University of Groningen

Corporate Governance and the Insolvency Risk of Financial Institutions

Ali, Searat; Hussain, Nazim; Iqbal, Jamshed

Published in:
North American Journal of Economics and Finance

DOI:
[10.1016/j.najef.2020.101311](https://doi.org/10.1016/j.najef.2020.101311)

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2021

[Link to publication in University of Groningen/UMCG research database](#)

Citation for published version (APA):

Ali, S., Hussain, N., & Iqbal, J. (2021). Corporate Governance and the Insolvency Risk of Financial Institutions. *North American Journal of Economics and Finance*, 55, [101311].
<https://doi.org/10.1016/j.najef.2020.101311>

Copyright

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

Take-down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.

Contents lists available at ScienceDirect

North American Journal of Economics and Finance

journal homepage: www.elsevier.com/locate/najef Corporate governance and the insolvency risk of financial institutions[☆]Searat Ali^a, Nazim Hussain^b, Jamshed Iqbal^{c,*}^a University of Wollongong, School of Accounting Economics and Finance, Faculty of Business and Law, NSW 2522 Australia^b University of Groningen, Department of Accounting, Faculty of Economics and Business, Groningen, Netherlands^c University of Vaasa, School of Accounting and Finance, P.O. Box 700, FI-65101 Vaasa, Finland

ARTICLE INFO

JEL classification:

G01
G20
G21
G30
G32
G34

Keywords:

Corporate governance
Insolvency risk
Bank risk-taking
Financial crisis
Financial institutions

ABSTRACT

We investigate whether shareholder-friendliness of corporate governance mechanisms is related to the insolvency risk of financial institutions. Using a large sample of U.S. financial institutions over the period 2005–2010, we find that corporate governance is positively related to the insolvency risk of financial institutions as proxied by Merton's distance to default measure and credit default swap (CDS) spread. We also find that "stronger" corporate governance increases insolvency risk relatively more for larger financial institutions and during the period of the financial crisis. Lastly, our results suggest that shareholder-friendliness of corporate governance mechanisms is viewed unfavorably in the bond market.

1. Introduction

"Corporate Governance deals with the ways in which suppliers of finance to corporates assure themselves of getting return on their investment." (Shleifer & Vishny, 1997, p. 737)

This paper studies the relationship between corporate governance and the insolvency risk of financial institutions around the global financial crisis. Every business manager in an agency relationship faces a dilemma of maintaining a balance between adopting riskier policies to increase shareholders' wealth and protecting their self-interests and human capital invested in the firm. This gives rise to agency problems (Demsetz, Saidenberg, & Strahan, 1997) in any firm. This issue of risk taking as an agency problem is more pronounced in the financial industry. After the global financial crisis, several studies examine risk-taking in financial institutions (see for

[☆] We thank Shams Pathan, Steve Swidler, Sami Vähämaa, James Gilkeson, Antonio-Trujillo-Ponce, Qiongbing Wu, Janne Äijö, Björn Rock and participants at the 2018 Financial Markets & Corporate Governance Conference, the 29th Australasian Finance and Banking Conference, International Finance and Banking Society (IFABS) 2017 Oxford Conference, and Finance Seminar at University of Vaasa for the valuable comments and suggestions. J. Iqbal gratefully acknowledges the financial support of the Marcus Wallenbergin foundation, Finnish Foundation for Economic Education, OP Group Research Foundation and Säästöpankkien Tutkimussäätiö for this project. Part of this paper was written while J. Iqbal was visiting the University of Groningen. Any errors are our own.

* Corresponding author.

E-mail addresses: searat@uow.edu.au (S. Ali), n.hussain@rug.nl (N. Hussain), jiqbal@uva.fi (J. Iqbal).

instance, Fahlenbrach and Stulz, 2011; Beltratti and Stulz, 2012; Erkens, Hunga, & Matos, 2012; Peni & Vähämaa, 2012; Berger et al., 2014; Iqbal, Strobl, & Vähämaa, 2015). In the financial industry, on one hand, managers must operate within regulatory constraints (Chen, Steiner, & Whyte, 2006) that require, especially banks, to maintain a minimum amount of capital and liquidity. The main goal of these prudential regulations is to improve resilience against economic shocks and ensure that financial institutions continue to finance economic activity and growth. On the other hand, financial institutions have decision making flexibility that can have a significant impact on the riskiness of the institution (Hubbard & Palia, 1995). Recently, some research efforts have also been devoted to examine the determinant of risk-taking in the financial industry in the presence of regulatory constraints (see for instance; Kosmidou, Kousenidis, Ladas, & Negkakis, 2017; Mourouzidou-Damtsa, Milidonis, & Stathopoulos, 2019). However, given that financial institutions can transmit financial instability to the overall financial system (Acharya, Anginer and Warburton, 2016), the role of shareholder-friendly corporate governance mechanisms in increasing (decreasing) insolvency risk is still an open question when it comes to financial institutions.

The fundamental role of corporate governance is to overcome the agency problems between agents (managers) and principals (shareholders) by aligning their interests. However, excessive monitoring may also lead to a deteriorated of firm value (Tosi Jr, & Gomez-Mejia, 1994). More specifically, when firms face crises situation the overly governed firms may have a lower value (Baek, Kang, & Park, 2004). Furthermore, the anecdotal evidence suggests that shareholder oriented governance mechanisms may force managers to take excessive risk which in turn leads to a higher level of insolvency risk. However, there is a paucity of research about this particular phenomenon for financial institutions, especially during the crisis period. Therefore, our study tries to fill this void by examining the relationship between shareholder-friendly corporate governance and insolvency risk in the US financial institutions. Furthermore, our paper analyzes how the relationship between shareholder-friendly governance and insolvency risk evolves during the financial crises for the larger financial institutions.

We utilize comprehensive data on the U.S. financial institutions from 2005 to 2010, thus including the period of recent financial crisis which previous studies excluded. We use Corporate Governance Quotient and Sub-Quotients (namely Board Quotient, Compensation Quotient, Audit Quotient, and Takeover Quotient) issued by Institutional Shareholder Services (ISS) to measure the strength of corporate governance mechanisms. To measure insolvency risk, we use traditional (i.e., distance to default [DD]) and innovative (i.e., credit default swap [CDS] spread) market-based measures. We utilize DD and CDS spread because these measures are bondholder-facing and can help explain how the strength of corporate governance mechanism is viewed in the bond market.

In this regard, Hilscher and Şişli-Ciamarra (2013) argue that higher CDS spread may indicate the reallocation of wealth from bondholders to shareholders. Recent studies (e.g., Bolton, Mehran, & Shapiro, 2015) utilize CDS spread to proxy insolvency risk and suggest that it is preferable because it also accounts for creditors' risk (Colonnello, 2017; Feldhutter, Hotchkiss, & Karakas, 2016). Further, previous studies argue that CDS spread is a more accurate and informative measure of credit risk (Blanco, Brennan, & Marsh, 2005; Norden & Weber, 2009). In this regard, despite the abundance of research that examines the role of CDS spreads in understanding corporate finance issues, surprisingly there is little research on the relations of corporate governance mechanisms to CDS spreads. We contribute to this debate by empirically examining whether the strength of corporate governance mechanisms affects credit market reaction in terms of CDS spreads for financial institutions.

We find that the insolvency risk of financial institutions, proxied by either its market-based DD or CDS spread, is positively associated (a negative credit market reaction) with the shareholder-friendliness of its corporate governance mechanisms. Furthermore, this positive association between corporate governance mechanisms and insolvency risk is more pronounced in larger financial institutions and during the financial crisis. These findings provide support to the argument that creditors view strong governance mechanisms negatively and may ask for more return on debt.

Our results are both statistically and economically significant as well as robust to several additional analyses, including the use of alternative proxies for both corporate governance index and insolvency risk, controlling for systemically important and large bank holding companies, and sub-sample analyses for troubled financial institutions. We use firm fixed effects, and propensity score matching estimation technique to show that our main results are not driven by endogeneity bias. Our results are also consistent to the use of alternative governance measure for longer and recent sample period. Lastly, we show that the strength of corporate governance mechanisms is negatively and significantly related to the Tier 1 capital ratio suggesting that shareholder-friendliness of corporate governance mechanisms increases insolvency risk by reducing bank capitalization.

Our paper makes several contributions to the literature. First, our paper contributes to the previous literature on the effects of corporate governance on risk taking in financial institutions (see Laeven & Levine, 2009; Pathan, 2009; Fahlenbrach & Stulz, 2011; Beltratti & Stulz, 2012; Erkens et al, 2012; Peni & Vähämaa, 2012; Berger et al., 2014; Iqbal et al., 2015)¹ by showing that shareholder-friendly corporate governance mechanisms may encourage excessive risk-taking, leading to higher insolvency risk for larger financial institutions during the crisis period. Second, our paper contributes to the literature on expropriation of bondholder wealth (Hilscher

¹ Mehran, Morrison and Shapiro (2011) survey studies investigating the relationship between corporate governance and measures of risk.

and Şişli-Ciamarra, 2013; Kang & Xu, 2019) by showing that shareholder-friendliness of corporate governance mechanisms is associated with increased CDS spreads, i.e. a negative credit market reaction. Finally, most of the previous studies on board effectiveness do not include financial institutions in their sample (see Adams, Hermalin, & Weisbach, 2010), we contribute to this stream of literature by examining the role of shareholder-friendly board in increasing the insolvency risk of financial institutions.²

In addition to the contribution to banking literature, the results have important practical implications. Financial regulators could benefit from this study that could provide a basis from which to enhance economic growth, reduce bankruptcy levels, and add value to the wealth of stockholders by focusing on corporate governance areas. Regulators should pay close attention because strong corporate governance mechanisms in the financial industry can encourage more risk taking, which can cause instability in the overall financial system.

The remainder of the paper is organized as follows. Section 2 presents the literature review and hypotheses. Section 3 presents the data and explains the variables used in the empirical analysis. Section 4 presents the methods and reports the empirical findings on the association between corporate governance mechanisms and the insolvency risk of financial institutions. Finally, section 5 concludes the paper.

2. Literature review and hypothesis development

Agency theory posits that corporate managers may pursue their own interests rather than maximizing shareholders' value and thus create a conflict of interest. This agency behavior stems from the view that corporate managers may be more risk averse than shareholders because they want to protect their undiversified human capital and investment in the firm. Shareholder-friendly corporate governance mechanisms can influence the behavior of managers and change their willingness to take more risks.³ In this regard, John Litov and Yeung (2008) show that the shareholder-friendliness of corporate governance mechanisms encourages risk-taking and promotes the growth of non-financial firms. More recently, in the wake of the financial crisis, several studies have shed light on the role of corporate governance towards risk-taking and financial performance of financial institutions (Adams, 2012; Fahlenbrach & Stulz, 2011; Iqbal & Vähämaa, 2019). Specifically, several studies focus on risk taking by financial institutions especially during the recent global financial crisis (Pathan, 2009; Laeven & Levine, 2009; Berger, Kick, & Schaeck, 2014; Iqbal et al., 2015). Overall, these studies suggest excessive, deemed inappropriate, risk taking by financial institutions during the financial crisis. Thus, stronger corporate governance practices may encourage increased risk-taking in the financial industry (Erkens, et al., 2012; Iqbal et al., 2015; Iqbal & Vähämaa, 2019) which may lead to the default of financial institution, especially during the periods of financial distress.

'Stronger' corporate governance not only affects the performance of the firms, measured by Tobin's Q (Gompers, Ishii, & Metrick, 2003; Brown & Caylor, 2009; Chhaochharia & Laeven, 2009; Amman, Oesch & Schmid, 2011) but also encourages increased risk-taking that can benefit shareholders at the expense of bondholders (Jensen & Meckling, 1976).⁴ Since, for financial institutions, the optimal degree of risk taking is higher than for non-financial firms because the market expects government support for financial institutions if they become distressed. Implicit and explicit government guarantees encourage financial institutions to take more risks (see Acharya et al., 2016).⁵ In addition, shareholder-friendly governance mechanisms may further encourage adopting riskier corporate policies (Chava & Purnanandam, 2010) which may, in turn, lead to higher insolvency risk in financial institutions. Shareholder-friendly governance mechanisms can provide incentives to managers for taking risky projects that can harm debtholders by increasing the agency cost of debt (Jensen & Meckling, 1976; LaFond & Roychowdhury, 2008; Kang & Xu, 2019). In contrast to non-financial firms, the expectation of government's implicit and explicit support in times of distress provides a unique environment to

² Most of the studies before GFC excluded financial firms from their sample because they were considered highly regulated. The additional regulatory oversight maybe viewed as a substitute (Adams & Mehran, 2012) for corporate governance in financial institutions. However, governance of institutions may be different from that of non-financial firms because of several reasons. For instance, financial institutions have larger number of stakeholders which complicates the governance of financial institutions. Apart from investors, depositors and regulators also have stake in the performance of financial institution because performance of financial institutions can also affect the health of the overall economy (Adams & Mehran, 2012). Implicit and explicit government guarantees provide financial institutions a different risk environment that are not applicable to non-financial firms. Therefore, it is important to consider financial institutions separately.

