UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

Bachelor Thesis in Financial Economics, Program in Business & Economics

The Greenfee of Beta

Unraveling the Impact of Sustainability on Systematic Risk

Abstract

This paper unravels the impact of sustainability on systematic risk. Literature suggests that enhanced sustainability reduces companies' systematic risk, thanks to e.g. product differentiation, a broader spectrum of investors holding the assets, or simply because there exists a specific ESG factor. Aiming to complement existing literature, we zoom in on the particular forces being investment commitments and investment horizon, potentially increasing companies' systematic risk as a consequence of enhanced sustainability. We examine this empirically by constructing a proxy variable defined as the sum of R&D- and capital expenditures scaled by revenue, intending to measure the relative investment commitments and investment horizon. This proxy variable is multiplied with the companies' ESG score, forming our variable of interest. Indeed, by running a fixed effect regression model using beta as the dependent variable, we find an indication of enhanced sustainability, through higher investment commitments and a longer investment horizon, inflating the systematic risk. However, our robustness checks fail to confirm the significance of this relationship, diminishing the confidence of our results. We recognize the need for further empirical studies, continuing trying to exhaustively map the relationship between sustainability and systematic risk.

Bachelor Thesis 15 credits

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Spring Semester 2023

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1 Introduction

1.1 Background

The stakeholder theory, initially proposed by R. Edward Freeman in 1984, offers an alternative approach to the traditional stockholder-based theories. In essence, it builds on the argument that organizations should be managed in the interest of all their stakeholders, and not solely in the interest of their shareholders. Freeman's intention was to offer a pragmatic approach to strategy that promotes organizations to be conscious of their stakeholders to achieve superior performance. In other words, the approach has a strategic rational apart from moral incentives and normative reasons (Laplume, Sonpar & Litz, 2008). While being pointful at the time, the relevancy and urgency of this mindset among corporate managers has accelerated ever since from society's standpoint.

In order to prevent the worst impact from climate change and sustain a livable planet, global warming needs to be limited to 1.5 °C above pre-industrial levels as called for in the Paris Agreement. This corresponds to a reduction of emissions of 45% by 2030, and to reach net zero emissions by 2050 (United Nations, 2023). However, in 2022 global CO2 emissions increased by 0.8%, largely driven by increased oil emissions as global travel continues to gradually recover from the Covid-19 pandemic (World Economic Forum, 2022). To get on the right trajectory, the situation calls for immediate action, and the responsibility of organizations is greater than ever.

Thorne and Mrema (2023) state that the future of business operations rely on organizations regenerating and conserving nature. A failure to act could lead to extensive, and in the worst case, irreversible nature loss. Such a loss could consequently result in widespread systemic risks and shocks to the global economy, including resource shortages, rising commodity prices, job losses and political instability. Regardless of industry or geographical footprint, no business is immune to these disruptions. Everyone has a responsibility to protect more than their bottom lines. They continue by claiming that it is the chair's responsibility to help their businesses navigate these risks. Putting nature on the agenda, is putting your business at the forefront of change.

Corporate actions in the scope of impacting social welfare are referred to as Environmental, Social and Governance (ESG), or Corporate Social Responsibility (CSR). The acronym ESG was developed in 2004 by 20 financial institutions responding to a call from Kofi Anon, Secretary-General of the United Nations (Gillan, Koch & Starks, 2021). Further, the Principles of Responsible Investment (PRI) is the world's leading proponent of responsible investment, and by becoming a member, asset managers commit to incorporating ESG issues into their investment analysis, decision-making process, and ownership policies and practices. From 2006 until 2021, the number of signatories grew from 63 to 3826, and as of today they have reached 7000 members (Principles of Responsible Investment, 2023). This exponential growth suggests a greater engagement from the financial industry in general, and asset managers in particular, for a multi-stakeholder view on managing corporations.

1.2 Problem description and analysis

The urgency of action to align with the Paris Agreement and increasing engagement from the world's asset managers to incorporate the ESG-perspective into their investments, both argue for the relevancy of the topic sustainable finance. Literature in the field is mainly dominated by research about the relationship between sustainable performance and financial performance measured as profitability, while there also exists research about the influence from sustainability on risk and companies' cost of capital. Risk being a crucial aspect to businesses' sustainability strategies as outlined by Thorne and Mrema (2023). According to literature, a common perception among investors is that sustainable companies are exposed to less uncertainty and thus require a lower rate of return (Landi et al., 2022). The equity cost of capital is decided by the company's systematic risk, or beta. Some important determinants of an asset's systematic risk include financial leverage, cyclicality, operational leverage, investment commitments, and the time horizon of the project. The consensus among researchers is that sustainable companies have a lower systematic risk, thanks to product differentiation, a broader spectrum of investors holding the assets, or simply because there exists a specific ESG factor (Gillan, Koch & Starks, 2021). However, to be at the forefront of sustainability, a long investment horizon as well as high investment commitments are required. In other words, there are reasons to believe that sustainable practices also comes with forces increasing the systematic risk.

1.3 Purpose

The purpose of this study is to examine specific forces behind the influence from sustainability on systematic risk. In particular, this study aims to complement existing research on the topic. Although there exists numerous studies in the scope of this topic, they primarily tend to focus on the slope coefficient of ESG as the main independent variable, while controlling for other relevant factors. It can therefore be argued that there exists room for a study that rather tends to focus on particular forces driving this relationship. While not arguing against the fact that a sustainable company has a lower systematic risk than an, in other ways comparable, less sustainable company, this study aims to shed a light on two forces, namely higher investment commitments and a longer investment horizon, that potentially increases the systematic risk of a sustainable company. In summary, the fundamental question we pose is: how does sustainability, through its effect on investment commitments and investment horizon, impact the systematic risk of companies?

2 Theoretical Framework

2.1 ESG

ESG has become a prevalent term amongst investors as it serves as a means of evaluating corporate activities concerning environmental, social, and governance domains. Moreover, ESG factors are often viewed as non-financial performance indicators, providing valuable insight into areas of concern surrounding business ethics, corporate governance, and corporate social responsibility (Kim & Li, 2021). However, regarding the concept of corporate social responsibility (CSR), there has been definitions differing significantly among various organizations. Despite the variations in interpretation, CSR generally denotes endeavors that promote social welfare exceeding the interests of the company and what is legally required (El Ghoul et al., 2011). Even though many treat these concepts the same, there are differences. For instance, ESG encompasses governance explicitly, while CSR addresses governance issues indirectly in relation to environmental and social concerns. As such, ESG represents a broader and more comprehensive framework than CSR (Gillan, Koch & Starks, 2021).

Many companies have begun to emphasize their ESG activities in order to be regarded as socially responsible. Concurrently, institutional investors as well as individual investors have increasingly integrated assessments of a company's ESG performance into their investment decision-making processes (Kim & Li, 2021). Consequently, there is a growing demand for precise and transparent ESG data and scores to facilitate accurate comparisons and informed decision-making.

