

OWNERSHIP STRUCTURE, BOARD COMPOSITION AND INVESTMENT PERFORMANCE

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Abstract

This paper explores the relation between ownership structure, board composition and firm performance among Swedish listed firms. The descriptive statistics show that Swedish board of directors has become more diversified in terms of gender. The analysis shows that board size has a significant negative effect on investment performance. Gender diversity has a small but negative effect on investment performance, and the same holds for CEO being on the board. When incorporating all the explanatory variables into the same equation the negative effect of larger boards dilutes the effect of gender diversity and having the CEO on the board.

Keywords: Corporate governance, board composition, investments performance, marginal q .

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1. Introduction

A large body of research has examined the link between board composition and firm performance.⁷⁷ A majority of the studies investigate how board structure influence firm performance, usually measured by Tobin's q or some accounting measure of profitability such as ROA. There are a number of recent Nordic studies investigating board composition⁷⁸ and firm performance, for example Bøhren and Strøm, (2005); Smith et al., (2006); Randøy et al., (2006); and Rose, (2007). The empirical results in most studies generally support a negative relation between board size and firm performance. The results of other board composition factors such as age, gender and nationality are far less consistent. In particular, the question of how ownership structure influences board composition and subsequently firms' performance is largely unresolved since very little empirical research exists.

This paper is a response to Randøy et al., (2006)'s call for further investigation and for the use of alternative methodologies⁷⁹ to evaluate performance.

Marginal q is used as an alternative, and in fact more appropriate, measure of firm performance. Contrary to the commonly used market to book ratios measuring the average return on the firms' investment, marginal q measures the return on the firm's marginal investment relative to the firms' cost of capital. Moreover, this paper adds further to the literature by empirically investigating the links between ownership structure, board composition and firm performance.

By examining a comprehensive panel of firms listed on the Stockholm Stock Exchange during 1999-2005 the paper also adds some methodological insights to the empirical literature. When studying ownership structure and corporate governance issues such as board composition Sweden provides a particularly advantageous example. Sweden is a small, open and export oriented economy with firms having a concentrated ownership structure typical to the continental European corporate governance model.

Our key findings are that board size has a significant negative effect on investment performance. The results also show that gender diversity has a small but negative effect on investment performance, and the same holds for having the CEO on the board. When incorporating all the explanatory variables into one equation however, the negative effect of larger

⁷⁷ See Carter et al. (2003); Hermalin and Weisbach (2003); John and Senbet (1998) for excellent reviews.

⁷⁸ Board structure refers both to the size and to the composition of boards.

⁷⁹ Most performance studies use Tobin's market to book value as performance measure (see for example Dalton et al.,

(1998); Dalton et al., (1999); Hermalin and Weisbach, (2003) for an overview).

boards reduces the effect of gender diversity and CEO on the board on firm investment performance. The descriptive statistics show that Swedish board of directors has become more diversified in terms of gender. Moreover, fewer firms have the CEO on the board, which can be interpreted as a sign of increased independency.

The rest of the paper is organized as follows. Section two continues with a discussion of the theoretical framework and previous empirical findings regarding the relationship between ownership, board composition and firm performance. Also, the empirically testable hypotheses are presented. Section three contains a description of the methodology used in the empirical investigation. Section four provides a description of the data and the descriptive statistics. After the empirical analysis in section five, section six concludes the paper.

2. Ownership Structure, Board Composition and Firm Performance

A number of studies make use of the agency theory and the resource based theory⁸⁰ when assessing the relation between board composition and firm performance (for overview see for example Randøy et al., (2006); and Dalton et al., 1999). Overall, the theoretical literature is, however, inconclusive as to the consequences of board structure. For example, the net effect of board heterogeneity could be either negative or positive. Hermalin and Weisbach (2003) argues that the lack of a coherent theoretical framework is conducive to that most of the contemporary research on board composition and firm performance is empirical driven.

Size and composition of boards usually differ to some extent between companies. Current research show that smaller and more dependent⁸¹ boards are more frequent in firms characterized by “high growth opportunities; high R&D expenditures and high stock return volatility whereas large firms have larger and more independent boards” (Linck et al., (2008), p. 2). Raheja (2005) presents a model that shows that the board of directors is larger when high levels of private benefits to insiders prevail, and larger boards are less effective than smaller boards.

2.1 Ownership and Board Structure

The main task of the board of directors is to control and monitor the management, i.e. to align the classical principal agent problem between the management and

⁸⁰ Randøy et al, (2006) provides the following description: *Resource dependency theory addresses how a board might facilitate access to valuable resources. The emphasis is on a firm’s ability to form links to secure access to critical resources, such as capital, customers, suppliers, or cooperative partners* (page 5).

