Aalto University
School of Business

Board size, meeting frequency and the variability of corporate performance

How corporate boards relate to performance variability in Nordics?

Bachelor's Thesis
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Finance
Spring 2020

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Title of thesis Board size, meeting frequency and the variability of corporate performance: How corporate boards relate to performance variability in Nordics?

Degree Bachelor of Science

Degree programme Finance

Thesis advisor(s) Joni Kokkonen

Year of approval 2020 **Number of pages** 24 **Language** English

Abstract

In this study, I examine how the board size and the board meeting frequency correlate with the variability of corporate performance using the standard deviations of three measures of performance; monthly stock return, return on assets (ROA) and Tobin's Q. My empirical analysis consists of OLS regressions using mainly a sample of 206 Nordic companies over the years 2015-2019. I find a significant and robust evidence on the positive correlation between board meeting frequency and the standard deviations of monthly stock return and ROA, while only insignificant evidence regarding the standard deviation of Tobin's Q. However, I do not find any significant relation between board size and performance variability. My further analysis contributes to the existing corporate governance literature by suggesting that the board meeting frequency is an active means of governance in the Nordic region especially under volatile circumstances and when used in abnormal amounts. Further, I suggest that the meeting frequency is more likely to determine endogenously by reacting to historical performance variability, not vice versa.

Keywords board of directors, board size, board meeting frequency, corporate performance variability, corporate governance

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1. Introduction

In a functioning market economy, companies adapt to a rapidly changing world and thus effective decision-making rises to a vital position. Effective decision-making is largely ensured by the good corporate governance, which is the responsibility of the board of directors. Inspired by this, corporate governance literature is interested in the operations of corporate boards. One interesting question is how the different board attributes affect or react to the variability of corporate performance, reflecting the board dynamics in different circumstances. In this study, I examine how two board attributes, the board size and the board meeting frequency, correlate with the variability of corporate performance using Nordic data mainly from 2015 to 2019.

1.1 Prior literature and the contribution of this thesis

Prior corporate governance literature focuses to a significant extent on looking for relation between board characteristics and the *level* of corporate performance (e.g., Yermack, 1996; Vafeas, 1999). However, relatively a little attention has been paid to the *variability* of corporate performance. The relation between board size and the variability of corporate performance has been studied using data from United States at the turn of the 21st Century, finding a negative correlation between the variables (Cheng, 2008). However, the relation between board meeting frequency and the variability of corporate performance has not been studied in any of the top journals, although closely related research has emerged (e.g., Vafeas, 1999). Overall, the relation between board attributes and performance variability has not been studied using Nordic data from the 21st Century.

With this study, I continue the existing literature in at least three ways. First, I observe the connection between board attributes and corporate performance variability, probably for the first time, with the post-financial crisis Nordic data. Second, I look for evidence as to whether the Cheng's (2008) findings from the United States at the turn of the 21st century about the negative relationship between board size and the variability of performance still exists. Finally, I continue the existing literature by observing relation between board meeting frequency and performance variability in a way that has not been implemented in any top journal.

1.2 Empirical findings

My findings provide a strong evidence of a positive correlation between board meeting frequency and the standard deviations of monthly stock return and ROA. My further analysis

indicates that the board meeting frequency is an active means of governance in the Nordic region especially under a volatile situation and when used in abnormal amounts. Further, I suggest that the meeting frequency is more likely to determine endogenously by reacting to historical performance variability, not vice versa. Regarding the relation between board size and the variability of corporate performance, I did not find any significant results, and the results are both in line or against the hypothesis of a negative relation, depending on the model.

1.3 Constraints of this thesis

In this study, I have had to manage several challenges regarding methods and data used, as well as general problems of endogeneity related to corporate governance literature.

First, as my analysis is based on OLS regression, which is highly sensitive to outliners, I have tried to treat that by narrowing my sample and using additional robustness checks. In addition, because the OLS regression is based on the assumption that variables are uncorrelated with each other, I have passed a pairwise correlation analysis on my variables.

Second, as my sample consists only of companies still being active at the early 2020 and having all necessary data available, the sample is quite limited and focuses on large companies due to the poor availability of Nordic data. Although risen probability of selection bias is difficult to manage, I have conducted several robustness tests to alleviate the concern. While I am unable to eliminate a survivorship bias, fortunately it is not as critical in measuring *variability* compared to the *level* of performance. Due to the lack of long time-series data, my sample period is limited to five years.

Finally, as corporate board attributes are often determined endogenously, it is hard to detect direct causalities between performance measures and board attributes. I have tried to detect this problem using specified robustness checks as a part of my further analysis.

1.4 Content summary

This thesis proceeds as follows. Section 2 reviews the previous literature, eventually leading to my hypotheses. In Section 3, I compile my sample and clarify the independent and dependent variables. In Section 4, I delve into my empirical model. In Section 5, I review the results of my main empirical model. In Section 6, I deepen my empirical analysis and test the robustness of my results. Section 7 summarizes and concludes this thesis.

2. Prior literature and hypotheses

2.1 Literature review

2.1.1 Corporate board as part of a corporate governance

Board of directors is a regulatory body of a firm, whose primary function is to appoint, supervise and dismiss the Chief Executive Officer ("CEO"). As board is a central body of a firm, considerable amount of literature has emerged around it. The main function of a board has seen to be the solving of a principal-agent problem between management and shareholders by combining their incentives (e.g., Hermalin & Weisbach, 2001). However, a clear theoretical framework on corporate boards has not emerged, and the research is thus mainly empirical. Prior literature has drawn particular attention to two subjects – relation between a board and a performance (e.g., Bhagat & Black, 1999; Hermalin & Weisbach, 1991; Yermack, 1996) and between a board and the CEO (e.g., Weisbach, 1988; Core, Holthausen, & Larcker, 1999).

Research on the relation between corporate board and corporate performance focuses especially on the independence and the size of a board. Firstly, no significant relation has been found between board independence and corporate performance (e.g., Bhagat & Black, 2000), although its theory is one of the most considered (Hermalin & Weisbach, 2001). Secondly, a negative relation has been found between board size and corporate performance (e.g. Yermack, 1996; Guest, 2009), explained by growing agency issues (e.g., Jensen, 1993) and consensus-seeking (Moscovici and Zavalloni, 1969). However, also opposite evidence is found as, for example, Boone, Field, Karpoff & Raheja (2007) suggest positive relation between the board size and the performance caused by information advantages of a larger board.

Research on the relation between a board and the CEO has drawn attention to the power of CEO. As a role of a board is to decide on CEO's compensation and dismissal, CEO has an incentive to seek influence over the board (e.g., Core et al., 1999). For example, it has been found that the insider dominant board does not respond as quickly to poor CEO performance as a highly independent board (Weisbach, 1988). Further, it has been found that the better the board responds to a poor CEO performance, the better the firm performs (Denis & Denis, 1995). Finally, relation between the CEO and a board is difficult to model, which in turn has made it important to isolate the effect of CEO power when modeling other board attributes.

Although corporate boards are highly studied topic, corporate governance literature is very UK and US focused and observes data mainly from the 20th century, creating certain limitations for the replication of research results. To underline a few differences, it has been suggested that, at the turn of the 21st century, boards have taken on a much larger role in the overall management of a company (MacAvoy & Millstein, 1999). Further, it has been observed that, corporate governance varies a lot depending on, i.e., financial markets and a general corporate culture (Kaczmarek, Kimino & Pye, 2012). For example, Nordic corporations have a larger proportion of independent directors (Oxelheim, Gregorič & Randøy, 2013) and boards are more involved in decision-making (Thomsen, 2016) than in the Anglo-Saxon counterparties.

2.1.2 Relation between board size and performance variability

Although the relation between board size and the *level* of corporate performance is still somewhat unclear — albeit skewed to a negative relation — a significant negative relation has been found between board size and the *variability* of corporate performance (Cheng, 2008). Cheng found the standard deviation of ROA (Tobin's Q) decreasing by 9% (17%) from its mean as board size increased by one. The findings support both the prior social psychology and economic literature on how decision-making in a larger board not only slows down but also moderates extreme opinions (Moscovici & Zavalloni, 1969) and reduces variability in decision quality (Sah & Stiglitz, 1991) – further causing a decrease in performance variability.

However, the impact of agency problems of a larger board on performance is unclear. The prior literature has observed free riding causing an increase in CEO power (Jensen, 1993), while the increase in CEO power has been seen, depending on study, either to increase (Adams, Almeida, & Ferreira, 2005) or decrease (Amihud & Lev, 1981) the variability of performance. Cheng (2008) does not seek to answer this, as he isolates the impact of CEO power from his analysis. Finally, none of the papers around the topic of a board size and the variability of corporate performance has been published in top journals using post-financial crisis Nordic data.

2.1.3 Relation between board meeting frequency and performance variability

Board meeting frequency is a board attribute that has not been studied in the same extent as board independence and size. Relation between board meeting frequency and the *variability* of corporate performance has not been directly studied in any top journals, but a negative correlation has been found between meeting frequency and the *level* of performance (Vafeas,

1999). Vafeas also found that the abnormal meeting frequency anticipates better *future* performance for companies having a poor *past* performance. If we develop these observations further, we can find possible links between meeting frequency and performance variability.

First, abnormal meeting frequency has been seen as a fire-fighting tool of a board (Jensen, 1993), supported by the positive relation between poor, yet often volatile, performance and meeting frequency (Vafeas, 1999). In addition, Vafeas argues that the meeting frequency is more sensitive to a poor than a good performance, as directors' legal responsibility to perform their duties properly forces them to focus especially on preventing disasters (Jensen, 1993).

