

The Influence of Board of Directors' Risk Oversight on Risk Management Maturity  
and Firm Risk-Taking

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Abstract

The Board of Directors' role in risk oversight has come under increased scrutiny, resulting in shareholder lawsuits, increased regulation, and more extensive disclosure and listing requirements. While theory predicts that Board risk oversight can benefit stakeholders by mitigating risk-related agency conflicts, critics argue that changes in Board practices in response to external pressure may simply be window-dressing. Using both archival and survey data on corporate risk management processes, we examine the influence of Board risk oversight responsibilities and practices on the maturity of the firm's risk management processes and risk-taking. We find the location of Board risk oversight responsibilities to be a major determinant of Board risk oversight practices, with greater oversight in firms that formally assign responsibilities to the Board as a whole as well as its committees. Supporting the view that risk oversight is conducted for economic reasons, the quality of Board oversight practices has a direct positive relation with the maturity of risk management processes, as well as a significant indirect influence on future stock return volatility and tail risk through the enhanced risk management maturity.

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## 1. Introduction

A variety of external events, including numerous inquiries into the causes of the financial crisis, changes in regulations and listing rules, and more stringent interpretations of directors' fiduciary responsibilities have fostered rising expectations for Boards of Directors to exert greater oversight of their organizations' risk management processes (Tonello, 2007; Simkins and Ramirez, 2008; Adams 2012; Gupta and Leech, 2014). The primary impetus behind these external pressures is agency-based beliefs that stronger Board oversight over risk management strategies and activities will lead to substantive improvements in risk management and more informed risk-taking. Many observers, however, argue that Board members often lack the time, skills, and information necessary for effective risk oversight (Ingley & van der Walt 2008; National Association of Corporate Directors, 2013), and contend that the adoption of governance practices that are advocated or mandated by external parties is often window-dressing (Menon & Williams, 1994; Westphal & Graebner, 2010). As a result, symbolic theories of corporate governance suggest that the externally-focused adoption of Board risk oversight will have little effect on the firm's risk management practices or risk-taking.

We examine these conflicting predictions using survey data on the Board risk oversight and organization-wide risk management practices of 297 publicly-traded firms headquartered in 28 countries. Combining these survey responses with publicly-available archival data, we investigate the risk management and risk-taking implications of two Board-level attributes that are prominently featured in Board risk oversight codes, rules, and regulations: (1) the formal definition and location of Board oversight roles and responsibilities, and (2) the risk oversight practices adopted by the Board to (in conjunction with top management) assess, monitor, and

communicate the organization's key risks, risk management strategies and activities, and emerging risk profile.<sup>1</sup>

We first examine the influence of Board risk oversight roles and responsibilities on Board oversight practices. The issue has been a particularly contentious topic in the corporate governance literature: while some risk oversight advocates call for risk responsibilities to reside with the entire Board, others demand Board audit committee oversight of risk management processes, and a third group prefers firms to assign risk oversight responsibilities to a stand-alone Board risk committee. Consistent with calls for formal assignment of oversight responsibilities, we find the lowest Board involvement in risk oversight when firms have not formally defined Board oversight roles and responsibilities. Risk oversight involvement is significantly greater when responsibilities are defined in Board committee charters than when no responsibilities are assigned. However, delegating all Board oversight responsibilities to one or more committees is associated with lower Board oversight involvement than assigning risk oversight responsibilities to the Board as a whole. The highest level of Board risk oversight involvement is observed when responsibilities are defined at *both* the Board and committee levels. We find no evidence that the presence of a dedicated risk committee influences the extent of Board involvement in risk oversight.

Consistent with Board risk oversight playing a substantive role in the development of risk management processes, we find positive associations between the extent of Board risk oversight involvement and the maturity of the firm's risk management processes. Furthermore, we find firms which fail to formally assign responsibilities for Board risk oversight have lower risk management maturity. However, conditional on formal assignment, the specific location of risk oversight responsibilities has no significant direct relation with the maturity of the risk

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<sup>1</sup> In the following, we will use the two terms Board risk oversight practices and Board risk oversight involvement interchangeably.

management process. Instead, the influence of oversight location on risk maturity is indirect through its significant impact on Board oversight involvement. We observe the strongest indirect effects when both the whole Board and one or more of its committees are assigned oversight responsibilities. Neither the presence of a dedicated risk committee nor a New York Stock Exchange listing (which requires the Board audit committee to review risk management activities) are significantly associated with risk management maturity.

Finally, we examine the effects of Board risk oversight practices and risk management maturity on three risk proxies: stock price volatility, idiosyncratic volatility, and tail risk. We find risk management maturity negatively related to firm risk, but no evidence that Board risk oversight has a direct effect on these risk measures. Rather, risk oversight involvement has a significant negative indirect effect on volatility and tail risk through its influence on risk management maturity. The lower volatility and tail risks do not come at the expense of firm performance, with Board oversight involvement and risk management maturity positively associated with buy-and-hold trading returns in the year following survey completion.

Our results are consistent with Board risk oversight, on average, having a substantive impact on the development of risk management practices and firm risk-taking. Moreover, the above findings, in conjunction with tests designed to mitigate endogeneity concerns, suggest a process in which broader and higher-level definition and assignment of risk oversight roles and responsibilities leads to greater Board involvement in understanding and overseeing risks and risk management activities. Greater Board involvement in risk oversight, in turn, promotes the development of more mature risk management processes, leading to decisions that reduce volatility and improve stock market performance in future periods.

Our study makes two primary contributions. First, we extend prior research on the determinants of risk management maturity by taking a closer look at the effects of Board risk

oversight practices. In doing so, we provide support for claims that the Board of Directors provides the foundation for effective ERM systems by setting the “tone at the top” and establishing the oversight needed to ensure that the process is embedded in the organization’s ongoing activities (COSO, 2004; Caldwell, 2012).

Second, we respond to calls for researchers to get into the “black box” of corporate governance in an effort to better understand how Board practices effect organizational outcomes (Adams et al., 2010). Prior research has focused on the relations between Board composition (such as percentage of outside directors and Board financial expertise) and the adoption of risk management procedures (e.g., Beasley et al., 2005; Baxter et al., 2013) or risk-taking (e.g., Pathan, 2009; Minton et al., 2014). Our access to detailed information on different Board risk oversight attributes allows us to extend this literature by providing insight into the processes by which Boards carry out their risk oversight responsibilities. In particular, our results indicate that Board oversight practices provide incremental ability to explain risk management maturity (and indirectly firm risk-taking) over and above common Board composition variables, suggesting that risk oversight practices represent an important and distinct dimension of corporate governance. In addition, our results complement prior research on Board committee structure (Klein 1998; Adams 2003; Brick & Chidambaram 2010; Reeb & Upadhyay 2010): We document how responsibilities for risk oversight are allocated between committees and the Board as a whole and demonstrate the consequences of these allocation decisions for the quality of Board risk oversight and risk management.

The remainder of the paper is organized as follows. Section 2 develops our hypotheses. Section 3 discusses our sample and variables, followed by our results in Section 4. Section 5 presents additional analyses and robustness tests and Section 6 concludes.

## 2. Overview and Hypotheses

### 2.1 The Board's Role in Risk Oversight

The ISO 31000 risk management standard defines risk as an uncertainty that, if it occurs, will have an effect on objectives (International Standards Organization, 2009). In the absence of any market imperfections, risk management activities should have no effect on firm value (Modigliani and Miller, 1958). However, prior research suggests that imperfections such as taxes, financial distress, underinvestment, asymmetric information, and undiversifiable stakeholders can make risk management a value-generating activity (e.g., Meulbroek, 2002; Nocco and Stulz, 2006).

Concerns that Boards have failed to properly oversee corporate risk-taking and risk management have led to the worldwide adoption of rules and codes calling for improved Board oversight over risk activities (OECD, 2014).<sup>2</sup> In the United States, New York Stock Exchange (NYSE) listing rules require Board audit committees to discuss the guidelines and policies that govern the process by which risk assessment and risk management is conducted. In addition, the Security Exchange Commission (SEC) now requires most public companies to disclose the extent of their Board's role in risk oversight. These external requirements are compounded by credit rating agencies and shareholder advisory groups (e.g., International Shareholder Services, Moody's, and Standard & Poor's) taking Board oversight effectiveness into consideration in their recommendations. These actions are consistent with agency-based theories of Boards' monitoring and advising roles (e.g., Fama 1980), and assume that an effective risk oversight process helps directors ensure that the organization has an effective system in place for identifying, evaluating, prioritizing, managing, and adapting to critical risks (e.g., Caldwell, 2010). By setting the

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<sup>2</sup> "Risk oversight" represents the practices used by the Board to determine that the firm has in place a robust process for identifying, prioritizing, managing, and monitoring its critical risks. In contrast, "risk management" represents management's role in planning, coordinating, executing, and handling the activities of the organization in order to minimize the impact of unwanted risk on desired outcomes.

appropriate “tone at the top,” strong Board risk oversight is expected to lead to substantive improvements in risk management and more informed risk-taking, thereby benefiting stakeholders by mitigating risk-related agency conflicts.

In contrast, many observers question whether the adoption of externally-focused Board oversight practices has any effect on firms’ risk management processes or risk-taking. Studies indicate that many Boards lack the time, skills, and information necessary for effective risk oversight (Ingley & van der Walt 2008; National Association of Corporate Directors 2013). In addition, institutional theories of corporate governance maintain that the adoption of governance practices that are promoted or mandated by external parties is often a symbolic move undertaken to conform to perceived good governance practice without any expectation of real economic benefit (Menon & Williams 1994; Westphal & Graebner, 2010; Saren & Christopher 2010). Contrary to substantive theories of Board risk oversight, these arguments suggest that the externally-focused adoption of Board risk oversight practices will have little effect on firms’ risk management processes or risk-taking.

## 2.2 Hypotheses

We examine whether Board risk oversight has a substantive impact on firm-level risk management processes and risk-taking by investigating the relations between Board oversight responsibilities and practices, the maturity of the firm’s risk management processes, and firm risk levels. Corporate governance research suggests that Board effectiveness is a function of the process the Board follows when carrying out its advising and monitoring roles, moving from the development of Board structure and responsibilities to the specific activities and actions undertaken by the Board and ultimately to the impact of these actions on firm decision-making

(e.g., Dulewicz et al., 1995; Cornforth, 2001; Ingley and van der Walt, 2005; Wan and Ong, 2005).

A similar process has been advocated in the Board risk oversight literature (e.g., Conference Board, 2007; RIMS, 2011; McNulty et al. 2013; Deloitte, 2014). As shown in the conceptual model in Figure 1, risk oversight proponents argue that the assignment and location of Board oversight responsibilities have a strong influence on the extent to which the Board is actively involved in risk oversight. Greater risk oversight involvement, in turn, is claimed to promote the development of more mature risk management processes, leading to more informed and sophisticated risk-taking. This conceptual model provides the foundation for our hypotheses and empirical tests.

### 2.2.1 Risk Oversight Responsibilities and Board Involvement in Risk Oversight

As advocated in governance codes and guidelines, the risk oversight process requires Board members to work closely with management both to understand and reach consensus regarding the risks inherent in the corporate strategy and the firm's risk appetite for executing that strategy, and to access timely information on current and emerging material risk exposures, risk response strategies, and the implementation and effectiveness of risk management procedures and infrastructure (e.g., COSO 2004; OECD 2014).

The need to formally define and assign Board risk responsibilities is a key feature of calls for strengthened Board oversight, and is claimed to drive risk oversight practices by establishing the direction and accountability needed for the Board to effectively carry out its various oversight activities (e.g., Tonello 2007; Deloitte 2014). However, the exact location of these responsibilities within the Board is the subject of considerable debate. Boards have taken three approaches to assigning risk oversight roles and responsibilities: (1) delegating all responsibilities



to one or more Board committees; (2) making the Board as a whole responsible for risk oversight; or (3) making the whole Board responsible with additional delegation of specific roles and responsibilities to Board committees. Risk oversight codes, rules, and regulations differ in their requirements or recommendations for the location of Board oversight responsibilities (OECD, 2014). The Australian Stock Exchange governance code, for example, calls for risk responsibilities to reside with the entire Board (ASX, 2007). The New York Stock Exchange listing rules, on the other hand, require Board audit committee oversight of risk management processes<sup>3</sup>, while regulators in many countries recommend or require financial services firms (such as large U.S. financial institutions covered by Dodd-Frank) to assign risk oversight responsibilities to a stand-alone Board risk committee.

Proponents of the committee assignment model argue that the committee setting is preferred because other major agenda items are not vying for attention, interactions among Board members and risk professionals are enhanced, the expertise of committee members whose backgrounds include risk or financial management can be better utilized, and the greater focus can ensure that risk is given proper attention. Board-level oversight advocates, on the other hand, maintain that the entire Board must be responsible for risk oversight in order to provide the overall Board and Board chairman support needed for risk management to become embedded in the annual Board agenda. Board-level proponents further argue that a single committee may not have the capability or capacity to oversee risk in its broadest form, and prevents the organization from utilizing the Board's full resources on this subject (Protiviti, 2010).

Surveys indicate that the committee-level Board responsibility model is the most widely adopted worldwide, with the Board audit committee most frequently charged with risk oversight (e.g., Beasley et al. 2010). However, evidence suggests that many directors believe risk oversight

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<sup>3</sup> Even if the Board sets up a separate risk committee, the audit committee charter of NYSE-listed firms must still address the committee's duty to discuss policies with respect to risk assessment and risk management.

should be the responsibility of the full board, with or without additional delegation of responsibilities to committees. A study by the National Association of Corporate Directors (2013) finds that one-third of responding directors whose firms assign risk oversight to one or more committees believe risk should be the responsibility of the full Board. In contrast, nearly all of those respondents (92.7%) who currently assign risk oversight to the full Board believe this to be the correct allocation. The NYSE requirement for audit committee oversight has also come under criticism, with the New York City Bar Association and the Society of Corporate Secretaries & Governance Professionals publicly calling on the NYSE to make the full Board responsible for risk oversight. The concern is that audit committees, which already face heavy workloads meeting financial reporting and compliance requirements, have limited expertise outside financial risks. These arguments suggest that Board oversight may be more effective when the entire Board is assigned responsibility for risk oversight, leading to our first hypothesis:

H1: The Board's involvement in risk oversight is greatest when risk oversight responsibility is assigned to the Board as a whole.

