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The Effect of Voluntary Environmental Disclosure on Firm Value

- A Study of Nordic Listed Firms

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Abstract

This paper empirically investigates the relationship between voluntary environmental disclosure and firm value. The analysis is based on a sample consisting of Nordic listed firms disclosing environmental information to the Carbon Disclosure Project in 2007 -2011. We investigate the impact of disclosure on firm value from both an accounting and a market perspective. We provide evidence of a significant, positive association between the level of voluntary environmental disclosure and Tobin's Q. Furthermore, we find that firms with improved disclosure from one year to the next experience abnormal excess return. Firms with stable or aggravated disclosure do not yield the same result. This implies that voluntary environmental disclosure is value-relevant for stakeholders, and has a positive impact on firm value.

Keywords: Carbon Disclosure Project, Voluntary Environmental Disclosure, Firm Value, Stock Returns, Tobin's Q, Fama/French Benchmark Factors

Preface

This paper concludes our major in financial economics at the Norwegian School of Economics. The project gave us an opportunity to work in depth on a topic of our choice over a full semester; a process which have been both challenging and rewarding.

Embarking on this thesis, we were motivated by the on-going debate on the value relevance of corporate social responsibility, and ended up examining the relation between voluntary disclosure of such activities and firm value. Settling on the final hypotheses was a long and dwelling process due to obstacles and uncertainties connected to obtaining data. Finding comparable measures for disclosure proved challenging, and we had to restrict our scope to only environmental disclosure. The subject of research is fairly new, and we hope that this thesis may provide insight in this relationship in the context of Nordic listed firms.

We would like to thank our supervisor Francisco Santos (NHH) for valuable comments and discussions. He has given us freedom and flexibility to define our own thesis and provided helpful guiding along the way. While thankful for all the help we have received, all remaining errors are our own.

This thesis is the final part of our Master of Science in Economics and Business Administration. We would like to take this opportunity to express gratitude for five outstanding years at NHH, and we want to thank friends and family for great support throughout the years.

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1. Introduction

The Nobel Peace Prize winner and former U.S. Vice President, Al Gore, claims that "integrating issues such as climate change into investment analysis is simply common sense". He is a leading advocate for sustainable capitalism; sustainable long-term value maximization through integrating environmental, social and governance issues into investment decisions (Generation Investment Management 2012). Al Gore calls it common sense, but is it so for all rational, wealth-maximizing investors? Does the management decision on whether to communicate environmental performance or not have an impact on the valuation of the firm?

In this paper we investigate the effects of voluntary environmental disclosure on the value of Nordic listed firms. Blowfield and Murray (2011) define corporate social reporting as accounting for non-financial aspects of a firm's performance, and extending the firm's accountability to a wide range of stakeholders within the society. Corporate social accounting consists of both environmental and social disclosure, and is a way for stakeholders to assess whether firm lives up to value expectations (Pruzan 2009). Non-financial disclosure allows investors to evaluate firms on ethical dimensions, compare performance and track development.

While third party organizations, like MSCI and Oecom, analyze and rank firms based on their social and environmental performance, it has become increasingly common for firms to initiate voluntary communication of their corporate social responsibility. According to the KPMG International Survey of Corporate Responsibility Reporting 2011, there is an increased willingness to report on corporate social issues amongst the largest companies across the globe. The emphasis on "softer" key performance indicators has increased, both as a result of government regulations and as a consequence of transformations in firm values.

The financial consequences of voluntary environmental disclosure are of potential interest for investors, firms and governments. For profit-maximizing investors, the impact of environmental disclosure is of value in investment analysis and in the decision between different investment strategies. Over the past years, there are indications of a shift in investor preferences. Sustainable capitalism, or social responsible investments, has gained momentum. The Carbon Disclosure Project (CDP) publishes Nordic reports on behalf of

signatory investors. Since the first publication in 2007, the number of signatory investors has increased from 315 with assets of US$41 trillion to 551 with assets of US$71 trillion (Carbon Disclosure Project 2007; 2011). Disclosure of social and environmental issues is an important factor when evaluating the sustainability of investment opportunities, and disclosure might affect the capital allocation of social responsible investors.

The financial effects of voluntary environmental disclosure are of interest to firms and managers in their strategic decision-making. Identifying the activities that affect the environmental performance of a firm is often costly, and firms with high environmental accounting have high corresponding disclosure costs. Disclosure can be an instrument in a differentiation strategy, aiming to develop a reputation of high environmental consciousness. The documentation of potential gains from voluntary environmental disclosure is value relevant to firms in their cost-benefit analyses, since firms will choose to disclose information until the marginal disclosure costs equals the marginal disclosure benefits (Orlitzky and Whelan 2007).

The effect of disclosure might affect government decisions. In 2010, The Norwegian Ministry of Finance presented a hearing proposal suggesting to implement requirements of social accounting for firms legally bound to maintain accounting records. Sweden and Denmark have already implemented similar regulations (KPMG 2011). If the potential benefit from environmental disclosure is greater than the subsequent costs, firms have an incentive to disclose environmental information voluntarily. Based on this incentive line of thought, one could argue that a documentation of financial benefits would lead to the need for less extensive government regulations on social accounting.

In our study, we examine the value effect of voluntary environmental disclosure on Nordic listed firms. These countries are examples of markets where there has been a striking rise in corporate social reporting the recent years (KPMG 2011). We restrict our focus to voluntary environmental disclosure, mainly because of limitations in available data on corporate social reporting. We base our measure of environmental disclosure on the carbon disclosure score given to firms reporting to the Carbon Disclosure Project[1]. This organization provides a

[1] Alternatively, we considered analysing corporate social reporting based on data from the Global Reporting Initiative (GRI). This would have allowed us to analyse corporate social reporting as a whole, but the data material is less extensive. In order to ensure the quality of our analysis, we choose to look at only environmental disclosure.

global standard for measurement and disclosure of information on climate change, and holds the largest collection of self-reported climate change data in the world (Carbon Disclosure Project, 2012).

To our knowledge, we are the first to investigate this topic in the Nordic capital markets. We use performance measures as proxies for firm value, and focus primarily on Tobin's Q and stock returns. Previous literature on the subject use other measures for firm value, like cost of capital or free cash flow (Plumlee et al. 2010; Clarkson et al. 2010; Dhaliwal et al. 2011). Our paper contributes to the area of research by looking at a different market and applying other firm value measures than earlier studies.

We look at the effects of different disclosure characteristics to analyze which aspects of voluntary environmental disclosure are relevant for valuation purposes. We do a preliminary test of the entire Nordic population to examine whether firms that initiate voluntary environmental disclosure experience higher firm value that the non-disclosing firms. We find a positive association between disclosure initiative and Tobin's Q, but due to endogeneity, the results suffer from estimation bias. To overcome the endogeneity problem, we include only disclosing firms in the regression sample. This enables us to test for firm value differences due to differences in disclosure policy.

Within the sample of firms reporting environmental information, we construct portfolios based on their disclosure characteristics. Using scores from the Carbon Disclosure Project, we assign the firms to an environmental disclosure index. From this index, we create three portfolios, and compare the firms with the highest, midrange and lowest levels of disclosure. To investigate the effect of changes in environmental disclosure, we create portfolios based on changes in the disclosure index. Firms are allocated to portfolios based on changes in disclosure score from last year, and we analyze differences among firms with improved, stable and aggravated disclosure.

In the first part of the analysis, we test how environmental disclosure is related to accounting measures. We use Tobin's Q as a valuation measure, and use proxies for environmental disclosure level as key independent variables. Regression results suggest that the level of disclosure is positively associated with firm value. We do not observe the same relation while looking at the impact of changes in disclosure level. In addition, we perform similar analyses with the operating measures ROE and ROA as dependent variables. On these

measures, the results of disclosure level effects are inconclusive, but we find an indication of a significant negative impact of disclosure change.

In the second part of the paper, we look at firm value from a market perspective, and investigate differences in stock returns between the constructed portfolios. We apply the three-factor model of Fama and French (1993); and then augment it with the momentum factor proposed by Carhart (1997). We understand that this is a joint test of the efficient market hypothesis and the value relevance of environmental disclosure. To be specific, the alpha in a strategy of going long in the high and selling short in the low portfolio is expected to be zero if markets are efficient, irrespective of the relevancy of disclosure policy. However, a positive alpha implies that disclosure is important for firm valuation, and that markets react slowly to this information.

First, we look at return differences between the portfolios based on level of disclosure. The results show that the quantity of disclosed information seems to be already incorporated in the market price. We find no evidence of a positive alpha in a strategy that buys the high disclosure portfolio and sells the low disclosure portfolio.

Finally, we look at the portfolios based on changes in disclosure level, and evaluate a strategy of buying the improvement portfolio and selling the aggravation portfolio. The improved disclosure portfolio experiences a higher alpha than the stable portfolio. The portfolio with aggravated disclosure experiences the poorest alpha of the three. This implies that improvements or aggravations in disclosure level appear to be relevant for firm valuation, but the market adjusts the stock price slowly. This finding indicates that firms benefit from improved environmental disclosure, in the form of higher stock returns.

The paper is structured as follows. Chapter 2 provides a review of the previous literature relevant for the topic. In chapter 3, we develop our hypotheses. Chapter 4 describes the dataset, research design and the methodology used in the empirical analysis. Chapter 5 presents the empirical findings from the hypotheses analysis. Chapter 6 provides a discussion of our results and findings, and in chapter 7 we will offer concluding remarks.

2. Literature review

The relationship between financial disclosure and firm value has been extensively analyzed in previous disclosure literature. Research on the impact of non-financial disclosure on firm value is less developed. With increasing focus on environmental and social consciousness and greater demand for documentation and reporting on these issues, the relationship between non-financial reporting and firm value is more relevant than ever.

Most previous literature on disclosure and firm valuation focuses on financial or mandatory disclosure (Healy and Palepu 2001; Leuz and Wysocki 2008). The consensus in most of this literature is that there is a negative association between increased disclosure and cost of capital. Assuming an inverse relationship between cost of capital and stock prices (Bodie et al. 2009), increased disclosure may lead to increased firm value. While economics-based models of disclosure establish a link between financial, mandatory reporting and subsequent economic effects, discretionary disclosure theories describe the relationship between voluntary disclosure and consequences of such activities (Verrecchia 2001). For the purpose of our thesis, we divide the relevant discretionary theories into two branches.

The first line of arguments presents models where firms are more likely to reveal favorable than unfavorable information to the market. The "good-news" theory of Verrecchia (1983) predicts managers to exercise discretion in disclosure decisions when investors have rational expectations about managerial actions. The decision to disclose or not is perceived as a signal indicating whether the information would have a positive or negative effect on the market price. A negative effect is either due to bad news or disclosure costs greater than the potential gains of disclosure. Managers decide the quantity of disclosed information based on predicted market reaction. This level of disclosure constitutes a disclosure threshold for the firm. Information above the threshold is withheld from the market. Investors are aware of the total information quantity possessed by the manager, but do not know the content. They will interpret the absence of disclosure as consistent with the information being above the disclosure threshold, signaling either bad news or high disclosure costs. Orlitzky and Whelan (2007) argue that the impact of signaling and transaction costs, as well as various other costs and benefits of disclosure, affect the disclosure quantity of the firm. They conclude that the level of social and environmental accounting should be set so that marginal costs of disclosure equal marginal benefits. Verrecchia (1983) predicts that firms with high potential

benefits connected to disclosure will disclose more information compared to firms with less potential benefits.

A second branch of discretionary disclosure literature suggests that that managers aim to create a reputation of providing credible disclosures, as a way to reduce market transaction costs (Healy and Palepu 2001). Theory on market liquidity proposes reduced information asymmetry as a potential benefit of increased disclosure. Uninformed investors may be less willing to trade in the stock market as a consequence of asymmetric information and adverse selection problems (Leuz and Wysocki 2008). Hence, disclosure decisions may affect capital allocation in the market. Reduced investor willingness to participate in market transactions may lead to market illiquidity and increased ask-bid spreads (Verrecchia 2001). Increased disclosure, more widespread information to investors, and publicity may increase the awareness and lead to an increased investor base for the firm (Merton 1987). This implies that the firm might benefit from investing resources in the improvement of quality or quantity of the disclosed information. Healy et al. (1999) find evidence that suggests increased voluntary firm disclosure to be linked to improved stock performance and increased stock liquidity. This line of literature suggests that firms should increase discretionary disclosure irrespective of good or bad news because such a policy will, with all other things held constant, increase firm value.

Disclosure of corporate social responsibility, and environmental responsibility as a subset of this, might affect financial performance through other channels than financial disclosure (Rodriguez et al. 2006). From a business perspective, theory suggests that CSR and environmental consciousness can be utilized to differentiate products and brands in competitive markets, and can be viewed as an investment in product differentiation (McWilliams and Siegel 2001). The disclosure of environmental activities can be a channel for communicating environmental commitment as a part of the differentiation strategy. Discretionary disclosure theory predicts voluntary disclosure reports to be used by high performing companies to distinguish themselves from low performing companies (Verrecchia 1983). Another channel of influence on financial performance is through investor preferences. Investors with high social awareness are willing to receive a lower rate of return on an investment in a social responsible firm (Richardson and Welker 2001).

Effects of disclosure are likely to affect the investment decisions of shareholders if the information disclosed is perceived as relevant to firm value. The literature examining the

effects of voluntary environmental disclosure on firm value is not conclusive on whether environmental information is value relevant for investors. Clarkson et al. (2008) divides previous literature within the field of environmental accounting research into three broad groups. The first group of studies examines the relevance of environmental performance information on firm valuation. The second category consists of studies that investigate the factors that affect managerial decisions on disclosure of environmental risks and opportunities. The last section of studies focuses on the relationship between firms' environmental performance and the level of environmental reporting and disclosure. We will mainly focus on literature from the first category in our literature review.

The earliest studies in this group of on environmental accounting research focus on specific events or liabilities, and subsequent impact on stock prices. Blacconiere and Patten (1994) examine the effects of a substantial chemical leak in India in 1984, and find evidence of a significant negative market reaction after the event. However, the reaction is mitigated for firms with more extensive environmental disclosures prior to the event, compared to other firms. Blacconiere and Northcut (1997) examine the relation between stock price changes due to the introduction of new environmental legislation in 1984 and environmental data of chemical firms. The study finds that firms with more comprehensive environmental reporting have an impaired negative stock price reaction to environmental regulation compared to less extensive disclosers. These studies differ from our study as they examine the effects of specific environmental events and mandatory disclosures on stock prices, but their findings document the existence of a relationship between environmental disclosure and firm valuation.

Yamashita et al. (1999) examines the rewards of environmental consciousness in the U.S. capital market. They reveal a positive, but insignificant effect on stock prices after the revelation of information on firm environmental consciousness. The study concludes that information on environmental performance does not appear to be very important for investors' short-term decisions in the capital markets. Al-Tuwaijri et al. (2004) find that environmental disclosure might reveal environmental practices which affect the financial performance of the firm, and thereby firm value. Clarkson et al. (2008) find a positive association between environmental performance and the level of social or environmental disclosure. Their analysis focuses on the rationale behind voluntary environmental disclosures, but does not answer whether or not non-financial disclosures have the intended valuation consequences.

Fisher-Vanden and Thorburn (2011) find announcements of commitment to reduce greenhouse gas emissions to be received negatively in the stock market. Firms experience significant negative abnormal stock returns as a consequence of such announcements, and their results show overall evidence of a conflict between environmental disclosure and firm value maximization. Dhaliwal et al. (2010) find that more stakeholder-oriented countries have stronger negative association between CSR reports and financial forecasts than countries with less matured CSR activities. They find evidence that firms' social performance has a greater likelihood of affecting the financial performance of the firm in stakeholder-oriented countries than in other countries. Al-Tuwaijri et al. (2004) provides a simultaneous equations approach to the relation between environmental disclosure, environmental performance and economic performance. The study reveals good environmental performers to disclose more than poor environmental performers, in accordance with discretionary disclosure theory on "good news".

Dhaliwal et al. (2011) look at the relation between voluntary corporate social disclosure and cost of capital, and investigate whether an initiation of voluntary disclosure is associated to a reduction in future cost of capital. They find that firms with a high prior year cost of capital are more likely to initiate voluntary disclosures of corporate social responsibility. The cost of capital reduction due to disclosure is superior for firms with high social performance, and firms that initiate voluntary disclosure appears to exploit the reduction benefit. These firms are more likely to raise capital after initiation, suggesting that corporate social disclosure has an impact on market capital allocation.

Richardson and Welker (2001) analyze the relationship between both financial and social disclosure and firms' cost of capital. In accordance with previous research, they find quantity and quality of financial disclosure to have a negative relation to cost of capital. Social disclosure behaves differently than expected and have an opposite effect. Results indicate a significant, positive relation between the level of social disclosure and cost of capital. Valuation models suggest an inverse relation between cost of capital and share price. Hence, their analysis implies that increased non-financial disclosure raises the firms cost of capital and lower share price (Richardson and Welker 2001).

Aerts et al. (2008) and Cormier and Magnan (2007) find evidence of an opposite relation between environmental disclosure and cost of capital in some contexts. Aerts et al. (2008) find that improved environmental disclosure translates into more precise analyst earnings

forecasts. This relation suggests a reduction in firms cost of capital and increased stock prices. They find the effect to vary according to industry, country and disclosure venue. The effect is mitigated in environmentally sensitive industries. Cormier and Magnan (2007) examine the relation between environmental disclosures and firm earnings and stock market value in country-specific settings. They base their study on environmental disclosures from Canada, France and Germany from 1992-1998. Their findings suggest that the decision to report environmental information is related to firm earnings and stock market valuation for German firms, but they fail to document a relation in France and Canada.

Two recent studies of direct relevance to our paper are Clarkson et al. (2010) and Plumlee et al. (2010). Clarkson et al. (2010) examine the impact of voluntary environmental disclosure on cost of capital and overall firm value. Their results show evidence of voluntary environmental disclosures being value relevant for investors in their assessment of future environmental risks and liabilities. They find a positive association between voluntary environmental disclosure and overall firm value, but fail to document an effect on cost of capital.

Plumlee et al. (2010) examine the relationship between environmental disclosure and overall firm value by analyzing both the denominator and numerator component of free cash flow valuation: cost of capital and cash flow. By using a self-constructed environmental disclosure quality index they find a positive relationship between disclosure quality and cost of capital. This result is consistent with the findings of Richardson and Welker (2001). However, they find a negative association between the issuance of standalone CSR reports and cost of capital. The latter is in accordance with discretionary disclosure theory that predicts decreased information asymmetry to reduce cost of capital. When analyzing the numerator component, they find that higher quality of voluntary environmental disclosure is positively associated with firms' expected future cash flow and thereby firm value. The study documents evidence of an overall positive effect of environmental disclosure on firm value.

3. Hypothesis development

In our study, we aim to investigate if voluntary environmental disclosure has an effect on firm value. Our goal is to determine whether differences in environmental disclosure characteristics affect stock returns and overall firm value.

