Aligned, informed, and decisive: Characteristics of value-creating boards

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Abstract

This paper explores empirically how board composition influences the conflict of interest between principals and agents, the production of information for monitoring and support, and the board's effectiveness as a decision-maker. The average board of our sample firms has six members who are mostly not owners. Gender diversity is low, roughly half the firms have employee directors, and most CEOs are neither directors in their firm nor elsewhere. Using a wide set of such board characteristics and new measures of board independence and director networking, we show that value-creating boards are aligned with their shareholders, but dependent on the CEO. Multiple directorships create valuable information networks, whereas increased diversity in terms of better gender mix, larger board size, and more employee directors is associated with lower value creation. Models accounting for endogenous board characteristics support these conclusions, which comply considerably better with the academic literature than with popular opinion and regulatory practice.

Keywords: Corporate governance, Board composition, Panel data methods, Endogeneity
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1 Introduction

How should shareholders and regulators design the board of directors in order to enhance value creation? According to theory and existing evidence, the three fundamental concerns in board design are to align the interests of principals and agents (Jensen and Meckling, 1976), provide information for monitoring and support (Fama, 1980), and to foster decisiveness, i.e., decision-making effectiveness (Fama and Jensen, 1983). This paper addresses the question of board design empirically by analyzing how firm performance relates to a wide set of board design mechanisms, such as director equity ownership, board independence, director network, age and gender diversity, board size, and the use of employee directors. The novel features of our study is to consider a more comprehensive set of board characteristics, use new proxies for board independence and director networking with stronger theoretical backing, study a richer sample in a different institutional environment, and use statistical tests which allow for endogenous board mechanisms.

Earlier research has focused on just one or a few of the board design mechanisms, such as insider ownership (McConnell and Servaes, 1990), board independence (Hermalin and Weisbach, 1991), director networks (Hallock, 1997), and board size (Yermack, 1996). However, boards have multiple functions, such as hiring and firing the CEO, monitoring the investment and financing projects, and setting the corporate strategy. The way boards solve this multidimensional task may not be captured empirically if one studies just a limited subset of board mechanism, such as insider ownership alone or director network alone or both. Also, if board mechanisms are internally related, the marginal effect of any one mechanism cannot be validly analyzed without simultaneously accounting for the others. For instance, if owner monitoring and CEO incentives are substitute disciplining mechanisms, information for monitoring purposes may be more valuable the smaller the CEO's equity holding in the firm. Our approach explicitly recognizes this multidimensional nature of the board design problem.

We introduce new empirical proxies for board independence and director network. Important parts of the board literature and most countries' corporate governance codes classify directors as dependent if they are affiliated, i.e., have past or present business or family relations to the firm. A possible reason why this literature has produced inconclusive evidence on how performance relates to board independence is that the independence proxy is theoretically ad–hoc. According to Hermalin and Weisbach (1998), which is the only rigidly developed theoretical model on this issue, what matters for director independence is not affiliation. Rather, it is the relative timing of entry, i.e., whether the director was appointed before or after the current CEO took office. Our independence proxy reflects this characteristic. Similarly, existing literature measures director network by the number of board seats a director holds in other firms (Kiel and Nicholson, 2003). This definition assumes every board is equally important networking-wise, and it double-counts when more than one of the firm's directors sit on the same outside board. Our network proxy avoids double-counting and treats each seat individually according to its information centrality. We do this by estimating the seat's position in the overall landscape of corporate boards, accounting for both the direct information effect of sitting on another firm's

board and the indirect effect of meeting directors on that board who hold seats in still other boards.

Our sample is the population of non-financial firms listed on the Oslo Stock Exchange from 1989 to 2002. This time series, which is long by international standards, allows us to study board dynamics over extensive periods, which is uncommon in the literature. For instance, Bhagat and Black (2002) classify board independence based on one single year, while performance is measured six years before and four years after. Also, our ownership structure data are unusually detailed, accounting for every equity holding of every owner in every firm at every year-end over fourteen years.

The institutional setting allows us to explore the impact of two board characteristics which are uncommon internationally. First, Norwegian corporate law rules that the CEO cannot be the chairman. Although not by law, it is also an empirical fact that other members of the management team are never directors in their firm. Moreover, the CEO is not on the board in roughly two thirds of our sample firms. Thus, in contrast to the US, regulation and a voluntary restriction on board composition jointly allow for boards which at least formally are less controlled by management than most boards in the US. This feature increases the power of tests that relate owner control to corporate performance. The second unusual characteristic is that when a listed Norwegian firm employs more than 200 people, the employees have the right to elect one third of the directors among themselves. Since roughly 40% our sample firms have employee directors, the cross-sectional variation of this board characteristic allows us to analyze the performance effect of employee directors, which is quite unexplored in the literature (Becht et al., 2003).

As our sample involves repeated observations of the same firm over time, we use the fixed effects technique to control for unobserved firm heterogeneity. We construct a static version of our model and estimate it with generalized least squares (GLS) and the general method of moments (GMM). To analyze potential endogeneity in the board mechanisms, we use GMM to estimate a model where alternative board characteristics are endogenously determined by each other and by performance. We also estimate a dynamic model, where past performance is a determinant of current performance along with current board design mechanisms. Because the underlying structural relationship between the variables is unknown, this setting of endogeneity is problematic with classic simultaneous equations methodology, which has been used earlier in similar contexts (Agrawal and Knoeber, 1996). Because the instruments needed in the simultaneous equations lack a theoretical rationale, and because the findings may be sensitive to the choice of instruments, such models may be unreliable (Bøhren and Ødegaard, 2006). Our GMM approach avoids such problems, as it allows us to use the moment conditions to validly estimate each equation separately even though it belongs to a simultaneous system.

We find that outside and inside ownership concentration is low, and that insider ownership by the CEO and by the directors tend to be complements rather than substitutes. The CEO is a director in the firm he runs in less than one third of the cases, and those CEOs who do sit on their companies' boards also sit on other boards more often than others. The average board

has six members, female directors are rare, average director age per board varies by almost fifty years across the sample, and there is often large age heterogeneity within the board.

Corporate performance is significantly higher when insider ownership is high and directors are dependent of the firm's CEO. The firm also performs better if the CEO is a director on his firm's board but not elsewhere, when the board has no CEOs from other firms, and when non-CEO directors also sit on other firms' boards. Firms with small boards, low gender diversity, and no employee directors are more profitable than others. These results are robust to alternative model specifications and quite insensitive to potential endogeneity. Still, and consistent with theoretical predictions, we do find that board design mechanisms are endogenous, both relative to performance and to each other. Better performance makes the board smaller and less independent, directors with strong networks both improve performance and gravitate towards well-performing firms, and the CEO owns a high equity share when the firm's directors do so as well.

These findings show that value-creating boards have directors who are aligned with the firm's owners through equity holdings. But well-functioning directors are also dependent on the CEO. This latter result runs counter to conventional wisdom and most corporate governance codes, but is quite consistent with existing empirical evidence. It shows that the board's support role may be a more critical resource than its control role, which is the only role captured by the Hermalin and Weisbach (1998) model and also the one receiving most of the attention in current board regulation. Similarly, it seems directors end up with multiple seats because their contribution to the firm is particularly valuable. Finally, the negative association we find between performance and diversity in terms of more gender mix, larger board size, and the use of employee directors do not support the popular claim that director heterogeneity is an underexploited board design mechanism.

The rest of the paper is organized as follows. Section 2 reviews the literature and explains where our methodology deviates from the one used by others. Section 3 describes the institutional framework, explains the data selection procedure, and presents the descriptive statistics. We formally test the relationship between board design and economic performance in section 4, whereas section 5 provides robustness checks. Section 6 summarizes and concludes.