It is important to note that, even if the ESG score is a measure that has increased in popularity and is now widely used for evaluating a company's sustainability, the score is measured differently across agencies. This lack of consistency has induced experts' skepticism of the ESG score as a measure of sustainability. The challenges of obtaining complete and accurate ESG ratings include discrepancies in measurements, data quality issues, and greenwashing by companies. ESG data noise also imposes a problem for independent agencies that are evaluating and assigning ESG scores to companies, causing a divergence in ratings. As a consequence of this divergence, identifying outperformers and laggards has become a challenging task for decision-makers. In addition, the divergence in ESG scores from the independent rating agencies disrupt companies' incentive to improve their rating due to the presence of conflicting signals about what to focus on (Stackpole, 2021). The lack of comparability does not only occur between companies, sometimes it is even difficult to compare the ESG score of an individual firm from year to year. This is because of modifications in the methodology or the adoption of alternative metrics or standards within a firm to assess the same thing (Pucker, 2021). It is fair to say that the existing literature agrees on the fact that the concept of ESG scores is far from a fully satisfactory level.

2.2 Systematic Risk

Systematic risk, also known as undiversifiable or market risk, refers to fluctuations in a stock's return due to systematic shocks that affect the whole market and cannot be diversified. In contrast, firm-specific risk is diversifiable when combining the stocks of multiple firms into a portfolio. Thus, investors do not receive compensation for holding firm-specific risk. One commonly used approach for calculating systematic risk is using beta (β) which measures the sensitivity of a stock or investment in response to systematic shocks to the economy. More specifically, beta can be calculated in a regression between the historical returns of a particular stock or investment and the returns of the overall market. The beta will then correspond to the slope coefficient that best fits this regression. A beta value of 1 signifies that the stock moves in tandem with the market, meanwhile a beta value exceeding 1 means that the stock exhibits a greater level of volatility compared to the market, and vice versa if the beta value is less than 1 (Berk & DeMarzo, 2019).

Beta is determined by several factors such as the cyclicality of a firm, operating leverage, investment commitments, and the time horizon of cash flows. Cyclical firms that are highly affected by the business cycle tend to have a high beta. The operating leverage is defined as the ratio of fixed costs to variable costs. A high operating leverage will lead to a high beta, as will high levels of investment commitments. Moreover, the time horizon of cash flows also impacts beta. Investments with long-term cash flows are more exposed to shifts in the discount rate arising from changes in the risk-free rate or market risk premium, which will affect the value of the investment. Hence, a project with long-term cash flows will have a higher beta (Brealey, Myers & Allen, 2019). When addressing beta, it is also imperative to acknowledge the distinction between levered and unlevered beta. The unlevered beta measures the market risk associated with a firm's underlying assets. If a firm alters its capital structure while maintaining its investments unchanged, the unlevered beta will remain unaffected. In contrast, the levered beta will vary to reflect the impact of the capital structure change on the firm's risk level (Berk & DeMarzo, 2019).

The cost of capital denotes the expected return that investors demand for their investments. This return is typically benchmarked against alternative investments in the market with similar risk and term. For risky investments, the cost of capital is comprised of the risk-free interest rate and a risk premium. A critical tool for estimating the risk premium is measuring the systematic risk of an investment by using beta. The market risk premium, defined as the difference between the expected return of the market portfolio and the risk-free interest rate, can calibrate investors' appetite for market risk. To compensate investors for the systematic risk they bear and the time value of their money, the cost of capital for an investment can be estimated using the widely known Capital Asset Pricing Model (CAPM). The CAPM formula expresses the cost of capital as the sum of the risk-free interest rate and the product of beta and the market risk premium. This formula implies that investments with a comparable level of risk should have a similar expected return, and that beta measures the additional risk investors are willing to bear for the potential of higher returns (Berk & DeMarzo, 2019).

3 Literature Review

3.1 ESG and Systematic Risk

Several studies within the scope of ESG, or the closely related acronym CSR, and systematic risk have reached the conclusion that the two variables are negatively correlated. Gillan, Koch and Starks (2021) conduct a review on the existing research in the field of ESG and CSR with an emphasis on corporate finance. The fifth section investigates the relationship between ESG/CSR attributes and firm risk, including systematic risk. The paper presents a number of holistic theories about the explanation to the influence from ESG/CSR on systematic risk. Firstly, companies with stronger ESG/CSR profiles could have different systematic risk exposures because of their resilience during crisis periods, or alternatively because there exists a specific ESG/CSR risk factor. Secondly, strong ESG/CSR companies could face a less price elastic demand thanks to a product differentiation strategy, resulting in a lower systematic risk. Third, responsible firms have a larger investor base than irresponsible firms, and thus have a lower risk. Lastly, there exists evidence that high ESG/CSR companies face lower litigation risk and consequently have a lower cost of capital.

El Ghoul et al. (2011) present two arguments to their hypothesis that, ceteris paribus, the cost of equity capital is lower for high CSR firms than low CSR firms. First of all, low CSR firms tend to have a smaller investor base due to investor preferences and information asymmetry. When fewer investors hold the stock of a firm, the opportunities for risk diversification is reduced and as a result the firm's cost of capital will be higher. Second of all, investors perceive socially irresponsible firms as having a higher level of risk because they may face uncertain future claims. Firms adopting a more environmentally pro-active posture experience a reduction in perceived riskiness from investors. A similar line of reasoning is done by Oikonomou, Brooks and

Pavelin (2012) who present a hypothesis that companies utilizing renewable energy sources and ensure great quality and safety characteristics of their products and services might be better equipped to respond to adverse systematic economic shocks. In other words, they should have a lower systematic risk. After performing their study, El Ghoul et al. clarify that firms with a better CSR score does exhibit lower cost of equity capital after controlling for other firm-specific determinants as well as industry and year fixed effects. In particular, they conclude that responsible employee relations, environmental policies, and product strategies contributes significantly to reducing a firm's cost of equity. Again, support can be found from Oikonomou, Brooks and Pavelin who suggest that supportive employees and communities during times of crisis could be a potential explanation to the negative relationship between ESG/CSR and systematic risk.

Albuquerque, Koskinen and Zhang (2019) present two opposing views on the relationship between firms adopting a CSR policy and their corresponding systematic risk. On the one hand, they argue that this is a way to increase product differentiation. All else equal, this results in a less price elastic demand leading to higher profit margins and product prices. Additionally, less price elasticity leads to lower elasticity of profits to aggregate shocks. On the other hand, adopting a CSR policy implies higher costs for the firm which could increase the systematic risk and decrease the market value of the firm. They continue by arguing that the outcome depends on the consumers' expenditure share on CSR goods. If the consumers' expenditure share on CSR is small enough, they predict that CSR firms have lower systematic risk and higher firm value. The lower the price elasticity of demand, and the higher the product differentiation, the more severe effect.