³ For instance, shareholder-friendly corporate governance mechanisms can be better investor protection, high number of independent board of directors, separation of the chairman and the CEO, not having poison pill in place etc. Because shareholders do not internalize the social costs associated with failures of financial institutions, they may find it optimal to increase the level of risk. Furthermore, the shareholders and investors expect the government to bailout the large financial institutions in case of their failures (Acharya, Anginer, & Warburton, 2016). However, managers tend to have a lower level of risk than those of the shareholders because of their firm-specific human capital and investment in the firm (Laeven and Levine, 2009; Erkens et al., 2012).

⁴ Corporate governance mechanisms and the board of directors are considered to be stronger and more shareholder-friendly when they provide effective monitoring and stronger protection of shareholder's interests, and more generally, better alignment of managers' interests with those of the shareholders. Adams (2012) and de Haan and Vlahu (2016) provide comprehensive discussions about the corporate governance of financial institutions and the elements of "good" governance.

⁵ Implicit government guarantee is the expectation by market participants that the government may provide bailout (Acharya et al., 2016). It is referred as implicit because government does not explicitly provide commitment to intervene. Implicit government guarantees are not limited to only banks but also for other financial institutions (Zhao, 2018).

consider financial institutions separately (Acharya et al., 2016; Zhao, 2018) because stronger corporate governance mechanisms in financial institutions can lead to excessive risk taking (Erkens et al., 2012; Anginer, Demircug-Kunt, Huizinga, & Ma, 2018).⁶

The existing literature suggests a positive link between corporate governance and insolvency risk of financial institutions. For instance, Anginer et al. (2018) find that share-holder-friendly corporate governance mechanisms are associated with greater insolvency risk (i.e., lower Z-score and DD) for a sample of international banks. Some other studies also examine the governance-insolvency linkage but provide contrasting evidence. Using a sample of Canadian financial institutions over the period of 2010 to 2013 (post-crisis), Switzer, Wang and Zhang (2016) find that large and more independent boards have higher insolvency risk as measured through DD. On the other hand, Switzer and Wang (2013) provide evidence that U.S. commercial banks with larger and more independent boards have lower levels of insolvency risk during the period from 2001 to 2007, that is, prior to the global financial crisis. With these mixed results, the issue of whether the strength of corporate governance mechanisms affects the insolvency risk for financial institutions requires further investigation.⁷ It is therefore imperative to empirically examine the association between the shareholder-friendliness of corporate governance mechanisms and insolvency risk of financial institutions, especially around the period of the global financial crisis. Therefore, we hypothesize that:

H1: Strong corporate governance mechanisms are positively associated with the insolvency risk of financial institutions.

3. Data and variables

In this study, we use a sample of 556 publicly traded U.S. financial institutions over the 2005–2010 period. We use this sample period mainly because the scope of our study is to examine the relationship between corporate governance and insolvency risk around the global financial crisis. We collect data on corporate governance mechanisms from the Corporate Governance Quotient (CGQ) database developed by Institutional Shareholder Services (ISS). ISS change the CGQ calculation methodology after 2010 therefore this is another reason that we restrict our sample period until 2010. Insolvency risk data is collected from the Credit Research Initiative (CRI) database managed by the Risk Management Institute (RMI) at the National University of Singapore.⁸ Lastly, data on financial statements and balance sheet variables are collected from the BankScope of Bureau Van Dijk.

Starting from the entire population of U.S. banks and diversified financials (950 financial institutions) in CGQ database,⁹ we first identify the financial institutions for which the insolvency risk data is available from the RMI-CRI database. Doing so, we are left with 650 financial institutions. We then eliminate the financial institutions from our sample that have insufficient data on financial statement and balance sheet variables found in BankScope. This leaves us with a final sample of 556 individual financial institutions and an unbalanced panel of 1,924 firm-year observations.¹⁰

3.1. Insolvency risk measures

The dependent variable in our study is the insolvency risk (*Insolvency Risk*). Since the seminal work of Beaver (1966), a number of accounting and market-based insolvency prediction models have been developed in the literature. The validity of accounting-based models has been questioned due to the backward-looking nature of the financial statements from which these models are derived (Agarwal & Taffler, 2008). Market-based models using the option pricing approach developed by Black and Scholes (1973) and Merton (1974) provide an appealing alternative to the prediction of insolvency conditions of listed firms and have been used in extant empirical studies (e.g., Hillegeist et al., 2004; Bharath & Shumway, 2008; Charitou et al., 2013). Such a methodological approach overcomes the criticisms of accounting-based models through the forward-looking nature of market data. Market data reflect expectations of a firm's future cash flows, and hence should be more appropriate for prediction purposes. Another prevalent feature of such models is their provision of a "finer" volatility assessment that aids in predicting the risk of insolvency (Beaver et al., 2005).¹¹ Empirical studies such as Hillegeist et al. (2004) recommend that researchers use market-based models of default prediction since these

⁶ For instance, Acharya et al. (2016) find that bondholders of the financial institutions, especially large ones, expect that the government will protect them in case of failure of financial institution.

⁷ Even for non-financial firms, studies find contradictory evidences. For instance, Chiang, Chung and Huang (2015) find that corporate governance is associated with bankruptcy possibility whereas Schultz, Tan, and Walsh (2017) find no relationship between probability of default and corporate governance characteristics.

⁸ RMI-CRI database covers over 60,000 listed firms in Asia Pacific, North America, Europe, Latin America, the Middle East and Africa. The RMI-CRI database provides historical time series of individual distance to default on a monthly frequency at the firm level. Thus, monthly frequency of individual distance to default requires an adjustment to annual frequency to be consistent with other variables.

⁹ ISS classification is based on S&P "GICS" (Global Industry Classification System). We download all firm-year observations for banks and diversified financials (GICS code of 4010 and 4020 respectively). These include diversified banks, regional banks, thrifts & mortgage finance, multi-sector holdings, specialized finance, other diversified financial services, consumer finance, asset management & custody banks, investment banking & brokerage, diversified capital markets, financial exchanges & data, and mortgage real estate investment trusts. Almost 75 percent of these financial institutions are categorized as Banks in Corporate Governance Quotient Database.

¹⁰ Almost 91 percent of the financial institutions are categorized as Banks in the final sample.

¹¹ Volatility is a critical factor in predicting default risk since it captures the probability that the value of a firm's assets will decrease to such a point that the firm will be unable to repay its debt obligations. Ceteris paribus, the higher the volatility, the higher is the default risk. Depending on asset volatilities, two firms with identical leverage ratios can have substantially different chances of financial distress. Therefore, measures of volatility should be incorporated in financial distress models.

models contain more information about default than accounting-based models. We, therefore, use the market-based Merton (1974) distance to default (DD) and credit default swap (CDS) spread as measures of insolvency risk (see appendix A: general procedure to calculate DD). Much like typical insurance, CDS is a financial contract.¹²

In a typical CDS contract, the protection seller offers the protection buyer insurance against the default of an underlying bond issued by a certain company (the reference entity). In the event of default by the reference entity, the seller commits to buy the bond for a price equal to its face value from the protection buyer.¹³ In exchange for the insurance, the buyer pays a quarterly premium, called the CDS spread, quoted as an annualized percentage of the notional value insured. Therefore, by definition, the CDS spread is the pricing of the insolvency risk (Das et al., 2009). The higher the insolvency risk of the reference entity, the larger is the CDS spread. Tang and Yan (2010) find that the CDS spread captures the major portion of the firm-level determinants of insolvency risk. Thus, the CDS spread should serve as a valid and robust measure of a firm's insolvency conditions.¹⁴

The CDS spread is referred as "actuarial spread" in RMI database.¹⁵ Actuarial spread is constructed on the design of traditional CDS but without upfront fee. Further, the construction of actuarial spread is based on the assumption that market participants are risk-neutral that is why no upfront fee is initially required. Therefore, the actuarial spread has the same features as the standard CDS spread.

3.2. Corporate governance measures

In this paper, we utilize the Corporate Governance Quotient (CGQ) index which measures the strength of corporate governance mechanisms and is issued by Institutional Shareholder Services (ISS).¹⁶ We obtain these data from the RiskMetrics Group. CGQ is a comprehensive corporate governance index comprised of 67 different firm-related characteristics including internal and external governance. The CGQ includes information about the board of directors, ownership structure, directors' education, audit committees, executive compensation structure, charter/bylaws, and form of incorporation. This data is obtained from surveys conducted by the ISS, company websites, and public filings. The values of CGQ ranges from 0 to 100, with higher values corresponding to stronger, more shareholder-focused corporate governance mechanisms.

In addition to the aggregate governance measure CGQ, we also use four sub-indices, called board, compensation and ownership, auditing, and takeover that summarize aspects of corporate governance. This is also an important reason that we use CGQ data provided by ISS which allows us to further examine the different aspects of internal and external governance mechanisms that can influence the insolvency risk of financial institutions. The takeover sub-index, for instance, has a higher score, if there are fewer corporate governance-related barriers to takeovers. These sub-indices take values from 1 to 5, with higher values representing stronger, more shareholder-friendly mechanisms.

3.3. Control variables

Following prior literature on bank risk-taking (e.g., Pathan, 2009; Berger et al., 2014; Mayordomo et al., 2014; Iqbal et al., 2015), we control for several institution-specific variables that may influence the insolvency risk of the financial institutions, specifically firm size, profitability, growth, and the structures of assets and income. When comparing financial institutions, size is the most important control variable. Larger financial institutions may pursue riskier corporate policies (Acharya et al., 2016). The size (*Size*) variable is constructed as the natural logarithm of total assets.

In addition to *Size*, we account for the institution's financial performance, growth, and asset and income structure. We measure financial performance with *Return on assets* which is calculated as the ratio of net income to total assets. *Growth* is measured as the percentage change in the amount of outstanding loans from last year to this year. We control for the institution's business model and asset structure with the ratio of net loans to total assets (*Loans to assets*) and the ratio of deposits to total assets (*Deposits to assets*). Finally, we use the ratio of non-interest income to total income (*Non-interest income*) to control for the level of income diversification and non-traditional banking activities.

In previous literature, the capital ratio (or leverage ratio) is used when comparing financial institutions. However, in this study, we do not control for capital ratio as the construction of DD and CDS preclude it.¹⁷ The construction of DD is based on the Merton (1974) model which assumes that firms are financed by equity.¹⁸ Further, CRI computes CDS spread based on the term structure of probabilities of default.¹⁹ CRI adopts the forward intensity approach of Duan, Sun and Wang (2012) to characterize term structure of probabilities of default. Thus, CDS spread is based on a physical probability that makes inclusion of equity, as a control variable,

¹² "The contract defines a reference instrument (a bond) issued by some reference entity (the obligor)" (Duan, 2014, p. 51).

¹³ In practice, the terms of the CDS could involve physical delivery of the defaulted bond or cash settlement.

¹⁴ DD and CDS have been used in previous studies (e.g. Ali, Liu, & Su 2018) as measures of insolvency risk of firms.

¹⁵ This paper uses CDS spread terminology for ease of understanding.

¹⁶ The ISS Corporate Governance Quotient been previously used as a proxy for the strength of corporate governance, for instance, in Chhaochharia and Laeven (2009), Ertugrul and Hegde (2009), Jiraporn, Kim, Kim, and Kitsabunnarat (2012) and Peni, Smith and Vahamaa (2013).

¹⁷ Although our results are robust to inclusion of capital ratio as control variable.

¹⁸ See Duan and Wang (2012) for the detail on measurement of distance to default.

¹⁹ For instance, see Duan (2014) for the detail on construction of CDS

problematic.²⁰ In addition, capital ratio also serves as a proxy for the insolvency risk (Borisova, Fotak, Holland, & Megginson, 2015). For instance, Anginer et al. (2018) do not control for capital ratio when using z-score and DD to proxy insolvency risk. The data on our control variables are obtained from Bureau van Dijk Bankscope. Following Ellul and Yerramilli (2013), we winsorize all the independent variables at the 1st and 99th percentiles to mitigate potential outlier effects.²¹ The definitions of variables are summarized in Appendix B.

4. Empirical analysis

4.1. Descriptive statistics and correlations

Table 1 presents the descriptive statistics for the variables used in the empirical analysis. Descriptive statistics show that our sample of financial institutions is quite heterogeneous in terms of corporate governance strength as CGQ varies from 0.5 (minimum) to 100 (maximum) and has an average of 53.09. Further, the corporate governance sub-indices, board, compensation, audit, and takeover, also vary from lowest (0) to the highest (5) possible values suggesting that our sample of financial institutions is diverse in terms of the strength of corporate governance mechanisms. In addition to this, our sample is also quite heterogeneous in terms of insolvency risk. DD has a minimum value of -2.04 and a maximum value of 11.78 with a mean value of 1.83. Moreover, CDS varies from a minimum of -2.40 to a maximum of 7.89 with a mean value of 3.93. Table 2 also shows that our sample is heterogeneous in terms of control variables. For instance, there is considerable variation in size, ranging from 11.08 to 21.54 (natural logarithm of total assets).

