UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

The impact of ESG during COVID-19

A quantitative study targeting ESG and stock returns on the Swedish stock market during COVID-19

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Abstract

In this thesis, we study whether ESG has a positive effect on stock performance during COVID-19, based on a sample of 153 listed firms in the Swedish stock market. We follow a Best-in-Class ESG screening strategy and compare the performance differences between the top and bottom ESG portfolios during 2019-2020. We do not find any statistically significant difference in raw returns and risk-adjusted returns between the top and bottom portfolios in the crash window. However, we find a significant negative difference in raw returns between the top and bottom portfolios in the pre-crash and recovery period. Moreover, we shed light on the impact of ESG and its pillars in explaining industry returns, by adding an ESG factor to the Fama-French three-factor model. We find that ESG impact tends to vary between sub-periods and across industries. Additionally, the Environmental and Governance pillars can be seen as the two primary pillars to affect the industry returns but in opposite directions.

Keywords: Environmental, Social and Governance (ESG), ESG Ratings, Socially Responsible Investments (SRI), COVID-19, Sweden

Acknowledgements

Before we express our gratitude, we would like to begin this thesis with a playful joke, to lighten up the mood in times of a pandemic.

Question: What kind of debt did the secret agent issue?

Answer: A bond, James Bond

Firstly, we would like to extend our gratitude to our supervisor, Dawei Fang, who guided, supported and provided valuable insight throughout our thesis work, even during these concerning times of COVID-19. Secondly, we would like to thank Adam Farago for devoting his time and help us find factor data for our regression models. Lastly, as we are approaching the last month of our master studies, we would like to express our appreciation to Gothenburg School of Business, Economics and Law for five rewarding years.

Gothenburg, 2021-06-21

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1. Introduction

As of 4 June 2021, there are over 170 000 000 worldwide related COVID-19 cases, and almost 3 600 000 deaths. In Sweden, the first case was reported on January 31, 2020, and currently, there are over 1 068 000 confirmed cases (WHO, 2021). The pandemic is arguably the largest social and economic crisis the world has witnessed since World WAR II outbreak (Diaz, Ibrushi and Zhao. 2020). The financial markets, policymakers, firms and investors have all been strongly affected by the global outbreak. Simultaneously, Environmental, Social and Governance (ESG) investment strategies (e.g., exclusion of certain stocks due to ethical or moral reasons), have gained popularity in recent years, not least during the pandemic, with high stock volatilities. According to Pagano, Sinclair and Yang (2018), the value of ESG investments in global markets has 15-folded between 2006 and 2016, where the net value of USD 4 trillion has increased to remarkably USD 60 trillion. At the end of 2019, the sustainable market for the five major markets (i.e., US, Europe, Japan, Canada, Australia) accounted for over USD 30 trillion, where the European Union leads with USD 14 trillion assets committed (Bialkowski and Stark, 2016; GSIA, 2018; OECD, 2020). Further, Libby and Carré (2020) estimate that the European ESG market will grow with a 13% Compound Annual Growth Rate (CAGR) between 2019 and 2025.

Previous academic studies have found mixed results on the relationship between a firm's ESG score and its stock performance. Some researchers have found a positive relationship (e.g., Kempf and Osthoff, 2007; Statman and Glushkov, 2009; Derwell, 2005; Edmans, 2011). By contrast, others find negative (e.g. Adler and Kritzman, 2008; Renneboog, Ter Horst and Zhang, 2008b), or insignificant or mixed results (e.g. Halbritter and Dorfleitner, 2015; Friede, Bush and Bassen, 2014; Lins et al. 2017). Nonetheless, there is a consensus among the majority of these researchers that the outcome is heavily influenced by the providers of the ESG scores, as well as the applied screening strategy.[1] Considering the ambiguity in empirical ESG literature, the question that follows is whether ESG has a positive effect on portfolio returns during COVID-19?

Moreover, the COVID-19 global pandemic has reopened the debate amongst researchers regarding ESG stock performance during market crises. As previous studies, before and during

[1] A screening strategy is when an investor either excludes certain industries and companies due to ethical reasons (e.g. negative screening) or picks companies based on their Environmental, Social and Governance practices (e.g. positive or Best-in-Class screening) (Hudson, 2006).

COVID-19, are mainly limited to US data and investigate performance differences in ESG funds, only a few have focused on performance differences between ESG stocks. This opens the path for further research focusing on other markets, such as Sweden, considering Sweden being one of the leading countries in ESG investing (Schieler, 2020). In this thesis, we aim to expand the current body of ESG literature by investigating whether ESG has a positive effect on portfolio returns during COVID-19 and answering the research questions of whether there is a significant difference in raw return and risk-adjusted return between high and low ESG scoring stocks. Additionally, expanding the three-factor model with a new ESG factor, as the difference in return between top and bottom portfolios, we examine if any differences in ESG can be attributed across industries, and if so, which of the three pillars of ESG is the main driver of industry returns.

