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# Larger board size and decreasing firm value in small firms[1]

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**Abstract**

Several studies hypothesize a relation between board size and financial performance. Empirical tests of the relation exist in only a few studies of large U.S. firms. We find a significant negative correlation between board size and profitability in a sample of small and midsize Finnish firms. Finding a board-size effect for a new and different class of firms affects the range of explanations for the board-size effect. © 1998 Elsevier Science S.A. All rights reserved.

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## 1. Introduction

Researchers in many disciplines have explored the effect of group size on group performance. In corporate finance, Yermack's (1996) study of Fortune

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500 industrial firms, partly confirmed by Bhagat and Black (1996),[2] verifies predictions by Jensen (1993) and others of a negative correlation between firm value and the size of a firm's board of directors. But many factors about firms, ranging from the nature of the board's role to the risk of bankruptcy, vary by country (Gilson and Roe, 1993; Roe, 1994) and by firm size (Eisenberg, 1995). Yermack's results might not extend to smaller firms or firms operating in different legal or cultural environments. Indeed, Yermack finds no consistent association between board size and firm value for board sizes below six, and recognizes that his sample, dominated by firms with large boards, is inappropriate for testing hypotheses about smaller boards.

This article finds a board-size effect in a random sample of approximately 900 small Finnish firms. The effect, confirming Yermack's findings, shows a negative correlation between firms' profitability, as measured by industry-adjusted return on assets, and board size. A board-size effect thus exists even among firms and in boards substantially smaller than those in Yermack's sample. Studies of board-size effects in smaller firms are of interest because the factors that drive the choice of board size and structure in this class of firms could differ from the factors influencing board size in large public firms. For example, small and midsized firms are frequently closely held, so the influence of agency problems between managers and owners on decisions affecting board size and structure are probably less prevalent in this class of firms. And although smaller firms comprise the vast bulk of firms (Cary and Eisenberg, 1995, p. 243), studies of large firms with publicly traded securities dominate the empirical literature.

The inverse relation between board size and industry-adjusted return on assets proves robust to controls for firm size, industry, firm age, and the change in assets as a proxy for growth opportunities. Furthermore, the result is robust to the endogeneity problem that arises if industry-adjusted return on assets is a function of board size. We use full-information maximum likelihood estimates to control for the endogeneity problem. We also investigate whether board sizes increases as a consequence of past poor performance, but find no significant relation between the lagged return on assets and the net change in board size.

As a preliminary matter, the propriety of comparing U.S. and Finnish results depends on Finnish boards being similar to U.S. boards. The mechanism by which board sizes are fixed and the duties of board members are similar in the two countries. In both countries, shareholders usually have the formal power to determine the size of the board, though the board itself often exercises substantial control over that decision. Finnish law states that the board need have only one member, plus a deputy member, if the share capital is less than one million

[2] Bhagat and Black find a negative correlation between firm performance and board size using the same measure of performance that Yermack uses, but using other measures of performance does not lead to the same result.

Finnish marks (about \$200,000). For firms with larger share capital, the board must consist of at least three members. Board members in both countries set overall policy for firms but daily decisionmaking rests with management. And boards in both countries are responsible for hiring senior management.

After explaining in Section 2 why board size matters, Section 3 presents the relation between board size and profitability. Section 4 discusses alternative explanations of the results, and Section 5 concludes.

## 2. Why board size matters

The literature discusses two main sources of the board-size effect: increased problems of communication and coordination as group size increases, and decreased ability of the board to control management, thereby leading to agency problems stemming from the separation of management and control (Jensen, 1993; Yermack, 1996). The literature focuses on board structures in public firms. Yermack's sample boards have from six to 24 members, with few firms having boards with fewer than six members. These firms' large boards can make coordination, communication, and decision making more cumbersome than in smaller groups (Jensen, 1993; Lipton and Lorsch, 1992; Yermack, 1996).

If impaired communication and coordination were the only source of the board-size effect, firms should be expected to adjust their board size to preserve value. Jensen, however, offers a reason why such adjustments might not occur. He suggests that larger boards lead to less candid discussion of managerial performance and to greater control by the CEO. Thus, larger board size can reduce the board's ability to resist CEO control. Yermack (1996, p. 210) suggests that 'CEO performance incentives provided by the board through compensation and the threat of dismissal operate less strongly as board size increases'.

When the focus shifts away from Fortune 500 companies, one expects a decrease in excess CEO control over boards. In small, private firms, little separation of ownership and control presumably exists, with a corresponding reduction in management-board conflicts. Thus, excess management control, while offering a plausible reason for persistent large boards in large, public firms, is a less forceful explanation for board-size effects in small firms. The board-size effect might remain in smaller firms if communication and coordination problems apply to much smaller board sizes than those suggested by Jensen (1993) and Lipton and Lorsch (1992). Interestingly, Yermack's data (1996, Fig. 1) suggest that the greatest loss in value occurs for board sizes in the range of five to ten members, the small end of his board sizes.

A possible third explanation of the board-size effect relates to the composition of the board. The proportion of outside directors is likely to be positively correlated with board size (Yermack, 1996, p. 191), and outside directors mostly own negligible equity stakes in firms. Outside directors thus bear a reputation cost if projects fail and the firm encounters financial difficulties, while their share of the gains is limited. This asymmetry suggests that outside directors have a bias against projects with a high variance that increase the probability of bankruptcy, even when the net present value of the projects is positive. If directors own equity, the effect could flow in the opposite direction, since more directors share the reputation cost; the cost of poor decision making is spread among a larger group, thereby cushioning the effect on any individual decision maker. Bhagat and Black (1996, p. 50) find that the median outside director stock ownership is only 1% for a sample of 780 public U.S. companies, suggesting that outside directors often want to avoid risk. This kind of effect can also exist for small firms, whose outside directors might be bank officers unwilling to take risks that could lead to bankruptcy.

