Norwegian School of Economics
Bergen, Spring 2019

Sustainability Disclosure and Stock Returns

A study of firm 10-K sustainability disclosure and stuck returns in the period 1994-2017.

Anders Bergfjord Fjellvikås

Supervisor: Nils Friewald

Master thesis, M.Sc. in Economics and Business Administration,

Economic Analysis.

NORWEGIAN SCHOOL OF ECONOMICS

Preface

This master's thesis marks the end of my Master of Science in Economics and Business

Administration at the Norwegian School of Economics, NHH. I have studied the nature of sustainability reporting in 10-K forms, and the association with both firm characteristics and stock market performance. I have developed a genuine interest in the complex role that firms possess concerning sustainable development. This interest spurred my curiosity in the economic contexts of firm sustainability reporting. During my third semester at NHH, I enrolled in the subject Applied Textual Data Analysis for Business and Finance. This subject fueled the idea of estimating sustainability disclosure levels by computerized parsing and gave me the tools to do so.

I want to offer my gratitude toward my supervisor, Nils Friewald. Thank you for the valuable feedback and guidance during the semester.

Finally, I would like to thank my family and friends that provided support and encouragement throughout this project. They motivated me to proceed through challenging times and frequently reminded me of the enjoyment I find in exploring the field of economics. Thank you.

Sustainability Disclosure and Stock Returns

Anders Bergfjord Fjellvikås

June 1st, 2019

Contents

List of Figures

List of Tables

Abstract

I utilize a keyword matching technique for comparing sustainability disclosure levels among publicly listed U.S. firms. By computerized parsing of the 10-K form, filed with the U.S. Securities Exchange Commission, I construct a sample of 88,464 firm-year sustainability disclosure observations. I find significant cross-sectional variation in sustainability disclosure in 10-K forms and document a steady increase in the form's usage as a tool for sustainability reporting since the 1990s. Several firm characteristics correlate with disclosure levels of sustainability relating information. Primarily firm size, geographical dispersion, and industry show significant variation in firm 10-K sustainability disclosure concurring with previous empirical work. After controlling for several firm characteristics, I document a negative association between a firm's sustainability disclosure and stock returns in microcaps. The relation between sustainability disclosure and stock returns is not statistically significant in the comparison of all firms. I document several firm characteristics that explain cross-sectional variation in stock returns. Furthermore, this paper provides insight on industry effects of sustainability disclosure levels, and investigate stock return effects by environmental, social, and governance-related disclosure.

1. Introduction

Privately owned firms share significant responsibility for sustainable development in free-market economies. Public and regulatory pressure has steadily shifted the goals of such firms from pure profits towards a social optimum. Consequently, an increasing number of firms have started to communicate their sustainability performance to stakeholders. Sustainability disclosure usually pertains to environmental practices, social issues, and ethical governance. Although this has been a topic of research since the mid-20th century, the last thirty years have seen a resurgence in empirical and theoretical work investigating firm sustainability disclosure. A popular tool for sustainability disclosure research is the standalone sustainability report. The growing need to communicate sustainable information to stakeholders has also manifested itself in annual reports. Although recognized as less informative in environmental, social and governance-related issues as standalone sustainability reports, annual reports to provide insights into the decision-making process and priorities of firm management. Furthermore, annual reports are much more frequent than standalone sustainability reports. Specifically, all publicly traded firms in the U.S. are required by law since 1997 to file a 10-K form with the Security Exchange Commission. Combined with modern processing power, these standardized annual reports have enabled the computerized estimation of relative sustainability disclosure levels, vastly increasing the sample size from previous research.

This paper employs a sustainability keyword match-count technique in 10-K forms to assign a firm-year sustainability disclosure score (SDS). Using this measure of relative sustainability disclosure, SDS, this paper investigates the relationship between firm characteristics, firm SDS and stock returns. Limiting the analysis to 10-K forms drastically increases the sample size of firm-year observations compared to much of previous empirical work in sustainability disclosure. The preliminary sample size is 88,464 firm-year observations, spanning the sample period of 1994 through 2017. This sample size is reduced later on due to the introduction of control variables with missing data. The two other sample sizes in this paper are 70,176 and 55,320, which is still large when compared to previous studies.

This paper makes a series of discoveries: First, it finds significant variation in the cross-section of firm sustainability disclosure in 10-K forms. The sustainability disclosure through the 10-K form has also been steadily increasing since the 1990s. Furthermore, this study finds a significant correlation between several important firm characteristics and estimated sustainability disclosure scores, concurring with previous empirical work. The paper finds significant industry differences in 10-K sustainability disclosure and its effect on stock returns. To investigate the relation between SDS and stock return, this paper employs both portfolio sorts and Fama-MacBeth cross-sectional regressions. Five portfolios are constructed and sorted on firm SDS. The results of a zero investment short high, long low SDS portfolio yields a statistically significant Jensen's alpha of 28 basis points, after controlling for the market, size, book-to-market ratio, momentum, and liquidity. This is equivalent to 3.36% annual difference in risk-adjusted returns. The Fama-Macbeth cross-sectional regressions yield results similar in magnitude. However, after further controlling for industry, geographical dispersion and operational cost to revenue ratio, the negative effect of firm SDS on stock returns is not significant for all firms in cross-section. However, there is a significant effect for a sample limited to microcaps[1]. The resulting cross-sectional difference of a 10% increase in SDS is a reduction of 1.4 basis points, on average for microcaps.

This paper is organized as follows: Chapter 2 explains the context and background of firm sustainability disclosure and its relation to firm characteristics and cost of equity capital and develops hypotheses in the respective contexts. Chapter 3 describes the methodology of estimating firm characteristics, sustainability disclosure scores and models used in stock return analysis. Chapter 4 presents descriptive statistics and analysis of firm characteristics in SDS. Chapter 5 documents the results from the preliminary stock return analysis, differences in environmental, social and governance disclosure, industry-specific effects, and the implications of additional controls. Chapter 6 summarizes the findings in chapter 5 in the contexts of hypotheses, and finally, chapter 7 concludes on the results of the paper, highlights weaknesses and suggests future work

2. Background, litterature and hypothesis development.

Sustainability disclosure (SD) can be defined as the release of information pertaining to environmental, social and governance (ESG) areas of firm operations. It has been the subject of research since the 1950s. For example, Heald (1957) discusses a new "corporate consciences" in the United States, as a response to a *Fortune* magazine article stating that "...American capitalism seemed to be what Marx predicted it would be and what all the muckrakers said it was - the inhuman offspring of greed and irresponsibility... It seemed to provide overwhelming proof of the theory that private ownership could honor no obligation except the obligation to pile up." As a response to this criticism, Heald (1957) discusses the firm's incorporation of social concerns in the decision-making process,

[1] Fama and French (2008) define microcaps as firms equal to or smaller than the 20th percentile of firm size on NYSE.

and their willingness to disclose such information to stakeholders. The research following this publication is analyzed in Ullmann (1985), which finds no conclusive systematic pattern between the social performance, economic performance and social disclosure levels of firms.

The last three decades have seen a steady increase in research pertaining to firm sustainability disclosure. This is likely due to the introduction of environmental concerns and the increased scale of firm operations, where the latter amplifies the consequences of bad sustainability practices. The demand for sustainable decision-making is closely linked with society's sensitivities to the externalities of business operations (Ullmann (1985)). Firms are increasingly demanded to implement societal concerns for sustainable development, both by stakeholders and government regulation (Deloitte Touche Tohmatsu Limited (2016)). This further emphasizes the importance of understanding the implications of sustainability disclosure for firm managers and stakeholders.

This paper investigates the association between relative sustainability disclosure levels and stock returns. Certain firm characteristics represent significant risk factors, and as such will influence cross-sectional variation in stock returns. Thus, an important part of this inquiry is the study of previous work pertaining to the disclosure of ESG information and firm characteristics. The first section of this chapter covers relevant literature pertaining to this topic. The second covers the ongoing discussion of the sustainability performance implication of sustainability disclosure.

2.1. Litterature and Hyopthesis development

Most of the research within sustainability disclosure focus on standalone sustainability reports or event studies. This has the benefit of enabling the measurement firm sustainability disclosure by quantitative and qualitative estimates[2]. However, there are severe limitations to the sample size as sustainability reports are still rather rare, and require an in-depth analysis to interpret. Consequently, while the research in sustainability reports offers a high quality of insight, it lacks in sample size, which is often small in empirical work. This paper differs from much of previous work by investigating firm sustainability disclosure using annually filed reports, namely the 10-K filed with the Security Exchange Commission. The benefit of analyzing 10-K reports is that all publicly listed firms in the US have been required to file such reports since 1997[3].Dhaliwal, Li, Tsang and Yang (2011) finds that firm do disclose ESG information in 10-K filings, but that the information is lower in quality and quantity than in standalone sustainability reports. A report by KPMG (2008) finds that firms increasingly use annual reports to disclose ESG information. There is a large body of empirical work documenting the effects of the firm characteristics on sustainability disclosure. These firm characteristics are likely to affect expected stock returns. Consequently, it is important to document, and control for these characteristics to avoid endogeneity issues through omitted variable bias.

The relation of sustainability disclosure and firm size is well documented in the literature (Branco and Rodrigues (2008); Clarkson, Li, Richardson and Vasvari (2008); Clarkson,

[2] Hummel and Schlick (2016) finds that the quality of information is a key determinant in the relation between firm sustainability performance and sustainability disclosure.

[3] The SEC started gathering 10-K filings in 1993, but filing the form was not required by law before 1997.

Overell and Chapple (2011); Cormier, Magnan and van Velthoven (2005); Patten (2002)). Branco and Rodrigues (2008) suggests that the positive relation between firm sustainability disclosure and size stems from firm size approximating visibility. Thus the company is subject to a more diverse stakeholder group and larger scrutiny from investors and analysts (Cormier, Magnan and van Velthoven (2005)).Clarkson, Li, Richardson and Vasvari (2008) explains the positive firm size and sustainability disclosure relation with the assumption that the production cost of information follows economies of scale, which are advantageous for larger firms. Following these results, the first hypothesis summarizes the expectation for the association between firm size and sustainability disclosure.

Hypothesis 1: There is a positive association between firm sustainability disclosure levels and firm size.

Fama and French (1993) documents firm size as a risk factor in an augmented asset pricing model from the capital asset pricing model. The size of firms, measured in the market value of common equity, represents a risk factor for investors. The argument is that smaller firms have fewer options in business opportunities and funding sources and higher uncertainty in earnings forecasts. Investors should be compensated with higher expected returns for assuming this additional risk in their portfolios. Thus, the firm size must be included in any analysis of the relation between firm sustainability disclosure and expected stock returns.

The geographical dispersion in firm ownership has a documented positive relation with firm sustainability disclosure (Patten (1992); Branco and Rodrigues (2008); Cormier and Magnan (1999); Cormier and Magnan (2003)). This effect is arguably similar to the visibility effect, which size is approximating in several studies. Garcia and Norli (2012) approximates the firm geographical dispersion by counting the number of state names mentions. This easy to incorporate in this paper. In conjunction, these studies lay the foundation for the second hypothesis.

Hypothesis 2: There is a positive association between firm sustainability disclosure levels and firm geographical dispersion.

As suggested in Merton (1987) investors seek compensation for owning local stock due to the under diversified investor pool, which is a consequence of investors being unaware of local stock. Thus, I also expect to see geographical dispersion explain cross-sectional variation in stock returns.

Several studies document sustainability disclosure variation by industry. In particular, firms in environmental-sensitive industries are observed to have increased levels of sustainability disclosure (Cho and Patten (2007); Cormier and Gordon (2001); Cormier and Magnan (2003); Patten (1992); Patten (2002)). Among the industries with the highest sensitivity are energy, chemicals, utilities or foresting. Given these results, I expect to find a varying level of SD in industries, and an increased level of sustainability disclosure in the industries previously listed.

Hypothesis 3: The level of firm sustainability disclosure differs by industry category.

Furthermore, Hou and Robinson (2006) document the variation in stock returns as a result of industry-specific concentration[4]. Thus, controlling for the industry might be

[4]Industry concentration is the degree to which a few small firms dominate the industry. See Hou and Robinson (2006).

crucial to avoid model endogeneity.

Cormier and Magnan (2003) suggests that informational cost is a key determinant in environmental disclosure. Firms with lower informational costs have arguably higher market liquidity as informational asymmetry is mitigated with the release of information. Consequently, I expect a positive association between firm sustainability disclosure and liquidity.

Hypothesis 4: There is a positive association between firm sustainability disclosure levels and liquidity.

Welker (1995) finds that disclosure quality has a significant negative association with bid-ask spreads. A consequence of higher liquidity is a lower expected return (Amihud and Mendelson (1986)). Thus, this study includes measures of liquidity to control for informational asymmetry effects which might correlate with both sustainability disclosure and stock returns.

Another documented measure for informational asymmetry includes the relation of book value and market value of assets. In a sustainability disclosure context, Aerts, Cormier and Magnan (2008) uses an augmented market-to-book ratio along with size to proxy for a firms environmental risk exposure, generally known as Tobin's Q (Al-Tuwaijri, Cristensen and Hughes (2004); Clarkson, Li, Richardson and Vasvari (2008); Clarkson, Overell and Chapple (2011)). A higher Tobin's Q (i.e. higher market value of assets to book value of assets) is a proxy for higher informational asymmetry. Book-to-market ratio, as calculated in Fama and French (2008) is the inverted Tobin's Q ratio, but limited to book equity and market equity. I expect to see a positive association between book-to-market ratio and sustainability disclosure, due to the documented negative association with Tobin's Q (Inverted book-to-market ratio).

Hypothesis 5: There is a positive association between firm sustainability disclosure levels and book-to-market ratio.

The analysis of stock returns must also control for the book-to-market ratio of Fama and French (2008)[5], as they find that the ratio significantly explains cross-sectional variation in stock returns.

Hummel and Schlick (2016) used operational costs to illuminate the quality of environmental disclosure. The argument is that environmental solutions in business operations are often more expensive [6], and as such should have higher operational costs, holding other effects equal. Firms that choose environmental practices are expected to communicate this as it increases the perceived value of the firm[7]. I conjecture that firms with higher operational costs to revenue also disclosure more ESG related information. This is the foundation of the sixth hypothesis.

Hypothesis 6: There is a positive association between firm sustainability disclosure levels and operational cost to revenue ratio.

[5]It is important to note that the Tobin's Q measure differs from book-to-market ratio by the inverted fraction and the inclusion of credit value of book and market. Thus, the book-to-market is a limited proxy for Tobin's Q, i.e. informational asymmetry

[6]most common reasons for the increased cost of environmental operations are safe disposal options and recycling, which are often not mandated by law

[7]See Shehata (2014) for voluntary disclosure theory, which posits that firms communicate positive news to raise the market capital.

The keyword match technique used in this paper for approximating sustainability disclosure enables an interesting look at environmental, social and governance (ESG) differences in expected stock returns. Each of the keywords in Appendix A is categorized as environmental, social, or governance, and can, therefore, provide analysis within each category[8]. Richardson and Welker (2001) finds a negative relation between COEC and social disclosure, which is in direct opposition to the findings of Dhaliwal, Li, Tsang and Yang (2011). Other studies document a positive relation with environmental disclosure and COEC (Aerts, Cormier and Magnan (2008)). Investigating the differences in ESG criteria can provide insights into any significant differences in stock returns. The seventh hypothesis of this paper relates to this.

Hypothesis 7: The association between form sustainability disclosure levels and stock returns differs with environmental, social and governance-related disclosure.