With this in mind, our thesis aims to contribute to the ESG literature with new useful data analyzing ESG investment practices in Sweden by investigating performance differences between high and low ESG scoring stocks. To the best of our knowledge, no previous study has examined the performance of ESG stocks on the Swedish market during the COVID-19 pandemic. Additionally, by investigating the impact of ESG and each pillar --- Environmental, Social and Governance --- across industries, we contribute to academic literature where current literature is lacking. Moreover, we believe that the adopted methodology and research analysis will be of high relevance and interest to long term investors, asset managers and researchers in the field of sustainable finance. In addition, our thesis distinguish itself from existing literature by being one of few studies examining the performance of ESG stocks built upon the classic three-factor model by introducing an additional ESG factor as a potential risk factor.

We examine 153 Swedish public firms with available ESG scores from Refinitiv Eikon (Thomson Reuters) during 2019-2020. The sample period is divided into three sub-periods, covering a pre-crash, crash and recover period. More specifically, the sample period starts from January 7, 2020, the first trading day after the first global COVID-19 case according to World Health Organization (WHO, 2020), until January 5, 2021. In addition, we examine 2019 in order to compare with normal market condition. Using daily data, we construct two value-weighted portfolios, a top ESG portfolio and a bottom ESG portfolio. Because ESG scores are highly correlated with industry, to disentangle the ESG effect from the industry effect, we sort the firms into two portfolios based on the percentile ranking of a firm's ESG score within its industry. If a firm's ESG score is ranked within the top half within its industry, we assign the firm to the top portfolio. Otherwise, we assign it to the bottom portfolio. By construction, the two portfolios have very similar number of firms (78 firms for the top portfolio vs 75 firms for the bottom portfolio) and roughly the same industry representation.

By applying the Fama-French three-factor model and testing return performances and risk-adjusted return performances with paired t-tests, we do not find any statistically significant differences in return and risk-adjusted return between the top and bottom portfolios in the crash window. However, we find a significant negative difference in raw returns in the pre-crash and recovery period between the top and bottom portfolios. Further, a significant negative difference in risk-adjusted return is only obtained in the recovery period. Moreover, built upon the Fama-French three-factor model, we construct an additional ESG factor as the return difference between top and bottom portfolios. In addition to the initial risk factors, our ESG factor enables us to significantly explain industry returns. We identify that ESG significantly explains industry returns, although, the ESG impact tends to vary between sub-periods and across industries. Additionally, the Environmental and Governance pillars can be seen as the two primary pillars to affect the industry returns but in opposite directions.

The remainder of the thesis has the following structure: (I) presenting a literature review of existing ESG studies, (II) presenting a background of socially responsible investing and the ESG phenomenon, (III) presenting relevant theories and the development of research questions, (IV) elaborating on the applied methodology used for our research questions, (V) presenting, analyzing and discussion our descriptive and empirical results (VI) and finally presenting a summary and conclusion together with suggested future research.

2. Literature Review

2.1 ESG studies prior to COVID-19

Although being a well-researched academic topic, the various results proceed the academic and social debate. The vast majority of existing literature presents a positive relationship between ESG score and firm performance.[2] Friede, Bush and Bassen (2015) reviews the findings from 2200 empirical studies since 1970. The authors conclude that roughly 50%, 40% and 10% of studies find a positive, neutral, or negative[3] relationship between a firm's ESG score and financial performance. Further, the authors report the Environmental and Social pillar as the most and least favorable pillar in terms of explaining financial performance. Kempf and Osthoff (2007) examine the relationship of U.S. equity portfolios with different ESG strategies

[2] See Appendix 1 for a full summary of literature examining the relationship between ESG and Stock Performance prior to COVID-19.
[3] A majority of the negative ESG effect stems from equity-linked studies (Friede, Busch and Bassen, 2015).

between 1991 and 2004. The authors conclude that investor can achieve their sustainability goals without sacrificing financial performance since sustainable portfolios yielded a noticeable higher abnormal return. On the contrary, Kemp and Osthoff (2007) find that low sustainable rated companies suffered a significant performance loss, possibly caused by market mispricing. A confirmative study by Derwall *et al.* (2005) suggests that "eco-efficient" labeled companies outperform less eco-efficient companies over the 1995-2003 period.

