquidity risk. The coefficient of the dummy variable for Islamic banks is positive and statistically significant at the 5% level in all four models of liquidity risk. The effect size is between 18.654 and 19.752, indicating that this finding is robust to alternative model specifications. The effect size is also economically significant because an Islamic bank's loan-to-deposit ratio is about 19 percentage points higher than that of a comparable conventional bank. The result indicates that a typical Islamic bank funds its loan portfolio largely using non-deposit sources. This finding clearly supports the hypothesis that liquidity risk is higher in Islamic banks relative to conventional banks (H_{1a}).

In Panel B of Table 3, we present the results for the credit risk models. The ratio of loan-loss reserves to gross loans is a credit risk measure in this panel. We find that Islamic banks have less exposure to credit risk compared to conventional banks regardless of what model is used. More specifically, the coefficient of the dummy variable for Islamic banks in four models resides between − 1.979 to − 2.147 with statistical significance at the 5% level. Thus, an Islamic bank's credit risk is about 2% lower than a comparable conventional bank. This finding remains qualitatively valid when we use the ratio of non-performing loans to gross loans as an alternative measure of credit risk. More specifically, the ratio of non-performing loans to gross loans is 2.231% lower in Islamic banks compared to their conventional counterparts.[16] This finding may be attributed to religious orientation of Islamic banks' borrowers who consider defaulting on loans as an immoral act (Abedifar et al., 2013; Baele et al., 2014). Abedifar et al. (2013) also find that Islamic banks' credit risk is lower compared to conventional banks. Thus, the results provide robust support for our hypothesis that compared to conventional banks, Islamic banks are exposed to lower credit risk (H_{1b}).

Table 4 provides the regression results with two alternative operational risk proxies as the dependent variables. Panel A uses asset return volatility as the operational risk measure. This panel shows that the coefficient of the Islamic bank dummy is negative, but statistically insignificant in all four operational risk models (Models 1–4). The results indicate that Islamic banks' operational risk is indistinguishable from conventional banks. When stock return volatility is used as the operational risk measure, the coefficient on the Islamic bank dummy becomes positive but remains statistically insignificant in all but the base model. In general, the results suggest

[16] The regression results for the ratio of non-performing loans to gross loans are not tabulated. The results are available from the corresponding author on request.

Table 4
Operational risk.

Variables	Panel A: Asset return volatility				Panel B: Stock return volatility			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Islamic bank dummy	− 0.047	− 0.041	− 0.006	− 0.105	2.126[a]	0.020	0.024	0.024
Corporate governance variables:								
Board governance		− 0.003	− 0.003	− 0.004		− 0.001[b]	− 0.001[a]	− 0.002[a]
OCL10			0.053	0.009			0.031	0.027
OCL20			− 0.098	− 0.091			− 0.001	0.002
OCL40			0.738[a]	0.760[a]			0.047[c]	0.043[c]
OCL51			− 0.0004	− 0.076			0.067[b]	0.075[a]
Bank-level accounting variables:								
Capital-to-asset ratio	− 0.003	− 0.003	− 0.004	− 0.007	0.113[a]	0.002[a]	0.002[a]	0.002[a]
Assets growth	0.001	0.001	0.001	0.003[b]	− 0.003	− 0.0004	− 0.0002	0.0001
Cost-to-income ratio	0.006[a]	0.006[a]	0.006[a]	0.005[a]	− 0.003	− 0.0003	− 0.0004[c]	− 0.001[b]
Income diversity	− 0.002[a]	− 0.002[a]	− 0.002[a]	− 0.002[a]	− 0.009	0.001	0.001	0.001
Bank size	− 1.094[a]	− 1.070[a]	− 1.091[a]	− 1.403[a]	− 0.712[c]	− 0.100[a]	− 0.107[a]	− 0.094[a]
Country-level control variables:								
Bank concentration				0.001				0.0004
National governance				0.526[a]				− 0.046[c]
Growth rate of per capita GDP				− 0.041[a]				− 0.003[c]
Constant	4.471[a]	4.569[a]	4.605[a]	5.948[a]	4.339[a]	0.589[a]	0.597[a]	0.470[a]
Overall R-square	0.138	0.136	0.149	0.162	0.207	0.239	0.263	0.297
Wald chi2	109.82[a]	110.32[a]	125.39[a]	175.830[a]	72.95[a]	65.48[a]	81.98[a]	109.13[a]

Notes: This table presents the GLS random effect estimation results of Eq. (1) for two proxies of operational risk—asset return volatility and stock return volatility. Model 1 includes an Islamic bank dummy and bank-specific accounting variables as regressors. Model 1 is cumulatively augmented by board governance, ownership concentration and country-level control variables to obtain Model 2, Model 3 and Model 4, respectively. Note that in addition to country-level control variables, Model 4 includes year and country dummies. Superscripts a, b and c indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 5
Insolvency risk.

Variables	Panel A: Z-score				Panel B: Naive distance to default (naïve DD)			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Islamic bank dummy	− 0.052	− 0.053	− 0.063	− 0.062	0.326[b]	0.349[b]	0.303[c]	0.340[b]
Corporate governance variables:								
Board governance		0.002[b]	0.002[b]	0.001[c]		0.007[c]	0.007	0.004
OCL10			0.104[b]	0.112[a]			− 0.106	− 0.244
OCL20			0.017	0.0375			0.260	0.084
OCL40			− 0.149[b]	− 0.121[b]			0.141	0.153
OCL51			0.046	0.047			− 0.041	− 0.019
Bank-level accounting variables:								
Assets growth	0.002	0.003	0.003	0.001	0.013[a]	0.012[a]	0.012[a]	0.010[a]
Cost-to-income ratio	− 0.001[a]	− 0.001[a]	− 0.005[a]	− 0.002[a]	0.0003	− 0.0009	− 0.003	− 0.003[c]
Income diversity	0.004 [b]	0.004[b]	0.005[b]	0.005[a]	0.0108[c]	0.0112[c]	0.016[c]	0.005
Bank size	0.182[a]	0.169[a]	0.158[a]	0.170[a]	0.0648	0.0512	0.0582	− 0.033
Country-level control variables:								
Bank concentration				0.005				− 0.018[a]
National governance				− 0.182				0.254
Growth rate of per capita GDP				0.012[a]				0.078[a]
Constant	1.01[a]	0.9324[a]	0.936[a]	0.838[a]	− 0.552	− 0.8702[c]	− 0.898[c]	2.13
Overall R-square	0.093	0.098	0.109	0.202	0.0448	0.050	0.057	0.412
Wald chi2	71.71[a]	76.21[a]	89.73[a]	223.34[a]	21.29[a]	24.08[a]	27.24[a]	297.01[a]

Notes: This table presents the GLS random effect estimation results of Eq. (1) for two proxies for insolvency risk— Z-score and naive distance to default (naïve DD). Model 1 includes an Islamic bank dummy and bank-specific accounting variables as regressors. Model 1 is cumulatively augmented by board governance, ownership concentration and country-level control variables to obtain Model 2, Model 3 and Model 4, respectively. Note that in addition to country-level control variables, Model 4 includes year and country dummies. Superscripts a, b and c indicate statistical significance at the 1%, 5% and 10% levels, respectively.

that Islamic and conventional banks encounter a similar operational risk. Thus, we find no support for the hypothesis that Islamic banks' operational risk is higher than that of conventional banks (H_{1c}).

Table 5 reports the results for insolvency risk, which is measured by Z-score in Panel A and by naïve distance-to-default (DD) in Panel B. The coefficient of the dummy variable for Islamic banks is negative but statistically insignificant when Z-score is used as the insolvency risk measure, suggesting that Islamic and conventional banks have similar insolvency risk exposures. However, when

naïve distance-to-default is used as an insolvency risk measure, the coefficient on the Islamic bank dummy becomes positive and statistically significant at the 5% level in all four naïve DD models (see Panel B). The coefficients range from 0.303 to 0.349, providing robust evidence of a larger distance to default or lower insolvency risk for Islamic banks compared to conventional banks. The coefficients are also economically significant, as on average Islamic banks are 0.323 more standard deviation away from the default threshold point than their conventional counterparts. Similar results hold constantly with naïve probability of default (naïve PD) as an alternative measure for insolvency risk (results are not tabulated). Subsequently, the hypothesis that there is a difference in insolvency risk between Islamic and conventional banks (H_{1d}) is rejected when Z-score is used as an insolvency risk measure. It is, however, supported when naïve distance-to-default and naïve probability of default is used to measure insolvency risk. The former finding is consistent with Abedifar et al. (2013), who also use the Z-score-based insolvency measure. Results from the naïve distance-to-default support Bharath and Shumway's (2008) contention that default risk measured by market data contains information different from default risk measured by accounting data. In summary, Islamic banks have higher liquidity risk, lower credit risk and lower insolvency risk compared to conventional banks. However, Islamic banks' operational risk is similar to that of conventional banks.