3.2 R&D- and Capital Expenditures

McWilliams and Siegel (1999) argue that previous research studying the impact of ESG/CSR on financial performance are misspecified by excluding R&D expenditures and advertising expenditures as control variables. The authors view the exclusion of R&D expenditures as especially problematic because there is an established link between R&D investment and long-run economic performance in literature. Investment in technical capital enhances knowledge which leads to product and process innovation and overall greater productivity. The outcome of their study confirms their initial concern as the magnitude of the relationship between corporate social responsibility and firm performance diminishes and is no longer significant when including R&D expenditures and industry fixed effects. This concept is followed by Oikonomou, Brooks and Pavelin (2012) who utilize R&D expenditure as a control variable in their models. They propose that R&D expenditures are positively correlated with corporate social performance, and that such investments constitute risky projects. Additionally, Albuquerque, Koskinen and Zhang (2019) include both R&D and capital expenditures as control variables as proxies for technological differentiation, further highlighting the importance of these variables.

In a paper studying the market's ability to value companies' R&D expenditures, Chan, Lakonishok and Sougiannis (2001) argue that many R&D-intensive companies have few recorded intangible assets and that their prospects are tied to the success of the outcome of their R&D activities, which are highly unpredictable. They further highlight that large expenditures usually are required at the outset and that a successful outcome is uncertain. The eventual benefits, if any, are likely to materialize in the long term. Referring to prior literature, they present a theory suggesting that investors have short term horizons so they fail to anticipate the benefits from long-term investments such as R&D. This resonates well with Porter (1992) who criticises America's effort of committing to capital investments, being "the most critical determinant of competitive advantage". He takes a more general approach than Chan, Lakonishok and Sougiannis, and focuses on investments as a broad definition. Porter claims that the root cause to recent American competitive shortcomings at the time, being the operation of the entire capital investment system, leads to, among other things, a short time horizon. This constitutes a hurdle to capital investments. To conclude, both papers derive a perception of a positive correlation between R&D- and capital expenditures and a longer investment horizon.

3.3 Investor Horizon and Sustainability

Studying the relationship between investor horizons and CSR, Boubaker et al. (2017) distinguishes between institutional long term investors and institutional short term investors and measures companies' proportion of both ownership forms. The authors conclude that ownership by institutional long term investors has a positive impact on CSR, while ownership by institutional short term investors is either negatively or not significantly associated with CSR scores. They find similar results when narrowing down to focus solely on public pension funds. They run Granger causality tests which show that the direction of the relationship goes from institutional long term investors to higher CSR scores and not the opposite. Why? Because "patient" capital enables the flexibility to develop a long-term perspective on their investments. Consequently, there is room for increased influence from institutional investors with sufficient time to consider institutional, regulatory, and structural conditions required to engage in CSR. Similarly, but taking it one step further, Glossner (2019) conducts a study investigating the same relationship but in a more complex way. Glossner approximates the investor horizon using the investor duration, which indicates how long institutional investors hold their stocks on average as well as the investor turnover, which indicates how frequently the investors have changed their holdings in the past. He reveals that not every CSR investment is alike. In fact, while long-term blockholder ownership is associated with a decrease in sustainability concerns, it is also associated with a significant decrease in sustainable strengths. Hence, by taking a more sophisticated view, he provides evidence that long-term investors prefer a CSR strategy that reduces the risk of ESG incidents. Consistent with Boubaker et al., Glossner also establishes changes in investor horizon to significantly affect future changes in sustainability, whereas changes in KLD scores (which is his variable for sustainability) does not imply future changes in the investor horizon. The above conclusions highlight an underlying chain of logic. Long term investors facilitate enhanced sustainability because of extending the managers' long term perspective in their decision making. Thanks to more monitoring, there will be less risk of underinvestments in long term assets for the sake of increasing short term profits. In other words, there is a positive relationship between increased sustainability and the companies' investment horizon.

3.4 Reverse Causality and Endogeneity

What has to be emphasized is that a firm's choice whether to engage in ESG/CSR activities may not be independent of its cost of equity capital. In other words, there exists a potential reverse causality problem. El Ghoul et al. (2011) suggests two alternative hypotheses to the direction of causality. Firstly, the good management hypothesis says that enhancing CSR performance improves relationships with stakeholders, and thus leads to better financial performance. Secondly, the slack resource hypothesis argues that better financial performance results in resource slack, which allows companies to enhance their CSR performance. Albuquerque, Koskinen and

Zhang (2019) further elaborate on a suspected endogeneity problem arising from the fact that a firm's financial resources may determine its CSR decisions, or that firms differentiating their product in other ways also might invest more in CSR. To mitigate such an issue, the authors conduct an IV regression using the political affiliation of the state where the company is headquartered as the instrument variable. This choice is based on literature suggesting that democratic voters care more about CSR. As hypothesized, the outcomes of the IV regression are consistent with the initial findings.

3.5 Hypothesis Development

To reiterate, McWilliams and Siegel (1999) as well as Oikonomou, Brooks and Pavelin (2012) argue that there exists a positive relationship between R&D expenditures and sustainability. In parallel, Chan, Lakonishok and Sougiannis (2001) and Porter (1992) suggest positive relationships between R&D- and capital expenditures and investment horizon. Further, Boubaker et al. (2017) and Glossner (2019) advocate a positive association between investor horizon and sustainability, which arises from the long term institutional owners' enabling and requirement of companies' investments in long term assets. Finally, Brealey, Myers and Allen (2019) explain that investment commitments and time horizon are two important determinants of beta, where both exhibit a positive relationship. In aggregate, there are reasons to believe that enhanced sustainability will, through investment commitments and investment horizon, have a positive impact on the systematic risk of companies. This leads to the formulation of the study's hypothesis that will be employed throughout the models: increased sustainability, through its effect on investment commitments and investment horizon, has a positive effect on systematic risk.

4 Methodology

4.1 The Method in General

The study is based on a quantitative method running a fixed effect OLS regression model. The dependent variable of the regression model is systematic risk, beta. The variable of interest in the model is an interaction term between the companies' ESG score and a proxy for the companies' investment commitments and investment horizon. The proxy equals the sum of the companies' R&D expenditures and capital expenditures, scaled by their revenue. We argue that when these financial metrics are scaled by revenue, they are indicative about the companies' relative investment commitments as well as their relative average project time-horizon. Further, the regression model controls for other relevant variables to minimize the risk of an endogeneity problem. Additionally, time fixed effects and firm fixed effects are leveraged, with the effort to remove as much potential endogeneity as possible in the models, including industry specific effects. Aspiring for complete transparency and comprehensiveness, the tables disclose the results from four models. One including time fixed effects and company fixed effects, one including only company fixed effects, one including only time fixed effects, and one excluding any fixed effects. Further, variables with infrequent data reporting are lagged as the information must be known to investors in order to be impactful. Finally, the estimated slope coefficient of the interaction term is studied to assess our hypothesis. Depending on the outcome of its direction and statistical significance, we can elaborate further on higher investment commitments and a longer investment horizon as two potential forces arising from a higher degree of sustainability, having a positive impact on the systematic risk.