2 Theory, evidence, and methodology

Becht et al. (2003) recently conclude that the theory of board design is grossly underdeveloped.[1] These characteristics of a young, immature paradigm are problematic for empirical research. Although the board design problem is multidimensional, each theory is partial and addresses one or a few board design mechanisms. Thus, theory cannot predict what the full set of value-creating board mechanisms looks like in equilibrium. Neither can it specify the expected

[1] "... formal analysis of the role of boards of directors and how they should be regulated is almost non-existent. ... In sum, the formal literature on boards is surprisingly thin given the importance of the board of directors in policy debates. This literature mainly highlights the complexity of the issues. There is also surprisingly little common ground between the models."

internal relationship between major mechanisms. For instance, theories of interest alignment (Jensen and Meckling, 1976), which deals with insider ownership, ignore potential links to decisiveness (Gjølberg and Nordhaug, 1996), which depends on board size. Consequently, such theories cannot validly predict whether insider equity holdings and board size are endogenously determined. This means the only feasible way forward is to specify expected performance effects of each individual mechanism from each partial theory. Therefore, the estimated relationship between the mechanisms and how they jointly drive performance should be regarded as observed empirical regularities, or stylized facts, rather than tests of well-founded hypotheses.

In the following, we explain our choice of focus and methodology by reviewing the existing literature. We organize the discussion around the three major concerns underlying the choice of any specific board design mechanism, which are to align the interests of principals and agents (section 2.1), provide information for monitoring and support (section 2.2), and to enhance the board's effectiveness as a decision-maker (section 2.3).

2.1 Interest alignment

Interest alignment in a board context concerns the firm's ownership structure and the degree of independence between the monitoring directors and the monitored officers.

The theory of corporate governance argues that ownership concentration matters for interest alignment by influencing the principal's incentives and power to monitor the agent (Shleifer and Vishny, 1986). Both properties are stronger the higher the ownership concentration, and inside ownership concentration (equity holdings by officers and directors) is more powerful than outside because inside owners are better informed and have direct access to the firm's strategic decision-making. However, because powerful insiders may entrench themselves and exploit their outside co-owners, the expected relationship between inside ownership concentration and market value is positive at low concentration levels and declining thereafter.

The empirical evidence on the relationship between outside concentration and firm performance is mixed and inconclusive (Gugler, 2001). As for inside concentration, which is the more relevant ownership characteristic in a board setting, the predicted curvilinear relationship has received consistent support by studies that ignore other board design mechanisms than insider ownership. However, this result does not carry over to the board literature, where the models include more board characteristics than just insider holdings. Hermalin and Weisbach (1991), Byrd and Hickman (1992), Yermack (1996), Cotter et al. (1997) and Bhagat and Black (2002) all find a positive relationship, but it is only significant in Hermalin and Weisbach (1991) and Yermack (1996).

Thus, adding more mechanisms to a board design model than just ownership structure may easily blur the mostly clean empirical relationship between insider ownership and firm performance found in simpler models. Our comprehensive model allows us to study this issue more closely. We measure outside ownership concentration by the Herfindahl index based on all outside owners.[2] Insider ownership is proxied for by the directors' aggregate equity fraction

[2]The Herfindahl index for outside ownership concentration is the sum of squared ownership fractions across

in the firm.

The board literature and existing corporate governance codes argue that monitoring quality is higher the stronger the independence between directors and managers. Such independence is generally thought to reflect the directors' ability to monitor the firm without feeling pressure from the CEO. Arguing that this issue involves more than just outside vs. inside directors, Byrd and Hickman (1992) introduce a finer partition by distinguishing between inside, affiliated outside, and independent outside directors. Only the latter type has no past or present business or family ties to the firm.

The empirical evidence on the relationship between such independence measures and firm performance is inconclusive. Baysinger and Butler (1985) estimate a ten-year lagged positive effect, Hermalin and Weisbach (1991) find no significant link, while the relationship is negative and significant in Yermack (1996), Agrawal and Knoeber (1996), Klein (1998), Bhagat and Black (1999), and Bhagat and Black (2002). One possible reason for this low consistency is the missing theoretical justification for the affiliation-based independence measure. Thus, to increase the power of the test, our independence measure will be founded on the Hermalin and Weisbach (1998) model, where the CEO's power to recruit dependent directors increases with the firm's past performance. This model predicts that the longer the history of good performance under the current CEO, the less independent the current board. Thus, the key independence criterion is not affiliation, but whether the director was appointed before or after the CEO took office.[3] Consistent with the Hermalin-Weisbach model, we measure a board's independence as the difference between the average tenure of the non-CEO directors and the tenure of the CEO:

$$\text{Independence} \equiv \frac{1}{\text{n}} \sum_{i=1}^{\text{n}} \text{non-CEO director tenure}_i - \text{CEO Tenure} \tag{1}$$

where non-CEO director tenure$_i$ is the number of years since non-CEO director i entered office, and n is the number of shareholder–elected directors. The average director has longer (shorter) tenure than the CEO when expression (1) is positive (negative). According to Hermalin and Weisbach (1998), the board is more independent the higher the value of (1).[4]

Carter and Lorsch (2004) argue that board independence is driven by the director's absolute rather than relative tenure, and that independence decreases rather than increases as tenure grows.[5] This happens because directors become emotionally more attached to the firm and its

all the firm's outside owners. Its maximum value is one (a single investor owns every share held by the outsiders), approaching its minimum value of zero as the ownership structure gets increasingly diffuse.

[3] A second reason for questioning the conventional independence definition in our setting is the institutional framework. The CEO of our sample firms is also a director in just one third of the cases, cannot hold the chair by law, and other members of the management team are never on the board. Thus, although most directors in our sample are independent in the Byrd-Hickman sense, they may not be so according to Hermalin and Weisbach (1998).

[4] Although not based on an underlying theoretical model, Westphal and Fredrickson (2001) did in fact use the fraction of directors appointed after the CEO took office as one of several independence measures.

[5] Absolute rather than relative CEO tenure has also been used as an independence proxy in the strategic management literature (Finkelstein and Hambrick, 1989).

management the longer they stay. Under this logic, a higher value of (1) means less independence rather than more. However, since (1) also reflects the tenure of the CEO, which is irrelevant under the Carter-Lorsch hypothesis, we will alternatively use board tenure, CEO tenure, and chair tenure as alternative proxies in our robustness tests.

2.2 Information

The quality of the board's monitoring and support functions depends on the quality of the information used. Information sources that can be modified by board design are CEO directorship, the CEO's directorships in other firms (which we call exported CEO director), another firm's CEO on our firm's board (imported CEO director), and non-CEO directors holding board seats in other firms (director network).

Agency theory suggests the CEO should not be on a board which is supposed to monitor him. In contrast, Carter and Lorsch (2004) posit that since the CEO has superior information about the firm and its environment, he should be a fully voting member. Because he is a member in about every third of our sample firms, we can explore the validity of these two competing predictions. While the CEO-chairman duality has been analyzed earlier, we are not aware of existing studies of CEO directorships.[6]

Similarly, whereas the agency logic may suggest that the CEO should pay full attention to his firm, the information perspective would argue that the firm may benefit from the information gained when the CEO is on other firms' boards. We use the exported CEO director variable to capture this design characteristic. Perry and Peyer (2005) show that when agency costs are high, the announcement of a new outside directorship for the CEO causes a negative share price reaction. Correspondingly, a CEO from another firm on our board (imported CEO director) may contribute little if he is already a fully committed CEO. Also, Gilson and Kraakman (1991) argue that imported CEO directors are bad monitors because they have the same role in the principal-agent setting as the CEO they are supposed to monitor. Again, the counterargument is the information idea that the imported CEO director brings new perspectives and makes all directors better informed. The net impact of these alignment and information effects can only be determined empirically.

Just like the CEO, non-CEO directors with multiple directorships may bring back information, but may also become overstretched monitors (Ferris et al., 2003). Fama (1980) argues that the average number of outside directorships held by the firm's directors proxies for the market value of the board's monitoring quality. This measure, which is predominant in finance-based board researchers, is simple, but potentially problematic. Although the information benefit may be positively related to the number of directorships, the measure is noisy because it ignores the uniqueness of each seat. Also, it does not distinguish between n direct director links to just one other firm versus one direct link per firm to n other firms. Moreover, it neglects indirect links

[6]Because the CEO director mechanism involves both alignment and information issues, it may be classified under either the alignment or the information heading. We choose the latter, but with no implicit assumption about relative importance.

created when the firm's director is on a second firm's board with someone who holds a seat in a third firm.