Thus, agency-based sources of the board-size effect could diminish in small firms with boards substantially smaller than Fortune 500 firms' boards. Some sources, such as outside director effects, might not diminish. Studying the effect of board size in our new sample of firms not only explores whether the board-size effect extends beyond large U.S. firms, it can also suggest which of the hypothesized sources of the board-size effect are candidates for future study.

## 3. Board size and firm profitability

### 3.1. Data description

We first ascertain whether a board-size effect on profitability exists in our sample of 785 healthy firms and 94 bankrupt firms. The sample of healthy firms is a random sample drawn from the database of Asiakastieto Oy, a Finnish credit bureau whose database includes about 120,000 firms, of which about 15,000 report financial data. All Finnish firms above a prescribed small size must file financial data with the Department of Trade and Manufacturing. Financial statements need not be filed if two of the following three conditions are fulfilled: (i) the company's sales are less than four million Finnish marks during the year, (ii) total assets are less than two million Finnish marks, and (iii) the number of employees is fewer than ten during the prior year. The Asiakastieto Oy data include all Finnish firms for which financial data are available. Thus, the range of firms in our sample is broad but the sample excludes very small firms and is dominated by small and midsize firms.

Asiakastieto Oy randomly selected 838 healthy firms from its database after we specified the approximate number of firms we wished to include in the sample. The Asiakastieto Oy database includes partnerships and individuals, as well as corporations. Since the board-size effects studied here are of interest only for corporations, we exclude 52 partnerships and individuals from the sample. In addition, a healthy firm with only one board member was excluded.

The financial data are based on financial reports covering 1992 to 1994. For each firm we use the most recent financial report available when the sample was selected in March 1996. All data used in this study, except the prior board size and two-year-earlier financial data used in Section 4.1, are from the databases of Asiakastieto Oy. Prior board size and earlier financial data come from documents available at the Patent and Registration Office (PRO). Every Finnish company is required to notify the PRO when the membership of its board of directors changes. This is the same source that Asiakastieto Oy uses to construct its databases.

The original sample of 108 bankrupt firms includes all firms that filed a bankruptcy petition between July 1995 and March 1996 for which financial statements prepared less than 40 months prior to the filing are available. As in the case of healthy firms, the financial data in the bankrupt firms' statements cover from 1992 to 1994. The median time between the bankruptcy filing and the day when financial statements were prepared is 32 months, the minimum time is 18 months, and the maximum time is 39 months. Ten unincorporated bankrupt firms and four bankrupt firms with only one board member were excluded from the sample.

We sample a higher proportion of bankrupt firms to ensure a reasonably sized sample of bankrupt firms. Analyzing whether bankruptcy is filed as a function of board size (among other things), one of our original goals, requires a representative sample of bankrupt firms. The firms in the database have an overall bankruptcy rate of 1.6% and a simple random sample of all firms reporting in a confined time period would result in the inclusion of very few bankrupt firms. Bankruptcy prediction studies routinely encounter this problem. Such studies often must collect data across many years to obtain a reasonable number of bankrupt firms to analyze (e.g., Ohlson, 1980).

For the combined sample, 70% of the firms report data covering 1994, about 26% report data covering 1993, and about 4% report data covering 1992. To ensure that combining the bankrupt and healthy firms does not affect our results, we present, where appropriate, results for the healthy firms alone as well as results for the combined sample. Where appropriate, we also use weighting to account for the oversampling of bankrupt firms, though unweighted results are not materially different from those reported here. We confirm our findings by controlling for the different years covered by the data.

Table 1, Panel A, presents descriptive statistics about the sample firms. Panel B shows their breakdown by industry. Board sizes and firm sizes are of particular interest. The sampled Finnish firms have median assets of 4.3 million Finnish marks (FM) (approximately $800,000) and mean assets of FM 38 million (approximately $7 million). Clearly, these Finnish firms differ quantitatively from Fortune 500 firms. Their boards have a median size of three members and a mean of 3.7 members. They are thus much smaller than the boards usually studied.

Table 1
Description of firm characteristics for 879 Finnish firms, 1992–1994

Panel A presents the mean, median, and standard deviation for the principal variables used in this study. The data come from a random sample of corporations included in the data base of Asiakastieto Oy, a Finnish credit bureau, for the period 1992 – 1994. We use the most recently available financial data for each firm as of the time the sample was drawn. The mean of 0.11 on the bankrupt dummy variable is a consequence of the oversampling of bankrupt firms, as reported in the text. It does not reflect the true proportion of bankrupt firms in the Asiakastieto Oy data base. Panel B presents a breakdown of mean and median assets and board size by industry. The industry groupings are based on standard Finnish two-digit industry codes, with some regrouping of small categories. Asiakastieto Oy's definitions of return on assets and solvency are the ones commonly used in Finland. Return on assets is (net income + interest expenses + change in reserves)/(total assets − short term accounts payable and accrued expenses − advances), and could be labeled return on investments. (Short term, non-interest-bearing debts are excluded from the denominator in computing return on investments but not in computing return on assets.) Solvency is defined as (shareholder's equity + reserves)/(total assets − advances).

