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Board Size and Corporate Risk Taking: Further Evidence from Japan — Source link

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ABSTRACT

Manuscript Type: Empirical

Research Question/Issue:
Due to a greater difficulty to achieve compromise, large decision making groups tend to adopt less extreme decisions. This implies that larger boards are associated with lower corporate risk taking. We test whether a similar effect applies to the case of Japanese firms. The result is expected to be weaker since Japanese boards form relatively homogenous groups. We further argue that growth opportunities moderate the relation between board size and risk taking.

Research Findings/Results:
Our results indicate that firms with larger boards exhibit lower performance volatility as well as lower bankruptcy risk. However, the effect is not as significant as in the US. The low cross-sectional variation in risk taking among Japanese firms is found to play a role. In addition, we show that the effect of board size is less significant when firms have plenty of investment opportunities, but much stronger when firms have fewer growth options.

Theoretical Implications:
Considering that risk taking contributes to firm performance, our results offer a rationale as to why larger boards might be associated with lower performance. However, they also suggest that this effect should be less detrimental to firms with significant investment opportunities.

Practical Implications:
Firms should adapt their decision processes to their business environment. In particular, they may need to adjust the size of their boards to the characteristics of their investment opportunity sets. Firms with fewer growth options would gain most by operating with smaller boards. By restricting their ability to take risks, firms could undermine their growth potential and performance.

Keywords: corporate governance, board size, risk taking, investment opportunities, performance volatility, bankruptcy risk.

INTRODUCTION

Risk taking is critical to corporate success. Whilst it is true that some firms are likely to fail as a result of the risks they take, few can expect to thrive without incurring a certain degree of risk. But what determines cross sectional differences in risk taking? Agency theory asserts that managers are reluctant to undertake risky projects out of concern for their personal welfare (Fama, 1980; May, 1995; Holmstrom, 1999). By analysing the decisions of a sample of plant managers, Bertrand and Mullainathan (2003) establish that the latter typically prefer not to take any risk. Focusing on the differential effect of a change in legislation providing greater protection from hostile takeovers, Low (2009) reveals that managers whose positions became more secure reduced their risk taking. Conversely, Mishra (2011) demonstrates that better monitoring through multiple large shareholders is associated with higher risk taking. From these results, it appears that agency conflicts play an important role in explaining differences in risk across firms.

Research in social psychology and organizational behaviour suggests a different perspective. According to Kogan and Wallach (1964) and Moscovici and Zavalloni (1969), the size of the decision-making group tends to have a negative effect on risk taking. Sah and Stiglitz (1986, 1991) argue that riskier projects are less likely to be accepted because of the greater difficulty to reach an agreement in large groups. Consistent with this idea, Cheng (2008) shows that US firms with larger boards are associated with lower performance volatility. Likewise, Adams and Ferreira (2010) reveal that larger groups are less extreme in their betting decisions while Bar et al. (2005) establish that team-managed mutual funds are less likely to deviate from their professed investment styles compared to individual managers.

In this paper, we try to address two questions. Our first question is whether the negative effect of board size on corporate risk taking extends to Japanese firms. There are various reasons to suspect that the outcome might be different. Japanese boards are mainly populated with insiders (Abegglen and Stalk, 1985; Viner, 1993; Phan and Yoshikawa, 2000; Jackson and Moerke, 2005; Li and Harisson, 2008; Aman and Nguyen, 2012). Their responsibilities are broader than in the US. According to Japan's Commercial Code, the board of directors is not only in charge of overseeing the company's business, but also responsible for making decisions on the way business is conducted. Decision-making is usually more collegial and involves greater effort at achieving consensus (Hofstede, 1980; Ouchi, 1981; Keys and Miller, 1984; Key et al., 1994; Crossland and Hambrick, 2007). In addition, Wiersema and Bird (1993) underline the homogeneity in Japanese organizations and infer from this observation that managers with dissimilar profiles are more likely to leave the firm, thus further increasing the uniformity of viewpoints already present in the organization. The Japanese business culture is also characterized by a low degree of individualism, especially relative to the US (Hofstede, 1980). At the board level, these characteristics (i.e., greater uniformity in managerial profiles and greater conformity in displayed behaviours) have the consequence that a lesser diversification of opinion is achieved by adding more directors. It thus follows that corporate risk taking in Japan might not decrease as much in relation to board size as in the US (Cheng, 2008).

Our second question is whether growth opportunities play a moderating role in the relation between board size and risk taking. The underlying model by Sah and Stiglitz (1986, 1991) presumes that all decision-making units evaluate the same number of projects. Only the size of the unit varies. However, firms have typically heterogeneous investment opportunity sets. Hence, there is no reason to believe that the effect should be the same for a firm with plenty of attractive investments and another one with few investments available. In fact, we argue that the negative effect of a large board should be weaker for high-growth firms but more severe for low-growth firms. The reasoning is that when a firm has a large number of projects, these projects can be allocated to and evaluated by smaller sub-groups of directors so that each of these sub-groups are effectively evaluating the same number of projects as the whole, but smaller, board of a firm with fewer projects. As a result, a greater proportion of risky projects survive the screening process.

Our empirical investigation involves several measures of risk. In line with Cheng (2008) we first estimate the dispersion over time of a firm's performance using operating profits, market-to-book value of assets, and stock returns. We then relate these risk indicators to the average board size and other key firm characteristics, such as firm size and leverage. But, since these risk indicators ignore the information in within-firm performance variations, our second approach is to measure risk by the absolute deviation from the firm's expected performance. Consistent with Adams et al. (2005) and Sanders and Hambrick (2007), we then use panel regressions to relate these risk measures to board size. This procedure is known as Glejser (1969) heteroskedasticity test. As robustness check, we consider two indicators of bankruptcy risk: Altman's Z-score and Olson's O-score whose calibration to Japanese companies is provided by Xu and Zhang (2009).

Using a large panel of Japanese firms listed on the Tokyo Stock Exchange over the period 2003-2007, we find that board size is negatively related to risk taking. However, the relation is not as significant as in the US which is partly due to the low cross sectional dispersion in risk taking among Japanese firms. We show that the effect of board size depends on the firm's investment opportunity set. When a firm has plenty of investment opportunities, a larger board does not necessarily result in lower risk taking because many risky projects can survive the screening process. On the other hand, if the firm has few investment opportunities, the effect of a larger board is to cause a significant reduction in the proportion of risky projects.[i]

The negative relation between board size and risk may also reflect an equilibrium in which both variables are jointly determined in response to the firm's environment (Hermalin and Weisbach, 2003). For example, firms may consider smaller boards to be better suited to risky business conditions. In that case, decreasing the board's size will not induce greater risk taking. On the other hand, the notion that risk is related to the complexity of the firm's operations suggests that risky firms should operate with larger boards because of their greater need for advice and monitoring (Coles et al., 2008; Linck et al., 2008; Guest, 2008). To identify the exogenous variation in board size, we use the firm's free float because shares dispersed in the public are unlikely to involve board representation. At the same time, variations in the free float should not affect the firm's governance and incentives to take risk, especially since institutional ownership is included in the risk regression. This instrumental variable approach generates somewhat larger coefficients for board size. However, exogeneity tests indicate that the difference with the OLS estimates is not statistically significant.

This study adds to the growing literature on optimal board structures. In a seminal paper, Yermack (1996) demonstrates the higher performance of firms with smaller boards of directors. However, Coles et al. (2008) show that this effect depends on the firm's characteristics. When firms have greater need for advice and monitoring, they actually benefit from operating with bigger boards. This may explain why earlier studies have found conflicting results regarding the effect of board size on firm performance (Dalton, Daily, Johnson and Ellstrand, 1999). In essence, these studies have mixed firms that benefit from the additional resources associated with larger boards with other firms for which larger boards lead to higher coordination problems. In this paper, our focus is on corporate risk taking. While Cheng (2008) suggests that larger boards are generally detrimental to risk taking, our first contribution is to show that this effect may depend on the composition of the board. More accurately, boards characterized by greater homogeneity, as is the case in Japan, are less likely to affect the selection of risky projects as their size increases. Our second contribution is to show that the effect of board size depends on the firm's investments opportunities. To be more precise, larger boards may not necessarily lead to lower risk taking and therefore lower firm value. But firms with few investment opportunities should make sure that their decision making processes are congruent with their low growth profile and would most benefit from operating with smaller boards.

This study also contributes to the literature on corporate risk taking. Since agency conflicts related to managerial risk aversion can be a major cause of suboptimal risk taking, the initial focus has been on the effect of incentives, especially equity ownership and executive stock options (Cohen et al., 1999; Rajgopal and Shevlin, 2002; Coles et al., 2006; Sanders and Hambrick, 2007; Wright et al., 2007). Another equally important determinant of risk taking is the monitoring role of financial institutions (Wright et al., 1996) and multiple large shareholders (Mishra, 2011). More recently, the attention has turned to the role of investor protection (John et al., 2008) and creditor rights (Acharya et al., 2011). Culture and local values have also been shown to explain the difference in risk taking across countries (Griffin et al., 2009). Our study adds to this growing list by extending the analysis of Cheng (2008) to the case of Japanese firms and by emphasizing the role of growth opportunities.

The rest of the paper proceeds as follows. We first provide a selected review of the literature on corporate risk taking and present the hypotheses. We then describe the sample and empirical methods. The empirical results are presented in the following section.

REVIEW AND HYPOTHESES

While agency conflicts and the mechanisms designed to mitigate these conflicts are important determinants of corporate risk taking, the following review focuses on the role of decision processes.

The Effect of Board Size on Corporate Risk Taking

In an influential paper, Kogan and Wallach (1964) argue that the size of the decision-making group decreases its propensity to take risk. The conventional wisdom is that it is much more difficult to convince a large group of peers to make controversial decisions considering the potentially adverse fallout. On the other hand, advocating a prudent alternative is unlikely to be met with stern opposition. It follows that large groups should express moderate positions that represent a compromise between the group's individual positions (Moscovici and Zavalloni, 1969).