We avoid these problems by applying the information centrality concept from social network analysis (Wasserman and Faust, 1994). This measure captures the firm's direct and indirect links to directors in other firms. It also treats each seat individually and avoids double counting. The higher the board's centrality score, the stronger the information effect of its directors' network. The score increases with the number of direct and indirect paths from our firm to other firms, and is higher the shorter the indirect path.[7]

2.3 Decisiveness

The decisiveness mechanisms are supposed to improve the board's effectiveness as a decision-making unit. The mechanisms we explore are board size, director gender, director age, and the use of employee directors.

Yermack (1996) and Eisenberg et al. (1998) document that performance decreases with increasing board size. This is consistent with Gjølberg and Nordhaug (1996), who show theoretically that increased board size is valuable only if new members bring new insights. If not, larger boards take longer time to decide and make more conventional decisions than smaller boards. Thus, performance suffers when increased board size reduces creativity and decisiveness.

A larger board may also produce more diversity, which Cadbury (2002) considers a valuable characteristic. This is why public choice theory suggests board designers must trade off the negative effect of longer decision time and stronger pressure on consensus against the positive impact of a wider opportunity set generated by a more diverse board (Buchanan and Tullock, 1962). Thus, the issue is not just whether board size grows, but whether it does with new directors who differ sufficiently from the existing ones. Gender and age are potential ways to create such diversity.

The empirical evidence on how firm performance correlates with gender is scant and conflicting. Shrader et al. (1997); Smith et al. (2005) document a negative relationship between female directors and firm performance, whereas Carter et al. (2003) find the opposite. As far as we

[7]Network theory uses concepts such as nodes and lines. In our setting, a node is a firm, and a line between two firms represents a joint director in the two firms. We define geodesic g_{jk} as the shortest path between two nodes j and k, and G as the total number of nodes. The node i is designated as n_i. Using Wasserman and Faust (1994, p. 192-197), our information centrality measure is constructed in the following way: Form the $G \times G$ matrix A with diagonal elements $a_{ii} = (1 + \text{sum of values for all lines incident to } n_i)$ and off-diagonal elements a_{ij}, where

$$a_{ij} = \begin{cases} 0 & \text{if nodes } n_i \text{ and } n_j \text{ are not adjacent} \\ 1 - x_{ij} & \text{if nodes } n_i \text{ and } n_j \text{ are adjacent} \end{cases}$$

x_{ij} is the value of the link from firm n_i to firm n_j, that is, 0 or 1. The inverse of A, which is $C = A^{-1}$, has elements $\{c_{ij}\}$, where we define $T = \sum_{i=1}^{G} c_{ii}$ and $R = \sum_{j=1}^{G} c_{ij}$. The information centrality index for firm n_i is:

$$C_i(n_i) = \frac{1}{c_{ii} + (T - 2R)/G}$$

The index measures the information content in the paths that originate and end at a specific firm.

know, age has not been studied in this setting. We will use the fraction of female directors and the variance of the directors' age to proxy for gender diversity and age diversity, respectively.

The use of employee directors is potentially a mechanism for both alignment, information, and decisiveness. Because employees are stakeholders with contractual claims on the firm's cash flow, the hold-up problem suggests that shared control with employees investing in firm-specific human capital may benefit owners (Becht et al., 2003). However, Williamson (1996) posits that since employees have a contractual claim, they should not be residual claimants as well. Because employees will defend their sunk human capital investments, they may oppose decisions which threaten their job security. This is the alignment dimension of employee directorships.

As for information, Raheja (2005) argues that inside directors may be valuable because outside directors are better monitors when firm-internal information comes through several channels. Thus, employee directors may supplement the CEO as a firm-internal information source. Employee directors may also matter for the board's decisiveness, as the conflict of interest between owners and employees may increase decision complexity and make the board a less effective decision maker. This is why Cadbury (2002) thinks boards should be unitary.

The empirical evidence suggests the net effect of employee directors on owner wealth is negative. FitzRoy and Kraft (1993) and Schmid and Seger (1998) show that German firms with employee directors are less profitable than other firms. Falaye et al. (2004) find that Canadian firms where shareholding employees hold director positions in their company spend less on new assets, take fewer risks, grow more slowly, create fewer new jobs, deviate more from value maximization, have more serious cash flow problems, and are less productive. Employees in Norwegian firms with more than 200 people have the right to elect one third of the directors. Because many listed firms are either smaller or exempted from this rule, 41% of our sample firms have employee directors.[8] We measure board-driven co-determination by the fraction of the firm's directors employed by the firm.

2.4 Endogenous board design mechanisms

A board mechanism may be endogenously determined by other variables in our model for two reasons. First, the firm's performance may drive its board composition. Such reverse causation occurs in the Hermalin and Weisbach (1998) model, where the board becomes less independent the better the firm performs. Similarly, Palia (2001) posits that insider ownership increases when performance grows, as equity-related compensation instruments are more often exercised when performance is strong.

Second, a board mechanism is endogenous when it is influenced by other board mechanisms in the model. An early example is Demsetz and Lehn (1985), who argue that when value-maximizing owners can freely choose their firm's corporate governance system, equilibrium occurs when each governance mechanism's marginal performance impact is identical across all mechanisms. This implies that the mechanisms are internally related and that the optimal set is

[8] Firms in the newspaper, shipping, petroleum extraction, and financial service industries are exempted. 62% of the firms have more than 200 employees, and two thirds of these firms have employee directors.

determined by exogenous factors such as the firm's industry, risk, and the stage of the business cycle.

We explore endogeneity by studying what happens to the relationship between current board mechanisms and current performance when we add past performance as a determinant of current performance (reverse causation). We also relate insider ownership, board independence, board size, and director network to the other board characteristics and performance. There are two reasons why this endogeneity is better analyzed with equation-by-equation estimation using GMM that with classic system estimation. First, because the true system of simultaneous equations is unknown, the coefficients in a misspecified simultaneous system will be biased. In particular, if the system misspecifies one local equation, the estimates of the remaining equations in the system will be contaminated. Thus, estimating each regression separately keeps the misspecification local. Second, equation-by-equation estimation with GMM produces consistent estimates for the system as a whole, provided the instruments are taken from the conditional moment restrictions produced from the panel structure of the data (Woolridge, 2002, p. 310).

3 Descriptive statistics

Our sample contains all non-financial firms listed on the Oslo Stock Exchange (OSE) at year-end at least once over the period 1989 to 2002.[9] To reduce censoring bias in the tenure measures, we start collecting director data in 1986. The ownership structure data covers every equity holding by every investor in every sample firm.[10]

Table 1, which is organized according to the three major concerns in board design, summarizes key properties of the frequency distributions for each board design mechanism. Table 2 defines the empirical proxies.

According to table 1, officers as a group hold on average 6.4% of the equity, and the CEO owns 3.6%. These figures reflect that powerful owners are mostly absent as inside monitors.[11]

The three largest owners as a group have on average simple majority. The average largest outside owner has less than one third of the equity, which means he cannot alone block a charter

[9]The OSE had an aggregate market capitalization of 68 bill. USD equivalents by year-end 2002, ranking the OSE sixteenth among the twenty–two European stock exchanges for which comparable data is available. During our sample period, the number of firms listed increased from 129 to 203, market capitalization grew by 8% per annum, and market liquidity, measured as transaction value over market value, increased from 52% in 1989 to 72% in 2002 (sources: `www.ose.no` and `www.fibv.com`).

[10]The public securities register provided the ownership data, accounting and share price data is from the OSE's data provider, and board data was collected manually from *Kierulf's Håndbok* and a public electronic register.