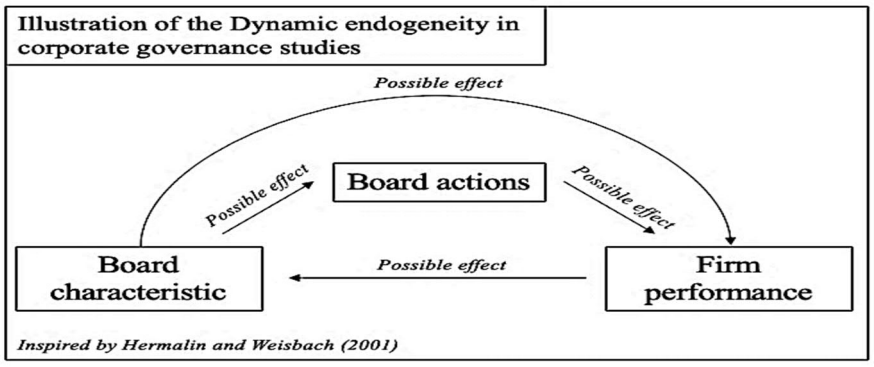
Second, the evidence of abnormal board meeting frequency anticipating better future performance implies that by increasing the number of meetings it may be possible to improve poor performance (Vafeas, 1999). In addition, Lipton & Lorsch (1992) suggest time being one of the greatest obstacles for directors to perform their duties, where increasing the meeting frequency could be helpful (Conger, Finegold & Lawler, 1998), while frequent board meetings has also been seen as a binding mechanism to elevate board work (Bryne, 1996). In Section 2.2, I will develop my hypotheses based on these prior observations.

All in all, if the board meeting frequency really matters, it would be a highly useful insight to real economy, as meeting frequency can be adapted to new circumstances more quickly and at the lower cost than many other board attribute (Vafeas, 1999). The Nordics can also be especially interesting field for the research, as boards are highly active to involve in corporate operations (Thomsen, 2016). In addition, board activity may have increased in general during the years, at least compared to the data used by Vafeas (1999) (MacAvoy & Millstein, 1999).

2.1.4 Endogeneity in corporate governance literature

Corporate governance literature is characterized by one significant issue – the problem of endogeneity, which often drives empirical results and thus complicates further analysis. Wintoki, Linck and Netter (2012) define three types of endogeneity – *Dynamic endogeneity, Simultaneity* and *Unobserved heterogeneity* – each of which I will present in this section.

Exhibit 1

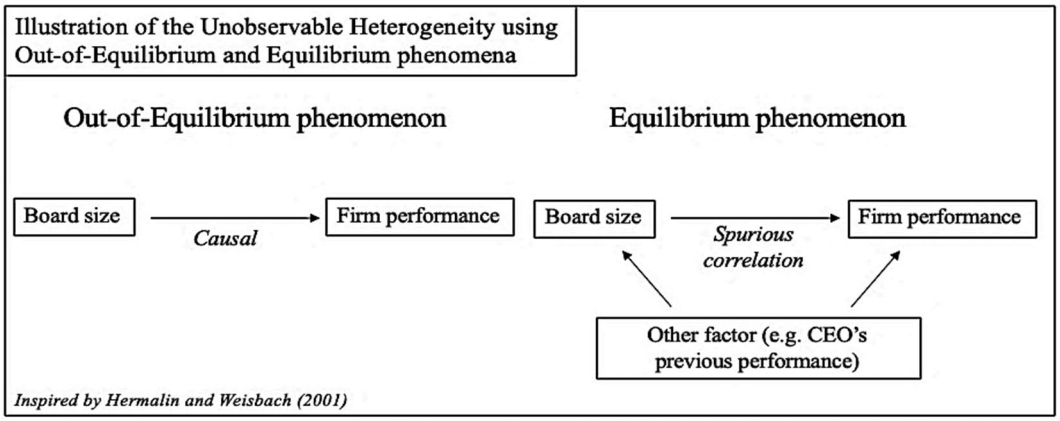


Firstly, *Dynamic endogeneity* visualized in Exhibit 1 arises from the fact that almost every correlation observed between board attributes and firm performance can be determined through several ways without external influence (Wintoki et al., 2012). As Exhibit 1 presents, decisions made by the board in history might have effect on performance, which in turn can return to board characteristics (Hermalin & Weisbach, 2001). Dynamic endogeneity has been suggested to be the most widely underestimated type of endogeneity by Wintoki et al. (2012).

Secondly, *Simultaneity* becomes a problem if the governance attributes used as independent variables in the regressions were determined simultaneously at the same time in each observation period (Wintoki et al., 2012). However, Simultaneity does not usually arise as a major problem in the study of performance variability, where time series data is often averaged.

Thirdly, *Unobserved heterogeneity* arises if variables such as corporate performance and board size are jointly determined by the influence of a third factor, such as CEO power. Hermalin & Weisbach (2001) have modeled Unobserved heterogeneity using two possible ways of causality, Out-of-Equilibrium and Equilibrium phenomena, as presented in Exhibit 2. In this study, Dynamic endogeneity and Unobserved endogeneity are the most critical types of endogeneity and they are likely to influence my further conclusions based on empirical results.

Exhibit 2



2.2 Hypotheses

In this section, I will develop the research question and two hypotheses of this thesis. As shown in the literature review, relation between the board attributes and corporate performance is highly studied topic – and rightly so. It should be noted, however, that little empirical evidence can be found on the relationship between the board attributes and the *variability* of performance, especially using a sample of Nordic companies in the post-financial crisis period. One of the leading empirical studies in this field is *Board size and the variability of corporate performance* by Cheng (2008), and I intend to utilize his methods in my own thesis to a large extent.

Based on the availability of data and the inspiration of the literature review, I have chosen board size and number of annual board meeting as my main objects of analysis. Having said that, I intend to examine how these two board attributes, the board size and the meeting frequency, correlate with the variability of within-firm, over-time corporate performance in Nordic countries mainly from 2015 to 2019. Next, I will go through my two hypothesis.

2.2.1 Hypothesis 1: Board Size and performance variability

Since the prior corporate governance literature agrees that board size is likely to be negatively correlated with the variability of corporate performance (Chang, 2008), I form the hypothesis of my thesis based on this. So, my first hypothesis is as follows:

Hypothesis 1*: Number of board members on the board of directors is negatively correlated with the variability of corporate performance.*

2.2.2 Hypothesis 2: Board meeting frequency and performance variability

While prior literature has not made a clear proposal on how board meeting frequency correlates with the variability of corporate performance, I have sought to create a basis for my hypothesis in my literature review. I argue that, based on the observations of Vafea (1999) and other prior literature (e.g., Jensen 1993, Conger et al., 1998), I can form a valid hypothesis. As prior literature indicates increasing board meeting frequency in response to poor, yet often volatile, performance, while better future performance in response to abnormal meeting frequency, this chain of events should create noticeable volatility. So, my second hypothesis is as follows:

Hypothesis 2*: Number of annual board meetings of the board of directors is positively correlated with the variability of corporate performance.*

3. Data behind the empirical model

3.1 Sample

My sample consists of publicly listed Nordic companies whose time series data is provided in the Thomson Reuters Eikon database. I started compiling my sample from 1,417 companies listed on Nasdaq Helsinki, Copenhagen, Stockholm or Iceland or Oslo Stock Exchange during 2015-2019. Of these companies, 280 had at least one observation of board size at Eikon, in addition to which I compiled 136 firm-year observations from the BoardEx database, finding at least one observation for 56 new companies. Eventually, I emerged with 336 Nordic companies having at least one observation on board size during 2015-2019. While Cheng (2008) limits his sample to companies having at least two useful observations, I have accepted only one useful observation due to lower data availability of Nordics. Further, I limited my sample to companies having at least one observation of the number of annual board meetings over the observed period. This requirement limits the final potential sample to 240 companies.

From this sample of 240 companies, like Cheng (2008), I removed 30 companies classified as financial institutions using the NAICS two-digit industry code of 52, which includes banks, brokers and insurance companies due to the lack of comparability. In addition, I removed three companies having less than two years from Initial public offering ("IPO") and one company whose extreme observations strongly distorted the regression. On the firm-year level, I have winsorized my underlying data at the 1st and 99th percentiles to reduce the influence of outliers. After all, my sample consists of 206 Nordic companies presenting up to 1,002 annual and 11,905 monthly observations during 2015-2019. My limited five-year-period is due to the fact that the collected observations accumulate to a significant extent in the second half of the 2010s and thus longer period would generate biased results. Sample companies are geographically located as follows; 115 from Sweden, 33 from Finland, 31 from Norway and 26 from Denmark.

3.2 Dependent variables

Similar to the closely related literature (e.g., Cheng, 2008; Yermack, 1996; Coles, Daniel & Naveen, 2006; Adams et al., 2005), I will use the standard deviations of following three dependent variables to describe performance variability broadly enough; 1. *Monthly stock return* to describe market-based equity performance 2. *Tobin's Q* to describe total corporate value performance 3. *Return on assets (ROA)* to describe accounting performance.