⁸¹ In Anglo-Saxon firms dependent boards are characterized by having many insiders on the board i.e. directors closely related to the management of the firm.

the owners of the firm (Fama and Jensen 1983). In corporate governance system characterized by concentrated ownership a second type of agency problems between the controlling and minority shareholders arise (see Villalonga and Amit, (2006); (Söderström Tson et al., (2003) for further discussion). In the Swedish system the controlling owner has a considerable impact on the composition of the board and its functioning. The board of directors is supposed to act in the interest of all owners. There is a possible problem that the interest of the minority shareholders is not properly acknowledged. The Swedish code of corporate governance⁸² highlights this dependency problem and rules regarding the composition of board of directors have been introduced on the Stockholm stock exchange.

One way for the board to become more independent is to appoint foreign directors. By reducing the ability of controlling owners to entrench the management foreign and institutional owners can also play a monitoring role (Bjuggren et al. 2007). As shown by Bilimora and Wheeler, (2000) one can assume a positive relationship between institutional owners and board diversity. Based on this discussion we formulate hypothesis one and two:

Hypothesis 1: The presence of a controlling owner reduces board heterogeneity

Hypothesis 2: Institutional and foreign owners increase board heterogeneity

2.2 Board Size

A number of empirical studies investigate the link between board size and firm performance (see Hermalin & Weisbach, (2003) for an excellent literature review). Jensen, (1993) argues that there is a negative relationship between large boards of directors, (above seven or eight members), and firm performance. Boards that exceed this number are much more likely to be controlled by the CEO and function less effectively. The empirical literature generally support the argument about “oversized boards” put forth by Jensen, (1993). For example Yermack, (1996) reports a negative relation between board size and Tobin’s q. The negative relation seems also to hold for Nordic firms, Randøy et al, (2006) for example, show that larger boards have a negative

⁸²The Swedish Code of Corporate Governance is a report based on the Swedish Companies Act (Aktiebolagslagen, 1975:1385). The code was implemented in 2005 and regulates the conduct of publicly traded firms in Sweden. For example companies traded on the Stockholm stock exchange (OMX) may only have one person from the senior management on the board; a majority of the board members that are elected at the annual shareholding meeting should be independent from the firm and at least two of these independent board members must also be independent from the largest shareholder (see Swedish Code of Corporate Governance for further details).

impact on firm performance. Based on the above reasoning we formulate hypothesis three:

Hypothesis 3: Board size has a negative impact on performance

2.3 Board Composition, Information Allocation and Decision Efficiency

In order to perform optimally the boards of directors must have access to accurate information. There is an ongoing discussion (van der Walt and Ingley 2003) in the literature regarding which type of directors or composition of directors that is optimally in this sense; outside directors with greater knowledge about the surrounding business environment and access to information from other firms (business partners, suppliers, competitors and external sources of capital) or inside directors with superior knowledge about the firm. The resource based view argues that increased diversification among board members is positive for the firm and its financial performance (van der Walt and Ingley 2003). A diversified board should be better at advising and counseling the management than a more homogenous board. The resources based view tends to focus on advantages with board diversity in terms of having access to a larger informational network and does not address the costs of decreased efficiency with respect to decision making.

Board heterogeneity is associated with a trade-off between increased costs in terms of longer decision time and lower external costs. That is, a trade-off between increased information efficiency associated with heterogeneous boards and decision efficiency associated with homogenous boards. Heterogeneous boards tend to be better informed regarding issues outside the firm and thereby better equipped to question and discuss corporate strategic decisions, whereas homogenous boards to a larger extent is based on trust, co-operation, as well as shared experience and values (Söderström Tson et al. 2003).

Age and gender diversity among board members are important factors measuring heterogeneity. Over the last years there has been an increase in board diversity in terms of gender among European firms. Norway, Sweden and Finland are the top three countries in this respect Grosword, et al., (2007). Bilimora and Wheeler (2000), report that female directors are often younger than their male colleagues, whereby appointing female directors would increase diversity both in terms of gender and age. The empirical results of gender diversity are however mixed. Bøhren and Strøm (2005) report a negative influence of gender diversity on firm performance whereas Smith et al., (2006) report a positive relationship between female representatives in the top management and firm performance in small Danish firms. The latter result is confirmed by Carter et al., (2003) in a study of U.S. based firms. Rose (2007), evaluates the impact of having women on boards of

directors in Danish public firms. The results indicate no significant relation between the presence of women and firm performance. One explanation, put forth by Rose (2007) is that, in order to be accepted, new "unconventional" members need to adopt the behavior of the more conventional board members and business leaders which removes any possible effects of women on the board. This non-significant relation between gender diversity and board composition is confirmed by Randøy et al., (2006). The discussion above results in the following hypothesis:

Hypothesis 4: There is no effect of board heterogeneity on firm investment performance

3. Method - Marginal q

Tobin's q (q_a) is one of the most common measures of firm performance in the literature. The measure is defined as the ratio between a firm's market value, M_t , and its replacement cost of capital, K_t . It measures the average return on capital to the firm's cost of capital. A q_a above one implies that the average return on capital is higher than the cost of capital, i.e. the firm should make further investments.

The marginal return on capital (marginal q) is however a more accurate measure of firm performance when examining adjustments of the capital stock. Mueller and Reardon (1993) derive marginal q (q_m) given the fact the market continuously value firm investments as the discounted present value of the future cash-flows created by the investments. One can also derive marginal q from Tobin's q . Marginal q (q_m) can be defined as:

$$q_m = \frac{\Delta M_t}{\Delta K_t} = \frac{M_t - M_{t-1} - \delta M_{t-1}}{K_t - K_{t-1}} \quad (1)$$

$-\delta$ is the depreciation rate. M_t defines a firm's market value in time t :

$$M_t = M_{t-1} + PV_t - \delta M_{t-1} + \mu_t \quad (2)$$

PV_t is the present value of the cash flows that investments, I_t , in period t generate, and μ_t represents a standard error term. Following Mueller and Reardon, (1993) we define investments as:

$$I = \text{After tax profits} + \text{Depreciation} - \text{Dividends} + \Delta \text{Debt} + \Delta \text{Equity} + \text{R\&D} + \text{ADV} \quad (3)$$

According to the standard net present value rule the firm should continue to investment until $PV_t = I_t$ or equivalent $PV_t/I_t = 1$. The latter expression can be rewritten as $PV_t/I_t = q_m$. To get an empirically testable equation we divide equation (2) by M_{t-1} and rearrange:

$$\frac{M_t - M_{t-1}}{M_{t-1}} = -\delta + q_m \frac{I_t}{M_{t-1}} + \frac{\mu_t}{M_{t-1}} \quad (4)$$

Equation (4) assumes efficient capital market in the sense that future cash flows are unbiased estimates. That is, μ_t/M_{t-1} goes to zero when t gets larger.⁸³ To study the effects of board structure on marginal q we construct interaction terms with variables accounting for board size, gender diversity, average age and a dummy for CEO participation on the board.

Operationally this is done by interacting $\frac{I_t}{M_{t-1}}$ from

equation (4) with the explanatory variable of interest. This generates the functional form: $Y = \alpha + \beta_1 X + \beta_2 Z$, and an empirically testable model of the form:

$$\frac{M_t - M_{t-1}}{M_{t-1}} = -\delta + \beta_1 \frac{I_t}{M_{t-1}} + \beta_2 Z_1 \frac{I_t}{M_{t-1}} + \dots + \beta_{i+1} Z_i \frac{I_t}{M_{t-1}} + \varepsilon_i \quad (5)$$

Z_i denotes the explanatory variables.

There are a number of advantages with using marginal q instead of Tobin's average q . (Mueller and Reardon, (1993); (Gugler and Yurtoglu 2003). The most important one is that marginal q does not (as can be the case with Tobin's q) mix average and marginal returns on investment. Moreover, marginal q is easy to interpret in an analysis of managerial discretion. A $q_m < 1$ indicates that the manager is over-investing. That is, the capital return of the investment project is less than cost of the investment. The shareholders would have been better off if the firm had distributed these funds directly to them instead of making the investment. Conversely, a $q_m > 1$ indicates that the manager is under-investing. The marginal investment generates a return that is higher than the cost of capital and the firm should have invested more. A q_m equal to one indicates that the management maximizes shareholder value.

4. Data and Descriptive Statistics

The empirical analysis makes use of an unbalanced dataset covering 105 firms, traded on the Stockholm stock exchange during the time period 1999-2005. The accounting and financial data are from the *Standard and Poor's COMPUSTAT Global* database. We only include non-financial firms with reported data for at least four years. The Jarque-Bera test indicates that the data on investment and market values are not normally distributed and scatter-plots shows that this is caused by a few number of extreme values. To control for the effects of these outliers we follow Gugler et al., (2004) but we only remove the last percentile of the observations with respect to the difference in change in market value and investment intensity.