[11]Although not shown in the table, more than 40% of the CEOs do not own shares in the firm they run. The average holdings when the CEO (the directors) does (do) invest is 6% (13%). Neither the directors nor the CEO holds equity in 36% of the firms, whereas both do in 44% of the cases, when their average aggregate holding is 20%. Because inside ownership increases the directors' incentives to monitor the CEO, it also reduces outside owners' need to monitor the board. Unlike what would be expected from an agency logic, however, table 1 suggests that the two insider ownership characteristics are used as complementary rather than substitute ways of reducing agency costs. This may suggest there is typically either overinvestment or underinvestment in these two alignment mechanisms.

amendment.[12] This pattern reflects that the ownership concentration of Norwegian firms is low by international standards.[13] The key implication in our setting is that the resulting separation between ownership and control makes the board a potentially important vehicle for reducing agency costs.

The average value of the independence proxy as defined in expression (1) is -0.301, reflecting that the average CEO has slightly longer tenure than the firm's average director. This figure also follows from the difference between the separate tenure figures reported for these two insider types, which are 2.2 and 1.9 years, respectively. Still, the large difference between the extreme values of the tenure variables and the high standard deviation of the independence proxy reflect considerable cross-sectional variation in (1), which is necessary to validly test the independence hypothesis. For instance, the average director took office almost 13 years before the CEO in the strongest independence case and more than 10 years after in the strongest dependence case.

As for the board's information function, the CEO is not a director in the firm in 70% of the cases. Every third CEO sits on another listed firm's board (exported CEO), but the median CEO has no outside directorships. Although not reported in the table, it turns out that a CEO sits significantly more often on other firms' boards when he is also a director in the firm he runs (31%) than otherwise (21%). Thus, a potentially problematic principal-agent relationship inside the firm (the agent monitors himself) may make the CEO create the same problem in other firms (one agent by profession monitors another agent by profession).

The director network measure reflects that more direct and indirect links to other boards makes the firm better connected to key parts of the information network. For instance, we find that 66% of the sample firms in 1997 had at least one direct link to another firm through overlapping directorships. The mean score on the network variable in table 1 is 0.184, varying between 0.069 and 0.320.

The third section of the table, which deals with mechanisms for influencing the board's decisiveness, reports summary statistics for board size, gender, age, and employee directors. Because employee directors may behave differently than other directors, we measure board size both with employee directors (Size) and without (Size1).

The average board has six members, and one less if we ignore employee directors. This is a very small average board by international standards.[14] Although the largest boards become less common over time, average size is quite stable. For instance, the 25% largest boards have

[12] Bøhren and Ødegaard (2006) show that there is little need to distinguish between cash flow rights (all equity capital; which is used in table 1) and voting rights (equity capital with voting rights) in our setting. The figures are almost identical if non-voting shares are ignored.

[13] Norwegian firms have a less concentrated ownership structure than any other European country except the UK. For example, the average largest owner holds close to 50% of voting equity in a continental-European listed firm, and 15% in the UK. The corresponding US figure is 3% (Barca and Becht, 2001). Norway has a civil law regime, which is generally considered less investor–protective than common law. Nevertheless, La Porta et al. (2000) find that Norway's regulatory environment provides better protection of shareholder rights than the average common law country. According to their theory of institutionally determined ownership structures, the strong investor protection is a major reason why Norway's ownership concentration is so low.

[14] Wymeersch (1998, p. 1105-1109) reports an average board size of 10.07 in the UK, 12.05 in France, 10.44 in Belgium, 12.00 in Italy, and 6.54 in the Netherlands. The average size of the German supervisory board is 13.25 (Hopt, 1998, p. 248). Carter and Lorsch (2004) find that the average US board has about 12 directors, which is down from 16 in the 1980s.

on average 8.97 members in the first half of the sample period and 8.67 in the second.

The average fraction of women on the board is 4.7% (Gender), dropping to 3.4% if we exclude employee directors (Gender1). Although not shown in the table, we find that employees elect women considerably more often than the owners (15% vs 3%, respectively). This may suggest that the fraction of women in the workforce is considerably higher than the fraction of women considered qualified for an owner-elected directorship. The proportion of female directors increases significantly with board size. Moreover, the substitution of male directors by females for given board size goes on over the whole sample period and is particularly strong after 1995. The fraction of female directors is roughly three times higher in the end of the sample period than in the middle.

Like gender, age is a potential source of board diversity. The average CEO is 47 years old and roughly three years younger than the average director. Average age per board varies between 27 and 74 years, and the standard deviation of director age per board is eight years on average, varying between zero (every director has the same age) and 22 years.

When we consider all boards regardless of whether or not they have employee directors, there is about one employee director per board on average. 42% of the sample firms have employees on their boards, declining from a typical value of 50% in the first half of the sample period to less than 40% in the second. The reason may be a higher proportion of firms in exempted industries, a relative increase in the fraction of small firms or a larger proportion of firms organized as holding companies. When employees are represented, they have between one and four seats on the board.

We measure performance by Tobin's Q and operationalize it as the market value of assets per unit book value. The market value of debt is set equal to its book value. Since we will later regress Q on board characteristics while controlling for firm size, we use sales rather than assets to measure firm size.[15]

Summarizing the descriptive statistics, outside and inside ownership concentration in our sample firms is low. Insider ownership by the CEO and by the directors are not used as substitute board mechanisms as suggested by the agency logic, but rather as complements. The board's average independence of the CEO is medium in the sense that the CEO and the average director have roughly the same tenure. The CEO is a director in the firm he manages in less than one third of the cases, and those who are sit on other listed firms' boards more often than others. This is still the exception than the rule, and more so at the end of the sample period than in the beginning. The information centrality measure shows that boards differ considerably in their

[15]None of the variables in table 1 are highly correlated. Although many bivariate correlation coefficients differ significantly from zero at the 5% level, they are still small. A rule of thumb says the correlation coefficient must exceed 0.7 before multicollinearity becomes a problem in regressions. Moreover, Hsiao (1986, p. 2-3) thinks multicollinearity problems are unlikely in panel data settings, since this normally involves more data points and larger data variability than in a cross-section. Also, our regressions will only use definitions of size and gender that exclude employee directors. To illustrate, the Pearson correlation between board size and the percentage of employee directors is 0.65 when employee directors are included in the size measure (Size). In contrast, the correlation is only 0.07 when the size measure ignores employee directors (Size1). This suggests multicollinearity will not be a problem in our regressions unless employee directors are included in the proxies for size and gender mix.

information access through their directors' links to other boards. The average board has six directors, female directors are rare, average director age per board varies by almost fifty years across the sample, and there is large age heterogeneity within the board. Less than half the firms have employee directors, and the fraction declines over time.

4 Statistical tests

We want to investigate the following relationship between economic performance and board design mechanisms:

$$\begin{aligned} Q = {} & \text{Constant} + \beta_1 \text{Directors' holdings} + \beta_2 (\text{Directors' holdings})^2 \\ & + \beta_3 \text{Outside concentration} + \beta_4 \text{Independence} \\ & + \beta_5 \text{CEO director dummy} + \beta_6 \text{Exported CEO} + \beta_7 \text{Imported CEO} + \beta_8 \text{Network} \\ & + \beta_9 \text{Size} + \beta_{10} \text{Gender} + \beta_{11} \text{Board age dispersion} + \beta_{12} \text{Fraction employee directors} \\ & + \gamma_1 \text{Firm size} + \gamma_2 \text{Risk} + u_{it} \end{aligned} \tag{2}$$

Because the descriptive statistics showed that insider ownership by non-CEO officers and by the CEO are strongly correlated, we use only the directors' aggregate holdings in (2). Removing employee directors from the proxies for independence, age diversity, network, size, and gender, we avoid multicollinearity problems and make it easier to separate the effects of shareholder–elected directors from those of employee–elected directors. On the other hand, some predictions do not distinguish between director types, such as the relationship between board size and decisiveness. We return to that issue in section 5 by including employee directors in the size, independence, and gender proxies. Our control variables are firm size and risk, which we measure by the log of sales revenues and the equity beta, respectively. Size is included due to its consistent correlation with observed returns in asset-pricing tests (Hawawini and Keim, 2000). Correspondingly, the variable risk controls for the impact of cash flow uncertainty on firm value. Our data set involves repeated observations of the same firm for up to fourteen years, we use the firm level fixed effects (FE) model to handle this panel data setting.[16]

The general structure of our FE model as expressed by the logic of Woolridge (2002, p. 251) is:

$$Q_{it} = \theta + \boldsymbol{\beta}(\text{Board mechanisms})_{it} + \boldsymbol{\gamma}(\text{Controls})_{it} + c_i + v_{it} \qquad \begin{cases} i = 1, 2, \ldots, N \\ t = 1, 2, \ldots, T \end{cases} \tag{3}$$

[16] If we ignored the time-series nature of the data and instead used a pooled cross section approach, we would also ignore possible correlation between observable and non-observable variables in general and the unobserved heterogeneity between firms in particular. The pooled approach may still try to capture firm heterogeneity by adding control variables such as the firm's age and industry. This is normally insufficient. For instance, two shipping firms founded in the same year may still have different optimal board design mechanisms if the firms have different exogenous characteristics such as location of headquarters, age of the fleet, and stage in their life-cycle. A further advantage of panel methods is that the moments needed for GMM estimation are readily available from the data structure. This property becomes particularly important when analyzing mechanism endogeneity in section 4.2.