Tobin's Q is officially determined by dividing the market value of assets by the replacement cost of assets. Due to the lack of necessary details, I will follow Cheng (2008) and form the best possible approximation of Tobin's Q as follows:

$$Tobin's\ Q_{i,t} = \frac{Book\ Value\ of\ \ Debt_{i,t} + Market\ Value\ of\ Equity_{i,t}}{Book\ Value\ of\ Assets_{i,t}}$$

$$Where\ i\ is\ observed\ company\ and\ t\ is\ observed\ period$$

Return on assets (ROA) is formed using slightly different definition than Cheng (2008):

$$Return\ on\ assets\ (ROA) = \frac{Net\ income\ (loss)\ for\ the\ fiscal\ year}{Average\ book\ value\ of\ total\ assets\ for\ the\ fiscal\ year}$$

In addition, I will model the unpredictable nature of variability, as Cheng (2008), using adjusted standard deviations of each dependent variable to form proxies for the variability of unpredictable performance. These three adjusted variables are *standard deviations of market-adjusted monthly stock return, industry-adjusted ROA* and *industry-adjusted Tobin's Q*. The market-adjusted monthly stock return is calculated as the difference between sample firm's monthly stock return and the monthly return of the market capitalization weighted Nasdaq OMX Nordic 120 Index provided by the Thomson Reuters Datastream. The industry-adjusted ROA is calculated as the difference between sample firm's annual ROA and the annual average ROA among the Nordic firms with the same two-digit NAICS industry code provided by the Eikon. The industry-adjusted Tobin's Q is defined in the same way as Industry-adjusted ROA.

3.3 Key independent variables

To test my hypotheses, I use the natural logarithm of *board size* and *the number of board meetings* as my key independent variables. Board size is the amount of directors on the board of directors on each year, and the natural logarithm is intended to make the variable more suitable in nature for a linear regression model (Cheng, 2008). The number of board meetings is the amount of annual board meetings of the board of directors and it describes board meeting frequency (Vafea, 1999). Board sizes have been collected from Thomson Reuters Eikon and BoardEx databases, while information on the number of annual board meetings is collected from Eikon only. As Cheng (2008), I have averaged all the independent variables over the observed period by firm, so every firm has only one observation in the main regressions.

Figure 1 shows the sample means of standard deviations of ROA by board size. As sizes has been averaged for each firm over 2015-2019, the means have been rounded to the nearest whole number (i.e. 6.66 ≈ 7). We can see that as board size increases, the standard deviation of ROA decreases, although not steadily. However, the standard deviation of ROA is exceptionally high for the board sizes of 15 and 16, but as samples are only one observation each, it may be well distorted to describe a direct correlation between these two variables.

Figure 1

Sample means of the Standard deviations of ROA by Board size (the right axis). Number of the averaged observations by Board size is also reported (the left axis). Total sample consists of 206 firms from 2015 to 2019.

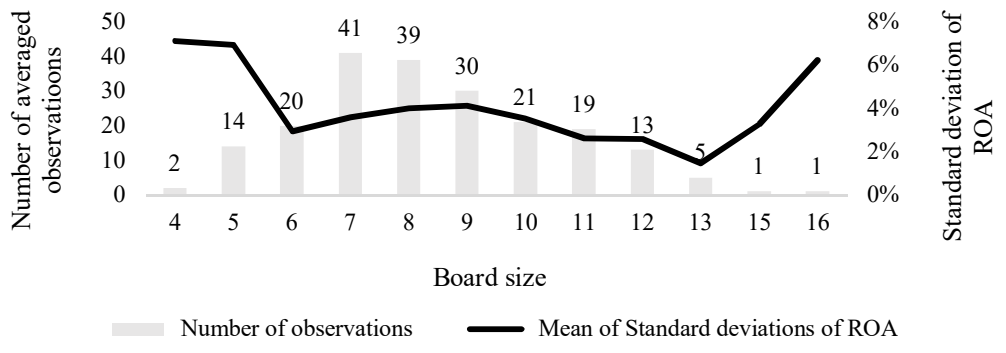
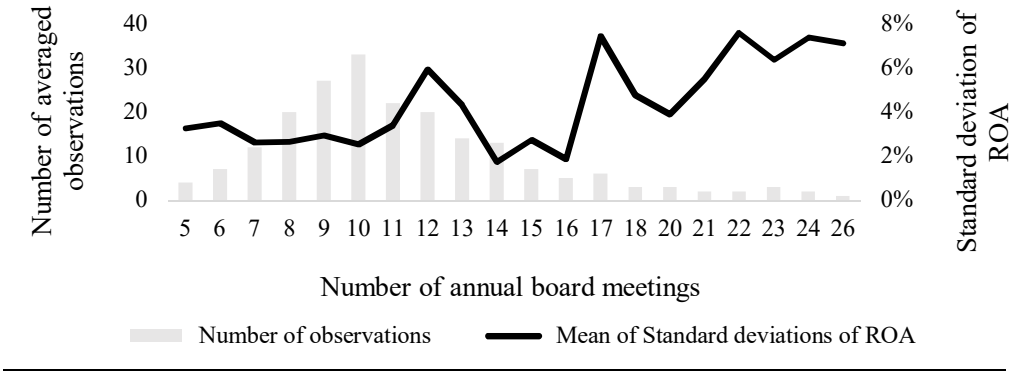


Figure 2 observes the sample means of standard deviations of ROA by the number of annual board meetings. As with Board sizes in Figure 1, the different amounts of board meetings have also been rounded to the nearest whole number. We can see that as the board meeting frequency increases, the standard deviation of ROA increases, but definitely not with steady slope. In addition, it can be observed that the overall sample is very strongly focused around 10 annual meetings. In this figure, the most interesting move occurs with board meetings amounts of 14 -16, with the standard deviation of ROA being at the lowest.

Figure 2

Sample means of the Standard deviations of ROA by the number of annual board meetings (the right axis). Also the Number of the averaged observations by Board size is reported (the left axis). Total sample consists of 206 firms from 2015 to 2019.



3.4 Control variables

In line with the prior literature (e.g., Yermack, 1996; Cheng, 2008; Vafea, 1999), I will employ several control variables that may correlate with the variability of corporate peformance. To clarify, I have divided these variables into corporate governance variables and company characteristics. All of my independent and dependent variables are shown in Table 2.

The corporate governance variables are presented in Table 1 using four categories suggested by Zahra & Pearce (1989) and used by Hirvelä (2019). My governance control variables are *board meeting attendance, board independence* and *CEO ownership*. Board meeting attendance is defined as an percentage of participants at board meetings out of the total amount of directors and its purpose is to control the analysis of meeting frequency. Board independence is a percentage of independent directors out of the total amount of directors, while "An independent director is not an employee, former executive, or relative of a current corporate executive of the company, and does not have substantial business relationships with the company, either personally or through his or her main employer" (Cheng, 2008). Board independence has been employed due to limit its effects on board dynamics (e.g., Hermalin & Weisbach, 1991; Yermack, 1996). These attributes have been collected from the Eikon added by some observations from the Boardex.

CEO ownership is defined as a share of the outstanding shares owned by the CEO. As CEO power has been found to have various effects on performance variability, Cheng (2008) has sought to limit its effect by adding CEO ownership to his model. Even if there is no direct database for CEO ownership in the Nordics available, I tried to gather the information manually from the public site named Market Screener.com[1]. I managed to collect only the most recent information about CEO ownership, which thus makes it the most uncertain attribute of my analysis. However, my analysis remains robust also when excluding CEO ownership.

Table 1

On this table, I present the corporate governance attributes of my regression models, divided into four categories as suggested by Zahra & Pearce (1989). Visualized by Hirvelä (2019, p. 7).

Category	Variable
Composition	Board Size
Characteristics	Board Independence
Structure	CEO Ownership
Process	Number of Board Meetings, Board Meeting Attendance

[1] Direct URL: https://www.marketscreener.com

In addition, like Cheng (2008), I use the following self-explanatory variables to control the effect of firm characteristics on performance variability: 1. *natural logarithm of total assets* 2. *capital expenditures scaled by sales* 3. *total debt scaled by total assets* 4. *years from IPO*. All of these variables, excluding few manually collected observations, are from the Eikon. Although "Years from IPO" is not a direct substitute for company age, in the absence of a better substitute, I use it to exclude the potential negative impact of firm age on performance variability. Both Cheng (2008) and Vafea (1999) are using the number of firm's business segments in their models to limit its possible negative effect on performance variability, but unfortunately, I had to leave this variable off and take this into account as a part of my analysis.

Similar to Cheng (2008) and Yermack (1996), I have also included ROA values from current (t) and prior (t-1) years as ROA has a large impact on performance levels and thus to the level of performance variability (Cheng, 2008). Finally, such as Cheng (2008), I use *industry dummy variables* to remove the fixed effects of different performance behaviors specific to certain industries. I have formed industry dummies using two-digit NAICS industry classifications.

Table 2

Summary statistics of independent and dependent variables
The sample consists of 206 firms with at least one observation of Board size and Number of annual board meetings from the Thomson Reuters and BoardEx databases over 2015-2019, with 1,002 annual observations for ROA and Tobin's Q as well as 11,905 monthly observations for the monthly stock returns. Financial firms with NAICS two-digit industry code of 52 are excluded. Financial items, stock returns, corporate govemance items and other firm characteristics, excluding CEO ownership, are from Thomson Reuters Eikon, complemented by BoardEx. CEO ownership is the CEO's share of the outstanding shares and it has been collected manually from the MarketScreener service. Return on assets (ROA) is net income (loss) divided by the average book value of assets during the fiscal year. Tobin's Q is the book value of debt plus the market value of equity, divided by the book value of assets. Board size is the amount of directors on the board. Number of board meetings is the amount of annual board meetings of the board of directors. Board meeting attendance is average percentage of Board meeting participants at Board meetings out of the total number of Board members. "An independent director is not an employee, former executive, or relative of a current corporate executive of the company, and does not have substantial business relationships with the company, either personally or through his or her main employer" (Cheng, 2008). Years from IPO is the number of full years since the initial public offering of company according to Eikon (with 114 being as a maximum amount of years). The other variables are self-explanatory.