We now turn to the effects of conditioning variables in the bank risk models. Table 3 shows that better board governance is associated with higher liquidity and credit risks, but this evidence is statistically weak and not robust to the model specification. Tables 4 and 5 show that board governance is conducive to reducing operational and insolvency risks, but the evidence is statistically significant and stronger only when these are measured by stock return volatility and Z-score, respectively. Therefore, the results for the board governance-risk nexus are mixed across risk measures, but consistent with Pathan's (2009) findings for U.S. bank holding companies and Beltratti and Stulz's (2012) findings for an international sample of banks.

As for the effects of ownership concentration, Tables 3–5 show that concentrated ownership measured by the 10% cut-off level of ownership (OCL10) increases liquidity risk, decreases insolvency risk but does not exert significant influence on credit and operational risks. The ownership concentration measured by the 20% cut-off point (OCL20) reduces liquidity and credit risks but has no influence on other two risk measures. The concentrated ownership measured by the threshold point of either 40% (OCL40) or 51% (OCL51) increases operational risk and insolvency risk but the effect disappears for liquidity and credit risks. Although the results are less robust across risk measures they agree with Laeven and Levine's (2009) finding that risk-taking tends to be greater in banks with one or two controlling owners than others.[17]

With regard to the effects of other control variables, Tables 3–5 indicate that the higher capital-to-asset ratio is associated with lower credit risk, but higher liquidity and operational risks. The latter finding is consistent with the argument that the higher capital-to-asset ratio may induce a bank to take more liquidity and operational risks as it increases their capacity to absorb risk (Berger and Bouwman, 2009). A higher asset growth rate reduces credit and insolvency risks but its effect is not robust for the other two risk measures. The higher cost-to-income ratio increases credit risk, accounting-based operational and insolvency risks but decreases market-based measure of operational risk. Income diversity and bank size reduce all but liquidity risk.

The higher banking industry concentration reduces liquidity risk but increases insolvency risk as measured by naïve DD, and the effect is insignificant for other risk measures. An improvement in national governance increases liquidity risk but its effect is mixed for operational risk and insignificant for credit and insolvency risks. The growth rate of per capita GDP reduces all but liquidity risk.

Eq. (1) allows only the intercept term of the risk model to vary between two bank groups. To examine whether both the intercept and slope parameters of the risk model differ between the bank groups, we estimate Eq. (1) separately for Islamic and conventional banks omitting the dummy variable for Islamic banks. Table A4 in the Appendix presents the results for Islamic banks. The results show that better board governance increases Islamic banks' liquidity risk but decreases operational risk and market-based measure of insolvency risk. The effect of board governance is not statistically significant for credit risk. The concentrated ownership at a lower threshold level (10% or 20%) generally decreases risk-taking but increases risk-taking at a higher level (40% or 51%). However, these effects are not robust across various risk measures.

Table A5 in the Appendix reports the results for conventional banks. The results show that in conventional banks better board governance does not significantly affect liquidity and operational risks but increases credit risk and insolvency risk. The latter outcome is in line with the findings of previous studies on board governance-risk nexus in conventional banks (Anginer et al., 2014; Pathan, 2009). Furthermore, the concentrated ownership generally increases risk-taking in conventional banks although results lack robustness across risk measures. The effects of other control variables also vary across risk measures concerning both Islamic and conventional banks.

We perform a Chow test (Chow, 1960) of the joint null hypothesis that the coefficients of risk determinants are equal for both Islamic and conventional banks.[18] The Chow test results are provided in Table A6. The null hypothesis is rejected for the models of liquidity risk, credit risk, and market-based measures of operational risk and insolvency risk. The results imply that the same set of risk determinants exerts differential effects on the risk-taking behavior of Islamic vis-à-vis conventional banks. An exception to this general finding occurs in the case of accounting-based measures of operational and insolvency risks.

[17] The ownership concentration measures (OCL10, OCL20, OCL40, OCL51) contain overlapping information. Thus, the risk models are also estimated using each of the ownership concentration measures separately. The corresponding results that are similar to those obtained from risk models when using all four measures of ownership concentration.

[18] The Chow test can be expressed as, $F = \frac{[RSS_{CS} - (RSS_{IB} + RSS_{CB})] / K}{(RSS_{IB} + RSS_{CB}) / (N - 2K)} \sim F(K, N - 2K)$, where RSS_{CS}, RSS_{IB}, RSS_{CB} refer to the residual sum of squares for the combined sample, Islamic bank sample and conventional bank sample, respectively; K is the total number of parameters; and N is the sum of the number of observations in the Islamic bank and conventional bank samples.

Table 6
Shariah supervisory board (SSB) composition and risk in Islamic banks.

Variables	Panel A: Liquidity risk	Panel B: Credit risk	Panel C: Operational risk		Panel D: Insolvency risk		
	LTCD	LLR	ARV	SRV	Z-score	naïve DD	naïve PD
SSB characteristics:							
SSB size	− 0.886	0.126	0.035	− 0.010[c]	− 0.009	− 0.02	− 0.018[b]
SSB academic qualifications	0.166	0.026	− 0.0003	− 0.001[b]	0.004[a]	0.017[b]	− 0.003[a]
SSB members' reputation	− 0.178	0.022	− 0.003	0.001[b]	− 0.005[a]	− 0.015[c]	0.001
Corporate governance variables:							
Board governance	0.553[c]	− 0.017	− 0.002	− 0.003[a]	0.004	0.017[c]	0.001
OCL10	37.070[a]	− 0.008	− 0.009	0.019	0.104[c]	0.890[b]	− 0.090[c]
OCL20	− 14.740	− 1.546[b]	0.151	0.009	0.027	0.171	0.041
OCL40	2.229	1.535	0.992[a]	0.075[c]	− 0.183[b]	0.492	− 0.057
OCL51	− 11.285	− 0.048	− 0.118	0.107[a]	0.045	0.735	0.003
Bank-level accounting variables:							
Capital-to-asset ratio	1.409[a]	− 0.071[b]	0.011[c]	0.004[a]			
Assets growth	− 0.074	− 0.015[a]	0.005[a]	− 0.001	− 0.0001	− 0.004	− 0.001
Cost-to-income ratio	0.055	0.038[a]	0.006[a]	− 0.001[a]	− 0.0005	0.019[b]	− 0.0002
Income diversity	− 0.029	− 0.006[a]	− 0.002[a]	0.001	0.0003[c]	0.002	0.0004
Bank size	− 5.650	− 4.383[a]	− 0.683[a]	− 0.138[a]	0.166[b]	0.186	0.041
Country-level control variables:							
Bank concentration	− 0.562[b]	0.033 [c]	0.001	0.001	0.0001	− 0.026[b]	0.001
National governance	15.870	0.390	0.282	− 0.042	− 0.145	1.675	− 0.167[a]
Growth rate of per capita GDP	1.158	− 0.189[b]	− 0.030	− 0.007[b]	0.006	0.075	− 0.004
Constant	78.699	8.92[c]	4.291[a]	0.776[a]	0.592[a]	1.252[b]	0.155
Overall R-square	0.140	0.132	0.177	0.576	0.238	0.547	0.208
Wald chi2	57.65[a]	113.80[a]	98.48[a]	227.29[a]	149.71[a]	238.27[b]	57.51[a]

Notes: This table presents the GLS random effect estimation results of Eq. (2) for our four risk measures—liquidity risk, credit risk, operational risk and insolvency risk. The loan-to-deposit ratio (LTCD) and loan-loss reserves to gross loans ratio (LLR) are proxies for liquidity risk and credit risk, respectively. Asset return volatility (ARV) and stock return volatility (SRV) are two alternative measures of operational risk. Z-score and naïve DD are inverse measures of insolvency risk, while naïve PD is a direct measure of insolvency risk. All risk models include year and country dummies. Superscripts a, b and c indicate statistical significance at the 1%, 5% and 10% levels, respectively.