Here, i is the firm, t is the time period, θ is a constant, $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ are the coefficient vectors for the board mechanisms and the controls, respectively, c_i is the unobserved, time-independent effect of firm i, and v_{it} is the idiosyncratic error, which varies across firms and time periods. We observe Q_{it} and the explanatory variables representing governance mechanisms and controls, and want to estimate $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ while holding the unobserved individual effect c_i constant. The error term v_{it} is assumed to be uncorrelated with the explanatory variables and c_i.

Since the unobserved c_i is constant over time per firm, the term disappears when we time-demean the variables. Although this approach handles unobserved time-independent firm heterogeneity, we include firm size and risk to control for observed firm heterogeneity, which is also allowed to vary over time.

We will apply the FE approach in several settings. The basic FE model (3) as specified in (2) is estimated in section 4.1. Section 4.2 analyzes mechanism endogeneity by first estimating a dynamic FE model where lagged performance allows for feedback from past performance to current board mechanisms. Subsequently, we estimate a FE model with five equations where the dependent variable is performance, directors' holdings, board independence, director network, and board size, respectively.

4.1 The basic model

Table 3 shows the estimates of model (2) as estimated with GLS and GMM, respectively. The overall fit as measured by R^2 is high in the GLS model. The F value is statistically significant, and the Breusch-Pagan test shows that the error terms are homoscedastic. The Hansen J statistic shows that the instruments are relevant in the GMM model. The overidentification test statistic suggests that the instruments are uncorrelated with the error term. Thus, both estimation methods show satisfactory test statistics. Furthermore, the estimated coefficient signs, the coefficient values, and also the level of significance are quite consistent across the two estimation methods. To simplify the discussion, we focus on the GMM estimates in the second column of results and limit the attention to estimated coefficients with a p-value of 10% or less.[17]

For the alignment mechanisms, there is a positive, significant relationship between performance and insider ownership. This is consistent with the extant literature, although the familiar, negative sign on the squared insider holdings is not statistically significant. Also, the insignificant effect of outside ownership concentration is in line with several other studies. As discussed, it has often been found in the board literature that when more board mechanisms than just ownership are included in a model, the significant relationship between ownership and

[17]The assumption underlying the GMM model in table 3 is that all board mechanisms and control variables are strictly exogenous. That is, $E\left(v_{it}|X_{i1},\ldots,X_{iT},c_i\right)=0$ when $(t=1,\ldots,T)$. These are the moment conditions, from which instruments may be constructed in order to identify the coefficients. We use the Amemiya and MaCurdy (1986) procedure, which involves the raw, the time-demeaned, and the squared time-demeaned explanatory variables. Furthermore, we include the Breusch et al. (1989) instruments, which are the average and standard deviation of firm-demeaned explanatory variables. Our choice of instruments illustrates the advantage of panel data that modified versions of variables included in the model can also be used as instruments. Variables not included in the model, such as the CEO's age and chairman tenure, are used as instruments as well.

performance tends to disappear. Yet, our more comprehensive model does support the robust finding in ownership structure research of a significant relationship between insider holdings and performance.

The inverse relationship between board independence and performance is consistent with the hypothesis that although more independence improves monitoring intensity, the cost is that independent directors are less knowledgeable about the firm than dependent ones. The finding is also in line with several earlier studies, who use different independence proxies than we do.

The positive sign for director network is the information provision mechanism with the strongest statistical significance. This finding shows that the information centrality measure, which reflects direct and indirect information links created when the firm's directors meet directors on other boards, does pick up information sources for the board with beneficial economic effects. Notice also that the positive effect of the CEO being a director in the firm he runs more than offsets the problematic effect of conflicting roles.

Every coefficient estimate under board decisiveness is negative and significant except the one for age dispersion. Although the inverse relationship between board size and performance is in line with the existing literature, it is still remarkable that this pattern turns up in our sample, which has small boards by international standards. This result suggests that optimal board size is indeed very moderate. Adding the finding that gender diversity is inversely associated with performance, it seems the homogeneous, small board is superior to the heterogeneous, large one. Finally, the use of employee directors is negatively associated with the firm's market value. This result supports the theoretical arguments and also the empirical findings from Germany and Canada that employee directors successfully defend their interests at the expense of owners and creditors.[18]

4.2 Endogeneity

The basic model (2) we just estimated will be biased if the design mechanisms are not exogenous relative to each other or to performance. We explore this potential problem by means of two different models, which we call the dynamic performance model and the integrated mechanism model, respectively.

The dynamic performance model rests on the idea that reverse causation between performance and board characteristics can be partially captured by including lagged performance as a

[18]To explore whether panel data estimation is required in our setting, we used OLS to estimate (2) on the pooled sample. This approach ignores both individual effects and time effects by assuming that the error term is identical across all firms and time periods. We found several noticeable differences. First, unlike the panel data model as estimated with GLS, pooled OLS reproduces the classic result in the ownership structure literature of a positive and quadratic relationship between insider holdings and corporate performance. Also, outside ownership concentration is inversely related to performance in a significant way. Second, the negative exported CEO effect becomes significant, and the significant coefficient of the network effect is higher. Third, only employee directors is significant among the decisiveness mechanisms, but its sign is reversed and its significance weaker. As expected, the importance of the control variables increases considerably, and the R^2 is less than one fifth. Overall, these findings show that unless we can ignore the panel data structure in our data set, the pooled model is seriously misspecified. ANOVA analysis of the the pooled OLS regression shows that the pooled model is indeed misspecified. 54% of the sum of squares in the estimated OLS error term is driven by fixed firm effects, 4% is due to time effects, and 40% is random. The remaining 2% is driven by joint individual and time effects.

determinant of current performance in (2). The required assumption is that lagged performance together with other explanatory variables are predetermined (Arellano, 2003, p. 144).[19] Since this assumption allows for feedback from past performance to current board design mechanisms, it means that if the dynamic model gives different board characteristics coefficient values from the basic model in table 3, then these explanatory variables are at least partially driven by performance. We specify the dynamic model as:

$$Q_{it} = \theta + \alpha Q_{i,t-1} + \boldsymbol{\beta}(\text{Board mechanisms})_{it} + \boldsymbol{\gamma}(\text{Controls})_{it} + c_i + v_{it} \tag{4}$$

where α is the coefficient of lagged performance and $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ are the coefficient vectors of the board mechanisms and control variables, respectively. Because the use of Q_{t-1} will bias the estimate of α in a fixed effects GLS model (Hsiao, 1986, p. 73-76), we use GMM, which avoids this problem when we add lagged performance to the list of instruments.

The estimates of the dynamic performance model is shown in the first column of results in table 4. The estimates mostly support the findings from the static versions in table 3, where the static GMM is the most relevant standard of comparison. The estimates from the static GMM model are also repeated in the second column of results in table 4. Focusing on the estimates which are significant at the 10% level, the three decisiveness mechanisms size, gender, and employee directors are fully consistent. For the information mechanisms, the network variable is consistent, whereas the positive performance effect of a CEO director is no longer significant. Under alignment, the loss of significance for Independence when lagged firm performance is accounted for supports the Hermalin and Weisbach (1998) hypothesis that performance influences board independence. That is, the performance effect of independent boards is not driven by independence per se, but by past performance and the CEO's power (lack of power) to increase dependence after a period of good (bad) performance. Similarly, both the linear and the quadratic insider holding term become more significant. This is consistent with the finding by Palia (2001) that high performance increases the probability that directors increase their shareholdings. Overall, these results show that past performance has a role to play because it influences the current board mechanisms, which in turn influence current firm performance.