One alternative to assigning oversight responsibilities to the audit committee is establishing a separate Board-level risk committee, a requirement for some financial institutions. Risk committees offer both advantages and disadvantages for Board oversight (Beaumier and DeLoach 2012; Enlight Research, 2013). Proponents contend that these committees can improve Board risk supervision in at least two ways. First, by providing a designated avenue through which information on a broad range of current and emerging risks can reach the Board, thereby breaking down fragmented risk oversight in which individual committees focus only on their own issues. Second, by relieving overtaxed committees of some risk oversight burdens, allowing them to focus on their core responsibilities. Risk committees can also serve a symbolic role by projecting an image of corporate responsibility to regulators and shareholders. On the downside,

risk committees can create role confusion because some of the committee's duties will invariably overlap with the responsibilities of other Board committees. Moreover, since Board members already serve on several committees, adding an additional committee can dilute the Board's focus.

Evidence on the use and implications of separate risk committees is limited. Subramaniam et al.'s (2009) examination of large Australian firms indicates that separate risk committees are more common in companies with larger boards, higher financial reporting risk, and lower organizational complexity. Ormazabal (2010) finds risk committee sophistication associated with lower firm volatility in financial firms, but no association in nonfinancial firms. Minton et al. (2014) find no evidence that the presence of a risk committee had an impact on banks' share price performance or return volatility during the financial crisis. Finally, Aebi et al. (2012) document that banks with a Board-level risk committee experienced *lower* buy-and-hold returns and return on equity during the crisis period.

None of these studies examines the relation between Board risk committees and Board oversight practices. We therefore extend this literature by examining the following hypothesis:

H2: The presence of a separate Board risk committee is positively associated with the Board's involvement in risk oversight.

### 2.2.2 Board Involvement in Risk Oversight and Risk Management Maturity

The second link in the conceptual model is between Board oversight involvement and the maturity of the firm's risk management processes. Because management is accountable to the Board of Directors, the Board's focus on effective risk oversight is said to be critical to setting the appropriate tone and culture towards effective risk management (COSO 2009). Consequently, if Board oversight practices are adopted for substantive reasons, then these practices should be significantly associated with the maturity of the firm's risk management processes.

Beasley et al.'s (2009) global survey supports claims that the Board is a key driver of risk management implementation, with 58 percent of the respondents receiving pressure from the full Board of Directors for increased senior executive involvement in risk management, and 51 percent receiving pressure from the Board audit committee. Further evidence is provided by Baxter et al. (2013), who find that financial institutions with either a risk officer or a risk committee have higher Standard & Poor's enterprise risk management ratings, as do financial firms that publicly disclose that their audit committees are assigned risk oversight responsibility. We test the following hypothesis to examine the proposed link between risk oversight involvement and risk management maturity:

H3: Greater Board risk oversight involvement is positively associated with the maturity of the firm's risk management process.

### 2.3 Risk Management Maturity and Firm Risk-Taking

The ultimate goal of integrated risk management processes is enhancing and optimizing the firm's risk-taking activities (e.g., Meulbroek, 2002; Nocco and Stulz, 2006). According to proponents of integrated enterprise risk management (ERM), investments in ERM will yield an improved understanding of the firm's overall risks, risk drivers, and risk interdependencies across the firm's portfolio of activities. This improved understanding, in turn, allows the firm to consider how each decision or unit contributes to the firm's overall risk profile and to recognize where interdependent risks can multiply or cancel each other out. By using this knowledge to coordinate risk-taking and risk responses across the enterprise, firms can minimize unwanted, suboptimal volatility due to uncoordinated actions and lessen the possibility of lower-tail outcomes. A number of studies provide empirical support for these claims, finding more mature or sophisticated risk management processes associated with lower firm volatility and tail risks (e.g., Ormazabal 2010; Ellul & Yerramilli 2013; Minton et al. 2014).

If stronger Board oversight has a substantive economic impact through its promotion of more mature risk management processes, we should not only see Board oversight positively associated with risk management maturity (hypotheses 2 and 3), but should also find a significant association between risk management maturity and risk-taking, leading to the following hypothesis:

H4: The maturity of the firm's risk management process is negatively associated with firm volatility and tail risk.

### 2.3.1 Other Potential Links

Our hypotheses assume a sequential process running from the assignment of Board risk oversight responsibilities to Board oversight involvement, which is expected to influence risk management processes and ultimately firm risk-taking. The underlying assumption is that Board oversight only influences risk-taking through its promotion of improved risk management processes, with no direct effect on risk-taking. Although consistent with research on Board processes, it could also be the case that risk oversight responsibilities and involvement directly affect risk-taking by influencing the Board's expertise and its strategic and risk-taking priorities (e.g., Lipton, 2014; Minton et al. 2014). To allow for this possibility, we include these additional links in our empirical tests but make no predictions regarding their signs or significance.

## 3. Sample and Variables

### 3.1 Sample

We draw our sample from publicly-listed companies that participated in Aon's Risk Maturity Index (RMI) survey between 2011 and 2013. Aon, a leading insurance broker and professional services provider, designed the RMI as a self-assessment tool for organizations to evaluate and benchmark their Enterprise Risk Management (ERM) capabilities. The extensive survey was

developed in collaboration with academic experts and risk professionals, and captures the essential elements of practitioner-oriented ERM frameworks such as those developed by the Committee of Sponsoring Organizations of the Treadway Commission (COSO, 2004) and the International Standards Organization (ISO, 2009).

The RMI survey is targeted towards high-level risk management, finance, and C-suite executives who are actively involved in the firm's risk management activities. Participation is solicited through industry and professional conferences, contacts with Aon clients, and Aon's website. Potential participants are pre-screened to ensure that they have the requisite knowledge of the firm's risk management processes and management interactions with the Board needed to answer the survey questions. Eligible respondents receive a unique password that allows access to the on-line survey and serves as a firm identifier. All participants are notified that their responses will be used for academic and Aon research purposes.

Our overall sample consists of 297 publicly-listed companies that completed the Aon survey between 2011 and 2013, although sample sizes can vary across our analyses due to missing variables. Half of the survey respondents hold the positions of Director of Risk Management or Risk Manager, 15% are Chief Risk Officers, 9% are Treasurers or Vice Presidents of Finance, 7% are Chief Financial Officers, and 3% are Chief Executive Officers. The remaining survey respondents hold other positions such as General Counsel or head of internal audit. Two-thirds of the respondents are Aon clients, and 5% have engaged Aon for ERM consulting advice.<sup>4</sup>

Table 1 reports the distributions of the sample firms across 28 countries (Panel A) and 16 industry groups (Panel B). Almost 52% of the firms are headquartered in the United States, 9% in

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<sup>4</sup> The ad hoc nature of the solicitation process prevents us from determining a response rate. Most of the clients use Aon for insurance brokerage or human resource management services. For confidentiality reasons, Aon did not provide us with information on which respondents are clients.

Australia, and 6% in the UK. The largest industry concentrations are in the manufacturing and financial institutions sectors.<sup>5</sup>

### 3.2 Variables

Aon provided the RMI survey respondents' identities to us on a confidential basis. This allows us to combine survey responses and publicly-available data in our tests. Appendix A describes the sources for the variables used in our analyses, with descriptive statistics in Table 2. Appendix B provides the specific survey questions and response distributions for our Board oversight variables.

#### 3.2.1 Board Responsibilities for Risk Oversight

We use two data sources to assess the formal assignment of Board roles and responsibilities for risk oversight. First, the Aon survey asked respondents whether the Board's roles and responsibilities for risk oversight are formally defined, and if so, whether they are defined in specific committee charters and/or for the Board as a whole (with respondents asked to indicate all that apply). Seven percent of the firms have not defined or do not understand the Board's risk oversight roles and responsibilities. Of the remainder, 46% have incorporated risk oversight responsibilities at the committee level but not the Board level, 13% for the Board as a whole but not individual committees, and 34% in both specific committee charters and for the Board as a whole.<sup>6</sup> We construct indicator variables for each of these four mutually exclusive categories (denoted *Roles Not Defined*, *Roles Defined Committee Only*, *Roles Defined Board Only*, *Roles Defined Both*, respectively). Second, we search BoardEx and company disclosures for evidence

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<sup>5</sup> Compared to the international sample of firms covered by FactSet, our sample has relatively more companies from the US, UK, and Australia, more manufacturing firms, and fewer financial institutions.

<sup>6</sup> We examine BoardEx and public documents to confirm responses regarding the assignment of Board risk responsibilities. In a few cases, adjustments were made based on the public data, primarily due to respondents indicating that the overall Board is responsible for risk oversight when both the overall Board and one or more committees have risk responsibilities in their charters.

of the existence of a dedicated risk committee on the Board of Directors. We form an indicator variable (*Risk Committee*) that equals one for firms having a dedicated risk committee (8% of the sample) and 0 otherwise.

### 3.2.2 Board Involvement in Risk Oversight

Four constructs are used to capture different dimensions of the Board's involvement in risk oversight. The first construct (denoted *Board Understanding*) represents average standardized responses to four questions on the consistency of Board understanding of the company's: (1) top risks, (2) existing risk management activities for key risks, (3) quantified risk appetite (i.e., the amount of risk the organization is ready and willing to take); and (4) its emerging risk profile. Responses are based on three point scales, where 1 = the Board's understanding of these risk management aspects is not being discussed during Board meetings, 2 = the Board's understanding is inconsistent, and 3 = the Board's understanding is consistent. Consistent Board understanding is most frequent for top risks (86% of respondents) and existing risk management activities (78%), and least consistent for risk appetite (not discussed in 22% and inconsistent in 29%) and emerging risk profile (not discussed in 10% and inconsistent in 29%). The four questions load on a single factor with an eigenvalue of 2.30 (the second-largest eigenvalue being 0.83) and a coefficient alpha of 0.71, indicating adequate construct reliability.

The second Board involvement construct captures the content and frequency of Board-level risk reporting. The construct is measured using responses to three questions. The first question asked respondents to indicate whether Board reporting on the organization's risk profile includes the following (with respondents asked to check all that apply): key risks and associated risk management activities; risk drivers and underlying causes; risk ownership responsibilities and accountabilities; risk management action plans and outcomes; risk tolerances and thresholds and



limits; risk performance metrics and trends; and information on emerging risks. We code responses to this question on a scale from 0 (none of these topics) to 7 (all of these topics). Consistent with the *Board Understanding* indicators, the most commonly reported topic is key risks and associated activities (94%) and the least common is risk tolerance and thresholds/limits (37%). The other two questions used to compute this construct capture the frequency with which (1) the full Board and (2) board committees receive risk reports, where 1 = infrequently or not on a predefined schedule, 2 = at least annually, 3 = at least twice yearly, and 4 = quarterly or more frequently. The full Board and committees receive risk reports at least quarterly in 25% and 41% of the sample companies, respectively. The variable *Board Reporting* equals the average standardized responses to these three questions, which load on a single factor with an eigenvalue of 2.02 (the second-highest eigenvalue being 0.62) and a coefficient alpha of 0.70.

Our third Board involvement construct reflects the consensus and communication between the Board and the management team with respect to risk management strategies. The variable is constructed using responses to two questions. The first asked the extent to which the Board and executive management have reached consensus on the overall risk management strategy for the organization, where 1 = overall strategy has not been discussed (13%), 2 = informal consensus has been reached (57%), and 3 = consensus reached with established and documented objectives (30%). The second question asked the extent to which communications from the Board and executive management highlight the alignment of risk management strategy with overall strategy, where 1 = communications do not highlight alignment (34%), 2 = yes, and include informal references to concepts of risk appetite and tolerance (52%), and 3 = yes, and include formal references to defined risk appetite and tolerances (14%). The variable *Board Alignment* is the average standardized response to these two questions, which load on a single factor with an eigenvalue of 1.48 (the second-largest eigenvalue being 0.52) and a coefficient alpha of 0.65.

The fourth Board involvement variable is based on the responses to a single question asking whether the firm's risk management leader (e.g., Chief Risk Officer or equivalent) engages Board members in dialogue outside of normal reporting requirements and appearances at meetings. *Board & Risk Manager Communication* is an indicator that equals one if such communication takes place (51% of the respondents) and zero otherwise.

We assess the overall sophistication of the Board's risk oversight involvement using a composite measure that includes all four of the individual Board involvement constructs. The four constructs load on a single second-order factor with an eigenvalue of 2.23 (the second-highest eigenvalue being 0.89) and a coefficient alpha of 0.71. The variable *Overall Board Involvement* represents the average standardized scores for *Board Understanding*, *Board Reporting*, *Board Alignment*, and *Board Risk Manager Communication*. Larger values represent more sophisticated Board risk oversight involvement.

### 3.2.3 Risk Management Maturity

We examine the relation between Board risk oversight practices and the firm's risk management processes and procedures using an adapted version of the Aon risk maturity index. The original Aon Risk Maturity Index is based on 181 survey questions that measure an organization's risk maturity across ten different dimensions: (1) Board understanding and commitment to risk management, (2) executive level risk management stewardship, (3) risk communication, (4) risk culture, engagement, and accountability, (5) risk identification, (6) stakeholder participation in risk management, (7) risk information and decision-making processes, (8) integrating risk management and human capital processes, (9) risk analysis and quantification to understand risk and demonstrate value, and (10) risk management focus on value creation. Aon uses a proprietary weighting scheme to aggregate responses to these 181 questions into a single

Risk Maturity Index that ranges from 0 (lowest possible score) to 200 (highest possible score).<sup>7</sup> We compute a risk maturity score for each firm, our measure of risk management sophistication, after excluding the Board-related dimension (which represents 20 of the 200 available points) from the Aon risk maturity index. This allows us to analyze the relations between Board *risk oversight* and the maturity of the firm's *risk management* activities. Risk maturity scores are rescaled to the 0 to 200 point range of the original Aon risk maturity index, with a mean of 108 in our sample. Figure 1 presents a histogram for risk maturity scores, overlaid with a normal density. The distribution of scores strongly suggests that the survey responses are *not* biased upwards, mitigating concerns that the nature of the survey design led respondents to present their companies' risk management practices in an overly favorable or desirable light. We use the natural logarithm of risk maturity scores (denoted *Risk Maturity*) in our empirical tests.