| | Median | Mean | Standard deviation | *N* |
|---|---|---|---|---|
| **Panel A. Firm characteristics** | | | | |
| Return on assets | 0.13 | 0.18 | 0.41 | 876 |
| Solvency | 0.23 | 0.24 | 0.45 | 879 |
| Board size | 3.00 | 3.71 | 1.52 | 879 |
| Assets (thousands of Finnish marks) | 4270 | 37,936 | 380,618 | 879 |
| Age of firm (years) | 7.00 | 10.80 | 11.00 | 879 |
| Member of corporate group | 0.00 | 0.27 | 0.44 | 879 |
| Bankrupt | 0.00 | 0.11 | 0.31 | 879 |

| | Number | Percent of sample | Mean assets | Median assets | Mean board size |
|---|---|---|---|---|---|
| **Panel B. Industries** | | | | | |
| Agriculture, forestry, logging | 8 | 0.91 | 6500 | 3579 | 4.0 |
| Mining & quarrying | 2 | 0.23 | 188,240 | 188,240 | 5.0 |
| *Manufacturing* | | | | | |
| Food, beverage, tobacco | 14 | 1.59 | 19,275 | 13,804 | 4.0 |
| Textiles, clothes, leather goods | 12 | 1.37 | 14,342 | 4564 | 3.3 |
| Wood & wooden products | 32 | 3.64 | 186,840 | 9803 | 3.8 |
| Metals, metal products, machinery | 68 | 7.74 | 10,109 | 4990 | 3.3 |
| Manufacturing, other | 59 | 6.71 | 12,587 | 5374 | 3.5 |
| Publishing and printing | 26 | 2.96 | 16,958 | 4534 | 4.5 |
| Energy & water supply | 12 | 1.37 | 108,755 | 36,494 | 6.3 |
| Building & construction | 89 | 10.13 | 11,261 | 4841 | 3.3 |
| *Trade* | | | | | |
| Retail trade | 116 | 13.20 | 10,953 | 4786 | 3.2 |
| Wholesale trade | 182 | 20.71 | 15,778 | 3330 | 3.7 |
| Hotels and restaurants | 21 | 2.39 | 4581 | 2804 | 3.1 |
| Transportation | 55 | 6.26 | 20,998 | 4643 | 3.9 |
| *Services* | | | | | |
| Finance & financial services | 5 | 0.57 | 23,592 | 20,564 | 4.6 |
| Real estate | 18 | 2.05 | 366,040 | 4056 | 5.0 |
| Management, legal, marketing | 98 | 11.15 | 98,837 | 3271 | 4.1 |
| Other services | 62 | 7.05 | 8578 | 2787 | 3.9 |

### 3.2. Regression analysis

The great majority of the firms in our sample are not publicly owned, so we cannot measure their performance by market-based valuation data. Yermack, however, notes that his findings about board size and firm value are mirrored in firm profitability. We use industry-adjusted measures of return on assets ($ROA$) to measure firm performance. We use industry median measures of $ROA$ to control for the effect of industry conditions and general economic conditions. The industry median ratios used are calculated at the two-digit SIC level. The residual between the firm's and the industry's median $ROA$ should be a better measure of managerial and firm performance than an unadjusted $ROA$.

The dependent variable is a square-root transformation of the difference between each firm's $ROA$ and the firm's industry's median $ROA$. We define the difference between firm and industry $ROA$ to be $\Delta ROA$, and compute an industry-adjusted $ROA$ ($ROA_{adj}$) as follows:

$$ROA_{adj} = sign(\Delta ROA) \times \sqrt{|\Delta ROA|}. \quad (1)$$

Although we report results using $ROA_{adj}$, none of the board-size effects reported are a consequence of using this particular functional form for the dependent variable. If we simply use $\Delta ROA$, the models would lose some of their explanatory power but the board-size effects would remain statistically significant.

Fig. 1 shows the mean and median values for $ROA_{adj}$ as a function of board size. $ROA_{adj}$ decreases with board sizes ranging from two to six members. Like Yermack, we find a negative correlation between board size and firm profitability, and we find that relation for board sizes smaller than his.

Our Fig. 1 can also be viewed as an extrapolation of Yermack's Fig. 1. His figure suggests major declines in value for firms with five to ten board members, and almost no effect among boards ranging from ten to 18 members. Our Fig. 1 extends the range of the effect down to smaller boards. Our data thin out for board sizes above six members. Of the 879 firms in the sample, only 32 have seven-member boards, 14 have eight-member boards, and ten have boards with nine or more members. So the fact that the board-size effect does not emerge as clearly in our data for boards larger than six (although our Fig. 1 lines do suggest its existence in boards with more than seven members) does not conflict with Yermack's findings.

To test whether the negative correlation is attributable to other factors, we model $ROA_{adj}$ as a function of factors that might explain profitability, as measured by $ROA_{adj}$, or board size. Board size ought to correlate with firm size because larger firms probably need larger boards. We account for size by controlling for the logarithm of each firm's assets, measured in thousands of Finnish marks.