Al-Tuwaijri et al. (2004) suggest that the quality of environmental disclosure can serve as an indication to the market of the quality of the firm's environmental practices. The environmental disclosures communicate information to the market about firm specific risks and liabilities connected to the environmental issues. Disclosure also provides information about potential emissions reduction and cleaning costs. Some recent studies suggest a positive effect of voluntary non-financial disclosure on firm value (Plumlee et al. 2010; Clarkson et al. 2010), while others suggest a negative relation (Fisher-Vanden and Thorburn 2011; Richardson and Welker 2001). All mentioned studies find disclosure to have an impact on firm valuation, but the findings are inconclusive on the direction of the effect. Based on this, we predict environmental disclosure to have an effect on firm value and develop our main null hypothesis:

H: Voluntary environmental disclosure is not associated with firm value.

Most previous studies have mainly focused on the effect of social or environmental disclosure on stock prices through cost of capital (Dhaliwal et al 2011; Clarkson et al 2010; Plumlee et al 2010). We divide the term "firm value", and investigate the relation from both a market and an accounting perspective, and develop further specifications of our main hypotheses.

First, we look at the effects of disclosure on accounting measures of firm value. Theory suggests that environmental disclosure can be implemented as part of a differentiation strategy in competitive markets. High performing firms use discretionary disclosures to distinguish themselves from low performing firms (Verrecchia 1983), implying that voluntary environmental disclosures can be used in a differentiation strategy to set good environmental performers apart from poor environmental performers. However, disclosure initiatives are connected with disclosure costs, and these costs are increasing with the extent of disclosure. McWilliams and Siegel (2001) propose that the costs of disclosure can be seen as investment in brand management. These arguments suggest that disclosure have an effect

on the accounting value of firms, and that the direction of the impact depends on whether the costs or benefits of disclosure are greater. We specify the following subset of hypothesis *H*:

H_I: A firm's voluntary environmental disclosure is not associated with the accounting value of the firm.

From a market perspective, we look at stock returns. The level of environmental disclosure reflects the amount of environmental information, risks and opportunities that is communicated to the market. Following the "good news" theory of Verrecchia (1983), managers will choose to disclose information to an information threshold. Managers consider information above the threshold as having an unfavorable effect on firm value, due to high disclosure costs or bad news. Investors will interpret the lack of disclosure as a signal that the information withheld will cause a negative market reaction. Firms with good news will then benefit from disclosing as much as possible. The second branch of discretionary disclosure literature suggests that discretionary disclosure increase firm value, regardless of good or bad news. High discretionary disclosure might lower market transaction costs and reduce information asymmetry (Healy and Palepu 2001; Leuz and Wysocki 2008; Verrecchia 2001). Healy et al. (1999) find evidence of increased voluntary firm disclosure to be associated with improved stock performance. Environmental disclosures might affect stock returns through investor preferences. Social responsible investors will accept lower rates of return on social responsible investments (Richardson and Welker 2001). Investors whose goal is profit maximization and who do not have the same preferences for social responsibility will not accept the discount on returns. Based on these arguments we predict that voluntary environmental disclosure to be value relevant for investors, and specify the following null hypothesis:

H_II: A firm's environmental disclosure is not associated with stock returns

4. Methodology

In this chapter, we present the methodology used in the empirical analysis chapter. We describe the approach, econometric methods, and dataset used in the analysis.

4.1 Analytical approach

We use regression methodology to test our main hypotheses. Previous research within the area of interest have applied several research designs; most commonly event-study or regression analysis. We assume the environmental disclosure score to be a summary of the transparency and voluntary disclosure of the firm throughout the year. Based on this assumption, it is not possible to pin-point exact announcement date and an event-study is not suited as research design as it looks at the effect of certain events within a short time window. Hence, we choose to apply regression models in our thesis.

To investigate the impact of environmental disclosure characteristics, we construct two sets of portfolios. One set of portfolios is based on disclosure level, and the other set is constructed based on changes in disclosure score. Orlitzky and Whelan (2007) suggest that the level of social and environmental accounting should be set at a level at which the marginal costs equals the marginal benefits of disclosure. Verrecchia (1983) predict managers to use discretion in disclosure decisions and disclose information up to a threshold level. Information above the threshold causes a negative market reaction, and is unfavorable for the firm. Based on this, we suspect the effect of absolute level of disclosure to be influential on managerial disclosure decisions, and we divide the disclosure sample into 3 portfolios: high, midrange and low disclosure.

We also want to test whether changes in disclosure from one year to the next are relevant for investors. An improvement in voluntary environmental disclosure might be perceived as a signal of increased environmental consciousness. Assuming that environmental consciousness is value relevant to investors, we expect this signal-effect to impact market valuation. To examine the effect of improvement or aggravation in disclosure, we construct three portfolios based on changes in disclosure level: improvement, no change and aggravation.

We apply the analysis on both sets of portfolios, and test the effects of disclosure characteristics on accounting and market measures. In addition to the portfolio division, we use disclosure score and change in score as alternative proxies for disclosure characteristics. To investigate our two sub-hypotheses we use two different sets of models and variables. From an accounting perspective, we measure firm value as Tobin's Q and test if there are significant differences between the groups of firms within each portfolio set. As a robustness test, we use alternative measures of firm value.

Next, we test the effect of environmental disclosure characteristics on market returns. This is not easy in our current setting because the disclosure score sums information that can be available through the year, and we cannot use an event study to isolate the effect of a disclosure score announcement. However, if markets are not efficient and disclosure has an impact on firm value, we might find differences between the two groups. We use the three-factor model of Fama and French (1993) and then we add the momentum factor of Carhart (1997) to investigate the effects of disclosure on stock returns. This is a joint test of the efficient market hypothesis and the effect of environmental disclosure. No observable differences in returns do not necessarily imply that disclosure has no impact, but positive alphas in such strategies are evidence of the disclosure relevancy.

All statistical analyses are performed in STATA.

4.2 Environmental disclosure and firm value

To analyze whether firm-specific environmental disclosure is associated with differences in firm value, we use regression analysis based primarily on accounting measurements. Following a similar logic to Gompers et al. (2003), we estimate the following regression;

$$Tobin's\ Q_{it} = a_{it} + b_t * X_{it} + c_t * W_{it} + e_{it}$$

Tobin's Q is the dependent variable, X_{it} is the disclosure variable, W_{it} is a vector of control variables and e_{it} is an error term.

4.2.1 Pooled OLS regression

The underlying data is unbalanced panel data, with both time-series and cross-sectional dimensions. The panel is unbalanced because not all cross-sectional members have

observations for all years. To analyze the data with OLS regression, we pool the cross sections over time by including year dummy variables in the regression equation:

$$Tobin's\ Q_{it} = a_{it} + b_1 * X_{it} + b_3 * SIZE_{it} + b_4 * LEV_{it} + b_5 * BM_{it} + b_6 * Y2008 + b_7 * Y2009 + b_8 * Y2010 + b_9 * Y2011 + u_{it}.$$

Where Tobin's Q is the dependent variable and X_{it} is the disclosure variable. All variables used in regression analysis are explained in section 4.4.5. When we apply OLS regression, we assume that the idiosyncratic error u_{it} is uncorrelated with the independent variables in each time period (Woolridge 2009). We assume no correlation, but are aware of a very likely endogeneity problem connected to this assumption. The problem of endogeneity occurs when the independent variable is correlated with the error term. This implies that the regression coefficients in the pooled OLS regression are biased (Woolridge 2009). Hence, if disclosure has an impact on firm value, then the firms that benefit the most from disclosure are the ones that will choose to do so. This magnifies the effect of disclosure. To overcome this problem, the main analysis of our hypotheses is based on a sample restricted to only disclosing firms. By looking at differences within this sample, we try to minimize the endogeneity problem.

4.2.2 Fixed effects model

Panel data can alternatively be analyzed through unobserved effects panel data methods. There are two common models, fixed effects and random effects transformations. We do a Hausman test to determine whether to use a random effects or fixed effects model.[2] The null hypothesis in the Hausman test is rejected, and we use fixed effects.

The fixed effects model uses a transformation to remove the unobserved effect a_i prior to estimation, and remove all time-constant independent variables (Woolridge 2009). Under OLS assumption, correlation between the unobserved effect and the independent variables will cause biased results. With fixed effects estimation, the unobserved effect a_i is allowed

[2] We compute a Hausman test in STATA under the full set of random effects assumptions. We use random effects estimates unless the Hausman test reject the assumption $Cov(x_{ijt}, a_i) = 0$, and find the unobservable effect a_i to be correlated with one or more explanatory variables. A rejection means that the key assumptions of the random effect model are false, and thus, we use the fixed effects model (Woolridge 2009)

to be correlated with the independent variables in the regression equation. STATA conducts the necessary adjustments to the regression.

$$Tobin's\ Q_{it} = a_{it} + b_1 * X_{it} + b_3 * SIZE_{it} + b_4 * LEV_{it} + b_5 * BM_{it} + u_{it}$$

Where u_{it} is the idiosyncratic error, and represents unobserved factors that change over time and affect the dependent variable, and X_{it} is the disclosure variable. All regression variables are described in section 4.4.5.

4.3 Environmental disclosure and stock returns

In this section, we describe the method applied in the analysis where we look at stock returns. By dividing the sample into portfolios based on disclosure characteristics, we are able to examine differences in market performance between portfolios. We derive portfolio returns and evaluate the portfolio performance through factor model regressions. The portfolio construction is described in section 4.4.4.

4.3.1 Portfolio returns

In order to derive the monthly returns for each portfolio, we retrieve a monthly return index, RI, for each stock from Datastream. This return index shows the monthly growth in share holdings, assuming dividends to be re-invested. Based on this, we calculate the monthly returns for each stock over the five-year period covered in this paper, following standard procedures in the literature (e.g. Bodie et al. 2009):

$$r_t = \frac{RI_t - RI_{t-1}}{RI_{t-1}}$$

We calculate both equal-weighted and value-weighted returns for each portfolio. In the calculation of the equal-weighted returns, we add the monthly returns of all the firms within the portfolio, and then divide the total return on the number of firms. For each period t, the equal-weighted portfolio return r_p^e is calculated as follows:

$$r_p^e = \frac{1}{n}\left(\sum_{i=1}^{n} r_i\right)$$

Where n is the number of firms in the portfolio and r_i is the monthly return of firm i.

The value weighted returns are calculated based on the firms' market capitalization as a fraction of the total portfolio market capitalization. Since there are firms from several countries included in the dataset, all data are converted into one common currency. M_i is the market capitalization of firm i and n is the number of firms in the portfolio. The market capitalization of each firm is retrieved from Datastream. The value-weighted portfolio return r_p^v is then calculated according to the following equation for each period t:

$$r_p^v = \sum_{i=1}^{n} (w_i * r_i), \qquad w_i = \frac{M_i}{\sum_{i=1}^{n} M_i}$$

The efficient market hypothesis predicts stock price to reflect all value-relevant information available to investors. A market is defined as efficient if the prices of securities fully reflect public information (Fama 1970). Investors trading in such a market should expect to obtain an equilibrium rate of return on their investments. When new information becomes available, the efficient market hypothesis predicts the stock price to respond quickly to the information and adjust to the fair level, where ordinary rates of return can be expected. The price will at all times reflect all current information, and only change in response to new information (Fama 1970).

Hence, in a semi-strong efficient market, there would be no potential benefit of active investment-management strategies. Stock prices would already reflect all relevant information and attempts to outperform passive strategies would be futile. A passive investment strategy would yield the same profits without the additional costs of active strategies.

4.3.2 Factor model regression

From a market perspective, we aim to examine the relationship between voluntary environmental disclosure and stock returns. The analysis of differences in stock returns is a joint test of the market efficiency hypothesis and the impact of voluntary environmental disclosure. We assume our Nordic capital markets to have a semi-strong form of market efficiency; where the stock price reflects historical information and all publicly available information regarding the firms' prospects.

The efficient market hypothesis predicts that security prices reflect all available information and it is difficult to outperform passive strategies through active management. Findings that do not reconcile with the market efficiency hypothesis are referred to as market anomalies. Patterns of returns that seem to contradict the efficient market hypothesis are interpreted in multiple ways in empirical finance. Several methods have been developed to account for the effects of differences in returns, and some equity characteristics have been identified as influential factors on realized returns.

Fama and French (1993) propose that market anomalies can be explained as results of risk premiums, and they interpreted the excess returns as risk premiums connected with the firm characteristics. They developed a three-factor model with systematic factors constructed to account for the effects of firm-level exposure to the market, market capitalization and book-to-market ratio. Carhart (1997) added one additional factor, and developed a four-factor model. The forth factor is constructed to capture momentum effects in the market, since one-year return momentum have been shown to significantly forecast future returns.

The factors are constructed by forming portfolios that mimic the risk connected to these characteristics. These models can be seen as performance attribution models that attribute differences in portfolio returns to different firm characteristics (Gompers et al. 2003). For our purposes, we only apply the model as a method of assessing performance attribution of firm characteristics and do not discuss the factors as proxies for risk.

We start our analysis by investigating the portfolio returns and whether there are differences in the returns over the period. In accordance with the efficient market hypothesis we expect the three portfolios to yield equal returns. If the three portfolios differ significantly in firm characteristics, then a disparity in returns might be explained by the differences in style factors. We base our analysis on the three-factor model of Fama and French (1993) and the four-factor model of Carhart (1997). The three-factor model of Fama and French (1993) is specified as follows:

$$R_t = \alpha + \beta_1 * \ RMRF_t + \beta_2 * SMB_t + \ \beta_3 * \ HML_t + \varepsilon_t$$

Carhart (1997) adds a return momentum factor to the three-factor model, and the four-factor model is given by

$$R_t = \alpha + \beta_1 * \ RMRF_t + \beta_2 * SMB_t + \ \beta_3 * \ HML_t + \beta_4 * \ MOM_t + \varepsilon_t$$

Where R_t is the dependent variable, $RMRF_t$, SMB_t, HML_t and MOM_t are the independent variables, β_1 to β_4 are the factor coefficients, and ε_t is the error variable.

The dependent variable R_t in the factor models is monthly excess stock return. We use both excess portfolio returns and return difference between the extreme portfolios as R_t. For each month t, excess stock return is measured as portfolio return r_p less risk-free rate:

$$R_p = \ r_p - \ r_f$$

In addition, we calculate monthly return differences between the extreme portfolios in each set of portfolios. The return difference R_{1-3} is calculated as the monthly excess return of portfolio 1 minus the excess return of portfolio 3. Portfolio 1 represents the upper extreme portfolios: high disclosure or improvement in disclosure. Portfolio 3 represents the lower extreme portfolios: low disclosure or aggravation in disclosure.

$$R_{1-3} = \ R_1 - \ R_3$$

The alpha – α – is the estimated intercept coefficient. We follow the logic of Gompers et al. (2003) and interpret this coefficient as the abnormal return of the investment; return beyond what could have been gained by a passive investment in the factors. $RMRF_t$ is the value-weighted market return in month t less the risk-free return, and SMB_t, HML_t and MOM_t are the month t returns on factor-mimicking, zero-investing portfolios constructed to capture size, book-to-market and return momentum effects (Carhart 1997). The coefficients β_1 to β_4, are often called factor loadings. If the factors are relevant in explaining return disparities, then excess return should be explained by performance attribution due to these factor loadings. The intercept of the equation, α, should be zero if the factors fully explain the portfolio. The factors are described in detail in section 4.4.6.

4.4 Dataset

In this section we introduce the Carbon Disclosure Project and present the underlying data used in the analysis.

4.4.1 Carbon Disclosure Project

The Carbon Disclosure Project (CDP) is an independent, non-profit organization that works for emissions reduction and sustainable use of natural resources. The organization provides a global standard for measurement and disclosure of information on climate change, and holds the largest collection of self-reported climate change data in the world (Carbon Disclosure Project, 2012). The Carbon Disclosure Project acts on behalf of institutional investors and help them reduce the climate change related risks in their portfolios and make sustainable investment decisions. A main focus in the Carbon Disclosure Projects strategy is to ensure that collected data is available, comparable and used efficiently (Carbon Disclosure Project, 2012). The reported information is submitted through a standard questionnaire, and the organization provides extensive guidelines on how to respond and report according to this questionnaire.

Based on the reported information, the CDP produce and publish several annual reports (Carbon Disclosure Project, 2012). In 2007, they expanded their publications to the Nordic countries and for the first time published a CDP Nordic report. This report summarizes the responses and submitted information of the largest listed firms in Finland, Denmark, Sweden and Norway.

4.4.1.1 Carbon Disclosure Score

The carbon disclosure score is determined based on firms' self-declared answers to the CDP questionnaire. This questionnaire is designed to best assess the understanding and disclosure of firm-specific exposure to climate-related issues, as well as the strategic and managerial focus on the business issues related to climate change. The extent of emission measurement and frequency and relevance of emissions disclosure are also important elements in the questionnaire and important in the determination of the final carbon disclosure score achieved. This questionnaire is initially self-declared, but firms can choose to have their reported answers verified externally. Externally verified data ensure greater confidence in the submitted material, and reflects positive in the assessment process (Carbon Disclosure

Project, 2011). Firms are ranked on a scale ranging from a minimum score of zero to a maximum score of 100.

The CDP Nordic report for 2011 provides guidelines for investors to interpret the ranking in levels of commitment to carbon disclosure. Firms with a disclosure score between 0 and 50 are described as low disclosing firms. Firms within this range have shown limited commitment to disclose climate related risks and emissions. Carbon disclosure scores between 50 and 70 are denoted as midrange. Firms in this range have an increased commitment to emission disclosure, and report more company-specific risks and opportunities. Firms with a carbon disclosure score above 70 are referred to as high disclosing firms. These are firms with high understanding of the business issues connected to climate change and emissions, and where these issues are built in to the core business (Carbon Disclosure Project, 2011).

4.4.2 Data description and sample selection

Our dataset consists of data for firms that have their primary listing on the stock exchange in Oslo, Stockholm, Copenhagen or Helsinki over the time period of 2006 - 2011. We retrieved all available ISIN numbers for firms with primary listings on the Nordic stock exchanges from the Compustat database. Firms we were unable to retrieve ISIN numbers for are excluded from the population. The sample of disclosing firms consist of firms that intersect on two data sources: firms that have their primary listing on one of the Nordic stock exchanges and firms that disclose their environmental performance to the Carbon Disclosure Project. All accounting and financial measures are retrieved from the Datastream database. The accounting data is retrieved annually at the end of the year, while the financial data is retrieved monthly. The disclosure data consists of annual carbon disclosure scores, retrieved from CDP Nordic reports[3]. Carbon disclosure scores are listed in appendix 1.