Table 2 shows the pairwise correlations among the variables used in the analysis. It can be noted from the table that CGQ and governance sub-indices have a negative correlation with DD and a positive correlation with CDS,²² suggesting better governed financial institutions have a greater level of insolvency risk. Moreover, as expected, the two insolvency risk variables, DD and CDS, are negatively correlated by construction ($r = 0.96$). As the correlation results are not controlled by other factors that affect financial distress, they should be viewed with caution.²³

4.2. Univariate tests

We start by investigating the association between corporate governance and insolvency of financial institutions in a univariate setting. We do so by dividing our sample of financial institutions into two groups formed on the basis of the strength of corporate governance. The first group comprises financial institutions with stronger corporate governance structures, that is, financial institutions with CGQ values in the top 30 percent. The second group includes financial institutions with weaker corporate governance structures, that is, those with CGQ values in bottom 30 percent. We analyze the significance of the difference in means using two-tailed *t*-tests under the null hypothesis that there are no differences in the means between the financial institutions with stronger and weaker corporate governance structures. We report the results of this analysis in Table 3.

We find that the two groups are significantly different in many respects. First, the difference of means for DD is negative and statistically significant, and for CDS spread is positive and statistically significant. Thus, the univariate analysis provides evidence that financial institutions with stronger corporate governance mechanisms are associated with a higher level of insolvency risk. Regarding the control variables, the univariate tests in Table 3 indicate that financial institutions with stronger governance structures are larger in size, have a lower amount of loans relative to total assets and a higher percentage of non-interest income. However, the financial institutions with stronger governance structures have significantly lower return on assets and loan growth compared to the financial institutions with weaker governance structures.

4.3. Regression results

Our baseline model to examine the association between corporate governance and insolvency risk follows several alternative panel regressions of the equation below:

$$\begin{aligned} \text{InsolvencyRisk}_{i,t} = & \alpha + \beta_1 \text{Governance}_{i,t} + \beta_2 \text{Size}_{i,t} + \beta_3 \text{Returnonassets}_{i,t} + \beta_4 \text{Loanstoassets}_{i,t} + \beta_5 \text{LoanGrowth}_{i,t} + \beta_6 \text{Depositstoassets}_{i,t} \\ & + \beta_7 \text{Non-interestincome}_{i,t} + \sum_{k=1}^{n-1} \alpha_k \text{Firm}_i^k + \sum_{y=2006}^{2010} \omega_y \text{Year}_i^y + \varepsilon_{i,t} \end{aligned} \quad (1)$$

where the dependent variable *Insolvency Risk*_{*i,t*} is one of the two alternative measures of insolvency risk: the DD or CDS spread for

²⁰ In addition, previous studies (e.g. Baselga-Pascual, Trujillo-Ponce, & Cardone-Riportella, 2015) argue that regressing capital ratio on the insolvency risk (measured by Z-score and distance to default) may be problematic because banks can alter their capital if they become more risk.

²¹ Our results are also robust to not winsorizing.

²² There is a significant negative correlation of CG variables with the components of DD i.e. asset volatility and equity volatility, suggesting that better governed firms are more volatile.

²³ We also observe a significant difference at the 1% level in the insolvency risk measures between the high CGQ firms and the low CGQ firms (results available on request).

Table 1
Descriptive statistics.

Variable	Mean	St.dev	Min	Max	P25	P75	Observations
<i>Insolvency risk variables:</i>							
DD	1.83	1.66	−2.04	11.78	0.65	2.86	1924
CDS	3.93	1.50	−2.40	7.89	2.98	4.88	1914
<i>Corporate governance variables:</i>							
CGQ	53.09	26.75	0.50	100.00	31.15	75.65	1924
BoardQ	3.01	1.32	0.00	5.00	2.00	4.00	1914
Compensation	3.52	1.33	0.00	5.00	2.00	5.00	1924
Audit	3.20	1.52	0.00	5.00	2.00	5.00	1924
Takeover	2.93	1.26	0.00	5.00	2.00	4.00	1924
<i>Control variables:</i>							
Size	14.50	1.68	11.08	21.54	13.47	15.02	1924
Return on assets	0.29	1.59	−11.48	14.39	0.14	1.03	1914
Loans to assets	67.78	14.77	0.99	93.54	61.55	77.18	1924
Loan growth	7.57	25.45	−84.15	704.49	−2.56	13.20	1924
Deposits to assets	0.78	0.13	0.00	0.98	0.74	0.86	1924
Non-interest income	22.73	36.80	−938.37	271.50	13.50	30.21	1924

This table reports the descriptive statistics for the sample. *DD*, is the Distance to Default, measures the difference between the asset value of the financial institution and the face value of its debt, scaled by the standard deviation of the financial institution's asset value. *CDS* is the credit default swap spread is the pricing of the financial distress risk (Das et al., 2009). *CDS* are credit derivatives that allow the transfer of the firm's default risk between two agents for a predetermined time period. *CGQ* (Corporate Governance Quotient) measures the strength of the firm's corporate governance mechanisms and *BoardQ* (Board Quotient) is a *CGQ* sub-index which measures the strength of the board of directors. Compensation index is based on compensation and ownership characteristics of financial institution. Auditing index is based on auditing characteristics. Takeover index is based on takeover characteristics. The control variables are defined as follows: *Size* is measured as the logarithm of total assets, *Return on assets* is the ratio of net income to total assets, *Loans to assets* is the ratio of net loans to totals assets, *Loan growth* is the percentage change in loans from year $t-1$ to year t , *Deposits to assets* is the ratio of deposits to total assets, and *Non-interest income* is the ratio of non-interest income to total income.

financial institution i at time t . The *DD* measures the difference between the asset value of the financial institution and the face value of its debt, scaled by the standard deviation of the asset value (see Campbell, Hilscher & Szilagyi, 2008, p. 2899). Second, the *CDS* spread is the pricing of the financial distress risk (Das et al., 2009). *CDS* are credit derivatives that allow the transfer of the firm's default risk between two agents for a predetermined time period. *Governance_{it}* is either the *CGQ* which measures the overall strength of the institution's corporate governance mechanisms or *BoardQ* which measures the strength of the board of directors.²⁴ In order to capture the effect of global financial crisis we also estimate modified versions of Eq. (1) where we include the interaction variable *Governance* $\times$ *GFC*. Where *GFC* denotes the crisis year 2008. Further, we use the interaction variable *Governance* $\times$ *Size* to investigate the effect of the size of the financial institution.

As discussed earlier, we use several firm-level variables in order to control for the effects of observable characteristics of financial institutions that may impact the insolvency risk. Control variables used in this study are consistent with the previous literature on the determinants of risk-taking in financial institutions (Laeven & Levine, 2009; Beltratti & Stulz, 2012; Bai & Elyasiani, 2013; Ellul & Yerramilli, 2013). Finally, the regressions also include firm and year fixed effects, and errors are clustered at the firm level.

Table 4 reports the results for ten alternative versions of Eq. (1) with the *DD* as the dependent variable. Models 1 and 6 include only *Size* and *Return on assets* as the control variables for the purpose of parsimony, whereas Models 2 and 7 include the full set of control variables and year fixed-effects, and Models 3 and 8 include both year and firm fixed-effects along with the full set of control variables. Further, Models 4 and 9 include interaction variables *CGQ* $\times$ *GFC* and *BoardQ* $\times$ *GFC*, respectively to control for the global financial crisis. Lastly, in Models 5 and 10 we include size interaction variables *CGQ* $\times$ *Size* and *BoardQ* $\times$ *Size*, respectively. The adjusted R^2 of all models are almost 50 percent. The *F*-statistics for all the ten alternative regressions are statistically significant at the 1 percent level.

Table 4 shows that the overall *CGQ* has a negative and statistically significant coefficient in Models 1, 2, and 3. *BoardQ* has a negative and statistically significant coefficient in Models 6 and 7. These results suggest that more shareholder-friendly corporate governance and a more shareholder-friendly board increases the insolvency risk of financial institutions. In Models 4 and 9, the negative coefficients for interaction variables, *CGQ* $\times$ *GFC* and *BoardQ* $\times$ *GFC*, suggest that strong corporate governance and a more shareholder-friendly board is associated with increased insolvency risk during the period of the financial crisis. Hence, the positive association between insolvency risk and strong corporate governance may be driven by the global financial crisis. In Models 5 and 10, the coefficients for the size interaction variables, *CGQ* $\times$ *Size* and *BoardQ* $\times$ *Size*, are negative and statistically significant suggesting that the positive association between the strength of corporate governance and insolvency risk is particularly important for larger financial institutions. However, *BoardQ* in Model 10 is positive and statistically significant suggesting that a more shareholder-friendly board reduces insolvency risk, especially in small financial institutions. This also suggests that larger financial institutions take on more

²⁴ We further estimate several versions of Eq. (1) where *Governance_{it}* is one of the sub-indices namely; board index, compensation and ownership index, auditing index, and takeover index which summarizes information regarding different aspects of corporate governance. These results are reported in Tables 6 and 7.

Table 2
Correlations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) DD	1.00												
(2) CDS	−0.96***	1.00											
(3) CGQ	−0.07***	0.07***	1.00										
(4) BoardQ	−0.05**	0.06***	0.83***	1.00									
(5) Compensation	−0.01	0.02	0.42***	0.27***	1.00								
(6) Audit	−0.01	0.02	0.34***	0.25***	0.06***	1.00							
(7) Takeover	0.10***	−0.09***	0.10***	0.04*	−0.10***	0.01	1.00						
(8) Size	0.14***	−0.11***	−0.02	−0.05**	−0.05**	0.13***	0.15***	1.00					
(9) Return on Assets	0.58***	−0.63***	−0.06**	−0.06***	−0.03	−0.04*	0.08***	0.07***	1.00				
(10) Loans to assets	−0.13***	0.14***	−0.04*	−0.01	0.10***	−0.08***	−0.09***	−0.34***	−0.12***	1.00			
(11) Loan growth	0.15***	−0.16***	−0.04*	−0.03	−0.08***	0.00	0.07***	0.02	0.26***	−0.05**	1.00		
(12) Deposits to assets	−0.07***	0.06**	0.02	0.03	0.07***	−0.12***	−0.07***	−0.27***	−0.19***	0.35***	−0.16***	1.00	
(13) Non-interest income	0.11***	−0.11***	0.00	−0.02	−0.06**	0.03	0.04*	0.20***	0.13***	−0.24***	0.04*	−0.18***	1.00

The table reports the pairwise correlations for the variables used in the empirical analysis. *DD*, is the Distance to Default, measures the difference between the asset value of the financial institution and the face value of its debt, scaled by the standard deviation of the financial institution's asset value. *CDS* is the credit default swap spread is the pricing of the financial distress risk (Das et al., 2009). *CDS* are credit derivatives that allow the transfer of the firm's default risk between two agents for a predetermined time period. *CGQ* (Corporate Governance Quotient) measures the strength of the firm's corporate governance mechanisms and *BoardQ* (Board Quotient) is a *CGQ* sub-index which measures the strength of the board of directors. Compensation index is based on compensation and ownership characteristics of financial institution. Auditing index is based on auditing characteristics. Takeover index is based on takeover characteristics. The control variables are defined as follows: *Size* is measured as the logarithm of total assets, *Return on assets* is the ratio of net income to total assets, *Loans to assets* is the ratio of net loans to totals assets, *Loan growth* is the percentage change in loans from year $t-1$ to year t , *Deposits to assets* is the ratio of deposits to total assets, and *Non-interest income* is the ratio of non-interest income to total income. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 3
Univariate tests.