Adams and Ferreira (2010) prove the existence of this moderation effect by comparing the betting behaviour of groups and individuals. While groups seem, on average, to behave in practically the same way as individuals, their bets are more likely to cluster around the historical mean while individual bets exhibit a greater tendency to stray away from the average. In addition, the dispersion of bets appears to decrease with the size of the group. In a similar study, Bar et al. (2005) examine the behaviour of individually-managed and team-managed mutual funds. Their main finding is that team-managed funds are less likely to deviate from their purported investment style. These funds also display a higher propensity to herd compared to individually-managed funds. The consequence is a marked difference in return volatility between the two types of funds, but no clear difference in average returns.

Sah and Stiglitz (1986, 1991) formalise the idea that the final decision of a group reflects a compromise among the opposite views of each group member. For example, bad projects are likely to be rejected since they can only be accepted if a sufficient number of group members concur (wrongly) that they are good projects. But the approval of (truly) good projects also requires a similar convergence of views between group members. It follows that large groups end up selecting average projects whose performance also tends to be more stable.

Applying this notion to corporate boards, Cheng (2008) provides evidence that the accounting and market-based performance of firms with larger boards is significantly less volatile. Firms with larger boards also appear to select less risky investments as indicated by the smaller dispersion in analysts' earnings forecasts. In the case of financial institutions, Pathan (2009) shows that board size is associated with lower return volatility. His results are also robust to alternative risk measures such as the Z-score or the proportion of nonperforming loans, which is likely to reflect riskier lending practices.

Based on the notion of moderation in groups, we can outline the first hypothesis whose credit can be attributed to Chen (2008).

Hypothesis 1: Larger corporate boards are associated with lower risk taking.

The Role of Growth Opportunities

Sah and Stiglitz (1986, 1991) build their argument for firms contemplating a fixed number of projects. In that case, adding more participants to the decision making group necessarily results in a higher proportion of risky projects being rejected and a higher proportion of low-risk projects being accepted. For the purpose of comparing risk taking across firms, it is thus critical to control for that parameter. In other words, one needs to compare the effect of board size for firms having the same number of projects. But obviously, firms have heterogeneous investment opportunity sets.[ii] For instance, a young innovative firm has typically more risky projects compared to an older firm of comparable size.

Because of this heterogeneity, the effect of board size is likely to vary across firms. In particular, a larger decision making group may not necessarily lead to a higher proportion of low-risk projects provided the firm has many investment opportunities. The idea is that, although a larger number of (good or bad) risky projects will end up being rejected, there will still be plenty of (mostly good) risky projects to pass the screening process. With this final set, a project-rich firm should have enough risky investments to undertake despite the rejection of many of its initial projects (due to the tighter screening associated with a larger board). As a result, this firm will exhibit a higher market value together with a high-risk profile. This implication fits well with recent findings from Coles et al. (2008) that larger boards can add value in some circumstances even though their impact is considered to be typically negative (Yermack, 1996; Andres et al., 2005; Guest, 2009).

In contrast, a firm with few investment opportunities will end up eliminating most of its risky projects if it happens to have a large decision making group. Assuming low-risk investments are unlimited (for example, investing in liquid assets is always possible) the consequence is that the proportion of risky projects on the firm's balance sheet will decrease with the number of board members. As a result, firms with few investment opportunities and large boards should display a lower risk profile along with a lower market value.

Altogether, the above arguments suggest a more specific hypothesis.

Hypothesis 2: The negative relation between board size and corporate risk is stronger for firms with few investment opportunities, but weaker (and possibly insignificant) for firms with plenty of growth opportunities.

To illustrate why larger boards need not be associated with lower risk taking, let us consider three firms displayed in Figure 1. To simplify the exposition, suppose that firm 2 has the same number of projects as firm 1, but twice the number of directors. According to the arguments of Sah and Stiglitz (1986, 1991) encapsulated in Hypothesis 1, firm 2 should exhibit a significantly lower level of risk taking. Hence, its lower position to the right of firm 1. Now, suppose that firm 3 has twice the number of projects available to firms 1 and 2, and the same number of directors as firm 2. Because it has a larger number of projects as well as a larger number of directors, firm 3 might allocate the responsibility of screening half of its projects to half of its directors, and the responsibility of screening the other half of its projects to the other half of its board members. In that case, the proportion of risky project being selected by each group of directors will be the same as for firm 1. Hence the position of firm 3 at the same level of risk as firm 1 right above firm 2.

In this theoretical example, risk taking can be totally unrelated to the firm's board size. In practice, it is unlikely that the allocation of responsibilities will be as radical. However, it is common that some tasks are allocated to a specific group of directors. For instance, reviewing the firm's accounts is essentially the responsibility of the members of the audit committee. Similarly, firms with a lot of projects are likely to require a certain specialisation among their board members. This ensures that each director is not overwhelmed by the task of assessing each project. As a result, the position of a firm similar to firm 3 is more likely to be between firm 2 and firm 3.

METHODOLOGY

Sample selection

To perform our tests and provide new insights relative to Cheng (2008), we focus on Japanese firms. This case is interesting because the composition of Japanese boards presents a greater degree of homogeneity. As a result, the moderation effect associated with larger decision making groups is expected to be weaker than in the US. Indeed, the very idea of a group effect on decision making is that adding more members to the group is tantamount to increasing the number of filtering layers through which each decision is evaluated. When the group members are randomly selected from a pool of managers with different characteristics, the screening of decisions becomes tighter as the size of the group increases. This implies that a smaller proportion of extreme (i.e., risky) projects tends to be selected by larger groups. However, when the selection of group members is highly correlated, the filtering process does not become tighter as additional members join the group. The explanation comes from the fact that these additional members can be viewed as being redundant. It follows that there might only be a weak relation between the size of the decision making group and the riskiness of the projects selected by the group.[iii]

On a number of criteria, Japanese boards can be described as remarkably homogenous. First, it has long been noted that they essentially involve the firm's top managers (Abegglen and Stalk, 1985; Dalton and Kesner, 1987; Phan and Yoshikawa, 2000; Jackson and Moerke, 2005; Li and Harisson, 2008). Put differently, outside directors are conspicuous by their absence. In fact, Aman and Nguyen (2012) show that a majority of Japanese firms have no outside director. The situation is unlikely to change in the near future since new listing rules introduced by the Tokyo Stock Exchange in 2009 only require firms to appoint one outside director or one independent statutory auditor. In the US, 8 directors out of 10 come from outside the firm (Coles et al., 2008). These directors bring a unique perspective and are hired for their expertise, which might not be available inside the firm (Pfeffer and Salancik, 1978; Fama and Jensen, 1983). Because US boards basically consist of outside directors (especially if the CEO is excluded), increasing their size leads to a greater diversity in executive profiles and this tends to result in lower risk taking. But for Japanese boards, a larger size might not result in a greater variety of experience since most directors are trained as generalists and have spent much of their careers with the same firm (Wairlerdsak and Suehiro, 2004). In a blunt statement, Viner (1993) observes that the path to the boardroom begins on the first day a new graduate arrives at the company's offices.

Another expression of the lack of diversity in Japanese boards is the near absence of female directors. A recent survey by Globe Women based in Washington shows that only 3% of Japanese firms have female directors against 61% in the US. Among all directors, the proportion of women is only 0.2% in Japan against 9.3% in the US. Terjesen et al. (2009) provide an interesting chart comparing the percentage of female directors in several countries. Japan is found to sit by far at the bottom of the list. Overall, Japanese boards can be pictured as almost exclusively composed of male executives having gone through similar experiences since they joined the company as young university graduates. Even in countries where boards are dominated by insiders, greater depth in the executive labor market ensures that their experience is more diverse than in the case of Japanese firms. As a result, Hypothesis 1 is likely to be weaker in Japan because of a lesser moderation effect associated with group size.

Within-Firm Over-Time Performance Variability

To generate estimates of corporate risk taking, we first follow Cheng (2008) and calculate the volatility over time of a firm's performance (called within-firm across-time volatility). This approach is relatively common and has been routinely applied to stock returns to produce estimates of return volatility as well as its decomposition into systematic and unsystematic risk. For instance, Pathan (2009) examines the role of board power on the risk-taking behavior of US bank holding companies using this type of decomposition. Like Cheng (2008) we consider three measures of performance: ROA, Tobin's Q and stock returns. ROA is defined as operating income over total assets. Tobin's Q is proxied by the market to book value of assets. While these two measures are computed annually, stock returns adjusted for dividends and splits are calculated monthly.

The performance measures are obviously correlated. For instance, higher returns are associated with higher Q ratios. Both measures also reflect higher realized or anticipated profitability. As a result, a positive correlation is also likely to exist between the corresponding volatility measures. In this respect, Wei and Zhang (2006) show that the higher (idiosyncratic) return volatility of US firms is related to their increasing earnings variability. In addition, we calculate industry-adjusted volatility using the 2-digit classification from the Tokyo Stock Exchange. For example, industry-adjusted volatility of ROA is computed as the volatility of ROA less median industry-ROA. These measures take out the variation in performance over time common to the industry, and can be interpreted as measures of idiosyncratic volatility.

This way of estimating risk has the unfortunate consequence of collapsing the initial panel (of 6,399 firm-year observations) into a single cross section (of 1,324 firms). To explain the cross sectional difference in risk, we thus calculate the average value of the explanatory variables over the sample period. The association between the 2×3 risk taking measures and their determinants is estimated by OLS with standard errors corrected for heteroskedasticity.

$$\begin{aligned}\mathrm{RISK}_i &= \gamma_0 + \gamma_1 \ln(\mathrm{BS})_i + \gamma_2 \mathrm{INDIR}_i + \gamma_3 \mathrm{SO}_i + \gamma_4 \ln(\mathrm{DIROWN})_i + \gamma_5 \mathrm{INST}_i \\ &\quad + \gamma_6 \mathrm{LNTA}_i + \gamma_7 \mathrm{CAPEX}_i + \gamma_8 \mathrm{DEBT}_i + \gamma_9 \mathrm{AGE}_i + \phi \cdot \mathrm{IND}_i + \eta_i\end{aligned} \tag{1}$$

On the left-hand side, RISK represents the standard deviation of ROA, log of Tobin's Q, or stock returns. On the right-hand side, BS is the number of board members; INDIR is the percentage of inside directors; SO indicates that the firm's executives have received stock options. DIROWN is the percentage of shares owned by all directors; INST is the cumulated ownership of institutional investors. LNTA is the log of total assets; DEBT is the ratio of total debt to total assets; CAPEX is capital expenditures divided by sales; AGE is proxied by the number of years since the firm's listing; IND is a vector of industry dummies based on the stock exchange's 2-digit industry classification; and η_i is the error term.

