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Abstract

In this paper the relation between ownership structure, board composition and firm performance is explored. A panel of Swedish listed firms is used to investigate how board composition affects firm performance. Board heterogeneity is measured as board size, age and gender diversity. The results show that Swedish board of directors have become more diversified in terms of gender. Also, fewer firms have the CEO on the board which can be interpreted as a sign of increased independency. The regression analysis shows that gender diversity has a small but negative effect on investment performance, and the same holds for CEO being on the board. The analysis also show that board size has a significant negative effect on investment performance. When incorporating all the explanatory variables into one equation however, 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.
JEL-codes: G30, L20, L21, L22, L25

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1. Introduction

A large body of research has examined the link between board composition and firm performance.[1] The majority of 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 composition[2] and firm performance, see 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 exist.

This paper is a response to Randøy et al. (2006)'s call for further investigation and for the use of alternative methodologies[3] to evaluate performance. Marginal *q* is used as an alternative, and in fact more appropriate, measure of 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. This paper also adds 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

[1] See Carter et al. (2003); Hermalin and Weisbach (2003); John and Senbet (1998) for excellent reviews.
[2] Board structure refers both to the size and to the composition of boards.
[3] 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 of performance measure used in studies on boards of directors).

empirical literature. When studying ownership structure and corporate governance issues such as board composition Sweden provides a particularly advantageous example. Empirical studies generally characterize Sweden as 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 boards reduce the effect of gender diversity and CEO on the board on firm investment performance. The descriptive statistics show that Swedish board of directors have 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 previous theoretical and empirical evidence regarding the relationship between ownership, board composition and firm performance. From this discussion the empirically testable hypotheses are drawn. Section three then follows with a description of the methodology used in the empirical investigation. A description of the data used and descriptive statistics are provided in section four. After the empirical analysis in section five, section six ends the paper with conclusions.

2. Ownership Structure, Board Composition and Firm Performance

Size and composition of boards usually differ to some extent between companies. Linck et al, (2007), show that smaller and more dependent[4] 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"* (p. 2). Coles et al, (2008) support the results. Raheja (2005) develops a model of determinants of board structure. According to the model verification costs of investments is a determining factor of board composition. Moreover, the model 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. 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 research on board composition and firm performance is mainly empirical driven because of a lack of a coherent theoretical framework.

A number of studies make use of the agency theory and the resource based theory[5] when assessing the relation between board composition and firm performance (see for example Randøy et al, (2006); and Dalton et al, 1999). According to the agency theory the main task of the board of directors is to control and monitor the management, i.e. to align principal agent problems (Fama and Jensen, 1983). Hence, in order to perform optimally the board must have access to accurate information.

[4] 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.

[5] Randøy et al, (2006) provide 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).

2.1 Ownership and Board Structure

Assuming that the objective of the firm is to maximize profit. That is, the management is employed to act in the interest of the owners and invest the firm's assets so that shareholder wealth is maximized. Two types of agency problems arise; first, agency problems caused by separation of ownership and control as accounted for by Berle and Means, (1932) and Jensen and Meckling, (1976); second, agency problems between controlling and minority shareholders. The first type of agency problem is more severe in firms having dispersed ownership i.e. firms in Anglo-Saxon countries. The ownership structure in Sweden and Continental-Europe is characterized by concentrated ownership, which makes them more vulnerable to a second type of agency problem, namely between controlling and minority shareholders (Villalonga and Amit, 2006). These firms suffer potentially from a dependency problem between the controlling owner and the board of directors (Saito and Dutra, 2006).

According to the *Swedish Code of Corporate Governance*[6] the managing director and the chairman of the board cannot be the same person. In most Swedish firms the managing director is the only director with a seat on the board. Hence, "insider directors" are directors associated with the controlling owner of the firm. One way for the board to become more independent is to appoint foreign directors. Foreign and institutional owners can also play a monitoring role, i.e. by reducing the ability of controlling owners to entrench the management (Bjuggren et al, 2007). Singh et al, (2000) and Bilimora and Wheeler, (2000)

[6]The 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).

suggest a positive relationship between institutional owners and board diversity. Based on this discussion we thus 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

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.