4.2 Variable Selection

As already established, the dependent variable of the regression model is systematic risk measured as beta, i.e. the percentage change in the company's stock price given a percentage change in the market.

In order to test our hypothesis, that a higher degree of sustainability comes with higher investment commitments and a longer investment horizon, and that these effects in their turn increases the systematic risk, an appropriate independent variable needs to be constructed. Based on the literature reviewed in section 3.2, the companies' R&D- and capital expenditures are used as a proxy for their investment commitments and investment horizon, i.e., the higher the expenditures the higher the investment commitments and the longer the investment horizon. Naturally, these metrics are highly dependent on the companies' size and conditions to make such investments, why the sum of the expenditures are scaled by revenue. This ratio is referred to as $Investments$. As we are studying the effect of this variable, only as a consequence of the effect from sustainability, an interaction term between ESG and $Investments$ is constructed, named $ESG{\times}Investments$. The variable ESG reflects the companies' ESG score reported by Refinitiv Eikon. Refinitiv's scoring system involves the collection and standardization of over 630 ESG measures covering ten main themes that encompass various aspects of ESG, which are sourced from company-reported data. The scoring process prioritizes industry-based relative performance, while accounting for the most significant industry metrics and minimizing potential biases related to company size and transparency. For a more thorough explanation of Refinitiv's ESG scoring system, see Appendix B. $ESG{\times}Investments$ and ESG are lagged by one year because ESG data are in the majority of cases updated annually in line with the companies' own ESG disclosure (Refinitiv, 2022). $ESG{\times}Investments$

constitutes the main independent variable while *Investments* and *ESG* are utilized as control variables. As a control variable, *Investments* is intended to capture the effect from product differentiation in accordance with Albuquerque, Koskinen and Zhang (2019), and is consequently not lagged by one period. *ESG* is predominantly employed as a control variable in order to facilitate comparisons to prior literature in the field.

Based on prior studies using systematic risk as the outcome variable and the availability of data, the following additional control variables have been identified and selected:

1. Financial leverage, because an excessively high level of financial leverage may lead to difficulty in meeting its creditors demand. Further, the higher a company's debt, the higher the volatility in the earnings (Oikonomou, Brooks & Pavelin, 2012). By controlling for the financial leverage, an analysis of the underlying asset risk independent of the companies' capital structure is enabled.

2. The market to book value ratio, because companies' with higher market to book value ratios are perceived to have stronger future prospects. These prospects may lead to greater variability in profitability and market performance and are thus considered to be more risky investments (Oikonomou, Brooks & Pavelin, 2012).

3. The dividend yield, as it can be thought to have a signaling effect of the management's perception of the uncertainty of future earnings (Oikonomou, Brooks & Pavelin, 2012). In other words, it can be argued that firms with a high dividend yield experience less volatile cash flows, and thus are less cyclical. This variable is lagged by one year as the dividends predominantly are decided annually.

4. The logarithm of market capitalization, because larger companies have a lower

probability of default and are generally thought of as being less risky. In line with prior studies, the logarithm is used to correct for the skewness of the measure (Oikonomou, Brooks & Pavelin, 2012).

4.3 Model Specification

Our main model specification is as follows:

$$Beta_{i,t} = \beta_1 L.ESG{\times}Investments_{i,t} + \beta_2 Investments_{i,t} + \beta_3 L.ESG_{i,t} +$$
$$\beta_4 Leverage_{i,t} + \beta_5 MTB_{i,t} + \beta_6 L.Div_{i,t} + \beta_7 lnMcap_{i,t} + \delta_t + \alpha_i + \epsilon_{i,t},$$

where "$L.$" means that the variable is lagged by one period.

4.4 Standard Errors

Since we are using panel data, a reasonable assumption is that there exists intersectional dependency and cross sectional independence. Therefore, clustered standard errors are used with one cluster constituting all company-specific observations. This kind of standard error assumes that observations within a cluster exhibit correlation. Standard errors without clustering may be overly optimistic in assuming that each additional time period reduces uncertainty by adding completely new information to the model. As a result, statistically insignificant parameters can erroneously appear as being statistically significant.

5 Data

5.1 Data Collection

The number of companies for which ESG data is maintained and ESG scores are calculated is continuously expanding, partly due to a broader universe of companies disclosing ESG information, and partly due to increased coverage. This makes recent years a more convenient period in terms of available observations. An optimal balance between a broad time window and the number of unique companies with exhaustive data points is decided at the time period 2018-2022.

There are numerous arguments to why US listed companies constitute the most appropriate sample group. Firstly, there is a high number of listed companies, in fact 13 266 according to Refinitiv Eikon. Secondly, the disclosure of metrics like ESG score and R&D expenditures is more extensive than in other markets. Thirdly, the American equity markets are the most important and relevant in the world economy. Lastly, given the purpose of this study, to complement existing research in the scope of sustainability and systematic risk, using US companies as a sample group in line with prior studies is a prerequisite for making comparisons meaningful. Table A in the appendices gives a brief description of the collected data and the manually constructed variables.

5.2 Sample Construction

The initial sample consists of 13 266 unique companies. However, a large majority of them do not have exhaustive data points. There are multiple reasons to this. Not every company is included in Refinitiv Eikon's ESG score coverage during the whole time period. Some companies lack data on R&D expenditures, probably because of their imperfect disclosure of financial information. Some companies have simply not existed and/or have not been listed as a public company during the whole time period. All companies with missing values are removed from our data set, leaving us with 399 unique companies. In order to construct the variable *Investments*, due to the nature of mathematics, all companies without revenue in any of the five years have to be dropped, which results in a final sample of 386 unique companies over a five-year time horizon. Worth noting is that the described actions, above all, removes smaller companies rather than larger companies from the data set, which could be used as an argument to that our sample is biased. This is discussed further in section 5.3. Further, as three variables are lagged in the model, the first time period is excluded apart from being employed for the lagged variables in the second time period, yielding a total of 1 544 observations instead of 1 930 observations.

Revisiting Taleb's (2008) quote on outliers: "Can you assess the danger a criminal poses by examining only what he does on an ordinary day? Can we understand health without considering wild diseases and epidemics? Indeed the normal is often irrelevant." In his book about the term "Black Swan", Taleb presents two possible approaches to extreme events. One is to rule out the extraordinary and only consider the "normal". Another approach is to recognize that in order to understand a phenomenon you need to consider the extremes. Put simply, Taleb argues that you cannot credibly study a phenomenon while excluding outliers as they contain valuable information, as long as they are not measurement errors.