### 3.2.4 Board Oversight and Risk Maturity Construct Validity Checks

We assess the validity of our board oversight and risk maturity constructs by examining their relation with the firms' risk management disclosures. The SEC requires publicly-traded US firms to disclose whether or how the Board or Board committees monitor risk.<sup>8</sup> Similar to Deloitte (2013), we use these disclosures to construct a Board risk oversight disclosure index for the US firms in our sample.<sup>9</sup> Assuming these disclosures are indicative of actual risk oversight sophistication, we expect this index to be positively associated with *Overall Board Involvement*. Consistent with this prediction, we find a significant positive relation between *Overall Board*

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<sup>7</sup> Due to the proprietary nature of the survey, we are not allowed to list all of the individual survey questions or the weights assigned to each survey response.

<sup>8</sup> See <http://www.sec.gov/rules/final/2009/33-9089.pdf>.

<sup>9</sup> The index ranges from 0 to 10 and represent a count of the number of disclosures from the following list: the disclosure notes that the full Board is responsible for risk, the audit committee is noted as the primary committee responsible for risk, other committees are noted as being involved in risk oversight, the compensation committee is disclosed as being responsible for overseeing risk in compensation plans, the company has a separate Board risk committee, the company discloses whether risk oversight/management are aligned with the company's strategy, the disclosure notes whether the CEO is responsible for risk management or how the CEO is involved, the company has a CRO, the company has a risk management committee (at the management level), and the disclosure notes how the Board is involved with regard to the company's risk appetite.

*Involvement* and the Board oversight index ( $p < 0.10$ , two-tailed). However, we find no significant association between the oversight index and *Risk Maturity*, suggesting that these disclosures reflect Board oversight but not overall enterprise risk management sophistication.

We also follow studies on risk management disclosures and construct a broader disclosure index by searching the US firms' 10-Ks for the number of phrases where the words 'risk', 'risks', 'risky', 'uncertain', 'uncertainty', or 'uncertainties' occur within five words of 'manage', 'managed', 'manager', 'managers', 'manages', 'management', 'mitigate', 'mitigated', 'mitigates', 'protect', 'protected', 'protects', 'reduce', 'reduced', 'reduces', 'control', 'controls', or 'controlled'. The resulting index has significant positive associations with both *Overall Board Involvement* and *Risk Maturity* ( $p < 0.05$ , two-tailed). Thus, at least for the US firms in our sample, our Board risk oversight and risk maturity constructs exhibit satisfactory convergent validity with external referents assessing the same constructs.

### 3.2.5 Firm Risk

If Board risk oversight practices improve risk-based decision-making, then we expect our Board oversight constructs to be related to observable measures of firm risk. We construct three proxies for firm risk to test this prediction. The first proxy, denoted *Stock Return Volatility*, measures the standard deviation of daily stock returns during the year following the survey response. This measure of aggregate firm risk has been used Ellul and Yerramilli (2013) and Cheng et al. (2014), among others. The second risk proxy, denoted *Idiosyncratic Volatility*, is the standard deviation of the residual from a market model of daily returns data for the year following the survey response. The equal-weighted return on the market is estimated by country. The third proxy for firm risk, denoted *Tail Risk*, is calculated as the negative of the average return

over the 5% lowest daily stock returns of the year (see Acharya et al. 2010; Ellul and Yerramilli 2013). Daily return data for US (international) firms are obtained from CRSP (Compustat Global).

### 3.3 Other Governance Mechanisms

Prior research indicates that Board composition and country-level governance characteristics are associated with the adoption of risk management practices and firm riskiness. We include a variety of governance-related control variables in our tests to ensure that our results are not driven by other governance mechanisms that may be correlated with risk oversight activities.

We gather data on Board characteristics from BoardEx, which covers both US and non-US firms, and from company websites and other public sources. Prior studies find that more independent Boards are associated with the use of and stock market responses to enterprise risk management processes (e.g., Beasley et al., 2005; Gordon et al., 2009). We use two variables to control for Board independence: (1) the fraction of non-executive directors (denoted *Outside Directors*), and (2) whether the Board chairperson is a non-executive director (*Outside Chair*=1) or not (*Outside Chair*=0). We also control for “busy” outside directors. Following Core et al. (1999), we identify busy outside directors as those who hold three or more Board seats. The variable *Busy Outside Directors* equals the number of busy outside directors scaled by the total number of directors.<sup>10</sup> We further control for the number of directors on the Board (denoted *Board Size*). Cheng (2008) finds that larger Boards make more compromises to reach consensus. Consequently, the decisions of larger Boards are less extreme, leading to lower variability in corporate performance.

Two director-level attributes that prior studies suggest are associated with Board monitoring and firm risk-taking are directors’ financial expertise (Dionne and Triki, 2005; Minton et al.

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<sup>10</sup> We acknowledge that “outside” directors are not necessarily “independent” of firm management.

2014) and gender (Adams and Ferreira, 2009; Nielsen and Huse, 2010). We control for financial expertise (denoted *Financial Education*) using the fraction of directors who have an MBA degree and/or a degree or certification in finance or accounting. *Female Directors* represents the fraction of female directors on the Board.

Prior research also indicates that country-level governance characteristics influence firm-level governance practices and risk-taking (e.g., Doidge et al. 2007; John et al. 2008; Acharya et al. 2011). Following John et al. (2008), we use three proxies to control for shareholder protections. The first proxy (denoted *Shareholder Rights*) is a revised version of the original LaPorta et al. (1998) anti-director rights index (Spamann 2010). The higher the index score, the more powerful shareholders are vis-à-vis corporate insiders. *Rule of Law* is drawn from Kaufmann et al. (2004) and is based on perceptions of the incidence of crime, the effectiveness and predictability of the judiciary, and the enforceability of contracts. Higher values imply stronger enforcement of and confidence in the law. *Disclosure Quality* is collected from Bushman et al. (2004) and captures the intensity and timeliness of corporate financial disclosures. A higher value reflects higher disclosure quality and financial transparency, which studies suggest are negatively associated with liquidity risk (e.g., Lang and Maffet 2011).

Houston et al. (2010) find that bank risk-taking also increases in country-level *creditor* protection, while Acharya et al. (2011) find that stronger creditor rights reduce corporate risk-taking. We collect data on creditor protection in bankruptcy (denoted *Creditor Rights*) from Djankov et al. (2007), with higher values implying stronger creditor protection.

### 3.4 Other Control Variables

We include several additional controls for other firm characteristics previously found to be associated with risk management practices and risk-taking. These variables are drawn from the FactSet and Compustat Global databases or from the firms' survey responses.

Research suggests that larger firms are more likely to implement sophisticated risk management processes due to their increased complexity and greater availability of resources to support risk management activities (Beasley et al. 2005; Hoyt and Liebenberg 2011; Baxter et al. 2013). We control for this possibility using  $\ln(\text{Market Cap})$ , which equals the natural logarithm of market capitalization. Similarly, less financially-constrained firms are expected to implement more sophisticated risk management processes due to greater resource availability (Rampini & Visvanathan 2010, 2013; Bodnar et al. 2014). We include three proxies for financial constraints: return on assets ( $ROA$ ), which equals net income over total assets; *Dividend Payer*, an indicator variable that equals one for dividend-paying firms and zero otherwise; and cash holdings scaled by total assets (denoted  $Cash / Assets$ ).

The opportunity cost of investing in risk management is also expected to depend on the value of currently available investment opportunities (Rampini & Visvanathan 2010). We proxy for the firms' growth opportunities using the book-to-market ratio (denoted  $Book / Market$ ), research and development expenses scaled by total assets (denoted  $R\&D / Assets$ ), and the change in revenue from the last period to the current period ( $Sales Growth$ ). We also include the book value of property, plant, and equipment scaled by total assets ( $PPE / Assets$ ) to control for firms' access to physical collateral (Rampini & Visvanathan 2010, 2013).

Since risk management decreases the risk of default, and debt holders are more likely to command lower interest rates and to abstain from imposing covenants when downside risk is lower, the benefits of risk management are likely to be associated with firm leverage (Leland

1998; Campello et al. 2011). We measure leverage as the ratio of short-term and long-term debt over total assets (denoted *Debt / Assets*).

We also control for the number of geographic regions a firm operates in (denoted *Geographic Regions*). Greater international exposure and complexity increase political, regulatory, currency, operational, and other risks, potentially increasing the benefits from risk management (Miller 1992; Gordon et al. 2009). We further control for the possibility that firms adopt more sophisticated risk management practices after experiencing a serious risk episode, either because of increased external pressure to adopt these practices or because these firms recognize the need for improved risk management. The indicator variable *Experienced Risk Event* equals one if the firm indicated in the survey that they had experienced a risk-related event in the past two years that had the potential to threaten its viability (25% of respondents) and zero otherwise.

In addition to these internally-focused predictors, we include an indicator that equals one if the company is listed on the New York Stock Exchange (39% of the sample) and zero otherwise. This variable (denoted *NYSE*) controls for New York Stock Exchange listing requirements that require the Board audit committee to include in its charter the responsibility to discuss risk assessment and risk management policies with management.

Finally, following Bartram et al. (2012), we control for the fraction of trading days with zero returns (denoted *Zero Returns*) when examining the relation between risk oversight and future stock return volatility.

## 4. Results

### 4.1 Univariate Correlations

Table 3 presents Pearson correlations between the main variables used in our analyses. The correlations between the assignment of Board oversight responsibilities and both Board risk



oversight involvement and risk maturity move from negative to positive as the level and breadth of responsibilities increases. The correlations are significantly negative when no roles have been established, negative but smaller in magnitude when risk oversight responsibilities are established at the committee level alone, positive but insignificant when the overall Board but not individual committees have oversight responsibility, and substantially more positive (as well as statistically significant) when both the Board and committees are assigned oversight responsibilities.<sup>11</sup> However, the presence of a distinct risk committee is not significantly correlated with either Board risk oversight involvement or risk maturity.

Failure to define oversight responsibilities is positively correlated with stock return and idiosyncratic volatilities and tail risks, but the other responsibility indicators are not significantly related to these risk measures. Despite these insignificant correlations, both *Overall Board Involvement* and *Risk Maturity*, which are positively correlated with the level and breadth of oversight responsibilities, are negatively related to the three firm risk measures, suggesting that any effect of Board oversight roles on risk-taking may come indirectly through their influence on Board involvement and the implementation of more sophisticated risk management processes.

#### 4.2 Analysis of Board Risk Oversight Involvement

We test our predictions regarding the relations between risk oversight responsibilities and the Board's risk oversight involvement in Table 4. If the highly observable act of incorporating risk oversight responsibilities in Board charters is simply a symbolic gesture to placate external parties (or if Boards lack the required skills to effectively conduct risk oversight), we should see no relation between oversight location and the Board's risk oversight involvement. Alternatively, if the assignment of risk responsibilities is a substantive move that establishes the role definitions

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<sup>11</sup> All of the correlation magnitudes are significantly different across the four groups ( $p < 0.05$ , two-tailed, Fisher z transformation), with the exception of the correlations between *Roles Not Defined* and *Overall Board Involvement* and between *Roles Defined Committee Only* and *Overall Board Involvement*, which are not statistically different.

and accountabilities needed to foster effective Board oversight, we should see the establishment and level of Board responsibilities positively associated with Board oversight involvement.<sup>12</sup>

We examine the effects of Board responsibilities and our control variables on *Overall Board Involvement*, as well as on its four components (Board understanding of risks, risk appetite, and risk management activities; Board risk reporting; Board and top management alignment regarding the overall risk management strategy of the organization; and direct communication between the Board and the firm's risk leader). We estimate the following model, with the assignment of oversight responsibilities at both the Board and committee levels serving as the (omitted) base case, industry fixed effects, year fixed effects, and standard errors clustered by country:

$$\text{Overall Board Involvement} = f(\text{Roles Not Defined, Roles Defined Committee Only, Roles Defined Board Only, Risk Committee, Ln(Board Size), Outside Directors, Outside Chair, Female Directors, Busy Outside Directors, Financial Education, Creditor Rights, Rule of Law, Shareholder Rights, Ln(Disclosure Quality), Other Controls) \quad (1)$$

Consistent with substantive explanations, the significant coefficients on the risk responsibility indicator variables imply that Board risk oversight practices become more sophisticated as the level and breadth of defined oversight roles increases. The most extensive risk oversight involvement is found in firms that have established oversight responsibilities at the Board *and* committee levels (the omitted base case group). Although firms that have established Board responsibilities at the committee level alone have significantly higher *Overall Board Involvement*

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<sup>12</sup> Multinomial logit analyses of the relations between our independent variables and the location of Board responsibilities for risk oversight indicates that firms with more female directors, stronger creditor rights, higher ROA, lower R&D, and recent risk events are more likely to have formally assigned Board oversight roles. Firms with larger Boards are more likely to assign oversight roles to either the entire Board or to its committees, but not both. Firms with more female directors, larger market capitalization, and stronger creditor rights, on the other hand, are more likely to assign oversight roles at the both Board and committee levels than at the Board or committee levels alone. Higher book-to-market ratios are associated with committee rather than joint Board and committee responsibilities, higher ROA with Board rather than both Board and committee, greater R&D expenditures with committee rather than both Board and committee, and cash liquidity with both Board and committee rather than Board alone. Consistent with NYSE listing requirements, firms on this exchange are more likely to place oversight responsibilities at the committee level (either with or without the Board also having oversight responsibilities). Dedicated risk committee are more likely when firms are headquartered in countries with stronger creditor rights, are larger, have more R&D expenditures, are in the financial services industry, and have experienced a major risk event. Risk committees are less likely when directors' financial expertise is greater, the Board is larger, and the firm operates in more geographic regions.

scores than firms that have not defined any risk responsibilities, they have significantly lower scores than firms that have defined oversight roles and responsibilities at the Board level (either with or without also defining committee responsibilities). These results are consistent with governance codes that claim the entire Board must be involved if risk oversight activities are to become fully embedded in the annual Board agenda (e.g., ASX, 2007). The evidence indicates that Board oversight involvement increases further when both the Board and committees have defined roles and responsibilities. The significantly higher *Overall Board Involvement* scores in this group indicate that establishing formal roles and responsibilities throughout the Board fosters greater Board understanding, consensus, and oversight of risk-taking and risk management activities than the other Board oversight responsibility practices. Results are similar when we examine the four components of *Overall Board Involvement*, with the exceptions of *Board Understanding* and *Board Alignment*, which are not significantly different in the *Roles Defined Board Only* and *Roles Defined Board and Committee* groups.