As opposed to previous literature (e.g. Kempf and Osthoff, 2007; Derwall, 2005), Halbritter and Dorfleitner (2015) cannot confirm a positive relationship between ESG score and stock performance. The authors do not find any significant returns differences between high and low ESG rated companies, which also applies to the Environmental, Social and Governance pillars. Hartzmark and Sussman (2019) examine a shock equivalent to 40% of the NYSE market cap and do not find any evidence of high-rated sustainable funds outperforming low-rated ones. However, they argue that ESG will assure a better risk-adjusted return. These results are in line with Nofsinger and Varma (2014), revealing that SRI mutual funds focusing on ESG issues outperform conventional funds in crisis periods. Nonetheless, the reduced downside risk comes at the cost of underperforming in non-crisis periods. Similar to Nofsinger and Varma (2014), Renneboog, Ter Horst and Zhang, (2008b) document that investors pay a price for ethics. SRI funds fail to exhibit superior alphas and strongly underperform their domestic benchmark portfolio. In addition, the authors cannot find any statistical evidence of underperformance compared to match conventional funds.[4] Callahan (2019) investigates the relationship between industry returns and ESG scores and notes that ESG stock selection may contribute to superior performance. Howbeit, 80% of the performance could be attributed to sector selection.[5] Further, Callahan (2019) suggests that managers manage their portfolio in line with current market themes and conditions due to lack of variation in ESG rating across industries.

2.2 ESG studies during COVID-19

Existing studies focusing on COVID-19 provide mixed evidence of whether ESG has a positive effect on portfolio returns.[6] Both Broadstock *et al.* (2020) and Diaz, Ibrushi and Zhao (2020) find empirical evidence that high ESG stocks significantly outperform low ESG stocks during

[4] Except for Sweden, France, Ireland, and Japan (Renneboog, Ter Horst and Zhang, 2008b).
[5] ESG stock performance was assisted by industry tilts since the study occurred in a bull market. Tilts towards economically sensitive and cyclical sectors (i.e., Technology, Consumer Discretionary) proved to be beneficial. Hence performance was attributed to sectors rather than particular stocks (Callahan, 2019).
[6] See Appendix 2 for a full summary of literature examining the relationship between ESG and Stock Performance during COVID-19.

the COVID-19 pandemic.[7] Broadstock *et al.* (2020) and Ferriani and Natoli (2020) also document that investors with high-ESG stocks tend to be more patient and generally hold their stocks to avoid losses during the pandemic, therefore used as a valuable hedge during COVID-19. Additionally, the authors provide evidence that an ESG investment strategy is useful to earn superior returns, even in normal times. Similar to Callahan (2019), Diaz, Ibrushi and Zhao (2020) examine the importance of the ESG and its pillars in explaining industry returns, by integrating an ESG factor as an additional risk factor to the initial three-factor model. The researcher concludes that the impacts of ESG and its pillar vary across industries and the Environmental and Social pillar are key drivers of the observed industry returns.

On the contrary, several studies have exhibited an opposing relationship between a firm's ESG score and stock performance. Folger-Laronde *et al.* (2020) find indications of a negative relationship between sustainable exchange-traded funds (ETFs) and conventional investments. Further, Hoang *et al.* (2020) do not find evidence supporting an overperformance of stocks with high ESG scores. However, the authors concluded that firms with high ESG scores are less volatile and more resilient to extreme market shocks. Moreover, Omura, Roca and Akai (2020), offer mixed evidence on the relationship between ESG scores and stock performance during COVID-19. The authors find that SRI indices outperform conventional indices, while they fail to provide evidence of a positive relation between ESG ETFs and stock performance. Accordingly, they conclude that ESG investing is not a useful investment strategy during a market crisis. Potential reasons for the results are (I) a persistent lack of transparency among the rating providers, which makes it more difficult for investors to identify sustainable funds, and (II) ETFs are affected by the different screening strategies used by fund managers (Chatterji, Levine and Toffel 2009; Omura, Roca and Nakai, 2020).

2.3 ESG pricing

Researchers have found various evidence between a firm's ESG score and stock performance without any clarification for underlying factors. Manescu (2011) provides three scenarios that could explain the differences in stock return and risk-adjusted return between high and low scoring ESG firms. The mispricing scenario is when an ESG effect exists, but without adequate information, ESG cannot be fully incorporated into stock prices and gets mispriced (i.e., either undervalued or overvalued). Whether this mispricing translates into a higher or lower risk-

[7] Broadstock *et al.* (2020) examine the CSI300 Index using ratings provided by SynTao Green Finance, while Diaz, Ibrushi and Zhao (2020) examine the U.S market using the ESG rating from Bloomberg.

adjusted return depends on whether a firms' ESG benefits outweigh its cost or vice-versa. Being consistent with the Efficient Market Hypothesis (EMH), the no-effect scenario states that there are not any differences in risk-adjusted return between firms with high and low ESG scores. Even if ESG adds relevant information for the stock price, all available information is incorporated into stock prices and superior return can therefore not be obtained. Lastly, the risk-factor scenario suggests that low ESG firms generate higher returns but at the cost of having a premium for being exposed to non-sustainability risk.