Firm financial disclosure has a documented negative effect on the cost of equity capital (COEC) (Healy and Palepu (2001)). The consensus is that the quality of disclosure determines the magnitude of a decrease in COEC. Greater financial disclosure increases the investor base of the firm through awareness, improving risk-sharing capabilities and reduces the COEC for the firm (Merton (1987)). Furthermore, financial disclosure reduces the informational asymmetry among investors, which increases the liquidity of the stock. This has a positive on the transactional costs and the bid-ask spread of the firm (Verrecchia (2001)), which Amihud and Mendelson (1986) demonstrate lead to lower COEC. It is likely that the same effects occur with nonfinancial, or sustainability disclosure. Dhaliwal, Li, Tsang and Yang (2014) finds that financial and nonfinancial disclosure acts as substitutes in reducing COEC. However, Richardson and Welker (2001) document COEC as increasing in the level of social disclosure levels. They ascribe this result to "biases in social disclosures". This is in contrast to Dhaliwal, Li, Tsang and Yang (2011), which documents a negative association between COEC and social disclosure. The two papers use different locations, which might contribute to the different results[9]. Clarkson, Fang, Li and Richardson (2013) finds no significant relation between voluntary environmental disclosure quality and COEC but finds a positive relationship between the former and stock returns. Aerts, Cormier and Magnan (2008) finds evidence that enhanced environmental disclosure results in more precise analyst forecasts. Furthermore, Al-Tuwaijri, Cristensen and Hughes (2004) argues that nonfinancial disclosure has an increasing effect on market value, which is common when the COEC decreases. Furthermore, Dhaliwal, Li, Tsang and Yang (2014) enforces the conclusion of a negative association between sustainability disclosure and ex-ante cost of equity capital documented in Dhaliwal, Li, Tsang and Yang (2011) The empirical findings in this section indicate that sustainability disclosure is negatively associated with expected returns. Thus, the final hypothesis posits that a negative association between risk-adjusted stock returns and firm sustainability disclosure exists.

Hypothesis 8: There is a negative association between firm sustainability disclosure levels and stock returns.

One theory posits that socially responsible investors screen away unsustainable firms. This causes perceived unsustainable firms to have increased relative expected returns for the reduced diversification opportunities pertaining to the stocks investor pool (Merton

[8]Some keywords belong to multiple categories due to different possible contexts.

[9]Richardson and Welker (2001) analyses Canadian firms, while Dhaliwal, Li, Tsang and Yang (2011) examines firms registered in the US.

(1987)). In other words, socially responsible investors pay a premium for screening away diversification opportunities. Ciciretti, Dalo and Dam (2017) estimates this premium to be 4.8% annually, using a sample of 1,000 firms in the U.S., Europe, and Asia between 2005 and 2014.

2.2. Sustainability disclosure and sustainability performance

An easy assumption to make is that this paper approximates firm sustainability performance by firm sustainability disclosure. This relation is, however, the topic of major discord in empirical work. The discussion in these sections focuses on the distinction between sustainability disclosure and sustainability performance, and the lack of foundation in the claim that sustainability disclosure directly measures sustainability performance. The paper focuses on the relation between disclosure and firm characteristics and the cost of equity, regardless of a firm's true sustainability performance.

There are two rather conflicting theories on the effect of firm sustainability reporting on sustainable performance: voluntary disclosure theory and legitimacy theory. Voluntary disclosure theory (see Shehata (2014)) posits that firms with high sustainability performance have an incentive to communicate this performance to investors in order to increase market value. Consequently, voluntary disclosure theory posits that firms with a high ESG disclosure rate perform better along with sustainability measures. This is supported in several empirical studies (Al-Tuwaijri, Cristensen and Hughes (2004); Clarkson, Li, Richardson and Vasvari (2008)). Contrary to the voluntary disclosure theory, the legitimacy theory argues that the voluntary disclosure of firm sustainability has a negative relation to sustainability performance. Disclosure of sustainability information improves public perception about the sustainability performance of the firm. (Deegan (2002)). Firms with poorer sustainability performance are therefore likely to disclose more as they try to mitigate political, legal and social risk (Deegan and Rankin (1996); Neu, Warsame and Pedwell (1998)). In other words, Firm with higher sustainability performance does not have the same incentive to disclose firm sustainability information as firms with poorer sustainability performance, holding all other effects equal. Thus, legitimacy theory posits that there is a negative relation between sustainability disclosure and sustainability performance. This is empirically supported by Cho, Guidry and Hageman (2012); Cho and Patten (2007); de Villiers and van Staden (2006).

The empirical and theoretical work on the relationship between sustainability disclosure and sustainability performance indicates the opposing results are a product of an incomplete measurement of the disclosure. Clarkson, Li, Richardson and Vasvari (2008) discovers that although there is a positive relation in the data supporting voluntary disclosure theory, there is also a "pattern" that fit the argumentation of legitimization theory[10]. The research on this subject lacks consistency in applied methodology, and as such is very susceptible to variation in definitions, sample selection, measurement method and sample

[10] Ullmann (1985) presents a large descriptive statistics analysis of former sustainability studies and finds no systematic relation between social disclosure, social performance, and economic performance. The paper argues that this is due to the lack of a standardized system of methodology. Hummel and Schlick (2016) estimates the qualitative aspects of sustainability disclosure and finds a point of reconciliation between the two conflicting theories: Firm sustainability performance is positively related to high-quality disclosure, while negatively related to low-quality disclosure. The quality of disclosure is estimated through verifiability, reliability, comparability, and consistency (Hummel and Schlick (2016)).

period (Patten (2002)). Reporting sustainable information is becoming more standardized and included in new regulation (Deloitte Touche Tohmatsu Limited (2016)), which might serve to establish a clearer, more comparable body of literature on the question at hand.

3. Methodology

This paper applies a simple sustainability keyword match count technique on firm 10-K reports to approximate relative firm sustainability disclosure levels. Although there are no general regulatory requirements for disclosing sustainability information in 10-K filings, the form is used as a tool for sustainability reporting (KPMG (2008); Dhaliwal, Li, Tsang and Yang (2011)).

This paper employs a sample of firms listed on the American Stock Exchange (Amex), NASDAQ or New York Stock Exchange (NYSE). The Center for Research in Security Prices (CRSP) provides data on stock returns adjusted for dividends, volume, bid and ask prices, and market prices. Variables such as book value, operational cost, revenue, and industry classification are downloaded from Compustat. The Electronic Data Gathering, Analysis, and Retrieval System (EDGAR), under the United States Security Exchange Commission (SEC), provides access to all 10-K forms. Form 10-K is an annual report filed with the SEC by publicly listed firms in the U.S. It is obligatory for public firms to file a 10-K form, or an augmentation, within 90 days of the end of its fiscal year. It provides a comprehensive description of operations and firm performance. Furthermore, it describes areas of operations, projects, and prospects a firm is engaging- or plan to engage in, along with additional information from managers to stakeholders and accounting figures.

This paper employs a crawler algorithm to access 10-K form with EDGAR. The crawler algorithm, which downloads, parses and cleans each 10-K filing, estimates the firm sustainability disclosure scores, SDS. The algorithm searches for the following forms for a firm-year observation in the following order: 10-K, 10-K405, 10-KSB, 10-KT, 10KSB, 10KSB40, 10KT405. The forms following 10-K include minor tweaks from 10-K, but satisfy the annual filing requirement to the SEC as a standard 10-K. If the algorithm does not find any of these forms, the firm is dropped from the analysis for the year. The algorithm matches the 10-K filings with the data from CRSP and Compustat using the CIK number. Firms with missing data from CRSP and Compustat are also omitted from the analyses. Furthermore, the algorithm excludes firms with less than 500 words in filed 10-K reports. The crawler algorithm parsed in total nearly 3.1 billion words, after 3 days of continuously running eight processors in parallel. The sample period is from January 1994 through December 2017. The analysis on stock returns incorporates the sustainability disclosure scores as of last December the previous year, displacing the period for the stock market analysis one year ahead, from January 1995 through December 2018.

The following sections present 1: The method for measuring firm characteristics, 2: How it calculates firm sustainability disclosure scores (SDS), and 3: Applied methods for estimating the impact of firm SD level on stock returns.

3.1. Firm features and market factors

This section documents the method of calculating firm characteristics and risk factors. These include the firm characteristics discussed in chapter 2, and known risk factors that explain variations in returns in cross-section and over time, namely momentum and volatility. Momentum strategies were discovered to systematically outperform the market by Jegadeesh and Titman (1993). Ang, Robert, Xing and Zhang (2006) finds that idiosyncratic volatility explains variations in cross-sectional returns, which market, size, book-to-market ratio, and liquidity effects factors could not account for. These will be important to control in order to avoid omitted variable bias in later exercises. Furthermore, an Amihud illiquidity proxy is included in addition to the bid-ask spread. Data gathered from Compustat are yearly. Any observation of Compustat data as of December is applied for the following year.

The financial data downloaded from CRSP is in monthly frequency. This represents two weaknesses for this study, as discussed in the sections for volatility and Amihud illiquidity measure. Listed below are firm characteristics with descriptions of the method by which they are calculated.

Book-to-market ratio
The book-to-market ratio is calculated as the measured value of book assets over the value of common equity (Fama and French (1993)). The book values are downloaded from Compustat. It is measured once a year. book-to-market ratios measured before or during December of year t are used for the year $t+1$.

Volatility
Volatility is calculated as the standard deviation of returns in the period $t-12$ to $t-1$. The return data is downloaded from CRSP, and is adjusted for dividends. It is preferably calculated as the standard deviation of a regression model with daily data. Ang, Robert, Xing and Zhang (2006) uses the three factor model of Fama and French (1993). This volatility measure will pick up systematic variation explained by other factors than idiosyncratic volatility, and thus is not an optimal solution for controlling for idiosyncratic volatility. It is however correlated, and consequently can be used to explain some cross sectional idiosyncratic variation.

Size Size is calculated as the product of market price and outstanding shares as in Fama and French (1993). Market price and outstanding shares are downloaded from CRSP.

Amihud illiquidity
Amihud illiquidity in this paper is calculated as the ratio of 100,000 times absolute return $|r_{i,t}|$ over dollar volume traded $\$Volume_{i,t}$, $ami_{i,t} = 100,000 \cdot \frac{|r_{i,t}|}{\$Volume_{i,t}}$. It is multiplied with 100,000 due to the vastly different sizes of the denominator and enumerator. The time frequency is monthly, which means that the price impact measure estimates the monthly price impact over monthly traded volume in dollars. Thus, it is not an optimal measure as it would be with daily data (Amihud (2002)). However, it does incorporate the dollar volume of transactions, which might further explain some cross sectional variation in stock returns. The volume, price and return data is downloaded from CRSP.

Bid-ask spread
The bid-ask spread is calculated as the percent spread between ask and bid price

over the mean between the two. $ba = 100 \cdot (P_a - P_b)/(0.5P_a + 0.5P_b)$. This measure is based on closing spreads for monthly observations. There are only 12 spread observations for a firm-year observation, rather than 252 (average number of trading days in a year). Observations of negative bid-ask spread is converted to zero [11]. Bid and ask price data is downloaded from CRSP.

Momentum

Momentum is calculated as the buy and hold return on an asset from month $t - 12$ to $t - 2$. The stock return data is downloaded from CRSP.

Operational cost to revenue ratio

Operational cost to revenue is calculated as the ratio of firm operational expenses over total revenue. Operational expenses and revenue data are downloaded from Compustat. It is measured once a year and observations before December of year t are used to represent operational cost to revenue ratio in year $t + 1$.

Garcia-Norli geographical dispersion

This measure is calculated by the number of U.S. state names mentioned in a firm-year 10-K filing. It is calculated as in Garcia and Norli (2012). It is measured once a year and observations before December of year t are used to represent operational cost to revenue ratio in year $t + 1$.

Industry classifications are downloaded from Compustat. They follow the system of the North American Industry Classification System (NAICS: 2). For the purpose of this paper, I divide the industries into the following main industries: Energy, manufacturing, wholesale and retail, transportation: production and sales, transportation: services, information, finance, professional-technical-management services and health[12]. The other industries are placed in the *other* industries category. I categorize firms into these industries based on two criteria: adequate sample size and common features. Some industries have a low sample size and had to either be aggregated in a larger industry category, or placed in the *other* classification[13]. See Appendix B for specific NAICS codes and sub-industries.

3.2. Firm sustainability disclosure score

I construct a list of keywords related to sustainability concerns of business operations (see Appendix A). The keywords are selected based on criteria such as exclusivity: the keyword cannot generally be used in non-sustainability language contexts, commonality: The use of the keywords is possible for most firms. Following this, there is potential for improving the list and engage in further analysis of the proper keyword. This could serve as a basis for further research in sustainability-related language analysis in 10-K filings. This section discusses the benefits and weaknesses in the calculated sustainability disclosure scores and presents some results from a validation exercise.

[11] A small subsample of observations showed negative bid-ask spread, which cannot persist in a functioning market

[12] I divide transportation between production and sales, and services, as there could likely be a difference in how sustainability affects these industry groups which are divided among consumer products and service providers.

[13] Agriculture is one example of an industry with few observations, and few shared features with the other industry classification. It is placed in the *other* category.

I construct the firm sustainability disclosure score (SDS) as:

$$SDS = \sum_{n=1}^{N} \log(1 + \eta^i_{n,t}/\bar{\eta}_{n,t}),$$

where firm i's SDS for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n. log is the natural logarithm. See Appendix A for a list of the keywords applied.

This measure captures some important mechanics. First, The sustainability disclosure score is increasing in keyword match count $\eta^i_{n,t}$, but the added score is lower when the use of a specific keyword is high, i.e. positive and diminishing returns[14]. This gives weight to broader use of sustainability language, instead of frequently repeating the same sustainability keyword. The purpose is to moderate the weight placed on a frequently mentioned keyword, as they are likely to pertain to the same issue. It is always positive to increase the focus a particular sustainability topic receives, but the first mention of the keyword should carry a higher added value than repeating the word for the tenth time. The natural logarithm perfectly incorporates these effects with always positive but diminishing added benefit in keyword match count. Second, it factors in the average use of a keyword $\bar{\eta}_{n,t}$ by all other firms in cross-section for a year t, such that the score is not determined by a few, very frequent keywords, but by the relative frequency compared to all firms in the sample. Consequently, disclosing information about specific or rarely reported sustainability concerns increases SDS more than reporting on very commonly used keywords.

This measure has some weaknesses pertaining to the lack of in-depth analysis most of the previous research emphasizes. The sustainability disclosure score omits several aspects of sustainability documented in previous research, like quality and quantity[15], and the relative hardness/softness of disclosed information[16]. previous work also focuses on the relative positivity and negativity of the disclosed information. This measure simply estimates the use of sustainability-related language in 10-K filings. The "blindness" of the SDS does, however, enable the large scale approximation and comparison of all firms with filed 10-K reports, which is one of the strengths of this paper.

The measure performs as desired when validated on a random sample of 68 firm sustainability ratings provided by Yahoo Finance (retrieved May 2019). The correlation coefficient ρ is 0.47, and the results from a univariate regression were $y_i = 52.68 + 0.41 \cdot SDS_i$, where y_i is the yahoo ranking, and SDS_i is the firm sustainability disclosure score from the 10-K analysis. The beta-coefficient has a t-statistic of 4.26, which is significant at the 0.1% level. The Yahoo sustainability rankings were downloaded in spring 2019 and estimated on a sample of 10-K SDS' from 2017. The sample-set is relatively small, due to the time it takes to manually transfer individual scores from Yahoo to the dataset. Furthermore, the sustainability ranking service at yahoo started in 2017, and most firms are consequently unrated. It is important to remember the distinction between sustainability disclosure and sustainability performance as discussed in 2.2. Cho, Guidry and Hageman (2012)

[14]In mathematical terms: $SDS'(\eta^i_{n,t}) = \frac{\partial SDS^i_t}{\partial \eta^i_{n,t}} > 0, \frac{\partial SDS'(\eta^i_{n,t})}{\partial \eta^i_{n,t}} < 0.$

[15]Quality is measured by Hummel and Schlick (2016) as verifiability, reliability, comparability, and consistency, and quantity relates to the economic measurement of the implications of sustainability performance of the firm.

[16]Hardness and softness is similar to quality and quantity. Hardness is disclosure relating to facts and events, and softness relates to an overall language use.

finds that sustainability ratings correlate more with sustainability disclosure than with actual sustainability performance. Thus, the exercise should be perceived as a validation between other ratings of firm sustainability disclosure and not necessarily sustainability performance.

3.3. Econometric models

This section describes the methods for estimating the effects of SDS on stock returns. There are two recurring methods applied in this paper: Five-factor model regression, and Fama-MacBeth style cross-sectional regressions. All regression estimations are done with ordinary least squares, OLS.