In contrast to the Board responsibility variables, the presence of a dedicated risk committee is not significantly associated with *Overall Board Involvement*, despite regulations and governance codes calling for the establishment of these committees. Moreover, Boards with a separate risk committee have lower Board and management alignment on risk management objectives and strategy (*Board Alignment*), even after controlling for whether the firm has defined responsibilities at the committee and/or Board levels. Similarly, NYSE firms' Board oversight involvement is not significantly greater than that of other firms after controlling for the location of Board responsibilities. Despite the exchange's audit committee oversight requirements, NYSE-listed companies actually score lower on Board reporting quality and frequency and on communication between the Board and the risk manager outside Board meetings. This evidence

is consistent with symbolic theories that firms implement governance practices that are pushed by external parties, but do not actually integrate these practices into their internal activities.

None of the firm- or country-level governance variables is significantly related to *Overall Board Involvement* in Model 1. When we examine the components of oversight involvement in Models 2-5, the country-level variables remain insignificant except for disclosure quality, which is positively related to the alignment between the Board and management. This is consistent with prior evidence that disclosure quality and transparency facilitate Board oversight (e.g., Armstrong et al. 2014). Of the Board characteristics variables, the fraction of outside directors and the presence of an outside chairperson are positively related to the Board's understanding of the firm's risk profile and the quality of Board risk reporting, respectively. These results suggest that outside Board members overcome their informational disadvantage by discussing risk issues more during Board meetings and demanding frequent and detailed risk reports. The risk leader is less likely to engage the Board outside of its regular meetings when there are more female directors on the Board. Surprisingly, financial education is negatively related to whether the Board's understanding of risk issues is discussed during Board meetings. These limited results suggest that any significant relations between Board characteristics or country governance variables and firm risk-taking found in other studies are unlikely to be driven by Board risk oversight practices.

Of the other control variables, only leverage and cash holdings are associated with *Overall Board Involvement*. Leverage is positively related to the Board's overall risk oversight involvement and its components *Board Understanding* and *Board & Risk Manager Communication*, suggesting that the benefits of risk oversight increase with leverage (Leland 1998; Campello et al. 2011). Cash holdings are negatively related to overall Board risk oversight involvement, consistent with Froot et al.'s (1993) prediction that capital-constrained firms invest

more in risk management, but inconsistent with Rampini and Visvanathan's (2010) opposite prediction.

#### 4.3 Board Risk Oversight as a Predictor of Risk Management Maturity

If Boards employ more sophisticated Board risk oversight for substantive reasons, we expect the Board oversight variables to be significantly associated with the maturity of the firm's risk management processes and firm risk-taking. In contrast, symbolic theories predict that the externally-focused Board oversight practices will have little influence on the firm's actual risk management practices or risk-taking.

Panel A of Table 5 examines the direct effects of Board responsibilities for risk oversight and Board risk oversight involvement on *Risk Maturity* by estimating the following equation with industry fixed effects, year fixed effects, and standard errors clustered by country:

$$\text{Risk Maturity} = f(\text{Roles Not Defined, Roles Defined Committee Only, Roles Defined Board Only, Risk Committee, Overall Board Involvement, Board Governance, Country Governance, Other Controls})$$

(2)

In Model 1, we include the risk responsibility and risk committee indicators but not *Overall Board Involvement* or its components. *Risk Maturity* is higher when Board responsibilities are defined at the Board level, with no significant difference between firms that establish these responsibilities at the Board level alone and firms that establish them at both Board and committee levels. *Risk Maturity* is significantly lower when roles are only defined at the committee level, and lower still when no responsibilities have been identified or defined. The presence of a risk committee is not significantly associated with *Risk Maturity*, again suggesting that many firms establish these committees for symbolic reasons.

When we introduce *Overall Board Involvement* as an additional predictor in Model 2, the adjusted R<sup>2</sup> increases from 0.182 to 0.512 and the risk responsibility indicators become

insignificant. This evidence indicates that the influence of Board risk oversight comes through active Board involvement in risk oversight activities rather than the establishment of Board responsibilities alone. A one standard deviation increase in the extent of Board involvement is associated with a 0.65 standard deviations increase in the natural logarithm of the risk maturity score. Model 3 replaces *Overall Board Involvement* with its four components. The adjusted R<sup>2</sup> increases further to 0.549. The coefficients on all four of the variables are positive and highly significant. Untabulated F-tests reveal that *Board Understanding* and *Board Alignment* are more strongly related to *Risk Maturity* than *Board Reporting* or *Board & Risk Manager Communication*. The coefficient on *Roles Not Defined* is negative and statistically significant in Model 3, while the coefficients on the other two responsibility variables remain insignificant, providing some evidence that failure to formally assign roles and responsibilities for risk oversight has a negative direct effect on *Risk Maturity*.

Several of the Board characteristic and country-level governance variables are significant after including the oversight involvement variables, indicating that these governance mechanisms influence risk management activities independent of Board oversight practices. The significantly positive relation between the fraction of female directors on the Board and risk maturity found in all of the models in Panel A of Table 5, together with the earlier results, suggest that female directors impact risk management maturity both directly and indirectly through their influence on Board oversight. Consistent with the hypothesis that directors' financial expertise facilitates risk management (Dionne & Triki 2005; Fernandes & Fich 2013; Minton et al. 2014), risk management processes are more mature in firms that have more financially-educated directors. This result stands in contrast to the negative association between financial expertise and *Board Understanding* in Table 4. Finally, the models provide some evidence that shareholder rights are

*negatively* related to risk management maturity, complementing John et al.'s (2008) finding of greater risk-taking in countries with stronger shareholder protection.

Few of the other control variables are consistently significant, especially when controlling for Board oversight. The one exception is firm size, which is positively related to risk maturity in all three models. Firms that experienced a risk event in the past that undermined the viability of the company have risk management processes that are less mature than those of other companies. We continue to find no significant association between the NYSE indicator and risk management practices.

Although the Board responsibility indicators are at best weakly associated with risk maturity after including the Board oversight involvement variables, they may still have significant *indirect* effects on risk maturity through their influence on Board risk oversight involvement. We examine the possibility of significant indirect effects by estimating a structural equations path model with the Board role indicators (as well as our control variables) having direct effects on *Risk Maturity*, as well as mediated, indirect effects on this variable through *Overall Board Involvement*.

Panel B of Table 5 summarizes the estimated indirect effects of the oversight variables through risk maturity. The Board responsibility variables have significant indirect effects on risk maturity through oversight involvement, with their impact differing by the location of responsibility. Consistent with their influence on Board oversight involvement, the indirect effects of risk responsibility on risk maturity is greatest when roles are defined at both the Board and committee levels, and become progressively smaller when roles are defined at the Board level alone, the committee level alone, or not at all. The presence of a standalone risk committee continues to have no significant association with risk maturity. With the exception of the insignificant risk committee results, the significant direct oversight involvement and indirect

oversight location effects are consistent with Board oversight playing a substantive role in promoting enhanced risk management.

#### 4.4 Board Risk Oversight and Risk Management as Predictors of Firm Risk

Table 6 reports the results of tests relating our Board risk oversight and risk management maturity variables to three proxies of future firm risk: total stock return volatility, idiosyncratic return volatility, and tail risk. All risk proxies are computed over the year following the survey response. We estimate the following equation with industry fixed effects, year fixed effects, and standard errors clustered by country:

$$\text{Firm Risk} = f(\text{Risk Maturity, Overall Board Involvement, Roles Not Defined, Roles Defined Committee Only, Roles Defined Board Only, Risk Committee, Board Governance, Country Governance, Other Controls}) \quad (3)$$

The results in Panel A of Table 6 indicate that *Overall Board Involvement* has a significant negative association with all three risk measures when *Risk Maturity* is not included in the model. However, these significant relations disappear after controlling for risk management maturity, which enters the models with significant negative coefficients. A one standard deviation increase in the natural logarithm of the risk maturity score is associated with a between 0.07 (for *Tail Risk*) and 0.12 (for *Idiosyncratic Return Volatility*) standard deviations decrease in firm risk. This compares to a between 0.14 and 0.18 standard deviations decrease in firm risk for a one standard deviation increase in return on assets. The insignificant relation between Board risk oversight involvement and future firm risk after controlling for risk management maturity indicates that Board oversight *in itself* does not have a substantial direct influence on risk-taking. Similarly, we find *no* evidence that the location of Board risk oversight responsibilities has a significant direct effect on firm risk. Thus, any impact of Board oversight practices on risk-taking would have to come through their influence on the maturity of the risk management process.



Consistent with prior studies, a number of Board characteristics exhibit significant direct effects on future volatility. Boards with outside chairpersons and Boards with fewer busy directors (common proxies for “stronger” Boards) are associated with lower volatility, although the fraction of outside directors on the Board has an unexpected positive association with firm risk. Thus, at least some Board characteristics appear to directly influence risk-taking, even after taking the firm’s risk oversight and risk management practices into account. None of the country-level governance proxies is a significant predictor of firm risk in our sample, contrary to John et al.’s (2008) findings using a larger, more diverse sample and different risk measures.

The associations between the financial control variables and volatility are generally consistent with the findings in Bartram et al. (2012) and Lin et al. (forthcoming). Stock return volatility is lower in larger, more profitable, and dividend-paying firms and firms with lower growth opportunities (i.e., higher book-to-market ratios). On the other hand, R&D intensive firms and companies with larger cash holdings have higher future volatility.

Firms that experienced a significant risk event in the past two years remain riskier than their peers. The fact that these firms exhibit no differences in Board oversight involvement, have lower risk maturity scores, and experienced higher future volatility suggest that the highly observable act of formally defining Board risk oversight roles may represent a symbolic response to external pressure to demonstrate the issue is being addressed, rather than a substantive effort to improve risk management.

Even though the NYSE listing requirements specify that the Board audit committee reviews risk management activities, we find only weak evidence that NYSE-listed firms experience lower future volatility. The NYSE indicator is significantly negatively related to idiosyncratic volatility but not to aggregate volatility or tail risk.

Although the Board oversight variables have no significant *direct* effect on firm risk after controlling for risk management maturity, it could still be the case that they have a significant *indirect* effect through their association with risk maturity. We examine this possibility by estimating a structural equations path model with the Board role indicators and *Overall Board Involvement* variable (as well as our control variables) having direct effects on volatility, as well as mediated indirect effects through *Risk Maturity*. Panel B of Table 6 summarizes the estimated indirect effects of the oversight variables on the volatility and tail risk measures through risk maturity. The Board oversight responsibility variables are not significant, while the coefficient on *Overall Board Involvement* is negative and significant using all three risk measure. These results imply that the only effect Board oversight responsibilities have on firm risk-taking is through their influence on the extent of Board oversight involvement, and that Board oversight involvement only influences risk-taking by promoting the implementation of more sophisticated risk management processes.

## 5. Additional Analyses and Robustness Checks

### 5.1 Board Risk Oversight and Risk Management as Predictors of Firm Performance

The analyses in Section 4 document that stronger Board risk oversight involvement and more mature risk management process are associated with lower firm risk in the future. On the one hand, the decrease in firm risk might reflect the reduction of risks which the firm has no comparative advantage bearing and for which it does not expect to earn compensating returns (Nocco and Stulz 2006). In this case, the effect on future performance is expected to be positive. On the other hand, risk-averse management might manage risk down to a level that is too conservative from a diversified shareholder's perspective (e.g., Amihud and Lev 1981), leading to negative share price performance as management passes up risky but valuable investment

projects. To examine these conflicting predictions, we test whether the decrease in firm risk associated with more sophisticated risk oversight and risk management practices has implications for future share price performance.<sup>13</sup> We measure stock return performance as the buy-and-hold return over the year following the date of survey participation. All regressions include industry and year fixed effects and standard errors clustered by country.

$$\text{Stock Return Performance} = f(\text{Risk Maturity, Overall Board Involvement, Roles Not Defined, Roles Defined Committee Only, Roles Defined Board Only, Risk Committee, Board Governance, Country Governance, Other Controls}) \quad (4)$$

Model 1 of Table 7 shows that higher levels of Board risk oversight involvement are associated with *better* future share price performance when not controlling for risk maturity. Model 2 documents that risk management maturity is also related to higher share price performance when not controlling for *Overall Board Involvement*. When both *Overall Board Oversight Involvement* and *Risk Maturity* are both included (Model 3), neither of the two variables is individually significant. However, an F-test rejects the hypothesis that *Board Oversight Involvement* and *Risk Maturity* are jointly insignificant ( $p = 0.0685$ ), indicating that the Board's involvement in risk oversight and risk management maturity together explain a significant amount of the variation in future stock returns. In two of the three specifications, *Roles Defined Board Only* is positively and significantly related to future share price performance, suggesting that Boards that retain total oversight responsibility appear to be more focused on using ERM to enhance value (a strategic issue) rather than simply emphasizing risk reduction, which may be better achieved through committees that focus on specific types of risks (Lipton, 2014).

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<sup>13</sup> If stock market investors can identify and assess companies' risk oversight and risk management processes prior to the beginning of our sample period, we expect to find no relation between our risk oversight and risk management proxies and future share price performance.

Taken together, these results are inconsistent with Board oversight and risk management activities leading firms to pass up risky but valuable investment opportunities, or reducing firm risk-taking to a level that is too conservative from a diversified shareholder's point of view. The results are more consistent with Board risk *oversight* (and to a lesser extent risk *management*) actually increasing firm value, as reflected in higher future share price performance.

## 5.2 Instrumental Variables Regressions

The results presented in section 4 are subject to two different interpretations. First, extensive Board risk oversight motivates executives to develop and maintain more mature risk management processes, which in turn lead to lower firm risk. The second interpretation is that Board risk oversight, risk management maturity, and firm risk are jointly determined by unobservable risk preferences of the firm. While it is difficult to empirically distinguish between these two interpretations, we conduct two additional analyses to confirm that the results in section 4 are not entirely driven by unobserved firm characteristics. In this section, we re-estimate the relation between Board risk oversight involvement and risk maturity using instrumental variables (IV) techniques. In the next section, we test whether the relation between risk management maturity and firm risk is driven by reverse causality.