In equation 1, the log of board size (BS) is the main explanatory variable and we expect its estimated coefficient to be negative. Board composition (INDIR) and financial incentives (SO and DIROWN) are included because of their potential effect on risk-taking. Stock options are considered to encourage managers to take greater risk due to their convex payoff structures. Sanders and Hambrick (2007) show that firms whose CEOs are loaded up with stock options exhibit extreme performance (i.e., very large gains as well as very large losses). Rajgopal and Shevlin (2002) establish that managers of oil and gas companies whose compensation is more sensitive to stock return volatility (due mainly to their stock options) take more exploration risk and maintain lower hedge ratios. Similarly, Coles et al. (2006) find that greater sensitivity to stock return volatility tends to induce riskier investment policies and higher financial leverage. Focusing on the change in corporate risk surrounding the passage of anti-takeover legislation in the US, Low (2009) confirms the tendency of managers to turn away from risk, especially when the threat of market discipline is removed. However, another interesting finding is that equity-linked compensation is able to mitigate this risk aversion. Following Cheng (2008) the remaining variables are included because of their influence on firm performance and because of the relation between performance level and volatility.

Absolute Deviation from Expected Performance

A more ingenious way proposed by Adams et al. (2005) for gauging corporate risk taking consists in measuring the absolute deviation from the firm's expected performance. Standard deviation of performance and absolute deviation from expected performance are two closely-related measures of risk. The key difference is that standard deviation is a weighted average deviation from the firm's average performance, while absolute deviation is the divergence with respect to the firm's expected performance at a particular point in time. Using ROA and Tobin's Q, expected performance is predicted using the following models including year and industry dummies:

$$\begin{aligned} ROA_{i,t} = {} & \gamma_0 + \gamma_1 \ln(BS)_{i,t} + \gamma_2 INDIR_{i,t} + \gamma_3 SO_{i,t} + \gamma_4 \ln(DIROWN)_{i,t} + \gamma_5 INST_{i,t} \\ & + \gamma_6 LNTA_{i,t} + \gamma_7 CAPEX_{i,t} + \gamma_8 DEBT_{i,t} + \gamma_9 AGE_{i,t} + \lambda \cdot YR_t + \phi \cdot IND_i + u_i + \varepsilon_{i,t} \end{aligned} \tag{2}$$

$$\begin{aligned} LNQ_{i,t} = {} & \gamma_0 + \gamma_1 \ln(BS)_{i,t} + \gamma_2 INDIR_{i,t} + \gamma_3 SO_{i,t} + \gamma_4 \ln(DIROWN)_{i,t} + \gamma_5 INST_{i,t} \\ & + \gamma_6 LNTA_{i,t} + \gamma_7 CAPEX_{i,t} + \gamma_8 DEBT_{i,t} + \gamma_9 AGE_{i,t} + \lambda \cdot YR_t + \phi \cdot IND_i + u_i + \varepsilon_{i,t} \end{aligned} \tag{3}$$

Consistent with Adams et al. (2005) and Cheng (2008) we include the board variables in the performance equations on the premise that they affect the level as well as the volatility of a firm's performance.[iv]

To predict stock returns, we use the CAPM and Fama and French (1993) three-factor model:

$$\begin{aligned} R_{i,t} - RF_t &= \alpha_i + \beta_i (RM_t - RF_t) + \varepsilon_{i,t} \\ R_{i,t} - RF_t &= \alpha_i + \beta_i (RM_t - RF_t) + \gamma_i HML_t + \varphi_i SMB_t + \varepsilon_{i,t} \end{aligned} \tag{4}$$

RM is the monthly return on a value-weighted market index; RF is the one-month repo rate. SMB (small minus big) and HML (high minus low) are the returns on the zero-investment factor-mimicking portfolios constructed according to Fama and French (1993).

In equations 2-4, the error term $\varepsilon_{i,t}$ represents the unexpected component of performance. Since we are interested in the deviation from expected performance, we take the absolute value of $\varepsilon_{i,t}$ as the proxy of firm i's risk-taking at time t. This variable is then regressed on the variables appearing on the right-hand side of the performance equations. Sanders and Hambrick (2007) use a similar approach to estimate the effect of stock options on corporate risk taking.

$$\begin{aligned} \left|\varepsilon_{i,t}\right| = {} & \gamma_0 + \gamma_1 \ln(BS)_{i,t} + \gamma_2 INDIR_{i,t} + \gamma_3 SO_{i,t} + \gamma_4 \ln(DIROWN)_{i,t} + \gamma_5 INST_{i,t} \\ & + \gamma_6 LNTA_{i,t} + \gamma_7 CAPEX_{i,t} + \gamma_8 DEBT_{i,t} + \gamma_9 AGE_{i,t} + \lambda \cdot YR_t + \phi \cdot IND_i + \eta_{i,t} \end{aligned} \tag{5}$$

With stock returns, the year dummies are replaced by monthly dummies. Equation 5 is then estimated using GLS random effects. Adams et al. (2005) and Pathan (2009) concede that fixed effect regressions are not suitable due to a lack of significant time-variation in board size. Zhou (2001) shows that fixed effects regressions can fail to detect a relationship even when the data is known to involve one. In addition, the panel is characterized by a large cross section and a short time series, causing fixed effects estimates to be inconsistent.

Bankruptcy Risk Indicators

Risk taking should also be associated with a higher probability of bankruptcy. In fact, the concept of risk involves the notion that higher risk should increase the odds of failure. In this respect, two models have been widely used in literature as well as in practice: Altman's Z-score and Olson's O-score. Both models have been calibrated by Xu and Zhang (2009) to fit Japanese firms. Given that we don't have bankruptcy data, we simply rely on their estimates. More precisely, Xu and Zhang (2009) provide the following results.

$$\text{Z-score} = -4.1776 - 0.5294\, V_1 - 0.2139\, V_2 - 1.0411\, V_3 - 0.4303\, V_4 - 1.3183\, V_5 \qquad (6)$$

V_1 = Working capital/Total assets;
V_2 = Retained earnings/Total assets;
V_3 = Earnings before interest and taxes/Total assets;
V_4 = Market value of equity/Book value of total liabilities;
V_5 = Sales/Total assets.

$$\begin{aligned}\text{O-score} = {} & -5.9422 - 0.0813\, W_1 - 0.0944\, W_2 - 0.2189\, W_3 + 0.2751\, W_4 \\ & - 0.8617\, W_5 - 0.0745\, W_6 + 0.0374\, W_7 + 1.5211\, W_8 - 0.6270\, W_9\end{aligned} \qquad (7)$$

W_1 = log (Total assets deflated by GNP price-level index);
W_2 = Total liabilities/Total assets;
W_3 = Working capital/Total assets;
W_4 = Current liabilities/Current assets;
W_5 = 1 if total liabilities > total assets, = 0 otherwise;
W_6 = Net income/Total assets;
W_7 = Operating cash flows/Total liabilities;
W_8 = 1 if net income < 0 for the last 2 years, = 0 otherwise;
W_9 = (Net income – Lagged net income)/ (|Net income| + |Lagged net income|).

While the O-score increases with the probability of bankruptcy, the Z-score varies in the opposite direction. We thus take its inverse to make it comparable to the other risk measures. We also check that the values of the Z-score are all positive to justify this transformation. Because the bankruptcy risk indicators can be calculated each year, we use the same panel regression framework as in the previous section.

$$\begin{aligned}1/\text{Z-score}_{i,t} \text{ or O-score}_{i,t} = {} & \gamma_0 + \gamma_1 \ln(\text{BS})_{i,t} \\ & + \gamma_2 \text{INDIR}_{i,t} + \gamma_3 \text{SO}_{i,t} + \gamma_4 \ln(\text{DIROWN})_{i,t} + \gamma_5 \text{INST}_{i,t} + \gamma_6 \text{LNTA}_{i,t} \\ & + \gamma_7 \text{CAPEX}_{i,t} + \gamma_8 \text{DEBT}_{i,t} + \gamma_9 \text{AGE}_{i,t} + \lambda \cdot \text{YR}_t + \phi \cdot \text{IND}_i + \eta_{i,t}\end{aligned} \qquad (8)$$

SAMPLE DESCRIPTION

Our sample includes most Japanese firms listed on the Tokyo Stock Exchange over the period 2003-2007. We are restricted to that period because of data availability. Our source for board and ownership information is Nikkei CGES (Corporate Governance Evaluation System). This database is offered by the Nihon Keizai (Nikkei) newsgroup and contains governance information collected from annual reports. 1,450 firms could be identified with complete governance information. Financial firms (banks, insurance, brokerage and asset management companies) were dropped because of their distinct performance and risk characteristics. This gave a final sample of 1,324 firms corresponding to 6,399 firm-year observations and 76,717 firm-month observations.[v] Consistent with the composition of the Japanese economy, the more represented industries are electric machinery, machine tools, chemicals and trading companies. The dataset is completed with accounting and stock return information using AMSUS (Active Management Support System) proposed by Quick Corp.[vi]

Table 1 provides descriptive statistics regarding firm characteristics, performance volatility, and board structures. At first glance, volatility of ROA appears to be particularly low at only 1.85%. However, this figure is consistent with the results of John et al. (2008) and Acharya et al. (2011) which both show that Japanese firms have the lowest level of cash flow volatility among 39 selected countries. To offer a more striking perspective, the cash flow volatility of Japanese firms is only 2.1% compared to 9% for US firms. Volatility of industry-adjusted ROA is slightly lower at 1.76% which suggests that only a small part of a firm's profitability is governed by industry conditions. At about 9.2%, volatility of monthly stock returns seems to be comparable to the typical volatility of a US stock whose average is about 10%.