Variables	Strong Governance Mean	Weak Governance Mean	Diff. in Means	
<i>Insolvency risk variables:</i>				
CDS	3.754	3.374	0.3783	***
DD	2.065	2.524	−0.459	***
<i>Corporate governance variables:</i>				
CGQ	86.492	14.428	72.064	***
BoardQ	4.385	1.492	2.893	***
Compensation	4.120	2.519	1.601	***
Audit	3.799	2.419	1.380	***
Takeover	3.275	2.942	0.333	***
<i>Control variables:</i>				
Size (Total assets)	14.678	14.649	0.030	
Return on assets	0.157	0.526	−0.370	***
Loans to assets	66.513	67.400	−0.888	
Loan growth	5.065	7.970	−2.905	***
Deposits to assets	0.774	0.772	0.003	
Non-interest income	23.352	22.919	0.433	

This table reports the results of two-tailed t-tests under the null hypothesis that there is no difference in the means between financial institutions with stronger and weaker corporate governance mechanisms. The subsample with stronger governance contains financial institutions with CGQ in the top 30% and the subsample of weaker governance contains financial institutions with CGQ in the bottom 30% of the sample. *CDS* is the credit default swap spread is the pricing of the financial distress risk (Das et al., 2009). *CDS* are credit derivatives that allow the transfer of the firm's default risk between two agents for a predetermined time period. *DD*, is the Distance to Default, measures the difference between the asset value of the financial institution and the face value of its debt, scaled by the standard deviation of the financial institution's asset value. *CGQ* (Corporate Governance Quotient) measures the strength of the firm's corporate governance mechanisms and *BoardQ* (Board Quotient) is a CGQ sub-index which measures the strength of the board of directors. The control variables are defined as follows: *Size* is measured as the logarithm of total assets, *Return on assets* is the ratio of net income to total assets, *Loans to assets* is the ratio of net loans to totals assets, *Loan growth* is the percentage change in loans from year $t-1$ to year t , *Deposits to assets* is the ratio of deposits to total assets, and *Non-interest income* is the ratio of non-interest income to total income. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

risk as they benefit from becoming bigger (Acharya et al, 2016; Zhao, 2018).

In summary, Table 4 indicates that financial institutions with stronger shareholder-friendly corporate governance mechanisms and board of directors are associated with greater insolvency risk, in particular for larger financial institutions and during the global financial crisis. Overall these findings are broadly consistent with the literature on risk-taking by banks and other financial institutions (see e.g., Pathan, 2009; de Haan & Vlahu, 2016; Iqbal et al., 2015; Acharya et al., 2016; Zhao, 2018). We also gauge the economic significance of the results by calculating the marginal effect of an increase in the CGQ from the 25th to the 75th percentile, corresponding to an increase in the CGQ from 31.15 to 75.66 (reported in Table 1). Multiplying the change in CGQ (44.51 points) by the coefficient on CGQ in model 2 of Table 4 (−0.003) gives a change in DD of approximately −0.1335, which represents a −7.30% of the mean DD (i.e., 1.83 reported in Table 1). This suggests that an increase in CGQ from the 25th percentile to the 75th percentile is associated with up to a 7.30 percent increase in the insolvency risk of financial institutions.

Table 5 presents the regression estimates of Eq. (1) with CDS spread as the dependent variable. Regressions in this table are similar to those in Table 4 with estimates of ten alternative versions of Eq. (1). Here, the adjusted R^2 s of these regressions vary from 45.1 percent to 51.7 percent. The F -statistics are statistically significant at the 1 percent level, indicating a good fit for the estimated models. Again, the *Governance* variable in Models 1–5 is CGQ and in Models 6–10 is BoardQ. Overall, the regression estimates with CDS as dependent variable are similar to the DD results reported in Table 4. The coefficient estimates for CGQ (in Models 1–3) and BoardQ (in Models 6–8) in Table 5 are positively associated with CDS spread indicating that stronger corporate governance mechanisms and more shareholder-friendly boards of directors increase insolvency risk. In Models 4 and 9, the positive coefficients for interaction variables, $CGQ \times GFC$ and $BoardQ \times GFC$, may suggest that the positive association between insolvency risk and strong corporate governance may be driven by the global financial crisis. In Models 5 and 10, the coefficients for the size interaction variables, $CGQ \times Size$ and $BoardQ \times Size$, are positive and statistically significant, suggesting that positive association between strength of corporate governance and insolvency risk is particularly important for larger financial institutions.²⁵ However, the overall CGQ in Model 5 and the BoardQ in Model 10 have negative and statistically significant coefficients suggesting that strong corporate governance and a more shareholder-friendly board reduces insolvency risk, especially in small financial institutions. Overall, these findings provide further evidence that insolvency risk of financial institutions is positively associated with shareholder-friendly corporate governance mechanisms during the global financial crisis and for the larger financial institutions. Again, our results are economically significant. We multiply the change in CGQ from the 25th percentile to the 75th percentile (i.e., 44.51 points) by the coefficient on CGQ (i.e., 0.003 in model 2 of Table 5) to obtain a change in CDS of approximately 0.1335, which denotes 3.40% of the mean CDS (i.e., 3.93 reported in Table 1). This

²⁵ Bigger financial institutions may be riskier, because they expect a bailout by regulators in case of failure (Acharya et al, 2016).

Table 4

Corporate governance and distance to default (DD).

Variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)	Model (10)
<i>Corporate governance variables:</i>										
CGQ	−0.004 ***	−0.003 ***	−0.003 *	−0.001	0.014					
	(−4.09)	(−3.21)	(−1.65)	(−0.92)	(1.63)					
CGQ × GFC				−0.003 *						
				(−1.73)						
CGQ × Size					−0.001 **					
					(−2.01)					
BoardQ						−0.090 ***	−0.060 ***	−0.019	−0.022	0.469 ***
						(−4.30)	(−3.01)	(−0.60)	(−0.76)	(2.74)
BoardQ × GFC									−0.070 *	
									(−1.74)	
BoardQ × Size										−0.036 ***
										(−3.11)
<i>Control variables:</i>										
Size	0.149 ***	0.126 ***	−0.469 **	0.127 ***	0.187 ***	0.147 ***	0.125 ***	−0.462 **	0.128 ***	0.231 ***
	(9.35)	(7.51)	(−2.52)	(7.56)	(5.43)	(9.27)	(7.44)	(−2.48)	(7.57)	(6.08)
Return on assets	0.284 ***	0.442 ***	0.266 ***	0.440 ***	0.442 ***	0.283 ***	0.441 ***	0.268 ***	0.439 ***	0.441 ***
	(25.87)	(23.69)	(12.52)	(23.57)	(23.71)	(25.84)	(23.55)	(12.56)	(23.46)	(23.63)
Loans to assets		−0.008 ***	0.0215 ***	−0.008 ***	−0.008 ***		−0.008 ***	0.022 ***	−0.008 ***	−0.008 ***
		(−3.85)	(3.98)	(−3.78)	(−4.03)		(−3.82)	(4.06)	(−3.78)	(−4.13)
Loan growth		−0.002	−0.002	−0.002	−0.002		−0.002	−0.002	−0.002	−0.002
		(−1.40)	(−1.65)	(−1.39)	(−1.43)		(−1.36)	(−1.63)	(−1.33)	(−1.39)
Deposits to assets		1.103 ***	0.460 ***	1.095 ***	1.053 ***		1.097 ***	0.418 ***	1.085 ***	1.040 ***
		(4.81)	(0.76)	(4.78)	(4.57)		(4.78)	(0.69)	(4.73)	(4.53)
Non-interest income		0.0001	0.001	0.000	0.000		0.0001	0.001	0.000	0.000
		(0.48)	(0.71)	(0.50)	(0.38)		(0.44)	(0.77)	(0.49)	(0.32)
Variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)	Model (10)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	No	No	No	No	Yes	No	No
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R ²	50.3%	53.2%	50.6%	53.2%	53.3%	50.3%	53.2%	50.5%	53.2%	53.4%
Observations	2122	1924	1924	1924	1924	2122	1924	1924	1924	1924

The table reports the estimates of ten alternative versions of the following panel regression specification:

$$DD_{i,t} = \alpha + \beta_1 Governance_{i,t} + \beta_2 Size_{i,t} + \beta_3 Returnonassets_{i,t} + \beta_4 Loanstoassets_{i,t} + \beta_5 LoanGrowth_{i,t} + \beta_6 Depositstoassets_{i,t} + \beta_7 Non-interestincome_{i,t} + \sum_{k=1}^{n-1} \alpha_k Firm_i^k + \sum_{y=2006}^{2010} \omega_y Year_i^y + \varepsilon_{i,t}$$

where the dependent variable $DD_{i,t}$ is the Distance to Default measures the difference between the asset value of the financial institution and the face value of its debt, scaled by the standard deviation of the financial institution's asset value. $Governance_{i,t}$ is either CGQ (Corporate Governance Quotient) which measures the strength of the firm's corporate governance mechanisms or $BoardQ$ (Board Quotient) which measures the strength of the board of directors. The control variables are defined as follows: $Size$ is measured as the logarithm of total assets, GFC is the dummy variable for global financial crisis, $Return\ on\ assets$ is the ratio of net income to total assets, $Loans\ to\ assets$ is the ratio of net loans to totals assets, $Loan\ growth$ is the percentage change in loans from year $t-1$ to year t , $Deposits\ to\ assets$ is the ratio of deposits to total assets, and $Non-interest\ income$ is the ratio of non-interest income to total income. $Firm_i^k$ is a dummy variable for firm i and $Year_i^y$ is a dummy variable for fiscal years. The t -statistics (reported in parentheses) are based on robust standard errors, which are adjusted for heteroskedasticity and within-firm clustering. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 5
Corporate governance and credit default swap spread (CDS).

Variables	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)		Model (7)		Model (8)		Model (9)		Model (10)	
<i>Corporate governance variables:</i>																				
CGQ	0.004	***	0.003	***	0.003	*	0.001		−0.013	*										
	(3.78)		(3.02)		(1.69)		(0.83)		(−1.70)											
CGQ × GFC							0.003	*												
							(1.68)													
CGQ × Size									0.001	**										
									(2.06)											
BoardQ											0.077	***	0.051	***	0.019		0.014		−0.427	***
											(4.05)		(2.79)		(0.65)		(0.51)		(−2.71)	
BoardQ × GFC																	0.069	*		
BoardQ × Size																	(1.89)		0.033	***
																			(3.05)	
<i>Control variables:</i>																				
Size	−0.103	***	−0.073	***	0.734	***	−0.0737	***	−0.130	***	−0.102	***	−0.072	***	0.728	***	−0.075	***	−0.168	***
	(−7.14)		(−4.74)		(4.30)		(−4.77)		(−4.11)		(−7.06)		(−4.67)		(4.26)		(−4.81)		(−4.80)	
Return on assets	−0.250	***	−0.483	***	−0.351	***	−0.481	***	−0.483	***	−0.250	***	−0.482	***	−0.353	***	−0.481	***	−0.482	***
	(−25.09)		(−27.87)		(−17.77)		(−27.74)		(−27.89)		(−25.07)		(−27.74)		(−17.79)		(−27.66)		(−27.82)	
Loans to assets			0.009	***	−0.011	**	0.008	***	0.009	***			0.008	***	−0.011	**	0.008	***	0.009	***
			(4.57)		(−2.11)		(4.51)		(4.75)				(4.54)		(−2.20)		(4.49)		(4.84)	
Loan growth			0.001		0.001		0.001		0.001				0.001		0.001		0.001		0.001	
			(0.87)		(0.77)		(0.87)		(0.90)				(0.84)		(0.76)		(0.81)		(0.87)	
Deposits to assets			−1.172	***	−0.245		−1.165	***	−1.126	***			−1.167	***	−0.206		−1.155	***	−1.117	***
			(−5.55)		(−0.43)		(−5.52)		(−5.31)				(−5.53)		(−0.36)		(−5.47)		(−5.29)	
Non-interest income			−0.001		−0.001		−0.001		−0.001				−0.001		−0.001		−0.001		−0.001	
			(−0.98)		(−1.15)		(−0.99)		(−0.87)				(−0.93)		(−1.20)		(−0.97)		(−0.81)	

(continued on next page)

Table 5 (continued)

Variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)	Model (10)
Variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)	Model (10)
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	No	No	No	No	Yes	No	No
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R ²	45.2%	51.6%	45.9%	51.6%	51.6%	45.2%	51.5%	45.8%	51.6%	51.7%
Observations	2122	1924	1924	1924	1924	2122	1924	1924	1924	1924

The table reports the estimates of ten alternative versions of the following panel regression specification:

$$CDS_{i,t} = \alpha + \beta_1 Governance_{i,t} + \beta_2 Size_{i,t} + \beta_3 Returnonassets_{i,t} + \beta_4 Loanstoassets_{i,t} + \beta_5 LoanGrowth_{i,t} + \beta_6 Depositstoassets_{i,t} + \beta_7 Non - interestincome_{i,t} + \sum_{k=1}^{n-1} \alpha_k Firm_i^k + \sum_{y=2006}^{2010} \omega_y Year_i^y + \varepsilon_{i,t}$$

where the dependent variable $CDS_{i,t}$ is the credit default swap spread is the pricing of the financial distress risk (Das et al., 2009). CDS are credit derivatives that allow the transfer of the firm's default risk between two agents for a predetermined time period. $Governance_{i,t}$ is either CGQ (Corporate Governance Quotient) which measures the strength of the firm's corporate governance mechanisms or $BoardQ$ (Board Quotient) which measures the strength of the board of directors. The control variables are defined as follows: $Size$ is measured as the logarithm of total assets, GFC is the dummy variable for global financial crisis, $Return\ on\ assets$ is the ratio of net income to total assets, $Loans\ to\ assets$ is the ratio of net loans to totals assets, $Loan\ growth$ is the percentage change in loans from year $t-1$ to year t , $Deposits\ to\ assets$ is the ratio of deposits to total assets, and $Non-interest\ income$ is the ratio of non-interest income to total income. $Firm_i^k$ is a dummy variable for firm i and $Year_i^y$ is a dummy variable for fiscal years. The t -statistics (reported in parentheses) are based on robust standard errors, which are adjusted for heteroskedasticity and within-firm clustering. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 6

Corporate governance sub-indices and distance to default (DD).

Variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
<i>Corporate governance variables:</i>						
Board	−0.128 *** (−5.00)	−0.089 *** (−3.99)	−0.064 *** (−2.98)	−0.012 (−0.37)	−0.044 (−1.42)	0.388 ** (2.09)
Compensation	−0.038 (−1.56)	−0.006 (−0.28)	0.001 (0.04)	−0.028 (−1.00)	0.087 (2.92)	−0.198 (−1.12)
Audit	−0.010 (−0.46)	−0.001 (−0.06)	0.007 (0.40)	−0.002 (−0.07)	−0.016 (−0.61)	0.293 * (1.76)
Takeover	0.057 (2.26)	0.031 (1.42)	0.033 (1.54)	−0.031 (−0.86)	0.060 (2.06)	0.255 (1.37)
Board × GFC					−0.034 (−0.80)	
Compensation × GFC					−0.163 *** (−3.99)	
Audit × GFC					0.035 (0.98)	
Takeover × GFC					−0.061 (−1.47)	
Board × Size						−0.031 ** (−2.44)
Compensation × Size						0.014 (1.16)
Audit × Size						−0.020 * (−1.73)
Takeover × Size						−0.015 (−1.21)
Variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
<i>Control variables:</i>						
Size	0.137 *** (7.33)	0.144 *** (8.86)	0.121 *** (7.10)	−0.450 ** (−2.39)	0.126 *** (7.36)	0.288 *** (4.15)
Return on assets		0.282 *** (25.69)	0.440 *** (23.49)	0.268 *** (12.54)	0.439 *** (23.50)	0.440 *** (23.53)
Loans to assets			−0.008 *** (−3.75)	0.022 *** (4.05)	−0.008 *** (−3.91)	−0.008 *** (−4.05)
Loan growth			−0.002 (−1.41)	−0.002 (−1.60)	−0.002 (−1.40)	−0.002 (−1.40)
Deposits to assets			1.106 *** (4.80)	0.431 (0.71)	1.127 *** (4.90)	1.066 *** (4.61)
Non-interest income			0.000 (0.44)	0.001 (0.74)	0.000 (0.45)	0.000 (0.43)
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	No	Yes	No	No
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R ²	34.6%	50.3%	53.1%	50.5%	53.6%	53.4%
Observations	2126	2122	1924	1924	1924	1924

The table reports the estimates of six alternative versions of the following panel regression specification:

$$DD_{i,t} = \alpha + \beta_1 Governance_{i,t} + \beta_2 Size_{i,t} + \beta_3 Returnonassets_{i,t} + \beta_4 Loanstoassets_{i,t} + \beta_5 LoanGrowth_{i,t} + \beta_6 Depositstoassets_{i,t} + \beta_7 Non - interestincome_{i,t} +$$

$$\sum_{k=1}^{n-1} \alpha_k Firm_i^k + \sum_{y=2006}^{2010} \omega_y Year_i^y + \varepsilon_{i,t}$$

where the dependent variable $DD_{i,t}$ is the Distance to Default measures the difference between the asset value of the financial institution and the face value of its debt, scaled by the standard deviation of the financial institution's asset value. $Governance_{i,t}$ represents one of the four sub-indices e.g. Board, Compensation, Audit and Takeover. The control variables are defined as follows: *Size* is measured as the logarithm of total assets, *GFC* is the dummy variable for global financial crisis, *Return on assets* is the ratio of net income to total assets, *Loans to assets* is the ratio of net loans to totals assets, *Loan growth* is the percentage change in loans from year $t-1$ to year t , *Deposits to assets* is the ratio of deposits to total assets, and *Non-interest income* is the ratio of non-interest income to total income. $Firm_i^k$ is a dummy variable for firm i and $Year_i^y$ is a dummy variable for fiscal years. The t -statistics (reported in parentheses) are based on robust standard errors, which are adjusted for heteroskedasticity and within-firm clustering. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

suggests that an increase in CGQ from the 25th percentile to the 75th percentile is associated with up to a 3.40% increase in the insolvency risk of financial institutions.

Table 6 reports the estimates of six alternative versions of Eq. (1) with the DD as the dependent variable. However, here $Governance_{i,t}$ represents four sub-indices: board, compensation, audit, and takeover. Model 1 only includes size as a control variable and Model 2 includes only *Size* and *Return on assets* as the control variables for parsimony. Whereas, Models 3 and 4 include a full set of control variables and year fixed-effect and Model 4 also includes firm fixed-effects along with a full set of control variables. Further,

Table 7

Corporate governance sub-indices and credit default swap spread (CDS).

Variables	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
<i>Corporate governance variables:</i>												
Board	0.108	***	0.077	***	0.057	***	0.015		0.035		−0.375	**
	(4.73)		(3.81)		(2.91)		(0.49)		(1.22)		(−2.20)	
Compensation	0.028		−0.000		−0.0061		0.013		−0.087	***	0.138	
	(1.26)		(−0.01)		(−0.32)		(0.52)		(−3.20)		(0.85)	
Audit	0.011		0.003		−0.013		−0.002		0.018		−0.172	
	(0.55)		(0.17)		(−0.77)		(−0.11)		(0.73)		(−1.12)	
Takeover	−0.054	**	−0.031		−0.019		0.054		−0.041		−0.250	
	(−2.35)		(−1.53)		(−1.00)		(1.61)		(−1.55)		(−1.46)	
Board × GFC									0.040			
									(1.03)			
Compensation × GFC									0.152	***		
									(4.07)			
Audit × GFC									−0.047			
									(−1.45)			
Takeover × GFC									0.049			
									(1.29)			
Board × Size											0.030	**
											(2.54)	
Compensation × Size											−0.010	
											(−0.92)	
Audit × Size											0.011	
											(1.06)	
Takeover × Size											0.016	
											(1.37)	
Variables	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
<i>Control variables:</i>												
Size	−0.092	***	−0.099	***	−0.069	***	0.702	**	−0.0729	***	−0.215	***
	(−5.46)		(−6.71)		(−4.39)		(4.08)		(−4.65)		(−3.36)	
Return on assets			−0.249	***	−0.482	***	−0.354	***	−0.481	***	−0.482	***
			(−24.92)		(−27.70)		(−17.81)		(−27.73)		(−27.75)	
Loans to assets					0.008	***	−0.012	***	0.009	***	0.009	***
					(4.50)		(−2.26)		(4.67)		(4.81)	
Loan growth					0.001		0.001		0.001		0.001	
					(0.85)		(0.70)		(0.84)		(0.84)	
Deposits to assets					−1.182	***	−0.201		−1.198	***	−1.139	***
					(−5.57)		(−0.35)		(−5.66)		(−5.35)	
Non-interest income					−0.001		−0.001		−0.001		−0.001	
					(−0.93)		(−1.19)		(−0.92)		(−0.90)	
Constant	Yes		Yes		Yes		Yes		Yes		Yes	
Firm fixed effects	No		No		No		Yes		No		No	
Year fixed effects	Yes		Yes		Yes		Yes		Yes		Yes	
Adjusted R ²	29.1%		45.2%		51.5%		45.8%		52.0%		51.7%	
Observations	2126		2122		1924		1924		1924		1924	

The table reports the estimates of six alternative versions of the following panel regression specification:

$$CDS_{i,t} = \alpha + \beta_1 Governance_{i,t} + \beta_2 Size_{i,t} + \beta_3 Returnonassets_{i,t} + \beta_4 Loanstoassets_{i,t} + \beta_5 LoanGrowth_{i,t} + \beta_6 Depositstoassets_{i,t} + \beta_7 Non - interestincome_{i,t} +$$

$$\sum_{k=1}^{n-1} \alpha_k Firm_i^k + \sum_{y=2006}^{2010} \omega_y Year_i^y + \varepsilon_{i,t}$$

where the dependent variable $CDS_{i,t}$ is the credit default swap spread is the pricing of the financial distress risk (Das et al., 2009). CDS are credit derivatives that allow the transfer of the firm's default risk between two agents for a predetermined time period. $Governance_{i,t}$ represents one of the four sub-indices e.g Board, Compensation, Audit and Takeover. The control variables are defined as follows: *Size* is measured as the logarithm of total assets, *GFC* is the dummy variable for global financial crisis, *Return on assets* is the ratio of net income to total assets, *Loans to assets* is the ratio of net loans to totals assets, *Loan growth* is the percentage change in loans from year $t-1$ to year t , *Deposits to assets* is the ratio of deposits to total assets, and *Non-interest income* is the ratio of non-interest income to total income. $Firm_i^k$ is a dummy variable for firm i and $Year_i^y$ is a dummy variable for fiscal years. The t -statistics (reported in parentheses) are based on robust standard errors, which are adjusted for heteroskedasticity and within-firm clustering. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Model 5 includes interaction variables *Governance Indices* × *GFC* for global financial crisis. Lastly, in Model 6 we include the size interaction variables *Governance Indices* × *Size*. The adjusted R^2 s of all the models are almost 50 percent except Model 1 where the adjusted R^2 s is 34.6 percent. The F -statistics for all the six alternative regressions are statistically significant at the 1 percent level.

Table 6 depicts that the overall board index has a negative and statistically significant coefficient in Models 1–3, suggesting that the presence of a more shareholder-friendly and strong board increases the insolvency risk of financial institutions. This is consistent with the previous literature finding that strong boards in financial institutions are associated with greater levels of risk (Pathan, 2009).

Table 8
Propensity score matching estimator.

Panel A: Pre-match propensity score regression and post-match diagnostic regression				
	Dependent variable: Equals 1 if CGQ is greater than median and 0 otherwise			
	Pre-match		Post-match	
Size	0.007 (0.23)		0.001 (0.03)	
Return on assets	−0.062** (−1.99)		0.027 (0.52)	
Loans to assets	−0.009*** (−2.75)		−0.001 (−0.13)	
Loan growth	−0.002 (−1.25)		−0.004 (−1.11)	
Deposits to assets	0.290 (0.76)		0.008 (0.01)	
Non-interest income	0.001 (0.94)		0.001 (0.30)	
Year fixed effects	Yes		Yes	
Constant	0.560 (0.91)		0.070 (0.06)	
Observations	2131		2082	
Pseudo R2	0.0069		0.0023	
Panel B: Differences in firm characteristics				
Variables	Treated group	Control group	Difference	t-stat
Size	14.455	14.433	0.022	0.30
Return on assets	0.240	0.240	0.000	0.01
Loans to assets	67.204	67.546	−0.342	−0.53
Loan growth	6.351	7.525	−1.174	−1.50
Deposits to assets	0.782	0.784	−0.002	−0.24
Non-interest income	23.885	23.113	0.772	0.59
Panel C: Propensity score matching estimator				
Variables	Firm year obs. with high CGQ	Firm year obs. with low CGQ	Difference	t-stat
DD	1.769	1.942	−0.173*	−1.65
CDS	3.978	3.814	0.164*	1.77
Panel D: Regression analysis based on treatment and control group				
Variables	DD	CDS		
	Model (1)	Model (2)		
CGQ	−0.135*** (−2.72)	0.062** (2.45)		
Size	0.149*** (9.17)	−0.027*** (−3.24)		
Return on assets	0.442*** (24.61)	−0.323*** (−34.78)		
Loans to assets	−0.005*** (−2.75)	0.003*** (3.15)		
Loan growth	−0.004*** (−2.81)	0.001* (1.65)		
Deposits to assets	0.857*** (3.67)	−0.594*** (−5.00)		
Non-interest income	0.001 (1.22)	−0.001*** (−2.94)		
Year fixed effects	Yes	Yes		
Constant	0.143 (0.41)	4.751*** (26.65)		
Observations	2082	2070		
Adjusted R ²	0.541	0.505		
F-Stat	205.036	176.802		

This table reports the results of propensity score matching estimation. Panel A reports the logit regression results. Here the dependent variable is a dummy variable which equals one if CGQ index is greater than the median and zero otherwise. Panel B reports the results of the second diagnostic test in which we examine the difference for each control variable between the treated financial institutions (financial institutions with stronger corporate governance mechanisms) and the matched control financial institutions (financial institutions with CGQ lower than median). Panels C and D report the propensity score matching estimates and the multivariate results using the matched sample. Independent variables are following. *Size* is measured as the logarithm of total assets, *Return on assets* is the ratio of net income to total assets, *Loans to assets* is the ratio of net loans to total assets, *Loan growth* is the percentage change in loans from year $t-1$ to year t , *Deposits to assets* is the ratio of deposits to total assets, and *Non-interest income* is the ratio of non-interest income to total income. Year fixed-effects are included in all regressions. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Model 5 shows that the compensation sub-index has a strong negative coefficient suggesting better alignment of interests increases insolvency risk during the period of the financial crisis. These findings are consistent with the previous literature that executive compensation is an important determinant of the cost of debt (Huang, Huang, & Lee 2019). Lastly, Model 6 shows that larger financial institutions with shareholder-friendly board have more insolvency risk.