3.3.1. Jensen's alpha

Jensen's alpha[17], or just alpha, is a common term for estimating abnormal returns, which are commonly known as returns after controlling for risk factors. Abnormal returns are in this context an estimate of performance relative to expected returns. The discussion of risk factors in sections 2 and 3.1 concludes that the cost of equity is related to more than just the market risk factor. I construct a five-factor model similar to the one applied in Garcia and Norli (2012). The five-factor model accounts for market risk, size, book-to-market ratio, momentum and liquidity effects.

Five portfolios are constructed based on firm sustainability disclosure scores (SDS). Each portfolio is rebalanced at the end of December of the year t. Any firm 10-K filed before or during December of year t is eligible for inclusion in a portfolio starting in January of year $t+1$ and lasts through December of year $t+1$. The *High* SDS portfolio consists of equities in the top quintile (80% or higher percentile) of the sustainability disclosure score. The *Low* portfolio consists of the bottom quintile (lower than 20-percentile) in SDS.

This paper reports Jensen's alpha on the model:

$$r_{pt} = \alpha_p + \beta_1(r_m - r_f)_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \beta_5 LIQ_t + \epsilon_t$$

where r_{pt} is either the return on a quintile SDS portfolio minus the yield on a 30-day treasury bill or the return on a zero investment portfolio long *Low* short *High*. α_p is the portfolio Jensen's alpha measure of abnormal returns, and ϵ_t is the model error term. The market portfolio r_m, size factor *SMB*, book-to-market factor *HML*, and momentum factor *MOM* are downloaded from CRSP. The liquidity factor *LIQ* is the traded liquidity factor by Pastor and Stambaúgh (2003), and downloaded from Chicago Booth research website (Chicago Booth Research Web), and downloaded from Chicago Booth research website (Chicago Booth Research Web). Jensen's alpha provides a measure of the abnormal returns, after controlling for these five systematic risk factors.

Portfolio returns will be presented both equally weighted (EW) and value-weighted (VW). Further explenations of methodology are found in table descriptions (Table 5, 7, 10, 11).

[17]Named after Michael Jensen, who first used it to estimate the performance of mutual funds Jensen (1967).

3.3.2. Fama-Machbeth cross-sectional regressions

Fama and MacBeth (1973) proposed a method of analyzing the effect of risk factors on returns in two steps. The first step is cross-sectional regressions to estimate the impact of the frim effect on contemporaneous returns. The second step estimates the time series effect of firm sensitivity to risk factors on stock returns in a given period. This paper estimates the time-series average of cross-sectional regression coefficients. Thus, each presented average is a time-series average of the monthly cross-sectional OLS coefficient. This is done for all firms, and in groups sorted on size. The size criteria are constructed by Fama and French (2008) and are grouped into micro caps, small caps and large caps. Microcaps are defined as firms with a market value of equity below or equal to the 20th percentile size firm on NYSE. Small caps are above the 20th percentile size and smaller or equal to the 50th percentile size on NYSE. Large caps are firms above the 50th percentile firm size on NYSE.

The monthly cross-sectional model is

$$r_{i,t} = \beta_0 + \sum_{m=1}^{M} \beta_{m,t} \cdot \phi_{i,m,t} + e_{i,t},$$

where $r_{t,i}$ is the return for firm i in month t and ϕ is one of the following M firm characteristics: SDS, computed as $SDS = \sum_{n=1}^{N} \log(1 + \eta^i_{n,t}/\bar{\eta}_{n,t})$, where firm i's SDS for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n. log is the natural logarithm.

Lagged is the return in month $t-1$. *Size* is the market value of common equity. *Bid-ask spread* is the percentage spread of the mean price between the bid and ask price. *Amihud illiquidity* is the price impact measure of Amihud (2002), tweaked to fit monthly data instead of daily. *Book-to-market ratio* is calculated as in Fama and French (1993), and described in 3.1.. *Momentum* is calculated as the buy and hold return in the period $t-12$ to $t-2$. *Volatility* is calculated as the standard deviation of the monthly returns in the period $t-12$ to $t-1$. All variables are applied in natural logarithm. Table 6 reports the result of this model in chapter 5.1.

Chapter 5.4 repeats the model with the inclusion of the following variables: *OCR* is the operational cost to revenue ratio of the firm. *Garcia-Norli dispersion* is the measure of firm geographical dispersion by Garcia and Norli (2012). *Industry controls* indicate the presence of industry dummies for the industries listed in Appendix B. The results are in table 12.

4. Descriptive statistics

This section covers the descriptive statistics of firm sustainability disclosure scores (SDS) and firm characteristics. The first section analyses the distribution of SDS over time and in the cross-sections. The second subchapter discusses the average firm characteristics of portfolios sorted on SDS. The third and final subchapter discusses the results from a pooled regression as described in subchapter 3.3.1.

4.1. Firm sustainability disclosure score summary statistics

Firm sustainability disclosure scores, SDS, are computed as $SDS = \sum_{n=1}^{N} \log(1 + \eta^i_{n,t}/\bar{\eta}_{n,t})$, where firm i's sustainability disclosure score (SDS) for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n in firm 10-K. The total given SDS scores with the crawler algorithm is 88,464 distributed over the sample period 1994 to 2017. The lowest number of 10-K filings was in 1994, with 1,158 forms filed, and the highest was in 1997 with 4,796. See Table 1 for summaries on firm-year observations.

Compustat and CRSP had missing values for operational cost-to-revenue ratio and industry classification, as well as book-to-market data. Consequently, data is increasingly omitted with the inclusion of these variables. Tables 1, 4 5, 7, and figure 1 use the full sample of 88,464 firm-year observations. Table 6 filters the sample size down to 70,176 sample observations, due to missing book-to-market data. Tables 2, 3, 8, 9, 10, 11 and 12 used a sample size of 55,320 firm-year observations due to missing data on operational costs to revenue or industry classification.

Table 1: Sustainability disclosure score statistics

This table reports summary statistics sustainability disclosure scores from firm 10-K filed in the period 1994 through 2017. The sustainability disclosure score is computed by $SDS = \sum_{n=1}^{N} \log(1 + \eta^i_{n,t}/\bar{\eta}_{n,t})$, where firm i's sustainability disclosure score (SDS) for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n. log is the natural logarithm. The statistics are calculated by yearly cross sections. Any 10-K filed before or during December of year -1 is eligible for inclusion in the cross-sectional measurement for year t. The columns indicate the cross-sectional measure, and the rows indicate the time series measure. Take column *Mean* for example: Means are calculated by cross sections each year, thus constructing a time-series of means. The row variables gives descriptive statistics of this time series. The same procedure is repeated for the other column measures.

Variable	Number of firms	Mean	Std	Min	Max	Median
Average	3,686	5.15	5.24	0	52.98	3.65
Median	3,706	4.97	5.02	0	53.22	3.65
Minimum	1,158	3.45	4.18	0	40.66	2.15
Maximum	4,796	7.31	6.26	0	60.01	5.45

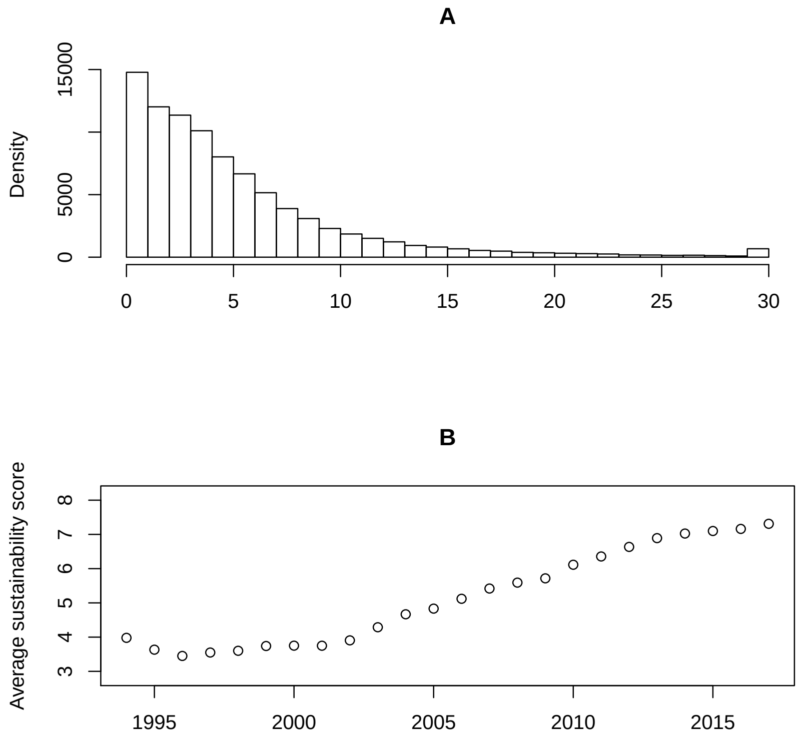
Table 1 presents the summary statistics of firm SDS scores. The first row shows us the average of the pooled firm-year SDS score is 5.15. The average SDS ranges from a low of 3.45 to a high of 7.31. The lowest average was in 1996, and the highest in 2017. This shows that the average SDS is relatively stable over the sample period. The graph in figure 1 supports this. the graph plots the yearly cross-sectional average from 1994 to 2017. There is a stable increase in average sustainability scores over the sample period[18]. It is natural to assume that SDS scores should not vary annually since counted keyword matches are divided over their annual cross-sectional means. However, the development

[18] There is a downturn from 1994 to 1996 in SDS, which could be explained by the fact that filing 10-K was voluntary prior to 1997 and thus primarily done by large firms. These large firms have higher SDS's than smaller firms that did not file before 1997

in figure 1 indicates that an increasing share of the keywords is used in 10-K forms over the sample period. This increases the total average of sustainability reporting scores.

The row labeled Median in table 1 indicates that the median of cross-sectional medians is 3.65, indicating that the distribution of SDS is skewed upwards. More importantly, the results in table 1 indicate a significant variation in the measure. The average cross-sectional standard deviation is 5.24, and it does not change by much over the period. The standard deviation ranges from a minimum of 4.18 to a maximum of 6.26. This stable but significant variation enables the inference of variation in firm characteristics and stock returns from variation in SDS.

Figure 1: Sustainability disclosure score



This figure includes a histogram of pooled sustainability reporting score and graph of the development of cross-sectional averages of SDS in the period 1994 through 2018.

The sustainability disclosure score is computed by $SDS = \sum_{n=1}^{N} \log(1+\eta^i_{n,t}/\bar{\eta}_{n,t})$, where firm i's SDS for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n. log is the natural logarithm. Panel A is a histogram of all firm SDS over the years 1994-2017. Panel B shows the yearly cross-sectional average SDS from 1994 through 2017.

4.2. Portfolio averages

Following the discussion of previous research in 2.1, the sustainability disclosure score (SDS) and stock returns will both vary with certain firm characteristics in cross-section. For example, I expect smaller, low liquidity firms with a low measure of geographical dispersion to have a low SDS. These characteristics are documented to influence stock returns in cross-section. Table 2 reports on cross-sectional average firm characteristics in five portfolios sorted on SDS. The characteristics are SDS, Size, book-to-market ratio, Amihud illiquidity, bid-ask spread, volatility, momentum, average operational cost to revenue ratio, median operational cost to revenue ratio and Garcia-Norli measure of geographic dispersion.

Table 2: Portfolio averages

This table reports time series averages from cross-sectional averages in quintile portfolios sorted on sustainability reporting score.
Each portfolio is rebalanced at the end of December of year t. Any firm 10-K filed before or during December of year t is eligible for inclusion in a portfolio starting in January of year $t+1$ and lasts through December of year $t+1$. The *High* portfolio consists of equities in the top quintile (80% or higher percentile) in SDS. *Low* consists of the bottom quintile (lower than 20-percentile) in SDS. *SDS* is computed by $SDS = \sum_{n=1}^{N} \log(1 + \eta^i_{n,t}/\bar{\eta}_{n,t})$, where firm i's SDS for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n. log is the natural logarithm. *Size* is the market value of common equity, measured in millions. *Book-to-market ratio* is calculated as in Fama and French (1993). *Amihud illiquidity* is the price impact as measured by Amihud (2002), but tweaked to fit monthly data. *Bid-ask spread* is the percentage spread between the bid and ask price over their mean price, $ba = 100 \cdot (P_a - P_b)/(0.5P_a + 0.5P_b)$. *Volatility* is calculated by the standard deviation of the monthly returns in the period $t-12$ to $t-1$. *Momentum* is calculated as the buy and hold return in the period $t-12$ to $t-2$. *Op.Cost-to-book ratio* is the ratio of total operational costs to revenue. *Median Op.Cost-to-book ratio* is the average cross-sectional median of the ratio of total operational costs to revenue. *Garcia-Norli dispersion* is the measure of firm geographical dispersion as in Garcia and Norli (2012). All variables are measured as of December of year t. The sample period is from January 1995 through December 2018.

Variable	High	2	3	4	Low
SDS	13.28	5.97	3.68	2.08	0.74
Size	5,928	4,130	3,483	2,940	1,737
Book-to-market ratio (BTM)	0.59	0.51	0.57	0.62	0.69
Amihud illiquidity (AMI)	0.40	0.65	1.42	0.94	1.45
Bid-ask spread (BA)	1.28	1.43	1.63	1.77	2.19
Volatility (VOL)	0.12	0.13	0.13	0.13	0.12
Momentum (MOM)	0.11	0.11	0.13	0.13	0.14
Op.cost-to-revenue ratio (OCR)	5.87	5.70	4.59	4.82	1.93
Median Op.cost-to-revenue ratio	0.85	0.88	0.89	0.89	0.89
Garcia-Norli dispersion (DISP)	14.23	11.81	10.87	10.22	9.06

The first row in table 2 indicates that the average SDS for firms classified in the High SDS portfolio is 13.28, while the average for firms in the low portfolio is 0.74. As expected, firm size is monotonically increasing in SDS, as anticipated by the empirical findings of Branco and Rodrigues (2008), Clarkson, Li, Richardson and Vasvari (2008), Clarkson, Overell and Chapple (2011), Cormier, Magnan and van Velthoven (2005), and Patten (2002). The average size of firms in the high SDS portfolio is three times larger than the average size of firms in the low SDS portfolio.

The book-to-market ratio reported in table 2 provides inconclusive results about the Tobin's Q relation with sustainability disclosure. [19]. The inconclusive results might stem from the omission of the credit side of the firm capital structure in the book-to-market

[19] A firm with higher disclosure rates should have a smaller Tobin's Q, i.e. a larger book-to-market ratio according to Al-Tuwaijri, Cristensen and Hughes (2004); Clarkson, Li, Richardson and Vasvari (2008); Clarkson, Overell and Chapple (2011).

ratio, which is accounted for in the Tobin's Q measure. The Amihud illiquidity measure provides indicative results of lower liquidity in firms with a lower SDS, although not conclusive as there is not a monotonically decrease in SDS[20]. The bid-ask spread paints a clearer picture of the SDS liquidity relation. It monotonically decreases in the SDS quintile portfolios. This is supportive of the results found inWelker (1995) and Verrecchia (2001) that high sustainability disclosure increases stock market liquidity.

Table 2 further reports an inconclusive relation volatility[21], and indicates a negative relation between firm SDS and momentum. Furthermore, there is an indication of outliers in the operational cost-to-ratio (OCR) measure, which seems to be increasing in SDS. The average cross-sectional median OCR indicates that there is no clear relationship. As expected, firm SDS is increasing in geographical dispersion[22].

The results in this section lend support to several of the hypotheses described in section 2.1. The next subchapter provides additional evidence, and consequently a discussion to each hypothesis relating to firm characteristics.

4.3. Pooled regression

The pooled regression in table 3 provides insight into the posits of hypotheses 1, 2, 4, 5, and 6. The hypotheses in question posit a positive relation between SDS and the following firm characteristics: firm size, geographical dispersion, liquidity, book-to-market ratio, and operational cost to revenue ratio:

Hypothesis 1: There is a positive association between firm sustainability disclosure levels and firm size.

Hypothesis 2: There is a positive association between firm sustainability disclosure levels and firm geographical dispersion.

Hypothesis 4: There is a positive association between firm sustainability disclosure levels and liquidity.

Hypothesis 5: There is a positive association between firm sustainability disclosure levels and book-to-market ratio.

Hypothesis 6: There is a positive association between firm sustainability disclosure levels and operational cost to revenue ratio.

