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Master Thesis

- The value relevance of Sustainability reporting in Norway-

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Abstract

This master thesis studies the effect of sustainability reporting quality on firm valuation. The existing literature presents a mixed view on this relation, partly because it is difficult to disentangle the disclosure effect from the underlying sustainability activities. This study uses two-way fixed effects models to analyze the data from 126 firms from 2018 to 2020. We find a negative association between sustainability reporting quality and firm valuation. We also find that, by publishing sustainability reports, firms that operate in sectors with primary climate impact have lower firm value than other firms. By analyzing the sustainability reports, we find that standardized reporting standards such as GRI is positively linked with reporting quality and firms' awareness of sustainability has increased over the years.

Our findings contradict several previous studies that confirm positive relationship between sustainability reporting quality and firm value. We consider that biases in sustainability disclosures, investors' preference, mediating factors and sample size can explain the variation.

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1.0 Introduction

1.1 Research Background

Financial reporting serves the interest of shareholders for decades (Christensen et al., 2021). It provides information about a firm's financial position, business performance and changes to its shareholders for decision-making. However, in recent years, there are different opinions on the purpose of financial reporting. One of the views is presented by a group of chief executive officers in the United States. They argue that firms should not only commit to their investors, but also to potential stakeholders, including customers, employees, suppliers, supporting communities and society (Business Roundtable, 2019).

Compared with the traditional view of financial reporting, the abovementioned stakeholders emphasize the need for firms to be "good" and "responsible" while doing business (Christensen et al., 2021). Issues such as carbon emissions, air pollution and working environment have gained more media coverage and attracted public attention over the recent years. There has also been observed a growing desire for investors to invest sustainably. For instance, a drastic increase in sustainable and responsible investment (SRI) has been documented in Europe since 2018, and one third of assets managed in the United States are labelled as sustainable investments (Eurosif, 2021; US SIF, 2020). To meet the growing interests, many firms discuss their corporate social responsibilities (CSR) in the annual report and communicate information about their environmental, social and governance (ESG) activities to the public. This strategy seems to be effective, as 82% of the investors participated in the 2018 global survey believe that ESG disclosures contain financially material information for investment decisions (Amel-Zadeh and Serafeim, 2018). In addition, the need for CSR assurance services has steadily risen over the years (Cohen et al., 2015).

Some recent discussions on sustainability reporting are the IFRS Foundation and the Corporate Sustainability Reporting Directive (CSRD) by EU legislation. In September 2020, the IFRS Foundation discussed the need for global sustainability standards and made an analysis of the current situation. The final report emphasizes the need to improve the reliability and comparability of sustainability reporting, as it will help businesses build public trust though reliable and transparent disclosures

(IFRS, 2020). The European Commission shares a similar opinion and defines a common reporting framework for non-financial statements for the first time in 2021, known as CSRD. It requires all large European companies to report in accordance with the European Sustainability Reporting Standards (ESRS) from 1. January 2024. Compared with existing sustainability reporting frameworks, the new standards extend the scope of sustainability reporting and help to reduce deliberately omitted information that is important for investors and other stakeholders (PlanA Academy, 2022). The EU Commision believes that the new requirements will help companies to develop responsible approaches to business (EFRAG, 2021).

Norway commits itself fully to sustainable development and environmental protection. In 2016, Norway ratified the Paris Agreement, aiming to reduce greenhouse gases by at least 40 percent by 2030 compared to 1990 levels. To achieve this goal, the Norwegian government has implemented several actions, including the promotion of renewable energy, phasing out fossil fuel subsidies etc. (The Norwegian Government, 2022). Meanwhile, Norway has been a pioneer of sustainability reporting. On June 1st, 2013, the Norwegian accounting legislation introduced a reporting mandate on CSR issues for all large companies in Norway (Kundson, 2017). These firms are required to discuss and report on their environmental and social impacts in the annual report (Norwegian Accounting Act §3-3c). Regulators believe that the reporting mandate will provide Norwegian firms with long-term benefits, such as increased reputation, good relationship with workforce and higher competitiveness in the market (Meld. St. 39 (2012-2013)).

However, the reporting practices in Norway as well as the disclosure quality have received some criticisms from the market. Investors are unable to make comparisons across firms and industries because of differences in reporting quality (The Governance Group, 2021). These differences are partly caused by the ambiguous law requirement and the use of boilerplate language by large firms (Nilsen & Ørbeck, 2020; Christensen et al., 2021). Complaints from investors and auditors show that the disclosure requirements in the Norwegian Accounting Act §3-3c cause confusion in the market, and that they can be interpreted by firms opportunistically. To solve this issue, the consultant to sustainability reporting at

Revisorforeningen Simen K. Kristiansen (2019) suggests that a materiality analysis or a set of quantitative standards can be used to enhance the comparability of sustainability reporting and reduce difficulties for assurance services. In addition, Lowzow and Bergo (2019) find that firms often use ambiguous and nice words in sustainability reports to impress investors rather than disclosing relevant information. This compliance issue also points to the underlying need for standardization of reporting standards and clarification of existing requirements (Brandsås, 2020).

This master thesis studies the association between sustainability reporting and firm value. We are interested in whether the current reporting mandate is of value relevance for investors. Also, with the upcoming IFRS global sustainability disclosure standards and the CSRD, we would like to discuss whether the new standards are likely to create a positive impact for investors and should be adopted in the same way as the financial reporting standards.

To formulate our research questions, it is important to review the academic literature. Traditionally, there are two different, yet not mutually exclusive views on the topic of value relevance of sustainability reporting. On one hand, sustainability reporting provides investors with relevant information for better decision-making. This reduces the information asymmetry between firms and investors, which could benefit firms in terms of better liquidity, lower cost of capital and higher firm value (Christensen et al., 2021).

On the other hand, sustainability reporting may lead to unfavorable financial consequences for investors. Negative externalities and social costs that were earlier not part of the financial statements, are internalized under the reporting mandate (Bushee and Leuz, 2005). Matsumura et al. (2014) find a negative correlation between firm value and reported CO_2 emissions, suggesting that the market actively punishes firms for their externalities. In addition, the reporting mandate could cause firms to alter their behavior, which may not be desirable for investors. For instance, following the disclosure mandate of mine-safety information in the United States, mining companies experience a significant increase in safety of mines, but overall productivity declines (Christensen et al., 2017). Similar phenomena have also been

observed in China. Chinese listed companies document decreases in both profitability and pollution levels after mandatory environmental reporting was introduced (Chen et al., 2017). Thus, the reporting mandate implies both benefits and costs for the investors. It can be difficult to determine the net effect of sustainability reporting.

1.2 Research Question

Building on the arguments made above, we explore the relation between sustainability reporting and the value relevance of financial statements. In particular, we focus on the following research question:

What is the association between sustainability reporting quality and firm valuation in Norway?

To answer this question, we first test whether sustainability reporting is positively, negatively or not associated with firm value. Then, we test if standardized sustainability reporting standards are preferred by investors compared to traditional discussion. In addition, inspired by Matsumura et al. (2014), we examine if the associations vary for firms that operate in sectors with different climate impacts. Finally, we discuss possible factors that cause firms to provide better information.

Compared to earlier studies, we believe that the master thesis is of relevance in three aspects. Firstly, the findings are based on data from Norwegian companies, meaning that the thesis can provide guidance to Norwegian policymakers, investors and firms. Secondly, the thesis clarifies the average effect of sustainability reporting in Norway. Both benefits and costs of sustainability reporting will be discussed in this text. Thirdly, the thesis provides one insight as to whether a standardized sustainability disclosure standard is of value relevance for investors. With the upcoming IFRS sustainability disclosure standards and the CSRD, the thesis can provide authorities with some useful insights.

2.0 Literature review

This chapter outlines the most important academic research on the topic of sustainability reporting, value relevance and firm response.

In section 2.1, we define sustainability, sustainable activity and sustainability reporting, and how sustainability reporting is different from financial reporting. In section 2.2, we define value relevance and review the economic effects of sustainability reporting and further comparing different valuation models used in the academic literature. In section 2.3, we review firm response to sustainability reporting while focus specifically on the relation between changes in firm's strategies and, behaviors and sustainability reporting.

2.1 Sustainability Reporting

2.1.1 Definition

The term *sustainability* has been steadily grown in use since 2000s (KPMG, 2020). However, in the academic literature, researchers prefer the term *corporate social responsibility* (CSR) (Huang and Watson, 2015). These phrases have similar meanings and are often used interchangeably. In our study, we mainly use the term sustainability to align our language with the upcoming IFRS sustainability disclosure standards.

Under the neoclassical economic theory, firms exist to increase shareholder value. Their output and pricing decisions are based on a cost-benefit analysis to maximize profit. (Friedman, 1952). Thus, "not-for-profit" sustainable activities deem to be worthless and costly for shareholders, as they sacrifice profit in the social interest (Kitzmueller and Shimshack, 2012).

However, this view is controversial for three reasons. Firstly, shareholders may have non-monetary preferences (Lins et al, 2017). These concerns are often not observable in calculation. Secondly, firms may have broader objectives than profit maximization, such as to meet the expectations and concerns of society and other stakeholders (Hart and Zingales, 2017). Thirdly, empirical evidence suggests that profit is not the *purpose* of sustainable activities, but rather a byproduct (Edmans,

2012). Edmans (2012) studies the effect of job satisfaction on future stock return for US. firms between 1984 to 2011. His study finds a causal relationship between employee well-being and business performance. In addition, it takes on average four to five years for benefits from CSR activities to be priced in the market. Thus, care of society is not at the expense of profit but rather supports profit (Edmans, 2012).

To reflect the mixed interests discussed above, the European Commission (2011, p. 6) defines sustainability as "the responsibility of enterprises for their impacts on society". Firms engage in sustainable activities to increase welfare for both shareholders, and society at large.

With the aforementioned definitions, Christensen et al. (2021) define *sustainability reporting* as a process where firms measure, disclose and communicate relevant sustainability information to their stakeholders. The disclosures are often published in a firm's annual report or as a stand-alone sustainability report. The reports can be both qualitative or quantitative, and financial or non-monetary.

Because of the variations in reporting practices, the *sustainability reporting standards* provide guidance on how firms report sustainability information (Christensen et al, 2021). In the meanwhile, the standards generate demand for assurance services. Firms search for the opportunity to verify the information, which can benefit them in terms of increased social capital and trust (Símnett, 2019; Lins et al., 2017).