We instrument the extent of Board risk oversight involvement using industry-level rankings of directors' and officers' perceived personal liability for risks, relative to the perceived importance of the other top risks the firms face. The rankings are drawn from Aon's 2011 Global Risk Management Survey, a separate confidential survey of 960 firms. Respondents were asked to identify their top ten risks, from a list of 50 risks in seven categories: financial (e.g., stock price volatility), external (e.g., climate change), corporate (e.g., damage to reputation), operational (e.g., business interruption), information technology (e.g., computer hacking),

crime/security (e.g., terrorism, employee crime), and human capital (e.g., failure to attract and retain talent). The relative industry rankings are based on the percentage of respondents in an industry that identified a given risk as being among their top ten.

We focus on directors' and officers' perceived personal liability risk because this risk is most directly related to external pressure for directors' personal involvement in risk oversight. Although the out-of-pocket liability risk for outside directors historically has been small in the United States due to director and officer insurance and indemnification (Black et al. 2006a), the current regulatory climate and public pressure for scrutiny has created a heightened risk of legal action against directors, as well as increased pressure to hold directors personally liable for judgments (Bebchuk et al. 2006; Laux 2010). For example, following the General Motors ignition switch crisis, several lawsuits were filed by G. M. shareholders against current and former board members for failing to exercise their fiduciary duty to oversee management. Similarly, in the aftermath of the 2008 financial crisis, the Boards of Directors of Citigroup and Goldman Sachs were sued for encouraging and failing to control excessive risk taking by the banks' employees. In addition to potential financial penalties, litigation also entails other costs for directors such as loss of reputation and the emotional burden, time, and aggravation associated with being a defendant in a lawsuit (Bebchuk et al. 2006; Black et al. 2006a, 2006b). These potential costs lead many commentators to argue that increased director liability risk induces greater board oversight (Laux 2010).

The exclusion restriction in IV estimation requires that directors' personal liability risk only influences risk management maturity through its effect on Board risk oversight involvement. This assumption is likely violated when directors' perceived liability risk is measured at the firm level: unobservable firm characteristics that influence risk management maturity might also be related to firm choices – for example the purchase of director and officer liability insurance – that impact

perceived personal liability risk. Our use of an industry rather than firm-specific proxy for personal liability risk mitigates concerns that this proxy reflects endogenous choices made by the individual firms in our sample.<sup>14</sup> We recode the ranking of the importance of director and officer liability risk such that higher values of the variable *Personal Liability Risk* imply greater perceived risk. We re-estimate Model 2 of Table 4 with two-stage least squares (2SLS) using *Personal Liability Risk* as an instrument for *Overall Board Involvement*.

In column 1 (2) of Table 8, we present the estimation results for the first (second) stage of the 2SLS procedure. In column 1, the positive and statistically significant coefficient on *Personal Liability Risk* implies that our instrument is a reliable predictor of Board risk oversight involvement. The F-statistic for the excluded instrument in the first-stage regression is 8.83 ( $p = 0.0062$ ) which – despite the small sample size – is only slightly below the cut-off value of 8.96 specified in Stock, Wright, and Yogo (2002). Hence, we believe that our instrument satisfies the relevance condition.

Column 2 of Table 8 presents the results of the second-stage IV regression. In line with the inferences drawn from Table 5, Board risk oversight involvement is positively and significantly related to risk management maturity. This finding mitigates concerns that the observed relation between Board risk oversight involvement and risk maturity is due to these practices being jointly determined by unobservable firm characteristics such as risk preferences. Consistent with the results in column 2 of Table 5, risk management maturity is unaffected by the allocation of risk oversight responsibilities when controlling for Board risk oversight involvement.

### 5.3 Reverse Causality Test

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<sup>14</sup> Because respondents to the Global Risk Management Survey were not informed that their responses would be used for academic research purposes, we were only provided with summary, industry-level results, and not with responses by individual firms.

An alternative interpretation of the association between higher risk maturity and lower risk is that less risky firms put in place more mature risk management processes. In order to mitigate concerns about reverse causality, we rely on survey evidence indicating that many firms implemented their ERM systems during the recent financial crisis (e.g., McKinsey 2013, 2014). If less risky firms increased Board risk oversight and implemented more sophisticated ERM systems during the crisis, we should observe significant negative associations between pre-crisis firm risk and our post-crisis oversight involvement and risk management maturity variables. In Table 9, we regress *Risk Maturity* and *Overall Board Involvement* on the three risk proxies measured over the year 2007 and the control variables collected for year-end 2006.<sup>15</sup> The control variables include the same Board composition proxies, country-level governance indicators, firm-level financials, and industry fixed effects as those included in Tables 4 and 5. Control variables results are not tabulated to simplify presentation. As shown in Table 9, we find no evidence that firm risk in 2007 predicts the extent of post-crisis risk oversight involvement or the maturity of risk management processes. These findings mitigate concerns that the negative relation between risk management maturity and future firm risk is driven by reverse-causality.

#### 5.4 Alternative Proxy for Overall Board Involvement

When constructing proxies for Board involvement in risk oversight, we assume that the respondents who completed the Aon survey were well informed about the Board's understanding of risks and risk management strategies, the frequency and content of risk reports, the agreement between the management team and the Board regarding corporate risk management strategy, and communications between risk leaders and directors outside Board meetings. Two factors support this assumption. First, the respondents represent high-level managers who are actively involved

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<sup>15</sup> We measure control variables for the year 2006 to ensure that the controls do not subsume the effect of firm risk on *Board Oversight Involvement* and *Risk Maturity*.

in the firms' risk management activities, and Aon took great pains to confirm that potential respondents had the requisite knowledge of the firm's risk management processes and management interactions with the Board needed to answer the survey questions. Second, our validity tests indicate that the risk oversight and risk maturity constructs are significantly associated with related firm risk disclosures, supporting the two constructs' convergent validity.

Nevertheless, we conduct additional analyses to examine the sensitivity of our results to potential measurement error in *Overall Board Involvement*. To do so, we re-compute *Overall Board Involvement* using the two individual oversight involvement proxies that should be of highest accuracy: *Board Reporting* (since management is responsible for supplying risk reports to the Board) and *Board & Risk Manager Communication* (since the respondents, who are senior managers actively involved in risk management, should know whether the Board engages risk leaders outside of regular Board meetings). The revised *Overall Board Involvement* construct represents the average of the standardized scores on *Board Reporting* and *Board & Risk Manager Communication*. In untabulated analyses, Board risk oversight involvement remains positively associated with risk maturity, with higher levels of Board involvement predicting more mature risk management processes (coefficient = 0.207,  $t = 11.30$ ). Similarly, Board oversight involvement continues to have no *direct* relation to future firm risk when controlling for risk management maturity, but still has a significant *indirect* effect through its significant association with risk management maturity (coefficient = -0.0006,  $t = -3.31$ ). These findings suggest that our results are not driven by survey respondents who were not sufficiently informed about the Board of Director's risk oversight practices to accurately answer the Board-related survey questions.

## 6. Conclusions



Our examination of the influence of Board risk oversight on risk management maturity and risk-taking finds that Board risk oversight involvement become more sophisticated as the level and breadth of defined oversight roles increases. While firms that fail to formally assign Board risk oversight roles experience the lowest level of Board understanding of and involvement in risk oversight, the most sophisticated Board risk oversight practices are found in firms that have established oversight responsibilities at the Board *and* committee levels. Consistent with Board oversight playing a substantive role in firm activities, we find greater risk oversight involvement associated with more mature risk management processes, and greater risk management maturity associated with lower future risks (without sacrificing firm performance). Although Board risk oversight has no significant direct effect on risk-taking, it has a significant indirect effect through its promotion of stronger risk management processes.

This study makes two primary contributions to the governance literature. First, we provide some of the first empirical support for claims that the formal assignment and allocation of Board responsibilities for risk oversight is an important prerequisite for sophisticated Board risk oversight practices. These results complement the limited prior research on Board committee structure by documenting how responsibilities for risk-oversight are allocated between committees and the Board as a whole and examining the consequences of these allocation decisions for the quality of Board risk oversight and risk management. More importantly, our findings that Board risk oversight involvement has a direct positive effect on risk management maturity and significant negative indirect effect on corporate risk-taking provides support for claims that the Board of Directors provides the foundation for effective ERM systems by setting the “tone at the top” and establishing the oversight needed to ensure that the process is embedded in the organization’s ongoing activities.

Second, we respond to calls for researchers to get into the “black box” of corporate governance in an effort to better understand how Board practices affect organizational outcomes (Adams et al., 2010). While direct evidence on the Board’s monitoring role is rare, our tests begin to provide insight into the processes Boards follow in monitoring a specific but important corporate activity: risk management. Furthermore, our results indicate that Board oversight practices provide incremental ability to explain risk management maturity and firm risk-taking over and above common Board composition variables, suggesting that Board oversight practices represent an important and distinct dimension of corporate governance.

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## Appendix A. Variable definitions

Variable	Definition	Source
Roles Not Defined	Indicator variable equal to 1 if board roles and responsibilities with respect to risk management are not defined and equal to 0 otherwise	Survey
Roles Defined	The inverse of Roles Not Defined	Survey
Roles Defined Committee Only	Indicator variable equal to 1 if board roles and responsibilities with respect to risk management are defined at the committee level and equal to 0 otherwise	Survey
Roles Defined Board Only	Indicator variable equal to 1 if board roles and responsibilities with respect to risk management are defined at the board level and equal to 0 otherwise	Survey
Roles Defined Board & Committee	Indicator variable equal to 1 if board roles and responsibilities with respect to risk management are defined both at the committee level and at the board level and equal to 0 otherwise	Survey
Risk Committee	An indicator variable equal to 1 if the Board has a dedicated, separate risk committee and equal to 0 otherwise.	BoardEx, company disclosures
Board Understanding	Constructed as the average across standardized (mean=0, SD=1) responses to survey questions that relate to board understanding of the organization's top risks, its existing risk management activities, and its risk appetite	Survey
Board Reporting	Constructed as the average across standardized (mean=0, SD=1) responses to survey questions that relate to board reporting on the organization's risk profile (key risks and associated risk activities, emerging risks, risk drivers and underlying causes, risk ownership responsibilities and accountabilities, risk management action plans and outcomes, risk performance metrics/trends) and to the frequency of reporting on risk management to the entire Board and/or to board committees	Survey
Board Alignment	Constructed as the average across standardized (mean=0, SD=1) responses to survey questions that relate to whether the board and management have reached consensus on the overall risk management strategy for the organization	Survey
Board & Risk Manager Communication	Indicator variable equal to one if the risk management leader engages board members in dialogue outside of normal reporting requirements and appearances and equal to zero otherwise	Survey
Overall Board Risk Oversight Involvement	Average of the standardized values of the four preceding variables	Survey
Personal Liability	Constructed from industry-level rankings of directors' and officers' perceived personal liability for risks, relative to the perceived importance of the other top risks the firms face. The variable is recoded such that higher values imply greater perceived importance of personal liability.	Survey
Risk Maturity	Natural logarithm of a risk maturity score that is based on AON's Risk Maturity Index, excluding questions related to the Board's involvement in risk management	Survey

Shareholder Rights	Country-level index of six shareholder protection rules, counting the number of protection mechanisms that are available. These shareholder protection mechanisms are: shareholder can mail their proxy vote to the firm; shareholders do not have to deposit their shares prior to the shareholder meeting; cumulative voting or proportional representation at Director elections; minority shareholders can challenge fundamental management decisions; existing shareholders have preemptive rights to new share issues; minimum ownership to call special meeting is less than or equal to 10%	Spamann 2010
Rule of Law	Composite score of indicators that measure the extent to which agents have confidence in and abide by the rules of society. These include perceptions of the incidence of crime, the effectiveness and predictability of the judiciary, and the enforceability of contracts	Kaufmann et al. 2004
Creditor Rights	Index aggregating different creditor rights. The index is formed by adding 1 when (1) the country imposes restrictions, such as creditors' consent or minimum dividends to file for reorganization; (2) secured creditors are able to gain possession of their security once the reorganization petition has been approved; (3) secured creditors are first in the distribution of the proceeds that result from the disposition of the assets of a bankrupt firm; and (4) the debtor does not retain the administration of its property pending the resolution of the reorganization.	Djankov et al. 2007
Ln(Disclosure Quality)	The natural logarithm of an index measuring average financial disclosure quality by country. Constructed on the basis of the prevalence of disclosures concerning research and development expenses, capital expenditures, product and geographic segment data, subsidiary information, and accounting methods.	Bushman et al. 2004
Ln (Board Size)	The natural logarithm of the number of Board members	BoardEx
Outside Directors	The fraction of outside directors on the Board	BoardEx
Outside Chair	In indicator variable that is equal to 1 if the chairman of the board is not an executive of the firm and equal to 0 otherwise	BoardEx
Female Directors	The fraction of female directors on the Board	BoardEx
Busy Outside Directors	The fraction of busy (more than two Board appointments) non-executive directors on the Board	BoardEx
Financial Education	The fraction of directors with a finance or accounting related education or an MBA.	BoardEx
Ln (Market Cap)	The natural logarithm of market capitalization.	FactSet / Compustat
ROA	The return on assets calculated as net income over total assets	Global (CG)
Book / Market	The ratio of the book value of equity to the market value of equity.	FactSet / CG
Debt / Assets	The sum of long term debt and short term debt scaled by total assets.	FactSet / CG
Dividend Payer	An indicator variable equal to 1 if the firm pays dividends and equal to 0 otherwise	FactSet / CG
R&D / Assets	Research and development expenditures scaled by total assets.	FactSet / CG
PPE / Assets	The book value of property, plant, equipment scaled by total assets.	FactSet / CG
Cash / Assets	The book value of cash and short term investments scaled by total assets.	FactSet / CG
Sales Growth	The change in sales from year t-1 to year t scaled by sales in year t-1.	FactSet / CG

Volatility	The standard deviation of daily stock returns over the year following the survey response.	CRSP / CG
Idiosyncratic Volatility	The standard deviation of the residuals from a market model over the year following the survey response.	CRSP / CG
Stock Return Performance	The Buy-and-hold stock return over the year following the survey response.	CRSP / CG
NYSE	Indicator variable equal to 1 if the company is listed on the New York Stock Exchange and equal to 0 otherwise	Hand collection
Experienced Risk Event	Indicator variable equal to 1 if the firm experienced a risk event over the past two years that had the potential to threaten the long-term viability of the company and equal to 0 otherwise	Survey
Geographic Regions	The number of geographic regions that the company operates in (Asia-Pacific (Non Australia / New Zealand); Australia / New Zealand; Central America & Caribbean; Europe (Eastern); Europe (Western); Middle East / Africa; North America; South America)	Survey
Zero Returns	The fraction of trading days during the year following the survey response on which the stock return is equal to 0.	CRSP / CG