The independent variables in the pooled regression in table 3 are: Size, book-to-market ratio (BTM), Amihud illiquidity measure (AMI), bid-ask spread (BA), volatility (VOL), momentum (MOM), Garcia-Norli measure of geographical dispersion (DISP), operational cost to revenue ratio (OCR), including dummy variables for years and industry. All variable observations are measured as of December and in natural logs, with momentum, dispersion, SDS, and bid-ask spread reported as the natural logarithm of 1 + its original

[20]The Amihud illiquidity result in table 2 is possibly caused by the sub-optimal time-frequency applied in this papers calculation of the Amihud illiquidity measure.

[21]Important to note that this is average firm volatility, and not the volatility of the entire portfolio, which might significantly change by the degree of correlation between assets.

[22]Similar to the empirical findings of Branco and Rodrigues (2008)

value[23].

The results show interesting effects of firm characteristics. First, as indicated by table 2 there is a positive significant relation between SDS and firm size, with a coefficient of 0.08\footnote{A coefficient of 0.08 means a 10% increase in size relates to a 0.8% increase in SDS on average.}, which is significant at the 0.1% level. The results from table 2 and 3 provide rather conclusive evidence to the first hypothesis, which relates to the positive association between firm sustainability disclosure and firm size.

The book-to-market coefficient is 0.06, which is statistically significant at conventional levels. This provides supporting evidence for hypothesis 5, that there is a positive association between firm sustainability disclosure levels. This is a similar result to previous work, which incorporates the total market value of the assets over the book value of assets, i.e. the Tobin's Q[24].

The Amihud illiquidity measure provides inconclusive evidence in both table 2 and 3. This is arguably due to the calculation of the measure, which is with monthly observations. Thus, the inconclusiveness of the reported results in Amihud illiquidity is as likely due to measurement error as it is due to a lack of covariation. The coefficient of the Amihud illiquidity measure in table 3 is negative but not statistically significant. The bid-ask spread is also inconclusive. Although statistically significant and positive (although small) in table 3, it is monotonically decreasing in SDS in table 2. Thus, I am unable to make any conclusive remarks relating to hypothesis 4.

Table 3: Pooled regression with SDS dependent variable

This table reports the coefficients from pooled time series regression with SDS as the dependent variable. All firm-year observations are pooled together and regressed with SDS as the dependent variable. All variables are measured as of December in year $t-1$ for a firm-yearr observation in year t. All variables are measured in natural logs, with momentum, dispersion, SDS and bid-ask spread reported as the natural logarithm of 1 + its original value. SDS is computed by $SDS = \sum_{n=1}^{N} \log(1 + \eta^i_{n,t}/\bar{\eta}_{n,t})$, where firm i's SDS for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n. log is the natural logarithm. *SIZE* is the market value of common equity. *BTM* is the book-to-market ratio and is calculated as in Fama and French (1993). *BA* is the percentage bid ask spread of the mean price between the bid and ask price, $ba = 100 \cdot (P_a - P_b)/(0.5P_a + 0.5P_b)$. *AMI* is the Amihud illiquidity price impact as measured in Amihud (2002), but tweaked to fit monthly data. *VOL* is the volatility calculated as the standard deviation of the monthly returns in the period t-12 to t. *MOM* is the momentum is calculated as the buy and hold return in the period t-12 to t-2. *OCR* is the ratio of total operational costs to revenue reported as of December. *DISP* is the measure of firm geographical dispersion by Garcia and Norli (2012). *YRS* is the presence of year dummy variables. *IND* is the presence of Industry dummy variables of the industry listed in the NAICS section. R^2 is the reported R-squared. *N* is the number of firm-year observations in the pooled time series. T-statistics are in parentheses. The sample period is from 1995 to and including 2018.

SIZE	BTM	AMI	BA	VOL	MOM	DISP	OCR	YRS	IND	R^2	N
0.08	0.06	-0.05	0.02	0.05	-0.04	0.29	0.07	Yes	Yes	0.32	55,320
(38.34)	(6.87)	(-0.63)	(2.53)	(9.01)	(-6.85)	(54.84)	(11.20)				

SDS is increasing in volatility, and decreasing in momentum. Both are statistically

[23] Momentum, dispersion, SDS, and bid-ask spread can be non-positive, which will produce minus infinite or undefined values by applying the natural logarithm.

[24] Al-Tuwaijri, Cristensen and Hughes (2004), Clarkson, Li, Richardson and Vasvari (2008) and Clarkson, Overell and Chapple (2011) finds a negative association with Tobin's Q, which is an augmented inverted book-to-market measure.

significant at the 0.1% level. An interesting result is the magnitude of the coefficient of geographical dispersion, which is 0.29, and statistically significant at the 0.1% level. The effect of geographic dispersion is significantly larger than other firm characteristics' coefficients. Combined with the result in table 2, the coefficient in table 3 provides strong support for the posit in hypothesis 2. Furthermore, the coefficient of operational cost to revenue ratio is statistically significant and positive. This supports the posit of hypothesis 7, although this might also be due to the outliers in operational cost to revenue ratio as documented in table 2

The results in this section demonstrate SDS correlate with other firm characteristics known to explain cross-sectional variation in returns. Consequently, it is important to control for these effects when estimating a model for expected returns.

5. Results

This section presents the analysis on SDS and stock returns in four sections: SDS and stock returns, ESG specific effects, industry analysis, and SDS and stock returns with additional controls.

5.1. SDS and stock returns

This subchapter presents and discusses the results in relation to the final hypothesis:

Hypothesis 8: There is a negative association between firm sustainability disclosure levels and stock returns.

Table 4 reports the equally weighted and value-weighted average returns on each of the quintile portfolios sorted on SDS. The advantage of including equally weighted portfolios is that the returns are not dominated by a few large companies. Including the value-weighted portfolio-returns have the purpose of better representing the general market effect of the portfolio.

Looking at equally weighted returns first, the *High* portfolio has the lowest average monthly return, with 98 basis points[25]. The average return is the highest in the middle portfolio, with 119 basis points per month. The difference in monthly returns between the *High* portfolio and the *Low* portfolio is 13 basis points on average, but it is not statistically significant. The *High* portfolio also reports the lowest average value-weighted returns with 55 basis points. The highest average value-weighted return is in the fourth quintile portfolio with 78 basis points. The difference between the high SDS and low SDS is 22 basis points, but this is not statistically significant. Table 4 reports systematically higher returns for equally weighted than value-weighted portfolios. This is indicative of smaller firms yielding higher returns than larger firms over time.

The results presented in table 4 does not account for risk factors, which chapter 4 documents correlate with SDS. Specifically, the performance of the *High* portfolio could be better than the others given the portfolio risk exposure. Table 5 documents the time-varying returns after controlling for five risk factors.

[25] One hundred basis points is 1%.

Table 4: SDS quintile portfolio returns

This table reports the average monthly returns on portfolios sorted on SDS.
Each portfolio is rebalanced in the end of December of year t. Any firm 10-K filed before or during December of year t is eligible for inclusion in a portfolio starting in January of year $t+1$ and lasts through December of year $t+1$. The *High* portfolio consists of equities in the top quintile (80% or higher percentile) of the SDS. The *Low* portfolio consists of the bottom quintile (lower than 20-percentile) in SDS. *Low - High* is the difference between the top and bottom quintile portfolio, with reported t-statistics in parentheses. $SDS = \sum_{n=1}^{N} \log(1 + \eta^i_{n,t}/\bar{\eta}_{n,t})$, where firm i's SDS SDS for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n. log is the natural logarithm. The sample period is January 1995 through December 2018. Returns are in percent.

Variable	High	2	3	4	Low	Low - High
EW Returns	0.98	1.15	1.19	1.16	1.11	0.13 (1.01)
VW Returns	0.55	0.59	0.75	0.78	0.77	0.22 (1.61)

Table 5 reports the intercept and coefficients from the model

$$r_{pt} = \alpha_p + \beta_1(r_m - r_f)_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \beta_5 LIQ_t + \epsilon_t,$$

where r_{pt} is either the return on a quintile SDS portfolio minus the yield on a 30-day treasury bill or the return on a zero investment portfolio long *Low* short *High*. α_p is the portfolio Jensen's alpha measure of abnormal returns, and ϵ_t is the model error term. The market portfolio r_m, size factor *SMB*, book-to-market factor *HML*, and momentum factor *MOM* are downloaded from CRSP. The liquidity factor *LIQ* is the traded liquidity factor by Pastor and Stambaúgh (2003), and downloaded from Chicago Booth research website (Chicago Booth Research Web).

Table 5 shows a decreasing Jensen's alpha by SDS quintile portfolios. The *Low* portfolio has the highest Jensen's alpha with 34 basis points, which is statistically significant, and *High* has the smallest with 0.06. Furthermore, both the equally weighted and the value-weighted long *Low* short *High* show a Jensen's alpha of 28 basis points, which is statistically significant for both models at conventional levels*Conventional levels is the 5% level*. This is equivalent to an annual return difference of 3.36%. This is somewhat smaller, but comparable to the 4.8% annual premium socially responsible investors pay as documented by Ciciretti, Dalo and Dam (2017).

The results in table 5 indicate support for the final hypothesis. There is a clear reduction in risk-adjusted returns in the high SDS portfolio compared to the others. Also, the *Low* portfolio is economically large and statistically significant. The *long Low short High* equally weighted portfolio has a negative market beta, which is indicative of larger firms in the *High* portfolio than in the *Low* portfolio, as documented in chapter 4. Table 6 illuminates the cross-sectional variation in returns and SDS after controlling for key firm characteristics.

Table 5: SDS quintile portfolio Jensen's alphas

This table reports the Jensen's alpha measure of abnormal portfolio return for portfolios sorted on SDS. Five portfolios are constructed based on SDS. Each portfolio is rebalanced in the end of December of year t. Any firm 10-K filed before or during December of year t is eligible for inclusion in a portfolio starting in January of year $t+1$ and lasts through December of year $t+1$. The *High* portfolio consists of equities in the top quintile (80% or higher percentile) in SDS. The *Low* portfolio consists of the bottom quintile (lower than 20-percentile) in SDS. SDS is computed by $SDS = \sum_{n=1}^{N} \log(1 + \eta^i_{n,t}/\bar{\eta}_{n,t})$, where firm i's SDS for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n. log is the natural logarithm. The regression model is

$r_{pt} = \alpha_p + \beta_1(r_m - r_f)_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \beta_5 LIQ_t + \epsilon_t$, where r_{pt} is either the return on a portfolio minus the yield on a 30-day treasury bill r_f (Panel A), or the return on a zero investment portfolio long Low short High (Panel B). α_p is the portfolio Jensen's alpha measure of abnormal returns, and ϵ_t is the model error term. The market portfolio r_m, size factor *SMB*, book-to-market factor *HML*, and momentum factor *MOM* are downloaded from CRSP. The liquidity factor *LIQ* is the traded liquidity factor by Pastor and Stambaúgh (2003), and downloaded from Chicago Booth research website (Chicago Booth Research Web). The column T is the number of monthly observations, and the column R^2 is the reported r-squared. Monthly portfolio returns are in percent. T-statistics are in parentheses. The sample period is from January 1995 through December 2018.

Portfolio	Alpha	Mkt-Rf	SMB	HML	MOM	LIQ	T	R^2
Panel A: Equally weighted Portfolios								
High	0.06	0.95	0.68	0.30	-0.22	0.14	288	0.91
	(0.53)	(35.81)	(20.23)	(8.23)	(-9.80)	(4.69)		
2	0.27	0.98	0.79	0.18	-0.25	0.05	288	0.94
	(3.07)	(45.04)	(28.75)	(5.87)	(-13.73)	(1.98)		
3	0.33	0.96	0.76	0.15	-0.24	0.04	288	0.93
	(3.51)	(41.57)	(26.08)	(4.79)	(-12.27)	(1.58)		
4	0.32	0.93	0.74	0.18	-0.22	0.03	288	0.93
	(3.43)	(41.00)	(25.92)	(5.84)	(-11.26)	(1.08)		
Low	0.34	0.82	0.62	0.22	-0.20	0.03	288	0.91
	(3.66)	(35.44)	(21.23)	(7.03)	(-10.12)	(0.98)		
Panel B: Long Low short High								
EW	0.28	-0.13	-0.06	-0.08	0.02	-0.11	288	0.14
	(2.30)	(-4.44)	(-1.56)	(-1.92)	(0.89)	(-3.35)		
VW	0.28	0.03	0.04	-0.02	-0.01	-0.17	288	0.07
	(2.04)	(1.03)	(0.88)	(-0.412)	(-0.278)	(-4.59)		

Table 6: Time series averages of cross-sectional regression coefficients

This table reports time series averages of cross-sectional regressions coefficients with monthly return as dependent variable. Cross-sectional regression coefficients are estimated each month with OLS, and the time series average is presented in this table. Thus, each coefficient is a time series average of the monthly cross-sectional OLS coefficient. This is done for all firms, and in groups sorted on size. The size criteria are constructed as in Fama and French (2008) and are grouped into micro caps, small caps and large caps. Micro caps are firms with market value of equity below or equal to the bottom 20th percentile of firm size on NYSE. Small caps are above the 20th percentile size and smaller or equal to the 50th percentile size on NYSE. Large caps are firms above the 50th percentile firm size on NYSE. The monthly cross-sectional model is

$r_i = \beta_0 + \sum_{m=1}^{M} \beta_m \cdot \phi_{i,m} + e_i,$

where $r_{t,i}$ is the return for firm i in month t and ϕ is one of the following M firm characteristics: SDS is computed as $SDS = \sum_{n=1}^{N} \log(1 + \eta^i_{n,t}/\bar{\eta}_{n,t})$, where firm i's SDS for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n. log is the natural logarithm. SDS is measured as of last December. *Lagged* is the return measured in month $t-1$. *Size* is the market value of common equity, measured in month $t-2$. *Bid-ask spread* is the percentage spread of the mean price between the bid and ask price, measured in month $t-2$. *Amihud illiquidity*, measured in month $t-2$, is the price impact measure of Amihud (2002), tweaked to fit monthly data instead of daily. *Book-to-market ratio* is calculated as in Fama and French (1993), and measured as of December the previous year. *Momentum* is calculated as the buy and hold return in the period $t-12$ to $t-2$, measured in month $t-2$. *Volatility* is calculated as the standard deviation of the monthly returns in the period $t-12$ to $t-1$, measured in month $t-2$. *Avg. adj.* R^2 is the reported average multiple adjusted r-squared in the cross-sectional regressions. *Avg. cross-sectional obs.* is the time series average of firm observations in the cross-sectional regressions. All variables except lagged return are measured in natural logs, with momentum, dispersion, SDS, lagged return and bid-ask spread reported as the natural logarithm of 1 + its original value. Stock returns are in percent. T-statistics are in parentheses. The sample period is January 1995 through December 2018. Monthly firm returns are measured in percent.

		Cross-sections grouped by size		
Independent variable	All firms	Microcaps	Small firms	Large firms
SDS	-0.09 (-1.65)	-0.33 (-5.00)	-0.04 (-0.64)	-0.06 (-1.11)
Lagged return	-3.76 (-7.65)	-5.09 (-9.18)	-2.58 (-4.50)	-1.81 (-2.65)
Size	0.05 (1.23)	-0.19 (-1.80)	-0.22 (-2.48)	-0.05 (-1.45)
Book-to-market	0.26 (4.05)	0.45 (5.60)	0.09 (1.18)	-0.00 (-0.02)
Amihud Illiquidity	10.44 (2.83)	7.41 (2.11)	89.86 (0.47)	461.22 (0.41)
Bid-ask spread	0.22 (1.94)	0.06 (0.74)	-0.30 (-1.32)	-0.05 (-0.15)
Volatility	1.66 (4.48)	3.05 (7.24)	0.59 (1.57)	-0.29 (-0.81)
Momentum	0.23 (1.26)	0.16 (0.88)	0.45 (2.11)	0.40 (1.69)
Intercept	4.36 (3.95)	10.58 (6.42)	5.33 (3.41)	0.98 (0.81)
Avg. adj. R^2	0.08	0.07	0.09	0.12
Avg. cross-sectional obs.	2,924	1,230	847	847

The coefficients in table 6 is the time series average of the cross-sectional regression coefficients from the model:

$$r_i = \beta_0 + \sum_{m=1}^{M} \beta_m \cdot \phi_{i,m} + e_i$$

where $r_{t,i}$ is the return for firm i in month t and ϕ is one of the following M firm characteristics: SDS, computed as $SDS = \sum_{n=1}^{N} \log(1 + \eta^i_{n,t}/\bar{\eta}_{n,t})$, where firm i's SDS for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n. log is the natural logarithm. SDS is measured as of last December. *Lagged* is the return in month $t-1$. *Size* is the market value of common equity, measured in month $t-2$. *Bid-ask spread* is the percentage spread of the mean price between the bid and ask price, measured in month $t-2$. *Amihud illiquidity*, measured in month $t-2$, is the price impact measure of Amihud (2002), tweaked to fit monthly data instead of daily. *Book-to-market ratio* is calculated as in Fama and French (1993), and measured as of December the previous year. *Momentum* is calculated as the buy and hold return in the period $t-12$ to $t-2$, measured in month $t-2$. *Volatility* is calculated as the standard deviation of the monthly returns in the period $t-12$ to $t-1$, measured in month $t-2$. All variable observations are measured in natural logs, with momentum, dispersion, SDS and bid-ask spread reported as the natural logarithm of 1 + its original value. Stock returns are in percent. The results listed in table 6 is the time series average of β_m for each of the preceding variables, with t-statistics in parentheses.