Yermack argues that more-diversified firms are likely to have larger boards. Boards of more-diversified firms may require more areas of expertise. A dummy

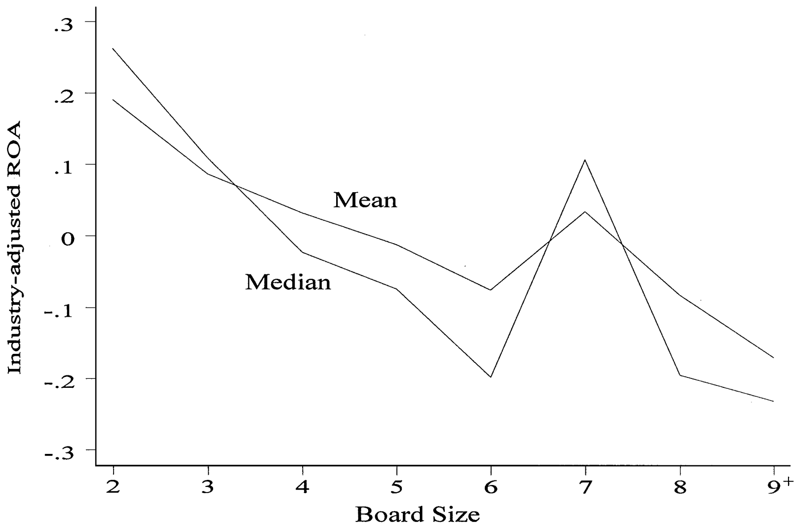


Fig. 1. The relations between board size and mean and median industry-adjusted returns on assets. Industry-adjusted return on assets is the square root of the difference between each firm's return on assets and the firm's industry's median return on assets, with the sign properly adjusted as described in Eq. (1). Industry medians are computed using standard Finnish two-digit industry codes. The random sample of 879 Finnish firms, 1992–1994, is drawn from the data base of Asiakastieto Oy. Fig. 1 includes all firms in the sample. It does not look materially different if we include only the firms that avoided bankruptcy.

variable for whether a firm is a member of a corporate group controls for diversification.

The board's quality can influence profitability. Boards with weak members can lead firms to lower profits. One measure of board quality is the financial performance of individual board members. We use the number of the board members' own personal payment disturbances as a measure of board quality. The payment disturbances recorded by Asiakastieto Oy include several types of debt default, including credit card debt, bad checks, unpaid bills of exchange, unpaid rents to landlords, and unpaid taxes. Actions taken by creditors to execute against a board member's assets and personal bankruptcy filings are also coded as payment disturbances.

Jensen and others suggest that a firm's ownership structure can affect board performance. In our group of predominantly small firms, ownership structure is probably not widely dispersed but we have no direct measure of dispersion. We can, however, indirectly control for ownership structure. Firm size is likely to be related to the proportion of the equity owned by the firm's CEO, the managing director. Thus, controlling for firm size can also help account for differences in the firms' ownership structure. The firm's age can also help control for differences in ownership structure. Older firms are more likely to have a more dispersed ownership structure than younger firms.

A firm's investment opportunities can affect profitability. Following Titman and Wessels (1988), we use each firm's change in assets from the prior year as a proxy for investment opportunities. Since the database does not include ratios of research and development expenditures to value, capital expenditures to value, and depreciation to value, we cannot test whether the results are sensitive to the choice of investment opportunity variables.

Table 2 presents descriptive statistics about the variables used to model $ROA_{adj}$ and their correlations with $ROA_{adj}$ and board size. Table 2 shows that board size and firm size are positively correlated, as are board size and firm age and diversification. Board size correlates negatively with $ROA_{adj}$. Our proxy for investment opportunities correlates positively with $ROA_{adj}$.

Ordinary least-squares regression models using the variables in Table 2 to model $ROA_{adj}$ suggest a substantial, significant board-size effect. But board size might itself plausibly be viewed as an endogenous variable that should be jointly estimated with $ROA_{adj}$. And modeling $ROA_{adj}$ and board size as endogenous dependent variables in a system of two equations yields different results, thereby suggesting the existence of endogeneity. Since ordinary least squares regression produces biased estimates in the presence of endogeneity, we use methods more appropriate for systems of equations. We therefore report simultaneous

Table 2
Descriptive statistics and correlations of variables used to model industry-adjusted return on assets for 879 Finnish firms, 1992–1994

Median values, mean values, and correlations of variables used in regression model of $ROA_{adj}$. $ROA_{adj}$ is a square-root transformation of industry-adjusted return on assets, as defined in Eq. (1). The number of board member payment disturbances is the aggregate number of defaults, late payments, and similar defalcations of all members of a firm's board of directors. The group dummy variable accounts for whether the firm is a member of a corporate group. The change in assets is the log of the difference between the firm's assets in the current accounting period and the firm's assets one year earlier. The sample is drawn from the database of Asiakastieto Oy. Significance calculations use correlation coefficients for all variables except the group dummy, for which a $t$-test is used $*p < 0.05$; $**p < 0.01$; $***p < 0.001$.

| | Median | Mean | Correlation with $ROA_{adj}$ | Correlation with board size | $N$ |
|---|---|---|---|---|---|
| $ROA_{adj}$ | 0.087 | 0.068 | 1.000 | − 0.167*** | 876 |
| Board size (log log) | 0.094 | 0.161 | − 0.179*** | 0.922*** | 879 |
| Assets (log) | 8.40 | 8.46 | − 0.185*** | 0.287*** | 870 |
| Assets (thousands of Finnish Marks) | 4270 | 37,936 | − 0.005 | 0.074* | 879 |
| Age of firm (years) | 7.00 | 10.84 | − 0.130*** | 0.147*** | 879 |
| Board member payment disturbances | 0 | 0.15 | − 0.004 | − 0.109** | 879 |
| Group dummy | 0 | 0.27 | − 0.219*** | 0.242*** | 879 |
| Change in assets (log) | 5.85 | 2.38 | 0.168*** | − 0.029 | 871 |

equation models of the following form:

$$ROA_{adj} = f(\text{board size, exogenous variables}), \quad (2)$$

$$\text{Board size} = g(ROA_{adj}, \text{exogenous variables}), \quad (3)$$

where $f$ and $g$ are linear functions.