5. Does Shariah supervisory board composition affect risk in Islamic banks?

To examine the effects of SSB composition on Islamic banks' risk, we modify Eq. (1) as follows:

$$Risk_{i,t} = \alpha + \beta_1 SSBSZ_{i,t} + \beta_2 SSBACQ_{i,t} + \beta_3 SSBREP_{i,t} + \gamma BG_{i,t} + \delta OWCL_{i,t} + \varphi X_{i,t} + \omega M_t + u_{i,t}, \quad (2)$$

where $SSBSZ_{i,\ t}$ is the Shariah supervisory board size, $SSBACQ_{i,\ t}$ is the SSB members' academic qualifications, $SSBREP_{i,\ t}$ is the proportion of reputed Shariah scholars on the SSB, and $u_{i,\ t}$is the random error term. This model is estimated for each risk measure for the sample of Islamic banks. Our model differs from that of Mollah et al. (2017) in that they consider only the accounting-based insolvency risk measure (Z-score), while we consider additional risk measures—liquidity risk, credit risk, operational risk and market-based insolvency risk measures (e.g. naïve DD and PD). Moreover, we consider additional risk determinants such as SSB composition and levels of ownership concentration.

Eq. (2) is estimated using the GLS random-effects estimator. The results are presented in Table 6. The SSB attributes exert no statistically significant influence on liquidity and credit risks. In contrast, larger SSB size reduces both operational and insolvency risks when these risks are measured in terms of stock return volatility (SVR) and naïve probability of default (naïve PD), respectively. This finding is consistent with hypothesis H_{2a}. The effect is economically significant as an additional SSB director reduces stock return volatility and probability of default by 1% and 1.8%, respectively. Higher academic qualifications of SSB members is conducive to reducing Islamic banks' insolvency risk regardless of how it is measured, providing supporting evidence for hypothesis H_{2b}. More specifically, 1 percentage point increase in PhD degree holders on SSB reduces Islamic banks' insolvency risk by 0.4%. A similar effect of SSB members' academic qualifications is found for the market-based measure of operational risk. A higher representation of reputed members on the SSB tends to increase both insolvency risk and operational risk, rejecting hypothesis H_{2c}. The result may stem from reputed Shariah scholars'concurrent membership of multiple Islamic banks' SSBs and boards of different national and international Shariah standard-setting organizations. This can lead to spreading their time and efforts thinly over several organizations and compromise their effective oversight of bank-level risk exposures.

Better board governance in Islamic banks leads to higher liquidity risk but lower operational and lower insolvency risks when the latter two are measured by market data. This result contradicts Mollah et al.'s (2017) finding that board governance increases Islamic banks' insolvency risk, which may be due to their omission of market-based measures of insolvency risk and the SSB attributes from the insolvency risk model. Bank risk generally increases when there is a higher level of ownership concentration. This finding is similar to those reported for the full sample of banks. The impacts of bank-specific accounting variables and country-level control

variables on Islamic banks' risk types are mostly similar to those reported for the full sample in Tables 3–5.[19]

6. Additional tests

The results in the previous sections are derived using contemporaneous explanatory variables in the risk models, assuming model parameters are the same across geographical regions and countries, and corporate governance is exogenously determined. This section tests the robustness of earlier results to the relaxation of these assumptions. In addition, the bank risk models are controlled for the GFC effect.

6.1. The lagged effects of the independent variables

We check the robustness of our earlier results using the one year lagged rather than contemporaneous explanatory variables in Eq. (1). This approach not only gives explanatory variables adequate time to affect the risk-taking behavior of banks but also addresses the potential issue of reverse causality. The findings related to the risk in Islamic banks and drivers of risk are consistent with those reported earlier in Tables 3-5. In summary, our results show that compared to conventional banks, Islamic banks have higher liquidity risk, lower credit risk and lower insolvency risk (measured by naïve distance to default and naïve probability of default). However, both bank groups face similar operational risk.[20]

6.2. Risk in Islamic banking in predominantly Muslim countries

We also examine whether risk-taking behavior of Islamic and conventional banks in predominantly Muslim countries differs from that in countries where Islam is not the dominant religion. Islamic banks operating in predominantly Muslim countries naturally have a larger customer base for Islamic banking products and a more favorable business environment compared to conventional banks, which may affect their risk-taking behavior. Following Abedifar et al. (2013), we define predominantly Muslim countries as a dummy variable that takes the value of one if 90% or more of the population in a sample country are Muslims, and zero if otherwise. This variable is interacted with the Islamic bank dummy and included as an additional regressor in Eq. (1). The risk effects of Islamic bank dummy are consistent with our earlier results as reported in Tables 3–5. The coefficient of interaction variable suggests that Islamic banks in predominantly Muslim countries have lower insolvency risk as measured by their naïve distance to default and naive probability of default, but they are similar to conventional banks with respect to the other three risk measures.[21] Our finding on insolvency risk is consistent with Adhikari and Agrawal (2016) but differs from Abedifar et al. (2013). The latter study finds that Islamic banks in predominantly Muslim countries have the same insolvency risk as conventional banks.

6.3. Risk in Islamic banking during the GFC

Islamic banks are often considered to be more resilient to a financial crisis than their conventional counterparts. To verify this a dummy variable for the GFC period is defined, which takes a value of one for the GFC period (2007 to 2009), and zero if otherwise. Eq. (1) is then estimated by adding an interaction variable of Islamic bank dummy and GFC period dummy. The results in Table 7 indicate that the risk effects of the bank type dummy remain consistent with our earlier results reported in Tables 3–5. The coefficient of the interaction variable is statistically insignificant in all but the operational risk model. A further investigation is conducted to examine the effects of different phases of the GFC (initial financial turmoil, sharp financial market decline and worsening macro-economic performance) on the relationship between bank type and bank risk.[22] The results show that the GFC affects operational risk positively only in the initial turmoil phase (2007) but the effect disappears in the subsequent phases. The effects of GFC phases are statistically insignificant for other risk measures. In general, Islamic banks were resilient during the GFC period and its three different phases.

6.4. Risk in Islamic banking across geographical regions

Eq. (1) is re-estimated separately for six geographical regions: Gulf Co-operation Council (GCC), non-GCC Middle East and North Africa (MENA), Europe and Central Asia, East Asia and Pacific, South Asia, and Sub-Saharan Africa. In Table 8, the results concerning our key variables of interest are presented. Panel A shows that Islamic banks' liquidity risk is higher in non-GCC MENA, Sub-Saharan Africa, East Asia & Pacific regions, but lower in Europe and Central Asia compared to their conventional counterparts. In GCC and South Asia, Islamic banks have the same liquidity risk as conventional banks. Islamic banks have lower credit risk than conventional banks in South Asia, Europe and Central Asia, Sub-Saharan Africa regions but similar credit risk in the other three regions (see Panel

[19] In addition, three restricted versions of Eq. (2) are estimated to assess whether the effect of SSB composition on bank risk is sensitive to the alternative model specification. The first model sets $\gamma = \delta = \varphi = \omega = 0$;the second model sets $\delta = \omega = 0$; and the third model sets $\omega = 0$. The results for these models do not provide additional insights on risk determinants and consequently, the results are not tabulated. However, they are available from the corresponding author on request.

[20] Detailed results for the robustness test are available from the corresponding author on request.

[21] Detailed results are available from the corresponding author on request.

[22] This is undertaken by defining the years 2007, 2008 and 2009, respectively, as the initial financial turmoil, sharp financial market deterioration and macro-economic deterioration phases of the GFC (following Dimitriou et al., 2013), and then interacting these phases' dummy variables with the Islamic bank dummy.

Table 7
The effects of the GFC on risk in Islamic banks.