The second model we use to explore mechanism endogeneity consists of five equations and is called the integrated mechanisms model in table 4. The first equation is the static GMM model from table 3. Each of the four other equations have a board mechanism as dependent variable, which is Directors' holdings, Independence, Network, and Size, respectively. As argued in section 2.4, we avoid several problems by estimating these equations separately rather than jointly as a simultaneous system.

The estimates of the integrated mechanisms model reflect two-way causation between contemporaneous performance on the one hand and independence, network, and board size on the

[19] Thus, lagged performance may be correlated with the lagged error term, but not with the contemporaneous and future ones. This assumption is the so-called sequential moment condition, which can be expressed as $E(v_{it}|X_{i1}, \ldots, X_{it}, c_i) = 0$ when $(t = 1, \ldots, T)$, where lagged performance is one of the explanatory variables.

other. More independence and larger boards reduce performance (seen from the performance equation), whereas better performance produces less independent boards and reduced board size (from the independence equation and size equation, respectively). There is also positive feedback between performance and network. Thus, busy directors both improve performance (the performance equation) and are attracted to well-performing firms (the network equation).

Overall, table 4 support the hypothesis that improved performance makes boards smaller and directors more dependent on the CEO. However, the coefficients for the performance variable in the four regressions are small compared to those of most board mechanisms.

Turning to the internal relationship between the board design mechanisms, the coefficient estimates are rather low when network is the dependent variable. This suggests the link between other mechanisms and network is quite moderate. The significant signs are mostly negative across all four equations, reflecting that board mechanisms are typically substitutes rather than complements. Moreover, the finding that several board design mechanisms are significantly internally related rather than independent lend some support to the equilibrium argument of Demsetz and Lehn (1985). However, the equilibrium hypothesis is falsified by our finding that many governance mechanisms enter significantly into the performance equation.

Finally, several board design mechanisms are significantly related to the exogenous determinants firm size and risk. For instance, board size grows with firm size, and the directors' information network is richer the more risky the firm's environment.

Summarizing, the empirical tests in section 4 have shown that the information access created by multiple directorships is positively related to performance in a statistically significant way in all three models. This is consistent with the hypothesis that well-connected directors create value through the network they bring along to the firm's boardroom. In contrast, more diversity produced by larger board size, more gender mix, and more employee directors is always negatively and mostly significantly associated with performance. This suggests heterogenous boards are less effective decision makers than homogeneous ones. As for interest alignment mechanisms, outside ownership concentration is never a statistically significant determinant of performance. However, insider ownership and board dependence are both positively associated with performance and in a statistically significant way under GMM estimation. Thus, the firm seems to benefit when their directors have strong economic monitoring and support incentives as well as close ties to management.

Finally, board design mechanisms are partially endogenous both relative to performance and to each other. Better performance tends to decrease board independence, reduce board size, and attract well-connected directors. Moreover, governance mechanisms are often substitutes. Nevertheless, this endogeneity does not invalidate the conclusions from our basic model estimated with GMM, since this method implicitly controls for such effects.

5 Robustness

Every regression model in section 4 operationalizes the theoretical concepts in the same way. However, table 1 specifies alternative proxies for several theoretical concepts that we have not

used yet. This section explores the robustness of our findings to alternative ways of empirically measuring the theoretical constructs of board independence, director network, gender mix, and board size.

The independence measure defined in expression (1), which we developed from the Hermalin and Weisbach (1998) logic, is based on the tenure of the CEO vs. the tenure of non-CEO directors. As discussed, however, Carter and Lorsch (2004) argue that board independence is a matter of absolute rather than relative tenure, and that independence decreases rather than increases as tenure grows. We test this competing hypothesis by alternatively operationalizing independence as board tenure, CEO tenure, and chairman tenure. Under the Carter-Lorsch hypothesis, the expected relationship to performance is negative for board and chairman tenure and zero for CEO tenure.

The second alternative operationalization is for the director network variable. Unlike our more elaborate proxy, existing papers simply uses the average number of outside directorships. We expect that the estimated coefficient of this more coarse measure will have the same sign as our proxy, but be less significant both economically and statistically.

Table 5 shows the results of re-estimating the fixed effects model (2) under alternative proxies for independence (models (1)-(3)), director network (model (4)) and for one combination of the two (model (5)). Model (6) is our static GMM model from table 3, and model (7) removes the control variables from model (6).

The estimates for model (7) are very close to those in (6). Thus, controlling for firm-specific differences in risk and size has no material effect on the estimated relationship between board design mechanisms and performance. This result also illustrates how the fixed effects model removes firm heterogeneity, and thereby makes control variables less important.

Comparing the estimates of the base-case model (6) to those using alternative empirical proxies in models (1)-(5), the first impression is that the estimated sign and economic significance of the board mechanisms influencing information access and decisiveness are very robust to alternative operationalizations.[20] However, as expected, the link between performance and the directors' information network in (4) and (5) is much weaker economically than under our more sophisticated information centrality measure used in the other models in the table. The statistical significance is at the same level under either operationalization.

Using the alternative independence measures in models (1)–(3), nothing happens to the relationship between performance and ownership structure. The negative association between independence and performance is no longer significant when independence is defined in terms of CEO tenure or chairman tenure (models (2) and (3)). In model (1), however, longer board tenure is associated with weaker performance in a significant way. This is consistent with the Carter and Lorsch (2004) hypothesis that less independence operationalized as longer board tenure produces lower performance. Thus, according to this logic, directors should not sit too long on the board to avoid becoming too closely attached to the CEO. In our base case model (6), however, which is based on the Hermalin and Weisbach (1998) logic that independence is

[20]The only exception is that when independence is measured as the number of outside directorships in models (4) and (5), the negative effect of exported and imported CEOs becomes statistically significant.

driven by relative tenure and not absolute, longer board tenure makes board independence grow rather than decline. This is because longer tenure increases the power of the directors relative to the CEO in the Hermalin and Weisbach (1998) model. Therefore, given our earlier result that performance falls as independence grows, it is not surprising to find the opposite under the Carter and Lorsch (2004) definition. This result shows that the theoretical rationale and the empirical operationalization of board independence are crucial. We prefer the Hermalin and Weisbach (1998) alternative, both due to its stronger theoretical backing and because our results using this definition are consistent with most existing evidence. Therefore, we maintain that according to our analysis, board independence and firm performance are inversely associated.

It may be argued that if we are concerned with the performance effect of board size or gender diversity, it is irrelevant whether the directors are elected by shareholders or employees. Due to potential multicollinearity and the desire to distinguish between stockholder-driven and employee-driven board effects, however, we have so far ignored employee directors in the gender and board size variables. To explore the effect of lifting this restriction, table 6 reestimates the static GMM model from table 3, letting size and gender reflect all the board's directors rather than only those elected by stockholders. We also include employee directors in our independence measure.

All estimated signs are maintained except for the insignificant risk variable, whereas the number of significant coefficients at the 10% level drops from eight to six. The relationship between performance and the alignment mechanisms is quite sensitive to whether of not employee directors are included in the board size, gender mix, and independence proxies. Outside ownership concentration becomes significant, insider holdings are not significant anymore, and independence becomes more significant. The CEO director variable loses significance, and the coefficient for gender is reduced by two thirds and becomes insignificant. Notice also that the revised definition of board size, gender, and independence maintains the significant association with performance for size, and strengthens it for independence.

To summarize, the robustness tests have shown that alternative ways of operationalizing information network, gender diversity, and board size have no fundamental effect on the interaction between performance and board composition. This also holds when we include employee directors in the measures of independence, board size, and gender, except that the association between gender and performance becomes weaker both economically and statistically.