For each model, we treat board size (log log) and $ROA_{adj}$ as endogenous variables and other variables as exogenous. The log log transformation of board size is used to make the distribution of the board size dependent variable more symmetric.

As discussed above, we treat a firm's age and status as member of a corporate group (group dummy) as primarily influencing board size. We treat investment opportunities and board quality, as measured by board members' payment disturbances, as primarily influencing profitability. We explore models in which firm size directly affects only board size and models in which firms size affects both board size and $ROA_{adj}$. We use full-information maximum likelihood estimators to solve Eqs. (2) and (3) simultaneously.

Table 3 reports the results for six models, three of which include all firms in the sample and three of which are limited to nonbankrupt firms. Table 3 confirms the relation in Fig. 1 between board size and firm profitability and the ordinary least squares results. Controlling for other factors, board size is negatively and significantly correlated with a firm's industry-adjusted return on assets. The results hold for both the combined sample and for the sample limited to nonbankrupt firms. Nearly all models omitting and adding other exogenous variables to one or both equations of Table 3 confirm the board-size effect.

Table 3 also shows that, as expected, profitability correlates positively with investment opportunities (represented by change in assets) and negatively, but insignificantly, with board members' payment disturbances. In the board size equation, also as expected, firm age, membership in a corporate group, and firm size all correlate positively with board size.

Finally, the statistical significance of the cross-equation correlation coefficient, rho, suggests the propriety of using full-information maximum likelihood estimation for the system in Eqs. (2) and (3) rather than an equation-by-equation method estimation procedure such as two-stage least squares.

Bhagat and Black (1996) suggest the importance of using alternative measures of firm performance in measuring board-size effects. One other measure available in our data is each firm's industry-adjusted operating margin to sales ratio. The operating margin is defined as earnings before taxes, extraordinary items, interest expense, and depreciation. In all models tested, this ratio correlates negatively with board-size but not always significantly. If there were reasons to believe that cross-sectional differences in the incentives to use different accounting methods influence our results, this ratio provides a more robust control. Small and midsize Finnish firms have their greatest discretion in the choice of depreciation methods and the operating margin to sales ratio does not depend on the choice of depreciation method. Inventory valuation methods cannot materially differ because all Finnish firms must use FIFO.

The negative correlations between board size and firm profitability in the different samples of firms studied here and by Yermack have implications for the sources of the board-size effect. Our boards range from two to nine in size, with a median of three members and a mean of 3.7 members. We observe declines in profitability even for board sizes of three, four, and five members. These sizes are below previously hypothesized optimal board sizes, though the hypotheses tend to focus on larger firms.

The small sizes of the boards and firms studied here suggest that they lack the same degree of separation of ownership and management that play a central role in existing explanations of the board-size effect. In these firms, managers presumably are owners. Thus, these small firms may lack the agency problems that enable managers to pursue their self-interest at the expense of the firm's overall value or profitability. Owner and manager interests coincide, yet we again find an inverse correlation between board size and firm performance.

## 4. Alternative explanations of board-size effects

The analysis shows that firms with small boards attain higher returns on investment in relation to their industry peers. There are several interpretations of this result: (i) communication and coordination problems apply to much smaller boards than those considered by Lipton and Lorsch (1992), Jensen (1993), and others; (ii) board size reflects the evolving nature of the firm; (iii) board size is correlated with board composition variables, and the composition explains the results; and (iv) companies adjust board size in response to their past performance.

Firms might increase their board size in response to poor profitability. A smaller board, having proven itself to be suboptimal, is enlarged. Such behavior would lead to a negative correlation between board size and profitability, but not because of value-enhancing characteristics of small boards. If board size increases after poor company performance, the cause of the relation between board size and return on assets may be the reverse of that reported here. Increasing board size in response to poor performance would also avoid the troublesome implication that firms with large boards are throwing away value. Rather, they are seeking to find an optimal board size. We start by exploring this explanation. We consider, as does Yermack, whether companies adjust board size in response to past performance.

We then briefly discuss whether the board-size effects might result from the evolution of the firm, which could coincide with changes in board size. As firms mature, their boards grow. Such growth changes the nature of the board. Board-size effects could be board effects unrelated to size. Board size could just be a proxy for the changing nature of the firm and board.

Table 3
Full-information maximum likelihood simultaneous equations models of $ROA_{adj}$ and board size

Full-information maximum likelihood (FIML) estimates of a set of simultaneous equations, Eqs. (2) and (3), modeling $ROA_{adj}$ and the log log of board size as the dependent variables. $ROA_{adj}$ is the square root of the difference between each firm's return on assets and the firm's industry's median return on assets, with the sign properly adjusted as described in Eq. (1). $T$-statistics are in parentheses. The firms consist of a random sample of 879 Finnish firms, 1992–1994, drawn from the data base of Asiakastieto Oy. The 'all firms' models include both active and bankrupt firms. The 'nonbankrupt only' models include only active firms. The first two columns report models using all exogenous variables in the $ROA_{adj}$ equation. The second and third pairs of columns report variations excluding first the firm's age, and then the firm's age and assets (log). Rho is the cross-equation correlation coefficient, the statistical significance of which supports the propriety of using FIML estimates. Following Yermack's (1996) suggestion that boards play a different role in industries subject to substantial government regulation, we repeat the analysis excluding utility companies and financial companies from the sample, with no material change in the results. $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