The data on ownership structure are from the *Owners and Power in Sweden's Listed Companies* by

Sundin and Sundqvist (1999-2005). Voting and equity shares are aggregated so that different types of owners such as families, mutual fund companies and foreign owners can be analysed. Furthermore, the database accounts for indirect shareholdings. The data on board composition are from *Directors and Auditors in Sweden's Listed Companies* by Sundin and Sundqvist. The database gives detailed information about all members of the board. Data on number of directors, female representation, CEO on the board and age structure are used in the analysis. Table 1 provides a description of the variables used.

⁸³ See Mueller and Reardon, (1993); Gugler, et al., (2004) for further discussion on derivation of marginal q .

Table 1. Description of variables

Variable	Description
Financial Data <i>Source: Standard and Poor's COMPUSTAT Global</i>	
M_t	Market value at the end of period t. Defined as the total value of outstanding shares plus total debt. (Compustat mnemonic item numbers: MKVAL + DT)
I_t	Investment in period t. $I_t =$ After tax profit + Depreciation – Dividends + Δ Debt + Δ Equity + R&D + ADV (Compustat mnemonic item numbers: IB + DP – DVC + Δ DT + SSTK - PRSTKC + XRD + XSGA)
Ownership data <i>Source: Sundin and Sundqvist "Owners and Power in Sweden's Listed Companies"</i>	
Ownership concentration	Percentage of the outstanding votes (V1) and capital (C1) of largest owner.
Institutional Ownership	Percentage of the outstanding votes held by mutual funds (IC and IV). (See Wiberg, (2008) for further discussion on institutional ownership).
Foreign Ownership	Percentage of ownership held by foreign owners (FC and FV). This type of owner is mostly foreign institutional owners.
Board Composition <i>Source: Sundin and Sundqvist "Directors and Auditors in Sweden's Listed Companies"</i>	
CEO on the board of directors	Dummy variable that equals one if the CEO is on the boards of directors zero otherwise.
Board size	Number of board members
Gender	Share of female board members
Age	Average age of board members

4.1 Descriptive Statistics

The Swedish corporate governance model is characterized by concentrated ownership and an extensive use of vote differentiated shares. The largest owner controls, on average, 34 percent of the outstanding votes and 24 percent of the capital shares (see Table 2). Previous research by Bjuggren et al, (2007) shows that vote-differentiated shares has a negative effect on investment performance. Around 60

percent of the sample firms have a vote-differentiated share structure.

Institutional and foreign ownership has increased over the last years. These types of owners controlled, on average, 12 and 19 percent of the outstanding votes respectively. Interesting to note is that the largest institutional and foreign owners, on average, have more cash-flow rights than outstanding votes.

Table 2. Descriptive Statistics - Ownership Structure (%)

	Mean	Median	Max	Min	Std.
C1	24.03	21.10	74.50	1.00	14.95
V1	34.22	30.40	89.50	2.90	20.09
Fc	21.36	16.15	91.10	0.30	18.29
Fv	19.41	11.80	91.10	0.00	19.15
Ic	13.57	11.25	54.90	0.00	11.75
Iv	10.78	7.9	67.60	0.00	10.49
Excess vote	10.22	4.30	49.10	- 20.20	12.59
Vote diff.	61.00	1.00	1.00	0.00	0.49
N = 1013					

The variables are defined as following; V1 is the percentage of the outstanding votes, C1 is the percentage of capital of the largest owner, FV and FC are foreign ownership in terms of outstanding votes in terms of capital respectively, IV and IC is institutional ownership in terms of votes and capital, Excess votes denotes the difference between outstanding votes and

capital with respect to the largest owner, and vote diff. is a dummy variable indicating if the company have a vote-differentiated share structure

The structure of board of directors has changed considerably over the last five years (Table 3). The two most salient features are the increase in female directors and the decrease in firms having the CEO on

the board. This development may indicate increased board diversity and independence. Over the last 6 years the share of female directors has increased by almost 10 percent, from 4.14 to 14.14 percent. At the same time the share of firms with the CEO on the

board has decreased by 30 percent from 89 percent to 59 percent in 2005. Swedish board of directors consists, on average, of 7-8 members, and the average age of a board member is 53 years.