In accordance with the conventional view and the modern view discussed above, researchers distinguish the goals of sustainability reporting by applying a *narrow approach* and a *broad approach*. The narrow approach defines *investors* as the users of sustainability reports and only information that is financially material for investment decisions should be disclosed. For example, this would include data required in the risk assessment or analyst forecast of future cash flows (Dahliwa et al., 2011; Grewal et al., 2020).

The broad approach regards all potential stakeholders as the users of sustainability reports. These stakeholders, including consumers, employees, local communities and society, may have different preferences for CSR information. Thus, companies are expected to disclose *all* relevant details about their impacts on the environment and society. By doing so, the externalities from business operations will be internalized in the financial statements (Christensen et al., 2021).

2.1.2 Differences between Sustainability Reporting and Financial Reporting

As most of the disclosure literature exists in the financial reporting section, one needs to examine whether the findings are still valid in the context of sustainability reporting. In this section, we review major differences between the two types of reporting.

Sustainability reporting differs from traditional financial reporting in three perspectives. First of all, sustainability reporting has a wider audience than financial reporting. The discussion in section 2.1.1 suggests that the users of sustainability reports may require different amounts of information, and that they may process CSR information differently. For instance, some will use sustainability information to evaluate whether the business operation meets the legal requirements, some find the information useful because it completes their financial analysis, while others assess the firm response to the current social and environmental issues (Christensen et al., 2021).

Thus, unlike financial reporting, sustainability reporting is multidimensional in nature (Kitzmueller and Shimhack, 2012). It needs to cover a wide range of topics that may not be monetary. The selection of disclosures can be affected by various factors, such as legal obligations, nature catastrophes or social events. Bonetti et al. (2018) show that Japanese firms disclose more forward-looking sustainability information after the Fukushima nuclear disaster. There is also documented a positive relationship between firms' CSR engagement and social activist campaign (Baron, 2001).

Sustainability reporting often has a close relationship with externalities. When firms report on their social and environmental impacts, the reporting will entail

financial consequences, such as costs to produce sustainability information, proprietary costs or litigation costs. Firms react to the reporting standards by using a generic or boilerplate language to avoid disclosing important information (Christensen et al., 2021). Thus, these reports are uninformative, and are merely some compliance documents (Hoogervorst, 2013).

One of the reasons that leads to uninformative sustainability reporting is the lack of uniformity in reporting standards. The heterogeneity in business operation of each individual firm makes it challenging for regulators to develop a standard that applies to all firms. As some CSR activities are not observable and non-monetary, it is difficult to measure and compare these impacts. The traditional accounting and auditing conventions, such as materiality and risk assessment, are limited in the context of sustainability reporting (Moroney and Trotman, 2016).

Thus, we conclude that the sustainability reporting is more diverse and complex in nature compared to the financial reporting,

2.2 Value Relevance

2.2.1 Definition

The value relevance approach studies the association between financial information and security market prices and returns. It examines whether investors respond to the accounting information and how to measure those responses.

Beaver (1968) is one of the earliest studies on value relevance of accounting information. He predicts investor behavior in response to financial statement information and then tests these predictions empirically. Beaver (1968) suggests that investors may first have different prior beliefs about a company's future performance. These beliefs are all based on the current market information. Then, upon the release of the earnings announcement, investors update their beliefs by analyzing the accounting numbers. Following the revision of their beliefs, investors may decide to buy or sell a firm's shares depending the types of information. When there is good news in the financial statements, investors become more interested in the company and vice versa. The total change in share prices is the result of new accounting information.

To test his predictions, Beaver (1968) examines trading volume reaction during the week of release of earnings announcements. He analyzes 506 annual earnings announcements of 143 NYSE firms in the period of 1961-1965 and concludes that the trading volume is below the normal level prior to the earnings announcement. Then, in the first two weeks after the announcement date, the trading volume experiences a drastic increase. His study seems to support the predictions mentioned above. However, Kim and Verrecchia (1997) argues that volume of trade is noisy as a measure of value relevance of financial statement information.

Alternatively, Ball and Brown (1968) examine the association between security market price change and earnings announcement. They investigate a sample of 261 firms listed in the New York Stock Exchange (NYSE) from 1957 to 1965 and separate them into two groups: one with reported earnings above the market expectations (GN) or below expectations (BN). The study shows that financial statement information both *causes* the stock price change under a narrow window study and *is associated* with price development in the following 12-month period. Their study indicates that the financial statement information is value relevant for investors in the market.

One of the reasons that supports the value relevance theory is that financial reporting provides new information to the market. When investors are more informed about a firm's business performance by analyzing accounting numbers, they will require less return for the investment (Amihud and Mendelson, 1986). Relevant financial information can also help investors to make better predictions about future cash flows and lower the cost of equity capital (Easley and O'Hara, 2004; Lambert et al., 2011). In addition, for investors and analysts outside the firm, the accounting information helps to monitor managerial behaviors and thereby improving corporate investment decisions (Bushman and Smith, 2001; Lambert et al., 2007). The disclosure can also cause positive spillovers by transferring information between firms and increased comparability (Admati and Pfleiderer, 2000).

2.2.2 Sustainability Reporting and Firm Value

Earlier studies show that investors care about sustainability information because sustainable activities are related to firm value and financial performance (Mackey et al., 2017; Kitzmueller and Shimshack, 2012). The value relevance approach is thus a useful tool to examine such equity-market effects. Traditionally, the literature differentiates between four types of effect of sustainability reporting: its impact on firm value, stock return and liquidity, firm risk and cost of capital, and asset allocation and portfolio holdings (Christensen et al., 2021). This review mainly focuses on the effects on firm valuation.

Dowell et. al (2000). are among the first to study the effect of local environmental standards on firm value across multinational enterprises. Their study consists of 107 firms listed on the S&P 500 from 1994-1997. They find that the adoption of a single, stringent environmental standard is associated with higher firm value. This positive correlation is supported by Gao and Zhang (2015). Their analysis of 2,022 income-smoothing firms in the United States from 1993 to 2010 shows that companies with better sustainability reporting have often higher contemporaneous earnings-return relationship and higher firm value. In addition, Elliott et al. (2014) study this relationship from another perspective. They wonder how investor behavior is affected under the presence of sustainability reporting. In their study, it suggests that investors will unintentionally increase firms' fundamental value when the CSR performance is positive and vice versa.

However, most of the literature focuses on voluntary disclosure. As reporting practices vary between firms, it is difficult to identify the market-equity effects of sustainability reporting. For instance, Plumlee et al. (2015) find a positive relation between voluntary sustainability disclosures and firm value, but Cho et al. (2015) do not find such evidence in their replicative study.

Christensen et al. (2021) suggest that a reporting mandate could help to mitigate this problem. When there is a guidance on how and when companies should report on their social and environmental impacts, the overall comparability of sustainability reporting increases. There will also be less room for companies to conceal important information from the public. The seminal study on this topic is

provided by Ioannou and Serafeim (2017). They compare firms in four countries with CSR reporting mandates, namely China, Denmark, Malaysia and South Africa. The study finds a significant increase in sustainability disclosure quality following the reporting mandate and firms affected by the mandate are on average associated with higher firm value. The relationship is later tested and explained by Barth et al. (2017). They show that firms with better disclosure quality will experience improved liquidity, lower cost of capital and enhanced investment efficiency. Contradictorily, Chen et al. (2017) find a negative correlation between firm value and CSR disclosure quality using data from Chinese firms.

It can be concluded that the literature does not agree on the average effect of sustainability reporting. This is mainly because of two reasons. Firstly, topics and disclosures in sustainability reports can affect reporting quality as well as firm valuation. The information selection process is driven by the heterogeneity in business operation, the lack of uniformity in reporting standards, the concerns from investors and stakeholders outside the firm and the managerial incentives to achieve better performance. The mixed interests create diversity in sustainability reporting. Secondly, it is impossible to distinguish the effect of sustainability reporting from its underlying CSR activities. It is thus difficult to say whether a change comes from reporting per se (Christensen et al, 2021).

2.2.3 Estimation Model

The most common methods to estimate value are the dividend discount model (DDM) or the discounted cash flow (DCF) model. The DDM shows that firm value can be determined by the expected present value of future dividends (Feltham and Ohlson, 1995). The DCF model uses expected future free cash flows to predict firm value. If applied consistently, the value is the same across the models.

Another equally important valuation model is the Ohlson model. It distinguishes between book value and the growth component. Mathematically, the Ohlson model can be expressed as:

$$PA_t = BV_t + G_t$$

where PA_t is the firm's market value, BV_t is the net book value of firm assets and G_t is the expected present value of future abnormal earnings at time *t* (Scott, 2015).

The abnormal earnings are the difference between actual earnings and expected earnings. Similar to the DDM and the DCF model, the Ohlson Model gives same result when the clean surplus assumption is satisfied (i.e., when all gains and losses affect the income statement).

Researchers mainly use the Ohlson Model to study the value relevance of sustainability reporting. For instance, Plumlee et al. (2015) estimates the effect of the quality of voluntary environmental disclosure on firm value and use the Ohlson Model to control the effect of unexpected earnings. Similarly, the Ohlson Model is also applied in the study by Koh et al. (2014). They study the effect of corporate social performance on security price of 3,029 firms.

2.2.4 Study by Barth et al. (2017)

Traditionally, accounting information is value relevant when it provides investors with new and unexpected information. However, it is difficult to disentangle the effect of reporting per se from the underlying CSR activities (Christensen et al., 2021). Thus, the causal relationship between security price change and release of sustainability reporting cannot be verified using a short-window event study.

The seminal study by Barth et al. (2017) examines the value relevance of sustainability reporting in an alternative way than the traditional method. They choose to analyze the association between integrated reporting quality and firm value. Their study focuses on the long-term, average effect of sustainability reporting. In addition, they explore the mechanisms that cause such association.

From 1. March 2010, all South African firms listed on the Johannesburg Stock Exchange (JSE) are requested to report sustainability information jointly with their financial statements, known as integrated reporting. Following the reporting mandate, EY South Africa launches Integrated Reporting Awards to honor firms with excellent CSR reporting practice. Barth et al. (2017) construct an integrated reporting quality proxy based on complied data by EY South Africa. In their study, they analyze 79 South African firms evaluated by EY in all four years between 2011 to 2014. The analyses consist of 292 firm-year observations.