A number of empirical studies investigate the link between board size and firm performance. For an excellent literature review see Hermalin and Weisbach, (2003). The empirical findings 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 study show that most firm value is lost when the board goes from small to medium sized. This result also seems to hold for Nordic firms, Randøy et al, (2006) for example, show that larger boards have a negative 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 Ingley and van der Walt, 2001) in the

literature regarding which type of directors or composition of directors that is optimally in this sense; outside directors with better knowledge about the surrounding business environment and access to information from other firms (business partners and competitors) or inside directors with superior knowledge about the firm.

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 (Tson Söderström, et al, 2003).

According to the resource based view, the board of directors is an important strategic resource in order for the firm to get knowledge, contact with the elite of the business world, external sources of capital, new geographical and industrial markets and competitors. Thus, increased diversification among board members is positive for the firm and its financial performance (van der Walt and Ingley, 2003). Due to increased knowledge and access to outside information 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.

Age and gender diversity among board members are other 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 (Grosvold 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, (2004) in an investigation of U.S. based firms. Rose (2007), evaluates the impact of having women on boards of directors in Danish public firms. The empirical analysis show 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

Marginal q (q_m) is essentially a marginal version of Tobin's q. Mueller and Reardon (1993), derive the marginal q with the insight that investments are valued continuously by the market as the discounted present value of the future cash-flows created by the investments. Alternatively, marginal q can be derived from Tobin's q, where Tobin's average q, q_a, is

defined as the market value, M_t, divided by the replacement cost of the firm capital at time t, K_t:

$$M_t / K_t = q_{a,t} \tag{1}$$

This measures the average return on the capital over its cost of capital. A q_a above one implies that the firm should invest further. However, for adjustments of the capital stock the marginal return on capital is more relevant. The marginal return on capital is then:

$$q_m = \frac{\Delta M_t}{\Delta K_t} = \frac{M_t - M_{t-1} - \delta M_{t-1}}{K_t - K_{t-1}} \tag{2}$$

where $-\delta$ is the depreciation rate. A firm's market value in period t is expressed as:

$$M_t = M_{t-1} + PV_t - \delta M_{t-1} + \mu_t \tag{3}$$

where PV_t is the present value of the cash flows that investments, I_t, in period t generate, and μ_t a standard error term. Investment is defined as: I = After tax profits + Depreciation – Dividends + ΔDebt + ΔEquity + R&D + ADV, where ΔD and ΔE are funds raised using new debt and equity issues. The net present value rule stipulates that investment should be made

up to the point where $PV_t = I_t$. This implies that $PV_t/I_t = 1$, which can be rewritten as $PV_t/I_t = q_m$. Dividing both sides of equation (3) by M_{t-1} and rearranging we get the empirically testable equation:

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

Equation (4) assumes efficient capital market in the sense that future cash flows are unbiased estimates. Hence, as t grows larger μ_t / M_{t-1} approaches 0. See Mueller and Reardon, (1993); Gugler and Yurtoglu, (2003) for more details on the derivation and properties of marginal q.

To study the effects of management, ownership and control interaction terms are constructed 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:

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

where Z are the explanatory variables.

The marginal q (q_m) has a number of advantages. Above all a marginal performance measure is more appropriate than an average Tobin's q, when testing hypotheses about managerial discretion, since average measures of performance confuse average and marginal returns. Secondly, q_m has a straightforward interpretation. If managers invest in a project that yields a return that is less than the cost of capital, $q_m < 1$. This means that managers are over-investing. That is, the marginal investment has a return less than the cost of capital and the shareholders would have been better off if the firm had distributed these funds directly to them instead. For the firm to maximize shareholder-value, q_m must be equal to one. Conversely, if $q_m > 1$ managers are not making enough investments. This means that the marginal investment had a return in excess of the cost of capital and that the firm should have invested more.

4. Data and Descriptive Statistics

In the empirical analysis an unbalanced dataset covering 105 firms, traded on the Stockholm stock exchange during the time period 1999-2005, is used. The financial data is provided by the *Standard and Poor's COMPUSTAT Global* database. Only non-financial firms with reported data for at least four years are included in the sample. The data on investment and market values are not normally distributed. The Jarque-Bera test indicates non-normality, 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 collected from the *Owners and Power in Sweden's Listed Companies* by Sundin and Sundqvist (1999-2005). This database provides detailed ownership data for Swedish listed firms. Voting and equity shares are aggregated so that different types of closely connected 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 collected 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 regression analysis. Table 1 provides a description of the variables used.