Table 3. Board Structure - Development over time

	Board Size	Average Age	CEO member of the board (%)	Gender Diversity (%)
2000	7.96	54.39	89.00	4.00
2001	7.70	52.75	81.00	6.00
2002	7.49	52.71	78.00	7.00
2003	7.44	53.31	73.00	7.00
2004	7.52	53.55	66.00	11.00
2005	7.44	53.52	59.00	14.00
Total average	7.56	53.31	73.00	9.00

Note: a) The table shows average values for each year. b) Table A1 presents more detailed descriptive statistics (mean, median, max and min values and standard deviation) for each variable. Gender diversity denotes share of female board of directors.

5. Empirical Analysis

The empirical analysis is divided into two parts; first the determinants of board structure and the relationship between ownership structure and board composition are investigated (section 5.1). Ownership structure is measured as ownership concentration with respect to the largest owner and foreign and

institutional ownership. The second step is to analyse the relationship between board structure and firms' investment performance (Section 5.2). We use both marginal and Tobin's q to estimate the effects of board structure on investment performance. Table 4 summarizes the hypothesis and expected effect on performance.

Table 4. Hypothesis and Expected Effects

Hypothesis:	Expected effects on boards:
H1: Ownership concentration	Homogenous Boards
H2: Institutional and Foreign Owner	Heterogeneous Boards
	Expected effect on investment performance:
H3: Board Size	Negative
H4: Board Diversity	Ambiguous

5.1 Determinants of Board Structure

Gender and age diversity are used as measures of board heterogeneity. The panel data methodology allows us to construct a fixed effect model that controls for both industry (two-digit) and time effects. Following previous studies we control for firm profit and size in terms of sales. Model 1-3 (Table 5) test the effects of ownership on board size. The estimations show a positive and significant relationship between firm size (measured as sales) and board size, i.e. large firms have larger boards of directors, a result well in line with previous research. The size of the firm also has a positive and significant effect on the average age (Model 7-9). The effect on gender diversity is statistical insignificant. Similarly, profit does not have any statistical significant effect on any of the board variables. The result is robust across various model specifications.

The results show that having the CEO on the board has a positive effect on the size of the board, and the average age. This parameter estimate is significant across all model specifications.

We then test the effect of ownership structure on board structure. The effect of ownership concentration on board composition is insignificant. Hence, it is not possible to confirm hypothesis 1, which states that the presence of a controlling owner should decrease board heterogeneity. Neither institutional nor foreign ownership have any statistical significant effect on board composition. Consequently, we cannot reject hypothesis 2. Foreign and institutional ownership however, are found to have a positive impact on board size. Another important determinant of board size is the size of the firm. Most studies report larger firms have larger board of directors.

Table 5. FE Regression on the Relationship between Ownership and Board Size

Dependent Variable:	Board Size			Gender Diversity			Average Age		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Sales	0.00*** (15.47)	0.00*** (15.11)	0.00*** (14.78)	0.00 (0.59)	0.00 (0.69)	0.00 (0.60)	0.000*** (4.88)	0.000*** (4.97)	0.000*** (4.60)
Profit	0.01 (1.11)	0.01 (1.03)	0.01 (1.18)	-0.00 (-0.09)	-0.00 (-0.05)	-0.00 (-0.09)	-.02 (-1.11)	-.02 (-1.02)	-.02 (-1.07)
CEO	0.61*** (4.56)	0.61*** (4.56)	0.51*** (3.87)	0.03*** (4.42)	0.03*** (4.44) (4.41)	0.03*** (4.41)	0.67** (2.13)	0.70*** (2.21)	0.63** (1.98)
V1	0.00 (0.24)			0.00 (0.15)			0.01 (1.22)		
FV		0.01* (1.71)			0.00 (-0.77)			-0.01 (1.14)	
IV			0.03*** (6.04)			0.00 (-0.12)			0.02 (1.56)
Constant	6.99*** (42.73)	6.90*** (48.65)	6.78*** (52.31)	0.08*** (9.08)	0.08*** (10.92)	0.08*** (11.40)	53.24*** (137.80)	53.71*** (160.02)	53.40*** (171.17)
R-square	0.4200	0.4217	0.4417	0.3350	0.3355	0.3350	0.2466	0.2475	0.2464
F-value	F(44, 934) = 15.37	F(44,934) = 15.48	F(44,934) = 16.80	F(44, 934) = 10.61	F(44,934) = 10.63	F(44,934) = 10.61	F(44,934) = 6.92	F(44,934) = 6.92	F(44,934) = 6.95
N. of obs.	979	979	979	979	979	979	979	979	979