| | All firms | Nonbankrupt only | All firms | Nonbankrupt only | All firms | Nonbankrupt only |
|---|---|---|---|---|---|---|
| **Panel A. $ROA_{adj}$ equation** | | | | | | |
| Board size (log log) | − 1.410*** | − 1.638** | − 1.353*** | − 1.572** | − 0.990*** | − 0.952*** |
| | ( − 3.326) | ( − 2.791) | ( − 3.636) | ( − 3.128) | ( − 6.194) | ( − 5.995) |
| Board member payment disturbances | − 0.032 | − 0.001 | − 0.032 | − 0.001 | − 0.033 | − 0.002 |
| | ( − 0.876) | ( − 0.068) | ( − 0.870) | ( − 0.067) | ( − 0.913) | ( − 0.085) |
| Assets (log) | 0.031 | 0.050 | 0.029 | 0.047 | – | – |
| | (1.171) | (1.349) | (1.159) | (1.389) | – | – |
| Change in assets (log) | 0.009** | 0.006 | 0.009** | 0.006 | 0.009*** | 0.008** |
| | (2.957) | (1.563) | (3.000) | (1.618) | (3.694) | (3.056) |
| Age of firm | 0.001 | 0.001 | – | – | – | – |
| | (0.335) | (0.254) | – | – | – | – |
| Constant | 0.013 | − 0.067 | 0.029 | − 0.047 | 0.212*** | 0.233*** |
| | (0.077) | ( − 0.297) | (0.183) | ( − 0.232) | (6.613) | (6.768) |

**Panel B. Board size equation (log log)**

| | | | | | | |
|---|---|---|---|---|---|---|
| $ROA_{adj}$ | − 0.067 | − 0.252 | − 0.073 | − 0.258 | − 0.065 | − 0.232 |
| | ( − 0.365) | ( − 1.456) | ( − 0.393) | ( − 1.487) | ( − 0.360) | ( − 1.395) |
| Assets (log) | 0.041*** | 0.041*** | 0.041*** | 0.041*** | 0.036*** | 0.034*** |
| | (4.633) | (4.647) | (4.626) | (4.633) | (3.932) | (3.684) |
| Age of firm | 0.002 | 0.001 | 0.002 | 0.001 | 0.002* | 0.002 |
| | (1.639) | (1.014) | (1.749) | (1.228) | (2.045) | (1.919) |
| Group dummy | 0.102** | 0.053 | 0.104** | 0.055 | 0.121*** | 0.087** |
| | (2.616) | (1.391) | (2.702) | (1.484) | (3.810) | (3.275) |
| Constant | − 0.229* | − 0.178 | − 0.227* | − 0.175 | − 0.194* | − 0.132 |
| | ( − 2.513) | ( − 1.948) | ( − 2.746) | ( − 1.920) | ( − 2.004) | ( − 1.358) |
| $\rho$ | 0.751* | 0.920* | 0.741* | 0.913* | 0.609* | 0.742** |
| $N$ | 862 | 771 | 862 | 771 | 862 | 771 |
| Log likelihood | − 682.302 | − 592.541 | − 682.361 | − 585.516 | − 683.236 | − 587.026 |

A third alternative explanation is a variation on the possibility that the changing nature of boards correlates with board size. For example, banks play a prominent role in financing small and midsize Finnish firms. In such firms, larger board sizes may correlate with the presence of a bank officer or employee on the board. In a growing firm, a bank officer or employee may be one of the early additions to the board. If banks enjoy a senior creditor position such as, for example, by having a security interest in the debtor's assets, the bank officer often has an incentive to avoid risky projects. If this is so, larger board size per se may be less important in explaining the board-size effect than is the presence on the board of a risk-avoiding bank officer.

### *4.1. Past performance and current board size*

We explore the direction of causation by estimating regression models of the association between past performance, changes in the board, and board size. To analyze director appointments and departures we supplement the data used in Section 3 by using the Patent and Registration Office data. We examine the board of directors information contained in the PRO's records for each firm for which data are available for the period two years prior to the year of the company's financial data used in Section 3. Such lagged data do not exist for the very young firms in the sample and, due to the delay between the end of accounting periods and the filing of accounting reports, such data also tend to be missing even for young firms that are more than than two years old. We find the two-years-earlier financial statements and board change data for 423 firms in our original sample.

Following Yermack (1996) and Hermalin and Weisbach (1988), we estimate count-based maximum likelihood regression models of the number of directors leaving and joining a company. The Poisson regressions used by these earlier authors are inappropriate for our data because the events, board appointments and departures, are overdispersed. In such cases, negative binomial regression is preferable to Poisson regression (Agresti, 1990, pp. 42, 457). We also estimate a Poisson regression model in which the dependent variable equals the change in the board size (director additions minus departures) from the period two years earlier. The explanatory variables for all models are the firm's two-year-earlier return on assets, two-year-earlier solvency ratio, the change in the firm's size, whether a new CEO was appointed during the two-year period, the firm's age, the firm's board size two years earlier, whether the firm later went bankrupt, and industry dummy variables. The earlier year's board size should influence appointments and departures because larger groups are more likely to suffer departures or need replacements than smaller groups. Table 4 presents the regression results.