The results in table 6 are interesting. The resulting average SDS coefficient from the entire sample indicate a negative effect of a 9 basis point reduction in relative returns on average from a 100% increase in SDS, which is weakly statistically significant[26]. By taking the natural log of the average SDS in the *High* and *Low* portfolios, and calculate their difference, and multiply that with -0.09, the predicted difference in returns is 0.26%, which is similar to the result in table 5, which reported a difference in alpha of 0.28%. The effect of SDS on average cross-sectional returns increased in the microcaps group, with an average cross-sectional coefficient of -0.33. This increase is economically and statistically significant. The effect of SDS on cross-sectional returns is reduced in the small and large firm groups, and not statistically significant.

The combined results in table 5 and 6 provide ample support for the conclusion that SDS has a negative effect on risk-adjusted stock returns. However, this is without controlling for industry classification, geographical dispersion or operational cost to revenue ratio.

5.2. Environmental, social and governance criteria

The keywords in Appendix A are classified as environmental, social or governance-related by their contextual usage scenario[27]. This enables the analysis of any differences in stock returns by the ESG category, which is the foundation for the seventh hypothesis.

Hypothesis 7: The association between form sustainability disclosure levels and stock returns differs with environmental, social and governance-related disclosure.

Table 7 reports the Jensen's alphas of the same model as in table 5, but with SDS calculated separately on environmental, social or governance criteria. The Jensen's alphas reported in the equally weighted quintile portfolios are positive and statistically significant. This is likely due to the large relative weight on small firms that outperform larger firms. The reported value-weighted alphas are negative, which is likely the result of unpriced idiosyncratic variation in the portfolio as a result of under-diversification.

The results in table 7 are quite interesting. Starting with equally weighted returns: the difference between the *High* and *Low* portfolio is larger in the environmental category. The Long *Low* short *High* portfolio yields a Jensen's alpha of 33 basis points, which is significant at conventional levels. This is larger than the equally weighted Jensen's alpha of the combined SDS reported in table 5, which indicates that the environmental disclosure represents the significant variation in portfolio risk-adjusted stock returns. The social and

[26]Weakly statistically significant implies significance at the 10% level, but not below the 5% level.

[27]Some keywords have contexts that can relate to two ESG categories and consequently have two classifications.

governance criteria yield no statistically significant zero investment Jensen's alpha. Both the environmental and governance are positive in the value-weighted portfolios, although not statistically significant. An interesting and perhaps controversial result is the negative difference in the social category. Although this result is not statistically significant, the direction is similar to the results of Richardson and Welker (2001), which is a source of discord in social disclosure research.

Table 7: ESG category

This table reports Jensen's alpha on quintile portfolios sorted on SDS by ESG category. Five portfolios are constructed based on SDS quintiles. Each portfolio is rebalanced in the end of December of year t. Any firm 10-K filed before or during December of year t is eligible for inclusion in a portfolio starting in January of year $t+1$ and lasts through December of year $t+1$. The *High* portfolio consists of equities in the top quintile (80% or higher percentile) of SDS. The *Low* portfolio consists of the bottom quintile (lower than 20-percentile) of SDS. SDS is computed by $SDS = \sum_{n=1}^{N} \log(1 + \eta^i_{n,t}/\bar{\eta}_{n,t})$, where firm i's SDS for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n.The keywords n are divided into three ESG categories: Environmental, Social and Governance (See Appendix A for specific keyword groupings). log is the natural logarithm. Each of these keyword groups report their separate portfolio Jensen's alpha based on the regression model

$$r_{pt} = \alpha_p + \beta_1(r_m - r_f)_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \beta_5 LIQ_t + \epsilon_t,$$

where r_{pt} is either the return on a portfolio minus the yield on a 30-day treasury bill r_f (Panel A), or the return on a zero investment portfolio long Low short High (Panel B). α_p is the portfolio Jensen's alpha measure of abnormal returns, and ϵ_t is the model error term. The market portfolio r_m, size factor *SMB*, book-to-market factor *HML*, and momentum factor *MOM* are downloaded from CRSP. The liquidity factor *LIQ* is the traded liquidity factor by Pastor and Stambaúgh (2003), and downloaded from Chicago Booth research website (Chicago Booth Research Web). The column T is the number of monthly observations, and the column R^2 is the reported r-squared. Monthly portfolio returns are in percent. T-statistics are in parentheses. The sample period is from January 1995 through December 2018.

	Environmental			*Social*			*Governance*		
Portfolio	Alpha	T	R^2	Alpha	T	R^2	Alpha	T	R^2
Equally weighted									
High	0.00 (0.04)	288	0.89	0.26 (2.59)	288	0.93	0.24 (2.67)	288	0.91
2	0.31 (3.68)	288	0.95	0.32 (3.29)	288	0.93	0.23 (2.69)	288	0.94
3	0.32 (3.54)	288	0.93	0.19 (2.30)	288	0.94	0.28 (3.25)	288	0.93
4	0.36 (3.44)	288	0.91	0.26 (3.17)	288	0.93	0.27 (3.12)	288	0.93
Low	0.33 (3.14)	288	0.90	0.28 (3.21)	288	0.93	0.28 (3.17)	288	0.93
Low-High	0.33 (2.23)	288	0.15	0.02 (0.22)	288	0.42	0.04 (0.67)	288	0.19
value-weighted									
High	-0.31 (-3.38)	288	0.88	-0.26 (-3.97)	288	0.94	-0.32 (-5.00)	288	0.95
2	-0.29 (-3.86)	288	0.93	-0.26 (-3.89)	288	0.94	-0.21 (-2.94)	288	0.93
3	-0.19 (-2.23)	288	0.92	-0.01 (-0.13)	288	0.92	-0.17 (-2.35)	288	0.92
4	-0.05 (-0.54)	288	0.90	-0.19 (-2.23)	288	0.90	-0.08 (-0.83)	288	0.90
Low	-0.07 (-0.61)	288	0.86	-0.31 (-3.03)	288	0.87	-0.17 (-1.88)	288	0.92
Low-High	0.23 (1.26)	288	0.18	-0.05 (-0.35)	288	0.07	0.15 (1.30)	288	0.23

The results in this section provide support for hypothesis 7. It is important to emphasize that the results in this section are sensitive to the qualitative analysis and selection of the keywords in question[28]. The results will likely differ significantly with different keywords

[28] See Appendix A for all keywords and their ESG classififcations

in the SDS calculation. However, the keywords employed in this paper yield different results on the stock return- SDS relation based on ESG classifications.

5.3. Industry analysis

This section investigates industry effects of SDS. Table 8 presents industry portfolio descriptive statistics. Table 9 and 10 repeats the calculations of table 4 and 5, but with quintile portfolios sorted within industries. Table 11 reports the EW and VW long *Low* short *High portfolio* Jensen's alpha by industry.

Table 8 reports time-series averages of monthly cross-sectional averages of portfolios sorted on industries. The results in chapter 5.1. and 5.2. provide support for the negative association between SDS and stock returns. However, as documented in Cho and Patten (2007), Cormier and Gordon (2001), Cormier and Magnan (2003), Patten (1992) and Patten (2002) firm sustainability disclosure differ by industry. Furthermore, Hou and Robinson (2006) finds that stock returns are lower in more concentrated industries[29]. Thus, the previous results might be caused by industry membership rather than variation in SDS. Table 8 confirms this correlation. In particular, the energy industry is markedly higher in SDS than the other industries. Consequently, previous SDS-stock return effects might be a result of different industry weights in portfolios. For example, the energy industry has the highest SDS by a significant amount, and the lowest equally weighted monthly average return, with 108 basis points. Furthermore, some industries might explain variation in other firm characteristics that affect sustainability disclosure scores and stock returns. The finance industry has the lowest average SDS and the lowest operational cost to revenue ratio. This emphasizes the importance of controlling for industry effects in estimating the true effects of SDS on stock returns. The average SDS by industry results in table 8 provide strong support for the third hypothesis:

Hypothesis 3: The level of firm sustainability disclosure differs by industry category.

Table 8 presents some interesting results in a general industry comparison context. First, finance has the lowest average SDS score with 3.27, while energy has the highest at 13.44. The best performing equally-weighted average monthly return industry is Information, and the largest average value-weighted return is finance. The largest book-to-market average is in finance as well. Transportation: Services perform best on both liquidity measures. The finance industry operates with a relatively tiny operational cost to revenue, which is 0.14 on average. This however as expected due to the nature of the business operating with significantly larger financial costs. The most geographically dispersed industry is the health industry, with a Garcia-Norli measure of 17.87 on average. The health industry is also the least represented industry in the industry analysis, with an average of 55 firms in cross-section. Health is furthermore the smallest industry in terms of average size in cross-section. This represents significant variation between industries that must be controlled for in order to estimate SDS effects in stock return.

[29]Industry concentration describes the degree to which a few large firms dominate the industry.

Table 8: Industry averages

This table reports time series averages of cross-sectional measures on portfolios sorted by industry. All firms are sorted into portfolios based on the industry listed in Appendix B. Cross-sectional averages are calculated each month, and the average of the time series of cross sectional averages are reported below.

SDS is computed by $SDS = \sum_{n=1}^{N} \log(1 + \eta^i_{n,t}/\bar{\eta}_{n,t})$, where firm i's SDS for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n. log is the natural logarithm. *EW Return* and *VW Return* is the average monthly return on an equally weighted and value-weighted portfolio, respectively. *Size* is the market value of common equity, measured in millions. *Book-to-market ratio* is calculated as by Fama and French (1993). *Bid-ask spread* is the percentage spread of the mean price between the bid and ask price, $ba = 100 \cdot (P_a - P_b)/0.5(P_a - P_b)$. *Amihud illiquidity* is the price impact as measured by Amihud (2002), but tweaked to fit monthly data. *Volatility* is calculated as the standard deviation of the monthly returns in the period $t-12$ to t. *Momentum* is calculated as the buy and hold return in the period $t-12$ to $t-2$. *Op.Cost-to-book ratio* is the ratio of total operational costs to revenue. *Garcia-Norli dispersion* is the measure of firm geographical dispersion by Garcia and Norli (2012). N is the cross-sectional average number of firms in the industry-sorted portfolios through the period. All variables are measured as of December, with the exceptions of *EW Return* and *VW Return*. The sample period is from January 1994 through December 2017.

Independent variable	Energy	Manufacturing	Transportation: Production & Sales	Transportation: Services	Wholesale and Retail	Information	Finance	Prof. technical. manag.	Health	Other
SDS	13.44	5.26	5.94	7.81	4.06	3.49	3.27	4.31	6.10	5.64
EW return	1.08	1.42	1.34	1.21	1.31	1.61	1.21	1.31	1.30	1.26
VW return	0.57	0.64	0.66	0.81	0.75	0.68	0.83	0.56	0.69	0.53
Size	4,627	4,596	5,265	4,766	4,723	6,572	3,253	1,916	1,634	3,411
Book-to-market	0.60	0.49	0.59	0.66	0.67	0.36	0.76	0.49	0.50	0.61
Amihud Illiquidity	0.33	0.46	0.31	0.24	3.13	0.37	0.57	0.56	0.61	0.72
Bid-ask spread	1.15	1.31	1.07	0.99	1.34	1.12	1.46	1.45	1.74	1.46
Volatility	0.11	1.14	0.11	0.10	0.12	0.14	0.08	0.14	0.14	0.12
Momentum	0.10	0.14	0.10	0.09	0.10	0.16	0.09	0.12	0.18	0.09
Op.cost-to-revenue ratio	0.72	0.88	0.90	0.78	0.92	0.86	0.14	0.91	0.90	0.83
Garcia-Norli dispersion	13.09	9.59	11.83	14.78	17.62	10.02	10.70	9.27	17.87	15.41
N	206	1142	86	77	209	277	775	117	54	216

Table 9 and 10 report the average within industry SDS effects on stock returns. Five portfolios are constructed within each industry based on SDS. The top quintile portfolio of SDS is aggregated by all industry top quintile SDS portfolio. The same method is applied to the other quintile portfolios. Consequently, each quintile portfolio in table 9 and 10 has the same industry weight.

I examine equally weighted returns first. The *High* portfolio has the lowest average monthly stock return, with 125 basis points. This is a large increase from the average of 98 basis points in table 4. This difference indicates that the earlier result is due to industry correlation with SDS. The highest average return is as in table 4 the third quintile portfolio. The difference in return between the *high* and *Low* portfolio is decreased from 13 basis points to 11. This difference is not statistically significant. For the value-weighted portfolio, the lowest average return is in the *High* portfolio, 57 which is slightly higher than the 55 basis points in table 4. Furthermore, as in table 4, the largest average return is in the fourth quintile portfolio. An interesting result is that the difference between the *Low* portfolio, and the *High* portfolio is reduced from 22 to 17 basis points, but also became weakly statistically significant. The difference in results between table 4 and 9 indicate the presence of industry bias in the previous estimation of SDS and stock returns. however, as the *high* SDS quintile portfolio has the smallest average EW and VW return, there is still an effect that persists after controlling for the industry. Table 10 presents the performance of each quintile portfolio based on the five risk factors presented in Section 5.1.

Table 9: Industry aggregated portfolio average returns

This table reports average returns of portfolios aggregated over industry quintiles of SDS.
Five portfolios is constructed based on the SDS in each industry. Each portfolio is rebalanced in the end of December of year t. Any firm 10-K filed before or during December of year t is eligible for inclusion in a portfolio starting in January of year $t+1$ and lasts through December of year $t+1$. The *High* portfolio consists of equities in the top quintile (80% or higher percentile) of the SDSs aggregated over all industries, SDS. The *Low* portfolio consists of the bottom quintile (lower than 20-percentile) in SDS aggregated over all industries. Each portfolio has a close to equal industry weight. The SDS, is computed by $SDS = \sum_{n=1}^{N} \log(1 + \eta^i_{n,t}/\bar{\eta}_{n,t})$, where firm i's SDS for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n. log is the natural logarithm.

Variable	High	2	3	4	Low	Low - High
EW Returns	1.25	1.29	1.38	1.34	1.35	0.11 (1.32)
VW Returns	0.57	0.59	0.78	0.87	0.74	0.17 (1.66)

Table 10 reports the results from regressing the portfolio constructed for table 9 on the model

$$r_{pt} = \alpha_p + \beta_1(r_m - r_f)_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \beta_5 LIQ_t + \epsilon_t$$

where r_{pt} is either the return on a portfolio minus the risk free rate (Panel A), or the return on a zero investment portfolio long low short High (Panel B). The market portfolio r_m, size factor *SMB*, book-to-market factor *HML*, and momentum factor *MOM* are downloaded from CRSP. The liquidity factor *LIQ* is the traded liquidity factor by Pastor and Stambaúgh (2003), and downloaded from Chicago Booth research website (Chicago Booth Research Web).