In line with Manescu (2011), Renneboog, Ter Horst and Zhang (2008a) argues that investing altruistically by excluding certain companies to gain shareholder value in the long run, may lead to a weaker financial performance in the short run due to stock market undervaluing ESG. According to Renneboog, Ter Horst and Zhang (2008b) there are two possible explanations for the underperformance. First, stock markets may overprice companies with high ESG scores, which may derive from a reluctance towards unsustainable corporate behavior, even if the behavior is not linked with higher risk. Given the high demand and acceptance for lower returns for a sustainable firm, investors might overvalue these firms to the extent that they underperform their peers. Second, performance differences between ESG and non-ESG portfolios are driven by different riskiness that the applied models, such as Capital Asset Pricing Model (CAPM) or three-factor model, may not capture. With this background in mind, using a newly developed approach with an ESG factor together with the well-known three-factor model, we hope to provide valuable insights into the impact of ESG investing during the COVID-19 pandemic. Considering that the existing ESG literature is limited to specific asset classes and countries, new data for the Swedish stock examining equities can potentially contribute to the reopened debate of ESG and stock performance and clarify whether ESG has a positive effect on portfolio returns during COVID-19 or if it is a case of market mispricing.

3. Background

3.1 Environmental, Social & Governance (ESG)

ESG investment is an extension of the SRI approach with a particular focus on Environmental, Social and Governance factors, while SRI focuses on company values and screening out unethical companies (Syed, 2017). The roots of SRI can be traced back to the colonial era in the U.S., however, it took until the 20th century before SRI began to unfold, where mutual funds actively screened out gambling, alcohol, and tobacco investments. Over the years, SRI evolved and among others found a place in environmental and social issues, which lead to the exclusion of investing in certain stocks due to its geographical area (MSCI, 2020: Caplan *et al.*, 2013). The core idea of SRI is an investment approach and portfolio construction that attempts to exclude certain industries and companies due to ethical or moral reasons. In addition, SRI considers social and environmental aspects besides financial return. This has led to companies and investors putting considerable effort into their Corporate Social Responsibility (CSR) and investment strategies that are morally accepted (Caplan *et al.* 2013; Syed, 2017). Correspondingly, asset managers are avoiding negative externalities and thereby excluding investments in business and industries that are considered unsavory, unethical, and immoral, such as weapons, alcohol, gambling, pornography and fossil fuel (Renneboog, Ter Horst and Zhang, 2008a).

Since the turn of the millennium, the concept of SRI has experienced tremendous growth and gradually become a part of the mainstream financial sector. According to Caplan *et al.* (2013), although institutions could benefit through a negative screening in their investment, this approach is argued to be too restrictive for many investors, lowering their return due to the limited amount of available securities. Nonetheless, considering the growth of SRI, there is still a great deal of uncertainty due to the lack of a uniform definition of SRI amongst investors and researchers. According to Goy and Schwarzer (2013), there are several definitions of SRI which vary between regions, areas and countries and affect the performance accordingly.

Moreover, ESG is more action related than SRI and integrates each of the E, S and G factors into the investment analysis to the extent they are essential for the investment performance. The aim is to enhance a firm's long-term value in order to mitigate risk and identify investment opportunities. ESG investment has changed the perception and broadened the view of SRI (Syed, 2017). According to Syed (2017), companies with a focus on ESG factors are perceived as better managed, performing better while taking on less risk. Further Boffo and Patalano (2020) argues that the main driver for investors to use ESG metrics is mainly for social and moral considerations (77%), additional (14%) are considering ESG due to risk mitigation and (6%) can be attributed to investors that seeks a positive alpha.

One of many ways for investors to make use of ESG factors and incorporate these in their investment strategies is through ESG ratings or scores. There is a considerable number of practices and methodologies regarding which metric to use and how each metric should be weighted in order to calculate a fair ESG score. In the progress to further develop ESG, third-party data providers, such as Refinitiv Eikon, Bloomberg, Morningstar and MSCI have assisted with the development of a score. ESG scoring has been criticized due to the non-existence of a uniform framework designed to properly grade companies. Nonetheless, the problem lies in the adopted methodologies of these providers, which has led to firms using different methodologies resulting in a great variation in scores. Confirming study by Boffo and Patalano (2020) documents that the correlation between the scores provided by the major data providers is low. This in turn affects the investors who use the final scores to find companies that best practices ESG. Thus, different ESG score systems produce different results for investors (Boffo and Patalano, 2020; Caplan, 2013).