The population includes firms from four different countries. Most firms report their accounting and financial data in their national currency. In order to achieve a meaningful analysis we have to convert all underlying data to one common currency. We retrieve monthly averages of daily listings of exchange rates from the Norwegian Central Bank[4]. To

[3] Annual CDP Nordic reports are available at: https://www.cdproject.net/en-US/Results/Pages/All-Investor-Reports.aspx

[4] Exchange rate listings are retrieved from: http://www.norges-bank.no/no/prisstabilitet/valutakurser/

achieve the required comparability, we translate all financial values and accounting measures into Norwegian Kroner (NOK). For the monthly data we use monthly listings in the conversion, and for the annual data we use end of year listings.

4.4.3 Data adjustments

The initial Nordic population includes a total of 766 listed firms. This includes 4656 annual observations of accounting data and a total of 51,509 monthly return observations. Regression analyses are vulnerable to extreme observation and outliers. We chose not to exclude outliers, because due to the nature of the capital markets included in the sample, we have no reason to believe the outliers are caused by errors in the dataset[5].

We exclude all observations with missing values and firms with incomplete data on all accounting variables. We have no reason to believe there is a systematic pattern in the missing observations, and hence, we believe that this adjustment will not create a bias in our results.

After adjusting for missing values and observations, the final population consists of a total of 36,448 monthly observations. This implies a reduction in observations of approximately 30 per cent. This is a significant reduction, but we find it necessary in order to ensure the quality of our analysis. We will refer to this adjusted, underlying population as the Nordic sample. As a consequence of the adjustments in the underlying population, the disclosure sample is adjusted accordingly. The final disclosure sample consists of 6180 observations of monthly returns. The final samples are listed in Table 1.

Table 1: Sample description

Year	***Initial population***	***Nordic sample***	***Initial sample***	***Disclosure sample***
2007	766	570	84	70
2008	766	574	110	99
2009	766	574	128	110
2010	766	574	131	113
2011	766	573	143	123

Initial population is the entire Nordic population before data adjustments. Nordic sample is the underlying population adjusted for missing data. Initial sample consists of firms that have their primary listing on the Nordic stock exchanges and disclose to the Carbon Disclosure Project. Disclosure sample is the adjusted disclosure sample.

[5] See appendix 2 for further examination of the outlying observations in the dataset.

Listed in Table 2 and 3 are the distributions by country. The distribution is fairly stable over the entire time period, with Sweden having the largest percentage of disclosing firms.

Table 2: Nordic sample distribution

Stock Exchange	***2007***	***2008***	***2009***	***2010***	***2011***
Oslo Stock Exchange	151	155	155	155	155
OMX Stockholm	206	206	206	206	206
OMX Copenhagen	103	103	103	103	102
OMX Helsinki	110	110	110	110	110
TOTAL	**570**	**574**	**574**	**574**	**573**

Table 3: Disclosure sample distribution

Stock Exchange	***2007***	***2008***	***2009***	***2010***	***2011***
Oslo Stock Exchange	12	13	15	19	23
OMX Stockholm	34	45	50	49	51
OMX Copenhagen	9	16	23	21	22
OMX Helsinki	15	19	22	24	26
TOTAL	**70**	**99**	**110**	**113**	**123**

4.4.4 Portfolio construction

We divide the disclosure sample into portfolio sets to analyze the effects of disclosure characteristics on firm value. The portfolios are reset at the start of each year, according to the new environmental disclosure ranking. This implies that investors sell their investment in the portfolio at the end of the year, and then reinvest at the start of the year in the adjusted portfolio.

There have been several measures for the degree of non-financial disclosure in related literature. Clarkson et al. (2010) and Plumlee et al. (2010) use self-constructed disclosure indices based on information retrieved from voluntary environmental disclosures in standalone environmental reports, CSR reports and corporate websites. Richardson and Welker (2001) use a social measure drawn from the Society of Management Accountants of Canada, which provide time-series data on disclosure scores based on disclosed information in annual reports. To construct an environmental disclosure index for the Nordic capital markets, following a similar approach to Clarkson et al. (2010) and Plumlee et al. (2010), is to time-demanding and complex for the scope of our thesis. We base our measure of disclosure on data drawn from a third party source, and use the carbon disclosure score from

the CDP Nordic reports as a measure for voluntary environmental disclosure. It allows us to compare the transparency on environmental issues of the sample firms.

We believe the carbon disclosure score is a well-suited proxy for voluntary environmental disclosure. The Carbon Disclosure Project rank the sample firms according to understanding and disclosure of firm-specific exposure to climate-related issues, as well as the strategic and managerial focus on environmental issues. One section of the CDP questionnaire assesses the firm's own communication of environmental disclosure based on information about the frequency, extent and relevance of their own reporting (Carbon Disclosure Project, 2012).

The CDP questionnaire relates to the previous fiscal year (Carbon Disclosure Project 2011), which implies that the carbon disclosure score of 2011 represent the assessment of firm disclosure of 2010 data. The CDP Nordic report is made publicly available in September each year. However, all firms in the disclosure sample communicate firm sustainability and environmental commitments throughout the year via firm websites or company reports[6]. Based on this, we consider the disclosure score to represent information about firm disclosure policy that has been available for stakeholders throughout the year. An analyst following the sample firms would, based on the continuous communication of environmental activities, be able to assess and rank the firms based on disclosure policy, and thus, the portfolios are set at the beginning of the year. Hence, for an investor wanting to follow an investment strategy based on disclosure characteristics, the information required to construct such portfolios is available at the beginning of the year. In addition, we believe that in order for the gains of disclosure to be compared to the corresponding costs of disclosure, the accounting measures of year t have to be compared to the disclosure score of year t.

4.4.4.1 Disclosure Level Portfolios

First, we construct portfolios based on the absolute level of disclosure. We rank the sample firms according to their carbon disclosure score from the CDP Nordic report, where a score of 100 reflects perfect disclosure, and zero is consistent with no disclosure. We use this to divide the sample into three portfolios. The lowest 30 per cent of the firms on the index is in the low disclosure portfolio (*Low*). Firms in the upper 30 per cent on the index are in the high disclosure portfolio (*High*). The rest of the firms in the sample constitute the midrange

[6] Listed in appendix 3 are the addresses of the sustainability websites for the firms in the Disclosure sample. These sites are where the firms communicate their environmental information to the public.

disclosure portfolio (*Midrange*). The environmental disclosure index and subsequent portfolios are adjusted each year, according to the new annual carbon disclosure score. Table 4 describes the portfolio distribution and show minimum, maximum and mean disclosure score for the firms in each portfolio.

Table 4: Disclosure Level Portfolios

		2007	***2008***	***2009***	***2010***	***2011***
High	***Mean***	75.16	70.73	71.42	79.40	81.54
	Max	100	89	84	90	97
	Min	64	57	67	71	74
	n	19	30	35	33	39
Midrange	***Mean***	49.32	47.75	59.03	63.4	66.64
	Max	63	56	66	70	73
	Min	34	39	48	58	59
	n	31	36	40	45	47
Low	***Mean***	18.95	28.33	31.29	37.43	43.89
	Max	32	38	45	57	58
	Min	0	12	5	8	1
	n	20	27	35	35	36
Total	***Mean***	47.66	49.53	54.15	60.03	64.69
	Max	100	89	84	90	97
	Min	0	12	5	8	1
	n	70	93	110	113	123

Listed is the mean, maximum and minimum value of the environmental disclosure score. N is the number of firms in each portfolio.

4.4.4.2 Disclosure Change Portfolios

Next, we allocate firms into portfolios according to change in disclosure level from the previous year. This is to capture whether improvement or aggravation in environmental disclosure score has an effect on firm value. We use each firms first reporting year as "base" year, and lose 12 monthly observations of stock returns for each firm. This implies that firms that only have reported to the Carbon Disclosure Project one year are excluded from the sample.

The change score is calculated by subtracting the environmental disclosure score of year t-1 from the score in year t. Firms with an improvement of more than five points in disclosure score from year t-1 to year t are allocated to the *Pos_Change* portfolio. Firms that experience a decline in disclosure score of more than five points from year t-1 to year t are in the *Neg_Change* portfolio. Firms with a stable disclosure score or firms that experience an increase or decrease in disclosure level of less than five points are in the *No_Change* portfolio. Table 5 describes the disclosure change portfolios.

Table 5: Disclosure Change Portfolios

		2008	*2009*	*2010*	*2011*
Pos_Change	***Mean***	60.65	64.52	68.79	71.93
	Max	88	84	90	97
	Min	20	30	18	41
	n	26	46	39	41
No_Change	***Mean***	51.23	49.92	62.44	69.49
	Max	89	79	83	89
	Min	33	22	24	49
	n	13	13	41	39
Neg_Change	***Mean***	44.83	42.17	47.26	53.05
	Max	74	71	63	83
	Min	12	7	20	12
	n	24	29	19	21
Total	***Mean***	52.68	55.00	62.03	67.06
	Max	89	84	90	97
	Min	12	7	18	12
	n	63	87	99	101

Listed is the mean, maximum and minimum value of the environmental disclosure score. N is the number of firms in each portfolio.

4.4.5 Variable description

In this section, we describe the regression variables used in the pooled OLS regression and the fixed effects regression.

4.4.5.1 Measures of firm value

To study the impact of disclosure on firm value, we look at several firm performance measures. There are various measurements of firm performance in related literature, and there is no common consensus on which approach is best to follow. We follow Gompers et al. (2003) and choose Tobin's Q as main proxy for firm value. This measure contains both market information and information about assets in place, which makes it a suitable proxy in our thesis.

Tobin's Q is defined as the ratio of market value of the firm to the replacement costs of the firm's assets (Lindenberg and Ross 1981). If Tobin's Q is higher than one, then the market value of the firm is higher than the recorded value of the firm's assets. This suggests that there are unrecorded assets valued in the firm. Tobin's Q has been used as proxy for growth opportunities in previous literature (Dhaliwal et al 2011), because Tobin's Q might reflect a long-term perspective of firm valuation. We follow the method applied by Kaplan and Zingales (1997) and calculate Tobin's Q as the market value of assets divided by the book value of assets. Market value of assets is defined as book value of assets plus the market

value of common equity less the sum of the book value of equity and balance sheet deferred taxes. Deferred taxes are the accumulated taxes that are deferred as a result of timing differences between accounting values of assets and liabilities and the reporting value for tax purposes. Following the literature we use the natural logarithms of Tobin's Q to incorporate non-linear relations.

We use alternative measures for firm performance to test the robustness of our results. One concern connected to using Tobin's Q as proxy for firm value is that we neglect the possibility that industries might systematically differ in voluntary environmental disclosure. A failure to industry-adjust could lead to distortions in the regression results. We compute an industry median Q for each year, and use it to find the industry-adjusted Tobin's Q for each firm (Gompers et al. 2003). The industry-adjusted value measure – Q' – is calculated as the firm's Tobin's Q minus the industry median Tobin's Q. The industry median is based on the two-digit sector code from Global Industry Classification Standard (see appendix 4), and calculated from the Nordic sample.

Both Tobin's Q and industry-adjusted Tobin's Q are measures of financial performance and based on both market and accounting information. In addition to these two measures, we use return on equity (ROE) and return on assets (ROA) as alternative proxies for firm value to examine whether we find the same results when we use operating performance as proxy for firm value. Both ROE and ROA show the relation between annual firm income and accounting values of equity and assets. The operating measures represent a still picture of the firm profitability and reflect a short-term firm value compared to Tobin's Q. Return on equity is retrieved from Datastream and defined as net income divided by book value of shareholder equity. Return on assets is calculated as earnings before interests and taxes (EBIT) divided by total assets. Both EBIT and total assets are retrieved from the Datastream database.

Table 6: Firm value variables

Variable	***Definition***	***Measurement***
Q	Tobin's Q	Log((Market value of equity + book value of assets – book value of equity – deferred tax) / book value of assets)
Q'	Industry adjusted Tobin's Q	Tobin's Q – Industry median Tobin's Q
ROE	Return on equity	Net income /Book value of equity
ROA	Return on assets	EBIT / Total assets

4.4.5.2 Disclosure variables

Environmental disclosure is our key independent variable of interest in the regressions. As mentioned in section 4.4.4, there have been several measures for non-financial disclosure in related literature. We use the carbon disclosure score from the Carbon Disclosure Project as a proxy for environmental disclosure.

To test the value effect of the decision to disclose versus not to disclose, we use a dummy variable DISC. If the firm is included in the Disclosure sample the dummy equals one, zero otherwise. The environmental disclosure score, EDSCORE, equals the carbon disclosure score of the firm. All firm scores are listed in appendix 1. The change in disclosure score from one year to the next is the disclosure change score CHSCORE. It is calculated as the disclosure score in year t minus the disclosure score in year t-1.

In alternative specifications we use dummies representing which portfolio the firm is in. The level portfolios constructed in section 4.4.4.1 are dummy variables for disclosure level, and the change portfolios in section 4.4.4.2 are dummies for disclosure change.

Table 7: Disclosure variables

Variable	***Description***	***Measurement***
DISC	Dummy variable for disclosing firms	Disclosing firms = 1, Non-disclosing firms = 0
*LEVEL_**	Dummy variable for disclosure level portfolio	Inclusion in *High* = LEVEL_1, *Midrange* = LEVEL_2, *Low* = LEVEL_3
EDSCORE	Environmental disclosure score	Score on environmental disclosure index
*CHANGE_**	Dummy variable for disclosure change portfolio	Inclusion in *Pos_Change* = CHANGE_1, *No_Change* = CHANGE_2, *Neg_Change* = CHANGE_3
CHSCORE	Disclosure change score	$EDSCORE_t - EDSCORE_{t-1}$

4.4.5.3 Control variables

We include a series of independent variables to control for potential influences on firm value. All control variables are retrieved directly from Datastream or easily calculated based on retrieved data. Following previous literature, all listed variables are in natural logarithms unless noted otherwise, to incorporate non-linear relations into our regression model.

Fama and French (1992) find that size and book-to-market equity are associated with stock returns. They find firm size to be negatively associated with expected returns and book-to market to have a positive relation. Firm size has been addressed in different ways in previous

literature. Richardson and Welker (2001) use a dummy variable to test for size effects, where the dummy variable equal to one if the market value of company *i* at the end of year *t* is above the sample median and zero otherwise. Gompers et al. (2003) use market capitalization. Elsayed and Paton (2005) use the natural logarithm for total assets as a measure for firm size. We aim to test our hypothesis from an accounting perspective and choose to follow the logic of Elsayed and Paton (2005) and use the book value of total assets as a proxy for firm size.

Book-to-market is defined as the ratio of book value of equity to the market value of equity. We retrieve the market-to-book ratio from Datastream, which is the balance sheet value of common equity divided by the market value of common equity. We calculate the book-to-market variable by deriving the inverse market-to-book ratio.

Fama and French (1992) find the level of debt to equity to be associated with returns. They suggest that the cost of equity increases with the degree of leverage. Leverage can also be considered a proxy for firm specific risk. Leftwich et al. (1981) propose that debt holders demand greater disclosure than equity holders and we therefor include a leverage variable to control for this effect. Leverage is the debt to equity ratio for firm *i* in year t, and is calculated by dividing book value of net debt by market value of shareholders equity. Leverage is not listed in natural logs because many observations have negative values.

Differences in profitability might affect the valuation of the firm. We use return on equity to control for effects of firm profitability. ROE is described in more detail in section 4.4.5.1. Annual return on equity for the sample firms are retrieved from Datastream, and are not listed in logs.

Table 8: Control variables

Variable	***Description***	***Measurement***
SIZE	Firm size	Log (Total assets)
BM	Book-to-market	Log (1 /market-to-book)
LEV	Leverage ratio	Book value net debt/market value of equity
ROE	Return on Equity	Net profits/Book value of equity
Y_YEAR	Dummy variable year	Use the first year of observations as reference year

4.4.6 Factor construction

In the factor model regression, we use calculated benchmark factors as independent variables. Most related literature has retrieved these factors from the Kenneth French website[7]. The annual Fama/French European Factors are based on 15 European capital markets, including the four Nordic countries[8]. To get benchmark factors that match our exact sample selection, we construct our own Nordic factors. We base our calculations on the Nordic sample, described in section 4.4.3.

4.4.6.1 RMRF

The RMRF factor is the market return minus the risk free return, and is in literature described as the excess return on an aggregated market proxy (e.g. Carhart 1997). This factor captures firm-level exposure to the market. It is derived from the value-weighted return of all Nordic stocks minus risk free rate. The underlying population consists of firms from four capital market, and we choose to use the equal-weighted average of the risk free rates in the four countries as r_f in our calculations. We define the domestic risk free rate as the return on 10 year government bonds. To obtain risk free rates for the four countries respectively, we retrieved monthly returns for 10 year government bonds from the national banks in each country[9]. The RMRF factor is then calculated as follows:

$$RMRF = r_m - r_f$$

Where r_m is the market return and r_f is the risk free rate.

4.4.6.2 SMB and HML

The SMB and HML factors are calculated based on returns of six portfolios. These are formed on size and book-to-market ratio and constructed at the end of each June. The median market equity divides the firms into two groups formed on size (Fama and French 1993). Median market value of equity (M) of the Nordic sample is calculated based on market values retrieved from Datastream. Firms with market equity above median are

[7] Benchmark factors are available on the Kenneth French website;
http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html#Benchmarks

[8] The annual Fama/French European Factors include Austria, Belgium, Denmark, Finland, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

[9] Information about interest rates and returns on government bonds are publicly available on the national banks websites; www.norges-bank.no, http://nationalbanken.dk, www.riksbank.se, http://www.suomenpankki.fi.

assigned to the big portfolio and firms with market equity below median are placed in the small portfolio.

Three portfolios are based on the firms' book-to-market ratio (Fama and French 1993). Book-to-market, BM, is calculated as the inverse fraction of the market-to-book value retrieved from Datastream. The Nordic sample is ranked according to their BM, and the population is then assigned to three groups based on this ranking. The 30 per cent with highest BM is assigned to the value portfolio, the 40 per cent mid-ranked firms are assigned to the neutral portfolio and the 30 per cent with lowest BM is assigned to the growth portfolio.

The two parallel portfolio assignments are combined and the Nordic market is divided into six final portfolios, shown in Figure 1. The benchmark factors can be derived from monthly value-weighted average returns. Value-weighted returns are based on the total market capitalization, and calculated following the same method as described in section 4.3.1.

Figure 1: SMB/HML Portfolios

	Median M	
70th BM percentile	Small Value	Big Value
	Small Neutral	Big Neutral
30th BM percentile	Small Growth	Big Growth

The size factor is calculated as the average return of the three small portfolios minus the average return of the three big portfolios. The SMB factor is given by the following equation (Fama and French 1993)[10]:

$$SMB = 1/3\ (Small\ Value + Small\ Neutral + Small\ Growth)$$

$$- 1/3\ (Big\ Value + Big\ Neutral + Big\ Growth)$$

[10] Kenneth French recently changed the way to divide the portfolios. We use his previous methodology in this factor construction.