Variable	n	Mean	St.Dev	Min	Q1	Median	Q3	Max
Measures of performance								
Monthly Stock Return	11,905	0.013	0.013	-0.054	0.007	0.013	0.019	0.059
Tobin's Q	1,002	1.99	2.09	0.47	0.92	1.23	2.06	12.25
ROA	1,002	0.066	0.097	-0.40	0.032	0.058	0.093	0.428
Covernance Variables								
Board Size	651	8.40	2.11	4	7	8	9.83	15.83
Number of Board Meetings	626	11.42	4.04	5	9	10.4	13	26
%-Board Meeting Attendance	580	94.4	4.8	71.4	92.5	95.5	97.5	1
%-Board Independence	651	64.5	20.0	0	53.9	63.6	80.0	1
%-CEO ownership	205	0.98	5.07	0	0.0002	0.028	0.12	55.5
Company Characteristics								
Assets (MEUR)	1,002	5,271.05	10,759.59	40.31	747.73	2,019.82	5,475.39	111,188.60
Capital Expenditures/Sales	1,002	0.11	0.30	0.04	0.02	0.04	0.09	3.34
Total Debt/Assets	1,002	0.24	0.15	0	0.13	0.23	0.32	0.80
Years from IPO	1,002	26.86	29.93	2	9	19	30	114

4. Empirical model

My analysis follows the methodology suggested firstly by Adams et al. (2005), which employs ordinary least squares (OLS) regression describing within-firm, over-time variability of corporate performance, while using control variables described in Section 3 to limit the cross-sectional effects on the analysis (e.g., Boone et al., 2007). All of the t-statistics will be presented as the Huber-White robust standard errors to control the heteroskedasticity.[2] My empirical model ("Model 1") replicates the model used by Cheng (2008) added by the number of board meetings and board meeting attendance. Model 1 is as follows:

$$
\begin{aligned}
&Standard\ deviation\ of\ monthly\ stock\ return, annual\ return\ on\ assets\ (ROA)\ or\ annual\ Tobin's\ Q \\
&= a_0 + a_1 \ln(Board\ size) && + a_7 ROA\ (prior\ year) \\
&+ a_2 Number\ of\ board\ meetings && + a_8 \ln(Total\ assets) \\
&+ a_3 Board\ meeting\ attendance && + a_9 Capital\ expenditures\ scaled\ by\ sales \\
&+ a_4 Board\ independence && + a_{10} Total\ debt\ scaled\ by\ Total\ assets \\
&+ a_5 CEO\ ownership && + a_{11} Years\ from\ IPO \\
&+ a_6 ROA\ (current\ year) && + industry\ dummies\ +\ errors
\end{aligned}
$$

Similar to Cheng (2008), all the variables have been averaged over 2015-2019, so Model 1 has only one observation for each firm.

Finally, before going through my empirical results, I will follow Boone et al. (2007) and Hirvelä (2019) and check the pairwise correlations between the selected variables by creating a pairwise correlation matrix. By this, I ensure that my variables are not too correlated with each other and thus are analyzable with sensitive OLS regression.

The results are shown in Table 3. For example, board size correlates positively (0.290) with assets and negatively (-0.240) with board independence and (-0.249) years from IPO. The correlation between board size and assets can be expected, as a larger firm often also has a larger board. The number of board meetings and board size correlates positively (0.176), which may be explained by the increased need for larger board communication. Total debt divided by assets correlates negatively with CEO ownership (-0.131) and positively (0.198) with capital

[2] See Eicker (1967), Huber (1967) and White (1980).

expenditures divided by sales. The former may be due to increased management incentives to lower the risk as the risk carried by CEO increases, while the latter may be due to the increased need for debt financing due to investments. As expected, all dependent variables describing performance as well as lagged ROA values correlate positively with each other. However, the key correlations are not alarmingly large and do not pose an obstacle to further analysis.

Table 3

Summary of Pairwise correlations.
This table shows the pairwise correlations between variables used in the further empirical analyses over the period of 2015-2019. Tobin's Q is the book value of debt plus the market value of equity, divided by the book value of assets. Return on assets (ROA) is net income (loss) divided by the average book value of assets during the fiscal year. ROAt is the last reported ROA of each firm. ROAt-1 is one year lagged value of ROAt. Board size is the amount of directors on the board. Number of board meetings is the amount of annual board meetings of the board of directors. Board meeting attendance is average percentage of Board meeting participants at Board meetings out of the total number of Board members. Board independence is a percentage of independent directors out of the total amount of directors on the board. "An independent director is not an employee, former executive, or relative of a current corporate executive of the company, and does not have substantial business relationships with the company, either personally or through his or her main employer" (Cheng, 2008). CEO ownership is the CEO's share of the outstanding shares. Assets is the book value of total assets. Years from IPO is the number of full years from IPO (with 114 being as a maximum amount of years). The other variables are self-explanatory.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Monthly Stock Return	*1*													
2. Tobin's Q	*0.478*	*1*												
3. ROA	*0.528*	*0.532*	*1*											
4. ROA t	*0.399*	*0.376*	*0.686*	*1*										
5. ROA t-1	*0.322*	*0.372*	*0.799*	*0.654*	*1*									
6. Board Size	*-0.250*	*-0.141*	*-0.131*	*-0.042*	*0.086*	*1*								
7. Number of Board Meetings	*-0.050*	*0.026*	*-0.235*	*-0.012*	*-0.200*	*0.176*	*1*							
8. %-Board Meeting Attendance	*-0.080*	*-0.044*	*-0.024*	*0.126*	*0.041*	*-0.053*	*-0.068*	*1*						
9. %-Board Independence	*0.048*	*0.061*	*0.068*	*0.028*	*-0.015*	*-0.240*	*0.244*	*0.239*	*1*					
10. %-CEO ownership	*0.060*	*0.005*	*-0.027*	*-0.292*	*0.046*	*-0.195*	*-0.052*	*0.120*	*0.080*	*1*				
11. Assets (MEUR)	*-0.093*	*-0.027*	*-0.073*	*0.076*	*0.034*	*0.290*	*-0.053*	*0.105*	*-0.139*	*-0.142*	*1*			
12. Capital Expenditures/Sales	*0.141*	*0.035*	*-0.071*	*0.011*	*0.096*	*0.066*	*-0.053*	*0.046*	*-0.015*	*-0.003*	*0.067*	*1*		
13. Total Debt/Assets	*-0.149*	*-0.356*	*-0.176*	*-0.038*	*-0.090*	*0.073*	*0.062*	*-0.015*	*0.020*	*-0.131*	*0.056*	*0.198*	*1*	
14. Years from IPO	*-0.182*	*-0.107*	*-0.057*	*0.000*	*0.006*	*-0.249*	*-0.092*	*0.049*	*-0.077*	*-0.0878*	*0.302*	*-0.059*	*0.087*	*1*

5. Empirical results

Table 4 shows the estimates of Model 1 according to a dependent variable, with the estimates in regressions (1) - (3) explaining over-time, within-firm performance variability during 2015-2019 and in regressions (4) - (6) explaining over-time, within-firm variability of unpredictable performance[3]. Both constant terms as well as industry dummies are included in the regressions, although not reported.

To further analyze the results of my regression, I recall my first hypothesis: *"The number of board members on the board of directors is negatively correlated with the variability of corporate performance."* As shown in Table 4, my model did not find any statistically

[3] See Sectio 4: "Empirical model".

significant relationship between Board size and performance variability, so I cannot reject the null hypothesis of uncorrelation. However, my results are largely in line with my hypothesis as well as Cheng's (2008) findings. Admittedly, there is also a statistically insignificant positive correlation between the variability of Tobin's Q and board size, which is the opposite of my hypothesis and Cheng's (2008) observations. It should be noted, however, that my model is clearly the weakest able to explain the scatter of Tobin's Q (adjusted $R^2 = 0.32$).

Although the results are not significant, I will quickly review the economic significance of the results as if they were. First, if the board size would increase by one standard deviation, i.e. 2.11[4], it would mean a 0.234 change in ln(Board size) for a board of the median size of eight directors. Ceteris paribus, this would mean, according to column (2) of the model, that the standard deviation of ROA would decrease by $-0.00237\ x\ 0.234 = -0.0017$, corresponding to a decrease of 4.8% (8.3%) from the mean of sample standard deviations of 0.037 (median 0.021). This would be relatively large economical result, but as estimators are not significant, the real link between board size and the variability of firm performance remains to be explored at the Nordic level in the post-financial crisis period.

However, I found statistically significant evidence to support my second hypothesis, which was: *"The number of annual board meetings of the board of directors is positively correlated with the variability of corporate performance."* As Table 4 shows, I found a positive correlation at the 1% significance level with the standard deviation of the monthly stock return and at the 5% level with the standard deviation of ROA, but only insignificant positive correlation with the standard deviation of Tobin's Q. Based on these findings, I can reject the null hypothesis of uncorrelation with monthly stock return and ROA. The findings are also consistent when estimating unpredictable performance variability shown in columns (4) - (6), which supports the robustness of my analysis. The findings are economically significant as, assuming no endogeneity[5], by increasing the number of board meetings by one standard deviation, i.e. 4.04, the standard deviation of monthly stock return would increase by $0.00155\ x\ 4.04 = 0.0068$, corresponding to an increase of 7,7% (8.2%) from the mean of sample standard deviations of 0.089 (median 0.083).