## Appendix B. Survey Questions and Descriptive Statistics for Board Risk Management Practices

### A. Indicators for the Board’s risk oversight responsibilities:

Not defined or understood	6.7%
Defined in specific committee charters	45.8%
Defined for the Board as a whole	13.5%
Defined in specific committee charters and for the Board as a whole	34.0%

### B. Indicators for Board Understanding construct

Board understanding of the organization’s top risks is:

N/A; not discussed	1.7%
Inconsistent	12.1%
Consistent	86.2%

Board understanding of the organization’s existing risk management activities for key risks is:

N/A; not discussed	4.7%
Inconsistent	17.9%
Consistent	77.4%

Board understanding of the organization’s quantified risk appetite (i.e., the amount of risk the organization is willing and able to take) is:

N/A; not discussed	21.6%
Inconsistent	29.3%
Consistent	49.2%

Board understanding of the organization’s emerging risk profile is:

N/A; not discussed	9.8%
Inconsistent	29.0 %
Consistent	61.3%

### C. Indicators for Board Reporting Content and Frequency construct

Board reporting on the organization’s risk profile includes: (check any and all that apply)

1. Key risks and associated risk management activities	93.6%
2. Risk drivers and underlying causes	58.6%
3. Risk ownership responsibilities and accountabilities	75.8%
4. Risk management action plans and outcomes	68.0%
5. Risk tolerances and thresholds / limits	36.7%
6. Risk performance metrics / trends	39.7%
7. Information on emerging risks	63.0%

The full Board receives risk reports:

Infrequently or not on a predefined schedule	15.5%
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At least annually	39.1%
At least twice yearly	20.5%
Quarterly or more frequently	24.9%
Board Committees (with risk management oversight responsibilities) receive risk reports:	
Infrequently or not on a predefined schedule	11.8%
At least annually	24.6%
At least twice yearly	22.9%
Quarterly or more frequently	40.7%

#### **D. Indicators for Board and Management Alignment on Objectives**

The Board and executive management have reached consensus on the overall risk management strategy for the organization:

No, overall strategy has not been discussed	13.5%
Yes, informal consensus has been reached	56.9%
Yes, with established and documented objectives for improving risk management	29.6%

Communications from the Board and executive management highlight the alignment of risk management strategy with overall strategy:

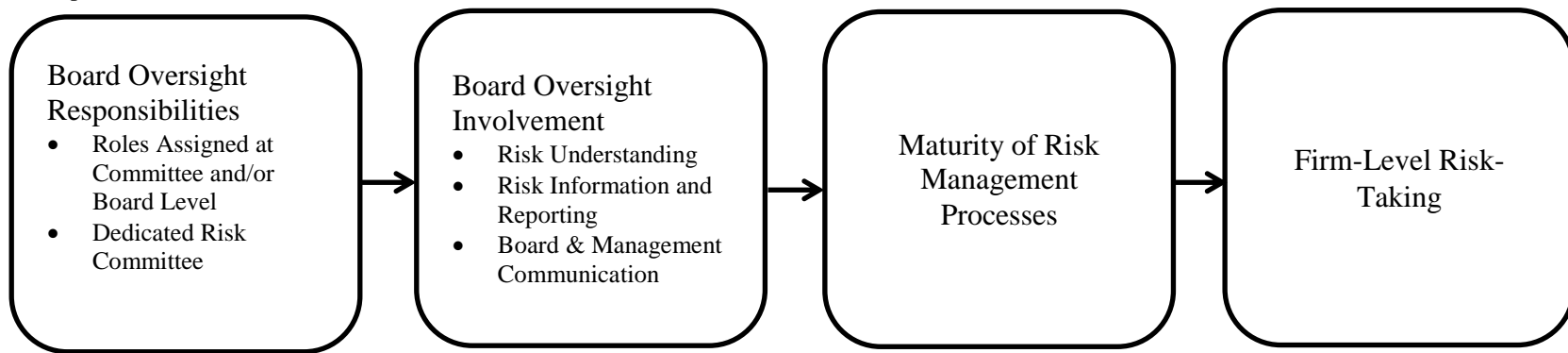
No, communications do not highlight alignment	33.7%
Yes, and include informal references to concepts of risk appetite and tolerance	52.2%
Yes, and include formal references to defined risk appetite and tolerances	14.1%

#### **E. Indicator for Board and Risk Management Leader Communications**

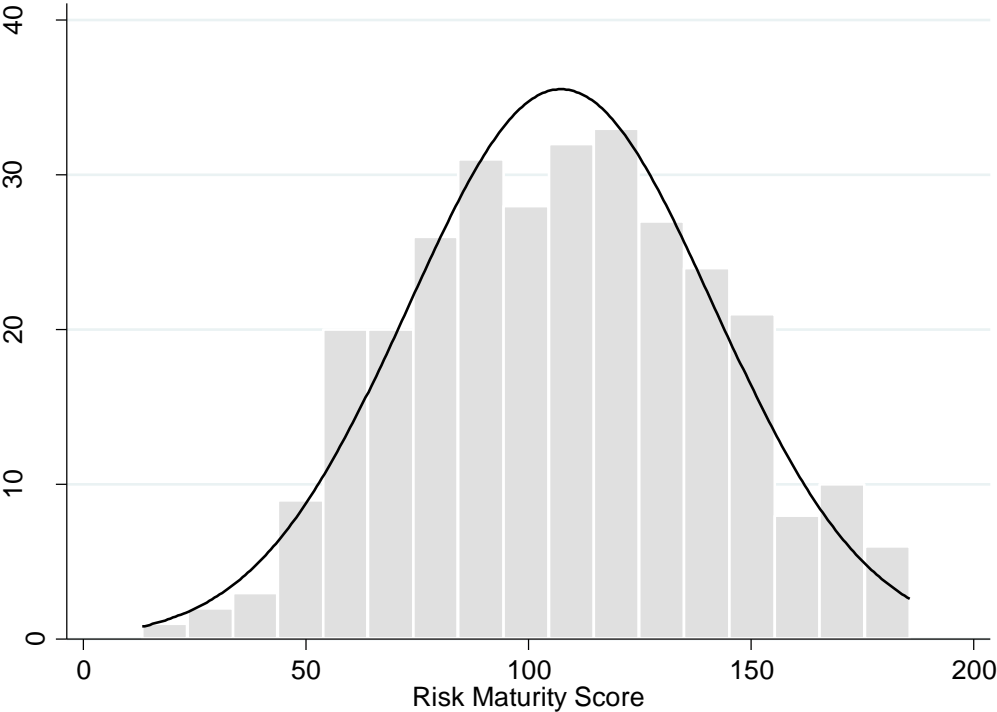
Does the Risk Management Leader engage Board members in dialogue outside of normal reporting requirements and appearances at meetings?

No	49.2%
Yes	50.8%

**Figure 1**  
Conceptual framework



**Figure 2**  
Histogram of *Risk Maturity Score* overlaid with a normal density



**Table 1**

## Sample composition by country and industry

This table reports the composition of the Aon survey sample used in this study by country (Panel A) and by industry (Panel B). The sample includes 297 listed companies surveyed by Aon. Industry groups are based on the 12 Fama & French industries, which we adapt by adding three additional industry groups: Construction, Education, and Logistics.

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*Panel A: Number and percentage of sample firms by country*

	Frequency	Percent
Australia	26	8.75
Austria	2	0.67
Belgium	7	2.36
Brazil	5	1.68
Canada	12	4.04
Denmark	1	0.34
Finland	7	2.36
France	2	0.67
Germany	6	2.02
Hong Kong, China	2	0.67
India	6	2.02
Ireland	1	0.34
Mexico	1	0.34
Netherlands	7	2.36
New Zealand	2	0.67
Norway	2	0.67
Pakistan	1	0.34
Philippines	3	1.01
Portugal	1	0.34
Singapore	2	0.67
South Africa	2	0.67
Spain	4	1.35
Switzerland	12	4.04
Taiwan	2	0.67
Thailand	1	0.34
Turkey	8	2.69
United Kingdom	18	6.06
United States	154	51.85
Total	297	100

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**Table 1** (continued)*Panel B: Number and percentage of sample firms by industry*

	Frequency	Percent
Business Equipment	21	7.07
Chemicals	26	8.75
Construction	7	2.36
Education	3	1.01
Energy	24	8.08
Healthcare	7	2.36
Logistics	7	2.36
Manufacturing	55	18.52
Financial	35	11.78
Non-Durables	18	6.06
Other	38	12.79
Professional Services	4	1.35
Retail	30	10.10
Telecommunications	10	3.37
Utilities	12	4.04
Durables	0	0
Total	297	100

**Table 2**

Summary statistics

This table presents descriptive statistics for the variables used in this study. All variables are defined in Appendix A.

	Mean	SD	25	Median	75
Roles Not Defined	0.07	0.25	0.00	0.00	0.00
Roles Defined Committee Only	0.46	0.50	0.00	0.00	1.00
Roles Defined Board Only	0.13	0.34	0.00	0.00	0.00
Roles Defined Board & Committee	0.34	0.47	0.00	0.00	1.00
Risk Committee	0.08	0.27	0.00	0.00	0.00
Overall Board Involvement	0.12	0.68	-0.34	0.20	0.61
Board Understanding	0.19	0.64	-0.17	0.44	0.76
Board Reporting	0.12	0.53	-0.20	0.15	0.54
Board Alignment	0.11	0.83	-0.58	0.17	0.66
Board & Risk Manager Communication	0.51	0.50	0.00	1.00	1.00
Risk Maturity (unlogged)	107.56	34.17	82.75	108.25	131.75
Board Size	10.16	3.16	8.00	10.00	12.00
Outside Directors	0.84	0.13	0.78	0.88	0.91
Outside Chair	0.60	0.51	0.00	1.00	1.00
Female Directors	0.13	0.10	0.06	0.13	0.20
Busy Outside Directors	0.31	0.21	0.14	0.30	0.50
Financial Education	0.38	0.18	0.25	0.38	0.50
Stock Return Volatility (t+1)	0.02	0.01	0.01	0.02	0.02
Idiosyncratic Volatility (t+1)	0.02	0.01	0.01	0.01	0.02
Tail Risk (t+1)	0.04	0.02	0.03	0.04	0.05
Stock Return Performance (t+1)	0.16	0.31	-0.01	0.16	0.31
Market Cap	13253.32	30717.76	1284.98	3324.10	8962.99
ROA	0.05	0.07	0.02	0.05	0.08
Book / Market	0.60	0.54	0.32	0.49	0.84
Debt / Assets	0.27	0.18	0.15	0.25	0.37
Dividend Payer	0.73	0.44	0.00	1.00	1.00
R&D / Assets	0.01	0.03	0.00	0.00	0.01
PPE / Assets	0.31	0.24	0.11	0.26	0.45
Cash / Assets	0.12	0.12	0.04	0.08	0.16
Sales Growth	0.15	0.42	-0.00	0.08	0.16
Zero Returns	0.05	0.07	0.01	0.03	0.07
NYSE	0.39	0.49	0.00	0.00	1.00
Experienced Risk Event	0.25	0.43	0.00	0.00	0.00
Geographic Regions	4.55	2.88	2.00	4.00	8.00
Shareholder Rights	3.02	1.19	2.00	2.00	4.00
Creditor Rights	1.62	1.01	1.00	1.00	2.00
Rule of Law	1.75	0.58	1.92	1.92	1.93
Disclosure Quality	89.39	10.12	87.32	87.32	100.00

**Table 3****Correlations**

This table presents Pearson's correlation coefficients among the main variables used in this study. \* denotes statistical significance at the 5% level.

All variables are defined in Appendix A.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) Roles Not Defined																	
(2) Roles Defined Committee Only	-0.25*																
(3) Roles Defined Board Only	-0.11	-0.36*															
(4) Roles Defined Board & Committee	-0.19*	-0.66*	-0.28*														
(5) Risk Committee	-0.08	0.04	-0.11*	0.08													
(6) Overall Board Involvement	-0.31*	-0.23*	0.10	0.33*	0.06												
(7) Risk Maturity	-0.29*	-0.16*	0.05	0.28*	-0.01	0.67*											
(8) Ln(Board Size)	-0.09	0.05	-0.01	0.00	-0.05	0.09	0.16*										
(9) Outside Directors	-0.13*	-0.02	-0.06	0.12*	-0.00	0.01	0.06	-0.09									
(10) Outside Chair	-0.05	0.01	0.12*	-0.07	0.03	0.10	0.04	-0.05	0.02								
(11) Female Directors	-0.18*	-0.08	0.03	0.16*	-0.01	0.07	0.17*	0.10	0.30*	-0.00							
(12) Busy Outside Directors	-0.07	0.06	-0.12*	0.06	0.06	0.06	0.10	0.07	0.08	0.05	0.07						
(13) Financial Education	-0.08	0.06	-0.15*	0.09	-0.06	-0.04	0.06	-0.17*	0.20*	0.02	0.04	0.20*					
(14) Stock Return Volatility (t+1)	0.17*	-0.06	-0.06	0.03	-0.02	-0.13*	-0.17*	-0.13*	0.05	-0.16*	-0.11	0.02	0.03				
(15) Idiosyncratic Volatility (t+1)	0.19*	-0.07	-0.02	-0.01	0.00	-0.14*	-0.20*	-0.16*	0.00	-0.09	-0.12*	-0.03	-0.01	0.94*			
(16) Tail Risk (t+1)	0.14*	-0.08	-0.05	0.05	-0.03	-0.12	-0.15*	-0.14*	0.07	-0.16*	-0.11	0.05	0.04	0.97*	0.90*		
(17) Stock Return Performance (t+1)	0.04	0.04	0.14*	-0.16*	-0.06	0.03	0.03	0.10	-0.12	0.13*	0.06	-0.11	-0.09	-0.37*	-0.29*	-0.49*	
(18) Ln(Market Cap)	-0.20*	0.01	-0.12*	0.18*	0.03	0.15*	0.28*	0.50*	0.14*	-0.04	0.20*	0.31*	-0.02	-0.29*	-0.33*	-0.25*	-0.09

**Table 4**

## Analysis of the Board of Director's Involvement in Risk Oversight Activities

This table reports analyses of the different dimensions of Board risk oversight activities. The survey construct *Board Understanding* relates to board understanding of the organization's top risks, its existing risk management activities, and its risk appetite. *Board Reporting* relates to board reporting on the organization's risk profile and to the frequency of reporting on risk management to the entire Board and/or to board committees. *Board Alignment* relates to whether the board and management have reached consensus on the overall risk management strategy for the organization. *Board & Risk Manager Communication* is an indicator variable equal to one if the risk management leader engages board members in dialogue outside of normal reporting requirements and appearances and equal to zero otherwise. *Overall Board (Risk Oversight) Involvement* represents the average across the four preceding variables. Models 1 through 4 are estimated using OLS. Model 5 is estimated using logit regression. All independent variables are defined in Appendix A. Industry fixed effects are included in all models but the education industry is omitted from Model 5 because in non of the sample firms in that industry do Board members and the risk manager communicate outside of the regular Board meetings. Test statistics based on standard errors clustered by country appear in parentheses below the coefficient estimates. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% level, respectively (two-tailed). Wald tests comparing the differences in coefficients for *Roles Not Defined*, *Roles Defined CommitteeOnly*, *Roles Defined Board Only* are reported at the bottom of the table.