Given the reasoning made by Taleb, we argue that no further cleaning of the data is necessary as we do not have reasons to believe that the outliers constitute measurement errors. As such, there is no reason to suspect that the data points are not genuine and should not be included in the model. Instead, to investigate the impact from outliers, we conduct a robustness check that performs winsorizing, i.e.

replacing extreme values with less extreme values. A second robustness check that takes the logarithm of variables with a skewed distribution is also performed, which is not done prior to the main model in order to remain in line with existing literature. To strengthen our argument that the outliers are genuine and not measurement errors, all observations of the dependent variable *Beta* outside of the first and 99th percentile are sanity checked by comparing the data points to an alternative source. Out of these 40 observations, 39 of them strongly align between Refinitiv Eikon and Capital IQ, while one deviates between the sources. According to us, this argues for the inclusion of outliers in the principal model given their indicated precision.

5.3 Descriptive Statistics

The aggregated market capitalization for the sample companies in 2018, 2019, 2020, 2021, and 2022 corresponds to approximately 37%, 43%, 49%, 48%, and 45% of the total market capitalization of public US companies in each year respectively, according to data provided by Siblis Research (2023). As almost half of the value of US companies are represented in the data set, we argue that it provides a robust reflection of the underlying population from a macro perspective. However, as noted in section 5.2, the actions taken to clean the data primarily removes smaller companies from the data set. Firstly, they tend to disclose less financial information and are subject to less external ESG data coverage (in this case from Refinitiv Eikon), and thus exhibit more missing values. Secondly, the companies without revenue are essentially early stage research companies, which are also small in this context. This raises a potential concern of the final sample being biased as it does not contain a substantial number of observations of smaller companies. In fact, this concern is confirmed when comparing the minimum value of the market capitalization for each year in the data set to the distribution of the underlying population. The minimum value in our sample approximately corresponds to the 45th, 45th, 53rd, 48th, and 49th percentile of the underlying population in 2018, 2019, 2020, 2021, and 2022 respectively. In all essence, this means that almost the entire smaller half of all US listed companies are unrepresented in the final sample, which will be critical to consider in the analysis. However, this sampling bias is not unique to this study but rather a repeated issue within the research field of ESG, exemplified by Landi et al. (2022) who exclusively, as well as Oikonomou, Brooks and Pavelin (2012) who primarily, draw samples from the S&P 500. All in all, it is an issue we cannot reject, but one that dominates the existing literature in the subject. Table 1 gives an overview of the data of the collected and constructed variables.

Table 1: Overview of variable data.

Variable	**Observations**	**Mean**	**Standard Deviation**	**Min**	**Max**
Beta	1,930	1.2445	0.5773	-0.6166	6.8505
ESG×*Investments*	1,930	24.3391	139.9870	0	2,976.5450
Investments	1,930	0.6910	4.8309	0	107.8021
RD (M USD)	1,930	974	3,737	0	73,213
Capex (M USD)	1,930	886	3,411	0	63,645
Revenue (M USD)	1,930	11,240	35,009	0.8140	513,983
ESG	1,930	51.9771	20.0743	0.9136	94.7901
Leverage	1,930	1.0480	3.3733	0	100.3306
MTB	1,930	7.4805	31.6906	0.0191	1,290.7200
Div	1,930	0.0111	0.0165	0	0.1787
Mcap (M USD)	1,930	45,885	172,881	34	2,901,645
lnMcap	1,930	22.9757	1.6372	17.3457	28.6963

Table 1 provides descriptive statistics of our variable data, including the number of observations, mean, standard deviation, minimum-, and maximum value. All variables used in the principal model and the underlying metrics are presented. See Appendix A for variable definitions.

6 Results

6.1 Principal model

The results across all four models from regressing our constructed variable $ESG{\times}Investments$ on $Beta$, including all control variables outlined in section 4.3 are presented below in table 2. This provides an indication of whether a higher degree of sustainability, through investment commitments and the investment horizon, increases the systematic risk.

Table 2: Regression of $ESG \times Investments$ on $Beta$.

	Beta (1)	Beta (2)	Beta (3)	Beta (4)
$L.ESG \times Investments$	0.00024***	0.00027***	0.00005	0.00006
	(0.00007)	(0.00007)	(0.00013)	(0.00013)
$Investments$	0.01031**	0.01067**	0.00604*	0.00580*
	(0.00419)	(0.00440)	(0.00342)	(0.00331)
$L.ESG$	0.00331*	-0.00251*	-0.00175	-0.00263*
	(0.00174)	(0.00152)	(0.00157)	(0.00147)
$Leverage$	0.02027	0.01376	0.02628	0.02410
	(0.01712)	(0.01758)	(0.01845)	(0.01849)
MTB	-0.00115	-0.00082	-0.00169	-0.00160
	(0.00111)	(0.00114)	(0.00116)	(0.00116)
$L.Div$	1.75754*	3.06617***	1.86501	2.54780*
	(0.94111)	(0.83949)	(1.63996)	(1.53431)
$lnMcap$	-0.04192	-0.03408	-0.06593***	-0.06079***
	(0.06391)	(0.05390)	(0.01954)	(0.01908)
$Constant$	2.05343	2.10017*	2.83926***	2.73181***
	(1.46338)	(1.25482)	(0.41941)	(0.41620)
Time fixed effects	Yes	No	Yes	No
Company fixed effects	Yes	Yes	No	No
Number of observations	1,544	1,544	1,544	1,544

Table 2 reports the results from our regressions for the principal model. The dependent variable is Beta and the main independent variable is $ESG \times Investments$*. All variables are defined in Appendix A. Clustered standard errors on company level are employed across all models and are presented in parentheses. "L." refers to a variable being lagged by one period. The symbols* *, **, *** *denote statistical significance at 10%, 5%, and 1%, respectively.*

Table 2 reveals that when using $ESG \times Investments$ and all the specified control variables, we observe a positive effect on $Beta$, significant at the 1% significance level. While the effect is rather modest, it does support our hypothesis that a higher degree of sustainability, as a consequence of investment commitments and the investment horizon, increases the systematic risk. Put in other words, the result suggests that the hypothesized relationship does exists, although having a moderate impact. In fact, the coefficient of 0.00024 indicates that when increasing the ESG score by one standard deviation, through its effect on investment commitments and the investment horizon, $Beta$ increases by approximately 0.005 unit. Given the mean of $Beta$, this corresponds to around 0.4% of the average equity risk in US firms according to our sample. The results remain intact when dropping the time fixed effects, but loses statistical significance when dropping the company fixed effects. However, before drawing any final conclusions about this relationship, complementary robustness checks to the principal model are appropriate.

6.2 Robustness Checks

Aiming to enhance the confidence of the results in section 6.1, we run two suitable robustness checks. Given the potential impact from outliers as discussed in section 5.2, a first robustness check performing winsorizing is conducted. This will provide a clarification of the outliers' impact on the result, although not making any statement about their raison d'être. Table 3 gives an overview of all variable data post winsorizing affected by the action. Note that $ESG \times Investments$ and $lnMcap$ are not winsorized on their own, but are redefined after winsorizing their underlying variables.