To test the value relevance of sustainability reporting, Barth et al. (2017) use the following regression model:

$$TobinQ_{it} = \beta_0 + \beta_1 IRQ\_R_{it} + \beta_2 Gov_{it} + \beta_3 CSRPerf_{it} + \beta_4 CSR\_SA_{it} + \beta_5 LowAQ_{it} + \beta_6 Complex_{it} + \beta_7 Fog_{it} + \beta_8 Prime_{it} + \sum \beta_j Controls_{it} + \varepsilon_{it}$$

where $TobinQ_{it}$ is market-to-book ratio of total assets for observation *i* at time *t*. IRQ_R_{it} is integrated reporting quality based on EY Integrated Reporting Awards. Gov_{it} is corporate governance score from Asset 4, the world's largest database of ESG information. $CSRPerf_{it}$ is the corporate social responsibility performance score from Asset 4. CSR_SA_{it} is an indicator variable that equals 1 if a firm issues a standard-alone CSR report in additional to its integrated report. $LowAQ_{it}$ is a measurement of low accounting quality. $Complex_{it}$ measures a firm's complexity. Fog_{it} measures the readability of annual reports and $Prime_{it}$ is an indicator variable that equals 1 if a firm is primarily listed on the JSE.

The regression shows a significant and positive relationship between integrated reporting quality and firm value. The result survives after controlling for industry fixed effects and year fixed effects. Barth et al. (2017) conclude that firms with better integrated reporting quality are associated with higher market-to-book ratio.

2.3 Firm Response to Sustainability Reporting

As discussed in section 2.2.2, new and better sustainability information can affect firm valuation. However, firm behavior is also affected by the mandatory disclosure of information. For example, firms may change part of their operation policies in response to the mandatory disclosure requirements. In this section, we review how firms respond to a CSR reporting mandate.

Firstly, firms may alter their behavior to meet disclosure requirements. For instance, Chen et al. (2017) study the effect of mandatory disclosure on pollution level. Following the reporting mandate to disclose sustainability information in 2008, affected Chinese firms reduce water waste and emissions level significantly. In addition, Chen et al. (2017) find that the effect is stronger when firms are located in cities with stricter regulation. However, these firms also experience a drop in profitability. A similar phenomenon has also been observed in the European Union

(EU) and Canada. Rauter (2020) shows that oil, gas and mining firms that disclose information about extraction payments in these countries have higher costs for extraction rights. Compared with their competitors, they have also fewer extraction licenses. This suggests that firms may sacrifice part of their profits in exchange for better reputation.

As discussed above, it is difficult to separate the effect of sustainability reporting from the effect of CSR activities. However, Christensen et al. (2017) provide empirical evidence on this topic. They analyze the effects of reporting mandates issued by the US government to report on mine-safety information and origins of purchases of minerals. The study finds that while productivity declines the overall safety of mines increases. They link this effect to sustainability reporting rather than the CSR activities because the information is already available on government website prior to public reporting (Christensen et al., 2017).

Secondly, firms may change their behavior after observing disclosures of peer companies. For instance, Johnson (2020) studies how violations in work-safety regulation mentioned in press releases incentivize its peer to avoid similar action. The study concludes that the compliance levels are higher when firms exist in proximity to local newspapers that receive press releases. Grewal (2021) studies the effect of mandatory disclosure of greenhouse gas emissions for UK listed companies. Her finding indicates that companies produce less emissions and the reductions are associated with peer benchmarking. The examples suggest that firms may seek to avoid actions that cause its peers negative financial or social consequences.

Thus, sustainability reporting can have real effects on business operations. Firms may adjust their CSR activities by reducing or disinvesting business activities that are not aligned with the requirements or peer benchmarking. The change can also come from stakeholder pressure (Christensen et al., 2021).

2.4 The Relationship between Pollution and Firm Value

As discussed above, sustainability reporting is value relevant for investors when it provides new and better information. The academic literature shows that sustainability disclosures reduce information asymmetry between firms and investors, which results in lower cost of capital and higher firm value. However, environmental issues such as carbon emissions have received more attention in recent years.

Matsumura et al. (2014) study the effect of carbon emissions and carbon disclosure on firm value. Their dataset covers firms listed on the S&P 500 that disclosed carbon emissions data voluntarily from 2006 to 2008. In their study, they find a negative association between carbon emissions and firm value, suggesting that the markets penalize firms for their carbon emissions. The result shows that firm value decreases by $212,000 for every additional thousand metric tons of carbon emissions. In addition, firms that do not disclose carbon emissions data face a further punishment for non-disclosure (Matsumura et al., 2014).

The findings by Matsumura et al. (2014) support the idea that carbon emission may reduce firm value. Thus, when analyzing the effect of sustainability reporting on firm value, we take this factor into consideration.

3.0 Institutional Details

3.1 Sustainability Reporting in Norway

Since 2013, the Norwegian Accounting Act obligates large Norwegian companies to disclose sustainability information. Firms can choose to discuss about their social responsibility in an annual report or as a stand-alone report. The topics covered in the sustainability report should at least include environmental impacts, social conditions, working environment, gender equality and anti-discrimination, human rights protection and anti-corruption. In addition, the information should be prepared in a way that enables the public to understand a firm's development, results, position and consequences of its activities (Norwegian Accounting Act §3-3c).

When reporting on social and environmental impacts, firms need to describe their business model and guidelines for handling matters and evaluate whether these items are working effectively. In addition, firms need to identify risk factors in not only their business operation, but also business relationships, products and services that can cause negative externalities (Norwegian Accounting Act §3-3c). The accounting requirement defines the content and timing of reporting quality.

However, investors and auditors criticize the law requirement for its ambiguity and difficulty for verification (Nilsen & Ørbeck, 2020; Kristiansen, 2019; Brandsås, 2020). In addition, firms use boilerplate language to avoid disclosing relevant information. However, the statement from the Ministry of Finance shows that it is impossible to define an overarching definition of social responsibility as it varies across firms and industries (Prop. 48 L, 2012, p. 21).

3.2 Voluntary Sustainability Reporting Standards

There are several voluntary sustainability reporting standards available at the moment. These standards are based on different principles to satisfy the needs from different investors and stakeholders. Perrini (2005) categorizes them into four categories:

- Rating indices that focus on socially responsible investment (SRI) criteria. These indices evaluate and rank listed firms based on their ESG

performance on a regular basis. For example, the Dow Jones Sustainability Index and The Global 100 Most Sustainable Corporations by Corporate Knights belong to this group.

- Standards that are principle-based and which focus on codes of practices. The United Nations Global Compact is an example of this type. It consists of ten universal principles, such as human rights protection, anti-corruption, environmental protection etc., and commits firms to implement, disclose and promote these principles (UN Global Compact, 2012). In addition, OECD guidelines for multinational enterprises and the World Business Council for Sustainable Development are also principle-based standards.
- Standards that help organizations to assess social responsibilities. For instance, ISO 26000 assists firms to recognize social responsibility and engage in CSR activities. It also emphasizes seven key principles of social responsibility, such as accountability, transparency, ethical behavior etc.
- Standards that prioritize reporting practice. Examples of this type are the Global Reporting Initiative (GRI) and KPMG Sustainability Reporting Survey.

3.3 Sustainability Reporting Quality

The Governance Group (TGC) is an external consulting and ranking service provider. Each year, TGC collects data from the 100 largest companies listed on the Oslo Stock Exchange. These firms are selected by their market capitalization at the end of the fiscal year based on public available information. After the selection process, TGC assesses whether companies are able to set specific goals for sustainability and to integrate sustainability with their reporting of strategy, risk and result performance. In table 1 below we summarize some of the evaluation criteria used by the analysts. In the analysis, each subsection is scaled from 0 to 4, where 0 indicates that the issue is not mentioned in the report and 4 indicates a solid reporting on the topic (The Governance Group, 2020).

TGC evaluates firms based on ESG factors. The final rating of a firm is the weighted average score of each subsection. The assessment process is controlled and validated by Norwegian Business School – Centre for Green Growth (The Governance Group, 2020).

Topics	Requirements to receive top rating
Environment	
--Emission	The company has a standard climate accounting, concrete emission reduction targets and a clearly defined climate strategy
--Climate Risk	The company reports climate risks that covers the most important part in TCFD recommendations.
--Other Environmental factors	The company reports one or more of the EU taxonomy's four environmental areas beyond climate.
Social	
--Human Rights	The company should identify relevant risks related to human rights and report how these risks are handled in line with the UN Guiding Principles (UNGP), including a due diligence process and relevant results and objectives.
--Development of Competence	The company reports on relevant topics such as recruiting, the talent and competence development process, as well as the results, objectives and strategy.
--Sick Leave and Injuries	The company has a complete performance reporting of injury and sick leave statistics, and specific goals and strategy to improve the performance.
--Equality	The company should have differentiated gender statistics for the board, management and the company as a whole, and clear goals and strategy to improve equality and diversity.
Governance	
--Materiality Analysis	The company discusses material sustainability issues and how they are identified, including stakeholders' perspective and involvement in the process.
--Reporting Standard	The report uses a recognized reporting standard and is verified by external parties.
--Supplier Follow-up	The company discusses the relevant risks related to supplier chain and how these risks are handled. The requirements, compliance and results should be presented in the sustainability reports.
--Whistleblower Mechanism	The company describes the internal and external alert channels, and discussion of how submitted alerts are handled.
--Corruption	The company discusses how corruption risks are evaluated and dealt with within the company and value chain.
--Strategic ESG possibilities	The company discusses green growth opportunities, goals and strategy to achieve the goals.

Table 1. Summary of evaluation criteria used by TGC (The Governance Group, 2021).

3.3.1 The Global Reporting Initiative (GRI)

Application of different reporting standards can affect both reporting quality and firm valuation (Christensen et al.,2021). Thus, we are interested in whether the use of a standardized reporting standard has an impact on the relationship between sustainability reporting quality and firm value. The chosen standard is the Global Reporting Initiative (GRI).