	Overall Board Involvement	Board Understanding	Board Reporting	Board Alignment	Board & Risk Manager Communication
	1	2	3	4	5
Roles Not Defined <sup>(1)</sup>	<b>-1.099***</b> (-7.57)	<b>-0.796***</b> (-3.03)	<b>-0.959***</b> (-10.14)	<b>-0.988***</b> (-6.91)	<b>-1.249***</b> (-3.16)
Roles Defined Committee Only <sup>(2)</sup>	<b>-0.449***</b> (-8.83)	<b>-0.220***</b> (-4.59)	<b>-0.241***</b> (-6.65)	<b>-0.514***</b> (-8.59)	<b>-1.169***</b> (-5.46)
Roles Defined Board Only <sup>(3)</sup>	<b>-0.172*</b> (-1.76)	0.102 (1.52)	<b>-0.181*</b> (-1.95)	-0.093 (-0.76)	<b>-0.974**</b> (-2.15)
Risk Committee	-0.051 (-0.60)	-0.103 (-1.08)	-0.055 (-0.86)	<b>-0.183*</b> (-1.71)	0.589 (1.57)
Ln(Board Size)	0.123 (0.89)	0.153 (0.87)	-0.018 (-0.23)	0.106 (0.91)	0.543 (0.98)
Outside Directors	-0.081 (-0.24)	<b>0.574**</b> (2.11)	-0.011 (-0.04)	-0.616 (-1.24)	-0.950 (-0.80)
Outside Chair	0.108 (1.38)	0.001 (0.03)	<b>0.114**</b> (2.75)	0.009 (0.11)	0.555 (1.57)
Female Directors	-0.016 (-0.06)	0.123 (0.30)	0.239 (1.50)	0.166 (0.52)	<b>-1.587*</b> (-1.65)
Busy Outside Directors	0.008 (0.05)	0.328 (1.64)	-0.065 (-0.43)	0.030 (0.12)	-0.795 (-1.14)
Financial Education	-0.269 (-1.24)	<b>-0.371**</b> (-2.23)	-0.038 (-0.24)	-0.263 (-0.84)	-0.477 (-0.66)
Creditor Rights	-0.016 (-0.15)	0.056 (0.58)	-0.002 (-0.03)	-0.038 (-0.39)	-0.200 (-0.92)
Rule of Law	-0.121 (-0.74)	-0.150 (-1.08)	0.019 (0.21)	-0.279 (-1.60)	0.034 (0.06)
Shareholder Rights	-0.045 (-0.44)	-0.061 (-0.70)	-0.043 (-0.86)	-0.006 (-0.06)	-0.065 (-0.24)
Ln(Disclosure Quality)	0.688 (1.20)	0.468 (0.94)	0.134 (0.42)	<b>1.518**</b> (2.22)	0.315 (0.15)

**Table 4** (continued)

Ln(Market Cap)	0.043 (1.44)	0.015 (0.33)	<b>0.052***</b> (2.77)	0.037 (1.13)	0.034 (0.33)
ROA	0.714 (1.12)	0.658 (1.34)	0.177 (0.34)	0.185 (0.21)	<b>4.059*</b> (1.87)
Book / Market	-0.042 (-0.65)	-0.064 (-0.74)	-0.016 (-0.27)	-0.053 (-0.66)	0.026 (0.13)
Debt / Assets	<b>0.343**</b> (2.19)	<b>0.507**</b> (2.56)	0.072 (0.32)	0.035 (0.13)	<b>1.532*</b> (1.76)
Dividend Payer	-0.022 (-0.29)	-0.015 (-0.29)	-0.011 (-0.26)	<b>-0.176**</b> (-2.08)	0.378 (1.29)
R&D / Assets	0.790 (0.68)	<b>2.476***</b> (3.14)	0.166 (0.23)	1.904 (1.09)	<b>-6.526*</b> (-1.81)
PPE / Assets	-0.160 (-1.10)	-0.133 (-1.23)	-0.148 (-1.33)	-0.183 (-0.68)	0.083 (0.27)
Cash / Assets	<b>-0.621**</b> (-2.22)	<b>-0.463*</b> (-1.99)	-0.556 (-1.67)	<b>-1.346***</b> (-4.46)	<b>2.035**</b> (2.18)
Sales Growth	-0.040 (-0.82)	0.103 (1.19)	-0.094 (-1.68)	0.082 (1.02)	<b>-0.591***</b> (-4.63)
Geographic Regions	-0.018 (-0.83)	-0.016 (-0.60)	-0.011 (-1.06)	-0.009 (-0.56)	-0.053 (-0.86)
NYSE	-0.212 (-1.60)	-0.079 (-0.85)	<b>-0.249***</b> (-4.21)	-0.042 (-0.29)	<b>-0.676*</b> (-1.65)
Experienced Risk Event	-0.015 (-0.24)	<b>-0.135**</b> (-2.40)	0.010 (0.14)	-0.075 (-0.89)	0.472 (1.42)
Observations	297	297	297	297	294
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.205	0.134	0.260	0.146	0.134
Test for differences in coefficients (p-values)					
(1) vs (2)	0.000	0.058	0.000	0.002	0.849
(1) vs (3)	0.000	0.001	0.000	0.000	0.626
(2) vs (3)	0.007	0.002	0.491	0.001	0.661

**Table 5**

## Analysis of risk maturity

This table reports analyses of organizations' Risk Maturity, which represents the natural log of the firm's risk maturity score. All Models in Panel A are estimated using OLS. Panel B presents the indirect effects of the assignment of *Board Risk Oversight Roles* (and controls) on *Risk Maturity*. These indirect effects are mediated by *Overall Board (Risk Oversight) Involvement*. The indirect effects and their standard errors are estimated via maximum likelihood in a path model. All independent variables are defined in Appendix A. In Panel A, t-statistics based on standard errors clustered by country appear in parentheses below the coefficient estimates. In Panel B, z-statistics appear to the right of the coefficients. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% level, respectively (two-tailed). Wald tests comparing the differences in coefficients for *Roles Not Defined*, *Roles Defined Committee Only*, *Roles Defined Board Only* are reported at the bottom of Panel A.

*Panel A: OLS*

	Risk Maturity		
	1	2	3
Roles Not Defined <sup>(1)</sup>	<b>-0.465***</b> (-4.94)	-0.085 (-1.70)	<b>-0.084*</b> (-1.72)
Roles Defined Committee Only <sup>(2)</sup>	<b>-0.174***</b> (-8.34)	-0.019 (-0.86)	-0.020 (-1.00)
Roles Defined Board Only <sup>(3)</sup>	-0.042 (-1.02)	0.017 (0.56)	-0.018 (-0.55)
Risk Committee	0.027 (0.37)	0.045 (0.83)	0.072 (1.32)
Overall Board Involvement		<b>0.346***</b> (15.04)	
Board Understanding			<b>0.157***</b> (4.92)
Board Reporting			<b>0.074***</b> (3.17)
Board Alignment			<b>0.172***</b> (13.02)
Board & Risk Manager Communication			<b>0.056**</b> (2.71)
Ln(Board Size)	0.109 (1.48)	0.067 (1.60)	0.063 (1.46)
Outside Directors	-0.163 (-1.06)	-0.135 (-1.07)	-0.137 (-0.96)
Outside Chair	0.060 (1.19)	0.023 (0.84)	0.044 (1.37)
Female Directors	<b>0.386**</b> (2.36)	<b>0.392***</b> (2.81)	<b>0.344**</b> (2.61)
Busy Outside Directors	0.033 (0.34)	0.030 (0.45)	-0.010 (-0.16)
Financial Education	0.088 (0.65)	<b>0.181**</b> (2.35)	<b>0.200***</b> (3.29)
Creditor Rights	0.010 (0.20)	0.015 (0.79)	0.010 (0.48)
Rule of Law	-0.095 (-1.36)	-0.053 (-1.19)	-0.025 (-0.64)

**Table 5** (continued)

Shareholder Rights	-0.066 (-1.24)	<b>-0.050*</b> (-1.87)	<b>-0.051*</b> (-1.87)
Ln(Disclosure Quality)	0.222 (0.82)	-0.016 (-0.10)	-0.125 (-0.81)
Ln(Market Cap)	<b>0.044***</b> (2.98)	<b>0.029***</b> (3.00)	<b>0.031***</b> (2.96)
ROA	0.335 (1.07)	0.088 (0.53)	0.146 (0.92)
Book / Market	-0.017 (-0.36)	-0.003 (-0.08)	0.003 (0.11)
Debt / Assets	0.142 (1.44)	0.023 (0.35)	0.036 (0.72)
Dividend Payer	-0.048 (-1.09)	<b>-0.040*</b> (-1.87)	-0.019 (-0.85)
R&D / Assets	<b>0.978*</b> (2.02)	0.704 (1.37)	0.323 (0.54)
PPE / Assets	0.137 (0.89)	0.192 (1.67)	<b>0.200*</b> (1.90)
Cash / Assets	<b>-0.391***</b> (-3.39)	<b>-0.176*</b> (-2.02)	-0.064 (-0.86)
Sales Growth	0.019 (0.80)	<b>0.033**</b> (2.39)	0.003 (0.14)
Geographic Regions	-0.001 (-0.12)	0.005 (1.20)	0.004 (1.09)
NYSE	-0.055 (-0.86)	0.019 (0.63)	-0.009 (-0.34)
Experienced Risk Event	<b>-0.061**</b> (-2.44)	<b>-0.056**</b> (-2.74)	<b>-0.033*</b> (-1.78)
Observations	297	297	297
Industry Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Adjusted R2	0.182	0.512	0.549
Test for differences in coefficients (p-values)			
(1) vs (2)	0.008	0.284	0.269
(1) vs (3)	0.002	0.170	0.334
(2) vs (3)	0.003	0.277	0.940

*Panel B: Indirect effects of Board risk oversight on risk maturity*

	Risk Maturity	
	b	z
Roles Not Defined	<b>-0.381***</b>	(-6.82)
Roles Defined Committee Only	<b>-0.155***</b>	(-7.86)
Roles Defined Board Only	<b>-0.060*</b>	(-1.96)
Risk Committee	-0.018	(-0.63)

**Table 6**

Analysis of Board risk oversight, risk maturity, and firm risk

This table reports analyses of the relation between risk oversight, risk maturity, and firm risk. All Models in Panel A are estimated using OLS. Panel B presents the indirect effects of *Board Risk Oversight Roles* and *Overall Board (Risk Oversight) Involvement* on firm risk. The indirect effects are mediated by *Risk Maturity*. The indirect effects and their standard errors are estimated via maximum likelihood in a path model. All independent variables are defined in Appendix A. In Panel A, t-statistics based on standard errors clustered by country appear in parentheses below the coefficient estimates. In Panel B, z-statistics appear to the right of the coefficients. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% level, respectively (two-tailed). Wald tests comparing the differences in coefficients for *Roles Not Defined*, *Roles Defined Committee Only*, *Roles Defined Board Only* are reported at the bottom of Panel A.

*Panel A: OLS*

	Stock Return Volatility (t+1)		Idiosyncratic Return Volatility (t+1)		Tail Risk (t+1)	
	1	2	3	4	5	6
Risk Maturity		<b>-0.002**</b> (-2.29)		<b>-0.003***</b> (-2.97)		<b>-0.004*</b> (-1.86)
Overall Board Involvement	<b>-0.001**</b> (-2.30)	-0.000 (-0.44)	<b>-0.001**</b> (-2.12)	0.000 (0.50)	<b>-0.003**</b> (-2.45)	-0.001 (-0.99)
Roles Not Defined <sup>(1)</sup>	0.003 (0.88)	0.002 (0.80)	0.003 (0.98)	0.002 (0.87)	0.004 (0.67)	0.004 (0.61)
Roles Defined Committee Only <sup>(2)</sup>	-0.001 (-0.56)	-0.001 (-0.58)	-0.001 (-0.43)	-0.001 (-0.47)	-0.003 (-0.91)	-0.003 (-0.94)
Roles Defined Board Only <sup>(3)</sup>	-0.001 (-0.87)	-0.001 (-0.83)	-0.001 (-1.12)	-0.001 (-1.08)	-0.002 (-0.64)	-0.002 (-0.61)
Risk Committee	-0.000 (-0.31)	-0.000 (-0.27)	-0.000 (-0.37)	-0.000 (-0.32)	-0.002 (-0.81)	-0.002 (-0.81)
Ln(Board Size)	0.001 (0.45)	0.001 (0.49)	0.001 (0.84)	0.001 (0.92)	0.001 (0.14)	0.001 (0.16)
Outside Directors	<b>0.009*</b> (1.95)	<b>0.009*</b> (1.85)	<b>0.007*</b> (1.81)	0.007 (1.65)	<b>0.023**</b> (2.36)	<b>0.023**</b> (2.23)
Outside Chair	<b>-0.002***</b> (-4.23)	<b>-0.002***</b> (-3.96)	<b>-0.002***</b> (-4.01)	<b>-0.002***</b> (-3.77)	<b>-0.005***</b> (-3.95)	<b>-0.005***</b> (-3.69)
Female Directors	0.001 (0.49)	0.002 (0.87)	0.001 (0.32)	0.002 (0.76)	-0.001 (-0.12)	0.001 (0.27)
Busy Outside Directors	<b>0.004*</b> (1.92)	<b>0.004*</b> (1.96)	0.002 (1.22)	0.002 (1.28)	<b>0.010**</b> (2.72)	<b>0.011***</b> (2.79)
Financial Education	-0.002 (-0.68)	-0.002 (-0.55)	-0.002 (-1.03)	-0.002 (-0.80)	-0.005 (-1.13)	-0.005 (-0.99)
Creditor Rights	-0.001 (-1.41)	-0.001 (-1.33)	-0.000 (-0.86)	-0.000 (-0.71)	-0.002 (-1.30)	-0.002 (-1.21)
Rule of Law	-0.001 (-0.69)	-0.001 (-0.77)	-0.001 (-0.98)	-0.001 (-1.11)	-0.004 (-1.25)	-0.004 (-1.30)
Shareholder Rights	0.001 (1.69)	0.001 (1.48)	0.001 (1.61)	0.001 (1.34)	0.003 (1.63)	0.003 (1.46)
Ln(Disclosure Quality)	0.003 (0.63)	0.003 (0.61)	0.004 (0.97)	0.004 (0.97)	0.010 (1.15)	0.010 (1.13)
Ln(Market Cap)	<b>-0.002***</b> (-6.73)	<b>-0.002***</b> (-6.33)	<b>-0.002***</b> (-7.84)	<b>-0.002***</b> (-7.27)	<b>-0.004***</b> (-5.93)	<b>-0.004***</b> (-5.54)