Japanese boards consist on average of 10.4 members, which is close to the figure for US firms reported by Coles et al. (2008). As a rule, Japanese firms appear to have dramatically reduced the size of their boards in the last few years. Analyzing a sample of large Japanese firms over the period 1992-1996, Basu et al. (2007) indicate that their boards typically consisted of 28 members.[vii] Still, some firms exhibit very large boards, like Toray Industries, a leading chemical company and the world's largest producer of carbon fibre, which had 30 directors throughout the sample period. On average, more than 9 directors out of 10 are employees of the firm, which clearly shows that Japanese boards are dominated by insiders. In contrast, US boards involve a majority of outside directors (Boone et al., 2007;

Coles et al., 2008). Distribution of ownership by company directors is positively skewed (with a median of 0.42% and an average of 3.62%) suggesting the application of a log transformation.

Average ROA (about 5.5%) and leverage (about 21.5%) are close to the figures for US firms provided by Adams et al. (2005). On the other hand, the average age of Japanese firms indicated by the number of years since their listing on the TSE is significantly higher than in the US.[viii] Concerning the two variables used as instruments for board size, average ownership by individuals is just over 33% while the average free float is relatively low at 20.6% of outstanding shares given the extensive presence of blockholders in the capital of Japanese firms (La Porta et al., 1999; Mishra, 2011).

The results in the lower panel indicate that the absolute deviation from expected ROA is only about 1.35% on average, which confirms the low average volatility of ROA. In comparison, Sanders and Hambrick (2007) report that the absolute deviation from expected ROA for US firms is about 3.72 % on average (which is 2.75 times higher than in Japan).

RESULTS

We begin the analysis by testing whether Hypothesis 1 holds in Japan using both cross sectional and panel regressions. We then evaluate the role of growth opportunities put forth in Hypothesis 2. The last part of this section is devoted to a number of sensitivity checks.

Effect of Board Size on Performance Volatility

Table 2 presents the cross-sectional regressions using within-firm performance variability. Overall, model fit is comparable to the case of US firms.[ix] Consistent with Cheng (2008), board size appears to be associated with lower risk taking. The results based on industry-adjusted performance point to a similar conclusion. The coefficient on the proportion of inside directors (INDIR) is generally negative, but not highly significant. In line with current literature, board ownership does not seem to be associated with a higher propensity to take risk (except for ROA volatility where the coefficient is significant at the 10% level). On the other hand, the stock option indicator (SO) is associated with significantly higher risk taking, particularly for the volatility of ROA and Tobin's Q. This effect is congruent with the findings reported by Rajgopal and Shevlin (2002), Coles et al. (2006), Wright et al. (2007), Sanders and Hambrick (2007) and Low (2009) regarding US firms.[x]

Less anticipated is the negative influence of institutional ownership (significant at the 1% level for both ROA and stock return volatility) which suggests that Japanese financial institutions do not press firms to take more risk (Morck and Nakamura, 1999). This result might be due to their dual role as shareholders and creditors.[xi] The influence of firm size is significant and consistently negative which reflects the greater diversification opportunities available to large firms. On the other hand, firm age does not appear to produce a similar reduction in risk. Consistent with Adams et al. (2005) leverage has a positive effect on the volatility of stock returns. In contrast, Cheng (2008) reports that leverage has no impact on the volatility of US shares.

Overall, the impact of board size is economically small. A one standard deviation increase in the log of board size is associated with a relatively trivial 0.10% (= 0.0028 × 0.3667) decrease in ROA volatility. Yet, this order of magnitude is comparable to the 0.18% (= 0.0013 × 1.38) decrease in ROA volatility resulting from a one standard deviation increase in firm size or the 0.11% (= 0.0060 × 0.183) increase in ROA volatility resulting from a one standard deviation increase in leverage. The effect on stock volatility appears to be more significant considering the 0.52% (= 0.0141 × 0.3667) decrease in volatility implied by a standard deviation increase in the log of board size. The corresponding impact from firm size and leverage are respectively 0.9% and 1.55%. To provide a comparison with US firms, a one standard deviation increase in board size can be associated with a 0.0211 × 0.28 = 0.60% decrease in ROA volatility and a 0.0396 × 0.28 = 1.13% decrease in stock volatility. Thus the influence of board size appears to be weaker in Japan.

A possible explanation for this result is the fact that Japanese boards are much more homogenous than US boards. The lesser diversity among Japanese directors implies that board size has a smaller impact on the filtering of corporate decisions. A completely different explanation is to point out the lack of significant cross sectional variation in risk taking among Japanese firms. Indeed, the statistics reported in Table 1 show that the standard deviation in ROA volatility is 1.72% while the standard deviation in stock return volatility is 3.82%. In comparison, Wright et al. (2007) reveal that the standard deviation in ROA volatility is 8.2% in the US. The standard deviation in the volatility of US stock returns is also much higher at 21.6%. Without significant variation in the dependent variable(s), the explanatory variables are bound to lack statistical power.

To show that this interpretation is valid, we use quantile regressions.[xii] The objective is to differentiate the effect of board size at different points of the conditional distribution of the dependent variable. In this respect, we choose the 75th quantile to represent high-risk firms and the 25th quantile to represent low-risk firms. The results presented in Table 3 show that the negative effect of board size is more significant when firms exhibit a high ROA volatility. In fact, the effect of board size at the 75th quantile is almost twice as large relative to the effect at the mean (using OLS). In contrast, the effect at the 25th quantile is small and statistically insignificant. The difference estimated using inter-quantile regression is significant at the 10% level. This suggests that the low volatility of ROA in Japan might be responsible for the small effect of board size. Focusing on the behavior of more risky firms reveals that board size is not only important, but also the most significant factor explaining the volatility of ROA. The results are similar using stock return volatility. The effect of board size at the 75th quantile is about two times the effect at the 25th quantile. The effect of firm size and leverage is also more significant for high-risk firms.

Deviation from Expected Performance

Our second step is to run Glejser (1969) heteroskedasticity tests on annual (for ROA and Tobin's Q) and monthly (for stock returns) panels of performance volatility measures. Following Adams et al. (2005) and Sanders and Hambrick (2007) for nonfinancial firms and Pathan (2009) for bank holding companies, firm effects are assumed to be randomly distributed and the standard errors are clustered by firm. As already mentioned, using panel regressions with firm fixed effects would require either a greater rate of change in board size or a longer period of observation in order to allow board size to change over that time as in Lehn et al. (2009) where observations are made every 5 years.

The regression results are presented in Table 4. For ROA and LNQ, risk is measured by the absolute deviation from predicted ROA and LNQ using equations 2-3. For stock returns, we use the CAPM and Fama French (FF) three-factor model described in equation 4. The residual does not include the firm effect which is assumed to be part of the firm's predicted performance. Consistent with our cross-sectional findings, board size is negatively associated with all the risk taking measures. However the impact is small and not highly significant, except for the volatility of stock returns. The results also indicate that firm size is associated with lower risk, consistent with greater diversification benefits. Older firms are also characterized by lower risk, but only for ROA and Tobin's Q. On the other hand, the higher risk arising from the use of financial leverage is only significant when risk is measured by the unexpected deviation of stock returns from the CAPM and Fama-French models.

The Moderating Role of Growth Opportunities

Although the above results provide some support for Hypothesis 1, the effect of board size is not statistically significant across all the risk measures and not as strong as in Cheng (2008). The argument expressed in Hypothesis 2 is that the influence of board size is not homogenous across all firms. To investigate whether there is a difference between firms with plenty of growth opportunities and firms with few good investments available, we split the sample using Tobin's Q. Firms with poor investment opportunities are identified by a ratio below the sample's median. Table 5 displays the results of the cross sectional (OLS) regressions. For high growth firms, larger boards do not seem to be associated with a statistically significant lower risk, except using stock return volatility. On the other hand, larger boards are found to sharply decrease the risk of firms with few investment opportunities. In fact, the (negative) slope appears to be about 50 percent steeper for each of the volatility measures. It can also be noted that despite the lower significance of board size, model fit tends to be better for high-Q firms with a stronger moderating effect on risk stemming from firm size.

To further highlight the role of growth options, we perform Glejser heteroskedasticity tests on a split sample using the median Tobin's Q updated each year to identify firms with poor investment opportunities. The results presented in Table 6 indicate that larger boards do not significantly affect risk taking provided that firms have plenty of investment opportunities. In contrast, if firms have few good investments available, board size seems to affect the outcome of the screening process, thus leading to much smaller deviation from expected performance. Although not strongly significant, the coefficient on board size for low-Q firms is always lower (i.e. with a steeper downward slope) than the coefficient for the pooled sample. The other covariates are similar to those appearing in Table 3. Firm size is associated with a lower risk of deviating from expected performance particularly for high-Q firms. Firm age has a similar impact on ROA and firm value, but no influence on stock returns, while the leverage ratio only has an influence on the idiosyncratic volatility of stock returns.

Robustness Checks

Our first concern is to ensure that the results related to Hypothesis 2 are robust to alternative measures of investment opportunities. Using industry-adjusted Tobin's Q, we find estimates similar to those shown in Tables 5 and 6. These results are not tabulated to save space. We then use a more distinct proxy for investment opportunities: average sales growth. Although the difference between high and low growth firms is not as significant, the results presented in Table 7 confirm that board size is associated with lower risk taking particularly when firms are characterised by low growth opportunities.