Table 7 reports the regression estimates of Eq. (1) with CDS spread as the dependent variable. Regressions in this table are similar to those in Table 6 with estimates of six alternative versions of Eq. (1). Here, also, $Governance_{j,t}$ represents four sub-indices. The adjusted R^2 of all the models vary from 29 percent to almost 52 percent. The F -statistics for all the six alternative regressions are statistically significant at the 1 percent level. The regression estimates reported in this table are comparable to Table 6 where the board index is positive and statistically significant in Models 1–3 showing that more shareholder-friendly and strong boards increase the insolvency risk of financial institutions. Model 5 shows that the compensation sub-index has a strong positive coefficient, suggesting better alignment of interests increases insolvency risk during the period of the financial crisis. Lastly, Model 6 shows that a shareholder-friendly board in a larger financial institution is associated with greater insolvency risk.

In summary, from the regression results reported in Tables 4, 5, 6, and 7, we find that insolvency risk of a financial institution is positively associated with the shareholder-friendliness of that financial institution's corporate governance especially for large financial institutions and during the period of the global financial crisis. Prior literature (e.g., Mehran et al., 2011; Beltratti & Stulz, 2012; de Haan & Vlahu, 2016) highlights that strong, shareholder-friendly governance practices may encourage more risk-taking in the financial industry in order to increase shareholders' wealth. Further, the positive association between shareholder-friendliness of corporate governance mechanisms and CDS spread indicates shareholders expropriation of bondholders' wealth. Although the focus of our paper is on US financial institutions during GFC, prior studies also show the positive impact of corporate governance on insolvency risk for a sample of international banks in the pre GFC (Anginer et al., 2018) and Canadian financial institutions in the post GFC (Switzer et al., 2016). Overall, these pieces of evidences suggest the relevance of our results to the non-US banking and financial sector.

4.4. Endogeneity

The main focus of our study is on the relationship between CGQ and insolvency risk. However, one may still raise concern that corporate governance can, to some extent, be endogenously determined. For instance, a strong preference for risk on the part of a financial institution's shareholders could jointly give rise to both considerable financial institution risk-taking and shareholder-friendly corporate governance (Anginer et al., 2018). This implies that not only may CGQ affect insolvency risk, but also insolvency risk may trigger changes in CGQ simultaneously.

To overcome this endogeneity problem, we have used the propensity score matching method (Pana et al., 2015; Hasan et al., 2020; Kabir et al., 2020) where we match firm-years with CGQ greater than the median (treatment group) with firm-years with CGQ lower than the median (control group). Table 8 reports the propensity score matching estimation results and compares the insolvency risk (measured by DD and CDS spread) of financial institutions in the treatment and control groups. First, we estimated the probability that a financial institution has stronger corporate governance mechanisms (i.e. has CGQ greater than the median). This probability is the propensity score and is the predicted value from a logit regression where the dependent variable is a dummy variable which equals one if CGQ is greater than the median and zero otherwise. The logit regression results are reported in the pre-match column of Panel A of Table 8 and the same control variables are included as in Tables 4 and 5. The regression results suggest that financial institutions with stronger corporate governance mechanisms have a lower loans to total assets ratio and lower performance as measured by return on assets ratio.

For this purpose, each financial institution with a CGQ greater than the median is matched to a financial institution with a CGQ lower than the median by the closest propensity score. We employ matching with replacement and allow for the control firms to be matched to multiple treatment firms. We further require that the difference between the propensity score of treatment and matched firms does not exceed 0.5% in absolute value.

In order to ensure that financial institutions in both groups (treatment and control) are almost similar in terms of observable characteristics, we perform two diagnostic tests. In the first test, we re-estimate the logit regression model for the post-match sample. The results of this regression are reported in the post-match column of Panel A of Table 8. All the regression coefficients are statistically insignificant and smaller than those in the column pre-match, suggesting that both groups are almost similar in terms of observable characteristics. Panel B of Table 8 reports the results of the second diagnostic test in which we examine the difference for each control variable between the treated financial institutions and the matched control financial institutions. Again, we find no significant difference in observable characteristics between the two groups. Thus, these results further confirm the corporate governance insolvency risk relationship.

Lastly, the propensity score matching estimates and the multivariate results using the matched sample are reported in Panel C and Panel D of Table 8, respectively. As it is evident in Panel C of Table 8, we find significant differences in both insolvency risk measures between the treatment and control groups. In detail, we find that DD is lower and CDS spread is higher in the financial institutions with stronger corporate governance mechanisms than the otherwise indistinguishable financial institutions with relatively weaker corporate governance mechanisms). Likewise, the multivariate results reported in Panel D of Table 8 show that financial institutions with stronger corporate governance have a greater insolvency risk. The results from this analysis further assert that stronger corporate governance mechanisms are associated with greater insolvency risk in the financial industry.

Table 9

Corporate governance and insolvency risk.

Variables	DD		CDS		Cost of Debt	
	Model (1)		Model (2)		Model (3)	
Corporate governance index	−0.014 (−1.89)	*	0.091 (1.91)	*	0.171 (1.97)	**
<i>Control variables:</i>						
Size	0.006 (1.92)	*	0.045 (2.10)	**	−0.043 (−1.40)	
Return on assets	0.021 (4.24)	***	−0.132 (−4.02)	***	2.412 (9.63)	***
Loans to assets	0.061 (2.45)	***	−0.449 (−2.72)	***	−0.096 (−9.31)	***
Deposits to assets	0.115 (2.96)	***	−0.771 (−3.03)	***		
Non-interest income	−0.000 (−0.78)		0.002 (1.05)			
Constant	Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes	
Adjusted R ²	0.5358		0.6141		0.1247	
F-Stat	36.02		49.65		22.10	

Here, the dependent variable in model 1 is *DD* (Distance to Default) which measures the difference between the asset value of the financial institution and the face value of its debt, scaled by the standard deviation of the financial institution's asset value, in model 2 is *CDS* (*Credit Default Swap Spread*) which is the pricing of the financial distress risk (Das et al., 2009), and in model 3 is *Cost of debt* which is the weighted average interest rate of the total fixed rate long term debt. *Corporate Governance Index* is Corporate Governance Pillar from Thomson Reuters ESG Scores which measures the shareholder-friendliness of the firm's corporate governance mechanisms. The control variables are defined as follows: *Size* is measured as the logarithm of total assets, *Return on assets* is the ratio of net income to total assets, *Loans to assets* is the ratio of net loans to totals assets, *Deposits to assets* is the ratio of deposits to total assets, and *Non-interest income* is the ratio of non-interest income to total income. The *t*-statistics (reported in parentheses) are based on robust standard errors, which are adjusted for heteroskedasticity and within-firm clustering. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 10

Corporate governance and channels affecting bank risk.

Variables	Tier 1 Capital		Non-performing Loans		Asset Growth	
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
CGQ	−0.008*** (−2.70)	−0.009*** (−3.45)	−0.001 (−0.77)	−0.002 (−1.26)	−0.022* (−1.78)	−0.013 (−1.44)
<i>Control variables:</i>						
Size	−0.496*** (−10.08)	−0.933*** (−19.04)	−0.016 (−0.53)	0.016 (0.48)	0.585*** (3.07)	0.697*** (4.35)
Return on assets	0.967*** (18.01)	0.728*** (14.03)	−1.120*** (−34.27)	−1.114*** (−31.00)	2.102*** (15.61)	1.727*** (9.85)
Loans to assets		−0.105*** (−16.67)		0.009** (2.03)		0.036* (1.91)
Loan growth		−0.002 (−0.35)		−0.009*** (−3.01)		0.372*** (35.01)
Deposits to assets		−12.532*** (−14.50)		1.204** (2.38)		10.845*** (5.05)
Non-interest income		−0.000 (−0.16)		0.002 (1.61)		−0.005 (−0.69)
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R ²	0.204	0.390	0.523	0.532	0.161	0.456
Observations	1892	1748	2211	2069	2185	2131

Here the dependent variables are *Tier 1 Capital* which is the ratio of bank's core equity capital to its risk-weighted assets, *Non-performing loans* which is the ratio of loans that are in default to total loans, and *Asset growth* which is the percentage change in assets from year *t*−1 to year *t*. *CGQ* (Corporate Governance Quotient) measures the strength of the firm's corporate governance mechanisms. The control variables are defined as follows: *Size* is measured as the logarithm of total assets, *Return on assets* is the ratio of net income to total assets, *Loans to assets* is the ratio of net loans to totals assets, *Loan growth* is the percentage change in loans from year *t*−1 to year *t*, *Deposits to assets* is the ratio of deposits to total assets, and *Non-interest income* is the ratio of non-interest income to total income. The *t*-statistics (reported in parentheses) are based on robust standard errors, which are adjusted for heteroskedasticity and within-firm clustering. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

4.5. Additional analysis

In order to check the robustness of our empirical findings, we perform several additional tests. First, we restrict our sample only to deposit-taking financial institutions, that is, financial institutions with a deposit to asset ratio of at least 10%. We then re-estimate all the regression models in [Tables 4 and 5](#). The regression results (not presented here) are similar to our previous results showing that strong corporate governance mechanisms and more shareholder-friendly boards are associated with a higher level of insolvency risk. This suggests that non-depository financial institutions do not drive our main findings.

Second, in order to examine whether our empirical findings are affected by the diversity of financial institutions, we restrict our sample to lending financial institutions and commercial banks, that is, financial institutions with a loans to asset ratio of at least 30%. We re-estimated all the regression models in [Tables 4 and 5](#) with this restricted sample. The regression results (not presented here) provide support to our main findings that financial institutions with strong corporate governance mechanisms are associated with a higher level of insolvency risk.

Third, we also examine the potential effect of the size of the financial institution on our results. For this purpose, we divided our sample into two subsamples where we either exclude the smallest 10 percent or the largest 10 percent of financial institutions from the main sample. The re-estimated regression results (not presented here) for the subsample without the smallest 10 percent of financial institutions are quite similar to our main results reported in [Tables 4 and 5](#), that is, stronger and shareholder-friendly governance provisions may be detrimental for the survival of the financial institutions during the period of crisis. However, the coefficient estimates for governance (not tabulated) for the subsample where we exclude the largest 10 percent of financial institutions mostly become insignificant although positively related to insolvency risk. These findings provide some evidence that, to some extent, larger financial institutions might be driving our results.

Fourth, we excluded the observations from the year 2008 (the year of the global financial crisis) to preclude the concern of extreme observations. We then re-estimated most of the regression models in [Tables 4 and 5](#) based on this sample. We observe, based on empirical results (not presented here), that our findings that stronger corporate governance mechanisms are associated with a higher level of insolvency risk in financial institutions do not change even when we exclude the extreme observations from 2008.

Fifth, since we utilize CDS spread as a measure for insolvency risk, therefore we also include the cost of debt among control variables.²⁶ We re-estimated most of the regression models in [Tables 4 and 5](#) by adding the cost of debt among control variables. Our results (not presented here) are qualitatively similar to our main findings that stronger corporate governance mechanisms are associated with a higher level of insolvency risk in financial institutions. However, the regression coefficients for CGQ become insignificant when we include firm fixed effects. Consistent with previous literature ([Borisova et al., 2015](#)), we find that a higher cost of debt is associated with a higher level of insolvency risk.

Sixth, following [Das et al. \(2009\)](#), we include volatility of equity returns among control variables and re-estimated most of the regression models in [Tables 4 and 5](#). Our results (not presented here) are qualitatively similar to our main findings that stronger corporate governance mechanisms are associated with a higher level of insolvency risk in financial institutions. The regression coefficients for CGQ are positive and statistically significant. Furthermore, the volatility of equity returns is positively associated with insolvency risk, which is consistent with the findings of [Das et al. \(2009\)](#).