Table 1: Description of variables

Variable	**Description**
Financial Data *Source: Standard and Poor's COMPUSTAT Global*	
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= After tax profit + Depreciation – Dividends + ΔDebt + ΔEquity + R&D + ADV (Compustat mnemonic item numbers: IB + DP – DVC + ΔDT + SSTK - PRSTKC + XRD + XSGA)
Ownership data *Source: Sundin and Sundqvist "Owners and Power in Sweden's Listed Companies"*	
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. (See Wiberg, (2008) for further discussion on institutional ownership).
Foreign Ownership	Percentage of ownership held by foreign owners. This type of owner is mostly foreign institutional owners.
Board Composition *Source: Sundin and Sundqvist "Directors and Auditors in Sweden's Listed Companies"*	
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 Diversity	Share of female board members
Average Age	Average age of board members

4.1 Descriptive Statistics

Swedish listed firms are characterized by a highly concentrated ownership structure. 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 a 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 of 7-8 members, and the average age of a board member is 53 years (see Table 3).

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	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. 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 marginal *q* to estimate the effects of board structure on investment performance. Table 4 summaries the hypothesis and expected effect on performance.

Table 4: Hypothesis and Expected Effects

Panel A: Ownership structure	
	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 approach allows us to construct a fixed effect model that controls for both industry (two-digit) and time effects. Model 1-3 (Table 5) test the effects of ownership on board size. Following previous studies we control for firm profit and size in terms of sales. 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. Link et al, (2007) for example, reports that larger US based firms have on average 10-11 board members whereas small and medium sized firms have 7-8 board members. The size of the firm also have 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.

When the effect of ownership structure on board composition and size is tested, the effect of ownership concentration on board size 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 (measures as sales) i.e. 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)	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)
Intercept	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 capital[7].

Dalton et al, (1998, 1999), argue that size and the associated complexity of larger firms could distract otherwise clear relationships between board composition and performance. Hence, sales and growth in sales are used to control for firm size when estimating Tobin's *q*. With the marginal *q* methodology size is controlled for via the market value of the firm. Table 6 presents the results when marginal *q* is the dependent variable, and Table 7 presents the results using Tobin's *q* as the 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 size on Tobin's *q* is negative and significant.

[7] 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})*boardsize		-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	-.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): $\frac{M_t - M_{t-1}}{M_{t-1}} = -\delta + \beta_1 \frac{I_t}{M_{t-1}} + \beta_2 Z_1 \frac{I_t}{M_{t-1}} + \ldots + \beta_{i+1} Z_i \frac{I_t}{M_{t-1}} + \varepsilon_i$

Where 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)
Boardsize	-.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 $q = \beta_0 + \beta_{1,i,t}$*Sales+ $\beta_{2,i,t}$Growthsales+ $\beta_{3i,t}B+\varepsilon_{it}$

Where 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 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. Considering Tobin's q, model T4 and T5 in Table 7 show that the negative and significant effect of the CEO on the board remain significant when more variables are included in the model.

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 show a significant non-linear behaviour.

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 are empirically driven. This study adds to this literature by using a more accurate measure of firm performance, the marginal q. Unlike most other cross-sectional studies, 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 increased independency of the board of directors. 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. None of the other variables are significant in all specifications of the model. When estimated separately both having the CEO as a member of the board and gender diversity have negative impact on the firm's investment performance. The estimate of gender diversity is significant and negative when estimated separately with the marginal q methodology, however it is 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})*boardsize	-0.32*** (-2.64)		
(I_t/M_{t-1})*boardsize^2	0.015** (1.94)		
(I_t/M_{t-1})*gender		-1.19** (-2.22)	
(I_t/M_{t-1})*gender^2		5.01 (1.55)	
(I_t/M_{t-1})*age			-0.05 (-1.26)
(I_t/M_{t-1})*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): $\frac{M_t - M_{t-1}}{M_{t-1}} = -\delta + \beta_1 \frac{I_t}{M_{t-1}} + \beta_2 Z_1 \frac{I_t}{M_{t-1}} + \ldots + \beta_{i+1} Z_i \frac{I_t}{M_{t-1}} + \varepsilon_t$

Where 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)
Boardsize	-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+ $\beta_{3i,t}B+\varepsilon_{it}$

Where 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.