Variables	Panel A: Liquidity risk	Panel B: Credit risk	Panel C: Operational risk		Panel D: Insolvency risk		
	LTCD	LLR	ARV	SRV	Z-score	naïve DD	naïve PD
Islamic bank dummy	18.383[b]	− 2.849[b]	− 0.180	0.028	− 0.059	0.287[c]	− 0.059[c]
Islamic bank × GFC	0.762	− 0.104	0.384 [b]	− 0.014	− 0.011	0.201	− 0.059
Corporate governance variables:							
Board governance	0.305	0.005	− 0.004	− 0.001[b]	0.001	0.004	− 0.001
OCL10	22.834[a]	− 0.089	0.009	0.031	0.112[a]	− 0.243[c]	0.049
OCL20	− 10.270[c] (− 1.72)	− 0.885[b]	− 0.093	− 0.0002	0.037	0.089	− 0.012
OCL40	− 4.183	0.601	0.789[a]	0.047[c]	− 0.122[b]	0.166	− 0.062
OCL51	− 4.646	0.003	− 0.079	0.093[a]	0.047	− 0.020	− 0.014
Bank-level accounting variables:							
Capital-to-asset ratio	1.306[a]	− 0.074[a]	− 0.008	0.002[a]			
Assets growth	− 0.045	− 0.016[a]	0.003[b]	− 0.000	0.001	0.011[a]	− 0.003[a]
Cost-to-income ratio	0.044	0.044[a]	0.005[a]	− 0.004[c]	− 0.005[a]	− 0.003[c]	0.001
Income diversity	− 0.024	− 0.007[a]	− 0.002[a]	0.008	0.005[a]	0.005	− 0.001
Bank size	− 2.032	− 4.800[a]	− 1.397[a]	− 0.115[a]	0.170[a]	− 0.041	0.027
Country-level control variables:							
Bank concentration	− 0.330[a]	0.022[b]	0.001	0.0004	0.0005	− 0.018[a]	0.004[a]
National governance	16.739[b]	− 0.056	0.504[a]	− 0.003	− 0.1827	0.264	− 0.055
Growth rate of per capita GDP	0.258	− 0.142[a]	− 0.041[a]	− 0.003[c]	0.012[a]	0.078[a]	− 0.014[a]
Constant	61.907[b]	15.245[a]	5.971[a]	0.404[a]	0.837[a]	2.175[b]	− 0.052
Overall R-square	0.110	0.142	0.164	0.3789	0.202	0.4126	0.400
Wald chi2	92.81[a]	259.09[a]	180.78[a]	160.99[a]	222.98[a]	297.17[a]	282.37[a]

Notes: This table presents the GLS random effect estimation results of Eq. (1) including Islamic bank and GFC period interaction dummy. The loan-to-deposit ratio (LTCD) and loan-loss reserves to gross loans ratio (LLR) are proxies for liquidity risk and credit risk, respectively. Asset return volatility (ARV) and stock return volatility (SRV) are two alternative measures of operational risk. Z-score and naïve DD are inverse measures of insolvency risk, while naïve PD is a direct measure of insolvency risk. All risk models include year and country dummies. Superscripts a, b and c indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 8
Risk in Islamic banks by geographical region.

Variables	GCC	Non-GCC MENA	South Asia	Europe & Central Asia	Sub-Saharan Africa	East Asia & Pacific
Panel A: Liquidity risk						
Islamic bank dummy	3.159	37.801[b]	6.517	− 8.10[b]	9.157[a]	6.932[a]
Board governance	0.170	− 0.046	0.203	− 0.921	− 2.749[b]	0.338
Panel B: Credit risk						
Islamic bank dummy	− 0.370	− 4.290	− 9.425[a]	− 2.366[a]	− 0.859[b]	− 0.457
Board governance	− 0.035[b]	0.094	− 0.010	− 0.044[b]	0.027	0.001
Panel C: Operational risk (ARV)						
Islamic bank dummy	0.162	0.121	− 1.466[a]	− 0.054	0.462[c]	− 0.038
Board governance	− 0.004	− 0.005	− 0.016	− 0.004	0.012	− 0.001
Panel D: Operational risk (SRV)						
Islamic bank dummy	0.0005	0.031	− 0.001	− 0.207[a]		
Board governance	− 0.0004[c]	− 0.001	− 0.004[b]	− 0.001		
Panel E: Insolvency risk (Z-score)						
Islamic bank dummy	− 0.108	− 0.207	0.305[b]	0.116	− 0.129	− 0.178[b]
Board governance	− 0.001	0.003	0.002	0.002	0.002	− 0.001
Panel F: naïve DD						
Islamic bank dummy	0.439[b]	2.944[b]	1.138[b]	− 2.363		
Board governance	0.001	− 0.001	− 0.029[b]	− 0.023		
Panel G:naïve PD						
Islamic bank dummy	− 0.087[b]	− 0.435[a]	− 0.143[b]	0.990		
Board governance	− 0.0004	− 0.0009	0.004[c]	0.001		

Notes: This table presents the GLS random effect estimation results of Eq. (1) for six geographical regions. The loan-to-deposit ratio (LTCD) and loan-loss reserves to gross loans ratio (LLR) are proxies for liquidity risk and credit risk, respectively. Asset return volatility (ARV) and stock return volatility (SRV) are two alternative measures of operational risk. Z-score and naïve DD are inverse measures of insolvency risk, while naïve PD is a direct measure of insolvency risk. All regression models include bank-level accounting variables, ownership concentration, country-level control variables as well as year and country dummies. Since SRV, naïve DD and PD are market-based risk measures, the results for these risk models are available only for regions having publicly traded Islamic banks. Superscripts a, b and c indicate statistical significance at the 1%, 5% and 10% levels, respectively.

B). The results in Panel C illustrate that Islamic banks' operational risk is similar to that of conventional banks in GCC, non-GCC MENA, Europe and Central Asia, and East Asia and Pacific regions but lower in South Asia and higher in Sub-Saharan Africa. The operational risk is lower in Europe and Central Asia's Islamic banks when measured by market data but similar in GCC, non-GCC MENA and South Asia (see Panel D). As reported in Panels E to G, Islamic banks' in GCC, non-GCC MENA and South Asia are less exposed to insolvency risk but their risk exposure is higher in East Asia and the Pacific region, and similar to that of conventional banks in the other two regions. With reference to the impacts of the board governance control variable, Table 8 shows that better board governance reduces liquidity risk, credit risk, and operational risk but increases insolvency risk. However, the board governance effect is not robust across regions and across accounting and market-based risk measures. The results on the impact of other control variables are qualitatively similar as documented in Tables 3–5 and hence not tabulated.

Overall, the full sample results hold in non-GCC MENA, Sub-Saharan Africa, and East Asia and Pacific regions for liquidity risk; in South Asia, Europe and Central Asia and Sub-Saharan Africa for credit risk; in GCC, non-GCC MENA and East Asia and Pacific regions for operational risk; in GCC, non-GCC MENA, Sub-Saharan Africa, and Europe and Central Asia for the Z-score based measure of insolvency risk; in all but Europe & Central Asia for the market-based measure of insolvency risk.

6.5. GMM estimation of the effect of SSB composition on risk in Islamic banking

Islamic banks' risk and SSB composition may be determined simultaneously. For instance, a risky bank may employ additional SSB members, or members with higher academic qualifications and good reputations. Consequently, we check the robustness of the earlier results for the impact of SSB composition on risk by replacing the contemporaneous SSB variables in Eq. (2) with their lag values. This reduces the endogeneity problem arising from possible reverse causality (Aebi et al., 2012). The results presented in Panel A of Table 9 are consistent with our earlier findings in Table 6.

However, the use of lag values of SSB composition may not account for the endogeneity problem arising from the possibility that current SSB attributes may be a function of past risk. We therefore follow Pathan and Faff (2013) and employ the two-step system GMM approach proposed by Arellano and Bover (1995) and Blundell and Bond (1998), which accommodates the possible dynamic endogeneity between risk and independent variables by means of appropriate instruments. This approach initially creates a dynamic

Table 9
Robustness test: Shariah supervisory board (SSB) and risk in Islamic banks.