The book-to-market benchmark factor is the average return on the two value portfolios minus the average return on the two growth portfolios (Fama and French 1993). The HML factor is calculated as following:

$$HML = ½ (Small\ Value + Big\ Value) – ½ (Small\ Growth + Big\ Growth)$$

4.4.6.3 MOM

The momentum factor, MOM, is based on six portfolios formed on size and prior (2-12) return. These portfolios are calculated and adjusted monthly, in contrast to the annually calculated portfolios used for SMB and HML. As before, the median market equity of the Nordic firms functions as the size breakpoint. Firms with market cap above market median are in the big portfolio, and firms with market cap below market median are allocated to the small portfolio.

The Nordic sample is assigned to three portfolios based on their prior returns. The monthly prior return breakpoint is the 70^{th} prior percentile and the 30^{th} prior percentile. Carhart (1997) define prior return as eleven-month returns lagged one month. For each firm the 11 month prior return is calculated as growth in the return index from 12 months prior to 1 month prior. For the first month, January 2007, the 11 month prior return refers to returns from the end of January 2006 to end of December 2006. We use the prior returns to rank the firms each month. We use this ranking to assign the firms into 3 portfolios where the 30 per cent with highest prior return is assigned to the up portfolio, the middle 40 per cent is assigned to medium portfolio, and the 30 per cent with lowest 11 month prior return is assigned to the down portfolio.

The two parallel group assignments are used to divide the sample into 6 momentum portfolios, shown in Figure 2. For each of the six portfolios a monthly value-weighted return is calculated.

Figure 2: MOM Portfolios

	Median M	
70th prior (2-12) percentile	Small Up	Big Up
	Small Medium	Big Medium
30th prior (2-12) percentile	Small Down	Big Down

The momentum factor is the equal-weighted average of the two portfolios with the highest 30 per cent prior return portfolios minus the equal-weighted average of the two portfolios with the lowest 30 per cent prior return (Carhart 1997).

$$MOM = ½ (Small\ Up + Big\ Up) – ½ (Small\ Down + Big\ Down)$$

4.4.6.4 Descriptive statistics of Nordic factors

To test the validity of our constructed factors, we examine the correlation between the Nordic factors and the European factors retrieved from the Kenneth French website. We do not assume a perfect correlation between the two sets of factors, but we should expect a certain degree of correlation between them. The correlation between European and Nordic factors is shown in Table 9.

Table 9: Correlation between Nordic and European factors

Factor	***RMRF***	***SMB***	***HML***	***MOM***
Correlation with respective European factors	0.8428	0.5356	0.5990	-0.7872

The three European factors of Fama and French (1993), SMB, HML, RMRF, are positively correlated with our constructed Nordic factors. This is in accordance with our expectations. The Nordic momentum factor has a strong negative correlation with the European momentum factor. The momentum effect shows the tendency of prior return to affect future returns. The negative correlation indicates that there are differences in effects of prior returns between the European countries and the Nordic countries. One possible explanation for this is that Nordic capital markets are more oil sensitive than the rest of the European capital markets. Another potential cause is that the financial crisis has had a different impact on the returns in the European sample, compared to the Nordic sample. The European sample includes countries that have been strongly affected by the financial turbulence: like Ireland, Greece, Portugal, Spain, and Italy. We cannot determine with certainty the reason we observe this negative correlation. Since the momentum factor behaves differently than expected, we choose to apply both the three-factor model of Fama and French (1993) and the four-factor model of Carhart (1997) to control the quality of our results.

5. Empirical Analysis

In this chapter, we present our empirical findings on the impact of voluntary environmental disclosure on firm value. Discussions and interpretations of the results are given in chapter 6.

5.1 Summary statistics

Table 10 presents summary statistics of the disclosure sample. We investigate correlations between the accounting and financial variables and environmental disclosure score, and compare mean values of the variables in extreme portfolios. When comparing only the extremes, we exclude *Midrange* and *No_Change* in order to isolate the effects of the extreme portfolios.

The upper part of the table relates to firms divided into portfolios based on the absolute level of disclosure. Correlations between the EDSCORE and accounting measures are shown in the first column. We observe low and insignificant correlations for all variables except from LEV and M. LEV is negatively correlated while M is positively correlated with EDSCORE, both with statistical significance. When looking at the differences in means, we observe that majority of the measures have higher values in the *High* portfolio compared to the *Low* portfolio, but only M is statistically significant at a 1 per cent level. This indicates that the *High* portfolio consists of larger firms than *Low* portfolio. LEV has a negative difference; however, the difference is not statistically significant.

The lower part of Table 10 presents the same analysis, but with portfolios based on the change in disclosure score. LEV, BM, and TA are positively correlated to CHSCORE, while there is a negative correlation with ROE, M, Tobin's Q, and industry-adjusted Tobin's Q. These correlations are not statistical significant. Differences in means reveal some variances in firm characteristics of the *Pos_Change* and *Neg_Change* portfolios. The control variables LEV, BM, TA, and M all have higher means in the *Pos_Change* portfolio, while the firm value proxies ROE, Q and Q' have lower mean values in this portfolio.

Assuming ROE and Q to be proxies for firm value, the summary statistics give an inconclusive indication of the association between firm value and environmental disclosure characteristics. In the next parts of the thesis, this will be thoroughly tested.

Table 10: Summary statistics

Level Portfolios				
	Corr with EDSCORE	***Mean High***	***Mean Low***	***Difference***
LEV	-0.087**	0.886	1.363	-0.478
ROE	0.060	0.103	0.076	0.027
BM	0.061	0.919	0.751	0.168
M	0.180***	58.6M	34.5M	24.1M***
TA	0.026	196M	157M	38.3M
Q	0.052	1.545	1.475	0.070
Q’	0.042	0.318	0.308	0.019
Change portfolios				
	Corr with CHSCORE	***Mean Pos_Change***	***Mean Neg_Change***	***Difference***
LEV	0.064	1.274	0.860	0.415
ROE	-0.051	0.089	0.107	-0.018
BM	0.024	0.790	0.740	0.050
M	-0.053	45.6M	51.3M	5.73M
TA	0.063	241M	165M	75.6M
Q	-0.016	1.542	1.606	-0.064
Q’	-0.014	0.360	0.411	-0.052

This table presents descriptive statistics for the relationship of the level and change portfolios with several financial and accounting measures in the period 2007-2011. The first column gives the correlations for each of these variables with the EDSCORE and CHSCORE. The second and third columns give means for these variables within the extreme portfolios. The final column gives the difference of the two means. The description of the portfolio construction is given in section 4.4.4, EDSCORE, CHSCORE and all control variables are described in section 4.4.5. The significance of difference in means is a two-sided t-test with alternative hypothesis of difference not equal to zero (HA: diff != 0). Significance at the 10, 5 and 1 per cent levels is indicated by *, ** and ***, respectively.

5.2 Pooled OLS regression

In this section, we regress firm value on disclosure initiative, absolute disclosure level and disclosure change.

5.2.1 Effect of disclosure initiative on firm value

We start by doing a preliminary test of our main hypothesis *H* and examine whether the initiative to voluntarily disclose environmental information has an effect on firm value. We use the entire Nordic sample and indicate the disclosure initiative with a dummy variable. The dummy variable equals one if the firm reports environmental information, zero otherwise. We use Tobin's Q as proxy for firm value and do a robust pooled OLS regression. To test the validity of the results we test for alternative measures of firm performance. We do additional regressions with industry-adjusted Tobin's Q, return on equity and return on assets as alternative proxies for firm value. The results for all four regressions are listed in Table 11.

When applying the natural logarithm of Tobin's Q as dependent variable, disclosure initiative has a positive and significant coefficient of 0.084 within a 99 per cent confidence interval. The R^2 is 0.775 which means that the independent variables explain a large portion of the variation in the dependent variable. This implies that, all other control variables held constant, disclosing firms have 8.4 per cent higher Tobin's Q than non-disclosing firms. However, when comparing firms in the disclosure sample to the rest of the Nordic sample, the results are potentially biased due to the endogeneity problem. Since the decision to disclose is voluntary, the effect of disclosure on firm value is very likely to be overestimated.

In the alternative regressions, we observe a change in the direction of the impact when modeling for operating performance compared to financial performance. Disclosure initiative has a significant positive effect on industry-adjusted Tobin's Q, similar to the findings for Tobin's Q. When we use operating measures as proxy for firm value, we find a significant negative effect of disclosure on both ROE and ROA. The R^2s for the alternative models are low which indicate that alternative models do not explain the variation in firm value as well as when modeling for Tobin's Q. As before, the results are potentially biased due to endogeneity.

Table 11: Pooled OLS on disclosure initiative in Nordic sample

Dependent variable:	***Q***	***Q'***	***ROE***	***ROA***
DISC	**0.084*** (0.016)**	**0.191*** (0.073)**	**-0.280** (0.141)**	**-0.083*** (0.013)**
Q	-	-	0.892 (0.719)	-0.076** (0.039)
SIZE	-0.040*** (0.005)	-0.113*** (0.025)	0.249*** (0.077)	0.052*** (0.007)
LEV	-0.010** (0.006)	-0.026 (0.024)	-0.317** (0.127)	-0.013*** (0.003)
BM	-0.511*** (0.013)	-1.155*** (0.083)	0.720 (0.527)	-0.057*** (0.015)
ROE	0.022** (0.010)	0.001 (0.067)	-	-
Y_2008	-0.022 (0.019)	0.565*** (0.082)	-0.325* (0.120)	-0.035** (0.016)
Y_2009	-0.017 (0.017)	0.314*** (0.084)	-0.212*** (0.079)	-0.057*** (0.013)
Y_2010	-0.006 (0.016)	0.262*** (0.100)	-0.285** (0.117)	-0.040*** (0.014)
Y_2011	-0.002 (0.020)	0.520*** (0.120)	-0.280** (0.112)	-0.095 (0.059)
_cons	0.650*** (0.067)	1.140*** (0.355)	-3.149*** (0.974)	-0.675*** (0.093)
R^2	0.775	0.362	0.212	0.027
N	2612	2612	2612	2612

The first column presents the coefficients from regressions of Tobin's Q on DISC and control variables. The second column lists the coefficients when regressing industry-adjusted Tobin's Q. Column thee shows the regression coefficients with ROE as dependent variable and the fourth column presents the results when regressing ROA on DISC and control variables. To analyze the panel data with OLS, we pool the cross-sections over time by including dummy variables Y_2008 – Y2011, and choose 2007 as base year. All other variables are described in section 4.4.5. Significance at a 10, 5 and 1 per cent level is indicated as *, ** and *** respectively. We use the White correction to deal with potential heteroscedasticity.

5.2.2 Effects of disclosure level on firm value

We test our hypothesis *H_I* and analyze the relationship between voluntary environmental disclosure and firm value, given by accounting measures. The null hypothesis predicts that there is no association between disclosed environmental information and the value of the firm. In this section, we investigate the effect of absolute disclosure level, and base the disclosure variables on EDSCORE and level portfolios.

5.2.2.1 Effect on Tobin's Q

The results from the robust pooled OLS regression of Tobin's Q are listed in the first column of Table 12. EDSCORE is the disclosure variable and size, leverage, book-to-market ratio, and return on equity are included as control variables. We find that the level of environmental disclosure has a positive coefficient of 0.001, significant at a 5 per cent level.

This indicates that a firm with 10 points higher disclosure score than comparable firms has an approximately 1 per cent higher Tobin's Q ratio, all other variables held constant.

Table 12: Pooled OLS on disclosure level

		Portfolios	***Only extreme***
Dependent variable:	***Q***	***Q***	***Q***
EDSCORE	**0.001** **(0.000)**	-	-
LEVEL_1	-	**0.018** **(0.023)**	**0.052**** **(0.025)**
LEVEL_3	-	**-0.038*** **(0.022)**	-
SIZE	-0.018** (0.009)	-0.017** (0.009)	-0.018* (0.010)
LEV	0.001 (0.005)	0.001 (0.005)	0.001 (0.006)
BM	-0.548*** (0.027)	-0.549*** (0.027)	-0.530*** (0.034)
ROE	-0.180*** (0.054)	-0.178*** (0.055)	-0.029 (0.046)
Y_2008	0.035 (0.037)	0.036 (0.037)	0.063 (0.053)
Y_2009	-0.017 (0.032)	-0.008 (0.032)	0.004 (0.040)
Y_2010	-0.007 (0.032)	0.009 (0.032)	0.011 (0.043)
Y_2011	-0.009 (0.032)	0.012 (0.032)	0.013 (0.044)
_cons	0.273* (0.157)	0.323* (0.167)	0.295 (0.189)
R^2	0.814	0.814	0.814
N	506	506	308

The first column presents the coefficients from regressions of Tobin's Q on EDSCORE and control variables. The second column shows coefficients when regressing Tobin's Q on portfolio inclusion in *High* and *Low* portfolios as disclosure level dummy variables (LEVEL_1 and LEVEL_3) and control variables. The third column restricts the sample to firms in the *High* and *Low* portfolios and the regression include a dummy variable for the *High* Portfolio (LEVEL_1) and the controls variables. To analyze the panel data with OLS we pool the cross-sections over time by including dummy variables Y_2008 – Y2011, and choose 2007 as base year. All variables are describes in section 4.4.5. Significance at a 10, 5 and 1 per cent level is indicated as *, ** and *** respectively. We use the White correction to deal with potential heteroscedasticity.

5.2.2.2 Alternative measures for disclosure level

In addition to the disclosure score, we use the portfolio construction from section 4.4.4 as an alternative measure of disclosure level. First, we use dummies for inclusion in the *High* or *Low* portfolio. The results are listed in the middle column in Table 12. We find that inclusion in *High* has a coefficient of 0.018 and inclusion in *Low* has a negative coefficient of 0.038. The *High* portfolio coefficient is not significant, while the *Low* portfolio coefficient is significant at a 10 per cent level.

Next, we follow the method of Gompers et al. (2003) and exclude the *Midrange* portfolio from the sample, and use a dummy for inclusion in the *High* portfolio as disclosure variable. We do this to isolate the effects of the extreme portfolios. This restriction reduces the sample to 308 observations. The results are listed in the right column of Table 12, and are consistent with previous findings. We find a positive effect of inclusion in the *High* portfolio. The coefficient of the disclosure variable is 0.052, significant within a 95 per cent confidence interval. This implies that firms in *High* have a 5.2 per cent higher Tobin's Q than firms in the *Low* portfolio.

5.2.2.3 Modeling with different proxies for firm value

We change the previous specification with three alternative measures of firm value as dependent variables. In separate regressions for each measure we use disclosure score or portfolio dummy as key independent variable. The results of these six regressions are listed in Table 13. First, we adjust for industry differences and regress with industry-adjusted Tobin's Q as the dependent variable. The coefficient for environmental disclosure score is positive, but not significant, at 0.002. The portfolio dummy with a coefficient of 0.048, show the same indication, but it is still insignificant. Next, we use the operating performance measures ROE and ROA as dependent variables. The disclosure variable EDSCORE has a significant, positive effect of 0.002 at a 5 per cent significance level on ROE, and an insignificant, and slightly positive effect on ROA. The latter coefficient is approximately zero. When comparing the *High* with the *Low* portfolio, both ROE and ROA is greater in High, but the coefficients are not significant. The R^2 for these regressions is relatively low, and indicate a lower degree of explanation compared to the main model.

Table 13: Disclosure level - Alternative proxies for firm value

Dependent variable	***Q'***		***ROE***		***ROA***	
	Full sample	*Only extremes*	*Full sample*	*Only extremes*	*Full sample*	*Only extremes*
EDSCORE	**0.002 (0.002)**		**0.002** (0.001)**		**0.000 (0.000)**	-
LEVEL_1	-	**0.048 (0.089)**	-	**0.018 (0.025)**	-	**0.002 (0.014)**
Q	-	-	-0.259** (0.115)	-0.033 (0.050)	0.115*** (0.115)	0.101*** (0.031)
SIZE	0.000 (0.028)	0.004 (0.037)	-0.002 (0.013)	0.025*** (0.010)	0.012*** (0.004)	0.014*** (0.005)
LEV	0.004 (0.13)	0.002 (0.016)	0.020* (0.115)	0.001 (0.004)	-0.006*** (0.001)	-0.006*** (0.002)
BM	-0.872*** (0.089)	-0.874*** (0.118)	-0.346*** (0.092)	-0.150*** (0.031)	-0.014 (0.010)	-0.016 (0.014)
ROE	-0.100 (0.112)	0.157 (0.170)	-	-	-	-
Y_2008	0.410*** (0.122)	0.596*** (0.185)	-0.001 (0.045)	-0.081* (0.046)	-0.021 (0.020)	-0.021 (0.026)
Y_2009	0.114 (0.124)	0.225 (0.166)	-0.075* (0.044)	-0.100*** (0.032)	-0.027** (0.012)	-0.015 (0.014)
Y_2010	0.067 (0.127)	0.228 (0.182)	-0.082** (0.033)	-0.071*** (0.032)	-0.023** (0.011)	-0.015 (0.013)
Y_2011	0.239* (0.125)	0.430** (0.184)	-0.054 (0.036)	-0.055* (0.032)	-0.011 (0.012)	-0.001 (0.012)
_cons	-0.426 (0.495)	-0.553 (0.679)	-0.028 (0.884)	-0.361** (0.167)	-0.173*** (0.065)	-0.200** (0.085)
R^2	0.500	0.489	0.365	0.225	0.289	0.254
N	506	308	506	308	506	308

The first column presents the coefficients from regressions of industry-adjusted Tobin's Q on EDSCORE and control variables. . First, the full disclosure sample is used and EDSCORE is the disclosure variable. Then, the sample is restricted to only the extreme portfolios, and the disclosure variable is the dummy for inclusion in *High.* Column two shows the regression coefficients with ROE as dependent variable and the third column presents the results when regressing ROA on EDSCORE and control variables. The same two alternative samples are used for these two regressions and marked as Full sample and Only Extremes. To analyze the panel data with OLS we pool the cross-sections over time by including dummy variables Y_2008 – Y2011, and choose 2007 as base year. All variables are described in section 4.4.5. Significance at a 10, 5 and 1 per cent level is indicated as *, ** and *** respectively. We use the White correction to deal with potential heteroscedasticity.

5.2.2.4 Summary of findings

Overall, the results of looking at the effect of disclosure level on firm value suggest a positive relation. The absolute level of environmental disclosure has a positive association with firm value, measured as Tobin's Q. The models with alternative proxies for firm value, although less significant, suggest the same positive association as the original model.

5.2.3 Effects of changes in disclosure on firm value

We want to investigate whether an improvement or aggravation in environmental disclosure score from year t-1 to year t has an effect on firm value. Tobin's Q remains our main proxy for firm value, and the disclosure variables are CHSCORE and change portfolios. We test the robustness of the results by looking at alternative measures.