The equally weighted results show a similar effect as in table 5. The smallest alpha is in the *High* portfolio. The largest alpha is in the *Low* portfolio, both statistically significant and economically large. The alpha for the *High* portfolio increased from 0.06 to 0.34. The long *Low* short *High* zero investment portfolio Jensen's alpha is reduced from 28 to 18 basis points, although still statistically significant. The value-weighted zero investment portfolio has a positive alpha of 14 basis points, but the estimate is not statistically significant. Evidently, the results in the value-weighted zero investment portfolio in chapter 5.1 is the result of industry-specific events. Table 8 documents that the highest average value-weighted return is in finance, with the smallest average SDS. Correspondingly, the second-lowest value-weighted return is in energy, which has the largest SDS. Controlling for the industry thus mitigates this effect, and consequently reduces the magnitude of the value-weighted zero investment portfolio.

The results in table 10 underlines that there is a difference when comparing firms within and between industries. An argument against comparison between industries is that there are very different environmental, social and governance concerns for each industry, and what might be considered a high sustainability disclosure policy in one industry could be considered low in another. One example of this is comparing the sustainability disclosure levels of firms between energy and finance, which operate with entirely different standards for sustainability disclosure. However, one could argue that a firms responsibility towards sustainable development goes beyond industry norms and that any firm should be compared to an ideal standard for societal progress instead of industry concerns. To conclude the results in table 10, there is an effect between SDS and risk-adjusted stock returns that persists with industry controls in the equally weighted portfolios, however, this effect is reduced in the value-weighted portfolios. The difference in EW and VW Jensen's alphas indicate that the effect is present for smaller firms, but mitigated when adjusted for market weights.

Table 11 reports the industry long *Low* short *High* zero investment alphas for both equally weighted and value-weighted portfolios. Starting with equally weighted portfolios: all alphas but in finance is positive. The negative alpha in the finance industry is not statistically significant. Only two other industries are statistically significant: Manufacturing and health. Manufacturing is weakly statistically significant with a Jensen's alpha of 0.24. The health industry has an economically significant alpha of 1.41%, which statistically significant at the 1% level. This represents an annual risk-adjusted return difference of 16.92%. The remaining industries are not statistically significant.

The value-weighted portfolio returns in panel B magnifies the results in the Manufacturing and health industry. The alphas increase from 0.24% to 0.38%, and 1.41% to 1.95% for manufacturing and health, respectively. The manufacturing industry is statistically significant at the 5% level and health industry at the 1% level. The annual return difference in the health industry is equivalent to an annual return difference of 23.4% on average, which is immense. The return difference could be explained by the profitable pharmaceutical industry, which would arguably have lower sustainability disclosure levels than a publicly listed hospital. However, these reflections remain speculation without an in-depth analysis of the health industry.

The energy sector is negative and statistically significant at the 10% level. The source of this result might be in line with the legitimacy theory, which posits that firms disclose sustainability information to reduce their legal and social risk. Thus, the high SDS portfolio in energy would be perceived as higher exposure to legal and social risk, and investors are consequently compensated with higher expected returns for incorporating this in their portfolios. Another, maybe more likely effect at play, is the recent formidable growth in the renewable energy sector (Sadorsky (2012)). Firms in the renewable energy sector are likely to disclose information about their environmentally safe business model and thus have higher average SDS. This effect is in line with the posits of voluntary disclosure theory. The remaining industries are not statistically significant.

Table 11 indicates that there are industry differences in the association between stock returns and sustainability disclosure levels. The general sentiment is that low SDS outperform a high SDS portfolio within the industry, although when individually examined differences in the effect of the SDS-stock return do emerge.a

Table 10: Industry aggregated portfolio Jensen's alphas

This table reports Jensen's alphas of portfolios double sorted in industry and SDS. Five portfolios is constructed based on the SDS for each industry. Each portfolio is rebalanced in the end of December of year t. Any firm 10-K filed before or during December of year t is eligible for inclusion in a portfolio starting in January of year $t+1$ and lasts through December of year $t+1$. The *High* portfolio consists of equities in the top quintile (80% or higher percentile) of the SDS, within each industry. The low portfolio consists of equities in the bottom quintile (lower than 20-percentile) of SDS within each industry. Thus, each portfolio has a close to equal industry weight. SDS is computed by $SDS = \sum_{n=1}^{N} \log(1 + \eta^i_{n,t}/\bar{\eta}_{n,t})$, where firm i's SDS for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n. log is the natural logarithm. The regression model is

$$r_{pt} = \alpha_p + \beta_1(r_m - r_f)_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \beta_5 LIQ_t + \epsilon_t,$$

where r_{pt} is either the return on a portfolio minus the yield on a 30-day treasury bill r_f (Panel A), or the return on a zero investment portfolio long Low short High (Panel B). α_p is the portfolio Jensen's alpha measure of abnormal returns, and ϵ_t is the model error term. The market portfolio r_m, size factor *SMB*, book-to-market factor *HML*, and momentum factor *MOM* are downloaded from CRSP. The liquidity factor *LIQ* is the traded liquidity factor by Pastor and Stambaúgh (2003), and downloaded from Chicago Booth research website (Chicago Booth Research Web). The column T is the number of monthly observations, and the column R^2 is the reported r-squared. Monthly portfolio returns are in percent. T-statistics are in parentheses. The sample period is from January 1995 through December 2018.

Portfolio	Alpha	Mkt-Rf	SMB	HML	MOM	LIQ	T	R^2
Panel C: Equally weighted industry aggregated portfolios								
High	0.34	0.95	0.61	0.33	-0.19	0.07	288	0.95
	(4.77)	(52.24)	(26.58)	(13.297)	(-12.47)	(3.70)		
2	0.41	0.96	0.70	0.26	-0.21	0.03	288	0.96
	(5.76)	(54.56)	(31.50)	(10.73)	(-13.56)	(1.77)		
3	0.51	0.93	0.68	0.25	-0.19	0.05	288	0.95
	(7.09)	(52.04)	(30.35)	(10.10)	(-12.44)	(2.65)		
4	0.48	0.91	0.67	0.22	-0.19	0.07	288	0.94
	(5.97)	(46.70)	(26.74)	(8.10)	(-11.05)	(3.27)		
Low	0.53	0.88	0.63	0.25	-0.20	0.05	288	0.93
	(6.33)	(42.52)	(24.41)	(8.99)	(-11.30)	(2.12)		
Panel D: Long Low and short High industry aggregated portfolios								
EW	0.18	-0.07	0.02	-0.08	-0.01	-0.03	288	0.08
	(2.22)	(-3.64)	(1.00)	(-2.89)	(-0.38)	(-1.17)		
VW	0.14	0.04	0.03	-0.06	0.07	-0.05	288	0.08
	(1.36)	(1.52)	(0.89)	(-1.73)	(3.32)	(-1.76)		

Table 11: Zero investment Jensen's alpha by industry

This table reports industry sorted Jensen's alphas from portfolios long bad short High.
Five portfolios are constructed based on the SDS for each industry. Each portfolio is rebalanced in the end of December of year t. Any firm 10-K filed before or during December of year t is eligible for inclusion in a portfolio starting in January of year t+1 and lasts through December of year t+1. The *High* portfolio consists of equities in the top quintile (80% or higher percentile) of the SDS. The *Low* portfolio consists of the bottom quintile (lower than 20-percentile) in SDS, which is computed by $SDS = \sum_{n=1}^{N} \log(1 + \eta^i_{n,t}/\bar{\eta}_{n,t})$, where firm i's SDS for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n. log is the natural logarithm.
The regression model is

$$r_{pt} = \alpha_p + \beta_1(r_m - r_f)_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \beta_5 LIQ_t + \epsilon_t$$

where r_{pt} is the return on a zero investment portfolio long Bad short High within an industry. The market portfolio r_m, size factor *SMB*, book-to-market factor *HML*, and momentum factor *MOM* are downloaded from CRSP. The liquidity factor *LIQ* is the traded liquidity factor by Pastor and Stambaúgh (2003), and downloaded from Chicago Booth research website (Chicago Booth Research Web). The column *T* reports the number of observations, and the column R^2 reports the r-squared. Portfolio returns are in percent. *t-statistics* are reported t-statistics. The sample period is from January 1995 through December 2018. Panel A is equally weighted returns. Panel B is value-weighted returns.

Industry	Alpha	T-statistic	T	R^2
Panel A: Equally weighted				
Energy	0.03	0.10	288	0.13
Manufacturing	0.24	1.95	288	0.08
Transportation: Production & Sales	0.13	0.47	288	0.11
Wholesale and Retail	0.29	1.34	288	0.03
Transportation: Services	0.34	1.09	288	0.08
Information	0.21	1.06	288	0.04
Finance	-0.01	-0.11	288	0.31
Prof. technical. manag.	0.04	0.13	288	0.16
Health	1.41	3.10	288	0.05
Other	0.17	0.75	288	0.02
Panel B: value-weighted				
Energy	-0.54	-1.66	288	0.20
Manufacturing	0.38	2.20	288	0.09
Transportation: Production & sales	0.32	1.06	288	0.03
Wholesale and Retail	0.33	1.04	288	0.05
Transportation: Services	-0.13	-0.33	288	0.02
Information	-0.06	-0.20	288	0.11
Finance	0.12	0.58	288	0.13
Prof. technical. manag.	0.47	1.36	288	0.07
Health	1.95	3.07	288	0.05
Other	0.48	1.59	288	0.14

5.4. SDS and stock returns with additional controls

The Fama-Macbeth style cross-sectional regression in chapter 5.1 finds a negative effect of SDS on cross-sectional returns. However, the model does not control for effects documented to vary with SDS and stock returns. Namely, the geographical dispersion, operational cost to revenue ratio (OCR) and industry classification of a firm. The results in chapter 4 provide strong evidence of the positive association between firm geographical dispersion and sustainability disclosure scores. Garcia and Norli (2012) finds that the geographical dispersion of stocks significantly influences stock returns. Furthermore, the results in chapter 4 indicate a positive relation with operational cost to revenue ratio. Firms with lower operational cost to revenue have arguably larger profit margins contributing to the firms' performance in the stock market. Thus, controlling for firms operational cost to revenue ratio is necessary. Chapter 5.3 finds that industry variation explains both variation in SDS and stock returns. Industry controls are thus added to the cross-sectional model. This section presents the results of average cross-sectional coefficients after including these controls in table 12.

Starting with the average SDS cross-sectional coefficient: The introduction of *OCR*, *Garcia-Norli dispersion* and industry dummies significantly reduced the effect of SDS on stock returns. The average cross-sectional coefficient is -0.01, and not statistically significant. This significant change is indicative of variation in the additional controls that explained the cross-sectional returns through correlation with SDS. The average coefficient for SDS is negative for all size groups, however only statistically significant in microcaps. The average coefficient is -14 basis points in the microcaps group. The interpretation of this coefficient is that a relative increase of 100% in SDS is associated with a 14 basis points lower stock return per month. The result in microcaps explains the difference in the equally-weighted quintile portfolio estimated in table 10.

The average coefficient for operational cost to revenue ratio (OCR) is economically large and statistically significant for all firms. A 10% relative increase in operational cost to revenue ratio leads to a decrease of almost 5 basis points on average in the cross-section of returns. The effect of OCR is magnified within microcaps in terms of effect and statistically significance, while reduced in the small and large size groups. The effect of geographical dispersion is only statistically significant in microcaps, at the 10% level, but negative for all groups. This is in line with the investor recognition hypothesis as discussed in Garcia and Norli (2012).

An unexpected result is the positive and significant average cross-sectional coefficient in size. Size is documented to have a negative impact on expected returns. This negative effect is present and statistically significant in each of the size groups. One reason for this result could be extreme outliers in the data close to the breakpoints. This is not further investigated in this paper.

Table 12: Time series averages of cross-sectional regressions coefficients with additional controls

This table reports time series averages of cross-sectional regresisons with firm-month returns as dependent variable. Cross-sectional regression coefficients are estimated with ols each month, and the average is presented in this table. Thus, each coefficient is a time series average of the monthly cross-sectional ols coefficient. This is done for all firms and in different groups sorted on size. The size criteria are as described by Fama and french (2008, Fama and French (2008)) and are grouped into micro caps, small caps and large caps. Micro caps are defined as firms with market value of equity below or equal to the 20th percentile size firm on NYSE. Small caps are above the 20th percentile size and smaller or equal to the 50th percentile size on NYSE. Large caps are firms above the 50th percentile firm size on NYSE. The monthly cross-sectional model is

$r_{t,i} = \beta_0 + \sum_{m=1}^{M} \beta_{mi} \cdot \phi_{i,m,t} + e_{i,t}$, where $r_{t,i}$ is the return for firm i in month t and ϕ is one of the following firm characteristics: *SDS* is computed by $SDS = \sum_{n=1}^{N} \log(1 + \eta^i_{n,t}/\bar{\eta}_{n,t})$, where firm i's SDS SDS for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n. log is the natural logarithm. SDS is measured as of last December. *OCR* is the operational cost to revenue ratio of the firm, measured as of last December. *Garcia-Norli dispersion* is the measure of firm geographical dispersion by Garcia and Norli (2012), measured as of last December. *Lagged return* is the return of the firm in $t-1$. *Size* is the market value of common equity, measured in month $t-2$. *Bid-ask spread* is the percentage spread of the mean price between the bid and ask price, measured in month $t-2$. *Amihud illiquidity*, measured in month $t-2$, is the price impact measure of Amihud (2002), tweaked to fit monthly data instead of daily. *Book-to-market ratio* is calculated as in Fama and French (1993), and measured as of last December. *Momentum* is calculated as the buy and hold return in the period $t-12$ to $t-2$, measured in month $t-2$. *Volatility* is calculated as the standard deviation of the monthly returns in the period $t-12$ to $t-1$, measured in month $t-2$. *Avg. adj.* R^2 is the average multiple adjusted r-squared of the cross-sectional regressions. *N* is the number of observations. *Industry controlls* indicate the presence of industry dummies for the industries listed in Appendix B. All variable observations are in natural logs (with the exeption of lagged returns), with momentum, dispersion, SDS and bid-ask spread reported as the natural logarithm of 1 + its original value. T-statistics are in parentheses. The sample period is January 1995 through December 2018. Monthly firm returns are measured in percent.

		Cross-sections grouped by size		
Independent variable	All firms	Microcaps	Small firms	Large firms
SDS	-0.01 (-0.32)	-0.14 (-2.28)	-0.01 (-0.25)	-0.06 (-1.25)
OCR	-0.48 (-3.20)	-0.79 (-4.74)	-0.34 (-1.59)	-0.10 (-0.30)
Garcia-Norli dispersion	-0.02 (-0.39)	-0.15 (-1.79)	0.06 (0.88)	-0.08 (-1.52)
Lagged return	-3.78 (-7.96)	-5.29 (-9.78)	-2.69 (-4.98)	-1.56 (-2.54)
Size	0.08 (2.00)	-0.22 (-2.18)	-0.21 (-2.08)	-0.07 (-1.94)
Book-to-market	0.17 (3.33)	0.36 (5.28)	0.01 (0.20)	-0.01 (-0.20)
Amihud Illiquidity	12.58 (3.26)	7.51 (2.01)	161.28 (0.76)	389.95 (0.27)
Bid-ask spread	0.35 (2.85)	0.08 (0.86)	-0.29 (-1.15)	-0.05 (-0.15)
Volatility	2.14 (5.22)	4.21 (8.87)	0.75 (1.83)	-0.24 (-0.66)
Momentum	0.16 (0.94)	0.00 (0.00)	0.50 (2.40)	0.42 (1.87)
Intercept	5.11 (4.60)	14.08 (8.54)	5.37 (3.32)	1.63 (1.23)
Avg. adj. R^2	0.09	0.08	0.10	0.15
Avg. cross-sectional obs.	2,305	950	678	677
Industry controlls	Yes	Yes	Yes	Yes

The table indicates a strong stock return reversion pattern, where the average cross-sectional lagged returns coefficients are large and statistically significant for the entire sample and all size groupings. The magnitude of the reversion effect is decreasing in firm size group. Both the liquidity measures are positive and statistically significant, which indicate a positive relation with illiquidity and stock returns, which concurs with Amihud and Mendelson (1986), and Amihud (2002)[30]. Furthermore, we see a statistically significant and positive average book-to-market ratio coefficient for the entire sample of firms, and a larger coefficient in microcaps. The volatility measure is also positive and statistically significant in explaining cross-sectional variation.