The voluntary Global Reporting Initiative (GRI) provides a comprehensive framework for global organizations to report on sustainability issues (Reynolds and Yuthas, 2008). It has been developed through dialogue between firm representatives, investors and other stakeholders in society to ensure overall reporting quality and enhance comparability and auditability of sustainability reporting (Bouten et al., 2011; Willis, 2003). GRI consists of three types of standards: universal standards, sector standards and topic standards. It allows firms to report in a structured way and in accordance with their own needs and concerns outside the firm.

Compared with other reporting standards, The GRI is the most widely used sustainability reporting standards in Norway. A survey by Nilsen and Ørbeck (2020) shows that 26 of the 50 biggest companies in Norway report in accordance with GRI in 2018, which is the highest among all reporting standards used in Norway.

Under the formulation process of the Norwegian Accounting Act paragraph § 3-3c, the Ministry of Finance states that reporting standards such as United Nations Global Compact and Global Reporting Initiative can be considered as an alternative method to fulfil the information reporting requirement, as they contribute to harmonization of international reporting regimes. However, the Ministry of Finance is aware of the reporting quality issue and carries out periodic national control to evaluate if these reporting standards meet the reporting requirement (Prop. 48 L, 2012, p. 26).

4.0 Hypothesis and Research Methodology

4.1 Discussion of the Research Method

The academic literature provides several methods to study value relevance of sustainability reporting. For instance, some researchers focus on the average effect of sustainability disclosure on firm value, while others study how information in sustainability reports affects firm behavior and investment decisions. One major problem with the latter method is that it is difficult to disentangle the news content of CSR activities from the valuation effects of reporting per se (Christensen et al., 2021). To separate the effects, one must study the contrafactual situation where investors only receive and react to the CSR information that publishes elsewhere than firm's sustainability reports. This is difficult to achieve in practice. Hence, there is little agreement on how stock markets respond to the release of CSR information (Flammer, 2013; Groening and Kanuri, 2013).

Alternatively, we choose to study the *average* effect of sustainability reporting quality and firm value. This method is, however, not ideal either. Although previous studies show that better reporting quality reduces information asymmetry between firms and investors in terms of lower cost of capital, better liquidity and higher firm value, there are other researches that point to the opposite direction. For example, sustainability disclosure may cause firms to cease business activities in areas with severe climate impacts, which reduces their profitability in the long run. It is also possible that firms with better sustainability reports disclose more unexpected bad news, which decreases firm value.

After comparing the two methods, we decide to focus on the long-term, average effect of sustainability reporting, rather than the immediate effect due to data availability. The results from this study reflect the average net effects of sustainability reporting quality on firm value and are not generalizable for firms outside the data.

4.2 Forming the Research Hypotheses

Our research question is:

What is the association between sustainability reporting and firm valuation in Norway?

In order to answer this question, we test the relationship between sustainability reporting quality and firm value. This study encompasses the 100 largest companies evaluated by TGC from fiscal year 2018 to 2020. The time period is relatively short compared to earlier studies due to limited data availability. The thesis consists of two parts: the first part studies whether sustainability reporting quality is associated with firm valuation. In line with the discussion in chapter 3, we test if carbon emissions and the use of GRI will affect this relationship. In the second part of our study, we are interested in what causes firms to produce better sustainability disclosure.

Part I: Sustainability Reporting and Valuation:

H1: *The average effect of sustainability reporting quality on firm value is positive.*

The hypothesis is motivated by Barth et al. (2017) who find a positive relation between sustainability reporting quality and firm value, suggesting that better sustainability reporting quality may reduce information asymmetry and creates trust between firms and investors. We are interested in whether the information asymmetry argument is the predominant effect for firms listed on the OSE.

However, as discussed in more detail in the literature review, the alternative hypothesis is that no such positive correlation exists (see for example Cho et al., 2015).

H2: *Companies using standardized sustainability reporting standards are associated with higher firm value.*

The economic motivation behind this hypothesis is that standardized reporting standards enhance comparability and credibility of sustainability information. If investors prefer the use of standardized sustainability reporting standards, then we anticipate a positive correlation between the usage and firm value.

H3: *The association discovered in H2 is stronger for companies with less pollution.*
As discussed in section 2.3, sustainability disclosures have real effects on firm behavior. When carbon emissions and pollutions are disclosed in the sustainability reports, it will affect firm value negatively. The view is supported by Matsumura et al. (2014) in section 3.4. Thus, we are interested in how pollution affect the association.

Part II: Sustainability Disclosure

The second part of the research question is what causes firms to produce better sustainability disclosure. We have raised the following hypotheses:

H4a: *Firm size is related to better sustainability disclosure*

H4b: *Higher growth rate on assets is related to better sustainability disclosure*

H4c: *Leverage is related to better sustainability disclosure*

H4d: *Use of standardized reporting standards is related to better sustainability disclosure*

To reduce information asymmetry, investors may require better disclosure when a firm grows larger in size or when its structure and ownership become more complicated. Specifically, for firms with high financial leverage, investors and creditors may request additional information to reduce the risk of investment. Thus, to keep investors and stakeholders informed about the CSR activities, a firm will improve its reporting quality.

H4e: *Profitability is related to better sustainability disclosure*

Producing sustainability reports is costly. Thus, the quality of sustainability disclosures may depend on the financial status of a company. For instance, when a firm has relatively low profitability, it may not be able to produce high quality reports. Thus, we believe that profitability may be associated with sustainability reporting quality.

4.3 Research Methodology

4.3.1 Panel Data

This master thesis studies the 100 largest firms listed on the Oslo Stock Exchange (OSE) from 2018 to 2020, contributing to a total of 299 firm-year observations. This *time period* is chosen because TGC first began to publish sustainability analysis reports from 2018, and the report for fiscal year 2021 is not yet available at the time of writing. We collect data from various sources, such as firms' annual reports and announcements, stock information from Oslo Stock Exchange and external rating service providers, The Governance Group. We use a panel data set to control for unobservable changes across years. For example, if there is an increase in environmental awareness over the years, the panel data set can identify and control for the changes. In addition, it will also help to capture the cross-sectional heterogeneity (Wooldridge, 2020).

4.3.2 Building up the Research Model

In our study, we use two-way fixed effects model to control for the entity and time fixed effects. The entity fixed effects refer to the unobservable heterogeneities that vary across entities but are static over time. The time fixed effects are the omitted variables that are constant across entities but evolve over time (Hanck et al.,2021). We confirm our choice of model by performing a Hausman Test. The results are shown in Appendix 4.

Inspired by Barth et al. (2017) and Ioannou and Serafeim's (2017) study, we use the following regression model to test the first hypothesis:

$$\ln (TobinQ)_{it} = \beta_1 SRSCORE_{it} + \beta_2 AssetGr_{it} + \beta_3 Cash_{it} + \beta_4 ROA_{it}$$

$$+\beta_5 Lev_{it} + \beta_6 Size_{it} + \beta_7 Div_{it} + \alpha_i + \lambda_t + u_{it}$$

$$where\ i = 1, \dots, 126\ and\ t = 2018 - 2020$$

In our model, *TobinQ* measures the market-to-book ratio of total assets. We perform a log transformation of *TobinQ* to reduce the influence of large outliers. This will be further discussed in section 4.4. *SRSCORE* is the annual sustainability reporting quality rated by The Governance Group. *AssetGr* measures the one-year asset growth. *Cash* is the cash ratio. *ROA* calculates the one-year return on assets. *Lev* is

the financial leverage. *Size* measures the firm size. *Div* is an indicator variable of dividend payment. The source and detailed calculation of each variable are presented in section 5.1.

The sustainability reporting quality evaluated by TGC are based on the information available on the 31st December each year. Thus, all variables are measured and calculated using data on the same date. In addition, we cluster standard errors by firm to correct for cross-sectional and time-series dependence in regression residuals (Gow et al., 2010). If H1 holds true, then we anticipate a significant, positive coefficient on $SRSCORE$.

Then, we modified the regression model to test the second hypothesis:

$$\ln(TobinQ)_{it} = \beta_1 SRSCORE_{it} + \beta_2 GRI_{it} + \beta_3 AssetGr_{it} + \beta_4 Cash_{it} + \beta_5 ROA_{it} + \beta_6 Lev_{it} + \beta_7 Size_{it} + \beta_8 Div_{it} + \alpha_i + \lambda_t + u_{it}$$

$$where\ i = 1, \dots, 126\ and\ t = 2018 - 2020$$

Variable *GRI* takes the value 1 if firm *i* includes a GRI index in its sustainability report and 0 otherwise. If a standardized reporting standard is more preferred by investors, then we expect a significant and positive coefficient on the test variable *GRI*.

The third regression model is:

$$\ln(TobinQ)_{it} = \beta_1 SRSCORE_{it} + \beta_2 GRI_{it} + \beta_3 SRSCORE_{it} * Pollution_{it} + \beta_4 AssetGr_{it} + \beta_5 Cash_{it} + \beta_6 ROA_{it} + \beta_7 Lev_{it} + \beta_8 Size_{it} + \beta_9 Div_{it} + \alpha_i + \lambda_t + u_{it}$$

$$where\ i = 1, \dots, 126\ and\ t = 2018 - 2020$$

Pollution takes the value 1 if the firm operates in a sector that has primary climate impact according to FTSE4Good Index. We provided a detailed list of industries with primary climate impact in Appendix 3. Since the model includes fixed effects at firm-level, it is not possible to find the effect of *Pollution* on *ln(TobinQ)* due to multicollinearity. We construct an interaction term to show this type of effect. If the third hypothesis holds true, we anticipate negative coefficient β_3.

Lastly, we use the following regression model to test what causes firms to produce better sustainability disclosure.

$$SRSCORE_{it} = \beta_1 AssetGr_{it} + \beta_2 ROA_{it} + \beta_3 Lev_{it} + \beta_4 Size_{it} + +\beta_5 GRI_{it} + \alpha_i + \lambda_t + u_{it}$$

$$where\ i = 1, \dots, 126\ and\ t = 2018 - 2020$$

If the test variables contribute to better sustainability reporting quality, the coefficient on the test variables should be significant and positive.