Table 1. Refinitiv Eikon ESG scores calculation methodology

Pillar	Category	Indicators in Scoring	Weights (%)
Environmental	Resource Use	20	11
	Emissions	28	15
	Innovation	20	11
Social	Workforce	30	16
	Human Rights	8	4
	Community	14	8
	Product Responsibility	10	5
Governance	Management	35	19
	Shareholders	12	6
	CSR Strategy	9	5
SUM		186	100

Source: Refinitiv Eikon (2021)

This thesis uses the overall ESG score provided by Refinitiv Eikon. The database covers over 9000 public companies and uses 500 different ESG measures to select the 186 most relevant fields for the overall scoring process. The overall ESG score is weighted over three pillars: Environmental (37%), Social (33%) and Governance (30%). Each pillar consists of several categories of measures and are weighted according to Table 1. As can be seen from the table, the first pillar, Environmental, describes how a firm handles issues in categories, such as resource usage, emissions, and innovation. The resource-use category refers to how and in what way a firm uses its resources, as well as the firm's ability to use more sustainable materials in its production. The emission category indicates how a company performs in terms of its caused emissions from production. In addition, it also measures the firm's willingness to reduce its existing emission levels. Innovation describes how a firm integrating or conducts new environmental solutions. The second pillar, Social, is divided into four categories (workforce, human rights, community, and product responsibility). The pillar describes sustainable choices in the social part of the organization. The workforce reflects the condition and environment for the employees. Human rights cover how the firm works towards human rights. Community shows how the firm works towards the overall society. Product responsibility describes the product's impact on customers, as well as the handling of customer privacy. The third pillar, Governance, is divided into three parts (Management, Shareholders and CSR strategy). It measures how a company follows specific practices for the management, how they treat their shareholders and how they work with a sustainable strategy including the ESG aspect. Since all three pillars have similar weights, they affect the overall score in a similar fashion.

4. Theory and Development of Research Questions

4.1 The Efficient Market Hypothesis (EMH)

Critics of ESG investing are often using the EMH as an argument. Fama (1970) proposes the basic idea that all available information should be incorporated into the stock price. If the hypothesis holds, securities are traded at fair values, and it would be impossible for investors to beat the market and earn superior returns. Any new information would directly be reflected in the stock price, which would make it impossible to beat the market (Fama, 1970).

Moreover, Fama (1970) argues that even if the hypothesis is strong, the degree of efficiency changes depending on the market situation. In order to define these degrees, Fama (1970) divided the hypothesis into three versions: Weak, Semi-strong and Strong. The weak form asserts that all market trading data (e.g., historical prices) is incorporated in the stock price. If this form holds, it would be impossible to gain superior returns by using a strategy based on historical prices. The semi-strong states that all available public information is incorporated in the stock prices. Information that is available to the public includes financial information such as ESG ratings. In other words, it would be impossible to beat the market with an ESG strategy since the stock prices would already incorporate a firm's ESG score. Additionally, a high or low score would not be an advantage for the firm if the semi-strong hypothesis holds. The strong form hypothesis states that all available information, even private information, is incorporated into the stock price. This indicates that it would be impossible to exhibit superior returns from insider trading, which is not always the case in practice (Rozeff and Zaman, 1988).

Lastly, Fama (1991) argues that there is no explicit test to determine whether markets are efficient. Instead, he suggests that several asset pricing models can be used to explain the variation in prices and the return of assets. Accordingly, these models can obtain valuable insights into how prices behave or investigate whether the information is reflected in the stock price. The three-factor model is one of the developed models and is used in this thesis, where we introduce an additional risk factor, the ESG factor, which helps us to significantly explain industry returns in addition to the Fama-French factors.