[4] See Table 2.
[5] Probably a weak assumption, discussed in Section 2.4 and tested in Section 6.2.

The model also shows several expected correlations at significant statistical levels, the strongest of which is the negative correlation between *assets* and standard deviation of each performance variable. This is expected, as large companies are often more mature and thus more stable. Further, even if the absolute changes in performance can be large, they are often small in relative terms. Finally, assets may also capture some of the decline in variability caused by the diversification of a firm, which Cheng (2008) models using the *number of business segments*.[6] Secondly, *CEO ownership* appears to correlate positively with variability, as

Table 4

Summary of the variability of corporate performance
This table presents the results of the Model 1 regression describing how the board size and meeting frequency explain the within-firm, over-time standard deviations of the Monthly stock return, Return on assets (ROA) and Tobin's Q from 2015 to 2019. The sample consists of 206 Nordic firms from the Thomson Reuters and BoardEx databases over 2015-2019, with 1,002 annual observations for ROA and Tobin's Q as well as 11,905 monthly observations for the monthly stock returns. Return on assets (ROA) is net income (loss) divided by the average book value of assets during the fiscal year. Tobin's Q is the book value of debt plus the market value of equity, divided by the book value of assets. Board size is the amount of directors on the board. Number of board meetings is the amount of annual board meetings of the board of directors. Board meeting attendance is average percentage of Board meeting participants at Board meetings out of the total number of Board members. Assets is the book value of total assets. Years from IPO is the number of full years since the initial public offering of company according to Eikon (with 114 being as a maximum amount of years). The other variables are self-explanatory. The Market-adjusted monthly stock return is calculated as the difference between sample firm's monthly stock return and the monthly return of the market capitalization weighted Nasdaq OMX Nordic 120 Index. The Industry-adjusted ROA is the difference between sample firm's annual ROA and the annual average ROA among the firms with the same two-digit NAICS industry code using all of the Nordic companies provided by Thomson Reuters Eikon. The Industry-adjusted Tobin's Q is defined in the same way as Industry-adjusted ROA. The independent variables are period means on a firm level. Robust t-statistics indicated as *, ** , and *** responding the 10%, 5%, and 1% significance levels. Constant term is not presented.

Dependent variable	Standard deviation of monthly stock return	Standard deviation of ROA	Standard deviation of Tobin's Q	Standard deviation of Market-adjusted monthly stock return	Standard deviation of industry-adjusted ROA	Standard deviation of industry-adjusted Tobin's Q
Independent variable	(1)	(2)	(3)	(4)	(5)	(6)
Ln(Board size)	-0.00538	-0.00237	0.29024	-0.00570	-0.00243	0.2591
	[0.0099]	*[0.0157]*	*[0.3066]*	*[0.0097]*	*[0.0142]*	*[0.2447]*
Number of board meetings	0.00155***	0.00198**	0.02996	0.00231***	0.00286**	0.03712
	[0.0005]	*[0.0008]*	*[0.0154]*	*[0.0005]*	*[0.0011]*	*[0.0149]*
Board independence	-0.00374	-0.00474	0.34024	-0.00874	-0.00875	0.1416
	[0.0105]	*[0.0016]*	*[0.3355]*	*[0.0103]*	*[0.0151]*	*[0.3167]*
Board meeting attendance	0.00015	-0.00012	0.00408	0.00023	0.00008	0.0081
	[0.0004]	*[0.0006]*	*[0.0126]*	*[0.0004]*	*[0.0006]*	*[0.0123]*
CEO ownership	0.0457**	0.1181*	0.5150	0.0553***	0.1075**	0.3911
	[0.0199]	*[0.0605]*	*[1.1577]*	*[0.0122]*	*[0.0516]*	*[1.126]*
ROA t	-0.0243	0.2863***	0.8078	-0.0276	0.2886***	-0.07892
	[0.0238]	*[0.0375]*	*[0.7355]*	*[0.0233]*	*[0.0341]*	*[0.7154]*
ROA t-1	-0.0465**	-0.3468***	0.4412	-0.0414	-0.3530***	-0.6893
	[0.0216]	*[0.0376]*	*[0.6674]*	*[0.0211]*	*[0.0309]*	*[0.6492]*
Ln(Assets)	-0.0112***	-0.00934**	-0.3012***	-0.0108***	-0.0071***	-0.2574***
	[0.0018]	*[0.0028]*	*[0.0566]*	*[0.0000]*	*[0.0026]*	*[0.0550]*
Capital expenditures/sales	0.0142**	0.0273*	0.3683*	0.01507**	0.02437*	0.3211
	[0.0070]	*[0.0110]*	*[0.2153]*	*[0.0007]*	*[0.0100]*	*[0.2094]*
Total debt/assets	0.0206	-0.0526*	-1.9630***	-0.0213	-0.0359	-1.651***
	[0.0150]	*[0.0237]*	*[0.4636]*	*[0.0148]*	*[0.0215]*	*[0.4509]*
Years from IPO	0.00006	0.00003	0.0013	0.00001	-0.0000	0.0012
	[0.0000]	*[0.0001]*	*[0.0023]*	*[0.0000]*	*[0.0001]*	*[0.0022]*
Fixed effects included	Industry	Industry	Industry	Industry	Industry	Industry
Sample size	206	206	206	206	206	206
R^2	0.50	0.50	0.41	0.52	0.56	0.45
Adjusted R^2	0.42	0.42	0.32	0.44	0.49	0.37

[6] See Section 4: "Empirical model".

regression (3) generates CEO ownership coefficient of 0.0553 at 1% significance level, while regressions (1), (4) and (2) generate coefficients of 0.046, 0.108 and 0.118 at levels of 5%, 5% and 10%, respectively. Thirdly, *capital expenditures scaled by sales*, as expected, correlates positively at 10% level with the standard deviations of monthly stock return and ROA. Capital expenditures are often associated with growth investment, strategy changes and acquisitions that are likely to be related to performance variability (e.g., Gompers, Ishii, & Metrick, 2003).

6. Deeper analysis of the results and robustness checks

In this section, I will test if my findings change under the different assumptions using stock return and ROA as main dependent variables. Robustness checks also provide more visibility into the relation of meeting frequency and performance variability. Further, I will conduct all the methods by including board size as an independent variable to detect possible findings.

6.1 More specified relation of meeting frequency and performance variability

To further examine the correlation between meeting frequency and performance variability, inspired by Guest (2009) and Hirvelä (2019), I have performed regressions using board size and the number of board meetings as dummy variables, thereby detecting specified correlations between performance variability and each number of board meetings and directors. Since Model 1 is ran using averaged values, I have rounded each value to the nearest whole number to create categories for dummies[7]. In addition, I have combined the largest categories into centralized categories due to small sample sizes.[8] The results of my regressions are shown in Appenix 1.

As Appendix 1 presents, meeting frequency is by far the most correlated with performance variability when the number of annual meetings exceeds 20, while the mean (median) value for the entire sample is 11.42 (10.4). The coefficient of 20-26 meetings with standard deviation of monthly stock return is 0.0394 at the 1% significance level and with standard deviation of ROA 0.0458 at the 5% level, while the coefficients of 15-19 meetings are only 0.0142 at the 10% level and -0.0001 at the insignificant level, respectively. In addition, regression A1 shows almost linear relation that the smaller the number of meetings, the lower the test coefficient. Although standard deviation does not take a position on the level of performance, observations

[7] Same way as in Section 3.3.
[8] See Figures 1 and 2 to see samples.

are consistent with Jensen's (1993) theory that the abnormal number of board meetings acts as a fire-fighting mechanism. All in all, these regressions are consistent with my previous analysis of significantly negative correlation.

To even further observe the nature between meeting frequency and performance variability, I have run regressions similar to Model 1, with the difference that the number of board meetings is changed to the standard deviation of annual board meetings. This dropped my sample size from 206 to 122 due to the lack of firms with two or more useful observations. As my results in Appendix 2 show, variability of board meeting frequency is positively related to performance variability at 5% significance level. These observations continue Jensen's (1993) and Vafeas' (1999) suggestions of board meeting frequency being as an active tool of corporate governance, by suggesting that it is more actively used under the volatile conditions.

Although I did not find any significant relationship between board size and performance variability in my main empirical analysis, there is a significant coefficient for certain board sizes according to Appendix 1. Results show that the most statistically and economically significant coefficients are the board sizes 6, 7, and 8, with significant coefficients ranging from -0.0197 to -0.0409 with significant levels from 1% to 5%. In my sample, the mean (median) board size is 8.4 (8), so these results are not consistent with my hypothesis or prior literature (Cheng, 2008) that the larger board size means less performance variability.

6.2 Problem of endogeneity in corporate governance studies

As discussed in Section 2.1.4, one of the major challenges in the corporate governance literature is the problem of endogeneity. As Cheng (2008), I have tried to detect if endogeneity exists in my model by switching the definitions of corporate governance variables. In Model 1, independent variables were averaged between 2015 and 2019, but Appenix 3 presents the results of regressions, which define the corporate governance attributes in three different ways.