Table 3: Overview of variable data post winsorizing.

Variable	**Observations**	**Mean**	**Standard Deviation**	**Min**	**Max**
Beta	1,930	1.2391	0.5358	0.1558	3.0613
$ESG \times Investments$	1,930	15.2871	35.9379	0.2433	384.2115
Investments	1,930	0.3801	1.1212	0.0124	8.9106
ESG	1,930	51.9846	19.9624	13.3325	89.3930
Leverage	1,930	0.9249	1.4042	0	9.7068
MTB	1,930	6.3773	7.7425	0.4387	46.7547
Div	1,930	0.0107	0.0145	0	0.0647
Mcap (M USD)	1,930	38,648	102,172	264	778,040
lnMcap	1,930	22.9763	1.6032	19.3911	27.3800

Table 3 provides descriptive statistics of our variable data post winsorizing, including the number of observations, mean, standard deviation, minimum-, and maximum value. Only the variables winsorized, or affected from an underlying metric being winsorized are being presented. See Appendix A for variable definitions.

When comparing the data in table 3 to the corresponding data pre winsorizing, it can be seen that, on a general level, the data set is especially subject to upper outliers. This is reflected by the fact that a clear majority of the means decrease from their initial level, and some of them drastically. Narrowing down the analysis to our key variables, all negative observations of $Beta$ are adjusted to 0.1558, and the maximum value has decreased from 6.8505 to 3.0613. Further, the mean of $ESG \times Investments$ has decreased substantially from 24.3391 to 15.2871 as a result of the adjustment of the upper outliers of $Investments$, with a reduced maximum value from 107.8021 to 8.9106. The effect on the reduction of $ESG \times Investments$ sourcing from ESG on the other hand can be regarded as negligible. Using the winsorized variables, four in other ways identical regression models are presented in table 4.

Table 4: Regression of $ESG \times Investments$ on $Beta$ post winsorizing.

	Beta (1)	Beta (2)	Beta (3)	Beta (4)
$L.ESG \times Investments$	0.00090	0.00101	0.00148*	0.00153*
	(0.00084)	(0.00091)	(0.00080)	(0.00081)
$Investments$	0.02252	0.02358	0.02835	0.02659
	(0.02925)	(0.03210)	(0.02377)	(0.02387)
$L.ESG$	0.00266*	-0.00309**	-0.00135	-0.00231
	(0.00158)	(0.00144)	(0.00155)	(0.00145)
$Leverage$	0.02416	0.01083	0.04311**	0.04028**
	(0.02061)	(0.02102)	(0.01957)	(0.01966)
MTB	-0.00098	0.00209	-0.00611*	-0.00565*
	(0.00323)	(0.00325)	(0.00338)	(0.00336)
$L.Div$	0.13445	2.13079	-0.02420	0.88926
	(1.41169)	(1.36841)	(1.82395)	(1.74299)
$lnMcap$	-0.00640	-0.02323	-0.05075***	-0.04649***
	(0.04937)	(0.04604)	(0.01728)	(0.01703)
$Constant$	1.27730	1.85776*	2.48226***	2.38223***
	(1.14762)	(1.07387)	(0.36215)	(0.35934)
Time fixed effects	Yes	No	Yes	No
Company fixed effects	Yes	Yes	No	No
Number of observations	1,544	1,544	1,544	1,544

*Table 4 reports the results from our regressions for the first robustness check. The dependent variable is Beta and the main independent variable is ESG×Investments. All variables are defined in Appendix A. Clustered standard errors on company level are employed across all models and are presented in parentheses. "L." refers to a variable being lagged by one period. The symbols *, **, *** denote statistical significance at 10%, 5%, and 1%, respectively.*

Consistent with the principal model, table 4 reveals that even after redefining outliers, we can observe a positive effect from $ESG \times Investments$ on $Beta$. In fact, the magnitude of the effect is severely stronger post winsorizing, indicating an enhancement of our hypothesis. However, no such conclusion can be drawn as the coefficient no longer is significant. This finding provides the insight that the significance partly is driven by the outliers. In contrast to the principal model, only the models excluding company fixed effects exhibit statistical significance post winsorizing. The implications of the differing results and significance levels between the regression model pre winsorizing and post winsorizing, as well as the justification of including the outliers or not, will be further discussed in section 7.1.

A second robustness check, paying attention to the skewness of multiple variables in the data set by deriving their logarithm is run. This allows a complementary analysis as the data is log-normally distributed, reducing the impact of skewness and linearizing relationships. As mentioned in section 5.2, this is not done prior to the principal model except for market capitalization for the purpose of remaining in line with existing literature, assuring the comparability to it. The skewed variables are $ESG \times Investments$, $Investments$, $Leverage$, MTB, and Div, i.e. all financial variables except $Beta$. Persistent with the first robustness check, $ESG \times Investments$ is not reconstructed directly, but in this case the product of ESG and the natural logarithm of $Investments$. Note that, as some of these variables contain observations with the value zero, missing values are generated when deriving the logarithm, diminishing the power of the model. Table 5 presents an overview of the logarithmized variables, clarifying the impact from the re-expression of them.

Table 5: Overview of variable data post logarithmizing.

Variable	**Observations**	**Mean**	**Standard Deviation**	**Min**	**Max**
Beta	1,930	1.2445	0.5773	-0.6166	6.8505
lnESG×Investments	1,929	-102.8054	71.4192	-417.3875	157.6895
lnInvestments	1,929	-1.8818	1.1573	-9.9874	4.6803
ESG	1,930	51.9771	20.0743	0.9136	94.7901
lnLeverage	1,703	-0.6427	1.4856	-9.7606	4.6085
lnMTB	1,930	1.4066	0.9528	-3.9594	7.1630
lnDiv	1,003	-4.1719	0.9520	-13.5055	-1.7219
lnMcap	1,930	22.9757	1.6372	17.3457	28.6963

Table 5 provides descriptive statistics of our variable data post logarithmizing, including the number of observations, mean, standard deviation, minimum-, and maximum value. For clarity, all variables going in to the second robustness check, logarithmized or not, are being presented. See Appendix A for variable definitions.

In line with one of the targeted consequences, table 5 demonstrates that the standard deviation of the logarithmized variables decreases substantially. Additionally, it confirms that the logarithmizing of skewed variables generates missing values. More specifically, due to the number of companies without any dividends, the variable $lnDiv$ generates 927 missing values. We argue that the model therefore is better optimized by not replacing Div by $lnDiv$ because the drawback, losing approximately half of the observations, clearly outweigh the benefit of doing so. Instead, Div will be replaced by a dummy variable, $dDiv$, with value 1 for all observations with dividends and value 0 for all observations without dividends, still neutralizing the impact from skewness in the underlying data. Consequently, the model is specified as follows:

$$Beta_{i,t} = \beta_1 L.lnESG \times Investments_{i,t} + \beta_2 lnInvestments_{i,t} + \beta_3 L.ESG_{i,t} + \beta_4 lnLeverage_{i,t} + \beta_5 lnMTB_{i,t} + \beta_6 L.dDiv_{i,t} + \beta_7 lnMcap_{i,t} + \delta_t + \alpha_i + \epsilon_{i,t}.$$

The regression model based on the above specification, as well as the complementary less constrained models, are presented in table 6.