Liquidity risk	Credit risk		Operational risk		Insolvency risk		
	LTCD	LLR	ARV	SRV	Z-score	naïve DD	naïve PD
Panel A: SSB composition and risk: lagged independent variables							
SSBSZ	− 1.700	− 0.031	0.004	− 0.004[c]	− 0.002	− 0.013	− 0.025[b]
SSBACQ	0.128	0.026	0.001	− 0.001[a]	0.003[a]	0.015[a]	− 0.001[c]
SSBREP	− 0.201	0.016	− 0.009	0.002[a]	− 0.003[b]	− 0.012[b]	0.003[a]
BG	0.455	0.003	− 0.004	− 0.003[a]	0.0011[c]	0.023[a]	− 0.003[c]
Panel B: SSB composition and risk: two-step system GMM							
$Risk_{it-1}$	0.467[a]	0.802[a]	0.584[b]	0.060	0.605[a]	− 0.425[a]	− 0.074
SSBSZ	− 2.681[c]	− 0.300	0.040	− 0.068[b]	0.005	− 0.413	− 0.112[b]
SSBACQ	− 0.088	0.029[c]	− 0.003	− 0.005[b]	0.003[b]	0.041[c]	− 0.008[b]
SSBREP	− 0.182	− 0.037	− 0.002	− 0.002	− 0.001[b]	− 0.019	0.015[c]
BG	0.075	0.011	− 0.003	− 0.002[c]	0.003[c]	− 0.046	0.001
Model fits:							
F-statistics	5.56[a]	10.70[a]	15.59[c]	4.22[a]	16.32[a]	30.13[a]	2.55[a]
Hansen test							
(p-Value)	0.99	0.98	0.654	0.876	0.737	0.808	0.99
AR (1) test	− 1.72[c]	− 1.68[c]	− 2.58[a]	− 1.72[c]	− 3.87[a]	− 2.00[b]	− 1.740[c]
AR (2) test	− 0.89	1.15	− 0.70	− 0.70	− 0.03	− 1.63	0.630
Panel C: Interaction between SSB and board governance							
SSBI	11.26 − 16.43	− 0.77 7.42	0.035 0.805	− 0.674 0.231[c]	0.168[c] − 0.114	0.956[a] − 0.07	− 0.23[a]
BG	0.66	0.005	− 0.003[a]	− 0.006	0.001	0.001	0.001
SSBI × BG	1.13	− 0.005	− 0.025[c]	− 0.005[a]	0.005[b]	0.02[b]	

Notes: This table presents the robustness test results for the governance variables. The results in Panel A are obtained by replacing contemporaneous independent variables in Eq. (2) by their lagged values. Panel B results are from the two-step system GMM estimation of Eq. (2). Panel C results are from the following equation: $Risk_{i,t} = \alpha + \beta SSBI_{i,t} + \gamma BG_{i,t} + \delta SSBI_{i,t} \times BG_{i,t} + \varphi OWCL_{i,t} + \omega X_{i,t} + \theta M_t + u_{i,t}$, where $SSBI_{i,t}$ is the SSB index value for bank i at time t. $SSBI_i$ is the average of: (i) a relative measure of SSB size [(SSB size$_i$ − min)/(max − min)], (ii) the proportion of SSB members with a doctorate degree and (iii) the proportion of SSB members with good reputations as Shariah scholar; where min and max denote the minimum and maximum SSB sizes. The loan-to-deposit ratio (LTCD) and loan-loss reserves to gross loans ratio (LLR) are proxies for liquidity risk and credit risk, respectively. Asset return volatility (ARV) and stock return volatility (SRV) are two alternative measures of operational risk. Z-score and naïve DD are inverse measures of insolvency risk, while naïve PD is a direct measure of insolvency risk. SSBSZ is the SSB size, SSBACQ is the SSB members' academic qualifications, SSBREP is the reputation of SSB members, BG is the board governance index and SSBI is the SSB index. In Panel B, Hansen test statistics test the null hypothesis that all instruments are valid. AR (1) and AR (2) are test statistics for first-order and second-order serial correlation, respectively. All risk models are controlled for the ownership concentration variables, bank-level accounting variables, country-level variables. Superscripts a, b and c indicate statistical significance at the 1%, 5% and 10% levels, respectively.

model of the first differences of all variables to account for the unobserved heterogeneity and omitted variable bias, and then estimates the model through GMM that employs the lagged independent variables as instruments for the current independent variables (Wintoki et al., 2012). Following Wintoki et al. (2012), all bank-specific variables are considered as endogenous covariates while country-level control variables are regarded as exogenous.[23]

Panel B of Table 9 provides the results of the two-step system GMM estimation where liquidity risk, credit risk, operational risk and insolvency risk proxies are used as dependent variables. The Hansen J-test result suggests that our instruments are valid. While the SSB attributes were unrelated for liquidity and credit risks in earlier analysis (see Table 6), we find here that larger SSB size decrease liquidity risk, and SSB members' academic qualifications increase credit risk, but the latter results are statistically weak. With respect to the effects of SSB composition on Islamic banks' insolvency risk and operational risk, the results are consistent with earlier results that were reported in Table 6.

6.6. The interactive effect of SSB and board of directors

In Eq. (2) the partial effects of SSB and regular board governance on Islamic banks' risks are examined. We now investigate their interactive role in influencing risk-taking to gain further insights into the efficacy of the dual governance system in Islamic banks.[24] The SSB and regular boards together may exert a synergistic effect on risk-taking by strengthening both moral and legal accountabilities of Islamic bank managers (Abdelsalam et al., 2016). The empirical results in Panel C of Table 9 show that the effects of SSB remain consistent with earlier findings in Table 6 for all but operational risk. There is no significant interactive effect of SSB and board of directors on liquidity and credit risks. However, the effect is negative and significant for operational risk and insolvency risk, supporting the risk-reducing effect of dual board structure.[25]

7. Conclusion

We examine risk in Islamic and conventional banks with particular attention being paid to whether risk of Islamic banks is influenced by their dual board governance structure. Unlike previous research, we examine several risk measures to gain a comprehensive insight into the risk difference between Islamic and conventional banks, and use a matched pair sample of two bank groups to mitigate sample selection bias. Panel data of 188 banks from 28 countries for the period 2003–2014 are used.

Our empirical results demonstrate that Islamic banks face higher liquidity risk, lower credit risk and lower insolvency risk but they are indistinguishable from conventional banks in terms of operational risk. These findings hold in a range of random-effects regressions with alternative conditioning variables from the following set: board governance, ownership concentration levels, bank-specific accounting variables and country-level control variables. The results also hold when contemporaneous independent variables are replaced with their lag values and risk models are run separately for different geographical regions. We also find lower insolvency risk exposure of Islamic banks in predominantly Muslim countries. Islamic banks are also resilient to the GFC. Parameters of Islamic banks' risk model statistically differ from those of conventional banks with respect to liquidity risk, credit risk and market-based measures of operational and insolvency risks.

For Islamic banks, we examine three aspects of SSB composition: size, academic qualifications and reputation of SSB members as drivers of risk. An increase in SSB size and the proportion of SSB members with higher academic qualifications decrease Islamic banks' insolvency risk and operational risk, but these risks become greater when the proportion of SSB members with reputation is higher. The SSB attributes do not influence liquidity and credit risks. The findings are robust to the use of lagged independent variables and a dynamic panel GMM estimator.

The study has significant policy implications for prudential regulators and international regulatory standard-setting bodies of Islamic banks (e.g. AAOIFI and IFSB) to develop a regulatory framework tailored for these institutions. For example, Islamic banks will be better placed to mitigate their liquidity risk, if: firstly, the central bank establishes an Islamic window to extend the lender of the last resort facilities to Islamic banks; and secondly, regulatory bodies set parameters under which Islamic fixed income securities (sukuk) markets can flourish. Our findings on the effects of SSB attributes on Islamic banks' risk also have implications for developing an effective governance structure for Islamic banks. More specifically, a dual governance structure with a large SSB that is over-represented by highly educated members is effective in reducing risk.

[23] Roodman's (2009) 'xtabond2' module in STATA 12 along with Wintoki et al.'s (2012) dynamic GMM codes is used to undertake system GMM estimation. In addition, Hansen's J-test is used for instrument validity and Arellano and Bond (1991) test is used to test for serially uncorrelated errors.