Firstly, regressions C1 - C2 have been run using means of corporate governance attributes from 2010 to 2014, i.e. up to five years before my actual sample period. Secondly, regressions C3 - C4 have been run using the first observation of each firm from 2015 to 2017, thus omitting the firms having corporate governance data available only for the years 2018 or 2019. The last two regressions, C5-C6 have been run using the last possible observations of corporate governance

attributes from 2018 to 2019, excluding firms having no data for either year. In addition, no CEO ownership have been included in regressions C1 - C4 due to the lack of time series data.

As Appendix 3 shows, endogeneity probably drives my empirical results strongly, as only the regressions C5 - C6 provide significant evidence for the relationship between board meeting frequency and performance variability. Although this underscores the problem of endogeneity, it supports Vafea's (1999) findings on the association between poor performance and meeting frequency, as often low success brings high levels of volatility. Like Vafea, I lean on the theory that board meeting activity responds strongly to past performance and not vice versa. However, also coefficients in regressions C1 - C4 are positive, although insignificant.

However, I would like to underline the limitations of regressions C1 - C4 arising especially from a possible sampling error. This is because the possibility of sampling error is very significant when the sample is limited to only 91 companies covering the whole Nordics. For example, in regressions C1 - C2, the sample mean (median) standard deviation of the monthly stock returns decreased by 7% (10.7%) from that of Model 1, indicating a significant change in the nature of the sample. Although it is dangerous to draw very strong conclusions from these regressions, they still provide important insights into the dynamics of my model and the sample in general.

6.3 Sample selection bias

Since my limited sample is very likely exposed to selection bias, I find it important to try to identify potential issues. Because I am unable to add more companies to my sample due to slightly relaxed requirements already with Model 1, I am thus unable to perform, for example, Heckman's (1977) two-stage method used by Cheng (2008). However, following Cheng, I have divided my sample into three categories based on market capitalizations: 1. the smallest 50% (regressions D1 - D2) 2. from 20^{th} to 80^{th} percentile (regressions D3 - D4) 3. the largest 50% (regressions D5 - D6). In his own paper, Cheng (2008) has used as a distinguishing principle whether a company is part of the S&P500 index or not. The results of my regressions are shown in Appendix 4.

As Appenix 4 shows, the results are mainly in line with the findings in Model 1. The number of board meetings coefficient is significant at the 1% level in regressions D1, D2, and D5, and at the 5% level in regression D4. The weakest levels of significance are observed for D3 (at

10% level) and especially for D6 regressions (insignificant), both of which are formed using a sample consisting of the largest firms. In addition, regressions D3 and D6 are also by far the weakest to explain the dependent variable (adjusted R-squared = 0.17 and 0.30). All the number of board meetings coefficients are positive, ranging from 0.004 - 0.0009. In addition, there is no significant relationship between board size and performance variability.

The results alleviate my concern about the severe sample selection bias, as five of the six regressions are in line with previous observations at significant levels of 1% - 10%. As my sample focuses on large Nordic companies reporting data to international data providers, is it especially encouraging to see the smallest companies of my sample giving significant results. However, I would like to underline the relatively small sample sizes (125 or 103 depending on the regression) and the resulting lower quality of modeling. For this reason, the regression of D2 and D5 has been done using a slightly larger sample (125).

Finally, I would like to highlight the problems created by a possible survivorship bias, which arises from the fact that my sample consists only of companies being still active in January 2020. However, even if I have not been able to collect the needed data to alleviate this problem, it probably is not as a major problem when studying the *variability* of performance compared to the *level* of performance, although missing firms could provide more evidence of how they have responded to volatility brought by, for example, poor performance.

6.4 Additional sensitivity checks

To further ensure the robustness of my analysis, I have taken additional sensitivity tests inspired by Cheng (2008) to make sure my empirical findings are robust to various factors. I divide these tests into two sections: 1. sensitivity to outliners 2. sensitivity to control variables

Firstly, I have limited the effect of outliners by changing the definition of independent variables. Similar to Cheng (2998), I have changed the definitions of all the independent variables from period means to period medians, since medians are more robust under the influence of significant outliners in time series. The results of my model are shown in Appendix 5, which shows that results are similar to Model 1. The number of board meetings coefficient is positive at a significant level of 1% with the standard deviation of monthly stock returns (E1) and at a level of 5% with the standard deviation of ROA (E2). However, there is still no significant

evidence for the relationship with Tobin's Q. In addition, no significant evidence was found between board size and performance variability.

Secondly, I have run regressions with four different combinations of independent variables, using the standard deviations of both monthly stock return (Appendix 6) and ROA (Appendix 7) as dependent variables. Regressions F1 and G1 have been conducted by adding two variables related to board, average board member compensation and board member term duration and two related to CEO, CEO board member and CEO compensation linked to TSR. The CEO board member is a dummy variable reflecting whether CEO is a board member or not. CEO compensation linked to TSR is also a dummy variable reflecting whether CEO's compensation is linked in total shareholder return ("TSR"). My observations remain robust to these additions.

Further, I have run regressions F2 and G2 by excluding all other governance variables than number of board meetings, which coefficient is positive at 1% significance level. Regressions F3 and G4 have been run by including all governance variables from the regressions F1 and G1 but excluding variables capital expenditures scaled by sales, total debt scaled by assets and years from IPO from both regressions and ROA variables only from regression G3. My results remain robust to these changes as well.

Finally, I excluded all the governance attributes with the most limited availability from regressions F4 and G4 leaving only board size and board independence. By this, I was able to raise sample size to 297 firms and test once again the relationship between board size and performance variability, although finding no significant evidence to support my first hypothesis. Overall, my results remain robust to all these assumptions and setups, when corporate performance is described by the standard deviations of monthly stock returns or ROA.

7. Conclusion

In this thesis, I have analyzed how the board size and the meeting frequency correlate with the within-firm, over-time variability of corporate performance using mainly a sample of 206 Nordic companies during 2015-2019. My two hypotheses were that the board size correlates negatively and the board meeting frequency positively with the variability of corporate performance, basing my hypothesis on previous literature either directly (Cheng, 2008) or indirectly (e.g., Vafea, 1999). Following the prior literature, I have defined corporate performance in three ways; as monthly stock return, return on assets (ROA) and Tobin's Q. By

this, I have covered a broad range variability related to market value of equity, accounting profitability and corporate value.

Based on my empirical model, I did not find any significant evidence to support my first hypothesis on the negative relation between board size and performance variability. However, I found a significant and robust evidence of positive relation between board meeting frequency and performance variability measured by monthly stock return or ROA, which is in line with my hypothesis. Regarding the standard deviation of Tobin's Q, I find only insignificant evidence. My further analysis indicates that the relation between board meeting frequency and performance variability is strongest with exceptionally high numbers of annual board meetings. Secondly, I observed that also the standard deviation of board meeting frequency is positively correlated with performance variability. Finally, I found a strong evidence that the board meeting frequency is more likely to determine endogenously by reacting to historical performance variability, not vice versa. These findings concern the Nordic region.

My findings suggest that increasing the board meeting frequency is likely to be a widely used mechanism of corporate governance in the Nordic countries to respond to a company's volatile situation, especially in terms of volatile stock returns. This suggestion contributes to prior literature, which has suggested that board meeting frequency is a quick as well as a cost-effective way to respond to a poor, yet often volatile, performance (Vafeas, 1999). Supported by prior literature, my findings also suggest that meeting frequency is most likely an active means of governance especially when used in abnormal amounts under volatile conditions. All in all, my findings provide new insight into the board processes in a highly interesting post-financial crisis Nordic environment, where boards are strongly involved in the management of the companies in international comparison.

To conclude, my findings provide more basis for future research on a board of directors. First, more comprehensive data would make it possible to examine the effectiveness of board meeting frequency as a tool of responding to performance variability, possibly anticipating more stable future development in the longer term, i.e., calming the situation. Second, it could be fruitful to observe how other management bodies change their operations in highly volatile circumstances, and to compare the effectiveness and the cost of these changes in relation to the change in board meeting frequency. Finally, as the relation between board size and performance variability could not be significantly established, it leaves room for future research to continue the research with broader and higher quality data.

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Appendixes

Appendix 1.

Summary of OLS regressions using Board size and Number of board meetings as dummy variables
This table shows the results of the regressions describing how the board size and meeting frequency explain the within-firm, over-time standard deviations of the Monthly stock return and Return on assets (ROA) from 2015 to 2019 using dummy variables to categorize different amounts of directors and annual board meetings. The independent variables are period means on a firm level. Board size and Number of board meetings have been rounded to the nearest whole number at firm level. Robust t-statistics indicated as *, ** , and *** responding the 10%, 5%, and 1% significance levels. Constant term is not presented.