6 Summary and conclusions

The basic question explored in this paper is how the composition of the board influences the firm's ability to create economic value. Our approach differs from the existing literature by analyzing board design with a wider set of board design mechanisms in a new institutional environment, using panel data rather than a single-period cross-section, and by measuring board independence and directors' information network in a novel way. We analyze potential endogeneity of board design mechanisms using GMM estimation, which allows us to validly determine the properties of a simultaneous system by estimating each of its individual equations

separately.

Studying all non-financial firms listed on the Oslo Stock Exchange over the period 1989-2002, we find that because ownership is often separated from control, the board's monitoring function becomes critical, particularly in firms where low inside ownership produces both weak value maximization incentives for management and low monitoring incentives for directors. The board's independence of the CEO is medium in the Hermalin and Weisbach (1998) sense, as the CEO and the average director have roughly the same tenure.

The CEO is also the firm's director in less than one third of the cases, and those CEOs who are directors also sit more often on other boards. Nevertheless, most CEOs do not play the roles of the monitor and the monitored at the same time. Our director network measure, which captures both the direct and indirect effects of multiple directorships, shows that firms differ widely in their director-driven access to information from other boards.

Board size is small, and gender diversity is low. In contrast, director age produces much more diversity, and less than half the firms have employee directors. Over the sample period, the CEO is gradually less often a director, female directors become much more common, and the use of employee directors declines.

Studying all non-financial firms listed on the Oslo Stock Exchange over the period 1989-2002, we find that regardless of model type and estimation method, economic performance is significantly higher in firms where its directors sit on several boards. Thus, overlapping directorships produce information networks whose value more than offsets the cost of having busy, overstretched directors. Higher board diversity produced by larger board size, stronger gender mix, and more employee directors are all negatively related to performance and almost always in a statistically significant way. This may happen because more diversity reduces the board's effectiveness as a decision-maker. The negative association between economic performance and the mandatory use of employee directors may also reflect a fundamental conflict of interest between investors and employees.

Whereas outside ownership concentration is very seldom a significant determinant of firm performance, insider ownership has this property almost without exception. Thus, non-director owners are ineffective monitors, but directors with ownership stakes produce valuable monitoring and support functions. Correspondingly, owners benefit if their firm's managers have equity-based incentives.

Economic performance is higher when directors are dependent rather than independent of the CEO. Thus, the longer the directors' arm's length distance to the firm, the less value they produce. This conclusion is strengthened by our finding that a firm performs better when the CEO is on the board. The result highlights the importance of trading off a director's role as a hands-off, neutral controller against the ability to enhance the management team by deep insight into the firm's strategic position. The board's support function, which is ignored in the Hermalin and Weisbach (1998) model and presently dominated by regulatory concern for independence after Sarbanes-Oxley, may deserve more attention. There may be a regulatory conflict between encouraging value creating board design in most firms and preventing potential

scandals in a handful of them.

Consistent with recent theoretical predictions, we find that causation does not just run from board characteristics to performance, but in the opposite direction as well. For instance, better performance reduces board independence and board size, and directors with strong networks both improve a firm's performance and are attracted to well-performing firms. Moreover, the board mechanisms jointly determine each other. For instance, equity holdings by the CEO tend to be higher the more of it held by the firm's directors. Although this mechanism endogeneity is captured by our GMM methodology and does not invalidate our conclusions, the observed endogeneity does make it more difficult to separate cause from effect, which is a well-known, chronic problem in corporate governance research.

Becht et al. (2003) concluded their recent survey of corporate governance research with the observation that the formal literature on boards is surprisingly thin. This reflects the fact that academic research on the relationship between board composition and economic performance is still in its infancy. We have tried to improve on this situation by searching systematically for characteristics of value-creating boards, using a comprehensive data set and a robust methodology. Our findings suggest that board designers should encourage insider stock ownership unless it threatens outside owners, ensure the CEO is a board member even if this reduces the board's independence, hire directors with close relationships to the firm rather than arms-length monitoring capacity, recognize the network value of directors with multiple seats rather than worry about potential overstretching, and be sceptical to the argument that diversity is a key to board success.

Some of these findings are politically incorrect (such as the questionable role of gender mix), run counter to key components of most country's corporate governance codes (such as the problematic role of independent directors), and point to directions for board research that differ from those implied by conventional wisdom (such as the importance of having owners rather than non-owner stakeholders on the board). Maybe board design has been shaped too strongly by practitioners and regulators based on their limited personal experience, political agendas, and recently by a concern with scandal prevention rather than value creation. This suggests there is a need for more academic research and less popular opinion on the characteristics of value-creating boards. Our findings support such a claim.

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Table 1 Summary statistics for board design mechanisms in all non-financial firms listed on the Oslo Stock Exchange 1989-2002.

Variable	Mean	Stdev	Median	Min	Max	N
Alignment						
Directors' holdings	0.064	0.190	0.000	0.000	1.000	1861
CEO holdings	0.036	0.140	0.000	0.000	1.000	1865
Ownership concentration	0.176	0.201	0.111	0.003	1.000	1784
Largest owner	0.293	0.233	0.220	0.003	1.000	1718
Three largest owners	0.498	0.220	0.478	0.047	1.000	1735
Independence	-0.301	2.110	0.000	-12.857	10.333	2205
Board tenure	1.886	1.695	1.500	0.000	11.333	2204
CEO tenure	2.161	2.445	1.000	0.000	16.000	2205
Chair tenure	1.874	2.321	1.000	0.000	16.000	2205
Information						
CEO director	0.296	0.457	0.000	0.000	1.000	2207
Exported CEO	0.348	0.747	0.000	0.000	6.000	2207
Imported CEO	0.281	0.538	0.000	0.000	4.000	2207
Outside directorships	0.536	0.547	0.400	0.000	4.333	2207
Network	0.184	0.077	0.203	0.069	0.320	2207
Decisiveness						
Size	6.024	1.961	6.000	2.000	15.000	2207
Size1	5.087	1.330	5.000	2.000	15.000	2207
Gender	0.047	0.097	0.000	0.000	0.556	2207
Gender1	0.034	0.090	0.000	0.000	0.667	2207
Board age dispersion	8.004	3.163	7.789	0.000	21.920	2207
Number of employee directors	0.938	1.206	0.000	0.000	4.000	2207
Employee directors	0.123	0.155	0.000	0.000	0.500	2207
Controls						
Firm size	13.313	2.029	13.074	5.366	23.006	1635
Risk	0.772	0.657	0.709	-0.994	8.127	1733
Performance						
Q	1.482	1.105	1.138	0.361	9.465	1678

The table shows descriptive statistics for the board design mechanisms, the control variables, and the performance measure. The board design mechanisms are classified according to their primary function (interest alignment, information provision, and decisiveness) as discussed in section 2. The variables are defined in table 2.

Table 2 The empirical proxies.

Variable	Definition
Alignment	
Directors' holdings	Fraction of equity owned by the board of directors
CEO holdings	Fraction of equity owned by the firm's CEO
Ownership concentration	Measured by the Herfindahl index, which is the sum of squared equity fractions across all the firm's outside owners
Largest owner	Fraction of equity held by the firm's largest outside owner
Three largest owners	Fraction of equity held by the firm's three largest outside owners
Independence	The average tenure of the non-employee directors minus the tenure of the CEO
Board tenure	The average tenure of non–employee directors
CEO tenure	The number of years since the CEO took office
Chair tenure	The chairman's tenure
Information	
CEO director	Dummy variable which equals 1 if the CEO is a member of his company's board and zero otherwise
Exported CEO	The number of outside directorships held by the firm's CEO
Imported CEO	The proportion of CEOs from other companies on the board
Outside directorships	A director's average number of outside directorships
Network	Non-CEO director information centrality as defined in footnote 2.2
Decisiveness	
Size	The number of directors
Size1	The number of non–employee directors
Gender	The proportion of female directors
Gender1	The proportion of shareholder elected female directors
Board age dispersion	The standard deviation of board age
Number of employee directors	The number of employee directors
Employee directors	The fraction of employe directors, measured as the number of employee directors divided by the number of directors
Controls	
Firm size	The natural logarithm of sales revenues
Risk	The firm's equity beta, estimated as the standardized covariance with the OSE total index, using daily stock returns data over the past two years
Performance	
Q	Market value of assets divided by its book value

Table 3 Firm performance explained by board design mechanisms in the base-case model.