Like Yermack and Hermalin and Weisbach, we find that poor performance, as measured by two-year-earlier return on assets, is associated with higher levels

Table 4
Regressions of effect of company performance on director appointments, departures, and net change in board size from two years earlier

Count-based maximum likelihood models of director departures and appointments that explore whether prior performance, as measured by two-year-earlier return on assets and solvency, explains current board size. The original sample is a random sample of 879 Finnish firms, 1992–1994, drawn from the data base of Asiakastieto Oy, a Finnish credit bureau. Prior board size and earlier financial data are collected from documents available at the Patent and Registration Office. All other data are from Asiakastieto Oy. The reduced sample size of 423 firms results from the unavailability of two-year-earlier data for many firms. The first two columns present maximum likelihood negative binomial models of the number of directors joining and leaving each company's board. The third column presents a Poisson maximum likelihood estimate of the net change in board size, equal to director additions minus director departures. To transform all dependent variable values in the Poisson regression to zero or positive values, a constant equal to the maximum decrease in board size is added to the dependent variable. Ordinary least squares estimates without such a transformation yield substantially similar results. New CEO is a dummy equal to one if the CEO two years earlier differs from the CEO at the time of our analyses presented in Section 3. Two-year-earlier board size, firm age, firm membership in a corporate group, and a bankruptcy dummy variable provide further controls. The conclusions do not depend on the addition of these variables and are robust to excluding the industry dummy variables. A likelihood ratio test of the hypothesis that $\alpha$ (the overdispersion parameter) = 0 verifies the appropriateness of the negative binomial models used for director appointments and departures. For both the appointments and departure regressions, the probability that we would observe these data conditional on $\alpha = 0$ (conditional on the process being Poisson) is less than 0.0001. Negative binomial regression therefore appears to be better suited to these data than Poisson regression. For testing the hypotheses of interest here, Poisson regression results do not materially differ from the negative binomial results we report. For the change in board size equation, one cannot reject the hypothesis that $\alpha = 0$ and therefore Poisson regression is suitable. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

| Dependent variables<br>Estimation | Director appointments<br>Negative binomial ML | Director departures<br>Negative binomial ML | Change in board size<br>Poisson ML |
|---|---|---|---|
| Return on assets (two-year lag) | − 1.208* | − 0.967* | − 0.008 |
| | ( − 2.540) | ( − 2.115) | ( − 0.087) |
| Solvency (two-year lag) | 0.122 | 0.113 | 0.016 |
| | (0.485) | (0.459) | (0.329) |
| Board size (two-year lag) | 0.159*** | 0.188*** | − 0.040*** |
| | (3.773) | (4.451) | ( − 3.732) |
| Change in log of assets | 0.021 | 0.036 | 0.008 |
| | (0.220) | (0.391) | (0.321) |
| Age of firm | − 0.017* | − 0.019* | 0.001 |
| | ( − 2.120) | ( − 2.407) | (0.610) |
| Group dummy | 0.023 | 0.014 | 0.015 |
| | (0.129) | (0.083) | (0.392) |
| New CEO | 1.554*** | 1.399*** | − 0.028 |
| | (7.653) | (7.176) | ( − 0.491) |
| Bankrupt dummy | 0.347 | 0.460 | − 0.030 |
| | (1.404) | (1.946) | ( − 0.538) |
| Industry dummy variables for industries listed in Table 1 (not separately reported) | | | |
| $\alpha$ (overdispersion parameter) | 0.645 | 0.621 | – |
| Sample size | 423 | 423 | 423 |
| Pseudo $R^2$ | 0.147 | 0.140 | 0.012 |

of both director appointments and departures. More board directors are replaced when earlier returns on assets are poor, but net board size does not change. The Poisson model of change in board size also provides no substantial evidence that board size decreases in response to past poor return on assets.

In the Poisson model, the net change in board size is negatively and significantly correlated with board size. This is not surprising since the many small boards in our sample cannot reasonably be expected to suffer a net decrease in size; only firms with larger boards can tolerate a net loss in board members.

We conduct additional tests of the appointment, departure, and net change dependent variables using many different combinations of explanatory variables. The size and significance of the coefficients on return on assets vary depending on the model chosen. But none of the models generate results with materially different implications for the direction of causation from the implications of the results reported in Table 4.

As an additional, albeit indirect, test of the direction of causation of the board-size effects, consider the likely determinants of optimum board size. The size of the firm would likely correlate with optimum board size, as might the nature of the firm's business. Therefore, if the board-size effects we observe are caused by firms striving for optimum size, our results might vary noticeably across industries. To test the extent to which our results depend on particular industries, we run ordinary least-squares return-on-asset models separately for each industry. The 17 industry-by-industry return-on-asset regressions for which coefficients can be computed yield 12 industries in which the board-size coefficient is negative, one in which it is positive but less than 0.001 and four in which it is positive. None of the positive coefficients approach traditional levels of statistical significance. If firms are striving for optimum board-size, one might expect greater variation in the sign of the board size coefficient across industries.

Like Yermack, we conclude that the evidence supports the interpretation that board size influences current firm value, rather than the opposite (that past performance determines current board size).

### *4.2. The evolving nature of the firm*

Board size could correlate with performance because changing board size reflects the changing nature of the firm. Boards of different size may differ in their performance because increasing board size represents the addition of outside directors and the maturing of young, previously high-risk firms. Board size would then correlate with performance not because of the consequences of size per se but because the board's changing size reflects the changing nature of the firm. In all of our models, however, we control, at least in part, for the evolving nature of the firm by including variables for firm size, firm age, and change in firm assets. Although these variables sometimes have explanatory power, controlling for them does not eliminate the board-size effect. We thus find little evidence that the changing nature of the firm – from a young and risk-seeking enterprise to a more mature enterprise – explains the observed board-size effects.