5.2.3.1 Tobin's Q as proxy for firm value

When calculating the disclosure change scores CHSCORE, we lose one year of observations for each firm. This implies that there are no observations for 2007, and we use 2008 as reference year for the year dummies. We use robust pooled OLS regression on Tobin's Q and the results are listed in the first column in Table 14. The coefficient of the disclosure variable is insignificant and approximately zero. The low and insignificant coefficient for disclosure change implies that improvement or aggravation in environmental disclosure score has no statistically documented effect on firm value.

Table 14: Pooled OLS on disclosure change

Dependent variable:	***Q***	***Portfolios Q***	***Only extreme Q***
CHSCORE	**0.000 (0.000)**	-	-
CHANGE_1	-	**-0.001 (0.027)**	**0.009 (0.025)**
CHANGE_3	-	**0.000 (0.029)**	-
SIZE	-0.023** (0.011)	-0.022** (0.011)	-0.023** (0.010)
LEV	0.007 (0.006)	0.007 (0.006)	0.005 (0.006)
BM	-0.537*** (0.035)	-0.537*** (0.034)	-0.553*** (0.033)
ROE	-0.142* (0.074)	-0.142* (0.073)	0.079* (0.046)
Y_2009	-0.040 (0.035)	-0.040 (0.035)	-0.045 (0.039)
Y_2010	-0.021 (0.035)	-0.021 (0.036)	-0.059 (0.043)
Y_2011	-0.014 (0.037)	-0.014 (0.036)	-0.074* (0.040)
_cons	0.439** (0.192)	0.439** (0.195)	0.443** (0.180)
R^2	0.805	0.805	0.837
N	349	349	243

The first column presents the coefficients from regressions of Tobin's Q on CHSCORE and control variables. The second column shows coefficients when regressing Tobin's Q on portfolio inclusion in *Pos_Change* and Neg_Change portfolios as disclosure level dummy variables (CHANGE_1 and CHANGE_3) and control variables. The third column restricts the sample to firms in the *Pos_Change* and *Neg_Change* portfolios and the regression include a dummy variable for the *Pos_Change* Portfolio (CHANGE_1) and the controls variables. We include dummy variables Y_2009 – Y2011, and choose 2008 as base year. All variables are described in section 4.4.5. Significance at a 10, 5 and 1 per cent level is indicated as *, ** and *** respectively. We use the White correction to deal with potential heteroscedasticity.

5.2.3.2 Alternative measures for disclosure change

We apply alternative measures for disclosure change to test the validity of our previous results. First, we use inclusion in disclosure change portfolios as dummy variables in the regression. The results are shown in column two in Table 14. The coefficients are very low and insignificant for both the *Pos_Change* and *Neg_Change* portfolio. This implies that we find no evidence of firms included in neither the improvement nor the aggravation portfolio to have a significantly higher or lower Tobin's Q that the firms with a stable disclosure score, ceteris paribus.

Last, we restrict the sample to only include the two extreme portfolios, *Pos_Change* and *Neg_Change*. The third column in Table 14 shows the regression output with Q as dependent variable, the dummy variable for the *Pos_Change* and the control variables. The *Pos_Change* dummy variable has a positive, but insignificant coefficient of 0.009. The R^2 for the model is 0.837 and the number of observations is reduced to 243.

5.2.3.3 Modeling with different proxies for firm value

We test the robustness of the results by modeling with alternative measures for firm value. The regression output is listed in Table 15. The R^2s are lower, and the models explain less of the variation in the firm value measure, than when regressing Tobin's Q. With industry-adjusted Q as dependent variable, the coefficient for disclosure change is the same as for Q; both insignificant and approximately zero. When analyzing only the extreme portfolios, we find no significant coefficient of inclusion in the *Pos_Change* portfolio. This supports the previous finding that improvements or aggravations in disclosure score have no effect on firm value.

When we apply operating performance measures as dependent variable, the coefficients for disclosure change are negative. With ROE as dependent variable, CHSCORE has an insignificant coefficient of -0.001. When restricting the sample to only the extremes, the dummy for inclusion in *Pos_Change* has a negative, insignificant coefficient. When regressing ROA, the coefficient of CHSCORE is significant at -0.001. The same is indicated in the extreme comparison where the dummy has a significant coefficient of -0.027. Both are significant at a 5 per cent level. This implies that an effort to improve the firms' environmental disclosure has a negative impact on operating performance.

Table 15: Disclosure change - Alternative proxies for firm value

Dependent variable:	***Q'***		***ROE***		***ROA***	
	Full sample	*Only extremes*	*Full sample*	*Only extremes*	*Full sample*	*Only extremes*
CHSCORE	**0.000 (0.002)**	-	**-0.001 (0.001)**	-	**-0.001** (0.000)**	-
CHANGE_1	-	**0.015 (0.085)**	-	**-0.018 (0.027)**	-	**-0.027** (0.014)**
Q	-	-	-0.197 (0.147)	0.082* (0.049)	0.135*** (0.020)	0.179*** (0.025)
SIZE	-0.010 (0.033)	-0.020 (0.034)	0.012 (0.017)	0.028** (0.011)	0.017*** (0.004)	0.015*** (0.005)
LEV	0.011 (0.014)	0.014 (0.016)	0.017 (0.013)	-0.002 (0.003)	-0.007*** (0.001)	-0.006*** (0.002)
BM	-0.832*** (0.100)	-0.866*** (0.105)	-0.319*** (0.118)	-0.086*** (0.027)	-0.011 (0.010)	0.027 (0.014)
ROE	0.022 (0.145)	0.453*** (0.172)	-	-	-	-
Y2009	-0.226** (0.098)	-0.238** (0.118)	-0.048 (0.043)	-0.038 (0.042)	-0.006 (0.021)	-0.000 (0.026)
Y2010	-0.275*** (0.102)	-0.342** (0.140)	-0.055 (0.045)	0.020 (0.041)	-0.006 (0.020)	0.013 (0.026)
Y2011	-0.098 (0.101)	-0.262** (0.121)	-0.018 (0.040)	0.006 (0.045)	0.011 (0.020)	0.020 (0.026)
_cons	0.242 (0.577)	0.396 (0.618)	-0.185 (0.282)	-0.442** (0.205)	-0.256*** (0.070)	-0.229*** (0.088)
R^2	0.521	0.552	0.336	0.211	0.372	0.341
N	349	243	349	243	349	243

The first column presents the coefficients from regressions of industry-adjusted Tobin's Q on CHSCORE and control variables. . First, the full disclosure sample is used and CHSCORE is the disclosure variable. Then, the sample is restricted to only the extreme portfolios, and the disclosure variable is the dummy for inclusion in *Pos_Change.* Column two shows the regression coefficients with ROE as dependent variable and the third column presents the results when regressing ROA on CHSCORE and control variables. The same two alternative samples are used for these two regressions and marked as Full sample and Only Extremes. To analyze the panel data with OLS we pool the cross-sections over time by including dummy variables Y_2009 – Y2011, and choose 2008 as base year. All variables are described in section 4.4.5. Significance at a 10, 5 and 1 per cent level is indicated as *, ** and *** respectively. We use the White correction to deal with potential heteroscedasticity.

5.2.3.4 Summary of findings

The direction of the effect of disclosure change depends on the proxy for firm value. The effect of disclosure change is approximately zero on financial performance measures, but we observe a negative effect on operating measures. Only the impact on ROA is statistically significant. However, the goodness of fit for the models with alternative firm value proxies is poorer than for the main model with Tobin's Q. Reasons for this could be that the variables are difficult to predict, or an omitted variable scenario. In the latter case, the estimates are biased.

5.3 Fixed effects regression

Our analysis is based on panel data, which may result in residuals that are correlated across firms or time leading to bias in OLS standard errors (Woolridge 2009). To control for this, we validate our analysis by using the panel data method of fixed effects.

5.3.1 Fixed effects on absolute disclosure level

The results from the fixed effects regression on Tobin's Q are listed in the left column of Table 16. We find the coefficient for the disclosure variable to be positive at 0.001 and significant within a 95 per cent confidence interval. The model has a coefficient of determination of 0.737. These findings are in line with the findings of the pooled OLS regression, and imply a positive association between environmental disclosure level and firm value.

Table 16: Fixed effects of disclosure level

		Portfolios	***Only extreme***
Dependent variable:	***Q***	***Q***	***Q***
EDSCORE	**0.001**** **(0.000)**	-	-
LEVEL_1	-	**0.016** **(0.014)**	**0.057**** **(0.022)**
LEVEL_3	-	**-0.016** **(0.015)**	-
SIZE	-0.199*** (0.042)	-0.195*** (0.042)	-0.171*** (0.064)
LEV	0.008 (0.009)	0.006 (0.009)	0.010 (0.014)
BM	-0.406*** (0.016)	-0.406*** (0.016)	-0.432*** (0.022)
ROE	0.005 (0.031)	0.001 (0.031)	0.032 (0.040)
_cons	3.470 (0.725)	3.460 (0.729)	2.99*** (1.11)
R^2 *(within)*	0.737	0.735	0.753
N	506	506	308

The first column presents the coefficients from FE regressions of Tobin's Q on EDSCORE and control variables. The second column shows coefficients when regressing Tobin's Q on portfolio inclusion in *High* and *Low* portfolios as disclosure level dummy variables (LEVEL_1 and LEVEL_3) and control variables. The third column restricts the sample to firms in the *High* and *Low* portfolios and the regression include a dummy variable for the *High* Portfolio (LEVEL_1) and the controls variables. All variables are described in section 4.4.5. Significance at a 10, 5 and 1 per cent level is indicated as *, ** and *** respectively. We use the White correction to deal with potential heteroscedasticity.

We apply alternative measures for disclosure level, and the results are shown in the second and third column of Table 16. Under fixed effects, we find that inclusion in the *High* portfolio has a positive coefficient of 0.016 and inclusion in the *Low* portfolio has a negative coefficient of 0.016. The results are not significant, but consistent with the findings of the OLS regression.

When excluding the *Midrange* portfolio from the sample, the *High* portfolio coefficient is significant within a 95 per cent confidence interval with a value of 0.057. This implies that a firm in the *High* portfolio has a 5.7 per cent higher Tobin's Q than a firm in *Low* portfolio. The results for the alternative measures of disclosure level are in line with the findings from the pooled OLS regression model.

5.3.1.1 Modeling for alternative proxies of firm value

As in the pooled OLS regression model, we apply three alternative dependent variables. Results are displayed in Table 17. When using industry-adjusted Tobin's Q as dependent variable, we find a positive and insignificant coefficient of 0.001 on EDSCORE. The dummy variable for inclusion in the High portfolio is also positive, but insignificant. This is in line with previous results.

Under fixed effects, we find that disclosure level has a significant negative effect on operating measures when using EDSCORE as key independent variable. The variable has a coefficient of -0.001 for both ROE and ROA, and the results are significant at a 10 and 5 per cent significance level respectively. The regressions with only *High* and *Low* portfolios indicate the same negative association, but are statistically insignificant. The findings indicate a negative association between the operating performance measures and level of disclosure, and are contradictory to previous findings.

Table 17: Fixed effects of disclosure level on alternative value proxies

Dependent variable:	***Q'***		***ROE***		***ROA***	
	Full sample	*Only extreme*	*Full sample*	*Only extreme*	*Full sample*	*Only extreme*
EDSCORE	**0.001 (0.001)**	-	**-0.001* (0.001)**	-	**-0.001** (0.001)**	-
LEVEL_1	-	**0.068 (0.084)**	-	**-0.052 (0.042)**	-	**-0.021 (0.022)**
Q	-	-	0.015 (0.091)	0.114 (0.143)	0.070 (0.045)	0.009 (0.060)
SIZE	-0.097 (0.143)	0.101 (0.244)	0.440*** (0.070)	0.599*** (0.114)	0.209*** (0.034)	0.240*** (0.060)
LEV	0.015 (0.031)	0.031 (0.053)	0.017 (0.016)	0.010 (0.026)	-0.012 (0.008)	-0.011 (0.014)
BM	-0.505*** (0.054)	-0.580*** (0.083)	-0.174*** (0.045)	-0.122 (0.074)	-0.029 (0.022)	-0.061 (0.039)
ROE	-0.006 (0.106)	-0.072 (0.154)	-	-	-	-
_cons	1.640 (2.483)	-1.795 (4.236)	-7.561*** (1.216)	-10.392*** (1.983)	-3.532 (0.601)	-4.114 (1.044)
R^2 *(within)*	0.251	0.243	0.178	0.195	0.125	0.118
N	506	308	506	308	506	308

The first column presents the coefficients from FE regressions of industry-adjusted Tobin's Q on the disclosure variable and control variables. First, the full disclosure sample is used and EDSCORE is the disclosure variable. Then, the sample is restricted to only the extreme portfolios, and the disclosure variable is the dummy for inclusion in *High*. Column two shows the regression coefficients with ROE as dependent variable and the third column presents the results when regressing ROA on EDSCORE and control variables. The same two alternative samples are used for these two regressions and marked as Full sample and Only Extremes. All variables are described in section 4.4.5. Significance at a 10, 5 and 1 per cent level is indicated as *, ** and *** respectively. We use the White correction to deal with potential heteroscedasticity.

5.3.1.2 Summary of findings

The fixed effects regressions on financial performance measures show results consistent with the findings in the pooled regression. The results with operating measures as proxies for firm value indicate an opposite direction of the effects than under pooled OLS. However, the coefficients of determination indicate a poor fit for these models.

5.3.2 Fixed effects on disclosure changes

Similar to the procedures in the pooled OLS regression, we employ the disclosure change score as key independent variable to capture the potential effect of change in environmental disclosure level from year t-1 to year t. The regression output is listed in column one in Table 18. The disclosure variable, CHSCORE, has a statistically insignificant coefficient of approximately zero. This result is in accordance with the results from the OLS regression, and supports the finding that improvement or aggravation in disclosure score has very little effect on firm value, measured as Tobin's Q.

Table 18: Fixed effects on disclosure change

Dependent variable:	***Q***	***Portfolios Q***	***Only extreme Q***
CHSCORE	**0.000 (0.000)**	-	-
CHANGE_1	-	**-0.004 (0.014)**	**0.004 (0.014)**
CHANGE_3	-	**-0.003 (0.016)**	-
SIZE	-0.274*** (0.062)	-0.274*** (0.062)	-0.172* (0.089)
LEV	0.031*** (0.011)	0.031*** (0.011)	0.040*** (0.015)
BM	-0.370*** (0.019)	-0.370*** (0.019)	-0.417*** (0.025)
ROE	0.001 (0.034)	0.005 (0.034)	0.054 (0.046)
_cons	4.86*** (1.085)	4.861*** (1.090)	3.034* (1.549)
R^2 *(within)*	0.684	0.684	0.744
N	349	349	243

The first column presents the coefficients from FE regressions of Tobin's Q on CHSCORE and control variables. The second column shows coefficients when regressing Tobin's Q on portfolio inclusion in *Pos_Change* and *Neg_Change* portfolios as disclosure level dummy variables (CHANGE_1 and CHANGE_3) and control variables. The third column restricts the sample to the extreme portfolios and the regression includes a dummy variable for the *Pos_Change* portfolio (CHANGE_1) and the controls variables. All variables are described in section 4.4.5. Significance at a 10, 5 and 1 per cent level is indicated as *, ** and *** respectively. We use the White correction to deal with potential heteroscedasticity.

We employ different measures for disclosure change to validate our findings, and the results are listed in Table 18. Column two shows the regression output when using portfolio dummies as disclosure variables. The results show that both the *Pos_Change* and *Neg_Change* dummies have negative, but insignificant coefficients of -0.004 and -0.003 respectively. When only including firms within the two extreme portfolios in the regression sample, the *Pos_Change* dummy has a positive and insignificant coefficient of 0.004. These findings are in line with the findings with OLS regression.

5.3.2.1 Modeling with different proxies for firm value

We model for alternative proxies for firm value and the results are listed in Table 19. The alternative models give a CHSCORE coefficient of -0.001 for all the value proxies when applying the full disclosure sample. The coefficients are statistically insignificant with industry-adjusted Q and ROE as dependent variable. With ROA as the dependent variable, the coefficient is significant at a 5 per cent significance level. When we restrict the sample to only include the extreme portfolios, the dummy variable for inclusion in *Pos_Change* is negative for all three firm value proxies. For industry-adjusted Q, the disclosure variable has an insignificant variable of -0.032. ROE has a significant disclosure coefficient of -0.047 at a

10 per cent level, and ROA has a significant coefficient of -0.034 at a 5 per cent level. These results are in accordance with the results of the pooled OLS regression. The R^2s are very low and imply that the models explain very little of the observed variation in the dependent variable.

Table 19: Fixed effects of disclosure change on alternative value proxies

Dependent variable	***Q'***		***ROE***		***ROA***	
	Full sample	*Only extremes*	*Full sample*	*Only extremes*	*Full sample*	*Only extremes*
CHSCORE	**-0.001 (0.001)**	-	**-0.001 (0.001)**	-	**-0.001** (0.000)**	-
CHANGE_1	-	**-0.032 (0.044)**	-	**-0.047* (0.026)**	-	**-0.034** (0.016)**
Q	-	-	0.020 (0.129)	0.196 (0.168)	0.086 (0.061)	0.131 (0.101)
SIZE	-0.056 (0.186)	0.230 (0.285)	0.624*** (0.119)	1.012*** (0.147)	0.318*** (0.056)	0.468*** (0.088)
LEV	0.045 (0.032)	0.066 (0.048)	0.017 (0.021)	-0.041 (0.029)	-0.008 (0.010)	-0.022 (0.017)
BM	-0.434*** (0.057)	-0.526*** (0.081)	-0.135** (0.060)	-0.045 (0.085)	-0.018 (0.028)	-0.020 (0.051)
ROE	0.042 (0.102)	-0.033 (0.148)	-	-	-	-
_cons	1.042 (3.253)	-3.997 (4.981)	-10.901*** (2.081)	-17.584*** (2.567)	-5.505*** (0.976)	-8.104*** (1.539)
R^2	0.227	0.266	0.150	0.282	0.148	0.209
N	349	243	349	243	349	243

The first column presents the coefficients from FE regressions of industry-adjusted Tobin's Q on the disclosure variable and control variables. First, the full disclosure sample is used and CHSCORE is the disclosure variable. Then, the sample is restricted to only the extreme portfolios, and the disclosure variable is the dummy for inclusion in *Pos_Change.* Column two shows the regression coefficients with ROE as dependent variable and the third column presents the results when regressing ROA on CHSCORE and control variables. The same two alternative samples are used for these two regressions and marked as Full sample and Only Extremes. All variables are described in section 4.4.5. Significance at a 10, 5 and 1 per cent level is indicated as *, ** and *** respectively.

5.3.2.2 Summary of findings

The results from the fixed effects regressions on disclosure change are consistent with the results we found in the pooled OLS regression. We cannot document any significant effect on financial performance measures and we find indications of a negative effect of disclosure change on operating measures. The R^2 for the alternative models, is however very low and indicates a poor fit for these models. Overall, our findings suggest that improvements or aggravations in the level of disclosed environmental information has no statistically significant impact on firm value.