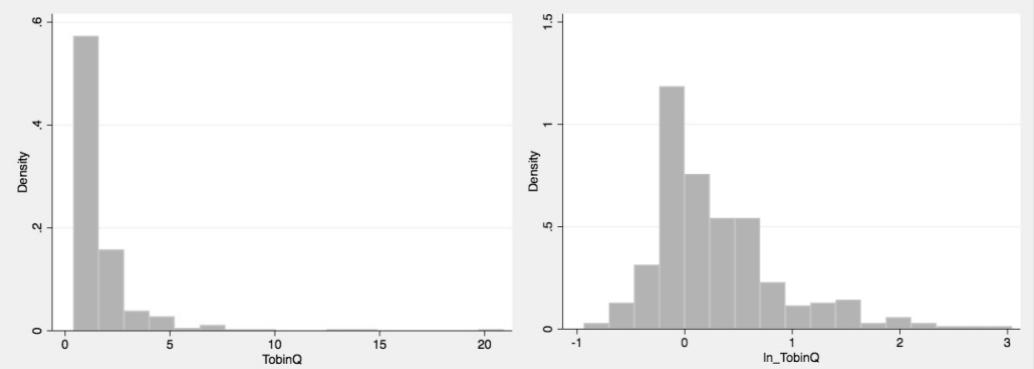
4.4 Validity

Our analysis in Appendix 4 suggests that the fixed effects model is the most appropriate model for our research questions. In this chapter, we discuss the major factors that can pose threats to validity of the regression model and methods we applied to reduce such interference.

Firstly, the traditional fixed effects model assumes that the error is not correlated with all observations of independent variables for an entity *i* over time. When this assumption is violated, it will lead to *omitted variable bias*. To reduce this type of bias, we add additional time fixed effects to our regression model. This known as the two-way Fixed Effect Model. Secondly, the model requires that variables are independent and identically distributed (i.i.d) across entities. Violating this assumption may result in *selection bias*. In our study, the research sample consists of 126 firms. These companies are chosen because they were one of the 100 largest companies from 2018 to 2020. As the sample is not chosen randomly, our findings may only be valid for large companies. We argue that although using a simple random sampling helps to reduce selection bias, it will also cause inconsistencies in estimators. Thus, we limit our research scope to large firms.

Thirdly, the fixed effects model assumes that large outliers are unlikely. Large outliers are the extreme observations that deviate significantly from the usual range of data. Including outliers in the model can result in distorted estimates of coefficients. After the data collection process, we find that outliers existed in variable *TobinQ*. For example, for most observations, the market-to-book ratio lies between zero and two, but there are ten observations that have a ratio larger than six. The distribution of *TobinQ* is thus strongly right skewed. Since all observations

of *TobinQ* are positive and larger than zero, we perform a log transformation to correct the effects of outliers. Graph 1 below shows the distribution of *TobinQ* before and after the log transformation.



Graph 1. Distribution of $TobinQ_{it}$ before (left) and after (right) log transformation.

Lastly, the fixed effects model assumes that there is no *autocorrelation* between variables. Autocorrelation is the degree of correlation of the same variables across time and often occurs in a time-series dataset. The model also requires that the variance of the error term is constant, known as *assumption of homoscedasticity*. When there are both autocorrelation and heteroskedasticity within entities, they may invalidate the usual and heteroskedasticity-robust standard errors used in the regression model (Hanck et al., 2021). To correct this issue, we use *clustered standard errors* in our regression, where 299 firm-year observations have been subdivided into 126 firm-groups. Within each group, we assume that there exists certain level of correlation between same variables. The regression result shows that the standard errors are larger when clustered standard errors applied, compared with the model using usual standard errors.

5.0 Data

This chapter provides information about our data collection process. We present the source of data and the criteria used in data selection process. In addition, we explain how variables are calculated and the importance of chosen variables. In section 5.2, we provide descriptive statistics of the panel dataset.

5.1 Variable Description

Dependent Variable

We are interested in the effect of sustainability reporting quality on firm value. Thus, the dependent variable is firm value. It consists of a firm's equity market capitalization and their current and non-current liabilities. In previous studies, the market-to-book ratio of total assets are employed when researchers compare firm value across entities because it reflects the relationship between market valuation of a firm's total assets and their carrying amount (Lang and Maffett, 2011). The difference between market value and book value is often a combined result of intellectual, human, social and natural capital, which is unobservable in financial statements (Barth et al., 2017). As a result, market-to-book ratio can help us to identify whether sustainability reporting quality is associated with firm value.

We name the market-to-book ratio as *TobinQ*. It is calculated as total assets minus total common equity plus common shares outstanding at year-end multiplied by share price at the release date of the sustainability reporting, divided by total assets. We obtain information of a firm's total asset, common equity and total shares outstanding from its annual reports and market price information is collected from Euronext. To find the association between sustainability reporting quality and firm value, we use the share price at the releasement date while rest of data are collected at year-end in accordance with Barth et al's (2017) study. We notice that the time difference can cause certain level of inaccuracy in regression estimator. However, since we have a relatively large data set, and there is limited availability of further information, we choose the method as mentioned above.

Independent Variable

Each year, The Governance Group publishes an analysis of sustainability reporting of the 100 largest firms on the Oslo Stock Exchange. The ratings are used as the

independent variable in our study, named as *SRSCORE*. In this part, we explain how TGC's rating can be used as a proxy for sustainability reporting quality.

In section 3.3, we discuss that ESG factors are of main importance in TGC's analysis reports. Each subsection in table 1 receives a score between 0 to 4 based on their reporting information. When there is no information about a specific topic, it receives 0 in score. When the topic is mentioned but there is little or no information about the handling process, it receives a score of 1. When the topic and handling process is mentioned, but no specific approach or results are presented, it receives 2. When the company discusses the relevance and handling of the topic and presents the achieved results, but there is no strategy and objectives for future periods, it is given a score of 3. When a company reports all of the above, it receives 4 (The Governance Group, 2021).

The overall sustainability reporting quality is the weighted score for each subsection. Climate and governance issues account for 35% of the final score respectively, as the climate field receives more public attention and regulatory press than other areas and governance factors are traditionally linked with significant financial consequences. Social factors are given a weight of 30% (The Governance Group, 2021).

From 2018 to 2020, we find a significant increase in number of companies that receive top rating. For instance, in 2018, only two companies, Equinor and Borregaard, receive a score of 4 for their sustainability report. 12 companies have been given a score of 3, 11 companies with score 2, 29 companies with score 1 and 46 firms with score 0. In 2019, total firm numbers that have a reporting quality score of 4, 3, 2, 1, 0 are 26, 22, 14, 15 and 23, respectively, and 35, 32,13, 8 and 12 for year 2020. From TGC's analyse, we can conclude that the overall reporting quality for listed firms has been improved. As a result, investors in the market are exposed to more nonfinancial information.

Control Variables

A control variable is a variable that is correlated with the dependent variable and possibly the independent variable. To enhance the internal validity of research, we include several control variables in our regression models. By introducing control variables, it helps to reduce the omitted variable bias and achieve more consistent results. In this part, we discuss the control variables used in the regression model: how they are calculated and why they are relevant for the study. All data used in this part is retrieved from firms' annual reports from 2018 to 2020.

AssetGr is the one-year asset growth rate. The variable is included because higher growth firm has often higher firm value (Barth et al., 2017). It is calculated by the change in total assets from prior financial year to current financial year, scaled by lagged total assets.

Cash is the cash and cash equivalent scaled by average total assets. Previous studies show that cash levels are positively correlated with firm value (Lee and Yeo, 2016; Barth et al., 2017). Thus, it is a relevant control variable in our research.

The return on assets, *ROA*, is the ratio of income before extraordinary items to lagged total assets. It measures the profitability of a firm. As the firm with higher profitability has normally higher firm value, the return on assets is used as a control for the effects of financial performance.

Lev is the financial leverage calculated as the total liabilities to the sum of total liabilities and the book value of common shareholder's equity. The variable is relevant because financial leverage is often negatively associated with firm value, as high debt ratio may lead to high interest payments and restriction of dividend distribution, which harms shareholder's interests.

Size measures the firm size and is calculated as the natural logarithm of the market capitalization at the beginning of the year. Prior studies show that firm size can affect both firm value and sustainability reporting quality (Amihud and Mendelson, 1989; Kim et al., 2012). Thus, there may exist a positive correlation between *Size* and *TobinQ* and *SRSCORE*.

Div is an indicator variable that equals to 1 if the firm declares or pays dividend in the current year and 0 otherwise. As dividend payment is one of the major factors that determines one's investment decision, it is thus used as control variable in our study.

5.2 Descriptive Statistics

In this section, we provide summary statistics and a correlation matrix between all relevant variables. The summary statistics can give a general direction of relationships and indicate whether there exist large outliers in dataset.

Variable	Obs	Mean	Std. Dev	Min	Max
TobinQ	299	1.7361	1.9535	0.3913	20.9161
Ln_TobinQ	299	0.3022	0.6031	-0.9382	3.0405
SRSCORE	299	1.9298	1.5233	0	4
Pollution	299	0.3679	0.4830	0	1
GRI	299	0.4548	0.4988	0	1
AssetGr	299	0.2675	1.3474	-0.5769	22.3680
Cash	299	0.1013	0.1372	0.0003	0.9360
ROA	299	0.0341	0.1561	-0.6661	1.7440
Lev	299	0.6013	0.2126	0.0000	1.1337
Size	299	9.0673	1.3052	5.4846	13.3313
Div	299	0.6689	0.4714	0	1

Table 2. Summary Statistics.

Table 2 provides distributional statistics for the variables used in regression models. It reveals that mean *TobinQ* is 1.7361, which indicates that, on average, a firm with average level of financial and nonfinancial performance will achieve a firm value that is 1.7361 times larger than its book value. The min and max *TobinQ* is 0.3913 and 20.9161 respectively, which suggests that there may exist larger outliers in the dependent variable. Thus, we modify our model by performing a log transformation of *TobinQ*.

Table 2 shows that mean *SRSCORE* is 1.9298, which can be interpreted as a firm with average level of sustainability reporting will on average receive a score of 1.9298 from TGC evaluation. In Appendix 2, we provide a detailed list of companies with their respective sustainability reporting rating from 2018 to 2020. Mean *Pollution* and *GRI* are 0.3679 and 0.4548, which shows 36.79% of the 126 firms operates in the industries that have primary climate impact, and 45.48% of 299 firm-year observations contain usage of GRI reporting standards.