The estimated equation is: $DV_{i,t} = \beta_0 + \beta_1 * Sales_{i,t} + \beta_2 * Profit_{i,t} + \beta_3 * CEO_{i,t} + \beta_4 * Owner_{i,t} + \varepsilon_{i,t}$. CEO is a dummy, taking the value one if the CEO is a member of the board and zero otherwise. The ownership variables are defined as following; V1 is the percentage of the outstanding votes, C1 is the percentage of capital of the largest owner, FV and FC are foreign ownership in terms of outstanding votes in terms of capital respectively, IV and IC is institutional ownership in terms of votes and capital. A fixed effect model controlling for industry and time effects is used. Industry dummies are defined on a two-digit SIC level. All values are deflated and expressed in 2005 years price level. The last percentile of the sample with respect to the difference between change in market value and investment ratio is removed to control for the effects of outliers. *** indicates a significance level at the 1% level, ** indicates a significance level at the 5% level, indicates a significance level at the 10% level. T-statistics are reported within brackets.

5.2 Board Structure and Firm Investment Performance

In the following section we estimate the effects of board size and composition on investment performance. Tobin's q is one of the most common measures of firm performance. It has a number of drawbacks however that can be mitigated by the marginal q methodology. One of the most important features of marginal q is the ability to measure the relative deviation from efficient investment levels without a priori specifying a firm specific cost of capital⁸⁴.

Firm size and the associated complexity of larger firms could distract otherwise clear relationships between board composition and performance Dalton et al., (1998, 1999). We therefore use sales and growth in sales to control for firm size in estimation with Tobin's q as dependent variable. With the marginal q methodology size is controlled for by the market value of the firm. Table 6 presents the results when change in market value is the dependent variable and Table 7 presents the results using Tobin's q is used as dependent variable.

The results for model M1 (Table 6) is consistent with previous research on marginal q for Sweden. The estimated marginal q for the sample firms is on average 0.87. Gugler, et al., (2004) estimate marginal q to be on average 0.65 for Swedish listed firms, in a multinational study of investment performance. Model M2 measures the effects of board size. The results reveal that there is a strong negative relationship between board size and investment performance. Both model M2 and M6 support hypothesis 3 which states that board size has a negative impact on firm performance. The result is again in line with previous research (see for example Yermack, (1996); Randøy et al., (2006); Bøhren and Strøm, (2005)). Also the effect of board size on Tobin's q is negative and significant.

⁸⁴ See e.g. Mueller and Reardon, (1993); Gugler and Yurtoglu, (2003) for further discussion and comparison between different performance measures

Table 6. FE Regressions on the relation between Board Composition and Firm Investment Performance – Marginal Q

	Dependent Variable: $(M_t - M_{t-1})/M_{t-1}$					
	Model M1	Model M2	Model M3	Model M4	Model M5	Model M6
(I_t/M_{t-1})	0.87*** (20.20)	1.45*** (11.12)	0.91*** (18.86)	1.35*** (3.35)	0.94 (14.93)	1.70*** (4.12)
(I_t/M_{t-1}) *board size		-0.09*** (-4.73)				-0.08*** (-4.20)
(I_t/M_{t-1}) *gender			-0.73* (-1.80)			-0.14 (-0.32)
(I_t/M_{t-1}) *age				-0.01 (-1.20)		-0.00 (-0.45)
(I_t/M_{t-1}) *CEO					-0.12* (1.63)	-0.12 (-1.55)
Intercept	-0.08*** (-3.26)	-0.06** (-2.26)	-0.07** (-2.80)	-0.08 (-3.16)	-0.08*** (-3.25)	-0.05* (-2.11)
R-square	0.48	0.4956	0.4855	0.4844	0.4852	0.4973
F-value	F(41, 944) = 21.30	F(42, 943) = 21.80	F(42, 943) = 20.92	F(42, 943) = 20.84	F(42, 946) = 20.95	F(45, 941) = 20.38
N. of obs.	986	986	986	986	986	986
Marginal Q	0.87	0.77	0.84	0.82	0.82	0.95

The estimated equation is eq (5):

$$\frac{M_t - M_{t-1}}{M_{t-1}} = -\delta + \beta_1 \frac{I_t}{M_{t-1}} + \beta_2 Z_1 \frac{I_t}{M_{t-1}} + \dots + \beta_{i+1} Z_i \frac{I_t}{M_{t-1}} + \varepsilon_i$$

Z_i denotes the explanatory variables. Board size equals the number of board of directors, gender is the share of female directors, age denotes average age of all board of directors and CEO is a dummy variable that takes the value one if the CEO is a member of the board and zero otherwise. A fixed effect model controlling for industry and time effects is used.