Table 6: Regression of $lnESG \times Investments$ on $Beta$.

	Beta (1)	Beta (2)	Beta (3)	Beta (4)
$L.lnESG \times Investments$	0.00029	0.00101	0.00083	0.00096
	(0.00086)	(0.00093)	(0.00101)	(0.00101)
$lnInvestments$	-0.12577**	-0.10891*	0.02014	0.01308
	(0.06168)	(0.06060)	(0.05239)	(0.05115)
$L.ESG$	0.00393	0.00078	0.00154	0.00096
	(0.00269)	(0.00268)	(0.00288)	(0.00281)
$lnLeverage$	0.01715	0.01723	0.05586***	0.05655***
	(0.01889)	(0.01937)	(0.01569)	(0.01560)
$lnMTB$	0.01360	0.03822	-0.14123***	-0.13879***
	(0.04825)	(0.04833)	(0.04007)	(0.03964)
$L.dDiv$	-0.06362	-0.06244	-0.11182*	-0.10225
	(0.07264)	(0.07390)	(0.06386)	(0.06390)
$lnMcap$	-0.09748	-0.09117	-0.05232***	-0.04674**
	(0.08698)	(0.07498)	(0.01974)	(0.01937)
$Constant$	3.10785	3.18576*	2.80263***	2.68841***
	(1.91856)	(1.65010)	(0.43122)	(0.42254)
Time fixed effects	Yes	No	Yes	No
Company fixed effects	Yes	Yes	No	No
Number of observations	1,370	1,370	1,370	1,370

Table 6 reports the results from our regressions for the second robustness check. The dependent variable is Beta and the main independent variable is $lnESG{\times}Investments$. *All variables are defined in Appendix A. Clustered standard errors on company level are employed across all models and are presented in parentheses. "L." refers to a variable being lagged by one period. The symbols* *, **, *** *denote statistical significance at 10%, 5%, and 1%, respectively.*

From table 6 we observe that, once again, the direction of our interaction variable remains as hypothesized, but it loses its statistical significance. This time, no version of the model displays statistical significance. This indicates that the skewed distribution of the independent variables, in addition to outliers, contributes to the significance in the principal model. Note that the interpretation of the coefficient changes after the re-expression of $ESG{\times}Investments$. In conclusion, the robustness checks fail to solidify our results, but on the other hand do not interfere with them.

7 Discussion

7.1 Results

The principal model suggests that there exists a slight positive relationship between sustainability and systematic risk, through its effect on investment commitments and investment horizon, supporting our hypothesis. All else equal, to be at the forefront of sustainability, companies must increase their investment commitments and investment horizon, forces increasing their systematic risk. As intended, our results provide an alternative and complementing perspective to the existing literature on the relationship between sustainability and systematic risk, compiled by Gillan, Koch and Starks (2021). Once again, it should be emphasized that our results do not argue against the general perception and empirical evidence of a negative relationship between sustainability and systematic risk, it exclusively aims to zoom in on the particular forces being investment commitments and investment horizon. Indeed, out of the coefficients on ESG showing at least a 10% significance level across our models, a majority exhibit a negative relationship to $Beta$. Our complementary findings resonate well with the proposition by Oikonomou, Brooks and Pavelin (2012) that R&D expenditures are positively correlated with corporate social performance, and that these investments constitute risky projects.

An interesting contrast to our result can be found in another hypothesis presented by Oikonomou, Brooks and Pavelin that companies utilizing renewable energy sources and ensure great quality and safety characteristics of their products and services have a lower systematic risk. These are tangible examples of desired outcomes that require higher investment commitments and a longer investment horizon, and thus according to our result should give rise to increased systematic risk. This makes us realize the importance of mentioning a distinction between the papers. This study focuses on the investment commitments and investment horizon per se, required to achieve the intended outcome. Oikonomou, Brooks and Pavelin on the other hand argue based on the scenario ex ante achieving such an outcome. In other words, it provides a more nuanced picture of the phenomenon rather than contradicting our results. A parallel to Albuquerque, Koskinen and Zhang (2019) who argue that adopting a CSR policy can either increase the systematic risk because of higher costs, or decrease the systematic risk as an outcome of greater product differentiation can be drawn.

While the two robustness checks confirm the direction of the relationship between $ESG{\times}Investments$ and $Beta$, they fail to support the outcome of the principle model as the coefficients lack statistical significance when including time fixed effects and company fixed effects. From the first robustness check, a conclusion that outliers are important observations when establishing the relationship can be made, which is in line with the rationale supported by Taleb (2010). As such, the results of the principal model should not be depressed. On the other hand, a more satisfying outcome would certainly be a significant result even post winsorizing, leaving no room for doubt. A potential explanation to the coefficient's rise in magnitude post winsorizing is the existence of outliers exhibiting an opposite relationship than the result, i.e. companies with a high value of $ESG{\times}Investments$ and low value of $Beta$, or vice versa, highlighting the presence of anomalies.

The second robustness check linearizes the relationship between variables and reduces the impact of skewness by centering the observations around its mean. Since the distribution of the concerned variables is positively skewed, in essence this primarily reduces the impact of upper outliers. Therefore, similar conclusions can be drawn again. It expresses the importance of upper outliers in the data set when establishing the relationship. Different from the principal model, the coefficient, after being divided by 100, should be interpreted as a unit change in $Beta$ after a percentage change in $ESG \times Investments$, making comparisons between the respective magnitudes pointless. In conclusion, even though the robustness checks fail to solidify our results, they certainly do not disproof them. One could justify that the principal model is the most central one and provides the most reliable examination of the relationship by arguing that the extreme observations after all are genuine and therefore should be considered. On the other hand, one could argue that the robustness checks provide more unviolated versions of our regression models as the implications are applicable on a general level and in the typical case, in contrast to the principle model being dependent on extreme observations.

7.2 Limitations

A central limitation of this study is the imperfectness of the ESG score as a measurement of sustainability. Claiming to study the impact of sustainability on systematic risk, through its effect on investment commitments and investment horizon, the success of the study is dependent on the accuracy of the ESG score as an assessment of companies' degree of sustainability. In reality, the efficiency of these assessments can be questioned. Due to its broad definition as presented in section 2.1, a company can achieve a relatively high ESG score thanks to a diverse board of governance, favorable employee relationships, or social commitments, despite extensive green house gas emissions. The question whether such a company should be regarded as sustainable is debatable. The imprecision is reflected by the ambiguity of ESG scores across different providers and the restraint of comparing the score between different years, as discussed by Stackpole (2021) and Pucker (2021). In other words, should this study have utilized ESG scores from another provider, the results could possibly have turned out differently.