Table 3 presents Pearson correlation matrix between dependent, independent and control variables. By analyzing whether one independent variable is highly correlated with one or more other independent and control variables, we can modify the research models to reduce the threat of multicollinearity, which often leads to undermined statistical significance (Hanck et al.,2021).

The correlation matrix from Table 3 shows some interesting findings: Firstly, the correlation coefficient for *SRSCORE* and *GRI* is 0.6605, which suggests that there exists certain degree of correlation between the two variables. At the same time, the correlation is not high, suggesting that SRSCORE and GRI may focus on different aspects of sustainability reporting. The result is in line with our assumption that firms with better sustainability disclosure tend to receive higher score in TGC's analyses. This hypothesis will be examined in our fourth research model.

Secondly, the correlation coefficient is 0.5412 between *SRSCORE* and *Size*. The correlation relationship is both positive and significant. By analyzing the panel data, we notice that the improvement of sustainability reporting quality starts from the largest firms. Such phenomenon can be explained by the accounting theory that larger firms have often complex structure and use disclosure to reduce information asymmetry between firms and their investors and creditors. This relationship will also be tested in our research model.

Thirdly, the coefficient for *ln_TobinQ* and *Size* is negative, which means that larger firms have less growth opportunities. As Barth et al. (2017) point out in their study, the coefficients reflect *Size*'s multivariate relationship with *ln_TobinQ*.

Lastly, we would like to point out that the correlation matrix itself does not display the effects one variable has on another. However, it is a useful tool to identify potential threats of multicollinearity. From Table 3, the correlation coefficients between *SRSCORE* and GRI, and between *AssetGr* and *ROA* are larger than 0.6, suggesting that exists strong correlations between these variables. Thus, we report the regression results in separate column if there is a change in significance level after correcting multicollinearity.

	ln_TobinQ	SRSCORE	Pollution	GRI	AssetGr	Cash	ROA	Lev	Size	Div
ln_TobinQ	**1**									
SRSCORE	-0.0060	**1**								
Pollution	-0.2875*	0.0124	**1**							
GRI	-0.0325	0.6605*	-0.1119	**1**						
AssetGr	0.0931	-0.1089	0.0611	-0.0744	**1**					
Cash	0.5280*	-0.1448*	-0.0651	-0.1443*	0.1351*	**1**				
ROA	0.1435*	-0.0434	-0.0325	-0.0221	0.6529*	0.1141*	**1**			
Lev	-0.2612*	0.0525	-0.0361	0.0706	-0.0010	-0.3851*	-0.0608	**1**		
Size	-0.0404	0.5412*	0.0794	0.4527*	-0.0749	-0.2349*	-0.0534	0.0304	**1**	
Div	-0.0841	0.2245*	-0.969	0.1860*	-0.1491*	-0.1937*	0.1833	0.0952	0.2380*	**1**

*Note: * p<0.05*

Table 3. Pearson Correlation Matrix.

6.0 Result

This part presents results from our tests of H1 to H4. The presented results are based on estimating a fixed effect model and in the Appendix 4, we provide additional quantitative information justifying this modelling choice.

6.1 Sustainability Reporting Quality on Firm value

In this section, we present the regression results and discuss whether the four research hypotheses are accepted. Our study shows that the relationship between sustainability reporting quality and firm value for Norwegian listed companies is different from Barth et al.'s (2017) analyses.

The main hypothesis of this master thesis is to investigate the association between sustainability reporting quality and firm value. We anticipate a positive and significant relationship because we believe that better sustainability reporting quality helps to reduce information asymmetry and to create trust between firms and investors.

The regression model used for this hypothesis is:

$$\ln (TobinQ)_{it} = \beta_1 SRSCORE_{it} + \beta_2 AssetGr_{it} + \beta_3 Cash_{it} + \beta_4 ROA_{it}$$

$$+\beta_5 Lev_{it} + \beta_6 Size_{it} + \beta_7 Div_{it} + \alpha_i + \lambda_t + u_{it}$$

$$where\ i = 1, \dots, 126\ and\ t = 2018 - 2020$$

Table 4 demonstrates the regression results for our first research hypothesis. Although Barth et al. (2017) find a positive relationship between sustainability reporting quality and firm value for companies listed in Johannesburg Stock Exchange, the situation is quite the opposite in Norway. Our study finds that *SRSCORE* has negative coefficient, which suggests that there is a negative relationship between sustainability reporting quality and firm value. The result is statistically significant at 10% level after fixing the standard errors for firm clusters. We discuss possible reasons in chapter 7.

Variables	Prediction	Model 1
SRSCORE	(+)	-0.0392*
		(0.0213)
AssetGr		0.0014
		(0.0262)
Cash		0.6646*
		(0.3621)
ROA		-0.1742
		(0.3494)
Lev		-0.1352
		(0.3105)
Size		0.1277
		(0.0883)
Div		0.0585*
		(0.0332)
2019.Year		-0.0666*
		(0.0384)
2020.Year		0.0886**
		(0.0433)
Constant		-0.8076
		(0.8338)
Firm Fixed Effect		YES
Year Fixed Effect		YES
Clustered Standard Errors		YES
Observations		299
Number of Firms		126
R-squared		0.3183

*Note: * p<0.1, ** p<0.05*

Table 4. The effect of sustainability reporting on firm value. The regression data has a total of 299 firm-year observation over the period 2018-2020.

Regarding the control variables, most notably *Cash* and *Div*, have positive coefficients, suggesting that firm value increases when cash level increases, or when firm pays out dividend. *Lev* has a negative coefficient, which means that high debt level is associated with low firm value. *ROA* has also a negative coefficient. However, it is inconsistent with growth firm having higher firm value. Our untabulated univariate statistics show that *ROA* has a positive effect on *ln(TobinQ)*, which indicates that the reported coefficient in Table 5 is the result of *ROA's* multivariate effect on *ln(TobinQ)*.

With the reported output from the regression model, we reject research hypothesis H1 and conclude that the average effect of sustainability reporting quality on firm value is negative.

6.2 GRI on Firm value

The second hypothesis aims to test whether investors prefer the use of standardized reporting standards in sustainability reports. We anticipate a positive coefficient because standardized reporting standards such as GRI enhance overall comparability and credibility of sustainability information.

The regression model used to test the second hypothesis is as follows:

$$\ln (TobinQ)_{it} = \beta_1 SRSCORE_{it} + \beta_2 GRI_{it} + \beta_3 AssetGr_{it} + \beta_4 Cash_{it} + \beta_5 ROA_{it} + \beta_6 Lev_{it} + \beta_7 Size_{it} + \beta_8 Div_{it} + \alpha_i + \lambda_t + u_{it}$$

$$where\ i = 1, \dots, 126\ and\ t = 2018 - 2020$$

Table 5 shows the effect of GRI on firm value. *GRI* has a positive coefficient of 0.0055, which indicates that by using a standardized reporting standard, it may increase firm value. However, the result is not statistically significant at any significance level, which means that our current data is not sufficient to give an answer to the research hypothesis. We cannot accept or reject our second hypothesis (H2).

One possible reason that leads to the insignificant result is the noise being too large and sample size being too small. We notice that by introducing data from 2020, the p-values for several coefficients reduce significantly. In chapter 7, we discuss possible research design that may help to solve this issue.

Variables	Prediction	Model 2
SRSCORE		-0.0394*
		(0.0212)
GRI	(+)	0.0021
		(0.0522)
AssetGr		0.0013
		(0.0263)
Cash		0.6650*
		(0.3645)
ROA		-0.1744
		(0.3512)
Lev		-0.1336
		(0.3153)
Size		0.1280
		(0.0896)
Div		0.0583*
		(0.0339)
2019.Year		-0.0665*
		(0.0383)
2020.Year		0.0884**
		(0.0442)
Constant		-0.8109
		(0.8559)
Firm Fixed Effect		YES
Year Fixed Effect		YES
Clustered Standard Errors		YES
Observations		299
Number of Groups		126
R-squared		0.3183

*Note: * p<0.1, ** p<0.05*

Table 5. The effect of GRI on firm value. The regression data has a total of 299 firm-year observation over the period 2018-2020.

6.3 Pollution on Firm Value

The third hypothesis seeks to answer whether pollution affect the association between sustainability reporting quality and firm value. Since sustainability information such as carbon emissions and pollutions can have real effects on firm behavior, we anticipate that firms which operate in sectors that have primary climate impacts will have lower firm value by publishing sustainability reports. That is to say, we expect coefficient β_3 to be negative.

The regression model used to test the third research hypothesis is:

$$\ln (TobinQ)_{it} = \beta_1 SRSCORE_{it} + \beta_2 GRI_{it} + \beta_3 SRSCORE_{it} * Pollution_{it} + \beta_4 AssetGr_{it} + \beta_5 Cash_{it} + \beta_6 ROA_{it} + \beta_7 Lev_{it} + \beta_8 Size_{it} + \beta_9 Div_{it} + \alpha_i + \lambda_t + u_{it}$$

$$where\ i = 1, \dots, 126\ and\ t = 2018 - 2020$$

Variables	**Prediction**	**Model 3**
SRSCORE		-0.0248
		(0.0233)
GRI		0.0061
		(0.05197)
SRSCORE*Pollution	(-)	-0.0440*
		(0.0224)
AssetGr		0.0011
		(0.0267)
Cash		0.6391*
		(0.3635)
ROA		-0.1799
		(0.3550)
Lev		-0.1032
		(0.3132)
Size		0.1218
		(0.0906)
Div		0.0736*
		(0.0365)
2019.Year		-0.0633*
		(0.0376)
2020.Year		0.0901**
		(0.0436)
Constant		-0.7807
		(0.8572)
Firm Fixed Effect		YES
Year Fixed Effect		YES
Clustered Standard Errors		YES
Observations		299
Number of Groups		126
R-squared		0.3311

*Note: * p<0.1, ** p<0.05*

Table 6. The effect of pollution on firm value.

Table 6 reveals that the interaction term has a negative coefficient, -0.0432, which leads to the belief that, for firms with high level of pollution, publishing

sustainability reports to the public is associated with lower firm value.[1] Our finding is in line with the results from Matsumura et al. (2014).

With the abovementioned regression results, we accept the third research hypothesis (H3) and conclude that pollution has a negative impact on the association between sustainability and firm value.