The comparison of the average multiple adjusted r-squared in table 6 and 12 shows that it is the same in all firms, but higher in all three size groups in table 12. This indicates that the introduction of the additional control variables provided the cross-sectional model with higher explanatory power after controlling for the additional noise. Furthermore, the sample sizes are smaller due to the omission of firm-year observations with missing industry and operational cost to revenue data, which can affect the results of the cross-sectional model.

6. Summary of results

The results in table 1 and figure 1 provide evidence for the validity of computerized estimation of sustainability disclosure in form 10-K. There is a steady increase in the use of sustainability language and a robust cross-sectional variation in the measure. The variation in the measure enables the analysis of effects by firm sustainability disclosure on other firm characteristics.

This paper set out to document the relation between sustainability disclosure and stock returns. However, the sustainability disclosure measure correlates with several firm characteristics that affect the returns of stocks. Thus, a large section of this paper is committed to documenting the relationship between firm SDS and firm characteristics. This section presents a discussion on each of the eight hypotheses stated in chapter 2.1, based on the results in chapter 4 and 5.

Hypothesis 1: There is a positive association between firm sustainability disclosure levels and firm size.

Table 2 and 3 provide strong evidence for the positive association between firm sustainability disclosure and size. This is in line with the findings of Branco and Rodrigues (2008), Clarkson, Li, Richardson and Vasvari (2008), Clarkson, Overell and Chapple (2011), Cormier, Magnan and van Velthoven (2005), and Patten (2002). Firm size is increasing monotonically in each of the quintile portfolios sorted on SDS. The pooled regression verifies this effect with a positive coefficient of 0.08. An interpretation of the coefficient is that an increase of 10% in firm size is related to a 0.8% increase in sustainability disclosure score. The coefficient is significant at the 0.1% level. These results present strong support for the posit of the first hypothesis.

[30] The Amihud Illiquidity average cross-sectional coefficient in table 12 blows up in group size. This is likely due to the use of monthly frequency data, rather than daily in its calculation.

Hypothesis 2: There is a positive association between firm sustainability disclosure levels and geographical dispersion.

This paper uses the measure of the geographical dispersion of Garcia and Norli (2012)[31]. The results from the table 2 and 3 are fairly conclusive. In table 3 the *High* SDS quintile portfolio mentions on average, five states more than the low SDS quintile portfolio. Furthermore, geographical dispersion increases monotonically in SDS quintile portfolios. The findings in table 2 is supported by the pooled OLS regression, which reports a positive coefficient of 0.29. A 10% increase in firm geographical dispersion is associated with a 2.9% increase in sustainability disclosure on average. This coefficient is significant at the 0.1% level. The results in both tables provide strong evidence for the positive association between firm geographical dispersion and firm sustainability disclosure. This is also in line with the empirical findings in Patten (1992), Branco and Rodrigues (2008), Cormier and Magnan (1999), Cormier and Magnan (2003).

Hypothesis 3: The level of firm sustainability disclosure differs by industry category.

Chapter 5.2 investigates industry effects in firm characteristics, sustainability disclosure, and stock returns. Table 8 provides industry summary statistics through the sample period. The table reports a significant difference in industry and average sustainability disclosure scores, which is similar to the results in Cho and Patten (2007), Cormier and Gordon (2001), Cormier and Magnan (2003), Patten (1992) and Patten (2002). The energy industry has a significantly higher SDS than the other industries, at around 13.44. The finance industry had the lowest average SDS, with 3.27, which is four times smaller than the energy sector. These significant differences provide rather conclusive evidence for the differences in sustainability disclosure by industry and strong support for the third hypothesis. Furthermore, these industry effects have significant implications for expected stock returns, which is addressed later on in the discussion about the final hypothesis.

Hypothesis 4: There is a positive association between firm sustainability disclosure levels and liquidity.

Previous research finds a positive association between reduced informational asymmetry and sustainability disclosure, which increases liquidity. This paper employs two measures of liquidity: The Amihud illiquidity measure of Amihud (2002), and the measured bid-ask spread percentage. Results are not as conclusive as with other firm characteristics. Table 2 reports the best liquidity in the *High* quintile SDS portfolio, and the worst in the *Low* quintile SDS portfolio, by both measures. Furthermore, the bid-ask spread is monotonically decreasing in SDS quintile portfolios. This is not the case for Amihud illiquidity measure. The results from the pooled regression are, however, rather conflicting. The Amihud illiquidity measure is negative as expected, however not statistically significant. The bid-ask spread coefficient is positive, and statistically significant, which is in opposition to the results in table 2. These contradictory results could be the result of the different methodologies applied in the tables, where the first table accounts for the time-series average of cross-sectional averages in quintile portfolios of SDS, and the pooled regression compares all firm-year observations over the entire sample period. Nevertheless, the conflicting results complicate any conclusion on the fourth hypothesis and indicate a need for further in-depth analysis.

[31] They estimate the geographical dispersion of a firm by counting the states mentioned in form 10-K.

Hypothesis 5: There is a positive association between firm sustainability disclosure levels and book-to-market ratio.

The employment of book-to-market ratio in the context of this analysis is two-pronged: first, empirical work in sustainability disclosure use a ratio called Tobin's Q(Al-Tuwaijri, Cristensen and Hughes (2004); Clarkson, Li, Richardson and Vasvari (2008); Clarkson, Overell and Chapple (2011)). It is used to proxy the informational asymmetry in the market a higher Tobin's Q, which means a lower disclosure rate, and thus the relation is inverted for the book-to-market ratio[32]. Second, the book-to-market ratio is a documented risk factor, which explains expected returns in cross-section. Given these arguments, the association between firm SDS and the book-to-market ratio is essential to document, and control for in the stock market analysis. The results in table 2 provide inconclusive results. The book-to-market Is largest in the *Low* quintile SDS portfolio. It decreases monotonically to the fourth portfolio before jumping up in size in the *High* SDS quintile portfolio. The pooled regression in table 3 reports a positive association between book-to-market ratio and firm SDS. The coefficient is 0.06, which is statistically significant at the 0.1% level. This result concurs with the proposed association between book-to-market and firm SDS by empirical work on Tobin's Q. The combined results yield some support for the actuality of the fifth hypothesis, although any conclusion would require a more in-depth analysis of the relation in question.

Hypothesis 6: There is a positive association between firm sustainability disclosure levels and operational cost to revenue ratio.

The operational cost to revenue ratio is relevant as voluntary disclosure theory posits that firms with higher environmental performance would have higher disclosure levels. Environmental options are usually more costly than the alternative, and thus a natural conjecture is that holding all else equal, environmentally friendlier firms have higher operational cost to revenue ratios. Furthermore, the profitability of firms determines the firms stock market performance. Thus, the correlation between the operational cost to revenue and SDS is essential to control for and understand to estimate the real impact of SDS on stock returns. In line with what the conjecture suggests, table 2 and 3 finds a positive association between the operational cost to revenue ratios and firm SDS. Table 2 indicates that there are extreme outliers in the data, as all the time-series average of cross-sectional average operational cost to revenues in SDS quintile portfolios are above 1. One argument for this is that some firms in each quintile portfolio are rapidly expanding business operations, and thus operate with higher operational expenditures over revenues. This notion is similar to the case of Tesla Inc., which did not turn a profit for a long time while expanding production, and funded the expansion with cash reserves. Nevertheless, the results indicate strong support for the sixth hypothesis.

Hypothesis 7: The association between form sustainability disclosure levels and stock returns differs with environmental, social, and governance-related disclosure.

The keywords used in the crawler algorithm have the additional dimension of environmental, social, and governance (ESG) category[33]. This enables the investigation into ESG differences in the discovered association between stock returns and firm SDS. Table 7

[32]The Tobin's Q measure has an inverted nominator-denominator compared to book-to-market. The results in the table should reflect this inversion, i.e., a positive association between book-to-market and SDS.

[33]See Appendix A for the full list of keywords with ESG categorizations

reports the difference when firm SDS is calculated on environmental, social, or governance-related keywords. The results in the equally weighted portfolio are that the effect of SDS and stock returns are not statistically significant for social and governance-related SDS. The effects are, however, enhanced in the environmental category, and statistically significant at the 5% level. Furthermore, an interesting result emerges in the value-weighted portfolios. As Richardson and Welker (2001) found, social SDS has a negative association with stock returns, although this effect is not statistically significant in this paper. It is interesting as it indicates that social disclosure affects stock returns differently than environmental and governance disclosure. However, as it is not statistically significant, we cannot conclude to the direction of effect. The effect of environmental SDS is reduced in the value-weighted portfolios and not statistically significant. This reduction indicates that the value-weighted results in table 5 stem from the combination of the ESG categories, rather than any individual category. Nevertheless, the result in table 7 indicates different effects on stock returns in the ESG categories, although any conclusion would require further exploration in the ESG effects on firm characteristics and stock returns.

Hypothesis 8: There is a negative association between firm sustainability disclosure levels and stock returns.

There is a consensus in the literature that the disclosure of sustainability information increases the value of the firm, and reduces the cost of equity capital. Furthermore, the body of academic literature investigating the effects of sustainability disclosure document the relation between firm sustainability disclosure and firm characteristics found to explain variation in stock returns. The results in chapter 5.1 indicate the negative association between stock returns and SDS. First, table 4 indicates that the lowest average monthly return is in the *High* quintile SDS for both equally weighted (EW) and value-weighted (VW) portfolios. The difference between the *High* and *Low* average portfolio returns is not statistically significant for both EW and VW returns. The results in this table are not adjusted for risk, which makes it a poor measure of portfolio performance. Five risk measures are accounted for in table 5. It shows that the cost of equity after controlling for risk is higher in the equally weighted *Low* portfolio, with a statistically significant Jensen's alpha of 0.34. The *Low* portfolio outperforms the *High* portfolio with 28 basis points per month, for both EW and VW returns. This effect is statistically significant at the 5% level for both EW and VW. The results are adjusted for five risk factors: market risk, size risk, book-to-market risk, momentum, and liquidity. The result is the reported time-series average the cross-sectional regression coefficients supports these results. The coefficient is negative and weakly statistically significant after controlling for key factors known to explain cross-sectional returns. The average cross-sectional coefficient is enhanced in microcaps and mitigated in small and large caps[34].

These preliminary results seemingly provide strong support for the negative association between SDS and stock returns. However, as documented in chapter 4 and 5.2, other effects are not controlled for that are likely to correlate with SDS and stock returns. As previously discussed, there are industry effects that correlate with both SDS and stock returns. For example, The low average returns in the *High* portfolio in section 5.1 is due to substantial weighting on individual sustainability sensitive industries like energy. Chapter 5.2 documents that the effects of SDS and stock returns persist in the equally weighted portfolio after controlling for industries (See table 10). The persistence of the

[34]The size groups are based upon the size criteria of Fama and French (2008).

return difference in the equally weighted portfolio, combined with the reduction of the value-weighted portfolio, indicates that the effects are pronounced in smaller firms.

Furthermore, the preliminary results of the relation between stock returns and SDS do not control for geographical dispersion or operational cost to revenue, which correlate with SDS. These are included in the analyses in table 12. The method is the same as in table 6, which estimates the average cross-sectional regression coefficients. The effect of SDS on stock returns is diminished after the introduction of these additional control variables. This indicates that the variation in stock returns previously ascribed to SDS was indeed the result of the correlation between SDS and industry-, operational cost to revenue and geographical dispersion. However, the effect of SDS on stock returns persists in microcaps, which explains the results in table 10, where equally weighted *Low* outperforms *High*, but not in value-weighted.

To conclude, the effect of SDS on stock returns is negative and statistically significant in microcaps after controlling for many risk factors. However, the effect diminishes in the analysis of all firms combined, as well as in small firms and large firms. The negative association in microcaps is indicative of investors that pay a premium for perceived sustainable firms if they are small.

7. Conclusion

7.1. Conclusion

The purpose of this paper is to investigate the association between stock returns and firm sustainability disclosure. It demonstrates a keyword matching technique in 10-K filings that enables arguably the most extensive sample size of firm sustainability disclosure of publicly traded firms in the U.S. I document that 10-K sustainability disclosure has a stable and significant cross-sectional variation, and is increasing over time. Furthermore, I document that this measure of firm sustainability disclosure differs with several firm characteristics such as size, geographical dispersion, and industry. These results concur with findings in previous research. In addition, I document that firm sustainability disclosure is associated with the firms' operational cost to revenue ratio. The study shows that this ratio is significant in explaining cross-sectional variation in stock returns. I show that the effects of firm sustainability disclosure in 10-K filings on stock returns vary with the industry and the environmental, social or governance category of the sustainability disclosure. I show that stock returns for firms classified as microcaps[35] relates to their sustainability disclosure, measured by the 10-K keyword match technique, after controlling for several firm characteristics. For microcaps, the effect of a 10% increase in sustainability disclosure corresponds to a decrease in cross-sectional returns of 1.4 basis points. This negative effect concurs with the literature that posits that an increased level of sustainability disclosure relates to a decrease in the firms' cost of equity capital.

This study demonstrates that significant cross-sectional variation in firm sustainability disclosure levels by 10-K filings. This enables research within the nature of sustainability

[35]Microcaps are classified by Fama and French (2008) as firms equal to or below the 20th percentile size of firms on NYSE.

disclosure in standardized annual filings, and for the enhancement of estimating firm sustainability disclosure in cross-section. The effects of sustainability disclosure on stock returns are just one of several topics that can be investigated through the use of the 10-K keyword match technique, which is crucial for understanding the implications of firms as socially responsible entities in the future. It also enables further research into why microcaps see a significant reduction in stock returns by increased SDS after controlling for a significant number of firm characteristics.

7.2. Limitations

There are some essential limitations of the research in this paper that I would like to address in this section. First, the sample size differs between analyses. Certain variables had missing observations in CRSP and Compustat. The introduction of some variables thus reduced the sample size. In turn, this paper then analyses the results from different samples, which might affect the validity of the results. For example in comparing the results from two cross-sectional regression tables (Table 6 and 12); the change might be due to smaller firms having fewer operational costs to revenue observation registered with Compustat. Thus, there is an implicit assumption in this paper that there is no systematic variation in missing data with CRSP and Compustat, such as smaller firms' data being less frequently registered.

Furthermore, the monthly frequency of the data reduces the accuracy of the Amihud illiquidity measure and volatility estimation. Volatility should also be calculated as the standard deviation of the predicted returns by some models incorporating at least the market risk factor. In this paper, there is arguably a high degree of systematic risk in the volatility metric, which is supposed to capture firms idiosyncratic volatility.

Another weak point might be the sample period. There could be significant changes in investor attitudes toward sustainability disclosure. Thus, the results based on the whole period hide what might be a more significant effect today. One idea would be to divide the period into segments and compare the results of periodical analyses.

Furthermore, sustainability disclosure might affect expected stock returns through some of the control variables, such as liquidity. This paper assumes that firms with liquid stocks disclose more ESG relating information. Thus, the models do not capture the indirect effect sustainability disclosure might have on stock returns through liquidity. This indirect SDS- stock return effect might also be the case for other characteristics like firm size, where the act of reporting sustainability information increases the size of the firm, which reduces the cost of equity capital.

The industry analysis also assumes that the overall sustainability disclosure levels do not drive average stock returns between industries. For example, socially responsible investors might choose to exclude specific industries from their portfolio due to low sustainability disclosure overall. Thus, the expected returns of firms in these industries are higher, holding all else equal.

7.3. Future work

This paper demonstrates the viability of 10-K computerized sustainability disclosure measurement. The concept of computerized parsing of 10-K forms for different purposes is far from new, but this paper demonstrates the viability of sustainability disclosure comparison by keyword matching, which enables significantly larger sample sizes. This concept has a significant potential for improvement in several ways. One is by researching the optimal choice of keyword lists by textual analysis. The optimal keyword choice could, for example, vary over time, or carry different meanings in different industries. There is also the possibility of incorporating sentiment analysis and other contextual analyses in the crawler algorithm to improve the scores approximation accuracy of firm sustainability disclosure.

This paper does not look at the event of disclosing ESG information, but rather the cross-sectional variation in relative disclosure levels. Studying the immediate period around the 10-K filing could yield significant contemporaneous market effects influenced by the sustainability-related contents of the filing. There might also be significant changes in the market reaction of sustainability disclosure in the '90s compared to today. This time-varying effect represents another topic for future research.