Dependent variable	Standard deviation of monthly stock return	Standard deviation of ROA			
Independent variable	A1	A2	Independent variable	A1 (continues)	A2 (continues)
Board size 4	-0.01299 *[0.0156]*	0.0111 *[0.0458]*	*Board meetings 8*	0.0067 *[0.0066]*	-0.0079 *[0.0105]*
Board size 5	0.0083 *[0.0109]*	0.0050 *[0.0215]*	*Board meetings 9*	0.0005 *[0.0071]*	0.0002 *[0.0113]*
Board size 6	-0.0197** *[0.0098]*	-0.0409** *[0.0172]*	*Board meetings 10*	0.0060 *[0.0069]*	-0.0084 *[0.0092]*
Board size 7	-0.0256*** *[0.00839]*	-0.0193 *[0.0170]*	*Board meetings 11*	0.0058 *[0.0071]*	-0.0016 *[0.0105]*
Board size 8	-0.0206** *[0.0088]*	-0.0316** *[0.0166]*	*Board meetings 12*	0.0176** *[0.0089]*	0.0089 *[0.0100]*
Board size 9	-0.0074 *[0.0082]*	-0.0205 *[0.0150]*	*Board meetings 13*	0.0195 *[0.0124]*	0.0120 *[0.0138]*
Board size 10-11	-0.0185** *[0.0072]*	-0.0169 *[0.0135]*	*Board meetings 14*	0.0158** *[0.0078]*	-0.0043 *[0.0109]*
Board size 12-17	-0.0086 *[0.0079]*	-0.0120 *[0.0132]*	*Board meetings 15-19*	0.0142* *[0.0084]*	-0.0001 *[0.0109]*
Board meetings 5	0.0146 *[0.0157]*	-0.0225 *[0.0191]*	*Board meetings 20-26*	0.0394*** *[0.0114]*	0.0458** *[0.0251]*
Board meetings 6	-0.0051 *[0.0089]*	-0.0052 *[0.0165]*	*Fixed effects included*	Industry	Industry
Board meetings 7	0.0067 *[0.0083]*	-0.0031 *[0.0121]*	*Sample size*	206	206
			R^2	0.58	0.57
			Adjusted R^2	0.47	0.45

Appendix 2.

Summary of OLS regressions using the standard deviation of number of annual board meetings
This table shows the results of the regressions describing how the board size and meeting frequency explain the within-firm, over-time standard deviations of the Monthly stock return and Return on assets (ROA) from 2015 to 2019 using the standard deviation of board meetings as a independent variable. The independent variables, excluding the standard deviation of number of annual board meetings, are period means on a firm level. Standard deviations are calculated over the sample period. Robust t-statistics indicated as *, ** , and *** responding the 10%, 5%, and 1% significance levels. Constant term is not presented.

Dependent variable	Standard deviation of monthly stock return	Standard deviation of ROA
Independent variable	B1	B2
Ln(Board size)	0.0139 *[0.0168]*	0.0292 *[0.0264]*
Standard deviation of number of annual board meetings	0.0032** *[0.0014]*	0.0045** *[0.0022]*
Board independence	0.0155 *[0.0183]*	0.0245 *[0.0313]*
Board meeting attendance	-0.0175 *[0.0732]*	-0.0726 *[0.1076]*
CEO ownership	0.1720 *[0.2405]*	-0.7651*** *[0.2017]*
ROA t	-0.0986* *[0.0593]*	0.3537*** *[0.1110]*
ROA t-1	-0.0644 *[0.0541]*	-0.4445*** *[0.1335]*
Ln(Assets)	-0.0114*** *[0.0033]*	-0.0136** *[0.0062]*
Capital expenditures/sales	0.0373* *[0.0200]*	0.0732*** *[0.0237]*
Total debt/assets	-0.0292 *[0.0214]*	-0.0643 *[0.0452]*
Years from IPO	0.0001 *[0.0000]*	0.0000 *[0.0000]*
Fixed effects included	Industry	Industry
Sample size	122	122
R^2	0.50	0.50
Adjusted R^2	0.39	0.38

Appendix 3.

Summary of the variability of corporate using different definitions for governance variables
This table shows the results of the regressions describing how the board size and meeting frequency explain the within-firm, over-time standard deviations of the Monthly stock return and Return on assets (ROA) from 2015 to 2019 using different definitions for governance variables. Corporate governance variables are defined as averaged values over 2010-2014 in regreesions C1 and C2, the first observable values of each firm between 2015-2017 in regressions C3 and C4 and the latest observable value between 2018-2019 in regressions C5 and C6. All other independent variables are period means on a firm level. Robust t-statistics indicated as *, ** , and *** responding the 10%, 5%, and 1% significance levels. Constant term is not presented.

Determination of governance variables	Mean 2010-2014		The First 2015-2017		The Latest 2018-2019	
Dependent variable	Standard deviation of monthly stock return	Standard deviation of ROA	Standard deviation of monthly stock return	Standard deviation of ROA	Standard deviation of monthly stock return	Standard deviation of ROA
Independent variable	C1	C2	C3	C4	C5	C6
Ln(Board size)	0.0222 *[0.0162]*	0.0330* *[0.0186]*	0.0273* *[0.0152]*	0.3125* *[0.0225]*	-0.0169 *[0.0094]*	-0.0195 *[0.0152]*
Number of board meetings	0.0011 *[0.0010]*	0.00072 *[0.0007]*	0.00052 *[0.0007]*	0.0008 *[0.0011]*	0.00144*** *[0.0004]*	0.0025*** *[0.0009]*
Board independence	0.0294 *[0.0228]*	0.00741 *[0.0262]*	0.0441** *[0.0202]*	-0.0472 *[0.0307]*	-0.0078 *[0.0085]*	-0.0120 *[0.0202]*
Board meeting attendance	0.0856 *[0.0789]*	0.00667 *[0.0903]*	-0.129** *[0.0619]*	0.0889 *[0.0851]*	0.0288 *[0.0257]*	0.0206 *[0.0546]*
CEO ownership					0.0374 *[0.0230]*	0.0036 *[0.0057]*
ROA t	-0.143*** *[0.0483]*	0.2638*** *[0.0684]*	-0.0578 *[0.0529]*	0.377** *[0.1144]*	-0.0127 *[0.0231]*	0.2861*** *[0.0547]*
ROA t-1	-0.004 *[0.0381]*	-0.321*** *[0.0845]*	-0.0116** *[0.0525]*	-0.5048*** *[0.1349]*	-0.0445 *[0.0237]*	-0.0344*** *[0.0663]*
Ln(Assets)	-0.0144*** *[0.00354]*	-0.0118*** *[0.0033]*	-0.0133*** *[0.0032]*	-0.0137* *[0.00611]*	-0.0093*** *[0.0019]*	-0.0075*** *[0.0027]*
Capital expenditures/sales	0.0276** *[0.0136]*	0.0376*** *[0.0097]*	0.0278* *[0.0148]*	0.0676*** *[0.0182]*	0.0230*** *[0.0094]*	0.0619** *[0.0246]*
Total debt/assets	-0.00213 *[0.0143]*	-0.0171 *[0.0209]*	-0.0141 *[0.0192]*	-0.0484 *[0.0457]*	-0.0371** *[0.0150]*	-0.0657** *[0.0315]*
Years from IPO	0.00002 *[0.0000]*	0.00003 *[0.0000]*	0.00003 *[0.0000]*	0.00001 *[0.0000]*	0.00005 *[0.0000]*	0.00004 *[0.0000]*
Fixed effects included	Industry	Industry	Industry	Industry	Industry	Industry
Sample size	91	91	110	110	202	202
R^2	0.51	0.52	0.56	0.51	0.49	0.50
Adjusted R^2	0.40	0.36	0.45	0.38	0.41	0.42

Appendix 4.

Summary of the variability of corporate performance using different samples
This table shows the results of the regressions describing how the board size and meeting frequency explain the within-firm, over-time standard deviations of the Monthly stock return and Return on assets (ROA) from 2015 to 2019 using different samples to illustrate possible selection biases. Samples in regreesions D1 and D4 consists of smallest 50% of companies included in original sample by market capitalization. Samples in regreesions D2 and 52 consists of companies included in original sample and being between 20th and 80th percentiles by market capitalization. Samples in regreesions D3 and D6 consists of largest 50% of companies included in original sample by market capitalization. The independent variables are period means on a firm level. Robust t-statistics indicated as *, ** , and *** responding the 10%, 5%, and 1% significance levels. Constant term is not presented.

Dependent variable	Standard deviation of monthly stock return			Standard deviation of ROA		
Sample by Market capitalization	The smallest 50%	From 20th to 80th percentiles	The largest 50%	Smallest 50%	From 20th to 80th percentiles	The largest 50%
Independent variable	D1	D2	D3	D4	D5	D6
Ln(Board size)	-0.0119 *[0.0088]*	0.0296 *[0.0104]*	0.0013 *[0.0088]*	-0.0079 *[0.0026]*	-0.0086 *[0.0187]*	0.0154 *[0.0179]*
Number of board meetings	0.0033*** *[0.0006]*	0.0031*** *[0.0006]*	0.0011* *[0.0006]*	0.00416** *[0.0020]*	0.0043*** *[0.0016]*	0.00098 *[0.0007]*
Board independence	0.0081 *[0.0104]*	0.0021 *[0.0101]*	-0.0099 *[0.0103]*	-0.0092 *[0.0238]*	-0.0183 *[0.0085]*	-0.0012 *[0.0159]*
Board meeting attendance	-0.0016 *[0.0351]*	0.0109 *[0.0431]*	0.0353 *[0.0351]*	-0.0394 *[0.0970]*	0.0364 *[0.0559]*	0.0632 *[0.0010]*
CEO ownership	-0.0154 *[0.0220]*	-0.0014 *[0.0037]*	0.0144 *[0.0230]*	-0.0091 *[0.0103]*	-0.0025 *[0.0076]*	-0.0076 *[0.0050]*
ROA t	-0.0202 *[0.0306]*	-0.0142 *[0.0234]*	-0.0251 *[0.0306]*	0.2928*** *[0.0602]*	0.2752*** *[0.0624]*	0.3126*** *[0.0956]*
ROA t-1	-0.0525** *[0.0245]*	-0.0503 *[0.0364]*	0.0439* *[0.0245]*	0.4089*** *[0.0644]*	-0.4000*** *[0.1014]*	-0.1563 *[0.1000]*
Ln(Assets)	-0.0067*** *[0.0021]*	-0.0126*** *[0.0034]*	-0.0054** *[0.0021]*	-0.0158*** *[0.0042]*	-0.0109 *[0.0070]*	0.0011 *[0.0030]*
Capital expenditures/sales	0.0274*** *[0.0312]*	0.0628* *[0.0251]*	0.0086*** *[0.0031]*	0.0599 *[0.0313]*	0.0749** *[0.0301]*	0.0061 *[0.0064]*
Total debt/assets	-0.0204 *[0.0114]*	-0.0086 *[0.0254]*	-0.0156 *[0.0114]*	-0.0339 *[0.0486]*	-0.0687 *[0.0572]*	0.0002 *[0.0202]*
Years from IPO	0.00022*** *[0.0000]*	0.0000 *[0.0000]*	0.00002 *[0.0000]*	0.00002 *[0.0003]*	0.0001 *[0.0001]*	-0.0000 *[0.0000]*
Fixed effects included	Industry	Industry	Industry	Industry	Industry	Industry
Sample size	103	125	103	103	125	103
R^2	0.54	0.55	0.35	0.65	0.63	0.46
Adjusted R^2	0.39	0.45	0.17	0.52	0.54	0.30

Appendix 5.