Our second concern is that the results regarding both hypotheses could be driven by the endogeneity of board size. For instance, high-risk firms may prefer to operate with smaller boards because it allows them to make quicker decisions in response to unexpected events. It may also be harder to find qualified directors in high risk sectors. Conversely, board positions in low risk firms may be more attractive for directors who anticipate they will be able to discharge their duty without suffering from undue stress. Incompetence is also easier to conceal in a low risk environment. If that case, OLS regressions will overestimate the negative impact of board size on the firm's risk taking. On the other hand, if high-risk firms require more expertise to handle the associated risk (Coles et al., 2008; Linck et al., 2008), they will tend to operate with larger boards. In that case, OLS estimates will underestimate the negative influence of board size on a firm's risk taking.

To partially mitigate this concern, we follow Cheng (2008) and substitute the first observation of board size to its average in the cross sectional regressions. All the estimates are found to be negative but somewhat smaller. For instance, the coefficient for ROA volatility is -0.0016 (compared to -0.0028) and the coefficient for stock volatility is -0.0112 (compared to -0.0141). These results are not tabulated to save space. Instead, we present the results of instrumental variable regressions. The effectiveness of this approach critically depends on the availability of valid instruments. In our case, we use the percentage of the firm's free float.[xiii]

This variable is likely to be a valid instrument because of its high correlation with board size and its low correlation with the unexplained variation in risk taking (for each of the risk taking proxies). The first assertion (high correlation with the endogenous regressor) can easily be tested by looking at the significance of the instrument in the board size (or first stage) regression. Furthermore, there is a compelling reason to expect firms with a larger free float to have smaller boards. In essence, it's because these shares are either held by small investors or by financial institutions for a trading purpose. In both cases, free float shares are unlikely to involve board representation. On the contrary, investors making a strategic investment are likely to trade off the loss of liquidity on their shares for a seat (or representation) on the board. The second assertion (absence of correlation with the error term) cannot be tested econometrically because we only have one instrument for one endogenous regressor (board size). However, there is no reason to suspect that the percentage of shares in the free float might affect the firm's risk taking beyond what the other exogenous variables already explain. In particular, while a large free float might potentially affect the firm's governance (and risk taking) by allowing other types of investor to exercise their influence, the incremental effect is likely to be trivial since we already control for the influence of institutional investors in the risk taking (second stage) regressions. In any case, the strength of the instrument ensures that the 2SLS results are less biased relative to the OLS estimates (Larcker and Rusticus, 2010).

Table 8 presents the results of the 2SLS regressions. The first-stage which is common to the three risk measures indicates that the excluded instrument is reasonably significant and has the predicted negative effect on board size. The F-value (9.06) is slightly above the critical level (8.96) suggested by Stock et al. (2002). Higher ownership by financial institutions also appears to be associated with larger boards, consistent with their more active role in Japan. The second-stage results suggest that board size plays almost no role in the firm's risk taking, except for return volatility where the effect is only significant at the 10% level. These results seem to contradict our previous findings. However, the Durbin and Wu-Hausman exogeneity tests show that the difference with the OLS estimates is actually insignificant. This suggests that the OLS estimates are not seriously biased and should thus be preferred because of their greater efficiency (Larcker and Rusticus, 2010).

Lastly, we consider bankruptcy indicators as substitute measures of risk taking.[xiv] The results presented in Table 9 continue to support our two hypotheses. The coefficient on board size is significantly negative for both bankruptcy indicators, and more so for firms with low growth opportunities. This difference is most evident for the Z-score. Among the other regressors, higher proportion of inside directors is associated with lower risk, suggesting concern for the safety of their human capital (May, 1995; Holmstrom, 1999). High institutional ownership is also found to be associated with lower risk, consistent with its negative effect on performance variability. On the other hand, higher leverage significantly increases the risk of bankruptcy while its effect on performance variability is relatively weak (except for stock returns).

CONCLUSION

The greater difficulty to reach consensus in large decision-making groups suggests that large boards are associated with lower risk taking. But, the inability to take risks can prevent firms from making the most of their available opportunities, which ultimately harms their performance. In line with this idea, Yermack (1996) presents evidence that firms with larger boards exhibit lower market valuations. However, the recent findings of Coles et al. (2008) reveal that large boards are not necessarily detrimental to firm performance. The intuition is that the marginal value of a board member depends on the firm's characteristics. When a firm requires more expertise, bringing an additional director to the board may not decrease the firm's value despite the higher coordination costs associated with a larger board. But when these conditions are not met, the higher coordination costs are likely to outweigh any marginal benefit that a director can add to the firm. In that case, larger boards can only decrease firm value.

In this paper, we have related the above results to corporate risk taking. Our main argument is that when a firm has plenty of investment opportunities, a larger board may not necessarily reduce the firm's ability to select risky projects. Although a greater number of projects are likely to be eliminated, there will still be enough risky projects to make their way through the board's selection process. Hence, that firm should be able to implement a sufficient number of good investments which will ultimately contribute to its higher value. On the other hand, if the firm has few investment opportunities, putting them to the approval of a large board will greatly reduce the number of risky projects being retained. Since there are few alternative projects to replace those rejected by the board, the firm's risk taking is likely to decrease along with its market value.

Using a low Tobin's Q (or a low sales growth) to identify poor investment opportunities, we found that performance variability falls significantly when firms operate with larger boards. The relation is comparatively weaker and often insignificant when firms have plenty of growth opportunities. These results which extend those of Cheng (2008) are robust to the performance indicator used for measuring risk and appear in the cross section as well as in panel data. To address endogeneity concerns, we have used an instrumental variable approach. The variation in board size unrelated to the unexplained component of risk-taking is isolated by using information contained in the distribution of the firm's ownership. The coefficient estimates are found to be generally larger. However, according to exogeneity tests, the different with OLS estimates is not significant.

Overall, the results highlight the importance of decision making processes. Consistent with the arguments of Hermalin and Weisbach (1998, 2003) firms need to adapt their governance structures to their operating environment. In the context of this paper, the implication is that firms should adjust the size of their boards to the quality of their investment opportunity sets. Ignoring this principle is likely to affect the firm's decisions, resulting in lower performance. In particular, by maintaining large boards in an environment characterized by decreasing investment opportunities, Japanese firms may hinder their ability to make bold decisions. This in turn could affect their future growth considering the positive link between risk taking and subsequent increases in sales documented by John et al. (2008).

Over the last decade, Japanese firms have moved in the right direction by dramatically reducing the size of their boards to make them comparable to US boards. It is hard to fathom that, not long ago, these boards used to consist of around 28 directors (Basu et al., 2007). For instance, Sony Corp. had 38 directors before it decided to trim its board to just 10 members. It is likely that these cumbersome decision making structures have prevented Japanese firms to react swiftly and purposefully to the growing threat of nimbler competitors. Their now considerably smaller board sizes should help them make more audacious decisions and regain their lost competitive advantages.

Nonetheless, more progress is still needed. A significant step would be to increase the diversity of profiles in the boardroom, as well as in the executive ranks, since the generation of ideas and innovative projects is unlikely to fit well with the uniformity of profiles that typifies today's corporate boards in Japan. But this change will only come if firms abandon their practice of picking up their managers through internal tournaments. A deeper external labour market for executive talent is also required to offer firms with credible alternatives to fill their upper management positions. Similarly, the practice of requiring women to choose between motherhood and career has contributed to squash gender diversity in top management layers to the point that only 3% of Japanese firms have female directors. In brief, a comprehensive solution to Japan's well-documented deficit in corporate risk taking (John et al., 2008; Griffin et al. 2009; Acharya et al. 2011) is likely to involve more than just a reduction in board size.

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Table 1: Descriptive statistics

Variables	Mean	Std dev	Q1	Median	Q3
Panel A: cross sectional data (N = 1,324 firms)					
Standard deviation of performance:					
ROA (in %)	1.85	1.72	0.76	1.29	2.35
LNQ (×100)	15.29	12.31	7.54	12.31	18.59
Return (in %)	9.42	3.82	6.80	8.67	11.05
Standard deviation of industry-adjusted performance:					
ROA (in %)	1.76	1.58	0.78	1.26	2.18
LNQ (×100)	12.51	11.07	6.25	9.39	15.30
Return (in %)	8.15	3.30	6.05	7.38	9.34
Average board, ownership and firm characteristics:					
BS (number of directors)	10.41	4.59	7.00	9.00	12.00
ln(BS)	2.25	0.37	1.99	2.24	2.49
INDIR	0.93	0.11	0.89	1.00	1.00
SO	0.33	0.45	0.00	0.00	0.00
DIROWN (% of shares)	3.62	7.73	0.13	0.42	2.56
INST (% of shares)	22.36	14.50	10.27	19.21	32.25
ROA (in %)	5.49	4.76	2.71	4.73	7.50
Tobin's Q	1.37	1.13	1.01	1.17	1.43
LNTA	11.73	1.38	10.79	11.49	12.48
CAPEX (% of total assets)	4.85	7.15	1.58	3.32	5.98
DEBT (% of total assets)	21.52	18.26	5.21	18.42	33.44
AGE	35.17	19.03	16.00	43.00	55.00
INDIV (% of shares)	33.04	15.73	21.02	31.25	42.84
FLOAT (% of shares)	20.64	11.18	11.67	18.94	28.27
Panel B: panel data (N = 6,399 firm-year or 76,717 firm-month observations)					
Absolute deviation from expected performance					
ROA (in %)	1.31	1.59	0.36	0.81	1.65
LNQ (×100)	9.32	10.90	2.83	6.45	12.09
Return using CAPM (in %)	6.01	6.62	1.97	4.35	7.96
Return using Fama French (in %)	5.71	6.22	1.89	4.15	7.58

In Panel A, standard deviations are calculated over the period 2003-2007. The other variables are averaged over the same period. ROA is operating income over total assets. Tobin's Q is the market to book value of assets. LNQ is the natural log of Q. Monthly stock returns are adjusted for dividends and stock splits. Industry-adjusted performance is computed by subtracting the industry median. LNTA is the log of total assets. CAPEX is capital expenditures over sales. DEBT is total debt over total assets. AGE is the number of years since the firm's listing. BS is the number of directors. INDIR is the proportion of insiders. SO indicates that the firm has issued stock options. DIROWN is the percentage of shares owned by all directors. INST is the ownership by financial institutions. INDIV is the percentage of shares held by individual shareholders. FLOAT is the free-float. In panel B, absolute deviation is relative to expected performance described in equations 2-4. Financial data is from Nikkei AMSUS. Board and shareholding data is from Nikkei CGES.