Seventh, to make sure that the governance and insolvency risk relationship is not driven by sample period biasness, we collected alternative additional governance data from other sources (e.g. Eikon database). We collected the corporate governance pillar data from Thomson Reuters ESG (Environment, Social and Governance) Scores available from the Eikon database for the period of 2002–2018. This corporate governance pillar, although not comparable with CGQ data from ISS in index calculation, refers to the set of mechanisms that strengthen the corporate governance of a firm. Corporate governance pillar is composed of two scores namely; management score and shareholder score. The management score is the measurement of a company's commitment to and effectiveness in following best practice corporate governance principles. The shareholders score measures a company's effectiveness in the equal treatment of shareholders and the use of anti-takeover mechanisms. In the additional analyses, we substitute the CGQ index with the corporate governance pillar of ESG score and re-estimated most of the regression models in [Tables 4 and 5](#). These results are reported in [Table 9](#). Our results show that stronger corporate governance mechanisms are associated with a higher level of insolvency risk in financial institutions. These results show that the small sample period does not drive our results. Further, we also investigate whether shareholder-friendliness of corporate governance mechanisms is related to the cost of debt financing. The results are reported in Model 3 of [Table 9](#). Consistent with previous literature ([Klock, Mansi, & Maxwell, 2005](#); [Li & Wang, 2016](#); [Kang & Xu, 2019](#)), we find that shareholder-friendliness of corporate governance mechanisms is related to a higher cost of debt. These results imply that shareholder-friendliness of corporate governance mechanisms may result in the expropriation of debtholders wealth by shareholders. Thus, debtholders require a higher return on debt from financial institutions with shareholder-friendly governance mechanisms.

Eighth, we examine whether shareholder-friendliness of corporate governance mechanisms is associated with tier 1 capital ratio, non-performing loans and asset growth to explore the channels through which corporate governance can affect the riskiness of the financial institutions. The results for these analyses are reported in [Table 10](#). Models 2, 4, and 6 include full set of control variables. The regression results show that corporate governance index is negatively and significantly related to Tier 1 capital (in Models 1 and 2) ratio providing support to our main results that shareholder-friendliness of corporate governance mechanisms is positively related to the insolvency risk of financial institutions by reducing bank capitalization. These findings provide support to our main results that

²⁶ "Debt capital can come from private sources (e.g., banks) or from public sources (the debt markets). In either case, the cost of debt is the applicable interest rate" ([Sharfman & Fernando, 2008](#)).

shareholder-friendliness of corporate governance mechanisms is positively related to the insolvency risk of financial institutions. We do not find significant association of corporate governance index with non-performing loans and asset growth (in Models 4 and 6).

Ninth, we use additional insolvency risk measure based on the probability of default model developed by [Duan Sun, and Wang \(2012\)](#) for the robustness of our results.²⁷ We re-estimated the regression models with the probability of default as a dependent variable. These additional analyses (reported in [online appendix Table OA1](#)) show that the friendly shareholder governance mechanisms increase the probability of default, confirming our main findings that strong corporate governance mechanisms are associated with higher insolvency risk of financial institutions.

Tenth, we control for systemically important financial institutions and bank holding companies in our sample. We perform these analyses to preclude the possibility that these large bank holding companies and systemically important financial institutions drive our main results. We re-estimate the regression models by additionally controlling two dummy variables that equal to 1 if a financial institution is systemically important or bank holding company and zero otherwise. These additional analyses (reported in [online appendix Table OA2](#) for DD and [Table OA3](#) for CDS) show that the controlling for both systemically important financial institutions and bank holding companies do not change our main findings.

Finally, we excluded troubled financial institutions from our sample, that is, those with a return on assets ratio of less than 2%.²⁸ We did so to examine the effect of the financial crisis on our findings. We re-estimated the regression based on this sample. The additional analysis (not tabulated) reveals that the exclusion of these extreme observations does not have much impact on our main findings. Overall, the additional analysis provides strong evidence that in financial institutions stronger and more shareholder-friendly governance mechanisms can lead to a higher level of insolvency risk.

5. Conclusions

Given the high-profile failures of financial institutions (e.g., Lehman Brothers) during the global financial crisis, investors and regulators are somewhat skeptical of financial market participants. The financial crisis is arguably related to the unethical behavior of corporate executives and failures of corporate governance to curtail increased risk-taking in financial institutions. Furthermore, friendly shareholder corporate governance mechanisms may not be favorable for bondholders. Therefore, in this study, we investigate whether shareholder-friendliness of corporate governance mechanisms is associated with insolvency risk of financial institutions by using bondholder-facing risk measures. The focus of our study is to examine the relationship between CGQ and insolvency risk and not the casual effect of CGQ on insolvency risk. In particular, our study contributes to the ongoing debate on the risk taking implications of shareholder-friendly corporate governance and provides what is to the best of our knowledge the first comprehensive and robust evidence on the relationship between corporate governance and insolvency risk of financial institutions around the global financial crisis. Further, our study also provides evidence that shareholder-friendliness of corporate governance mechanisms are related to a negative credit market reaction.

Based on the sample of 556 US financial institutions over the period from 2005 to 2010 and using two measures of insolvency risk, namely market-based DD and innovative CDS spread, our results suggest that more shareholder-friendly corporate governance is related to increased insolvency risk of the financial institutions and a negative credit market reaction. This empirical relationship is robust against the inclusion of firm specific characteristics, year and firm fixed effects, alternative sample specifications (e.g., excluding troubled financial institutions) and alternative proxies for both strength of corporate governance mechanisms and insolvency risk. Overall, our findings on the positive association between corporate governance and insolvency risk are consistent with the earlier research, on financial institutions and banks, showing that the shareholder-friendly corporate governance encourages corporate executives to take on more risk, which might ultimately lead to increased insolvency risk and might be unfavorable for bondholders.

CRedit authorship contribution statement

Searat Ali: Conceptualization, Formal analysis, Methodology, Project administration, Writing - original draft, Writing - review & editing. **Nazim Hussain:** Data curation, Writing - review & editing. **Jamshed Iqbal:** Conceptualization, Data curation, Funding acquisition, Methodology, Resources, Writing - original draft, Writing - review & editing.

Appendix A. General procedure to calculate distance to default (DD)

The [Merton \(1974\)](#) model views the firm's equity value as a European call option on the firm's assets, with a strike price equal to the face value of the firm's liabilities. This is because of the shareholders' limited liability and their residual claim on the firm's assets. If the firm's value exceeds the level of liabilities (strike price) at the time of maturity, when the value of the equity is positive, shareholders exercise their option and the firm survives. If the firm's value falls below the level of liabilities (strike price) at the time of maturity, when the value of equity becomes zero, the model assumes shareholders do not exercise their option and the firm defaults.

²⁷ [Duan et al. \(2012\)](#) propose forward looking probability of default model to predict corporate defaults. See [Duan et al. \(2012\)](#) for details on methodology. We collect the probability of default data from CRI (NUS) website.

²⁸ We further analyze these excluded troubled financial institutions separately. The results reported in [online appendix Table OA4](#) for DD and [Table OA5](#) for CDS are qualitatively similar to our main findings i.e. stronger corporate governance mechanisms increase insolvency risk among troubled financial institutions.

Thus, the larger the positive distance between firm value and firm liabilities, the lower is the probability of financial distress.

Value of firm (V_A) = value of equity (V_e) + Value of debt (X)

Value of equity (V_e) = Value of firm (V_A) – Value of debt (X)

Value of firm (V_A) > Value of debt (X) → Value of equity (V_e) is positive (firm survives)

Value of firm (V_A) < Value of debt (X) → Value of equity (V_e) is zero (firm defaults)

The Merton (1974) model has two important assumptions for the calculation of DD. First, it assumes that the value of the firm follows the geometric Brownian motion that is expressed as follows:

$$dV_A = \mu V_A dt + \sigma_A V_A dW \quad (A1)$$

where V_A denotes the value of firm's assets, μ represents expected continuously compounded returns on the firm's assets, σ_A indicates instantaneous volatility of the firm's assets, and dW is a standard Wiener process.

Second, the model assumes that the firm has only two securities outstanding; namely, common stock and a zero coupon bond maturing at time (T).

Based on these two assumptions, the equity of the firm can be viewed as a call option on the value of the firm's assets, with a strike price equal to face value of the debt maturing at time T . Therefore, the market value of equity as a function of the total value of the firm's assets can be expressed by using Black and Scholes' (1973) formula for call options:

$$V_e = V_A N(d_1) - X e^{-rT} N(d_2) \quad (A2)$$

where V_e is the market value of the firm's equity, X is the face value of the debt, r is the risk-free rate, T is the time horizon for the maturity of debt, N symbolizes the function of the cumulative standard normal distribution, and d_1 and d_2 are given by the following formulas:

$$d_1 = \frac{\ln\left(\frac{V_A}{X}\right) + \left(r + \frac{1}{2}\sigma_A^2\right)T}{\sigma_A \sqrt{T}}, d_2 = d_1 - \sigma_A \sqrt{T} \quad (A3)$$

In Eq. (A.2), V_e , X , r , and T are readily observable and known factors, whereas V_A and σ_A are difficult to observe and are unknown factors. This means there are two unknowns in one equation, so a unique solution to Eq. (A.2) is not available. Thus, another equation involving one of the two unknown factors is required.

As in the Merton (1974) model, it is assumed that the value of the firm's equity is a function of the value of its assets and time, so the second equation that relates the volatility of the firm's equity to the volatility of the firm's assets can be written as:

$$\sigma_e = \left(\frac{V_A}{V_e}\right) \frac{\partial V_e}{\partial V_A} \sigma_A \quad (A4)$$

According to the Black-Scholes-Merton model, the term $\frac{\partial V_e}{\partial V_A}$ in Eq. (A4) is equal to $N(d_1)$, and can be rewritten as follows:

$$\sigma_e = \left(\frac{V_A}{V_e}\right) N(d_1) \sigma_A \quad (A5)$$

Now, Eq. (A.2) and (A.5) can be solved simultaneously for the values of V_A and σ_A , and DD can be calculated by using the following equation:

$$DD = \frac{\ln\left(\frac{V_A}{X}\right) + \left(\mu - \frac{1}{2}\sigma_A^2\right)T}{\sigma_A \sqrt{T}} \quad (A6)$$

The probability of default (PD) is calculated as follows:

$$PD = N(-DD) \quad (A7)$$

In a nutshell, for the calculation of DD, the following steps are required:

- 1) Estimating the volatility of the firm's equity (σ_e) through historical stock price data or option-implied volatility data. Historical stock price data to estimate the volatility of the firm's equity is easily available. Following the Hull (2009) methodology, equity volatility can be calculated as:

$$R_i = \ln(pr_i - pr_{i-1}) \quad (A8)$$

where R_i is the daily stock returns, $\ln$ is the natural logarithm, pr_i is the stock price at the end of the day and pr_{i-1} is the stock price at the end of the previous day: $i = 1, 2, 3 \dots n$.

Annualized volatility is then estimated as:

$$\sigma_e = \frac{1}{\sqrt{\frac{1}{n}}} \sqrt{\frac{1}{n-1} \sum_{i=1}^n R_i^2} - \frac{1}{n(n-1)} \left(\sum_{i=1}^n R_i \right)^2 \quad (\text{A9})$$

where n denotes the number of observations in one year i.e., number of trading days.

- 2) Selecting the forecasting horizon (T). Generally, the forecast horizon is one year ($T = 1$).
- 3) Measuring the face value of the debt (X). Generally, current liabilities plus half of the non-current liabilities are used to proxy the face value of debt, as also advised by Moody's KMV.
- 4) Collecting the risk-free rate (r). 3-month bank accepted bill or T-bills can be used to proxy risk-free rate.
- 5) Measuring the market value of equity (V_e). It is calculated as the number of outstanding shares multiplied by market price per share.

Solving Eq. (A.2) and (A.5) simultaneously for the values of (V_A) and (σ_e), and then calculate the DD using Eq. (A.6) and PD using Eq. (A.7).

Appendix B. Variable definitions and data Sources.

Variable name (notations)	Definition	Data source
<i>Insolvency risk variables</i>		
Distance to default (DD)	Annual average of distance to default based on stock based on stock price variability	Risk Management Institute
Credit Default Swap Spread (CDS)	Credit derivatives that allow the transfer of the firm's default risk between two agents for a predetermined time period	Risk Management Institute
<i>Corporate governance variables</i>		
Corporate governance quotient (CGQ)	Overall corporate governance index	ISS
Board (BoardQ)	Corporate governance index based on board characteristics	ISS
Compensation and ownership	Corporate governance index based on compensation and ownership characteristics	ISS
Audit	Corporate governance index based on auditing characteristics	ISS
Takeover	Corporate governance index based on takeover characteristics	ISS
<i>Bank control variables</i>		
Size	Natural logarithm of total assets	BankScope
Return on assets	Ratio of net income to total assets	BankScope
Loan growth	Percentage change in the amount of outstanding loans	BankScope
Loans to total assets	Ratio of net loans to total assets	BankScope
Non-interest income	Ratio of non-interest income to total income	BankScope
Deposit to assets	Ratio of deposits to total assets	BankScope

Supplementary data

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.najef.2020.101311>.