6.4 Firm Size, Growth Rate, Leverage, GRI and Profitability on Sustainability Reporting Quality

The last research question examines which factors affect sustainability reporting quality. Specifically, we study the effect of firm size, asset growth rate, leverage, GRI and profitability on *SRSCORE*. We anticipate positive coefficients for all five variables: when a firm grows larger in size or has a high leverage ratio, investors and creditors may require additional information to reduce information asymmetry and investment risks. Standardized reporting standard such as GRI provides guidance on type and amount of information to be disclosed, and high profit rate means that firms can bear the cost to produce a good sustainability report. The regression model to test the hypothesis is:

$$SRSCORE_{it} = \beta_1 AssetGr_{it} + \beta_2 ROA_{it} + \beta_3 Lev_{it} + \beta_4 Size_{it} + +\beta_5 GRI_{it} + \alpha_i + \lambda_t + u_{it}$$

$$where\ i = 1, \dots, 126\ and\ t = 2018 - 2020$$

The regression results in Table 7 shows that *GRI* has positive coefficient. This means that companies that publish sustainability reports in accordance with GRI reporting standards will receive a higher score of 0.9136 in TGC's analyses. The coefficient is statistically significant at 1% significance level.

Due to multicollinearity, we test the effect of *AssetGr* and *ROA* separately. In Table 7 Model 4a and 4b, both variables have a negative coefficient, which indicates that higher growth rate and higher profit rate is associated with lower sustainability reporting quality. The mentioned regression results are statistically significant at 1% significance level in respective models. We discuss possible reasons in chapter 7.

[1] We have also examined the coefficients β_1 and β_3 in a separate regression model where GRI is dropped due to high correlation with SRSCORE. The regression gives similar results, and the significance levels remain unchanged. Thus, it leads to the same conclusion as presented in 6.3.

Size has a positive coefficient. The result confirms our hypothesis that there is a need for information disclosure when a firm's market value is high. *Lev* has negative coefficient, which suggests that high debt ratio is related to lower sustainability reporting quality. The result does not align with our hypothesis that creditors will demand information disclosure to reduce information asymmetry. Rather, it may reflect the consequence that firms do not have sufficient resource to produce sustainability reports. However, the results are not significant at any significance level.

Variables	**Prediction**	**Model 4a**	**Model 4b**	**Model 4**
AssetGr	(+)	-0.0432***		0.0241
		(0.0105)		(0.0727)
ROA	(+)		-0.6180***	-0.8486
			(0.2246)	(0.8780)
Lev	(+)	-0.6296	-0.9818	-1.0865
		(1.0252)	(1.0602)	(1.0902)
Size	(+)	0.0997	0.0894	0.0829
		(0.1532)	(0.1555)	(0.1594)
GRI	(+)	0.9105***	0.9132***	0.9136***
		(0.1753)	(0.1754)	(0.1761)
2019.Year		1.1157***	1.1184***	1.1165***
		(0.1107)	(0.1091)	(0.1099)
2020.Year		1.5657***	1.5710***	1.5734***
		(0.1460)	(0.1437)	(0.1437)
Constant		0.1088	0.4195	0.5421
		(1.5550)	(1.5793)	(1.6458)
Firm Fixed Effect		YES	YES	YES
Year Fixed Effect		YES	YES	YES
Clustered Standard Errors		YES	YES	YES
Observations		299	299	299
Number of Groups		126	126	126
R-squared		0.6470	0.6488	0.6490

*Note: *** p<0.01*

Table 7. Various Factors on Sustainability Reporting Quality. The regression data has a total of 299 firm-year observation over the period 2018-2020.

Furthermore, we notice that the year fixed effects for fiscal year 2019 and 2020 is positive and significant, which indicates that there is increased awareness on sustainability reporting. The coefficients from Table 7 exhibit that, compared with

2018-level, firms' average sustainability reporting score increases by 1.1165 in 2019, and 2.6899 in 2020. The increase in sustainability reporting quality over the years may be a result of peer benchmarking as shown in Grewal's (2021) study, or the consequence of more regulatory requirements and recommendations on environmental protection issues.

Given the regression results from Table 7, we accept the hypothesis H4d that the use of standardized reporting standards is related to better sustainability disclosure and reject H4b and H4e because they have significant and negative coefficients. We fail to accept or reject hypothesis H4a and H4c.

7. Interpretation of Regression Results

In this chapter, we discuss possible reasons why the regression results are not in line with our assumptions. Specifically, we focus on the relation between sustainability reporting quality and firm value. By examining previous studies and analyzing the data set, we provide some explanations that could be relevant for future research.

In our study, we find that sustainability reporting quality is negatively associated with firm value. That is, firms with better disclosures in sustainability topics have lower firm value. Our findings are different to several previous studies, such as Plumlee et al. (2015), Gao and Zhang (2015) and Barth et al. (2017). It is important to emphasize that our study do not focus on the *content* of sustainability disclosure. Rather, the sustainability reporting score measures the completeness and informativeness of sustainability disclosures. The scores do not demonstrate whether the sustainability reports contain good or bad news.

Having examined our firm data, we propose some explanations for the negative relationship between sustainability reporting quality and firm value.

First, if there is a bias in sustainability reporting, then the reported results could hold. The bias refers to the fact that firms often use sustainability reporting for self-promotion, while neglecting parts of their negative CSR impacts. When examining the international data used in previous studies, we notice that most findings are associated with voluntary disclosures. One major problem is that when firms choose to only report their successful stories, the sustainability reports will generate a positive correlation with firm value. However, when firms are required to disclose relevant negative information, then the negative correlation could take the dominant effect.

Second, many sustainability investments have negative present value, which may increase the overall risk profile of the company and reduce shareholder value (Richardson and Welker, 2001). Some arguments that support the positive relationship between sustainability reporting quality and firm value are that investors have non-monetary interests and that CSR investments have long-term

strategic advantage and potential cost savings (Edmans, 2012; Porter & van der Linde, 1995). However, when investors in the market do not have such non-monetary interest and only focus on the short-term benefits, *and* when there is a positive correlation between sustainability disclosure and CSR activities, then the negative association could hold. The negative effects have also been observed by Chen et al. (2017) where they find that firms in China experience a reduction in future profitability following the CSR reporting mandate. What's more, it is worth discussing whether the purpose of sustainability reporting is for the good of investors, or for the sake of other stakeholders in the society.

Third, there may exist some mediating factors that affect the sign and the strength of the relationship between sustainability reporting quality and firm value. For instance, the literature suggests that media coverage, customer's sustainability awareness and investors' reactions to CSR activities can have an impact on the relationship (Cahan et al., 2015; Servaes and Tamayo, 2013; Elliott et al. 2014). In addition, Brammer and Millington (2008) find in their study that the relationship can be U-shaped, which indicates that the association between sustainability reporting quality and firm value may not be linear. By adding additional variables to control for the mediating effects, or using nonlinear regression models, the results may be different from we have found in this study.

Finally, the results may be specific to the data used in this analysis. The time frame of the thesis includes the period of corona-pandemic. Due to limited data availability, it is not possible to cover the time period prior to 2018. As a result, the negative association between sustainability reporting quality and firm value may be contingent on the macroeconomic conditions. In addition, the sample size of 299 firm-year observations is relatively small compared to previous studies. Our results call for future research that covers longer time period, preferably complete business cycles.

The data also shows that our analysis contains a significant amount of growth firms which are characterized by unusually high growth rate and profitability relative to their industry competitors. From TGC's annual analyses, these firms often receive lower sustainability reporting scores. The view is supported by our result that firm's

asset growth rate and profitability are negatively related to the sustainability reporting quality. The finding suggests that more research is needed in the future.

8. Conclusion

The objective of this master thesis is to investigate the relationship between sustainability reporting quality and firm value. In section 1.2, we present the following research question:

What is the association between sustainability reporting and firm valuation in Norway?

To answer this question, we collect firm data and sustainability reporting score from companies' annual reports and TGC's analyses. 126 firms that are listed on Oslo Stock Exchange meet the selection criteria, contributing to a total of 299 firm-year observations. The thesis uses the two-way Fixed Effects Model to control for entity fixed effects and time fixed effects.

Based on the regression results in section 6.2, we conclude that there exists a negative relationship between sustainability reporting quality and firm value. We also find that, for firms that operate in a sector with primary climate impact, publishing sustainability reports has negative impact on firm value. Both results are statistically significant at 10% significance level.

Our study also finds that the use of using standardized sustainability reporting standards increases sustainability reporting quality, and the overall reporting quality for all firms increases over the years. However, we do not find any solid evidence on whether using standardized sustainability reporting standards, namely GRI, has any impact on firm value.

Our findings contradict several previous studies where sustainability reporting quality is positively linked to firm value. We provide some explanations for the differences. First, there may exist consistent biases in sustainability reporting. Second, investors in the market may not have non-monetary or focus exclusively on short-term benefits. Third, there may exist other mediating factors that affect the sign of the relationship, or the association cannot be generalized using linear regression. Fourth, small sample size and noises from growth firms may bias the regression results.

Despite the negative relation founding in our study, it does not mean that the sustainability disclosures have an overall negative impact on firm. Although sustainability activities may seem costly in the eyes of investors, they can generate positive effects among other groups such as customers, employees, regulators and partners in the supply-chain. There are also different reasons why firms wish to engage in CSR activities, such as to sponsor community events or for the sake of corporate philanthropy (Christensen et al., 2017). These activities will benefit a broader range of stakeholder than the primary audience of financial statements. As a result, the net effect of sustainability disclosures needs still to be examined.

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Appendix

Appendix 1. Variable definitions by Barth et. al (2017)

Variable	Explanation
TobinQ	the market-to-book ratio of total assets calculated as total assets minus total common equity plus common shares outstanding at year-end multiplied by share price at the release date of the sustainability reporting, divided by total assets.
SRSCORE	the sustainability reporting quality measured by external ranking service provider *The Governance Group*. The value ranges from 0 to 4 as 0 being the worst or no disclosure and 4 as the best reporting practice.
AssetGr	the asset growth by analyzing one-year change in total assets from the prior financial year to the current financial year, scaled by lagged total assets. $Cash$: cash and cash equivalent scaled by average total assets.
Cash	cash and cash equivalent scaled by average total assets.
ROA	the return on assets calculated as the ratio of income before extraordinary items to lagged total assets.
Lev	financial leverage calculated as the total debt to the sum of total debt and the book value of common shareholder's equity.
Size	firm size and is calculated as the natural logarithm of market capitalization at the beginning of the year.
Div	the variable is equal to 1 if the firm declares or pays dividend in the current year and 0 otherwise.