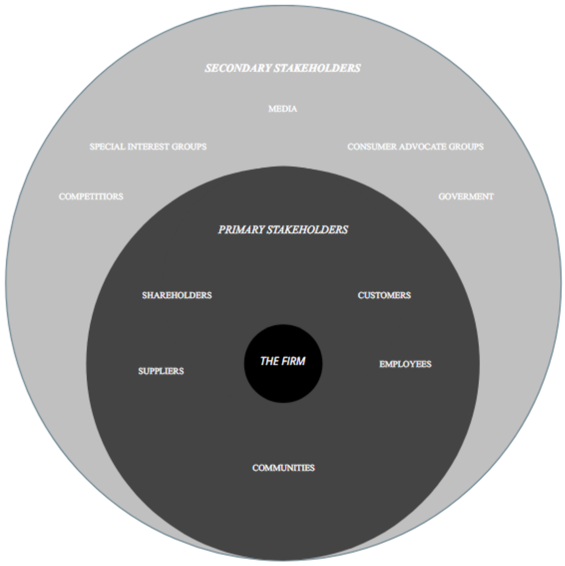
4.2 Shareholder Theory

Previous studies documenting a negative correlation between ESG scores and stock performance often refer to the Shareholder theory developed by Milton Friedman (Renneboog, Ter Horst and Zhang, 2008b; Marsat and Williams, 2013). Friedman (1970) argues that a firm should have a social responsibility to its shareholders, rather than a social responsibility to society, and further states that a firm's main goal is to maximize the profits for its shareholders, as long it conforms to the rules and regulations of society. Moreover, Friedman (1970) elaborates that this theory can lead to managers abusing their position of power and act in the interest of the shareholders rather than the overall interest of the business. As a result, the firm may avoid actions that would improve the overall value of the company or its shareholders in the long run (Friedman, 1970). However, with tighter regulations, many companies are constrained to introduce more sustainable actions and report information regarding their sustainable work in order to avoid potential fines (Scholtens and Sievänen, 2013). Providing additional information is costly, although these costs can be canceled out since the firm easily can be financed due to increased corporate disclosure (Cuadrado-Ballesteros, Garcia-Sanchez and Martinez-Ferrero, 2016). Lastly, researchers (e.g., Aureli *et al,* 2018; Lo and Kwan, 2017) documents the positive impacts of ESG reporting, where companies' ESG-activities on average increase the value for their shareholders, not only through higher financial returns.

4.3 Stakeholder Theory

Freeman (1984) along with other pioneers developed an alternative theory, the stakeholder theory, which in comparison to the shareholder theory takes more dimension into considerations. The theory explores how actors such as employees, customers and suppliers influence a firm's long-term performance. Freeman (2010) further argues that a firm creates long-term benefits by incorporating all its stakeholders and by maximizing the collective welfare for all stakeholders. In addition, Freeman (2010) states the importance of understanding a company's stakeholders and their influence, in order to create sustainable relationships and stabilize transactions between the firm and the stakeholders. To simplify this process, Freeman (2010) introduced a stakeholder map, which illustrates all these kinds of stakeholders and how they are affecting the organization. An example of a stakeholder map is illustrated in figure 1.

Figure 1. An example of a stakeholder map



As illustrated in figure 1, all stakeholders play an important role in a business; however, the primary stakeholders have a larger capability to affect the business relative to secondary stakeholders. Noteworthy is that shareholders have an internal and external interest in the business since they both act as a customer, as well as a financier to the business.

Furthermore, there is evidence that incorporating ESG can be beneficial for businesses. Berman *et al*. (1999) mention that there is a relationship between the economic performance of a business and the level of engagement with stakeholders. For a business to gain economic benefit, competitive advantage and increase in market value, businesses must take all the stakeholders into consideration (Clarkson, 1995; Fisman *et al.*, 2006). Clarkson (1995) elaborates that better ESG reporting will lead to a more efficient performance metric, i.e., ESG ratings, as stakeholder's interest in sustainable activities increases. In addition, Signori *et al.* (2021) state that ESG metrics can be used to verify a firm's social and stakeholder's responsibility. According to Sila and Cek (2017) using ESG as a strategic tool can change stakeholder's perceptions and assure that stakeholders are not affected by any activities they might perceive as unsustainable. In summary, stakeholder theory demonstrates the importance of including the interest of all stakeholders, as well as incorporating ESG as a strategic tool. Thus, efficiently managing the stakeholders will also increase shareholder value.

4.4 Development of Research Questions

Existing ESG literature builds upon the above discussed theories and their general discussion often refers to EMH and whether it is possible to generate superior returns through ESG investing. Despite the extensive research on this topic, there is still a lack of knowledge in explaining ESG and stock performance during COVID-19. More specifically, literature covering the impact of ESG explaining industry returns, especially during an economic downturn. Additionally, the existing literature is limited to only a few countries. As we address earlier, research covering the Swedish stock market is to the best of our knowledge unexplored, therefore, we pursue to fill the research gap by examining the empirical question of whether ESG has a positive effect on stock performance with the following three research questions:

I:	Is there a significant difference in the stock performance between high and low ESG scoring firms in Sweden during COVID-19?
II:	Is there a significant difference in the risk-adjusted return between high and low ESG scoring firms in Sweden during COVID-19?
III:	Can any differences in ESG be attributed across industries? If so, which of the three pillars of ESG is the main driver of industry returns?