Another fundamental limitation of this study is the variable *Investments*. While being carefully and consciously architected based on previous literature and the availability of data, it is in the end a proxy and by its very nature not a one hundred percent thoroughly rigorous reflection of what we intend to measure. Ideally, one would leverage the true data points for investment commitments and investment horizon. However, these data points require the access to internal company information, which would be a time consuming and inconvenient process to acquire given the number of observations necessary for a contributory study. We recognize the need for and encourage further research in the field, should accessible, more appropriate, and effective proxies closer to the underlying reality be identified. An interesting twist to our study would be to take inspiration from Boubaker et al. (2017) and Glossner (2019), taking the investor view on investment horizon rather than the company view on the matter. Such a perspective is advantageous given the, to a larger extent, established proxies available to measure investor horizon.

Further, continuing the discussion initiated in section 5.3, a third limitation lies inherent in the sample employed in our model. It should be emphasized that our results are subject to a sample bias considering that a substantial fraction of the population, being smaller companies, is left out in the final sample. We have no reason to believe that the relationship would be any different for this subpart of the population, but we remain humble in the fact that it could influence the results would they have been included in the final sample. Given the accelerating number of companies being covered by ESG score providers, it is only a question of time before a similar, complementary study can be made that covers a broader spectrum of the underlying population. Once more we call for further research adding to the understanding of this phenomenon.

Lastly, as highlighted by El Ghoul et al. (2011) there might exist a reverse causality problem between sustainable activities and the cost of equity. In our case this corresponds to a scenario where a company with a higher systematic risk chooses to enhance their sustainable practices, leading to increased investment commitments and a longer investment horizon. Given the consensus that a higher level of sustainability decreases systematic risk, we cannot rule out such actions taken by managers in order to enhance the value of the company. Despite this potential, according to us the chain of logic assumed throughout our study is the more probable one. Additionally, Albuquerque, Koskinen and Zhang (2019) sheds light on the risk of endogeneity from the access to financial resources and effort of differentiation. R&D- and capital expenditures might, apart from investment commitments and investment horizon, reflect the companies' engagement to differentiate themselves as part of their strategy, adding noise to our model. Building on the relationship suggested by Gillan, Koch and Starks (2021), that sustainable companies through a product differentiation strategy diminishes the systematic risk, it would cause an underestimated magnitude of the coefficient on $ESG \times Investments$. However, we argue that this effect is absorbed by the control variable $Investments$, eliminating such concerns in our models.

8 Conclusion

We attempt to complement the existing studies examining the relationship between sustainability and systematic risk, by narrowing down the focus to the impact arising from investment commitments and investment horizon. Defining a proxy variable based on literature aimed to reflect these forces, and multiplying it by the companies' ESG score, we empirically test for this effect. Our results indicate that enhancing sustainability, through higher investment commitments and a longer investment horizon, slightly inflates the company's systematic risk. Disappointingly, our results are neither reinforced after winsorizing or after logarithmizing skewed variables, why no such general conclusions can be drawn.

Given the indication of our results, a more comprehensive and informed approach by investors and corporate managers to the integration of sustainability in their decision making is enabled. While on aggregate decreasing the systematic risk and consequently enhancing the firm value, this effect could to a slight extent be offset by the requirement of increased investment commitments and a longer investment horizon. These insights help provide a clearer picture of a concept not yet, par excellence, serving the Paris Agreement. The need for urgent action, together with the fact that we cannot confidently establish the indicated results, or rule out our results being driven by our limitations, argue for the need of further research looking beyond the one dimensional relationship between sustainability and systematic risk to exhaustively map the phenomenon.

In conclusion, our findings contribute to the existing work on sustainability and systematic risk. We observe an indication of the fact that sustainability, through its effect on investment commitments and investment horizon, increases companies' systematic risk. In other words, a greenfee of beta does seem to exist, but the question requires further examination for a definite answer.

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Appendices

A Description of variables

Table A: Variable definition and construction.

Variable (name in code)	**Definition**	**Source**
Levered Beta (*Beta*)	Covariance between security and market.	Eikon
ESG Score (*ESG*)	See Appendix B.	Eikon
Total Debt to Total Equity, Percent (*Leverage*)	$\frac{Total\ debt}{Total\ equity} \times 100$	Eikon
Price to Book Value per Share (*MTB*)	$\frac{Closing\ price}{Book\ value\ per\ share}$	Eikon
Dividend Per Share Yield % (*Div*)	$\frac{Dividend\ per\ share\ mean\ estimate}{Price}$	Eikon
Company Market Cap (*Mcap*)	Aggregated market value for all share types.	Eikon
Research and Development (*RD*)	Expenses for research and development.	Eikon
Capital Expenditures, Discrete (*Capex*)	Sum of purchase of fixed assets, intangibles, and software development costs.	Eikon
Total Revenue (*Revenue*)	Revenue from all operating activities.	Eikon
Log Market Cap (*lnMcap*)	The natural logarithm of *Mcap*.	-
Proxy for investment commitments and investment horizon (*Investments*)	$\frac{(RD+Capex)}{Revenue}$	-
Interaction of ESG and proxy variable ($ESG{\times}Investments$)	$ESG \times Investments$	-
Dividend dummy variable (*dDiv*)	Value 1 for all observations with dividends, value 0 for all observations without dividends.	-

B ESG Score

Table B: Overview of Refinitiv's ESG score.

Source: Refinitiv, 2022.

Pillar	**Category**
Environmental	Resource use
	Emissions
	Innovation
Social	Workforce
	Human rights
	Community
	Product responsibility
Governance	Management
	Shareholders
	CSR strategy

Table B provides an overview of the construction of the ESG score and its three pillars. Refinitiv collects and calculates over 630 company-level ESG measures. The process is entirely automated, data driven, and characterized by transparency, thereby ensuring its objectivity, and eliminating hidden calculations or inputs. The 186 most comparable and material measures per industry constitute the foundation of the overall company assessment and scoring process. In turn, they are grouped into 10 categories that formulate the three pillar scores (environmental, social, and corporate governance) and the total ESG score. The final ESG score is a weighted sum of the three pillars, where the weights from environmental and social vary per industry, while the weight from corporate governance is constant across all industries (Refinitiv, 2022).

The score ranges from 0 to 100, where the least sustainably performing companies, laggards, are assigned a score in the first quantile from 0 to 25. Scores within this range indicates that the company has a poor relative ESG performance, and that their transparency in reporting ESG data is insufficient. On the other side of the spectrum lies the leaders in the fourth quantile from 75 to 100. This indicates an excellent relative ESG performance and a high degree of transparency in reporting ESG data. The score also provides the foundation to letter grades ranging from D- to A+ (Refinitiv, 2022).