**Table 6** (continued)

ROA	<b>-0.023***</b> (-5.54)	<b>-0.023***</b> (-5.54)	<b>-0.027***</b> (-3.90)	<b>-0.026***</b> (-3.97)	<b>-0.051***</b> (-5.49)	<b>-0.050***</b> (-5.54)
Book / Market	<b>-0.005**</b> (-2.59)	<b>-0.005**</b> (-2.64)	<b>-0.005**</b> (-2.41)	<b>-0.005**</b> (-2.46)	<b>-0.012**</b> (-2.75)	<b>-0.012***</b> (-2.79)
Debt / Assets	-0.002 (-0.86)	-0.001 (-0.78)	<b>-0.003*</b> (-1.89)	<b>-0.003*</b> (-1.88)	-0.008 (-1.43)	-0.007 (-1.41)
Dividend Payer	<b>-0.006***</b> (-9.92)	<b>-0.007***</b> (-9.91)	<b>-0.006***</b> (-11.58)	<b>-0.006***</b> (-11.86)	<b>-0.015***</b> (-13.92)	<b>-0.015***</b> (-14.20)
R&D / Assets	<b>0.019**</b> (2.30)	<b>0.021**</b> (2.33)	0.018 (1.49)	0.020 (1.53)	0.023 (1.33)	0.026 (1.45)
PPE / Assets	-0.001 (-0.49)	-0.000 (-0.09)	0.001 (0.78)	0.001 (1.41)	-0.002 (-0.98)	-0.001 (-0.63)
Cash / Assets	<b>0.014***</b> (4.28)	<b>0.014***</b> (4.20)	<b>0.014***</b> (5.65)	<b>0.014***</b> (5.40)	<b>0.027***</b> (4.46)	<b>0.026***</b> (4.38)
Sales Growth	0.000 (0.17)	0.000 (0.36)	-0.000 (-0.55)	-0.000 (-0.33)	-0.000 (-0.14)	0.000 (0.01)
Geographic Regions	0.000 (0.24)	0.000 (0.33)	-0.000 (-0.86)	-0.000 (-0.74)	0.000 (0.42)	0.000 (0.50)
NYSE	-0.001 (-0.90)	-0.001 (-0.87)	<b>-0.001*</b> (-1.77)	<b>-0.001*</b> (-1.88)	0.000 (0.26)	0.000 (0.27)
Experienced Risk Event	<b>0.002**</b> (2.65)	<b>0.002**</b> (2.52)	<b>0.002**</b> (2.47)	<b>0.002**</b> (2.33)	<b>0.005**</b> (2.60)	<b>0.004**</b> (2.49)
Zero Returns	0.003 (0.27)	0.003 (0.26)	0.014 (1.27)	0.013 (1.32)	0.016 (0.53)	0.015 (0.53)
Observations	274	274	274	274	274	274
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.459	0.461	0.434	0.439	0.435	0.435
Test for differences in coefficients (p-values)						
(1) vs (2)	0.0361	0.0538	0.0444	0.0762	0.0474	0.0644
(1) vs (3)	0.141	0.170	0.113	0.146	0.273	0.313
(2) vs (3)	0.831	0.861	0.593	0.619	0.645	0.616

*Panel B: Indirect effects of Board risk oversight on firm risk*

	Return Volatility (t+1)		Idiosyncratic Volatility (t+1)		Tail Risk (t+1)	
	1		2		3	
	b	z	b	z	b	z
Roles Not Defined	0.0002	(1.45)	0.0003	(1.55)	0.0004	(1.38)
Roles Defined Committee Only	0.0000	(0.30)	0.0000	(0.30)	0.0000	(0.31)
Roles Defined Board Only	0.0000	(-0.52)	-0.0006	(-0.54)	-0.0001	(-0.51)
Risk Committee	-0.0001	(-0.56)	-0.0001	(-0.56)	-0.0001	(-0.56)
Overall Board Involvement	<b>-0.001***</b>	(-2.64)	<b>-0.001***</b>	(-3.60)	<b>-0.002**</b>	(-2.09)

**Table 7**

Analysis of Board risk oversight, risk maturity and stock return performance

This table reports analyses of the relation between risk oversight, risk maturity and firm stock return performance. All Models are estimated using OLS. All independent variables are defined in Appendix A. T-statistics based on standard errors clustered by country appear in parentheses below the coefficient estimates. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% level, respectively (two-tailed). Wald tests comparing the differences in coefficients for *Roles Not Defined*, *Roles Defined Committee Only*, *Roles Defined Board Only* are reported at the bottom of the Table.

	Buy & Hold Stock Return Performance (t+1)		
	1	2	3
Risk Maturity		<b>0.051*</b> (1.91)	-0.000 (-0.01)
Overall Board Involvement	<b>0.043**</b> (2.33)		0.043 (1.61)
Roles Not Defined <sup>(1)</sup>	0.155 (1.14)	0.135 (1.05)	0.155 (1.14)
Roles Defined Committee Only <sup>(2)</sup>	0.073 (1.19)	0.063 (1.07)	0.073 (1.19)
Roles Defined Board Only <sup>(3)</sup>	<b>0.123*</b> (1.76)	0.119 (1.69)	<b>0.123*</b> (1.75)
Risk Committee	0.058 (0.80)	0.055 (0.77)	0.058 (0.80)
Ln(Board Size)	<b>0.159**</b> (2.06)	<b>0.160**</b> (2.12)	<b>0.159**</b> (2.06)
Outside Directors	-0.243 (-1.12)	-0.243 (-1.10)	-0.243 (-1.12)
Outside Chair	<b>0.095*</b> (2.01)	<b>0.097**</b> (2.06)	<b>0.095*</b> (2.01)
Female Directors	0.227 (1.63)	0.199 (1.43)	0.227 (1.59)
Busy Outside Directors	-0.053 (-0.41)	-0.052 (-0.41)	-0.053 (-0.41)
Financial Education	0.039 (0.46)	0.025 (0.28)	0.039 (0.46)
Creditor Rights	-0.001 (-0.03)	-0.005 (-0.12)	-0.001 (-0.03)
Rule of Law	0.006 (0.09)	0.007 (0.10)	0.006 (0.08)
Shareholder Rights	-0.054 (-1.09)	-0.051 (-0.99)	-0.054 (-1.08)
Ln(Disclosure Quality)	-0.216 (-0.66)	-0.197 (-0.60)	-0.216 (-0.66)
Ln(Market Cap)	<b>-0.035***</b> (-2.88)	<b>-0.035***</b> (-2.84)	<b>-0.035***</b> (-2.82)
ROA	<b>0.415***</b> (3.05)	<b>0.427***</b> (2.88)	<b>0.415***</b> (3.04)
Book / Market	<b>0.103*</b> (2.02)	<b>0.102*</b> (2.00)	<b>0.103*</b> (2.01)

**Table 7** (continued)

Debt / Assets	0.246 (1.18)	0.249 (1.19)	0.246 (1.17)
Dividend Payer	<b>0.135***</b> (4.27)	<b>0.136***</b> (4.24)	<b>0.135***</b> (4.29)
R&D / Assets	0.143 (0.24)	0.139 (0.23)	0.144 (0.24)
PPE / Assets	0.017 (0.18)	0.002 (0.02)	0.017 (0.18)
Cash / Assets	-0.012 (-0.09)	-0.026 (-0.20)	-0.012 (-0.09)
Sales Growth	<b>-0.057**</b> (-2.62)	<b>-0.060***</b> (-2.84)	<b>-0.057**</b> (-2.60)
Geographic Regions	0.007 (0.91)	0.006 (0.88)	0.007 (0.89)
NYSE	-0.023 (-0.66)	-0.028 (-0.81)	-0.023 (-0.66)
Experienced Risk Event	-0.011 (-0.25)	-0.010 (-0.23)	-0.011 (-0.24)
Observations	274	274	274
Industry Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Adjusted R2	0.171	0.167	0.168
Test for differences in coefficients (p-values)			
(1) vs (2)	0.373	0.407	0.368
(1) vs (3)	0.757	0.869	0.755
(2) vs (3)	0.263	0.22	0.266

**Table 8**

Instrumental variables analyses of the relation between Board involvement and risk maturity

This table reports instrumental variables analyses of the relation between Board risk oversight involvement and organizations' risk management maturity scores. Risk Maturity is the natural log of the firm's risk maturity score. The independent variable of interest (*Overall Board Involvement*) is instrumented with a survey item (*Personal Liability Risk*), which captures industry-level rankings of directors' and officers' perceived personal liability risk, relative to the perceived importance of the other top risks the firms face. The variable *Personal Liability Risk* is recoded such that higher values imply greater perceived importance. All variables are defined in Appendix A. Model 1 (2) represents the first (second) stage of the two-stage least-squares estimation procedure. The F-test for the excluded instrument is presented at the bottom of the table. Test-statistics based on standard errors clustered by country appear in parentheses below the coefficient estimates. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% level, respectively (two-tailed).

	First stage Overall Board Involvement 1	Second stage Risk Maturity 2
Personal Liability Risk	<b>0.017***</b> (2.97)	
Overall Board Involvement		<b>0.259***</b> (2.84)
Roles Not Defined	<b>-1.111***</b> (-7.50)	-0.163 (-1.27)
Roles Defined Committee Only	<b>-0.480***</b> (-8.24)	-0.062 (-1.44)
Roles Defined Board Only	<b>-0.199**</b> (-2.23)	-0.010 (-0.33)
Risk Committee	-0.008 (-0.08)	-0.009 (-0.22)
Ln(Board Size)	0.136 (1.00)	0.050 (1.21)
Outside Directors	-0.143 (-0.45)	-0.176 (-1.58)
Outside Chair	0.115 (1.62)	0.029 (1.02)
Female Directors	-0.137 (-0.53)	<b>0.338***</b> (2.62)
Busy Outside Directors	0.079 (0.41)	0.059 (0.76)
Financial Education	-0.267 (-1.51)	0.104 (1.53)
Creditor Rights	-0.029 (-0.30)	0.014 (0.65)
Rule of Law	-0.089 (-0.57)	-0.045 (-1.16)
Shareholder Rights	-0.034 (-0.34)	<b>-0.046*</b> (-1.92)
Ln(Disclosure Quality)	0.610 (1.17)	-0.035 (-0.21)

**Table 8** (continued)

Ln(Market Cap)	0.035 (1.06)	<b>0.029***</b> (2.92)
ROA	0.398 (0.65)	0.139 (0.91)
Book / Market	-0.018 (-0.28)	-0.013 (-0.43)
Debt / Assets	0.206 (1.18)	0.055 (0.75)
Dividend Payer	0.020 (0.25)	<b>-0.049**</b> (-2.47)
R&D / Assets	0.087 (0.10)	<b>0.599**</b> (2.49)
PPE / Assets	-0.183 (-1.27)	<b>0.158*</b> (1.73)
Cash / Assets	<b>-0.690**</b> (-2.72)	<b>-0.231**</b> (-2.31)
Sales Growth	-0.024 (-0.68)	0.026* (1.82)
Geographic Regions	-0.018 (-1.03)	0.006 (1.27)
NYSE	-0.151 (-1.16)	0.016 (0.51)
Experienced Risk Event	-0.013 (-0.21)	<b>-0.060***</b> (-2.98)
Observations	297	297
Year Fixed Effects	Yes	Yes
Adjusted R2	0.198	0.485
F-stat (p-value) of excluded instrument	8.83 (0.0062)	

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**Table 9**

Reverse Causality Test: Firm Risk before the Crisis and Risk Maturity

This table reports the results of a test for reverse causality in the relation between, Board risk oversight, risk maturity and firm risk. Risk Maturity and Overall Board Involvement are regressed on Stock Return Volatility, Idiosyncratic Volatility, and Tail Risk measured over the year 2007. All Board composition and financial control variables are measured in the end of 2006. All Models are estimated using OLS. All independent variables are defined in Appendix A. Test-statistics based on standard errors clustered by country appear in parentheses below the coefficient estimates. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% level, respectively (two-tailed).

	Risk Maturity						Overall Board Involvement					
	1	2	3	4	5	6	7	8	9	10	11	12
Stock Return Volatility	-3.073 (-0.58)	-1.332 (-0.29)					-11.837 (-0.90)	-4.682 (-0.37)				
Idiosyncratic Volatility			-2.912 (-0.50)	-1.095 (-0.20)					-11.639 (-0.82)	-4.078 (-0.31)		
Tail Risk					-0.136 (-0.69)	-0.065 (-0.43)					-0.360 (-0.72)	-0.120 (-0.27)
<i>Control Variables:</i>												
Board Composition	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Country Governance	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Financials	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	260	234	260	234	260	234	260	234	260	234	260	234
Adjusted R2	0.0383	0.0683	0.0379	0.0682	0.0395	0.0686	0.0679	0.0537	0.0662	0.0533	0.0661	0.0533