5. Methodology

5.1 Data sampling

The thesis sample is collected using different criteria from Refinitiv Eikon. More specifically, the criteria requirements are (I) country of exchange, (II) available ESG score and (III) daily price data from January 7, 2019, to January 5, 2021. There are 900 Swedish equities available on Refinitiv Eikon, out of these only 161 equities had an available ESG score. Further, by removing stocks that do not have available pricing data for the whole period, our final data sample consists of 153 listed firms in Sweden. The sample is divided into two portfolios (see Appendix 3). The time period covering 2019-2020 is used to compare the ESG effect during COVID-19 and under normal market conditions. Using daily price data is in accordance with the methodology in previous research examining the impact of the COVID-19 pandemic (Broadstock *et al.* 2020; Omura *et al*., 2020 and Rahman *et al*., 2020). The benchmark of choice used in this thesis is the OMXSPI index which accounts for all shares listed on Nasdaq Stockholm (Stockholm Stock Exchange). Industry sector codes were also collected for each firm according to Global Industry Classification Standards (GISC). The sample of 153 firms was categorized into 10 different industry sectors. Different sectors have different numbers of firms and there are five underrepresented sectors; Energy (2), Communications (4), Technology (6), Consumer Staples (8) and Basic Materials (8). The other five sectors have at least 18 firms. All industries are included in the analysis but we take the underrepresentation of the five sectors into account when we draw conclusions. A detailed distribution of firms over different sectors can be found in Appendix 4. Moreover, to examine the ESG effect, we divided the sample period into two parts: (I) January 8, 2019 – January 3, 2020 and (II) January 7, 2020 – January 5, 2021. Further, both sample parts are divided into three sub-periods: Pre-crash, Crash and Recovery.[8] The sub-periods used in the thesis for our main analysis are defined as follows:

Pre-crash: January 7, 2020 - February 21, 2020
Crash: February 24, 2020 - March 31, 2020
Recovery: April 1, 2020 - January 5, 2021

This is in line with previous research (Broadstock *et al*. 2020; Omura et al., 2020; Ferriani and Natoli, 2020 and Folger-Laronde *et al.*, 2020). The reasoning for including the first part of our sample period is to investigate for any differences in results with the COVID-19 year. More specifically, to investigated if there are any differences in ESG investing between crisis and non-crisis periods. The sample period extends from January 7, 2020, the first trading day after the first global COVID-19 case according to World Health Organization (WHO, 2020), until January 5, 2021. In line with Ferriani and Natoli (2020), the crash period is defined as February 24, 2020 until March 31, 2020. The length of the crash period is however ambiguous and varies a lot in previous literature (March 20 – March 31, 2020). Therefore, the end date for the crash period is in this thesis set to the end of March 2020. The rest of the year is defined as the recovery period, i.e., between April 1, 2020 until January 5, 2021. Even though the pandemic has not ended, global markets have recovered from the initial market crash and can be seen as a recovery period.

5.2 Portfolio Construction

By summarizing the overall ESG scores for each industry in descriptive statistics, we could distinguish the distribution of the industry scores. Table 2 shows a clear industry bias, where some industries have a very low score in general which would have affected the overall results. We, therefore, constructed the portfolios following a Best – in – Class approach[9], suggesting

[8] Definition of the equivalent sub-periods for 2019: Pre-crash (Jan 8-Feb 21, 2019), Crash (Feb 22-Mar 29) and Recovery (Apr 1, 2019 – Jan 3, 2020)
[9] A Best-in-Class screening strategy is also used by (e.g. Kempf and Osthoff, 2007; Halbritter and Dorfleitner,2015; Derwell *et al., 2005;* Diaz, Ibrushi and Zhao, 2020).

that the best performing companies in terms of ESG score within a sector or industry are selected without any regard to the sustainability of the industry.

According to Hudson (2006), the approach can be described as a "*diversified active portfolio strategy with the aim of enhancing performance in the long run by tilting the portfolio toward strong all-round (financial and social) performers*" (Hudson, 2006, p.78).

Table 2. The descriptive statistics for industry ESG score

Industry ESG-score	Mean	Median	Minimum	Maximum	N
Basic Material	66.12	73.32	32.63	81.23	8
Comsumer Discretionary	50.78	51.48	12.30	84.35	28
Consumer Staples	58.48	59.83	40.81	76.91	8
Energy	57.29	57.29	47.65	66.93	2
Financials	44.38	42.46	3.76	78.33	18
Health Care	43.40	40.60	8.91	86.05	21
Industrial	49.17	46.61	2.30	90.19	37
Real Estate	45.78	45.46	11.10	85.72	21
Technology	37.06	46.51	3.16	54.49	6
Communications	71.93	74.17	55.25	84.13	4