Table 2: Relation between board size and risk taking using cross sectional data

	Standard deviation of performance			Std deviation of industry-adjusted performance		
	ROA	LNQ	Return	ROA	LNQ	Return
Ln(BS)	-0.0028 †	-0.0154	-0.0141 **	-0.0030 *	-0.0146 †	-0.0106 **
	(-1.95)	(-1.55)	(-5.00)	(-2.33)	(-1.65)	(-4.31)
INDIR	0.0017	-0.0217	-0.0097 †	-0.0004	-0.0128	-0.0089 †
	(0.57)	(-1.08)	(-1.77)	(-0.14)	(-0.71)	(-1.89)
SO	0.0038 **	0.0289 **	-0.0004	0.0033 **	0.0204 **	-0.0005
	(3.58)	(4.19)	(-0.22)	(3.43)	(3.27)	(-0.30)
Ln(DIROWN)	0.0013 †	0.0013	0.0012	0.0012 †	0.0015	0.0011
	(1.72)	(0.30)	(0.87)	(1.79)	(0.37)	(0.91)
INST	-0.0001 **	-0.0004	-0.0003 **	-0.0002 **	-0.0004	-0.0003 **
	(-2.72)	(-1.07)	(-3.26)	(-3.73)	(-1.22)	(-3.70)
LNTA	-0.0013 **	-0.0120 **	-0.0065 **	-0.0012 **	-0.0071 *	-0.0059 **
	(-2.91)	(-3.43)	(-7.55)	(-2.99)	(-2.27)	(-7.83)
CAPEX	-0.0086	0.1563 *	-0.0221	-0.0021	0.1303 *	-0.0028
	(-1.26)	(2.17)	(-0.98)	(-0.35)	(2.16)	(-0.14)
DEBT	0.0060 *	-0.0890 **	0.0853 **	0.0044	-0.0368 *	0.0671 **
	(2.02)	(-4.69)	(13.88)	(1.61)	(-2.18)	(12.51)
AGE	-0.0030	-0.0074	0.0176 *	-0.0028	-0.0517 *	0.0062
	(-0.90)	(-0.30)	(2.36)	(-0.92)	(-2.34)	(0.93)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
F value	10.56 **	10.99 **	39.03 **	12.56 **	8.84 **	33.36 **
R^2	0.193	0.1794	0.3498	0.1996	0.1695	0.3119

The sample consists of 1,324 firms listed on the Tokyo Stock Exchange over the period 2003-2007 with available board information in the Nikkei CGES database. Performance variability is calculated over the sample period. ROA is operating income over total assets. LNQ is the log of market to book value of assets. Stock returns are adjusted for dividends and stock splits. Industry-adjusted performance is obtained by subtracting the industry's median performance. All the explanatory variables are averaged. BS is the number of directors. INDIR is the proportion of insiders. SO indicates that the firm has issued stock options. DIROWN is the percentage of shares owned by all directors. INST is the ownership by financial institutions. LNTA is the log of total assets. CAPEX is capital expenditures over total assets. DEBT is total debt over total assets. AGE is the number of years since the firm's listing. Standard errors are corrected for heteroskedasticity. **, *, † indicate that the t-ratios between brackets are significant at the 1%, 5% and 10% level.

Table 3: Conditional effect on risk taking at different quantiles

	Standard deviation of ROA			Std deviation of stock returns		
	.75 Qtile	.25 Qtile	.75 - .25	.75 Qtile	.25 Qtile	.75 - .25
Ln(BS)	-0.0051 **	-0.0013	-0.0038 †	-0.0149 **	-0.0078 **	-0.0071 †
	(-2.88)	(-1.46)	(-1.93)	(-3.20)	(-2.65)	(-1.78)
INDIR	-0.0012	0.0003	-0.0015	-0.0071	-0.0053	-0.0018
	(-0.42)	(0.24)	(-0.44)	(-0.76)	(-0.89)	(-0.20)
SO	0.0038 *	0.0012	0.0026	-0.0007	0.0023	-0.0030
	(2.23)	(1.28)	(1.61)	(-0.27)	(1.11)	(-1.19)
Ln(DIROWN)	0.0011	-0.0001	0.0012 †	0.0001	0.0007	-0.0007
	(1.21)	(-0.19)	(1.75)	(0.05)	(0.72)	(-0.37)
INST	-0.0001 †	0.0000	-0.0001	-0.0004 *	0.0001	-0.0004 **
	(-1.69)	(-0.66)	(-1.23)	(-2.58)	(0.92)	(-3.57)
LNTA	-0.0011 †	-0.0003	-0.0007	-0.0071 **	-0.0029 **	-0.0042 **
	(-1.85)	(-0.93)	(-1.58)	(-5.41)	(-3.24)	(-3.38)
CAPEX	-0.0111	-0.0027	-0.0084	-0.0131	-0.0372 †	0.0241
	(-1.09)	(-0.86)	(-0.79)	(-0.41)	(-1.93)	(0.77)
DEBT	0.0070 *	0.0015	0.0055	0.0905 **	0.0573 **	0.0332 **
	(2.06)	(0.73)	(1.14)	(11.33)	(11.08)	(3.67)
AGE	-0.0061	-0.0044 **	-0.0017	0.0118	0.0008	0.0110
	(-1.56)	(-2.97)	(-0.39)	(1.33)	(0.10)	(1.08)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.1524	0.0828	N.A.	0.249	0.1654	N.A.

The sample consists of 1,324 firms listed on the Tokyo Stock Exchange over the period 2003-2007 with available board information in the Nikkei CGES database. Performance variability is calculated over the sample period. ROA is operating income over total assets. LNQ is the log of market to book value of assets. Stock returns are adjusted for dividends and stock splits. Industry-adjusted performance is obtained by subtracting the industry's median performance. All the explanatory variables are averaged. BS is the number of directors. INDIR is the proportion of insiders. SO indicates that the firm has issued stock options. DIROWN is the percentage of shares owned by all directors. INST is the ownership by financial institutions. LNTA is the log of total assets. CAPEX is capital expenditures over total assets. DEBT is total debt over total assets. AGE is the number of years since the firm's listing. The equations are estimated using quantile regressions with bootstrapped standard errors involving 50 replications. **, *, † indicate that the t-ratios between brackets are significant at the 1%, 5% and 10% level.

Table 4: Relation between board size and risk taking using panel data

	Absolute deviation from expected performance using			
	ROA	LNQ	CAPM	Fama-French
Ln(BS)	-0.0013	-0.0094 †	-0.4972 **	-0.3815 **
	(-1.58)	(-1.85)	(-3.55)	(-2.87)
INDIR	-0.0003	-0.0120	-0.0241	0.0852
	(-0.31)	(-1.50)	(-0.11)	(0.43)
SO	0.0019 **	0.0067 †	-0.1640 †	-0.1327
	(2.91)	(1.89)	(-1.72)	(-1.46)
Ln(DIROWN)	-0.0001	0.0010	0.0437	0.0732
	(-0.10)	(0.34)	(0.63)	(1.14)
INST	-0.0084 *	0.0055	-0.0126 *	-0.0076 †
	(-2.38)	(0.33)	(-2.55)	(-1.66)
LNTA	-0.0012 **	-0.0042 †	-0.3765 **	-0.3214 **
	(-3.88)	(-1.93)	(-7.61)	(-6.67)
CAPEX	-0.0022	-0.0085	-0.0002	0.0027
	(-0.68)	(-0.28)	(-0.03)	(0.29)
DEBT	0.0021	-0.0161	0.0488 **	0.0409 **
	(1.11)	(-0.86)	(12.63)	(11.63)
AGE	-0.0057 *	-0.0411 *	0.0002	-0.0021
	(-2.24)	(-2.50)	(0.05)	(-0.59)
Industry and year dummies	Yes	Yes	Yes	Yes
Wald test	388.28 **	394.92 **	2170.58 **	1775.41 **
R^2	0.121	0.081	0.0655	0.057

Expected performance is described in equations 2-4. Absolute deviation from expected performance is the absolute value of the residual described in equation 5. ROA is operating income over total assets. LNQ is the log of market to book value of assets. BS is the number of directors. INDIR is the proportion of insiders. SO indicates that the firm has issued stock options. DIROWN is the percentage of shares owned by all directors. INST is the ownership by financial institutions. LNTA is the log of total assets. CAPEX is capital expenditures over total assets. DEBT is total debt over total assets. AGE is the number of years since the firm's listing. The sample for ROA and LNQ consists of 6,399 firm-year observations. The sample for stock returns consists of 76,717 firm-month observations. The equations are estimated using GLS random effects with standard errors clustered by firm. **, *, † indicate that the z-values in brackets are significant at the 1%, 5% and 10% level.