5.4 Portfolio returns

5.4.1 Disclosure level portfolios

We calculate both the value-weighted and equal-weighted portfolio returns for each period t, following the method described in section 4.3.1.

Figure 3 shows the value-weighted returns over the 5-year time period. By investing NOK 1000 in the *High* portfolio at the beginning of 2007, the investment grows to NOK 1370.7 by November 31, 2011. This equals a value-weighted return of 37.1 per cent over the 5-year period, and an annualized return of 7.4 per cent. A similar investment in the *Midrange* portfolio yields a value-weighted 5-year return of 62.1 per cent and 0.1 per cent for the *Low* portfolio. These results show that *High* outperforms *Low*, but an investment in the *Midrange* portfolio yields the best return over the 5-year period.

Figure 3: Value-weighted returns of level portfolios

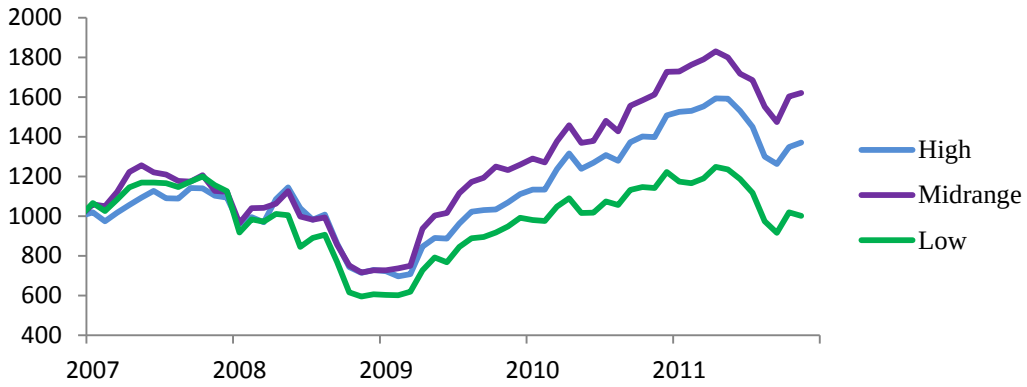
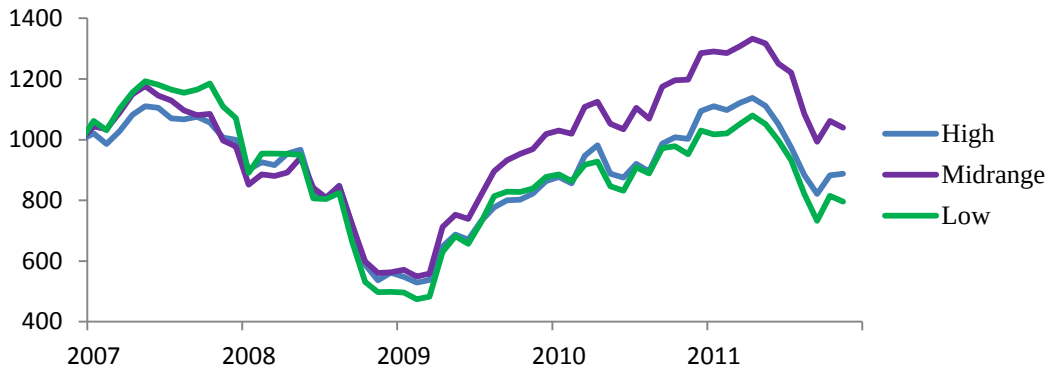


Figure 4 shows the equal-weighted portfolio returns. By investing NOK 1000 in the *High* portfolio at the beginning of 2007, the investment has declined to NOK 887.2 by the end of November 2011. This constitutes a return of – 11.4 per cent over the 5-year period, and an annualized return of – 2.3 per cent. For the *Midrange* portfolio the 5-year investment yields a return of 5.3 per cent, or an annualized return of 1.1 per cent. An investment in the *Low* portfolio gives a 5-year return of – 20.5 per cent, and an annualized return of – 4.1 per cent.

Figure 4: Equal-weighted returns of level portfolios



The portfolio growth patterns follow the same trend for both value-weighted and equal-weighted returns, and we observe differences in portfolio returns. The *Midrange* portfolio outperforms the *High* and *Low* portfolios, and *High* yields a higher return than *Low*. When calculating equal-weighted returns, the returns of small firms in the portfolio are given greater weighting than under value-weighted return calculation. As we observed in the summary statistics, the size differences between *High* and *Low* are statistically significant, which implies that the *High* portfolio consists of larger companies than the *Low* portfolio. The differences between the value-weighted and equal-weighted returns for our portfolios suggest that the larger firms in the sample yields relatively higher returns than the smaller firms. We will use both value-weighted and equal-weighted returns in the following analysis.

5.4.2 Disclosure change portfolios

We examine the differences in returns between the disclosure change portfolios. We also observe disparities in returns using this portfolio construction, but the differences are distributed differently than with level portfolios. By investing NOK 1000 in the *Pos_Change* portfolio at the beginning of 2008, the investment grows to NOK 1473.7 by November 31, 2011. This equals a value-weighted return of 47.4 per cent over the 4-year period, and an annualized return of 9.5 per cent. A similar investment in the *No_Change* portfolio gives a value-weighted 4-year return of 14.4 per cent, equal to 2.9 per cent annualized. The *Neg_Change* portfolio yields a 4-year return of 5.3 per cent, which means an annualized return of 1.1 per cent.

Pos_Change outperforms the two other portfolios and gives the best return over the 4-year period. The *No_Change* portfolio yields a better return than the *Neg_Change* portfolio. This

implies that investing in firms that improve their disclosure score by more than five points from one year to the next yields a better return than investing in firms with a fairly stable disclosure level over the time period. Investing in firms which reduce the quantity of disclosed information gives the poorest return over the time period. Figure 5 shows the trends in the value-weighted portfolio returns.

Figure 5: Value-weighted returns of change portfolios

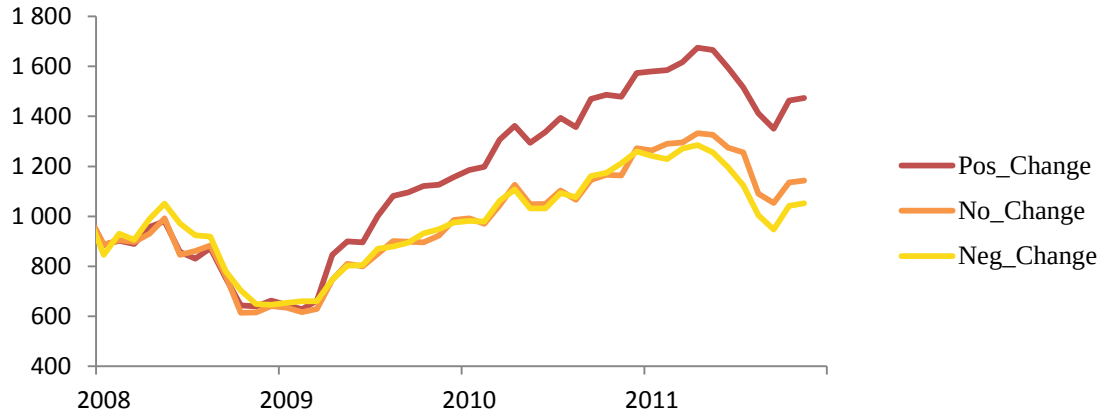
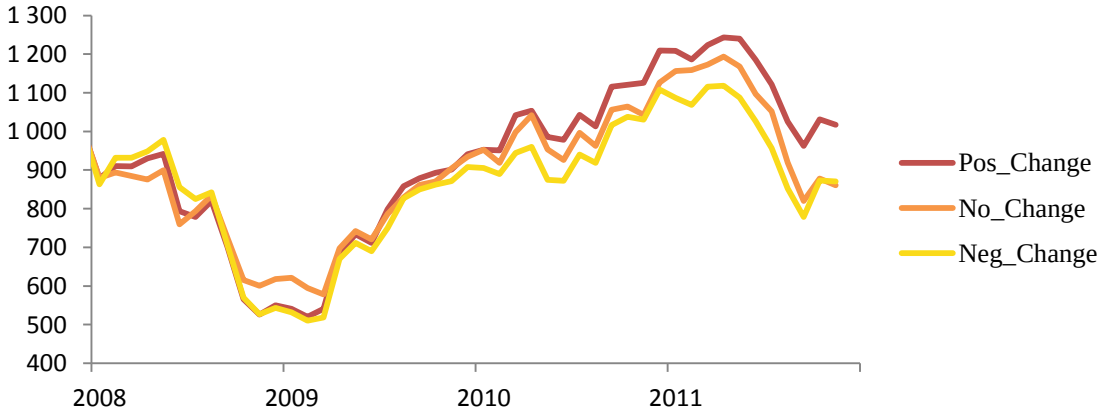


Figure 6 shows the equal-weighted portfolio returns. By investing NOK 1000 in *Pos_Change* at the beginning of 2008, the investment grows to NOK 1021.8 by the end of November 2011. This constitutes a return of 2.2 per cent over the 4-year period, and an annualized return of 0.44 per cent. For *No_Change*, the 4-year investment yields a return of – 13 .5 per cent, or an annualized return of 2.7 per cent. An investment in *Neg_Change* gives a 4-year return of – 13.06 per cent, and an annualized return of – 2.61 per cent.

Figure 6: Equal-weighted returns of change portfolios



The portfolio growth patterns follow the same trend for both value-weighted and equal-weighted returns. Firms with improved disclosure score yield the highest returns and firms with aggravated disclosure yield the poorest returns.

5.5 Factor model regressions

In this section, we examine our sub-hypothesis *H_II* by regressing stock returns on voluntary environmental disclosure characteristics. In the previous section, we examined the differences in portfolios returns. The results revealed a disparity in the returns, both when constructing portfolios based on disclosure level and on disclosure change. As proposed in section 4.3.2, one explanation for these observed disparities can be that the performance differences are driven by differences in firm characteristics of the portfolios. To examine this, we apply the three-factor model of Fama and French (1993) and the four-factor model of Carhart (1997). When comparing our constructed Nordic factors to the European factors, we found the Nordic momentum factor to behave differently than expected. To account for this, we use both models in the analysis. The dependent variable R_t in the regression is monthly excess portfolio returns or monthly return differences between the extreme portfolios in each set of portfolios.

5.5.1 Disclosure level and stock returns

First, we examine the relationship between the absolute level of environmental disclosure and stock returns.

5.5.1.1 Three-factor model for disclosure level

The results of the three-factor model on both value-weighted and equal-weighted returns are listed in Table 20. With value-weighted returns, we find that the *Midrange* portfolio preforms better than both the *High* and *Low* portfolios. None of the extreme portfolios have significant alpha coefficients, but *Midrange* has a significant intercept at a 10 per cent significance level. *Midrange* has the highest alpha of 0.36, while both *High* and *Low* have negative alphas, of -0.03 and -0.43 respectively. The return difference *High-Low* has an insignificant alpha of 0.40. This alpha is the abnormal return on a zero-investment strategy that buys the *High* portfolio and sells short the *Low* portfolio.

When applying the three-factor model on the equal-weighted portfolio returns, *High* has a significant alpha of -0.48 at a 10 per cent level. *Midrange* has an insignificant alpha value of -0.17, and *Low* has an alpha of -0.49, which is significant at a 10 per cent significance level. All portfolio alphas are negative when weighing the returns equally, with *Midrange* having the least negative alpha, and *Low* having the most negative value. The return difference

between the two extreme portfolios has an insignificant alpha value of 0.01 with equal-weighted returns.

Table 20: Three-factor model of disclosure level portfolios

Value-weighted returns

	α	***RMRF***	***SMB***	***HML***	R^2
High	-0.03 (0.21)	1.02*** (0.05)	-0.14** (0.06)	-0.01 (0.06)	0.93
Midrange	0.36* (0.21)	1.02*** (0.06)	-0.02 (0.06)	0.07 (0.07)	0.94
Low	-0.43 (0.36)	1.05*** (0.10)	0.01 (0.10)	0.08 (0.10)	0.89
High-Low	0.40 (0.45)	-0.04 (0.13)	-0.15 (0.14)	-0.09 (0.13)	0.08

Equal-weighted returns

	α	***RMRF***	***SMB***	***HML***	R^2
High	-0.48* (0.25)	0.96*** (0.07)	0.09 (0.09)	0.22*** (0.07)	0.93
Midrange	-0.17 (0.22)	0.93*** (0.06)	0.24*** (0.07)	0.24*** (0.07)	0.95
Low	-0.49* (0.25)	1.11*** (0.07)	0.20** (0.08)	0.36*** (0.07)	0.94
High-Low	0.01 (0.33)	-0.15 (0.10)	-0.11 (0.12)	-0.14 (0.10)	0.28

The level portfolios are described in section 5.2.1. The last row contains the results when we use the portfolio that buys the High portfolio and sells short the Low portfolio. The portfolios are reset at each year-end, according to new disclosure data. The independent variables are RMRF, SMB and HML. These variables are constructed to capture market, size and book-to-market effects, see section 4.4.6. Standard errors are reported in parenthesis. All variables are described in section 4.4.5. Significance at a 10, 5 and 1 per cent level is indicated as *, ** and *** respectively. We use the White correction to deal with potential heteroscedasticity.

5.5.1.2 Four-factor model for disclosure level

Table 21 shows the regression output from applying the four-factor model on value-weighted returns and equal-weighted level portfolio returns. The *Midrange* portfolio has a significant alpha of 0.39 at a 10 per cent significance level. Both *High* and *Low* have insignificant and negative alphas of -0.06 and -0.41 respectively. The *High-Low* return difference has an insignificant, but positive alpha of 0.35. These findings are consistent with the results of the three-factor model.

With equal-weighted returns, the *High* portfolio has an alpha of -0.52 and *Low* has an alpha of -0.54, both significant at a 5 per cent significance level. The *Midrange* alpha is insignificant at -0.18. The return difference *High-Low* has a positive, but insignificant alpha of 0.02.

Table 21: Four-factor model of disclosure level portfolios

Value-weighted returns

	α	***RMRF***	***SMB***	***HML***	***MOM***	R^2
High	-0.06 (0.22)	1.02*** (0.07)	-0.17* (0.09)	-0.03 (0.09)	0.04 (0.07)	0.93
Midrange	0.39* (0.23)	1.01*** (0.06)	0.01 (0.09)	0.10 (0.09)	-0.04 (0.08)	0.94
Low	-0.41 (0.32)	1.05*** (0.10)	0.02 (0.11)	0.09 (0.09)	-0.02 (0.32)	0.89
High-Low	0.35 (0.42)	-0.03 (0.13)	-0.19 (0.16)	-0.12 (0.14)	0.06 (0.13)	0.09

Equal-weighted returns

	α	***RMRF***	***SMB***	***HML***	***MOM***	R^2
High	-0.52** (0.24)	0.96*** (0.07)	0.05 (0.11)	0.19*** (0.06)	0.05 (0.08)	0.93
Midrange	-0.18 (0.20)	0.93*** (0.06)	0.24*** (0.08)	0.24*** (0.07)	0.01 (0.07)	0.95
Low	-0.54** (0.25)	1.11*** (0.07)	0.16 (0.11)	0.32*** (0.09)	0.06 (0.08)	0.94
High-Low	0.02 (0.34)	-0.15 (0.10)	-0.10 (0.16)	-0.13 (0.11)	-0.01 (0.12)	0.28

The level portfolios are described in section 5.2.1. The last row contains the results when we use the portfolio that buys the High portfolio and sells short the Low portfolio. The portfolios are reset at each year-end, according to new disclosure data. The independent variables are RMRF, SMB, HML, and Momentum. These variables are constructed to capture market, size, book-to-market, and momentum effects, see section 4.4.6. Standard errors are reported in parenthesis. All variables are described in section 4.4.5. Significance at a 10, 5 and 1 per cent level is indicated as *, ** and *** respectively. We use the White correction to deal with potential heteroscedasticity.

5.5.1.3 Summary of findings

The results of both the three-factor and four-factor model show that the *Midrange* portfolio has the highest alpha value, and outperforms the two extreme portfolios. *High* performs better that *Low*, but the results are not statistically significant. Overall, we find little evidence of disclosure level having a significant effect on stock returns.

5.5.2 Disclosure change and stock returns

To test the impact of change in disclosure level, we repeat the same tests as in 5.5.1 on the portfolios constructed to capture disclosure change effects.

5.5.2.1 Three-factor model for disclosure change

The regression output from the three-factor model on value-weighted and equal-weighted portfolio returns are listed in Table 22. With value-weighted returns for the change portfolios, we find that the *Pos_Change* portfolio outperforms the two other portfolios with a significant alpha of 0.55. *Neg_Change* has a negative alpha of 0.6 within a 5 per cent

significance level. We find a slight negative alpha for the *No_Change* portfolio of 0.04, but this coefficient is not significant. When comparing the returns of *Pos_Change* to the returns of *Neg_Change*, we find a significant alpha of 1.16 at a 5 per cent significance level. This indicates that very little of the differences in raw returns can be attributes to differences in style between the two extreme portfolios. An investment strategy based of investing in the *Pos_Change* portfolio and going short in the *Neg_Change* portfolio yields a monthly abnormal excess return of 1.16 per cent, or about 13.9 per cent annually.

When applying the same model on the equal-weighted returns we find no significant alphas. However, the alpha coefficient has the highest value for *Pos_Change* at - 0.08, and the lowest value for *Neg_Change* at -0.43. This indicates that the *Pos_Change* portfolio yields a higher abnormal return than the *Neg_Change* portfolio, although the results are not statistically significant. The return difference between the two extreme portfolios gives a positive, but insignificant alpha of 0.36. Hence, we observe the same trends for the equal weighted returns as observed for value-weighted returns, but with less statistical significance.

Table 22: Three-factor model with disclosure change portfolios

Value-weighted returns

	α	***RMRF***	***SMB***	***HML***	R^2
Pos_Change	0.55* (0.29)	1.03*** (0.06)	-0.11** (0.06)	0.22*** (0.07)	0.93
No_Change	-0.04 (0.33)	0.96*** (0.07)	0.00 (0.09)	0.14* (0.07)	0.91
Neg_Change	-0.60** (0.28)	1.02*** (0.06)	-0.11 (0.07)	-0.25*** (0.06)	0.92
Pos_Change-Neg_Change	1.16** (0.51)	0.01 (0.11)	-0.01 (0.10)	0.47*** (0.13)	0.26

Equal-weighted returns

	α	***RMRF***	***SMB***	***HML***	R^2
Pos_Change	-0.08 (0.29)	1.00*** (0.06)	0.07 (0.09)	0.34*** (0.07)	0.94
No_Change	-0.45 (0.39)	0.79*** (0.08)	0.29*** (0.10)	0.29*** (0.10)	0.89
Neg_Change	-0.43 (0.27)	1.11*** (0.07)	0.03 (0.08)	0.32*** (0.08)	0.95
Pos_Change-Neg_Change	0.36 (0.27)	-0.11* (0.07)	0.04 (0.07)	0.02 (0.08)	0.10

The change portfolios are described in section 5.2.2. The last row contains the results when we use the portfolio that buys the *Pos_Change* portfolio and sells short the *Neg_Change* portfolio. The portfolios are reset at each year-end, according to new disclosure data. The independent variables are RMRF, SMB and HML. These variables are constructed to capture market, size and book-to-market effects, see section 4.4.6.. Standard errors are reported in parenthesis. All variables are described in section 4.4.5. Significance at a 10, 5 and 1 per cent level is indicated as *, ** and *** respectively. We use the White correction to deal with potential heteroscedasticity.