Summary of the variability of corporate performance variability using medians of variables
This table shows the results of the regressions describing how the board size and meeting frequency explain the within-firm, over-time standard deviations of the Monthly stock return, Return on assets (ROA) and Tobin's Q from 2015 to 2019. All independent variables are medians instead of means over the sample period. Robust t-statistics indicated as *, ** , and *** responding the 10%, 5%, and 1% significance levels. Constant term is not presented.

Dependent variable	Standard deviation of monthly stock return	Standard deviation of ROA	Standard deviation of Tobin's Q
Independent variable	E1	E2	E3
Ln(Board size)	-0.0066 *[0.0090]*	-0.0116 *[0.0155]*	0.1910 *[0.2146]*
Number of board meetings	0.0019*** *[0.0005]*	0.0027** *[0.0012]*	0.0338 *[0.0261]*
Board independence	-0.0030 *[0.0096]*	-0.00564 *[0.0162]*	0.3891* *[0.2187]*
Board meeting attendance	0.0274 *[0.0392]*	0.0111 *[0.0705]*	0.1562 *[0.9537]*
CEO ownership	0.245* *[0.0120]*	0.0046* *[0.0061]*	0.4135 *[0.4594]*
ROA t	-0.0336* *[0.0250]*	0.2747*** *[0.0548]*	0.7146 *[1.1519]*
ROA t-1	-0.0414 *[0.0226]*	-0.3367*** *[0.0650]*	0.5007 *[1.2410]*
Ln(Assets)	-0.0110*** *[0.0019]*	-0.0081*** *[0.0026]*	-0.2759*** *[0.0563]*
Capital expenditures/sales	0.0143** *[0.0067]*	0.0280* *[0.0296]*	0.3857* *[0.2128]*
Total debt/assets	-0.0164 *[0.0162]*	-0.0497* *[0.0296]*	-1.9107*** *[0.5920]*
Years from IPO	0.0006 *[0.0000]*	0.0000 *[0.0000]*	0.0013 *[0.0014]*
Fixed effects included	Industry	Industry	Industry
Sample size	206	206	206
R^2	0.54	0.55	0.40
Adjusted R^2	0.39	0.45	0.31

Appendix 6.

Summary of four OLS regressions on the variability of monthly stock return
This table presents the results of the Model 1 regression describing how the board size and meeting frequency explain the within-firm, over-time standard deviations of the Monthly stock return from 2015 to 2019 using four different sets of independent variables. Four new governance variables have been included in regression F1. CEO board member is a dummy variable, which defines wheter CEO is member of a board or not. CEO compensation linked to TSR is also a dummy variable reflecting whether CEO's compensation is linked in Total shareholder return ("TSR"). Regression F2 excludes all other governance variables than Number of borard meetings. Regression F3 excludes all corporate financial characteristicst except ln(Assets). Regression F4 excludes variables with more limited availability allowing to increase sample size when estimating relation between board size and performance variability one last time The independent variables are period means on a firm level. Robust t-statistics indicated as *, ** , and *** responding the 10%, 5%, and 1% significance levels. Constant term is not presented.

Dependent variable	Standard deviation of monthly stock return			
Independent variable	F1	F2	F3	F4
Ln(Board size)	-0.0131 *[0.0104]*		-0.0105 *[0.0104]*	0.0011 *[0.0095]*
Number of board meetings	0.0018*** *[0.0005]*	0.0020*** *[0.0005]*	0.0020*** *[0.0006]*	
Board independence	-0.0032 *[0.0098]*		-0.0074 *[0.0104]*	-0.0005 *[0.0087]*
Board meeting attendance	0.0111 *[0.0364]*		0.0301 *[0.0381]*	
Average board member compensation	-0.0000 *[0.0000]*		-0.0000 *[0.0000]*	
Board member term duration	-0.0031 *[0.0043]*		-0.0010 *[0.0046]*	
CEO ownership	0.0454** *[0.0178]*		0.0385** *[0.0190]*	
CEO board member	0.0053 *[0.0040]*		0.0042 *[0.0042]*	
CEO compensation linked to TSR	0.0070 *[0.0046]*		0.0048 *[0.0048]*	
ROA t	0.00080 *[0.0221]*	-0.0264 *[0.0232]*		-0.0620** *[0.0282]*
ROA t-1	-0.0475** *[0.0227]*	-0.0446** *[0.0221]*		-0.0365 *[0.0269]*
Ln(Assets)	-0.0108*** *[0.0019]*	-0.0111*** *[0.0013]*	-0.0113*** *[0.0019]*	-0.0114*** *[0.0019]*
Capital expenditures/sales	0.0184** *[0.0071]*	0.0146** *[0.0068]*		0.0085 *[0.0068]*
Total debt/assets	-0.0368** *[0.016]*	-0.0229 *[0.0152]*		0.0394** *[0.0184]*
Years from IPO	0.0000 *[0.0000]*	-0.0000 *[0.0000]*		0.00002 *[0.0000]*
Fixed effects included	Industry	Industry	Industry	Industry
Sample size	203	206	203	297
R^2	0.48	0.49	0.46	0.44
Adjusted R^2	0.39	0.43	0.38	0.40

Appendix 7.

Summary of four OLS regressions on the variability of Return on assets (ROA)
This table presents the results of the Model 1 regression describing how the board size and meeting frequency explain the within-firm, over-time standard deviations of the ROA from 2015 to 2019 using four different sets of independent variables. Four new governance variables have been included in regression G1. CEO board member is a dummy variable, which defines wheter CEO is member of a board or not. CEO compensation linked to TSR is also a dummy variable reflecting whether CEO's compensation is linked in Total shareholder return ("TSR"). Regression G2 excludes all other governance variables than Number of borard meetings. Regression G3 excludes all corporate financial characteristicst except ln(Assets), ROA t and ROA t-1. Regression G4 excludes variables with more limited availability allowing to increase sample size when estimating relation between board size and performance variability one last time. The independent variables are period means on a firm level. Robust t-statistics indicated as *, ** , and *** responding the 10%, 5%, and 1% significance levels. Constant term is not presented.

Dependent variable	Standard deviation of ROA			
Independent variable	G1	G2	G3	G4
Ln(Board size)	0.0067 *[0.0179]*		0.0111 *[0.0184]*	0.0306 *[0.0190]*
Number of board meetings	0.0024* *[0.0012]*	0.0043*** *[0.0016]*	0.0026* *[0.0013]*	
Board independence	0.0026 *[0.0195]*		-0.0041 *[0.0199]*	0.0101 *[0.0206]*
Board meeting attendance	-0.0214 *[0.0764]*		0.0095 *[0.0802]*	
Average board member compensation	0.0000 *[0.0000]*		0.0000 *[0.0000]*	
Board member term duration	0.0062 *[0.0056]*		0.0093 *[0.0060]*	
CEO ownership	0.1263* *[0.0653]*		0.1153* *[0.0672]*	
CEO board member	0.0070 *[0.0066]*		0.0049 *[0.0071]*	
CEO compensation linked to TSR	-0.0005 *[0.0052]*		-0.0041 *[0.0057]*	
ROA t	0.3083*** *[0.0455]*	0.2765*** *[0.0543]*	0.2932*** *[0.0438]*	0.0025 *[0.1291]*
ROA t-1	-0.3616*** *[0.0614]*	-0.3397*** *[0.0644]*	-0.3529*** *[0.0612]*	-0.0839 *[0.1568]*
Ln(Assets)	-0.0104*** *[0.0026]*	-0.0095*** *[0.0021]*	-0.0113*** *[0.0029]*	-0.0171*** *[0.0050]*
Capital expenditures/sales	0.0286* *[0.0164]*	0.0277* *[0.0152]*		0.0230* *[0.01338]*
Total debt/assets	-0.0627** *[0.0295]*	-0.0524* *[0.0285]*		-0.0152 *[0.0286]*
Years from IPO	0.0000 *[0.0000]*	0.0000 *[0.0000]*		0.0001 *[0.0001]*
Fixed effects included	Industry	Industry	Industry	Industry
Sample size	203	206	203	297
R^2	0.53	0.48	0.50	0.26
Adjusted R^2	0.45	0.42	0.41	0.20