References

- Acharya, V., Anginer, D., & Warburton, A. J. (2016). The End of Market Discipline? Investor Expectations of Implicit Government Guarantees, Working paper.
- Adams, R. (2012). Governance and the financial crisis. *International Review of Finance*, 12(1), 7–38.
- Adams, R., & Mehran, H. (2012). Bank board structure and performance: Evidence for large bank holding companies. *Journal of Financial Intermediation*, 21, 243–267.
- Adams, R. B., Hermalin, B. E., & Weisbach, M. S. (2010). The role of boards of directors in corporate governance: A conceptual framework and survey. *Journal of Economic Literature*, 48(1), 58–107.
- Agarwal, V., & Taffler, R. (2008). Comparing the performance of market-based and accounting-based bankruptcy prediction models. *Journal of Banking and Finance*, 32(8), 1541–1551.
- Ali, S., Liu, B., & Su, J. J. (2018). Does corporate governance quality affect default risk? The role of growth opportunities and stock liquidity. *International Review of Economics & Finance*, 58, 422–448.
- Ammann, M., Oesch, D., & Schmid, M. (2011). Corporate governance and firm value: International evidence. *Journal of Empirical Finance*, 18, 36–55.
- Anginer, D., Demircuc-Kunt, A., Huizinga, H., & Zhu, M. (2018). Corporate governance and bank insolvency risk international evidence. *Journal of Financial Economics*, 130(2), 327–346.
- Baek, J. S., Kang, J. K., & Park, K. S. (2004). Corporate governance and firm value: Evidence from the Korean financial crisis. *Journal of Financial economics*, 71(2), 265–313.
- Bai, G., & Elyasiani, E. (2013). Bank stability and managerial compensation. *Journal of Banking and Finance*, 37(3), 799–813.
- Baselga-Pascual, L., Trujillo-Ponce, A., & Cardone-Riportella, C. (2015). Factors influencing bank risk in Europe: Evidence from the financial crisis. *North American Journal of Economics and Finance*, 34, 138–166.
- Beaver, W. H. (1966). Financial ratios as predictors of failure. *Journal of Accounting Research*, 4, 71–111.

- Beaver, W. H., McNichols, M. F., & Rhie, J.-W. (2005). Have financial statements become less informative? Evidence from the ability of financial ratios to predict bankruptcy. *Review of Accounting Studies*, 10(1), 93–122.
- Beltratti, A., & Stulz, R. M. (2012). The credit crisis around the globe: Why did some banks perform better? *Journal of Financial Economics*, 105(1), 1–17.
- Berger, A. N., Kick, T., & Schaeck, K. (2014). Executive board composition and bank risk taking. *Journal of Corporate Finance*, 28, 48–65.
- Bharath, S. T., & Shumway, T. (2008). Forecasting default with the merton distance to default model. *Review of Financial Studies*, 21(3), 1339–1369.
- Black, F., & Scholes, M. (1973). The pricing of options and corporate liabilities. *The Journal of Political Economy*, 81(3), 637–654.
- Blanco, R., Brennan, S., & Marsh, I. W. (2005). An empirical analysis of the dynamic relation between investment-grade bonds and credit default swaps. *The Journal of Finance*, 5, 2255–2281.
- Bolton, P., Mehran, H., & Shapiro, J. (2015). Executive compensation and risk taking. *Review of Finance*, 19(6), 2139–2181.
- Borisova, G., Fotak, V., Holland, K., & Megginson, W. L. (2015). Government ownership and the cost of debt: Evidence from government investments in publicly traded firms. *Journal of Financial Economics*, 118(1), 168–191.
- Brown, L. D., & Caylor, M. L. (2009). Corporate governance and firm operating performance. *Review of Quantitative Finance and Accounting*, 32, 129–144.
- Campbell, J., Hilscher, J., & Szilagyi, J. (2008). In search of distress risk. *The Journal of Finance*, 63, 2899–2939.
- Charitou, A., Dionysiou, D., Lambertides, N., & Trigeorgis, L. (2013). Alternative bankruptcy prediction models using option-pricing theory. *Journal of Banking and Finance*, 37(7), 2329–2341.
- Chava, S., & Purnanandam, A. (2010). CEOs versus CFOs: Incentives and corporate policies. *Journal of Financial Economics*, 97, 263–278.
- Chen, C. R., Steiner, T. L., & Whyte, A. M. (2006). Does stock option-based executive compensation induce risk-taking? An analysis of the banking industry. *Journal of Banking & Finance*, 30(3), 915–945.
- Chhaochharia, V., & Laeven, L. (2009). Corporate governance norms and practices. *Journal of Financial Intermediation*, 18(3), 405–431.
- Chiang, S. M., Chung, H., & Huang, C. M. (2015). A note on board characteristics, ownership structure and default risk in Taiwan. *Accounting and Finance*, 55, 57–74.
- Colonnello, S. (2017). Internal Governance and Creditor Governance: Evidence from Credit Default Swaps, IWH Discussion Papers, No. 6/2017.
- Das, S. R., Hanouna, P., & Sarin, A. (2009). Accounting-based versus market-based cross-sectional models of CDS spreads. *Journal of Banking and Finance*, 33(4), 719–730.
- de Haan, J., & Vlahu, R. (2016). Corporate governance of banks: A survey. *Journal of Economic Surveys*, 30(2), 228–277.
- Demsetz, R. S., Saidenberg, M. R., & Strahan, P. E. (1997). Agency problems and risk taking at banks. FRB of New York Staff Report, (29).
- Duan, J. C. (2014). Actuarial par spread and empirical pricing of CDS by decomposition. *Global Credit Review*, 4, 51–65.
- Duan, J. C., Sun, J., & Wang, T. (2012). Multiperiod corporate default prediction – A forward intensity approach. *Journal of Econometrics*, 170(1), 191–209.
- Duan, J. C., & Wang, T. (2012). Measuring distance-to-default for financial and non-financial firms. *Global Credit Review*, 2, 95–108.
- Ellul, A., & Yerramilli, V. (2013). Stronger risk controls, lower risk: Evidence from U.S. bank holding companies. *The Journal of Finance*, 68, 1757–1803.
- Erkens, D. H., Hunga, M., & Matos, P. (2012). Corporate governance in the 2007–2008 financial crisis: Evidence from financial institutions worldwide. *Journal of Corporate Finance*, 18, 389–411.
- Ertugrul, M., & Hegde, S. (2009). Corporate governance ratings and firm performance. *Financial Management*, 38(1), 139–160.
- Fahlenbrach, R., & Stulz, R. (2011). Bank CEO incentives and the credit crisis. *Journal of Financial Economics*, 99, 11–26.
- Feldhutter, P., Hotchkiss, E., & Karakas, O. (2016). The value of creditor control in corporate bonds. *Journal of Financial Economics*, 121, 1–27.
- Gompers, P., Ishii, J., & Metrick, A. (2003). Corporate governance and equity prices. *Quarterly Journal of Economics*, 118, 107–155.
- Hasan, M. M., Cheung, A., & Taylor, G. (2020). Financial statement comparability and bank risk-taking. *Journal of Contemporary Accounting & Economics*, 16(3), Article 100206.
- Hillegeist, S. A., Keating, E. K., Cram, D. P., & Lundstedt, K. G. (2004). Assessing the probability of bankruptcy. *Review of Accounting Studies*, 9(1), 5–34.
- Hilscher, J., & Şişli-Ciamarra, E. (2013). Conflicts of interest on corporate boards: The effect of creditor-directors on acquisitions. *Journal of Corporate Finance*, 19, 140–158.
- Huang, G.-Y., Huang, H. H., & Lee, C. I. (2019). Is CEO pay disparity relevant to seasoned bondholders? *International Review of Economics & Finance*, 64, 271–289. <https://doi.org/10.1016/j.iref.2019.05.014>
- Hubbard, R. G., & Palia, D. (1995). Executive pay and performance evidence from the US banking industry. *Journal of financial economics*, 39(1), 105–130.
- Hull, J. (2009). *Options, futures, and other derivatives*. Pearson education.
- Iqbal, J., & Vähämaa, S. (2019). Managerial Risk-Taking Incentives and the Systemic Risk of Financial Institutions. *Review of Quantitative Finance and Accounting*, 53, 1229–1258.
- Iqbal, J., Strobl, S., & Vähämaa, S. (2015). Corporate governance and the systemic risk of financial institutions. *Journal of Economics and Business*, 82, 42–61.
- Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, 3(4), 305–360.
- Jiraporn, P., Kim, J.-C., Kim, Y. S., & Kitsabunnarat, P. (2012). Capital structure and corporate governance quality: Evidence from the Institutional Shareholder Services (ISS). *International Review of Economics & Finance*, 22(1), 208–221. <https://doi.org/10.1016/j.iref.2011.10.014>
- John, K., Litov, L., & Yeung, B. (2008). Corporate Governance and Risk-taking. *The Journal of Finance*, 63(4), 1679–1728.
- Kabir, M. N., Miah, M. D., Sharma, P., & Ali, S. (2020). Institutional and foreign ownership vis-à-vis default risk: Evidence from Japanese firms. *International Review of Economics and Finance*, 69, 469–493.
- Kang, J.-K., & L. XU. (2019). Executive stock ownership guidelines and debtholder wealth. *The Accounting Review*, 94(2), 267–295.
- Klock, M., Mansi, S., & Maxwell, W. (2005). Does Corporate Governance Matter to Bondholders? *The Journal of Financial and Quantitative Analysis*, 40(4), 693–719.
- Kosmidou, K., Kousenidis, D., Ladas, A., & Negkakis, C. (2017). Determinants of risk in the banking sector during the European Financial Crisis. *Journal of Financial Stability*, 33, 285–296.
- Laeven, L., & Levine, R. (2009). Bank governance, regulation and risk taking. *Journal of Financial Economics*, 93(2), 259–275.
- LaFond, R., & Roychowdhury, S. (2008). Managerial ownership and accounting conservatism. *Journal of Accounting Research*, 46(1), 101–135.
- Li, H., & Wang, Y. (2016). How do Corporate Governance Decisions Affect Bondholders? *The Quarterly Journal of Finance*, 6(3).
- Mayordomo, S., Rodríguez-Moreno, M., & Peña, J. I. (2014). Derivatives holdings and systemic risk in the U.S. banking sector. *Journal of Banking and Finance*, 45, 84–104.
- Mehran, H., Morrison, A., & Shapiro, J. (2011). *Corporate governance and banks: What have we learned from the financial crisis?* Federal Reserve Bank of New York: Staff report.
- Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. *The Journal of Finance*, 29(2), 449–470.
- Mourouzeidou-Damtsa, S., Milidonis, A., & Stathopoulos, K. (2019). National culture and bank risk-taking. *Journal of Financial Stability*, 40, 132–143.
- Norden, L., & Weber, M. (2009). The co-movement of credit default swap, bond and stock markets: An empirical analysis. *European Financial Management*, 15, 529–562.
- Pana, E., Vitthum, S., & Willis, D. (2015). The impact of internet-based services on credit unions: A propensity score matching approach. *Review of Quantitative Finance and Accounting*, 44(2), 329–352.
- Pathan, S. (2009). Strong boards, CEO power and bank risk-taking. *Journal of Banking and Finance*, 33(7), 1340–1350.
- Peni, E., & Vähämaa, S. (2012). Did Good Corporate Governance Improve Bank Performance during the Financial Crisis? *Journal of Financial Services Research*, 41, 19–35.
- Peni, E., Smith, S. D., & Vahamaa, S. (2013). Bank corporate governance and real estate lending during the financial crisis. *Journal of Real Estate Research*, 35(3), 313–343.
- Schultz, E. L., Tan, D. T., & Walsh, K. D. (2017). Corporate governance and the probability of default. *Accounting and Finance*, 57, 235–353.
- Sharfman, M. P., & Fernando, C. S. (2008). Environmental risk management and the cost of capital. *Strategic Management Journal*, 29, 569–592.
- Shleifer, A., & Vishny, R. W. (1997). A survey of corporate governance. *The Journal of Finance*, 52(2), 737–783.

- Switzer, L. N., & Wang, J. (2013). Default risk estimation, bank credit risk, and corporate governance. *Financial Markets, Institutions & Instruments*, 22, 91–112.
- Switzer, L. N., Wang, J., & Zhang, Y. (2016). Effect of corporate governance on default risk in financial versus nonfinancial firms: Canadian evidence. *Canadian Journal of Administrative Sciences*. <https://doi.org/10.1002/cjas.1423>
- Tang, D. Y., & Yan, H. (2010). Market conditions, default risk and credit spreads. *Journal of Banking and Finance*, 34(4), 743–753.
- Tosi, H. L., Jr, & Gomez-Mejia, L. R. (1994). CEO compensation monitoring and firm performance. *Academy of Management journal*, 37(4), 1002–1016.
- Zhao, L. (2018). Market-based estimates of implicit government guarantees in European financial institutions. *European Financial Management*, 24, 79–112.