[24] To investigate the interactive effects we modify Eq. (2) as follows: $Risk_{i,\,t} = \alpha + \beta SSBI_{i,\,t} + \gamma BG_{i,\,t} + \delta SSBI_{i,\,t} \times BG_{i,\,t} + \varphi OWCL_{i,\,t} + \omega X_{i,\,t} + \theta M_t + u_{i,\,t}$, where $SSBI_{i,\,t}$ is the SSB index value for bank i at time t. $SSBI_i$ is the average of: (i) a relative measure of SSB size [(SSB size$_i$ − min)/(max − min)], (ii) the proportion of SSB members with a doctorate degree, and (iii) the proportion of SSB members with good reputations as Shariah scholars; where min and max represent the minimum and maximum SSB sizes, respectively. The mean of SSBI is 0.355 with a standard deviation of 0.167. Instead of using three attributes of SSB, this model uses a composite index of SSB and interacts it with the regular board governance index BG, for the sake of parsimony and mitigating possible multicollinearity.

[25] We also investigate the joint effect by adding three interaction terms between the three attributes of SSB and regular board governance index ($SSBSZ_{i,\,t} \times BG_{i,\,t}$, $SSBACQ_{i,\,t} \times BG_{i,\,t}$ and $SSBREP_{i,\,t} \times BG_{i,\,t}$) to Eq. (2). We find a negative interaction effect for $SSBACQ_{i,\,t} \times BG_{i,\,t}$ irrespective of the risk measures used but the results are mixed for the other two interaction terms. Detailed results are available from the corresponding author on request.

Appendix

Table A1
Construction of board governance index.

No.	Board attributes	Standard of governance attributes
1	Board size	5 < Board size < 16
2	Board independence	> 50% of the directors are independent non-executive directors
3	CEO duality	CEO and chairman are separate
4	Board members' financial expertise	The percentage of financially expert board members of a bank in a year is larger than the average financially expert board members across all banks during the year
5	Board members multiple directorships position	The percentage of board of directors with three or more directorship positions in a bank in one year is larger than the average percentage across all banks during the year
6	Audit committee size	The bank has a separate audit committee with a minimum of two board members
7	Audit committee chairman independence	The audit committee chairman is an independent non-executive director
8	Risk management committee size	The bank has a separate risk management committee with a minimum of two board members

Notes: This table presents the individual board attributes and their corresponding standards used to define dummy variables for these attributes. The board governance index is constructed following Aggarwal et al. (2010), which equals the average of eight dummy variables expressed in percentage.

Table A2
Variables description: bank risk determinants.

Variables	Unit	Measures
Islamic bank	Dummy	A dummy variable which equals one if a bank is an Islamic bank, zero if otherwise
SSB characteristics		
SSB size	Integer	The number of members serving on the SSB of an Islamic bank at the end of each year.
SSB academic qualifications	Percentage	SSB academic qualifications is the number of SSB members with doctorate degrees, as a percentage of the total SSB members.
SSB members' reputation	Percentage	SSB members' reputation is the number of internationally reputable Shariah scholars on the SSB, as a percentage of total number of SSB members of a bank.
Corporate governance variables		
Board governance	Percentage	Board governance is an index developed with eight board of directors' attributes (see Table A1).
OCL10	Dummy	Ownership concentration level 1 is a dummy variable takes a value of one if at least one shareholder has10% or more direct and indirect ownership in a particular year, and zero if otherwise.
OCL20	Dummy	Ownership concentration level 2 is a dummy variable takes a value of one if at least one shareholder has as 20% or more direct and indirect ownership in a particular year, and zero if otherwise.
OCL40	Dummy	Ownership concentration level 3 is a dummy variable takes a value of one if at least one shareholder has 40% or more direct and indirect ownership in a particular year, and zero if otherwise
OCL51	Dummy	Ownership concentration level 4 is a dummy variable takes a value of one if at least one shareholder has 51% or more direct and indirect ownership in a particular year, and zero if otherwise.
Bank-level accounting variables		
Capital-to-asset ratio	Percentage	Ratio of equity capital to total assets.
Total assets growth	Percentage	Percentage growth of total assets in each year.
Cost-to-income ratio	Percentage	A measure of cost inefficiency.
Income diversity	Percentage	Ratio of non-interest income to total operating income.
Bank size	Log	Logarithm of total assets.
Country-level control variables		
Bank concentration ratio	Percentage	Assets of the three largest banks as a percentage of total banking industry assets.
National governance	Integer	

		National governance is the average value of six institutional governance indicators (voice and accountability, political stability, government effectiveness, regulatory quality, rule of law and control of corruption) reported in the World Bank's Worldwide Governance Index.
Growth rate of per capita GDP	Percentage	Annual growth rate of per capita GDP in percentage.

Table A3
Summary of differences between this study and the closest previous studies on Islamic banks' risk.

Prior literature				Research gaps				
Authors	Research focus	Bank, country controls	Key findings	SSB attributes	Interactive effects of SSB & boards	Levels of ownership concentration	Liquidity & operational risks, naïve DD	Matched sample
Čihák and Hesse (2010)	Insolvency risk (77 IBs, 397 CBs, 1993–2004)	Yes	Large (small) Islamic banks are less (more) stable than their conventional counterparts.	No	No	No	No	No
Beck et al. (2013)	Efficiency, asset quality, stability and business models (88 IBs, 422 CBs,1995–2009)	Yes	Islamic banks face higher insolvency risk than that of conventional banks.	No	No	No	No	No
Abedifar et al. (2013)	Credit risk and Insolvency risk (118 IBs, 354 CBs, 1999–2009)	Yes	Islamic banks have similar insolvency risk but lower credit risk compared to those of conventional banks.	No	No	No	No	No
Kabir et al. (2015)	Credit risk (37 IBs, 156 CBs,2000–2012)	Yes	Islamic banks' credit risk is higher than that of conventional banks.	No	No	No	No	No
Mollah et al. (2017)	Insolvency risk and board governance (52 IBs, 104 CBS, 2005–2013)	Yes	Board governance increases insolvency risk in Islamic banks.	No	No	No	No	No
Our study	Liquidity risk, Credit risk, Operational risk, Insolvency risk & SSB composition (188 matched IBs & CBs, 2003–2014)	Yes		Yes	Yes	Yes	Yes	Yes

Notes: This table summarizes the key features of prior studies on Islamic banks' risk and the research gaps we attempt to address. SSB is the Shariah supervisory board. IBs is the Islamic banks and CBs is the conventional banks. 'No' means not being investigated in previous studies and 'Yes' represents the alternative.

Table A4
Corporate governance and risk-taking in Islamic banks.

	Panel A: Liquidity risk	Panel B: Credit risk	Panel C: Operational risk		Panel D: Insolvency risk		
	LTCD	LLR	ARV	SRV	Z-score	naïve DD	naïve PD
Corporate governance variables							
Board governance	0.664[b]	− 0.002	− 0.003	− 0.001[b]	0.002	0.020[b]	− 0.002[b]
OCL10	3.71[a]	0.260	− 0.026[c]	0.026	0.125[b]	1.216[a]	− 0.103[b]
OCL20	− 1.659	− 1.789[b]	0.143	0.004	− 0.008	0.278	− 0.008
OCL40	1.250	1.437	1.027[a]	0.078[b]	− 0.216[a]	− 0.224	− 0.007
OCL51	− 1.78	− 0.164	− 0.048	0.104[a]	0.070	0.269	− 0.047
Bank-level accounting variables							
Capital-to-asset ratio	1.263[a]	− 0.069[b]	0.004	0.003[a]			
Assets growth	− 0.072	− 0.016[b]	0.004[a]	− 0.0007	− 0.003	− 0.007	0.0005
Cost-to-income ratio	− 0.134	0.039[b]	0.003[b]	− 0.0009[a]	− 0.0007[c]	0.008[c]	− 0.0002
Income diversity	0.004	− 0.006[b]	− 0.001[a]	0.0002	0.0002	− 0.004	0.0002
Bank size	− 4.466	− 2.428[b]	− 0.978[a]	− 0.146[a]	0.1639[a]	0.274	− 0.025
Country-level control variables							
Bank concentration	− 0.441[c]	0.013	− 0.002	− 0.0003	− 0.001	− 0.031[a]	0.0029[a]
National governance	33.105	0.099	0.428	− 0.047	− 0.067	2.122[a]	− 0.181[a]
Growth rate of per capita GDP	0.838	− 0.127[c]	− 0.045[a]	− 0.006[b]	0.017[a]	0.112[b]	− 0.005
Constant	49.735[a]	11.58[a]	4.472[a]	0.799[a]	0.858[a]	4.166[c]	− 0.020[c]
Overall R-square	0.288	0.1209	0.1305	0.502	0.054	0.4310	0.3171
Wald chi2	103.22[a]	83.32[a]	72.21[a]	120.44[a]	53.29[a]	129.11	93.07[a]