Table 5: Effect of growth opportunities on the relation between board size and risk taking (OLS regressions)

	Std deviation of ROA		Std deviation of LNQ		Std deviation of Return	
	Low Q	High Q	Low Q	High Q	Low Q	High Q
Ln(BS)	-0.0028 †	-0.0018	-0.0174 *	-0.0100	-0.0178 **	-0.0102 **
	(-1.86)	(-0.80)	(-1.99)	(-0.65)	(-3.93)	(-2.88)
INDIR	0.0046	-0.0012	-0.0119	-0.0361	-0.0045	-0.0141 †
	(1.13)	(-0.29)	(-0.59)	(-1.16)	(-0.55)	(-1.91)
SO	0.0026 †	0.0035 *	0.0125 *	0.0201 †	-0.0014	-0.0029
	(1.82)	(2.25)	(2.00)	(1.91)	(-0.47)	(-1.17)
Ln(DIROWN)	0.0015 †	0.0010	0.0016	-0.0001	0.0033	-0.0005
	(1.84)	(0.82)	(0.50)	(-0.01)	(1.58)	(-0.28)
INST	-0.0001	-0.0002 **	0.0000	-0.0009 †	-0.0002	-0.0004 **
	(-1.02)	(-3.06)	(0.08)	(-1.71)	(-1.36)	(-3.30)
LNTA	-0.0012 *	-0.0021 **	-0.0055	-0.0208 **	-0.0044 **	-0.0089 **
	(-2.30)	(-3.30)	(-1.43)	(-4.23)	(-3.32)	(-7.73)
CAPEX	-0.0147	-0.0145 †	0.0819	0.1483 †	-0.0741 **	-0.0079
	(-1.04)	(-1.86)	(0.97)	(1.70)	(-4.65)	(-0.32)
DEBT	-0.0005	0.0074	-0.1032 **	-0.1122 **	0.0821 **	0.0808 **
	(-0.15)	(1.55)	(-4.86)	(-3.53)	(10.49)	(8.51)
AGE	-0.0040	-0.0005	-0.0162	0.0187	0.0185 †	0.0193 †
	(-1.05)	(-0.10)	(-0.89)	(0.45)	(1.76)	(1.89)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
F value	6.07 **	9.08 **	6.43 **	8.03 **	17.7 **	27.02 **
R^2	0.2087	0.2201	0.1524	0.2157	0.3432	0.4285

The sample consists of 1,324 firms listed on the Tokyo Stock Exchange over the period 2003-2007 with available board information in the Nikkei CGES database. Performance variability is calculated over the sample period. ROA is operating income over total assets. LNQ is the log of market to book value of assets. Stock returns are adjusted for dividends and stock splits. Low Q (High Q) indicates that the firm's average Q ratio is below (above) the sample median. All the explanatory variables are averaged over the sample period. BS is the number of board members. INDIR is the proportion of insiders. SO indicates that the firm has issued stock options. DIROWN is the percentage of shares owned by all directors. INST is the ownership by financial institutions. LNTA is the log of total assets. CAPEX is capital expenditures over total assets. DEBT is total debt over total assets. AGE is the number of years since the firm's listing. Standard errors are corrected for heteroskedasticity. **, *, † indicate that the t-ratios between brackets are significant at the 1%, 5% and 10% level.

Table 6: Effect of growth opportunities on the relation between board size and risk taking (panel regressions)

	Absolute deviation from expected performance using							
	ROA		LNQ		CAPM		Fama French model	
	Low Q	High Q	Low Q	High Q	Low Q	High Q	Low Q	High Q
Ln(BS)	-0.0020 *	-0.0001	-0.0118 *	-0.0071	-0.7697 **	-0.3951 *	-0.6130 **	-0.3080 †
	(-2.27)	(-0.08)	(-2.39)	(-0.87)	(-3.85)	(-2.23)	(-3.37)	(-1.75)
INDIR	0.0001	-0.0008	-0.0054	-0.0233 †	0.1181	-0.4038	0.3498	-0.4151
	(0.10)	(-0.46)	(-0.75)	(-1.71)	(0.38)	(-1.43)	(1.25)	(-1.53)
SO	0.0011 †	0.0020 †	0.0031	0.0023	-0.3535 **	-0.0121	-0.3115 *	-0.0012
	(1.68)	(1.90)	(1.04)	(0.39)	(-2.78)	(-0.10)	(-2.54)	(-0.01)
Ln(DIROWN)	0.0003	-0.0005	-0.0009	0.0010	-0.0333	0.0053	0.0124	0.0365
	(0.67)	(-0.51)	(-0.35)	(0.19)	(-0.32)	(0.06)	(0.14)	(0.46)
INST	-0.0029	-0.0166 **	-0.0056	-0.0119	-0.0121 †	-0.0250 **	-0.0102 †	-0.0176 **
	(-0.59)	(-3.73)	(-0.42)	(-0.41)	(-1.72)	(-3.93)	(-1.73)	(-2.91)
LNTA	-0.0013 **	-0.0017 **	-0.0004	-0.0097 **	-0.2633 **	-0.5734 **	-0.1652 **	-0.5378 **
	(-3.10)	(-3.72)	(-0.22)	(-2.97)	(-4.07)	(-9.25)	(-2.83)	(-8.80)
CAPEX	-0.0045	-0.0025	-0.0337	-0.0032	-0.0200 †	0.0116	-0.0201 *	0.0158
	(-0.59)	(-0.70)	(-1.55)	(-0.07)	(-1.95)	(0.91)	(-2.11)	(1.32)
DEBT	0.0044 †	-0.0033	0.0143	-0.0642 **	0.0530 **	0.0457 **	0.0449 **	0.0375 **
	(1.67)	(-1.20)	(0.49)	(-3.33)	(9.50)	(9.68)	(9.44)	(8.54)
AGE	-0.0045	-0.0047	-0.0350 **	-0.0269	-0.0019	0.0083 †	-0.0053	0.0066
	(-1.47)	(-1.19)	(-2.72)	(-0.96)	(-0.38)	(1.65)	(-1.18)	(1.37)
Industry and time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald χ^2	210.91 **	248.87 **	211.24 **	600.99 **	1305.44 **	1409.57 **	1088.29 **	1202.85 **
R2	0.1323	0.1251	0.0616	0.0961	0.0693	0.0754	0.0581	0.069

Expected performance is described in equations 2-4. Absolute deviation from expected performance is the absolute value of the residual described in equation 5. ROA is operating income over total assets. LNQ is the log of market to book value of assets. Excess returns are relative to the CAPM or Fama-French 3-factor model. Low Q (high Q) indicates that the firm's Q ratio is below (above) the sample median in the same year. BS is the number of directors. INDIR is the proportion of inside directors. SO indicates that the firm has distributed stock options. DIROWN is the percentage of shares owned by all directors. INST is the ownership by financial institutions. LNTA is the log of total assets. CAPEX are capital expenditures over total assets. DEBT is total debt over total assets. AGE is the number of years since the firm's listing. The sample for ROA and LNQ consists of 6,399 firm-year observations. The sample for stock returns consists of 76,717 firm-month observations. The equations are estimated using GLS random effects with standard errors clustered by firm. **, *, † indicate that the z-values in brackets are significant at the 1%, 5% and 10% level.

Table 7: Effect of growth opportunities using sales growth (OLS regressions)

Dependent variable	Volatility of ROA		Volatility of LNQ		Volatility of Returns	
	Low SG	High SG	Low SG	High SG	Low SG	High SG
Predicted ln(BS)	-0.0026	-0.0025	-0.0161 †	-0.0117	-0.0142 **	-0.0114 **
	(-1.49)	(-1.13)	(-1.71)	(-0.77)	(-3.34)	(-3.16)
INDIR	0.0021	0.0011	-0.0251	-0.0345	-0.0049	-0.0142 †
	(0.60)	(0.23)	(-1.41)	(-1.11)	(-0.62)	(-1.95)
SO	0.0032 *	0.0033 *	0.0173 *	0.0239 *	-0.0020	-0.0013
	(2.26)	(2.18)	(2.37)	(2.30)	(-0.71)	(-0.52)
Ln(DIROWN)	0.0018 †	0.0002	-0.0014	-0.0068	-0.0016	0.0017
	(1.96)	(0.19)	(-0.35)	(-0.93)	(-0.87)	(0.95)
INST	-0.0001	-0.0002 *	-0.0001	-0.0006	-0.0002	-0.0004 **
	(-1.63)	(-2.51)	(-0.31)	(-1.16)	(-1.45)	(-3.23)
LNTA	-0.0014 **	-0.0015 *	-0.0069 *	-0.0212 **	-0.0061 **	-0.0074 **
	(-2.65)	(-2.13)	(-2.36)	(-3.82)	(-5.24)	(-6.07)
CAPEX	-0.0129	-0.0114	0.0862	0.1821	-0.0352	-0.0088
	(-1.08)	(-1.28)	(1.21)	(1.64)	(-1.30)	(-0.29)
DEBT	0.0079 *	0.0068	-0.0660 **	-0.0965 **	0.0861 **	0.0852 **
	(1.97)	(1.40)	(-3.67)	(-2.63)	(9.92)	(9.38)
AGE	-0.0044	0.0010	-0.0123	0.0244	0.0221 *	0.0183 †
	(-1.02)	(0.18)	(-0.50)	(0.60)	(2.12)	(1.70)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
F value	5.89 **	4.93 **	6.50 **	4.52 **	22.48 **	20.08 **
R^2	0.1959	0.1939	0.2208	0.1881	0.3706	0.3736

Growth opportunities are estimated using average sales growth (SG) over the sample period. Low SG (High SG) indicates that the firm's average sales growth is below (above) the sample median. The variables are the same as in Table 4. The sample consists of 1,324 firm observations. Standard errors are corrected for heteroskedasticity. **, *, † indicate that the t-ratios between brackets are significant at the 1%, 5% and 10% level.