Variable	GLS	GMM
Alignment		
Directors' holdings	0.507	0.924*
Directors' holdings sqrd	-0.414	-0.712
Ownership concentration	0.283	0.192
Independence	-0.014	-0.011*
Information		
CEO director	0.058	0.081*
Exported CEO	-0.026	-0.030
Imported CEO	-0.052	-0.055
Network	1.621**	1.385**
Decisiveness		
Size	-0.077**	-0.053**
Gender	-0.808**	-0.626**
Board age dispersion	0.002	0.000
Employee directors	-1.252**	-1.061**
Controls		
Firm size	-0.056**	-0.036**
Risk	0.025	-0.002
N	1510	1502
Centred R^2	0.665	
P-value, F	0.000	
P-value, Breusch-Pagan	0.000	
P-value, J		0.357
P-value, over-ID		0.720

The table shows estimates of the base-case fixed effect regression model in expressions (2) and (3). The dependent variable is Tobin's Q, which we measure as the market value of the firm over its book value. Every variable is time demeaned by subtracting a given firm's observation in a given year from the firm's overall mean across the years. Instruments for the GMM estimation are the raw, the time-demeaned, and the squared time-demeaned explanatory variables, the average and standard deviation of firm-demeaned explanatory variables, and variables not included in the regressions. Significant results at the 5% (10%) level are marked with ** (*).

Table 4 Endogeneity of board design mechanisms.

	Dynamic	Integrated mechanisms model				
	performance	Per-	Directors'	Inde-		
Variable	model	formance	holdings	pendence	Network	Size
Alignment						
Directors' holdings	1.076**	0.924*	1.378	0.064	0.823	
Directors' holdings sqrd	-0.905*	-0.712		-1.669	-0.061	-0.351
Ownership concentration	0.096	0.192	0.048*	-0.381	-0.065**	-1.088**
Independence	0.000	-0.011*	-0.001		-0.001	-0.034**
Information						
CEO director	0.026	0.081*	-0.018**	-0.355**	-0.014**	0.024
Exported CEO	-0.022	-0.030	0.005	-0.234**	0.007**	-0.044
Imported CEO	-0.263	-0.055	-0.020	-0.322	-0.033*	-0.505**
Network	1.144**	1.385**	0.025	-0.792		1.023**
Decisiveness						
Size	-0.063**	-0.053**	0.009**	-0.245**	0.008**	
Gender	-0.494**	-0.626**	0.067	0.868	-0.108**	0.691*
Board age dispersion	-0.001	0.000	-0.003**	0.077**	-0.001	0.038*
Employee directors	-0.911**	-1.061**	0.028	-0.915	0.004	-3.838**
Controls						
Firm size	-0.028*	-0.036**	0.002	0.060	-0.002	0.061**
Risk	-0.020*	-0.002	-0.008	0.146*	0.004**	0.072**
Past performance						
Tobin's Q lagged	0.095*					
Performance						
Tobin's Q			0.000	-0.094**	0.012**	-0.085**
N	1283	1502	1502	1502	1502	1502
P-value, J	0.250	0.357	0.435	0.000	0.310	0.000
P-value, over-ID	0.182	0.720	0.806	0.000	0.254	0.000

The table explores mechanism endogeneity by means of two models. In the dynamic performance model in the first column of results, firm performance is the dependent variable, and lagged performance is added as an independent variable to the basic model (2). The second model, termed the integrated mechanisms model, consists of five equations. The first equation is the static performance model (2) estimated with GMM in table 3. Each of the four other equations have a board mechanism as the dependent variable, which is Directors' holdings, Independence, Network, and Size, respectively. The five equations in the second model are estimated separately. The instruments correspond to those used table in 3. Firm performance is measured as Tobin's Q, which we operationalize as the market value of the firm over its book value. All variables in all models are time-demeaned, which means that for each firm and each variable, we subtract a given year's observation from the firm's overall mean across the years. Significant results at the 5% (10%) level are marked with ** (*).

Table 5 Alternative empirical proxies for board independence and director network.

	(1) Board tenure	(2) CEO tenure	(3) Chair tenure	(4) OD	(5) BT OD	(6) Base case	(7) No controls
Alignment							
Insiders' holdings	0.975*	0.911*	0.879*	0.903*	0.976*	0.924*	0.716**
Insiders' holdings sqrd	-0.782	-0.694	-0.658	-0.691	-0.781	-0.712	-0.601
Ownership concentration	0.180	0.197	0.203	0.179	0.180	0.192	0.127
Independence	-0.038**	-0.004	-0.010	-0.014**	-0.050**	-0.011*	-0.012*
Information							
CEO director	0.090*	0.084*	0.088*	0.077	0.092*	0.081*	0.071
Exported CEO	-0.030	-0.028	-0.029	-0.065**	-0.066**	-0.030	-0.016
Imported CEO	-0.158	-0.055	-0.082	-0.341*	-0.488**	-0.055	-0.032
Network	1.327**	1.358**	1.371**	0.249**	0.276**	1.385**	1.457**
Decisiveness							
Size	-0.051**	-0.048**	-0.047**	-0.036**	-0.036**	-0.053**	-0.072**
Gender	-0.600**	-0.643**	-0.622**	-0.696**	-0.636**	-0.626**	-0.586**
Board age dispersion	-0.004	-0.002	-0.001	0.000	-0.003	0.000	0.001
Employee directors	-0.974**	-1.002**	-1.027**	-0.927**	-0.800**	-1.061**	-1.164**
Controls							
Firm size	-0.022	-0.030*	-0.028	-0.032*	-0.013	-0.036**	
Risk	0.006	0.000	0.002	0.001	0.009	-0.002	
N	1502	1502	1502	1502	1502	1502	1612
P-value, J	0.533	0.421	0.451	0.402	0.710	0.357	0.297
P-value, over-ID	0.670	0.655	0.689	0.812	0.687	0.720	0.956

The table shows the results of using alternative operationalizations for board independence in models (1)-(3), director network in model (4), and a combination of the two in model (5). Model (6) is the base-case model estimated with GMM in table 3, and (7) is model (6) without the controls for firm size and risk. OD is the average number of outside directorships held by the firm's board members, and BT is the board tenure proxy from model (1). The dependent variable is Tobin's Q, which we measure as the market value of the firm over its book value. Each variable is time demeaned in the regressions. For each firm and each variable, we time demean by subtracting a given year's observation from the firm's overall mean. The regressions use the same instrument set as in table 3, but with new variable definitions. Significant results at the 5% (10%) level are marked with ** (*).

Table 6 Including employee directors in the empirical proxies for board size, gender diversity, and board independence.

	(A)	(B)
Alignment		
Directors' holdings	0.777	0.924*
Directors' holdings sqrd	-0.734	-0.712
Ownership concentration	0.254**	0.192
Independence	-0.014**	-0.011*
Information		
CEO director	0.061	0.081*
Exported CEO	-0.016	-0.030
Imported CEO	-0.033	-0.055
Network	1.300**	1.385**
Decisiveness		
Size	-0.031**	-0.053**
Gender	-0.198	-0.626**
Board age dispersion	0.002	0.000
Employee directors	-0.581**	-1.061**
Controls		
Firm size	-0.035*	-0.036**
Risk	0.019	-0.002
N	1498	1502
P-value, J	0.137	0.357
P-value, over-ID	0.589	0.720

The table shows estimates of the static GMM model from table 3 when including (model (A)) and not including (model (B)) employee directors in the definition of board size, gender diversity, and board independence. The dependent variable is Tobin's Q, which we measure as the market value of the firm over its book value. Each variable is time demeaned in the regressions. For each firm and each variable, we time demean by subtracting a given year's observation from the firm's overall mean. The instrument set is as in table 3, except that the new variable definitions replace the ones from table 3. Significant results at the 5% (10%) level are marked with ** (*).