Industry dummies are defined at two-digit SIC level. All values are deflated and expressed in 2005 years price level. The last percentile of the sample with respect to the difference between change in market value and investment ratio is removed to control for the effects of outliers. *** indicates a significance level at the 1% level, ** indicates a significance level at the 5% level, indicates a significance level at the 10% level. T-statistics are reported within brackets.

Table 7. FE Regressions on the relation between Board Composition and Firm Investment Performance - Tobin's Q

	Dependent Variable: Tobin's Q				
	Model T1	Model T2	Model T3	Model T4	Model T5
Sales	0.00 (-0.03)	0.00 (-1.40)	0.00 (-1.19)	0.00 (-1.26)	0.00 (0.10)
Growth sales	0.00 (0.05)	0.00 (0.19)	0.00 (0.20)	0.00 (0.41)	0.00 (0.26)
Board size	-0.05*** (-2.71)				-0.05** (-2.37)
Gender		-0.08 (-0.23)			0.29 (0.78)
Average Age			-0.01 (-1.31)		-0.01 (-0.99)
CEOdummy				-0.26*** (-3.26)	-0.23*** (-2.87)
Intercept	1.80*** (11.85)	1.42*** (22.10)	2.27*** (4.47)	1.59*** (21.17)	2.34*** (5.01)
R-square	0.2972	0.2919	0.2930	0.2995	0.3044
F-value	F(43, 941) = 9.1	F(43, 941) = 8.95	F(43, 941) = 9.00	F(43, 941) = 9.29	F(46, 938) = 8.87
N. of obs.	985	985	985	985	985

The estimated equation is eq (5): Tobin's $q = \beta_0 + \beta_{1,i,t} * \text{Sales} + \beta_{2,i,t} * \text{Growth sales} + \beta_{3,i,t} * \text{B} + \varepsilon_{it}$

Z_i denotes the explanatory variables. Board size equals the number of board of directors, gender is the share of female directors, age denotes average age of

all board of directors and CEO is a dummy variable that takes the value one if the CEO is a member of the board and zero otherwise. A fixed effect model controlling for industry and time effects is used. Industry dummies are defined at two-digit SIC level. All values are deflated and expressed in 2005 years price level. The last percentile of the sample with respect to the difference between change in market value and investment ratio is removed to control for the effects of outliers. *** indicates a significance level at the 1% level, ** indicates a significance level at the 5% level, indicates a significance level at the 10% level. T-statistics are reported within brackets.

To test hypothesis 4, we incorporate board diversity, age and gender diversity, into the model. Model M3 shows that gender diversity has a negative and significant effect on firm investment performance. The change in marginal q , from 0.87 to 0.84 is however negligible. Also, the effect of gender diversity loses significance in the model including all board characteristics (model M6). The effect of gender diversity on Tobin's q is insignificant (model T2 and T5; Table 7). Age diversity is also found to have no significant effect on firm performance. This result is robust with respect to performance measure.

CEO as a member of the board of directors is negative and significant both in terms of marginal q and Tobin's q . Marginal q decreases from 0.87 to 0.82 for these firms. The effect vanishes in the full model (M6) however. The negative and significant effect of CEO as a director remains significant even when more variables are included in the model (model T4 and T5, Table 7). We have also checked for non-linearity among the explanatory variables (see appendix table A2 and A3). Only the variable board size in the marginal q model shows a significant non-linear behavior.

To sum up, the analysis shows that, independently of choice of performance measure, board size affect investment performance negatively. The estimated coefficient of gender diversity is negative and significant, although the economic impact on marginal q is small. Also, the effect of gender diversity loses significance when estimating the full model of marginal q . The results are in line with Randøy et al., (2006) who show that board diversity only affect firm performance if diversity leads to larger boards.

6. Conclusion

This paper examines the determinants of board structure as well as the effects of board heterogeneity on investment performance. Due to the lack of a coherent theoretical framework the majority of the research on board of directors is empirically driven. This study adds to the literature by using a more accurate measure of firm performance, the marginal q . Unlike most other studies on board of directors, we use a panel data approach which covers 188 firms during the time period 1999-2005.

The descriptive statistics show that over the last five years there has been a sharp decrease in the number of firms having the CEO on the board of directors. This can be interpreted as a sign of increased independency. Furthermore, the share of female directors has, increased from 4 to 14 percent.

The empirical analysis shows that ownership concentration does not affect board size or board composition. There is however, a positive relationship between institutional and foreign ownership and board size. Furthermore, having the CEO as a member of the board increases the size of the board as well as the gender diversity and average age.