5.5.2.2 Four-factor model for disclosure change

We add the momentum factor and test the four-factor model on disclosure change portfolio returns. Table 23 shows the output from the regression analysis. For value-weighted returns, we find that *Pos_Change* yields the highest alpha at 0.36. The *No_Change* portfolio has the second best alpha at -0.21, and the *Neg_Change* portfolio has the lowest alpha value of -0.36. None of the alphas has statistical significance. The difference in returns of *Pos_Change* and *Neg_Change* yields an alpha of 0.72. This alpha is not statistically significant, but it indicates that it could be profitable to invest in the positive change portfolio and sell short the negative change portfolio.

With equal-weighted returns for the three portfolios, we find the same trend as described for value-weighted returns. *Pos_Change* has the highest value of alpha with negative 0.23, and *Neg_Change* has the lowest value of alpha with -0.57. The *No_Change* portfolio is in between with an alpha of -0.46. Only the alpha for *Neg_Change* shows statistical significance. The alpha for the return difference between the extreme portfolios is not significant, but the result supports previous findings.

Table 23: Four-factor model with disclosure change portfolios

Value-weighted returns						
	α	***RMRF***	***SMB***	***HML***	***MOM***	***R^2***
Pos_Change	0.36 (0.28)	1.03*** (0.06)	-0.23*** (0.08)	0.12* (0.07)	0.17* (0.08)	0.94
No_Change	-0.21 (0.34)	0.96*** (0.07)	-0.10 (0.09)	0.04 (0.08)	0.15 (0.09)	0.91
Neg_Change	-0.36 (0.26)	1.02*** (0.05)	0.02 (0.06)	-0.13** (0.06)	-0.20*** (0.07)	0.93
Pos_Change-Neg_Change	0.72 (0.45)	0.01 (0.09)	-0.25** (0.12)	0.25** (0.11)	0.36** (0.14)	0.37
Equal-weighted returns						
	α	***RMRF***	***SMB***	***HML***	***MOM***	***R^2***
Pos_Change	-0.23 (0.28)	1.00*** (0.06)	-0.01 (0.11)	0.26*** (0.09)	0.12 (0.09)	0.94
No_Change	-0.46 (0.39)	0.79*** (0.08)	0.29** (0.13)	0.29** (0.12)	0.00 (0.11)	0.89
Neg_Change	-0.57** (0.25)	1.11*** (0.07)	-0.04 (0.10)	0.25*** (0.09)	0.11 (0.09)	0.95
Pos_Change-Neg_Change	0.34 (0.34)	-0.11* (0.07)	0.03 (0.10)	0.02 (0.11)	0.01 (0.10)	0.10

The change portfolios are described in section 5.2.2. The last row contains the results when we use the portfolio that buys the *Pos_Change* portfolio and sells short the *Neg_Change* portfolio. The portfolios are reset at each year-end, according to new disclosure data. The independent variables are RMRF, SMB, HML, and MOM, see section 4.4.6. Significance at 10, 5 and 1 per cent are indicated as *, ** and *** respectively. Standard errors reported in parenthesis. All variables are described in section 4.4.5. We use the White correction to deal with potential heteroscedasticity.

5.5.2.3 Summary of findings

When we test the performance attribution model on change portfolios, the results from both factor models indicate the same relations. *Pos_Change* outperforms the two extreme portfolios, and *No_Change* performs better than *Neg_Change*. However, we are not able to document significant relations in all the tests, and value-weighted returns yield more significant results than equal-weighted returns. Overall, the findings suggest that there is a positive association between an improvement in disclosure level and abnormal excess returns. An investment strategy of going long in the *Pos_Change* portfolio and selling short in the *Neg_Change* portfolio yields a positive abnormal excess return.

6. Results and discussions

6.1 Environmental disclosure and firm value

Our main null hypothesis *H* aims to determine whether firms receive value benefits from voluntary environmental disclosure. If firms experience an increase in firm value as a consequence of disclosure, they would have an economic incentive to initiate environmental disclosure voluntarily. The logic behind this argument is similar to the one presented by Telle (2006) and Orlitzky et al. (2003) about the incentive effect of a positive association between CSR performance and economic performance. Such an incentive might have implications for investors, managers and governments.

We do a preliminary test of the value effect of disclosure initiatives, and test the Nordic sample against the Disclosure sample. We find that firms participating in voluntary environmental disclosure have a significantly higher Tobin's Q than non-disclosing firms in the Nordic sample. This indicates that the initiative to disclose environmental information is perceived positively, and leads to an increase in firm value.

The results are contradictory when modeling for operating performance measures as proxy for firm value. The disclosure initiative has a significantly negative relationship with return on equity and return on assets. Literature suggests that discretionary disclosure can be costly (Verrecchia 1983), and our findings suggest that the added cost of disclosure is better reflected in proxies based on operating performance rather than financial performance. The results from the preliminary test are potentially biased due to the problem of endogeneity. The decision to disclose is voluntary, and there is a possibility that only firms that benefit from disclosure have chosen to do so. In that case, the impact of disclosure is magnified and the results are biased.

Next, we investigate the impact of environmental disclosure characteristics within the firms who have chosen to disclose environmental information. Our null hypothesis *H_I* predicts that voluntary environmental disclosure has no association with firm value. First, we look at the effect of absolute disclosure level. We find a positive association between Tobin's Q and the level of environmental disclosure which allows us to reject the null hypothesis. This result holds when adjusting Tobin's Q for industry and when applying different disclosure level variables, and is consistent under both OLS and FE regression. These findings are in

line with the positive associations between disclosure and firm value found by Plumlee et al. (2010) and Clarkson et al. (2010).

Our findings are not conclusive when modeling with operational performance measures as proxies for firm value, and thus, we are unable to draw a conclusion about how level of disclosure is reflected in those measures. With pooled OLS we find indications of a positive effect of disclosure level, but under FE we find indications of an opposite effect. The R^2s for these models are very low and suggest that the independent variables predict little of the variation in the dependent variable. This could imply that the variable is difficult to predict, or there are omitted variables in the regression. In the second scenario, the results could be biased.

Next, we examine the effects of changes in a firm's environmental score. We want to test whether evidence of improvement in a firm's quality or quantity of environmental reporting is valued. When modeling with financial performance measures as dependent variable, we find no significant effects. Neither for Tobin's Q nor industry-adjusted Tobin's Q do we find evidence of impacts of change in disclosure score. Regressions with operating measures as proxy for firm value indicate a negative association between disclosure and firm value. These results are consistent under both OLS and FE assumptions. The results are conflicting when modeling with different firm value proxies. This might be explained by the nature of the performance measures. The operating performance measures reflect short term performance, while Tobin's Q reflects growth opportunities and long-term performance. One possible interpretation of the negative impact on short-term value is that disclosure costs are accounted for in the short term, while benefits from environmental activities are assumed to be of longer term. A reason why we observe this disparity when analyzing the effects of change and not when analyzing for level can be implementation costs. Expanding the scope of environmental reporting might lead to increased disclosure costs, while maintaining a stable level of disclosure does not require the same resources.

6.2 Environmental disclosure and stock returns

Next, we investigate the relationship between environmental disclosure and stock returns. The null hypothesis *H_II* predicts no association between voluntary environmental disclosure and stock returns.

First, we investigate the association between the level of environmental disclosure and stock returns. We find that firms in the *Midrange* portfolio outperform the two extreme portfolios. Discretionary disclosure theory predicts that it will be favorable to disclose information up to a threshold (Verrecchia 1983). Disclosure above this threshold are either bad news that will lead to a negative market reaction or yield a net loss since disclosure costs exceeds benefits received. Orlitzky and Whelan (2007) argue that the level of disclosure is set at the equilibrium between marginal disclosure costs and marginal disclosure benefits. This might explain why the *Midrange* portfolio outperforms to the two other portfolios. Firms in the *High* portfolio experience a negative market reaction due to disclosure above threshold level. The negative market reaction can be caused by the revelation of bad news or increased disclosure costs. Firms in the *Low* portfolio experience a negative market reaction due to investors perceiving the lack of disclosure as a sign of bad news. This interpretation is in line with the "good news" theory of Verrecchia (1983).

Next, we examine the effects of changes in a firm's environmental score on stock returns. We find that firms with increased environmental disclosure yield a higher return than firms with decreased environmental disclosure. This is in line with Healy et al. (1999) who find evidence that increased voluntary firm disclosure is linked to improved stock performance. An explanation of this finding might be an increased investor base due to improved awareness of the firm (Merton 1987). The attraction of investors with preferences for responsible investments is another possible explanation. Assuming efficient markets, the positive association indicates that the market appreciates the new disclosed information as positive and value relevant, and adjusts the stock price to a fair, higher level.

The efficient market hypothesis predicts that the market will react to and incorporate new information into the valuation of stocks. We find that firms with an improved disclosure level yield a higher rate of return compared to the rest of the sample firms. This suggests that changes in disclosure level represent new information to the market, and that the market adjusts slowly as a consequence of improved or decreased disclosure. We do not find the same market reaction to absolute level of disclosure. This can be interpreted as if the level of disclosure represents known information to investors and that disclosure level already is incorporated in the stock price.

6.3 Limitations and suggestions for further research

Some limitations of our study are worth mentioning. The field of voluntary social and environmental disclosure research is fairly new, and the models that have been applied in these studies are not as validated as models on financial disclosure. Environmental disclosure might be affected by other variables than suggested by traditional, discretionary disclosure literature. As a consequence, the regression results might be biased due to omitted variables like management, technology and research and development.

We document findings that support the prediction of voluntary environmental disclosure to have an effect on firm value. The results however, do not suggest the causality of the relationship. It gives an indication that environmental disclosure is associated with higher firm value, but we do not document that the firms have so because they disclose their environmental performance.

Our study consists of firms from four different countries. We do not control for differences between the countries, and treat the sample as homogeneous. However, there are differences in government regulations in the Nordic countries. This and other country-specific factors might affect the disclosure decisions of firms. In addition, a further examination of disclosure differences between industries than we provide might give improved insight.

We tried, but were unable to find sufficient data on environmental performance matching our sample. Initially, we wanted to investigate the relation between environmental disclosure, environmental performance and firm value. According to "good news" theory, one could predict that only firms with favorable information and high environmental performance would choose to disclose. The fact that we could not find suitable data to test this is a limitation in our study.

Overcoming the limitations of our study could be of interest for future research on the topic.

7. Conclusion

This paper empirically investigates the relationship between voluntary environmental disclosure and firm value. The analysis is based on a sample consisting of Nordic listed firms disclosing to the Carbon Disclosure Project in the period of 2007 to 2011.

Using pooled OLS regression, we find a positive relation between voluntary environmental disclosure and firm value, measured as Tobin's Q. The results suggest that firms with higher environmental disclosure level have higher value than firms with lower level of environmental disclosure. This finding indicates that environmental disclosure is value relevant. When controlling for fixed effects in the estimation, we find a similar impact. We employ the factor models of Fama and French (1993) and Carhart (1997) to analyze the impact of environmental disclosure on the market valuation of a firm, given by stock returns. We find that the level of environmental disclosure seems to be known information to the market, while changes in disclosure from one year to the next is perceived as new information. This causes a positive market reaction and we find evidence of a positive relation between disclosure improvement and stock returns. This is the opposite of the negative market reaction documented by Fisher-Vanden and Thorburn (2011), but in accordance with findings of a positive relation between non-financial disclosure and firm value presented by Plumlee et al. (2010) and Clarkson et al. (2010).

Overall, our findings document a positive relation between voluntary environmental disclosure and firm value. The impact of disclosure has potential consequences for firms, investors and government. For firms and managers, the positive association on firm value is value relevant in their disclosure decisions. Our findings suggest a possible negative, short-term effect of disclosure on firm profitability, but document a positive effect on Tobin's Q, which reflect firm value on a longer-term basis. Disclosure can be interpreted as having a negative short-term effect due to disclosure costs, but yielding long-term benefits. Potential benefits are product differentiation, increased firm awareness and lower transaction costs. For investors, increased disclosure might lead to decreased information asymmetry, and greater knowledge of ethical dimensions of the firm. For governments, a positive relation between environmental disclosure and firm value indicate that firms will have an incentive to disclose their environmental performance voluntarily. If so, the need for government regulation on social and environmental accounting will be less extensive.

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Appendix 1: List of CDP Nordic Scores

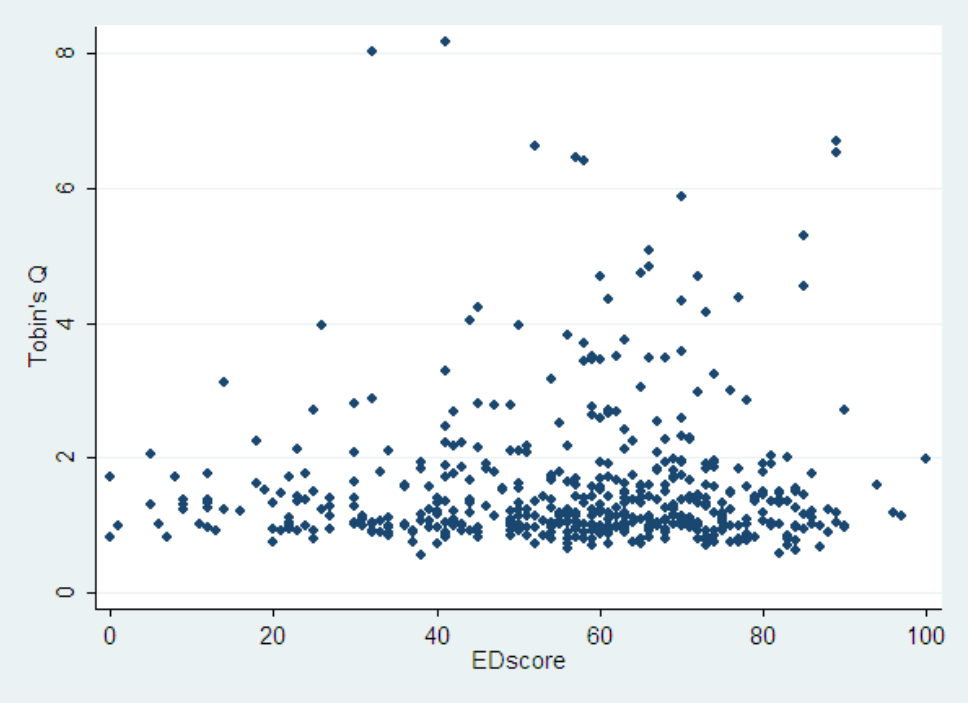
	2007	2008	2009	2010	2011
A.P. MOELLER - MAERSK A/S			67	66	73
AF AB					73
AHLSTROM (A) OY		45	61	55	57
AKER ASA	9	23			
ALFA LAVAL AB	41	54	56	47	
ALM. BRAND		25	12		
ALMA MEDIA OYJ		42	26	63	78
AMER SPORTS CORP					51
ARENDALS FOSSEKOMPANI ASA				9	
ASSA ABLOY AB	41	44	42	34	41
ATEA ASA			63	69	84
ATLAS COPCO AB	45	47	67	60	72
ATRIUM LJUNGBERG			61	60	68
AURIGA INDUSTRIES A/S			50		22
AXFOOD AB		43	45	70	51
BANG & OLUFSEN AS		37	48	46	49
BOCONCEPT HOLDING				66	
BOLIDEN AB	50	38	44		78
CARGOTEC CORP		32	57	60	52
CARLSBERG A/S	53	76	71	68	59
CASTELLUM	45	66	43	30	49
CERMAQ ASA				63	75
CLAS OHLSON AB		81	58	61	67
COLOPLAST A/S	68	49	66	66	65
DAMPSKIBSSELSKABET NORDEN AS		49	54	79	82
DANSKE BANK	55	57	63	66	66
DE SAMMENSLUTTEDE VOGNMAEND		30	30	38	56
DFDS AS			44		
DNB ASA	32	39	62	59	63
DNO INTERNATIONAL ASA		30	44	42	69
DOF ASA					60
EKORNES ASA					80
ELECTROLUX AB	27	70	76	74	86
ELEKTA AB			61	62	76
ELISA CORP					70
ELTEK ASA					27
ENIRO AB	14	74	45	43	
ERICSSON	82	88	63	72	82
FABEGE	59	83	50	54	
FINNAIR OY	34	34	61	61	78
FLSMIDTH & CO AS				61	54
FORTUM OYJ	100	74	79	82	97
GENMAB AS		14	30	24	12
GETINGE AB	68	44	48	60	63
GN STORE NORD A/S			5		
H LUNDBECK A/S	59	49		80	79
HAFSLUND ASA			70	71	47
HENNES & MAURITZ AB	41	85	58	52	57
HEXAGON AB	5				
HEXPOL AB					46
HOLMEN AB	75	54	66	60	64
HUFVUDSTADEN	41	58	41	89	88
HUHTAMAKI OYJ	56	60	42	40	31
HUSQVARNA AB		55	39	60	40
INDUSTRIVERDEN	0	20	7		41
INTRUM JUSTITIA AB		36	22		
INVESTMENTS AB KINNEVIK	59	78	40	52	56
INVESTOR		68	64	59	73
JM AB			65	67	66
KEMIRA OY	16	37	42	38	30
KESKO OYJ	73	85	71	73	80
KONECRANES PLC	18		33	71	52
KONGSBERG GRUPPEN ASA					50
KUNGSLEDEN		32	67	68	68
LASSILA & TIKANOJA GROUP		40	54		57
LATOUR INVESTMENT AB		22	22		
LEMMINKAINEN OYJ					69
LINDAB INTL AB		38	58	62	70
LUNDIN PETROLEUM AB		51	76	83	74