Notes: This table presents the GLS random effect estimation results of Eq. (1) for four risk measures in Panels A to D. The loan-to-deposit ratio (LTCD) and loan-loss reserves to gross loans ratio (LLR) are proxies for liquidity risk and credit risk, respectively; asset return volatility (ARV) and stock return volatility (SRV) are two proxies for operational risk, Z-score, naïve DD and naïve PD are three proxies for insolvency risk. All risk models include country and year dummies. Superscripts a, b and c indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table A5
Corporate governance and risk-taking in conventional banks.

	Panel A: Liquidity risk	Panel B: Credit risk	Panel C: Operational risk		Panel D: Insolvency risk		
	LTCD	LLR	ARV	SRV	Z-score	naïve DD	naïve PD
Corporate governance variables							
Board governance	0.0047	0.014[c]	0.0007	− 0.0009	− 0.002[c]	− 0.012[c]	0.0032[b]
OCL10	0.826[c]	− 0.271	0.204[c]	0.036	0.073	− 0.236	0.057
OCL20	− 2.55	0.020[c]	− 0.269	0.050[c]	0.061	− 0.061	0.009
OCL40	− 6.207	0.079	0.513[b]	− 0.003	0.019	0.264	− 0.131[c]
OCL51	− 0.703	0.180	0.002	0.015	− 0.098[c]	− 0.504[c]	− 0.110[c]
Bank-level accounting variables							
Capital-to-asset ratio	0.584[b]	− 0.076[b]	− 0.022[b]	0.002			
Assets growth	0.201[a]	− 0.031[a]	− 0.013[a]	− 0.005	0.007[c]	0.003	− 0.0009
Cost-to-income ratio	0.063	0.046[a]	0.007[a]	− 0.0002	− 0.003[a]	0.017[b]	− 0.002[b]
Income diversity	− 0.195	− 0.031[b]	− 0.038[a]	0.006[a]	0.008[a]	0.039[b]	− 0.005[c]
Bank size	− 1.813	− 2.189[a]	− 1.388[a]	− 0.079[c]	0.195[a]	0.182	− 0.025
Country-level control variables							
Bank concentration	− 0.058	− 0.002	0.005[c]	− 0.0005	0.0001	− 0.017[a]	0.004[a]
National governance	21.55[a]	− 2.933[a]	0.190	0.056	− 0.226	0.770[a]	− 0.189[a]

Growth rate of per capita GDP	− 0.522	− 0.044[c]	− 0.047[a]	− 0.001	0.020[a]	0.1314[a]	− 0.025[a]
Constant	77.536	12.117[a]	6.529[a]	0.127[b]	0.695[b]	− 0.196[b]	0.445[c]
Overall R-square	0.135	0.206	0.236	0.1688	0.363	0.205	0.1908
Wald chi2	54.6[a]	165.65[a]	213.22[a]	40.64	227.69[a]	56.14[a]	51.15[a]

Notes: This table presents the GLS random effect estimation results of Eq. (1) for four risk measures in Panels A to D. The loan-to-deposit ratio (LTCD) and loan-loss reserves to gross loans ratio (LLR) are proxies for liquidity risk and credit risk, respectively; asset return volatility (ARV) and stock return volatility (SRV) are two proxies for operational risk, Z-score, naïve DD and naïve PD are three proxies for insolvency risk. All risk models include country and year dummies. Superscripts a, b and c indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table A6
Chow test results on the homogeneity of the coefficients of the determinants of risk.

	Panel A: Liquidity risk	Panel B: Credit risk	Panel C: Operational risk		Panel D: Insolvency risk		
	LTCD	LLR	ARV	SRV	Z-score	naïve DD	naïve PD
Chow test: F-statistic	3.90[b]	2.78[b]	1.92	5.96[b]	1.19	2.258[b]	2.14[b]

Notes: This table presents the Chow test results of the joint null hypothesis that the coefficients of risk determinants are same for both Islamic and conventional banks. The loan-to-deposit ratio (LTCD) and loan-loss reserves to gross loans ratio (LLR) are proxies for liquidity risk and credit risk, respectively; asset return volatility (ARV) and stock return volatility (SRV) are two proxies for operational risk, Z-score, naïve DD and naïve PD are three proxies for insolvency risk. The F-statistics are significant at the 5% level for all but asset return volatility and Z-score proxies of operational and insolvency risks respectively. Superscripts a, b and c indicate statistical significance at the 1%, 5% and 10% levels, respectively.

References

Abdelsalam, O., Dimitropoulos, P., Elnahass, M., Leventis, S., 2016. Earnings management behaviors under different monitoring mechanisms: the case of Islamic and conventional banks. J. Econ. Behav. Organ. 132, 155–173.
Abedifar, P., Molyneux, P., Tarazi, A., 2013. Risk in Islamic banking. Rev. Financ. 17, 2035–2096.
Acharya, V.V., Mora, N., 2015. A crisis of banks as liquidity providers. J. Financ. 70, 1–43.
Adhikari, B.K., Agrawal, A., 2016. Does local religiosity matter for bank risk-taking? J. Corp. Finan. 38, 272–293.
Aebi, V., Sabato, G., Schmid, M., 2012. Risk management, corporate governance, and bank performance in the financial crisis. J. Bank. Financ. 36, 3213–3226.
Aggarwal, R., Erel, I., Stulz, R., Williamson, R., 2010. Differences in governance practices between US and foreign firms: measurement, causes, and consequences. Rev. Financ. Stud. 23, 3131–3169.
Anginer, D., Demirgüç-Kunt, A., Huizinga, H., Ma, K., 2014. Corporate governance and bank insolvency risk: international evidence. In: World Bank Policy Research Working Paper, (WPS7017).
Arellano, M., Bond, S., 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. Rev. Econ. Stud. 58, 277–297.
Arellano, M., Bover, O., 1995. Another look at the instrumental variable estimation of error-components models. J. Econ. 68, 29–51.
Baele, L., Farooq, M., Ongena, S., 2014. Of religion and redemption: evidence from default on Islamic loans. J. Bank. Financ. 44, 141–159.
Balachandran, B., Faff, R., 2015. Corporate governance, firm value and risk: past, present, and future. Pac. Basin Financ. J. 35, 1–12.
Baltagi, B., 2008. Econometric Analysis of Panel Data. vol. 1 John Wiley & Sons.
Bantel, K.A., 1993. Strategic clarity in banking: role of top management-team demography. Psychol. Rep. 73, 1187–1201.
Bantel, K.A., Jackson, S.E., 1989. Top management and innovations in banking: does the composition of the top team make a difference? Strateg. Manag. J. 10, 107–124.
Beck, T., Demirgüç-Kunt, A., Merrouche, O., 2013. Islamic vs. conventional banking: business model, efficiency and stability. J. Bank. Financ. 37, 433–447.
Beltratti, A., Stulz, R.M., 2012. The credit crisis around the globe: why did some banks perform better? J. Financ. Econ. 105, 1–17.
Berger, A.N., Bouwman, C.H., 2009. Bank liquidity creation. Rev. Financ. Stud. 22, 3779–3837.
Berger, A.N., Kick, T., Schaeck, K., 2014. Executive board composition and bank risk taking. J. Corp. Finan. 28, 48–65.
Bharath, S.T., Shumway, T., 2008. Forecasting default with the Merton distance to default model. Rev. Financ. Stud. 21, 1339–1369.
BIS, 2001. The New Basel Capital Accord. Discussion paper. Basel Committee on Banking Supervision (May, 2001).
BIS, 2008. Principles for Sound Liquidity Management and Supervision. Basel Committee on Banking Supervision (September, 2008).
BIS, 2011. Principles for the Sound Management of Operational Risk. Discussion paper. Basel Committee on Banking Supervision (July, 2011).
Blundell, R., Bond, S., 1998. Initial conditions and moment restrictions in dynamic panel data models. J. Econ. 87, 115–143.
Boyd, B.K., Haynes, K.T., Zona, F., 2011. Dimensions of CEO–board relations. J. Manag. Stud. 48, 1892–1923.
Burkart, M., Gromb, D., Panunzi, F., 1997. Large shareholders, monitoring, and the value of the firm. Q. J. Econ. 112, 693–728.
Chen, H.L., 2014. Board capital, CEO power and R&D investment in electronics firms. Corp. Gov. 22, 422–436.
Chong, B.S., Liu, M.-H., 2009. Islamic banking: interest-free or interest-based? Pac. Basin Financ. J. 17, 125–144.
Chow, G.C., 1960. Tests of equality between sets of coefficients in two linear regressions. Econometrica 28, 591–605.
Čihák, M., Hesse, H., 2010. Islamic banks and financial stability: an empirical analysis. J. Financ. Serv. Res. 38, 95–113.
Coles, J.L., Daniel, N.D., Naveen, L., 2008. Boards: does one size fit all? J. Financ. Econ. 87, 329–356.
Dalton, D.R., Daily, C.M., Johnson, J.L., Ellstrand, A.E., 1999. Number of directors and financial performance: a meta-analysis. Acad. Manag. J. 42, 674–686.
Deutsch, Y., Ross, T.W., 2003. You are known by the directors you keep: reputable directors as a signaling mechanism for young firms. Manag. Sci. 49, 1003–1017.
DeYoung, R., Jang, K.Y., 2016. Do banks actively manage their liquidity? J. Bank. Financ. 66, 143–161.
Diamond, D.W., 1989. Reputation acquisition in debt markets. J. Polit. Econ. 97, 828–862.
Diamond, D.W., Rajan, R.G., 2001. Liquidity risk, liquidity creation and financial fragility: a theory of banking. J. Polit. Econ. 109, 287–327.
Diamond, D.W., Rajan, R., 2009. The credit crisis: conjectures about causes and remedies. Natl. Bur. Econ. Res. W14739.
Dimitriou, D., Kenourgios, D., Simos, T., 2013. Global financial crisis and emerging stock market contagion: a multivariate FIAPARCH–DCC approach. Int. Rev. Financ. Anal. 30, 46–56.
Dunlap, W.P., Cortina, J.M., Vaslow, J.B., Burke, M.J., 1996. Meta-analysis of experiments with matched groups or repeated measures designs. Psychol. Methods 1, 170–177.