In line with previous research we find that board size has a strong and negative effect on firm performance. When estimated separately having the CEO as a member of the board has a negative impact on the firm's investment performance (both measured as change in market value and with Tobin's q). The estimate of gender diversity is also significant and negative when estimated separately with the marginal q methodology. It is, however, not robust to other specifications of the model or with respect to the Tobin's q methodology.

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Appendix

Table A1. Descriptive Statistics – Board of Directors

	Mean	Median	Max	Min	Std.
Board Size	7.56	7.00	13.00	3.00	2.14
Average Age	53.31	53.79	105.64	38.25	4.42
CEO member of the board (%)	73.00	1.00	1.00	0.00	0.44
Gender Diversity	9.00	0.00	67.00	0.00	0.11

Table A2. FE Regressions on the relation between Board Composition and Firm Investment performance – Marginal Q

	Dependent Variable: $(M_t - M_{t-1})/M_{t-1}$		
	Model A1	Model A2	Model A3
(I_t/M_{t-1})	2.25*** (5.21)	0.92*** (18.79)	2.54*** (2.12)
$(I_t/M_{t-1}) * \text{boardsize}$	-0.32*** (-2.64)		
$(I_t/M_{t-1}) * \text{boardsize}^2$	0.015** (1.94)		
$(I_t/M_{t-1}) * \text{gender}$		-1.19** (-2.22)	
$(I_t/M_{t-1}) * \text{gender}^2$		5.01 (1.55)	
$(I_t/M_{t-1}) * \text{age}$			-0.05 (-1.26)
$(I_t/M_{t-1}) * \text{age}^2$			0.00 (1.06)
Intercept	-0.06*** (-2.32)	-0.07*** (-2.84)	-0.08*** (-3.14)
R-square	0.50	0.49	0.49
F-value	F(43, 942) = 21.44		F(43, 942) = 21.38
N. of obs.	986		986

The estimated equation is eq (5):
$$\frac{M_t - M_{t-1}}{M_{t-1}} = -\delta + \beta_1 \frac{I_t}{M_{t-1}} + \beta_2 Z_{1t} \frac{I_t}{M_{t-1}} + \dots + \beta_{i+1} Z_{it} \frac{I_t}{M_{t-1}} + \varepsilon_i$$

z_i denotes the explanatory variables. Board size equals the number of board of directors, gender is the share of female directors, age denotes average age of all board of directors and CEO is a dummy variable that takes the value one if the CEO is a member of the board and zero otherwise. A fixed effect model controlling for industry and time effects is used. Industry dummies are defined at two-digit SIC level. All values are deflated and expressed in 2005 years price level. The last percentile of the sample with respect to the difference between change in market value and investment ratio is removed to control for the effects of outliers. *** indicates a significance level at the 1% level, ** indicates a significance level at the 5 % level, indicates a significance level at the 10 % level. T-statistics are reported within brackets.

Table A3. FE Regressions on the relation between Board Composition and Firm Investment Performance - Tobin's Q

	Dependent Variable: Tobin's Q		
	Model T1	Model T2	Model T3
Sales	0.00 (-0.06)	0.00 (-1.40)	0.00 (-1.17)
Growth sales	0.00 (0.05)	0.00 (0.19)	0.00 (0.25)
Board size	-0.06 (-0.56)		
Boardsize^2	0.00 (0.10)		
Gender		-0.28 (-0.38)	
Gender^2		0.64 (0.31)	
Age			-0.04 (-0.90)
Age^2			0.00 (0.67)
Intercept	1.84*** (4.34)	1.43*** (21.70)	2.81*** (2.17)
R-square	0.30	0.29	0.26
F-value	(44,490)=8.97	(44,490)=8.74	44,490)=8.80
N. of obs.	985	985	985

The estimated equation is: $Tobin's\ q = \beta_0 + \beta_{1,i,t} * Sales + \beta_{2,i,t} * Growthsales + \beta_{3,i,t} * B + \varepsilon_{it}$

z_i denotes the explanatory variables. Board size equals the number of board of directors, gender is the share of female directors, age denotes average age of all board of directors and CEO is a dummy variable that takes the value one if the CEO is a member of the board and zero otherwise. A fixed effect model controlling for industry and time effects is used. Industry dummies are defined at two-digit SIC level. All values are deflated and expressed in 2005 years price level. The last percentile of the sample with respect to the difference between change in market value and investment ratio is removed to control for the effects of outliers. *** indicates a significance level at the 1% level, ** indicates a significance level at the 5 % level, indicates a significance level at the 10 % level. T-statistics are reported within brackets.