### *4.3. The composition of the board*

Board size might correlate with the composition of the board. In firms as small as those in our sample, there is sometimes pressure to add family members or relatives to the board even though such additions might not optimize value. When a firm expands its board for other reasons, likely entrants are company outsiders or a bank officer. If these board members have a negligible equity stake, they have the incentive to avoid risk since they bear a reputation cost if projects turn out to be unsuccessful and the firm fails. If the omitted projects on average have a positive value, avoiding risk could translate into lower returns on assets for firms with large boards. Banks bear the downside risk if firms fail to meet their debt obligations. Thus, bank officers, acting in the interest of their employers, have a particular incentive to avoid risks. Risk-averse outside directors and bank officers could translate into lower returns on investments.

Our data do not allow us to explore all composition-related reasons for the board-size effect. We can, however, indirectly explore bank officer effects. Bank officer board members are not separately identified in our data but a useful proxy variable exists. The financial data reveal whether each firm has issued debt secured by a floating charge. In Finland, the holder of a floating charge has a security interest in the debtor's assets that can be sold in bankruptcy, including the firm's inventory and receivables. The floating charge's priority is limited to 60% of the value of the property securing the loan. After the years covered by this study, the law was changed to reduce the floating charge's priority to 50%. In Finland, loans secured by floating charges are issued almost exclusively by banks. Thus, firms that have granted floating charges are more likely than other firms to have a substantial relationship with a bank and to have a bank officer on the board of directors.

To explore whether the addition of bank officers explains larger board sizes, we regress board size as a function of firm assets, firm age, the corporate-group dummy variable, and a dummy variable that equals one when a floating charge has been issued. Table 5 presents the results. It shows that, controlling for firm size, age, and diversification, board size is negatively correlated with the presence of floating charge debt. If the presence of floating charge debt is a reasonable proxy for the presence of a bank officer on the board or bank influence on a firm, then increased board size is not associated with the presence of bank officers on the board. Table 5 also shows that firm size, presence in a corporate group, and age all have the expected positive correlation with board size.

The floating charge's influence raises the question whether controlling for it would affect our analysis of the effect of board size on profitability. In models

Table 5
Regression of board size (log log)

Regression of log log of board size weighted to reflect oversampling of bankrupt firms. $T$-statistics based on robust standard errors (White, 1980, 1982) are in parentheses. The firms consist of a random sample of 879 Finnish firms, 1992–1994, drawn from the data base of Asiakastieto Oy, a Finnish credit bureau. We are interested in whether bank officer presence on the board increases board size, which might suggest that our board-size effect results from financially troubled firms increasing their board size to add bank representation. Lacking a direct measure of bank officer presence, we use the existence of the floating charge, an indicator of secured borrowing, as a proxy for bank officer presence. The results offer no evidence that board size increases with the presence of a floating charge. We interpret this as evidence that board size does not increase for financially troubled firms due to the addition of bank officers to the board. In a regression that includes industry dummy variables for the industries reported in Table 1, the coefficient for the floating charge dummy variable is $-0.048$ ($t = -1.975$). *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

| Independent variables | |
|---|---|
| Assets (log) | 0.052*** |
| | (7.159) |
| Age of firm | 0.002* |
| | (2.566) |
| Floating charge dummy | − 0.082*** |
| | ( − 3.655) |
| Group dummy | 0.090*** |
| | (3.500) |
| Constant | − 0.286*** |
| | ( − 4.916) |
| Adjusted $R^2$ | 0.128 |
| Number of firms | 870 |

similar to those in Table 3 that include a floating charge dummy variable, the profitability board-size effect remains large and statistically significant. The board-size effect survives our effort to model the role of bank influence.

If the board-size effect is a function of outsiders and bank officers on the board, it does not necessarily imply that owners of firms with large boards throw away value. Rather, owners may choose a board composition that matches their own preferences. Suppose boards with outsiders and bank officers make more careful decisions. Following the Pratt (1964) and Arrow (1971) definition of risk aversion, owners of closely held firms with low initial wealth would prefer board structures that engender a careful policy, since they are more risk averse. Wealthier owners would prefer a board structure associated with more daring behavior, for two reasons. First, the greater wealth reduces their absolute risk aversion. Second, they are in a better position to diversify their investments. Questions relating board size to board structure and owners' preferences are beyond the scope of this paper but are interesting areas for further research.

## 5. Conclusion

We present evidence that a negative correlation between board size and profitability extends to small firms with small boards in Finland. This extension of previous findings has implications for the source of the board-size effect. It supports the hypothesis that problems in communication and coordination can extend to smaller boards and firms. It also suggests that agency problems at the levels faced by Fortune 500 companies are not a prerequisite to the existence of a board-size effect. The effect's presence in small to midsize firms with small boards shows that board-size effects can exist even when there is less separation of ownership and control than in large firms. And if there is an ideal board size, the board-size effect in our firms suggests that the ideal board size varies with firm size.

In closely held firms, an explanation based solely on communication and coordination problems would imply that owners choose suboptimal board structures. Board-size effects thus may have different roots in small, closely held firms than in large firms. An alternative explanation is that board size reflects the composition of the board. Larger boards can consist of more outsiders, who foster more careful decision-making policy in firms since the reputation cost if the firm fails is likely to be high in comparison with their private benefit if a project turns out to be profitable. The possible change in risk preferences induced by the change in board composition does not necessarily mean that owners choose suboptimal board sizes. Rather they might choose boards that match their own preferences. Owners with most of their wealth invested in one particular firm might prefer a board composition associated with careful decision making, while more-diversified investors might choose board structures associated with bolder investment policies.

Although we suggest several sources of the board-size effect, the data do not allow us to isolate the effect's origin. Interesting directions for further research include whether the board-size effect found for our small, closely held firms can be explained by board composition variables not explored here, as well as the interplay among board size, board composition, and the risk preferences of owners.

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