Appendix 2 Sustainability Reporting Scores for 126 Reported Firms by TGC

Firm	2018	2019	2020
Borregaard	4	4	4
Equinor	4	4	4
DNB	3	4	4
Entra	3	4	3
Gjensidige	3	4	4
Grieg Seafood	3	4	4
Mowi	3	4	4
Norsk Hydro	3	4	4
Orkla	3	4	4
SpareBank 1 Østlandet	3	4	4
Storebrand	3	4	4
Telenor	3	4	3
Veidekke	3	4	4
Yara International	3	4	4
Aker BP	2	4	4
Atea	2	4	4
Bakkafrost	2	4	4
Fjordkraft	2	1	3
SalMar	2	4	3
Lerøy Seafood Group	2	4	4
Nordic Semiconductor	2	4	4
Scatec Solar	2	4	4
Schibsted	2	4	3
Wallenius Wilhelmsen	2	2	3
AF Gruppen	1	3	3
Aker	1	1	3
Aker Solutions	1	4	4
Akva Group	1	1	2
B2Holding	1	0	2
BW LPG	1	2	3
BW offshore Limited	1	3	3
Elkem	1	3	4
Europris	1	4	4
Golden Ocean Group	1	3	3
TietoEVRY	1	3	4
Kongsberg Automotive	1	3	2
Kongsberg Gruppen	1	4	4
Norway Royal Salmon	1	3	3
Norwegian Property	1	3	2
Salmones Camanchaca	1	0	4
SpareBank 1 Nord-Norge	1	3	4

SpareBank 1 SR-Bank	1	3	4
Subsea 7	1	3	4
TGS-NOPEC	1	4	4
Tomra Systems	1	2	3
Wilh. Wilhelmsen Holding	1	3	3
XXL	1	3	3
Arcus	0	1	1
Arendals Fossekompani	0	1	3
Austevoll Seafood	0	3	4
Bonheur	0	0	2
Bouvet	0	0	3
Fjord1	0	1	1
FLEX LNG	0	2	3
Hexagon Composites	0	2	3
NEL	0	0	2
Norwegian Air Shuttle	0	1	1
Norwegian Energy Company	0	0	1
Norwegian Finans Holding	0	1	2
NTS	0	0	0
Ocean Yield	0	1	2
Odfjell drilling	0	2	4
Olav Thon Eiendomsselskap	0	0	3
Otello Corporation	0	0	0
Protector Forsikring	0	0	0
Sbanken	0	1	3
Selvaag Bolig	0	1	2
SpareBank 1 Ringerike Hadeland	0	1	2
SpareBank 1 Østfold Akershus	0	1	3
Sparebanken Møre	0	1	3
SpareBanken Vest	0	3	4
Stolt-Nielsen	0	2	3
Treasure	0	0	0
SpareBank 1 SMN	1	3	4
DNO	0	0	0
PGS	2	2	
Höegh LNG Holdings	1	3	
NRC Group	1	2	
Odfjell	1		
RAK Petroleum	1	0	
ABG Sundal Collier	0		0
American Shipping CO	0		
Axactor	0	0	
Borr Drilling	0	2	

Akastor	1	3	
Gaming Innovation Group	0		
IDEX	0		
Komplett Bank	0	0	
Kværner	0	3	
Magseis Fairfield	0		
MPC Container Ships	0		
Nordic Nanovector	0		
Northern Drilling	0	0	
Pareto Bank	0	0	
Frontline	0	2	3
SpareBank 1 BV	0	2	
Shelf Drilling	0	3	
Solon Eiendom	0	0	
The Scottish Salmon Company	0		
Spectrum	0		
VoW (Scanship Holding)		0	2
SATS		2	4
Adevinta		3	3
Norske Skog		3	4
Self-Storage Group		0	
PCI biotech		0	
Medistim		0	0
Crayon Group Holding		0	0
Avance Gas Holding		2	
SAS AB			3
REC Silicon			0
Photocure			1
Pexip Holding			3
Multiconsult			1
Link Mobility Group			0
KMC Properties			0
Kitron			2
Kid			3
Hofseth BioCare			2
Hafnia Limited			0
Cadeler			3
BW Energy Limited			1
BEWI			3
Atlantic Sapphire			4
Asetek			3
Arctic Zymes Technologies			0

Appendix 3 Sectors with primary climate impact by FTSE4Good Index Series (2022)

Primary Impact Subsector Category		Secondary Impact Subsector Category	
533	Exploration & Production	583	Renewable Energy Equipment
537	Integrated Oil & Gas	587	Alternative Fuels
573	Oil Equipment & Services	2717	Defense
577	Pipelines	2723	Containers & Packaging
1353	Commodity Chemicals	2727	Diversified Industrials
1357	Speciality Chemicals	2733	Electrical Components & Equipment
1733	Forestry	2737	Electronic Equipment
1737	Paper	2757	Industrial Machinery
1753	Alumnium	2771	Delivery Services
1755	Nonferrous Metals	2775	Railroads
1757	Iron & Steel	2777	Transportation Services
1771	Coal	2791	Business Support Services
1773	Diamonds & Gemstones	2793	Business Training & Employment Agencies
1775	General Mining	2795	Financial Administration
1777	Gold Mining	2797	Industrial Suppliers
1779	Platinum & Precious Metals	3355	Auto Parts
2353	Building Materials & Fixtures	3357	Tires
2357	Heavy Construction	3533	Brewers
2713	Aerospace	3535	Distillers & Vintners
2753	Commercial Vehicles & Trucks	3537	Soft Drinks
2773	Marine Transportation	3573	Farming & Fishing
2779	Trucking	3577	Food Products
2799	Waste & Disposal Services	3722	Durable Household Products
3353	Automobiles	3724	Nondurable Household Products
7573	Gas Distribution	3726	Furnishings
7575	Multiutilities	3728	Home Construction
5751	Airlines	3743	Consumer Electronics
7535	Conventional Electricity	3745	Recreational Products
		3747	Toys
		3763	Clothing & Accessories
		3765	Footwear

3767	Personal Products
3785	Tobacco
4533	Health Care Providers
4535	Medical Equipment
4537	Medical Supplies
4573	Biotechnology
4577	Pharmaceuticals
5333	Drug Retailers
5337	Food Retailers & Wholesalers
5371	Apparel Retailers
5373	Broadline Retailers
5375	Home Improvement Retailers
5377	Specialized Consumer Services
5379	Speciality Retailers
5553	Broadcasting & Entertainment
5555	Media Agencies
5557	Publishing
5752	Gambling
5753	Hotels
5755	Recreational Services
5757	Restaurants & Bars
5759	Travel & Tourism
6535	Fixed Line Telecommunications
6575	Mobile Telecommunications
7537	Alternative Electricity
7577	Water
8355	Banks
8532	Full Line Insurance
8534	Insurance Brokers
8536	Property & Casualty Insurance
8538	Reinsurance
8575	Life Insurance
8633	Real Estate Holding & Development
8637	Real Estate Services
8671	Industrial & Office REITs
8672	Retail REITs
8673	Residential REITs
8674	Diversified REITs
8675	Speciality REITs
8676	Mortgage REITs
8677	Hotel & Lodging REITs
8771	Asset Managers
8773	Consumer Finance
8775	Speciality Finance
8777	Investment Services
8779	Mortgage Finance

8985	Equity Investment Instruments
9533	Computer Services
9535	Internet
9537	Software
9572	Computer Hardware
9574	Electronic Office Equipment
9576	Semiconductors
9578	Telecommunications Equipment

Appendix 4 Modelling Choice

As discussed in section 4.3.2, we perform F-test, Breusch-Pagan Test and Hausman Test to find the best fit regression model for our panel data. The F-test indicates whether each fixed effect term has a significant effect on the response. By rejecting the null hypothesis, we can conclude that fixed effects model is preferred to pooled-OLS model. The Breusch-Pagan Test examines whether homoskedasticity is present, which is a core assumption for OLS Model. By rejecting the null hypothesis, we can conclude that heteroscedasticity is present and thus random effects model is preferred to Pooled-OLS- Model.

We use Hausman Test to decide whether fixed effects model or random effects model should be used. The Hausman Test studies whether the unique errors u_i are correlated with the regressors. If we reject the null hypothesis that there is no such correlation, the fixed effects model is preferred to random effects model. If we cannot reject the null hypothesis, the result suggests that random effects model *may* be a better fit regression model for the panel data than fixed effects model.

Hypothesis 1	**H_0**	**Result**	**Probability**	**Rejection of H_0**
F-test	All $u_i = 0$	17.47	0.0000	YES
Breusch-Pagan Test	Var(u) = 0	103.98	0.0000	YES
Hausman Test	Difference in coefficient not systematic	36.99	0.0000	YES

Hypothesis 2	**H_0**	**Result**	**Probability**	**Rejection of H_0**
F-test	All $u_i = 0$	17.37	0.0000	YES
Breusch-Pagan Test	Var(u) = 0	103.82	0.0000	YES
Hausman Test	Difference in coefficient not systematic	37.43	0.0000	YES

Hypothesis 3	**H_0**	**Result**	**Probability**	**Rejection of H_0**
F-test	All $u_i = 0$	16.62	0.0000	YES
Breusch-Pagan Test	Var(u) = 0	100.85	0.0000	YES
Hausman Test	Difference in coefficient not systematic	41.86	0.0000	YES

Hypothesis 4	**H_0**	**Result**	**Probability**	**Rejection of H_0**
F-test	All $u_i = 0$	2.58	0.0000	YES
Breusch-Pagan Test	Var(u) = 0	124.26	0.0000	YES
Hausman Test	Difference in coefficient not systematic	3.05	0.0403	YES

Table 8. Test Results for Model Choice for Hypothesis 1-4. The null hypothesis is rejected at 5% significance level.

Table 8 suggests that Fixed Effects Model suits our panel data best. We reject the null hypothesis for F-test and Hausman test under all our four research hypotheses, suggesting that there exist fixed effects that affect the predicator or outcome variables. Our test results are in line with previous studies, such as Lee and Yao (2016) and Barth et al. (2017).