	2007	2008	2009	2010	2011
MARINE HARVEST ASA	50				74
MEDA AB		41	70	63	61
MELKER SCHÖRLING		40			6
METSO OYJ	64	52	64	61	41
MTG-MODERN TIMES GROUP AB			43	62	70
NCC AB	50	22	66	59	55
NESTE OIL OYJ	69	53	64	64	58
NKT HOLDING A/S		37	63	54	63
NOBIA AB	68	78	58	46	51
NOKIAN TYRES PLC			23	32	
NORDEA BANK		50	58	50	87
NORDNET					49
NORSK HYDRO ASA	84	54	61	59	56
NORSKE SKOGINDUSTRIER A/S		56	84	83	87
NOVO NORDISK A/S	66	56	73	89	89
NOVOZYMES A/S	72	54	70	77	85
ODFJELL SE					65
OP BANK GROUP	32	43	24	34	
ORION CORP	44	30	41	58	65
ORKLA ASA		62	68	71	75
OUTOKUMPU OY	72	61	51	86	84
OUTOTEC OYJ			74	90	81
PA RESOURCES AB				13	
PEAB AB			26	20	71
PGS-PETROLEUM GEO-SERVICES	25	32	70	71	68
POYRY PLC				8	
PRONOVA BIOPHARMA ASA			70	69	
RATOS	23	31	12	18	12
RAUTARUUKKI OY		56	69	61	63
RENEWABLE ENERGY CORP AS	32	21			
ROCKWOOL INTERNATIONAL A/S			68	78	86
ROYAL UNIBREW			34		
SAAB AB	75	57	75	81	81
SALMAR ASA			54	84	85
SANDVIK AB	41	40	73	63	54
SANOMA CORP	59	39	27	24	43
SAS AB	34	33	37	25	74
SCANIA AB	63	12	76	74	59
SCA-SVENSKA CELLULOSA AB	56	57	63	90	86
SCHIBSTED ASA	0			57	73
SEB	50	22	67	82	81
SECURITAS AB					71
SKANSKA AB	9	40	67	85	83
SKF AB	69	62	69	71	80
SOLAR AS					54
SOLSTAD OFFSHORE					75
SPONDA PIC		20			
SSAB CORP		65	72	78	77
STATOIL ASA	94	57	40	39	60
STOCKMANN AB	50	21	12		1
STOREBRAND ASA	36	63	72	77	84
SVENSKA HANDELSBANKEN	32	36	11	36	76
SWEDBANK	32	61	42	67	72
SWEDISH MATCH AB	59	55	59	45	60
TALVIVAARA MINING CO LTD				60	56
TDC A/S	19	79	69	75	59
TELE2 AB	0		54	70	73
TELENOR ASA	68	84	65	63	72
TELIASONERA AB	86	89	71	80	72
TIETO CORP	36		25	65	96
TOMRA SYSTEMS A/S	59	63	55	64	74
TOPDANMARK			56	62	69
TORM AS		41	73	77	73
TRELLEBORG AB	75	53	63	69	65
TRYG/TRYG VESTA	23	81	69	75	80
UPM-KYMMENE CORP	31	49	72	90	83
UPONOR OYJ				60	65
VAISALA OYJ				67	65
VEIDEKKE A/S		49	68	50	60
VESTAS WIND SYSTEMS A/S	50	51	77	82	72
VOLVO AB	63	42	60	57	56
WALLENSTAM				27	66
WIHLBORGS FASTIGHETER				33	61
WILLIAM DEMANT			70	70	61
YARA INTERNATIONAL ASA	50			38	

Appendix 2: Outlying observations

An outlying observation is unusual in size and can have several explanations. According to Woolridge (2009) it can be explained by one of three reasons; an error in the recording of the value, the observation should not have been included in the sample or the observation is correctly recorded and is unusually large or small, and a valid observation. However, if the outlier is explained by reason one or two, the observation should be removed from the sample. We use a scatterplot of Tobin's Q against environmental disclosure score to identify outliers in the disclosure sample.

Figure 7: Scatterplot of Tobin's Q against environmental disclosure score



The observations of Tobin's Q range from 0.548 to 8.191. Figure 7 shows that the majority of observations are grouped between the minimum and four. 21 observations have a Tobin's Q above four, a total of eight firms. The Nordic capital markets are relatively small, but have some major international companies listed. This implies that some firms are very large, but the majority of the listed firms are small. This can explain the outlying observations, and we have no reason to suspect the outlying observations to be invalid. We choose not to remove the outliers in our analysis.

Appendix 3: List of sustainability websites

Discloure Sample	Sustainability/ responsibility website
A.P. MOELLER - MAERSK A/S	http://www.maersk.com/Sustainability/Pages/Welcome.aspx
AF AB	http://www.afconsult.com/no/Barekraftige-losninger/
AHLSTROM (A) OY	http://www.ahlstrom.com/en/sustainability/Pages/default.aspx
AKER ASA	http://www.akerasa.com/section.cfm?path=377,493
ALFA LAVAL AB	http://www.alfalaval.com/about-us/sustainability/pages/sustainability.aspx
ALM. BRAND	http://www.almbrand.dk/abdk/OmAlmBrand/Investor/CSRiAlmBrand/index.htm
ALMA MEDIA OYJ	http://www.almamedia.fi/environment_1
AMER SPORTS CORP	http://www.amersports.com/about/social_responsibility/environmental_actions/
ARENDALS FOSSEKOMPANI ASA	http://www.arendalsfoss.no/index.php?show=20&expand=18,20
ASSA ABLOY AB	http://www.assaabloy.com/en/com/Sustainability/
ATEA ASA	http://www.atea.no/miljopolitikk
ATLAS COPCO AB	http://www.atlascopco.com/corporateresponsibility/
ATRIUM LJUNGBERG	http://www.atriumljungberg.se/Omoss/Ansvarsfullt-foretagande1/
AURIGA INDUSTRIES A/S	http://www.auriga-industries.com/en/auriga_industries/csr/
AXFOOD AB	http://www.axfood.se/sv/Hallbarhet/
BANG & OLUFSEN AS	http://www.bang-olufsen.com/en/the-company/heritage/enviroment
BOCONCEPT HOLDING	http://www.boconceptholding.dk/
BOLIDEN AB	http://www.boliden.com/Sustainability/Environmental-responsibility/
CARGOTEC CORP	http://www.cargotec.com/en-global/about-us/sustainability/Pages/default.aspx
CARLSBERG A/S	http://www.carlsbergdanmark.dk/omos/CSR/Miljoe/Pages/default.aspx
CASTELLUM	http://www.castellum.se/om-castellum/ansvarsfullt-foeretagande.html
CERMAQ ASA	http://www.cermaq.com/portal/wps/wcm/connect/cermaqno/home/sustainability/
CLAS OHLSON AB	http://om.clasohlson.com/foretaget/Hallbar-utveckling/Miljo/
COLOPLAST A/S	http://www.coloplast.no/coloplastnorge/om%20coloplast/ansvar/responsibilityfortheenvironment
DAMPSKIBSSELSKABET NORDEN AS	http://www.ds-norden.com/profile/csr/systematicapproach/
DANSKE BANK	http://danskebank.dk/da-dk/Om-banken/Samfundsengagement/Pages/Miljoe.aspx
DE SAMMENSLUTTEDE VOGNMAEND	http://www.dsv.com/AboutUs/CorporateSocialResponsibility/ Environment
DFDS AS	http://www.dfdsgroup.com/About/Responsibility/
DNB ASA	https://www.dnb.no/om-oss/samfunnsansvar.html
DNO INTERNATIONAL ASA	http://www.dno.no/responsibility/qhse/environment/
DOF ASA	http://www.dof.no/QHSE-92.aspx
EKORNES ASA	http://www.ekornes.no/om-ekornes/miljo-og-samfunnsansvar
ELECTROLUX AB	http://group.electrolux.com/en/category/sustainability/
ELEKTA AB	http://www.elekta.com/company/sustainability/the-environment.html
ELISA CORP	http://www.elisa.com/on-elisa/corporate/corporate-responsibility/environmental-responsibility/
ELTEK ASA	http://www.eltek.com/wip4/detail_ir.epl?cat=28989
ENIRO AB	http://www.eniro.com/en/About-Eniro/Corporate-responsibility/
ERICSSON	http://www.ericsson.com/thecompany/sustainability_corporateresponsibility
FABEGE	http://www.fabege.se/en/Corporate-Governance/Corporate-responsibility-/
FINNAIR OY	http://www.finnair.com/NO/NO/responsibility
FLSMIDTH & CO AS	http://www.flsmidth.com/en-US/Investor+Relations/Governance
FORTUM OYJ	http://www.fortum.com/en/sustainability/pages/default.aspx
GENMAB AS	http://ir.genmab.com/csr.cfm
GETINGE AB	http://www.getinge.com/about-us/sustainability/
GN STORE NORD A/S	http://www.gn.com/EN/GNAbout/Pages/CorporateSocialResponsibility.aspx
H LUNDBECK A/S	http://www.lundbeck.com/global/corporate-responsib
HAFSLUND ASA	http://www.hafslund.no/om-hafslund/artikler/les_artikkel.asp?artikkelid=2099
HENNES & MAURITZ AB	http://about.hm.com/content/hm/AboutSection/en/About/Sustainability.html#cm-menu
HEXAGON AB	http://www.hexagon.com/en/Corporate-Responsibility.htm
HEXPOL AB	http://www.hexpol.com/www/Hexpol.nsf/(Siteindex)/EnvironmentalandSocialResponsibility
HOLMEN AB	http://www.holmen.com/Sustainability/
HUFVUDSTADEN	http://hufvudstaden.se/en/About-Hufvudstaden /Quality-and-the-environment/
HUHTAMAKI OYJ	http://www2.huhtamaki.com/web/sustainability
HUSQVARNA AB	http://husqvarnagroup.com/en/corporate-responsibility
INDUSTRIVERDEN	http://www.industrivarden.net/About-us/Social-responsibility/
INTRUM JUSTITIA AB	http://www.intrum.com/About-Us/Our-role-in-society/
INVESTMENTS AB KINNEVIK	http://www.kinnevik.se/en/Corporate-Governance/Introduction/
INVESTOR	http://www.investorab.com/en/AboutInvestor/CSR/default.htm
JM AB	http://www.jm.se/Templates/TwoColumnPage.aspx?id=3153
KEMIRA OY	http://www.kemira.com/en/sustainability/pages/default.aspx
KESKO OYJ	http://www.kesko.fi/en/Responsibility/
KONECRANES PLC	http://www.konecranes.com/portal/eng/about_us/corporate_responsibility/
KONGSBERG GRUPPEN ASA	http://www.kongsberg.com/en/kog/aboutus/corporatesocialresponsibility/
KUNGSLEDEN	http://www.kungsleden.se/en/about-kungsleden/corporate-responsibility/
LASSILA & TIKANOJA GROUP	http://www.lassila-tikanoja.com/en/lassilatikanoja/corporate_responsibility/Pages/Default.aspx
LEMMINKAINEN OYJ	http://www.lemminkainen.com/Company/Responsibility/Environmental_responsibility
LINDAB INTL AB	http://www.lindab.com/global/pro/about-lindab/lindab-life/environment/Pages/default.aspx
LUNDIN PETROLEUM AB	http://www.lundin-petroleum.com/eng/corporate_responsibility.php
MARINE HARVEST ASA	http://marineharvest.com/en/CorporateResponsibility/
MEDA AB	http://www.meda.se/csr/
MELKER SCHÖRLING	http://www.melkerschorlingab.se/en/corporate-governance/csr
METSO OYJ	http://metso.com/corporation/sd_eng.nsf/WebWID/WTB-041115-2256F-42F2F?OpenDocument
MTG-MODERN TIMES GROUP AB	http://www.mtg.se/en/modern-responsibility/
NCC AB	http://www.ncc.no/no/OM-NCC/Miljo/
NESTE OIL OYJ	http://www.nesteoil.com/default.asp?path=1,41,12079
NKT HOLDING A/S	http://www.nkt.dk/uk/Menu/CSR

NOBIA AB	http://www.nobia.com/About-Nobia/Running-sustainable-business/
NOKIAN TYRES PLC	http://www.nokiantyres.no/Miljo-og-sikkerhet
NORDEA BANK	http://www.nordea.com/Om+Nordea/Samfunnsansvar/56492.html
NORDNET	http://org.nordnet.se/en/about/about-nordnet/how-we-do-it/responsibility
NORSK HYDRO ASA	http://www.hydro.com/no/Var-framtid/Miljo/
NORSKE SKOGINDUSTRIER A/S	http://www.norskeskog.com/Responsibility.aspx
NOVO NORDISK A/S	http://www.novonordisk.com/sustainability/default.asp
NOVOZYMES A/S	http://www.novozymes.com/en/sustainability/Pages/default.aspx
ODFJELL SE	http://www.odfjell.com/AboutOdfjell/CorporateSocialResponsibility/Pages/default.aspx
OP BANK GROUP	https://www.op.fi/op/op-pohjola-gruppen/ansvarskansla?id=80400&srcpl=1&kielikoodi=sv
ORION CORP	http://www.orion.fi/en/Sustainability/
ORKLA ASA	http://www.orkla.no/Miljoe-og-samfunn/Miljoe
OUTOKUMPU OY	http://www.outokumpu.com/en/Sustainability/Pages/Sustainability.aspx
OUTOTEC OYJ	http://www.outotec.com/default____40847.aspx?epslanguage=EN
PA RESOURCES AB	http://www.paresources.se/en/Environment-safety-and-society/
PEAB AB	http://www.peab.com/About-Peab/Sustainability-report/
PGS-PETROLEUM GEO-SERVICES	http://www.pgs.com/en/About-us/Commitments/HSEQ/Environment/
POYRY PLC	http://www.poyry.com/about-poyry/corporate-responsibility
PRONOVA BIOPHARMA ASA	http://www.pronova.com/getfile.php/WEB/Janne/Filarkiv/Other/HealthSafetyandEnvironment.pdf
RATOS	http://www.ratos.se/Corporate-Responsibility/
RAUTARUUKKI OY	http://www.ratos.se/Corporate-Responsibility/
RENEWABLE ENERGY CORP AS	http://www.recgroup.com/en/sustainability/
ROCKWOOL INTERNATIONAL A/S	http://www.rockwool.com/environment
ROYAL UNIBREW	http://www.royalunibrew.com/Default.aspx?ID=1149
SAAB AB	http://www.saabgroup.com/en/About-Saab/Investor-relations/Saabs-responsibilities/
SALMAR ASA	http://www.salmar.no/About-SalMar/HSE
SANDVIK AB	http://www.sandvik.com/en/about-sandvik/sustainability/
SANOMA CORP	http://www.sanoma.com/corporate-responsibility
SAS AB	http://www.sasgroup.net/SASGroup/default.asp
SCANIA AB	http://www.scania.com/scania-group/sustainability/
SCA-SVENSKA CELLULOSA AB	http://www.sca.com/en/sustainability/
SCHIBSTED ASA	http://www.schibsted.com/our-social-responsibility/
SEB	http://www.seb.no/pow/wcp/sebgroup.asp?website=TAB7&lang=en
SECURITAS AB	http://www.securitas.com/en/Our-Responsibility/
SKANSKA AB	http://www.skanska.no/no/Om-Skanska/Samfunnsansvar/
SKF AB	http://www.skf.com/portal/skf/home/sustainability?contentId=004213&lang=en
SOLAR AS	http://www.solarnorge.no/Menu/Om+Solar/Milj%c3%b8
SOLSTAD OFFSHORE	http://www.solstad.no/greenoperations/
SPONDA PIC	http://www.sponda.fi/en/responsibility/spondability/Pages/default.aspx
SSAB CORP	http://www.ssab.com/en/Investor--Media/Sustainability/31/
STATOIL ASA	http://www.statoil.com/no/environmentsociety/pages/default.aspx
STOCKMANN AB	http://www.stockmanngroup.fi/en/responsibility
STOREBRAND ASA	http://www.storebrand.no/site/stb.nsf/Pages/baerekraftige-investeringer.html
SVENSKA HANDELSBANKEN	http://www.handelsbanken.com/ About_the_group/Investor_Relations/Corporate_Social_Responsibility
SWEDBANK	http://www.swedbank.com/corporate-sustainability/index.htm
SWEDISH MATCH AB	http://www.swedishmatch.com/en/Sustainability/Environment/
TALVIVAARA MINING CO LTD	http://www.talvivaara.com/Sustainability/environmental-responsibility
TDC A/S	http://tdc.com/publish.php?dogtag=com_profile_cr_climate
TELE2 AB	http://www.tele2.no/andre-engasjement.html
TELENOR ASA	http://www.telenor.no/om/samfunnsansvar/klimaogmiljo.jsp
TELIASONERA AB	http://www.teliasonera.com/en/corporate-responsibility/environment/
TIETO CORP	http://www.tieto.com/about-us/corporate-responsibility/environmental-responsibility
TOMRA SYSTEMS A/S	http://www.tomra.com/default.asp?V_ITEM_ID=18
TOPDANMARK	http://inv.dk.topdanmark.com/csr.cfm
TORM AS	http://csr.torm.com/environment-climate
TRELLEBORG AB	http://www.trelleborg.com/en/The-Group/Corporate-Responsibility/
TRYG/TRYG VESTA	http://www.tryg.no/om-tryg/samfunnsansvar/klima-og-miljoe/index.html
UPM-KYMMENE CORP	http://www.upm.com/EN/RESPONSIBILITY/Pages/default.aspx
UPONOR OYJ	http://www.uponor.no/about-uponor/uponor-as-a-partner/sustainability.aspx
VAISALA OYJ	http://www.vaisala.com/en/sustainability/Pages/default.aspx
VEIDEKKE A/S	http://www.veidekke.no/miljo-og-samfunn/
VESTAS WIND SYSTEMS A/S	http://www.vestas.com/en/about-vestas/sustainability.aspx
VOLVO AB	http://www.volvogroup.com/group/global/engb/responsibility/environmental_responsibility/Pages/default.aspx
WALLENSTAM	http://www.wallenstam.se/om/om-oss/miljo-samhallsansvar/
WIHLBORGS FASTIGHETER	http://wihlborgs.com/About-Wihlborgs/CSR-Sustainable-enterprise/
WILLIAM DEMANT	http://www.demant.com/csr.cfm
YARA INTERNATIONAL ASA	http://www.yara.com/sustainability/index.aspx

Appendix 4: Global Industry Classification Standard

The Global Industry Classification Standard is developed by the MSCI and aim to enhance investor research and asset management for financial professionals (MSCI 2012). The GICS classifies companies based on their core business on four levels – sector, industry group, industries and sub-industries. The structure consists of 10 sectors, 24 industry groups, 68 industries and 154 sub-industries (MSCI 2012). We choose use the annual two-digit sector codes to classify the firms in our population. The rationale behind not using a more detailed industry classification is the relatively small sample size and the desire to get a larger number of observations in each category. Table 24 show the sector distribution of our disclosure sample in 2011. The distribution is fairly stable over the period.

Table 24: Global Industry Classification Standard

Sector Code	***Sector name***	***Percentage of disclosure sample (2011)***
10	Energy	6 %
15	Materials	14 %
20	Industrial	30 %
25	Consumer Discretionary	11 %
30	Consumer Staples	5 %
35	Health Care	7 %
40	Financials	17 %
45	Information Technology	5 %
50	Telecommunications Services	4 %
55	Utilities	2%