The paper also finds interesting differences in SDS effects on stock returns by industry. Notably, a significant, consistent zero investment return difference in SDS in the health industry. Furthermore, the energy industry has an opposite reaction than expected. This industry difference indicates that future research would find interesting effects with an industry-specific analysis of sustainability disclosure and stock returns in both health and energy. There is a vast amount of research within energy firms and sustainability disclosure. The comparison with other industries might, however, yield curious results as it did in this paper.

References

Aerts, W., Cormier, D., Magnan, M., 2008, *Corporate environmental disclosure, financial markets and the media: An international perspective.* Ecological Economics, 64(3):643-659.

Al-Tuwaijri, S.A., Christensen, T.E., Hughes, K.E., 2004 *The relations among environmental disclosure, environmental performance, and economic performance: A simultaneous equations approach.* Accounting, Organizations and Society 29(5-6):447-471.

Amihud, Y., 2002, *Illiquidity and stock returns: cross-section and time-series effects.* Journal of Financial Markets, 5(1): 31-56.

Amihud, Y., Mendelson, H., 1986, *Asset pricing and the bid-ask spread.* Journal of Financial Economics, 17(2):223-249.

Ang, A., Robert J. H., Xing, Y., Zhang, X., 2006, *The Cross-Section of Volatility and Expected Returns.* The Journal of Finance, 61(1):259-299.

Blacconiere, W.G., Patten, D.M., 1994, *Environmental disclosures, regulatory costs, and changes in firm value.* Journal of Accounting and Economics, 18(3):357-377.

Botosan, C.A., Harris, M.S., 2000, *Motivations for a change in disclosure frequency and its consequences: an examination of voluntary quarterly segment disclosures.* Journal of Accounting Research, 38(2):329-353.

Botosan, C.A., 1997, *Disclosure Level and the Cost of Equity Capital.* The Accounting Review, 72(3):323-349.

Branco, M.C., Rodrigues, L.L., 2008, *Factors influencing social responsibility disclosure by Portuguese companies.* Journal of Business ethics, 83(4):685-701.

Cho, C.H., Guidry, R.P., Hageman, A.M., Patten, D.M., 2012, *Do actions speak louder than words? An empirical investigation of corporate environmental reputation.* Accounting, organizations and Society, 37(1):14-25.

Cho, C.H., Patten, D.M., 2007, *The role of environmental disclosures as tools of legitimacy.* Accounting, organizations and Society, 32(7-8):639-647.

Ciciretti, R., and Dalo, A., and Dam, L., 2017, *The Price of Taste for Socially Responsible Investment.* CEIS Working Paper No. 413.

Clarkson, P.M., Fang, X., Li, Y., Richardson, G.D., 2013, *The relevance of environmental disclosures: Are such disclosures incrementally informative?* Journal of Accounting and Public Policy, 32(5):410-431.

Clarkson, P.M., Overell, M.B., Chapple, L., 2011, *Environmental reporting and its relation to corporate environmental performance.* A Journal of Accounting, Finance and Business Studies, 47(1):27-60.

Clarkson, P. M., Richardson, G. D., Vasvari, F. P., 2008, *Revisiting the relation between environmental performance and environmental disclosure: An empirical analysis.* Accounting, Organizations and Society. 33(4-5):303-327.

Cormier, D., Magnan, M., van Velthoven, B., 2005, *Environmental disclosure quality in large German companies: Economic incentives, public pressures or institutional conditions?* European Accounting Review, 14(1):3-39.

Cormier, D., Magnan, M., van Velthoven, B., 2005, *Environmental disclosure quality in large German companies: Economic incentives, public pressures or institutional conditions?* European Accounting Review, 14(1):3-39.

Cormier, D., Magnan, M., 2003, *Environmental reporting management: a European perspective.* Journal of Accounting and Public Policy, 22(1):43-62

Cormier, D., Gordon, I.M., 2001, *An examination of social and environmental reporting strategies* Accounting Auditing and Accountability Journal, 14(5):587-616.

Cormier, D., Magnan, M., 1999, *Corporate environmental disclosure strategies: determinants, costs and benefits* Journal of Accounting, Auditing and Finance, 14(3):429-451

Dhaliwal, D., Li, O., Tsang, A., Yang, Y. 2014, *Corporate social responsibility disclosure and the cost of equity capital: The roles of stakeholder orientation and financial transparency.* Journal of Accounting and Public Policy, 33(4):328-355.

Dhaliwal, D., Li, O., Tsang, A., Yang, Y. 2011, *Voluntary Nonfinancial Disclosure and the Cost of Equity Capital: The Initiation of Corporate Social Responsibility Reporting.* The Accounting Review, 86(1):59-100.

Deegan, C., 2002, *Introduction: The legitimizing effect of social and environmental disclosures - A theoretical foundation.* Accounting Auditing and Accountability Journal. 15(3):282-311.

Deegan, C., Rankin, M., 1996, *Do Australian companies report environmental disclosures by firms prosecuted successfully by environmental protection authority* Accounting Auditing and Accountability Journal. 9(2):50-67.

Deloitte Touche Tohmatsu Limited, 2016, *Sustainability disclosure: Getting ahead of the curve.* Deloitte Development LLC.

Fama, E. F., French, K. R., 2008, *Dissecting anomalies.* Journal of Finance , 63(4):1653-1678.

Fama, E. F., French, K. R., 2002, *The equity premium.* Journal of Finance , 57(2):637-659.

Fama, E. F., French, K. R., 1993, *Common risk factors in the returns on stocks and bonds.* Journal of Financial Economics , 33(1):3-56.

Fama, E. F., MachBeth, J., 1973, *Risk, return and equilibrium: empirical tests.* Journal of Political Economy, 91(3):607-636.

Garcia, D., Norli, Ø., 2012, *Geographic dispersion and stock returns.* Journal of Financial Economics, 106(3):547-565.

Heald, M., 1957, *Management's Responsibility to Society: The Growth of an Idea.* The Business History Review, 31(4):375-384.

Healy, P.M., Palepu, k.G., 2001, *Information asymmetry, corporate disclosure, and the capital markets: A review of the empirical disclosure literature.* Journal of Accounting and Economics, 31(1-3):405-440.

Hou, K., and Robinson, D.T., 2006, *Industry Concentration and Average Stock Return.* Journal of Finance, 61(4):1927-1956

Hummel, K., Schlick, C., 2016, *The relationship between sustainability performance and sustainability disclosure - Reconciling voluntary disclosure theory and legitimacy theory.* Journal of Accounting and Public Policy, 35(5):455-476.

Jegadeesh, N., and Titman, S. 1993, *Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency.* The Journal of Finance, 48(1):65-91.

Jensen, M. C., and Meckling, W. H., 1976, *Theory of the firm: managerial behavior, agency costs and ownership structure.* Journal of Financial Economics, 3(4): 305-360

Lev, B., 1992, *Information Disclosure Strategy.* California Management Review, 34(4):9-32.

Meek, G.K., Roberts, C.B., and Gray, S.J., 1995, *Factors influencing voluntary annual report disclosures by U.S., U.K. and Continental European multinational corporations.* Journal of International Business Studies, 26(3):555-572.

Merton, R. C., 1987, *A simple model of capital market equilibrium with incomplete information.* Journal of Finance, 42:483-510.

Jensen, M.C.,1967, *The Performance of Mutual Funds in the Period 1945-1964.* Journal of Finance, 23(2):389-416

Neu, D., Warsame, H., and Pedwell, K., 1998, *Managing public impressions: environmental disclosures in annual reports.* Accounting, Organizations and Society, 23(3):265-282.

Owusu-Ansah, S., 1998, *The impact of corporate attribites on the extent of mandatory disclosure and reporting by listed companies in Zimbabwe.* The international Journal of accounting, 33(5):605-631.

Pastór, L., Stambaúgh, R. F., 2003, *Liquidity Risk and Expected Stock Returns.* Journal of Political Economy, 28(2):642-685.

Patten, D.M., 2002, *The relation between environmental performance and environmental disclosure: A research note.* Accounting, Organizations and Society, 27(8):763-773.

Patten, D.M., 1992, *Intra-industry environmental disclosures in response to the Alaskan oil spill: a note on legitimacy theory* Accounting, Organizations and Society, 17(5):471-475.

Richardson, A.J., Welker, M., 2001, *Social disclosure, financial disclosure and the cost of equity capital.* Accounting Organizations and Society 26(7):597-616.

Sadorsky, P., 2012, *Modeling renewable energy company risk.* Energy Policy, 40:39-48.

Shehata, N., F., 2014, *Theories and Determinants of Voluntary Disclosure.* Accounting and Finance Research, 3(1).

Singhvi, S.S., Desai, H.B., 1971, *An Empirical Analysis of the Quality of Corporate Financial Disclosure.* The Accounting Review, 46(1):129-138.

Ullmann, A. A., 1985, *Data in search of a theory: A critical examination of the relationships among social performance, social disclosure, and economic performance of U.S. firms.* The Academy of Management Review, 10(3):540-557.

de Villiers, C., van Staden, C.J., 2006, *Can less environmental disclosure have a legitimising effect? Evidence from Africa.* Accounting, Organization and Society, 31(8):763-781.

Verrecchia, R.E., 2001, *Essays on disclosure.* Journal of Accounting and Economics, 32(1-3):97-180.

Welker, M., 1995, *Disclosure Policy, Information Asymmetry, and Liquidity in Equity Markets* Contemporary Accounting Research, 11(2):801-827.

SEC: The Electronic data Gathering, Analysis, and Retrieval System. Retrieved April 2019:
`https://www.sec.gov/edgar.shtml`

Chicago Booth: Pastor and Stambaugh traded liquidity factor. Retrieved April 2019:
`https://faculty.chicagobooth.edu/lubos.pastor/research/`

KPMG. 2008. KPMG international survey of corporate social responsibility reporting 2008. Retrieved April 2019:
`https://home.kpmg/xx/en/home.html`

North American Industry Classification System. Retrieved April 2019:
`https://www.naics.com/`

Yahoo Finance. Retrieved May 2019:
`https://finance.yahoo.com/`

Appendices

Appendix A - Sustainability context keywords

List of all keywords uses in the 10-K matching algorithm and sustainability disclosure score calculation.

The matching algorithm matches a word if it contains the full letter combination of one of the words below. Words that have additional letters without spacing will also match (see **Sustainab** or **Ethic**). The algorithm is not case sensitive. Firm sustainability disclosure scores, SDS, are computed as $SDS = \sum_{n=1}^{N} \log(1 + \eta^i_{n,t}/\bar{\eta}_{n,t})$ where firm i's sustainability disclosure score (SDS) for year t is a function of the counted number of matches $\eta^i_{n,t}$ over the yearly average match count $\bar{\eta}_{n,t}$ for a sustainability keyword n in form 10-K. The following are the keywords with ESG classifications and brief descriptions of applied contexts.

Acidification
Environmental. Related to fresh- and saltwater acidification, threatening the existence of local ecosystems. Chemical plants and factories are examples of firm types that can cause water acidification.

Air quality
Environmental. Generally can be applied to most firms. Air quality has become a major issue in industrialized areas or urban areas with heavy traffic emissions.

Aerosol
Environmental. Aerosol contains polluting particles that can cause harm by polluting the atmosphere and breaking up the ozone layer.

Carbon dioxide
Environmental. Carbon dioxide is the major climate change enabling greenhouse gas.

Co2 Environmental. same meaning as previous, but with different formulation to capture the use of the abbreviation of carbon dioxide.

Charity
Social, governance. A higher degree of charitable contributions can have a strong positive social impact for the charity target. Furthermore, it shows that the managers of the firm are willing to divert profits into social causes, which is a sign of strong governance.

Child development
Social. Companies that support child development programs provide a high social benefit to the area of effect.

Clean
Environmental. The use of the word clean illustrates an initiative of minimizing waste products and pollution for the firm.

Climate change
Environmental. The use of the word shows an understanding of the environmental consequences of unsustainable business operations.

Corruption
Governance. Firms that address problems with corruption both internally or externally demonstrate a focus on amending such issues. It also shows an attitude toward dealing with corruption, instead of utilizing it, furthering corrupt behavior internally and externally.

Democra

Social, governance. Democratic, democracy. The use of the word can have several meanings. Internally, it can be the degree to which employees can voice opinions or engage in firm decision making. Externally, it can be the political climate in the regions of firm operations.

Diversity

Governance. The use of the word shows that the management of the firm is aware of the benefits of a diverse workforce and that the management does not profile potential employees.

Education

Social. Shows to which degree the firm is engaged in the education of both its own workforce and the educational system in the area of operation.

Emission

Environmental. Relates to greenhouse gas emissions. Addressing their own emissions is positive as it shows that the firm is aware of any emission-related problems, or that the development in emissions is positive.

Environmental

Environmental. The use of the word generally relates to the environmental concerns of the firm. Applicable in a broad sense.

Equality

Social. The use of the word demonstrates the firms focus on social equality in the society in which it operates.

Equal opportunity

Governance. The use of the word demonstrates the degree the firm is aware of opportunity discrepancies among the population in the area of operations. Also, demonstrates the degree that the firm provides equal opportunity for the workforce and in hiring practices.

ESG

Environmental, social, governance. common abbreviation for environmental, social and governance. Relates to the overall degree of sustainability a firm or project demonstrates.

Ethic

Social, governance. Matches with ethics, ethical and ethically. The use of the word illustrates the degree the firm is aware of ethical concerns.

Fresh water

Social. Low access to fresh water is one of the larger humanitarian concerns today. The use of word demonstrates the awareness of the firm of this issue.

Gender

Governance, social. Demonstrates firm recognition of possible gender discrepancies or unfairness both internally and externally.

Global Warming

Environmental. The use of the word shows that the firm recognizes the global warming issue and has an awareness of its own responsibilities relating to the issue.

Greenhouse
Environmental. Relates to the greenhouse effect or greenhouse gasses. The use of word demonstrates awareness of the causing factor of climate change and global warming.

Human
Social. Relates to examples like humanitarian situations or human rights. Demonstrates awareness of social and environmental issues affecting humans.

Life Expectancy
Social. Demonstrates the awareness of the social conditions in which the firm operates.

NGO
Social, governance. A non-profit organization operating independently of any government. The use of word relates to the degree a firm works with NGO's in operations.

Non-profit
Social, governance. Same context as the previous keyword.

Ozone
Environmental. Shows the degree to which a firm is aware of issues relating to the depletion of the ozone layer.

Pollut
Environmental. Pollution, pollutant(s). Use demonstrate the degree a firm is aware of issues related to pollution and pollutants.

Recycl
Environmental. Recycle, recycling. Demonstrate firm initiatives for appropriate waste management.

Renewab
Environmental. Renewable, renewability. Focus on renewable resources for sustainable business operations.

SDG
Environmental, social, governance. Abbreviation of the UN's Sustainable Development Goals. Demonstrates the intention a firm has in relation to the SDG's

Sustainab
Environmental, social, governance. Sustainable, sustainability. Use of word demonstrates firm sustainability focus.

Appendix B - Industry grouping codes and brief descriptions

This appendix contains a list of all industries and their NAICS codes with descriptions. The codes are listed with the first number of digits to encapsulate the industry group. All firms have a 6-digit NAICS code, and the first number of digits determines their classification in the list below. The codes are updated as of 2017.

Energy

21: Mining, Quarrying and Gas Extraction.

22: Utilities.

Manufacturing

31 - 33: Manufacturing (with the exception of 336: Transportation equipment manufacturing.)

Wholesale and retail

42: Wholesale trade (with the exception of 4231: Motor Vehicle and Motor Vehicle Parts and Supplies Merchant Wholesalers)

44 - 45: Retail trade (with the exception of 441: Motor Vehicle and Parts Dealers.)

Transportation: Sales and Production

336: Transportation equipment manufacturing.

4231: Motor Vehicle and Motor Vehicle Parts and Supplies Merchant Wholesalers.

441: Motor Vehicle and Parts Dealers.

Transportation: Services

48 - 49: Transportation and Warehousing.

Information

51: Information

Finance

52: Finance and insurance.

53: Real estate and renting and leasing.

Professional, technical and management services

54: Professional, scientific, and technical services.

55: Management of companies and enterprises.

Health

62: Health care and social assistance.

Other

All other industries not included above are classified here.