Table 8: Instrumental variable regressions

	Ln(BS)	Standard deviation of performance: ROA	LNQ	Return
Predicted ln(BS)		0.0247	0.0801	-0.0710 †
		(1.22)	(0.59)	(-1.71)
FLOAT	-0.0024 **			
	(-3.01)			
INDIR	-0.5658 **	0.0175	0.0330	-0.0422 †
	(-11.62)	(1.48)	(0.41)	(-1.73)
SO	-0.0573 **	0.0054 **	0.0345 **	-0.0037
	(-2.78)	(3.65)	(3.43)	(-1.16)
Ln(DIROWN)	-0.0050	0.0020 *	0.0038	-0.0003
	(-0.37)	(2.03)	(0.70)	(-0.17)
INST	0.0025 **	-0.0002 *	-0.0007	-0.0001
	(2.82)	(-2.57)	(-1.18)	(-0.67)
LNTA	0.1252 **	-0.0050 †	-0.0248	0.0011
	(14.49)	(-1.83)	(-1.41)	(0.20)
CAPEX	-0.3519 *	-0.0007	0.1839 *	-0.0386
	(-2.53)	(-0.07)	(2.29)	(-1.44)
DEBT	0.0291	0.0064 †	-0.0876 **	0.0845 **
	(0.48)	(1.95)	(-4.41)	(12.59)
AGE	-0.0510	-0.0004	0.0016	0.0122
	(-0.76)	(-0.10)	(0.06)	(1.41)
Industry dummies	Yes	Yes	Yes	Yes
F test (instrument)	9.0579 **			
Partial R^2	0.0073			
Durbin χ^2		2.3474	0.5384	2.2666
Wu-Hausman F value		2.3123	0.5244	2.1953
F value (model)	30.38 **			
Wald χ^2		226.69 **	398.02 **	561.46 **
R^2	0.3714	0.1224	0.1202	0.1583

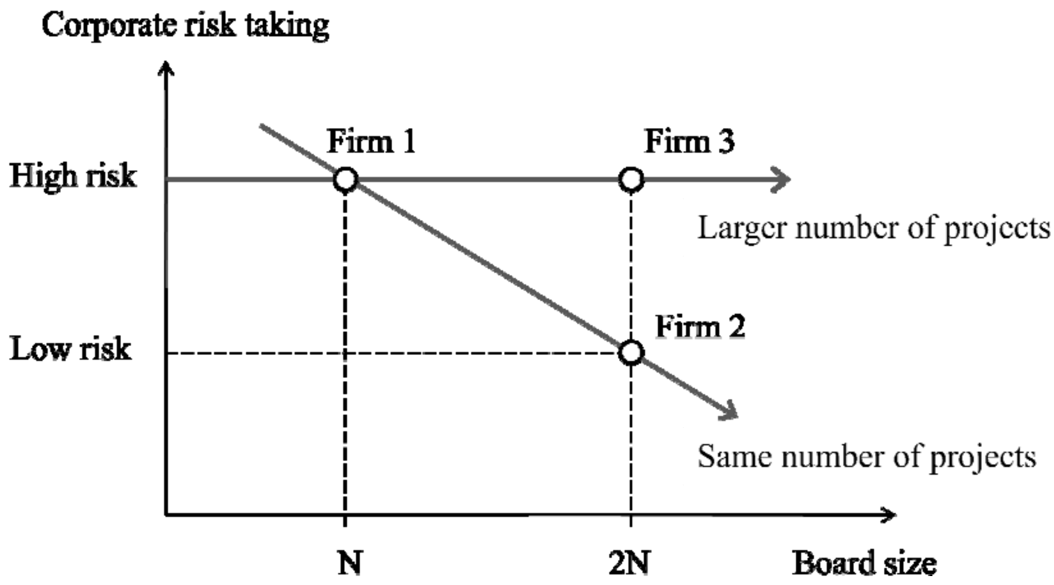
The exogenous variation in board size (BS) is identified using the percentage of free float (FLOAT). INDIR is the proportion of inside directors. SO indicates that the firm has distributed stock options. DIROWN is the percentage of shares owned by all directors. INST is the ownership by financial institutions. LNTA is the log of total assets. CAPEX are capital expenditures over total assets. DEBT is total debt over total assets. AGE is the number of years since the firm's listing. Standard errors are corrected for heteroskedasticity. **, *, † indicate significance at the 1%, 5% and 10% level. The Durbin χ^2 and Wu-Hausman F test the exogeneity of board size.

Table 9: Relation between board size and risk taking using bankruptcy risk (panel regressions)

	Olson's O-score			Altman's Z score (inversed)		
	all firms	low Q	high Q	all firms	low Q	high Q
Ln(BS)	-0.1664 **	-0.2035 **	-0.1398 **	-0.0244 **	-0.0289 **	-0.0160
	(-4.45)	(-3.51)	(-2.94)	(-3.04)	(-2.74)	(-1.40)
INDIR	-0.1530 *	-0.1999 *	-0.0983	-0.0359 **	-0.0640 **	-0.0084
	(-2.51)	(-2.07)	(-1.32)	(-3.04)	(-3.21)	(-0.60)
SO	0.0371	0.0581	0.0441	-0.0180 *	-0.0192	-0.0114
	(1.33)	(1.31)	(1.31)	(-2.50)	(-1.65)	(-1.44)
Ln(DIROWN)	0.0155	0.0360	-0.0004	0.0018	0.0073	-0.0069
	(0.86)	(1.31)	(-0.02)	(0.27)	(0.76)	(-1.27)
INST	-0.7488 **	-0.5782 **	-0.8919 **	-0.1752 **	-0.2308 †	-0.1375 **
	(-6.06)	(-3.09)	(-5.33)	(-2.99)	(-1.79)	(-3.41)
LNTA	-0.0428 **	-0.0500 *	-0.0292	0.0567 *	0.1071	0.0303 **
	(-3.17)	(-2.44)	(-1.60)	(2.32)	(1.57)	(4.92)
CAPEX	-0.3567 *	-0.5339 †	-0.2133	0.0521	0.0932	0.1161
	(-2.23)	(-1.89)	(-1.14)	(0.54)	(0.42)	(1.56)
DEBT	0.3598 **	0.4932 **	0.3076 *	0.4926 **	0.2783	0.6023 **
	(3.69)	(3.60)	(2.13)	(5.38)	(1.20)	(15.02)
AGE	0.0691	-0.0520	0.1158	0.3031 **	0.4647 *	0.1525 **
	(0.68)	(-0.39)	(0.76)	(2.84)	(2.37)	(2.92)
industry and year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Wald χ^2	836.64 **	505.58 **	582.77 **	1565.87 **	880.6 **	2428.27 **
R^2	0.1347	0.1463	0.1428	0.3191	0.3126	0.6194

Olson's O-score and Altman's Z score are calculated according to Xu and Zhang (2009). BS is the number of directors. INDIR is the proportion of inside directors. SO indicates that the firm has distributed stock options. DIROWN is the percentage of shares owned by all directors. INST is the ownership by financial institutions. LNTA is the log of total assets. CAPEX is capital expenditures over total assets. DEBT is total debt over total assets. AGE is the number of years since the firm's listing. The equations are estimated using GLS random effects with standard errors clustered by firm. **, *, † indicate significance at the 1%, 5% and 10% level.

Figure 1: Effect of board size on corporate risk taking



The following assumptions are made: Firm 1 and firm 2 have the same number of projects. Firm 3 has twice as many projects. Firm 2 and firm 3 have twice the number of directors of firm 1. Projects for firms 1 and 2 are screened by the entire board. Projects for firm 3 are screened by half of the board so that each director screens the same number of projects as the directors of firm 1.

Endnotes

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[i] The combination of poor investment opportunities and large corporate boards might explain why Japanese firms have been found to be significantly less risky than US firms. For more detail, see John et al. (2008).

[ii] One implication of this heterogeneity is illustrated by the study of Lang and Litzenberger (1989) which showed that dividend increases essentially affect the value of low-Q firms, but have no particular impact on the value of high-Q firms.

[iii] The same idea applies to portfolio diversification. As more stocks are randomly included in a portfolio, the risk of the portfolio decreases towards a minimum representing un-diversifiable risk. But if the stocks included in the portfolio are highly correlated, the risk of the portfolio will not decrease much although a large number of stocks appear to have been included in the portfolio.

[iv] Note that in contrast to Adams et al. (2005) the model does not include a measure of CEO power. This should be inconsequential since Ahn et al. (2009) establish that Japanese CEOs have no effect on firm performance apart from a short-lived positive abnormal return on the day a CEO change is announced. In addition, Crossland and Hambrick (2007) demonstrate that Japanese cultural values (particularly high uncertainty avoidance and low individualism), high ownership concentration and low board independence lead to a relatively small CEO effect on a number of organizational outcomes.

[v] Stock return volatility is computed using monthly observations.

[vi] The data is identical to the one in Nikkei NEEDS which has been extensively used in Japanese accounting and finance research. AMSUS provides analytical tools useful for financial analysis and portfolio management.

[vii] For instance, Sony Corp. had 38 directors, most of whom were executives responsible for individual business divisions. In 1997, the number of directors was cut to just 10 members (including 3 outside directors). Toyota had an even larger board consisting of 58 directors. Spurred by corporate governance reform at Sony, the car manufacturer decided in 2003 to trim the size of its board to 27 members (Yoshimori, 2005).

[viii] In Cheng (2008) average firm age is about 25 years compared to 35 years in our sample. Direct comparison with Adams et al. (2005) cannot be made since firm age is measured by the number of years since incorporation.

[ix] However, the regressions using the log of Tobin's Q produce significantly higher R-squared.

[x] The results in Table 2 only prove the existence of a positive correlation between stock options and risk taking and should not be viewed as demonstrating causality since we do not control for the endogeneity of the stock option indicator. In fact, Coles et al. (2006) indicate that high-risk firms are more likely to issue stock options. Nonetheless, endogeneity can bias the estimated coefficients on the other exogenous regressors. To ensure that this is not a serious problem, we re-estimate the risk (volatility) equations without the indicator of stock options. The coefficients on board size are found to be slightly more negative (by about 10 percent) which is consistent with the positive correlation between risk taking and the existence of executive stock options.

[xi] Shareholders usually gain from higher corporate risk taking since equity is a call option on the firm's assets. In contrast, debtholders lose since corporate debt involves the same payoff as a short put option on the firm's assets.

[xii] For more details on quantile regressions, see Koenker (2005).

[xiii] We also use the percentage of shares held by individual investors for further sensitivity check. Since these two variables are highly correlated, we do not consider them jointly. Instead, we extract the main factor using principal component analysis and use it as instrument for board size. The result is qualitatively similar.

[xiv] As Boubakri et al. (2011) we also use the difference between max and min performance over the sample period. The results with this risk measure are similar to those based on the standard deviation of performance.