El-Hawary, D., Grais, W., Iqbal, Z., 2007. Diversity in the regulation of Islamic financial institutions. Q. Rev. Econ. Finance 46, 778–800.
Ernst & Young, 2016. World Islamic Banking Competitiveness Report.
Errico, M.L., Farahbaksh, M.M., 1998. Islamic Banking: Issues in Prudential Regulations and Supervision. International Monetary Fund.
Fama, E.F., Jensen, M.C., 1983. Separation of ownership and control. J. Law Econ. 26, 301–325.
Griffin, J.M., Kelly, P.J., Nardari, F., 2010. Do market efficiency measures yield correct inferences? A comparison of developed and emerging markets. Rev. Financ. Stud. 23, 3225–3277.
Hambrick, D.C., Mason, P.A., 1984. Upper echelons: the organization as a reflection of its top managers. Acad. Manag. Rev. 9, 193–206.
Ho, D.E., Imai, K., King, G., Stuart, E.A., 2007. Matching as nonparametric preprocessing for reducing model dependence in parametric causal inference. Polit. Anal. 15, 199–236.
IFSB, 2005. Capital Adequacy Standard for Institutions Offering Only Islamic Financial Service. Islamic Financial Services Board.
IFSB–IRTI, 2014. Islamic financial services industry development: ten-year framework and strategies – a mid-term review. In: Islamic Financial Services Board and Islamic Research and Training Institute, (Accessed on 30 January 2017 from). http://www.ifsb.org/docs/2014-06-17_IFSB-IRTI%20A%20MID-TERM %20REVIEW_FINAL.pdf.
Jensen, M.C., Meckling, W.H., 1976. Theory of the firm: managerial behavior, agency costs and ownership structure. J. Financ. Econ. 3, 305–360.
Jiang, W., Wan, H., Zhao, S., 2016. Reputation concerns of independent directors: evidence from individual director voting. Rev. Financ. Stud. 29, 655–696.
John, K., Litov, L., Yeung, B., 2008. Corporate governance and risk-taking. J. Financ. 63, 1679–1728.
Kabir, M.N., Worthington, A., Gupta, R., 2015. Comparative credit risk in Islamic and conventional bank. Pac. Basin Financ. J. 34, 327–353.
Khan, T., Ahmed, H., 2001. Risk Management: An Analysis of Issues in Islamic Financial Industry: Islamic Development Bank. Islamic Research and Training Institute.
Laeven, L., 2013. Corporate governance: what's special about banks? Annual Review of Financial Economics 5, 63–92.
Laeven, L., Levine, R., 2009. Bank governance, regulation and risk taking. J. Financ. Econ. 93, 259–275.
Merton, R.C., 1974. On the pricing of corporate debt: the risk structure of interest rates. J. Financ. 29, 449–470.
Minton, B.A., Taillard, J.P., Williamson, R., 2014. Financial expertise of the board, risk taking, and performance: evidence from bank holding companies. J. Financ. Quant. Anal. 49, 351–380.
Mollah, S., Zaman, M., 2015. Shari'ah supervision, corporate governance and performance: conventional vs. Islamic banks. J. Bank. Financ. 58, 418–435.
Mollah, S., Hassan, M.K., Al Farooque, O., Mobarek, A., 2017. The governance, risk-taking, and performance of Islamic banks. J. Financ. Serv. Res. 51, 195–219.
Pathan, S., 2009. Strong boards, CEO power and bank risk-taking. J. Bank. Financ. 33, 1340–1350.
Pathan, S., Faff, R., 2013. Does board structure in banks really affect their performance? J. Bank. Financ. 37, 1573–1589.
Roodman, D., 2009. How to do xtabond2: an introduction to difference and system GMM in STATA. Stata J. 9, 86–136.
Safieddine, A., 2009. Islamic financial institutions and corporate governance: new insights for agency theory. Corp. Gov. 17, 142–158.
Schaeck, K., Cihak, M., Maechler, A., Stolz, S., 2012. Who disciplines bank managers? Rev. Financ. 16, 197–243.
Sensoy, A., 2016. Systematic risk in conventional and Islamic equity markets. Int.Rev. Financ. 16, 457–466.
Shehzad, C.T., de Haan, J., Scholtens, B., 2010. The impact of bank ownership concentration on impaired loans and capital adequacy. J. Bank. Financ. 34, 399–408.
Shleifer, A., Vishny, R.W., 1986. Large shareholders and corporate control. J. Polit. Econ. 94, 461–488.
Stulz, R.M., 2005. The limits of financial globalization. J. Financ. 60, 1595–1638.
Sun, L., Chang, T.-P., 2011. A comprehensive analysis of the effects of risk measures on bank efficiency: evidence from emerging Asian countries. J. Bank. Financ. 35, 1727–1735.
Sundararajan, V., Errico, L., 2002. Islamic Financial Institutions and Products in the Global Financial System: Key Issues in Risk Management and Challenges Ahead. International Monetary Fund.
Thomson Reuters, 2016. State of the Global Islamic Economy Report 2016/17. (Accessed from) https://ceif.iba.edu.pk/pdf/ThomsonReuters-stateoftheGlobalIslamicEconomyReport201617.pdf.
Wintoki, M.B., Linck, J.S., Netter, J.M., 2012. Endogeneity and the dynamics of internal corporate governance. J. Financ. Econ. 105, 581–606.
Wooldridge, J.M., 2010. Econometric Analysis of Cross Section and Panel Data. MIT Press.