Additionally, following the approach of Diaz, Ibrushi and Zhao, (2020) and Broadstock *et al.* (2020), we construct both industry-neutralized and value-weighted ESG portfolios by ranking firms according to their ESG score within each industry. Firms with a higher ESG score than the industry median belongs to the top portfolio and firms with a lower ESG score than the industry median belongs to the bottom portfolio. By doing so, regardless of whether the industry average ESG score is high or low, 50% of the firms are included in the top portfolio and 50% in the bottom portfolio. This methodology eliminates to some extent an industry effect that could appear in the portfolios if they were constructed by the overall ESG ranking. Neutralizing the industry effect is important, since otherwise, the ESG factor would capture the industry differences. A detailed explanation of the industry-neutralization can be found in Appendix 5. Our final top and bottom portfolios consist of 78 firms and 75 firms, respectively. We use value-weighted portfolios for the main analysis and equal-weighted portfolios as a robustness test. The value-weights for each firm are calculated according to the following equation:

$$Firm\ i's\ weight = \frac{MV_{i,t}}{\sum MV_{i,t}} \tag{1}$$

where:
$MV_{i,t}$= firm i's market capitalization on day t

In equation 1, value-weighted portfolio returns are obtained by (I) calculating daily market capitalization ("market caps") for each firm using closing prices and shares outstanding, (II) summing daily market caps for each firm to obtain the daily total market cap of all firms in the portfolio, (III) dividing each firm's daily market cap with the daily total market cap, to obtain each firm's value weight, (IV) multiplying firms daily log returns with its respective weight to receive daily value-weighted returns for each firm, (V) value-weighted portfolios are obtained by summing the daily value-weighted returns in the respective portfolios. In equation 2, the equal-weighted portfolio returns are calculated by dividing 1 with the total number of firms in each portfolio. These weights are then multiplied with the firm's daily log returns to receive the equal-weighted portfolio returns.

$$Equal - weighting = \frac{1}{N} \quad (2)$$

where:
N = Total number of firms

5.3 Simplified Sharpe ratio

In order to examine the difference in risk-adjusted return, we use a simplified daily Sharpe ratio inspired by Omura, Roca and Nakai (2020). The Sharpe ratio determines the return in relation to taken risk (Sharpe, 1966). The simplified Sharpe ratio follows the foregoing methodology. First, the annualized log returns are calculated by the following formula:

$$r_{t,j} = [ln(p_{t,j}) - ln(p_{t-1,j})] * 252 \quad (3)$$

where:

$r_{t,j}$ = annualized log return of firm j on day t

$p_{t,j}$ = close price of firm j on day t

Second, we use the average daily log return for the top and bottom ESG firms to analyze the performance of the overall the top and bottom portfolios. The simplified Sharpe ratio is calculated by the following formula:

$$Sharpe_{t,j} = r_{t,j} / \sigma_{t,j} \quad (4)$$

where:

$r_{t,j}$ = annualized log return of firm j on day t

$\sigma_{t,j}$ = 30-day rolling standard deviation for top and bottom portfolio

According to Omura, Roca and Nakai (2020), 30-day rolling standard deviation will capture sufficient information for our estimation while minimizing the effect of the previous periods.

6. Results and Analysis

6.1 Descriptive results

Table 3 presents the descriptive data including the mean, standard deviation (volatility), skewness, minimum, maximum and the number of observations (trading days) between January 7, 2020 – January 5, 2021. The sample consists of 153 firms divided into top and bottom portfolios consisting of 78 and 75 firms, respectively. Both portfolios are value-weighted, and all statistical data are provided on a daily frequency.

Table 3. Descriptive results for top and bottom portfolios and the benchmark

	Top portfolio	**Bottom portfolio**	**OMXSPI**
Panel A: Full Period			
Mean	0.000147	0.000932	0.000462
Standard Deviation	0.018117	0.019431	0.017764
Skewness	-1.25997	-1.78191	-1.44781
Minimum	-0.11678	-0.12905	-0.11805
Maximum	0.071601	0.062871	0.070141
# Of Trading days	251	251	251
Panel B: Pre-crash			
Mean	0.001336	0.003354	0.001559
Standard Deviation	0.008343	0.009015	0.008231
Skewness	-0.07403	-0.78168	-0.14553
Minimum	-0.02247	-0.02065	-0.0216
Maximum	0.022014	0.018921	0.021178
# Of Trading days	33	33	33
Panel C: Crash			
Mean	-0.01009	-0.01153	-0.00989
Standard Deviation	0.037874	0.043035	0.038333
Skewness	-0.46383	-0.67367	-0.523
Minimum	-0.11678	-0.12905	-0.11805
Maximum	0.071601	0.062871	0.070141
# Of Trading days	27	27	27
Panel: D Recovery			
Mean	0.001388	0.002275	0.001736
Standard Deviation	0.014394	0.014309	0.013625
Skewness	-0.41233	-0.46439	-0.47781
Minimum	-0.0489	-0.04418	-0.04684
Maximum	0.046698	0.039204	0.043112
# Of Trading days	191	191	191

Notes: Table 3 presents the descriptive statistics for the OMXSPI, top and bottom portfolios (value-weighted) for all sub-periods. Panel A examines the full period (January 7, 2020 – January 5, 2021). Panel B examines the period before the market crash (January 7, 2020 – February

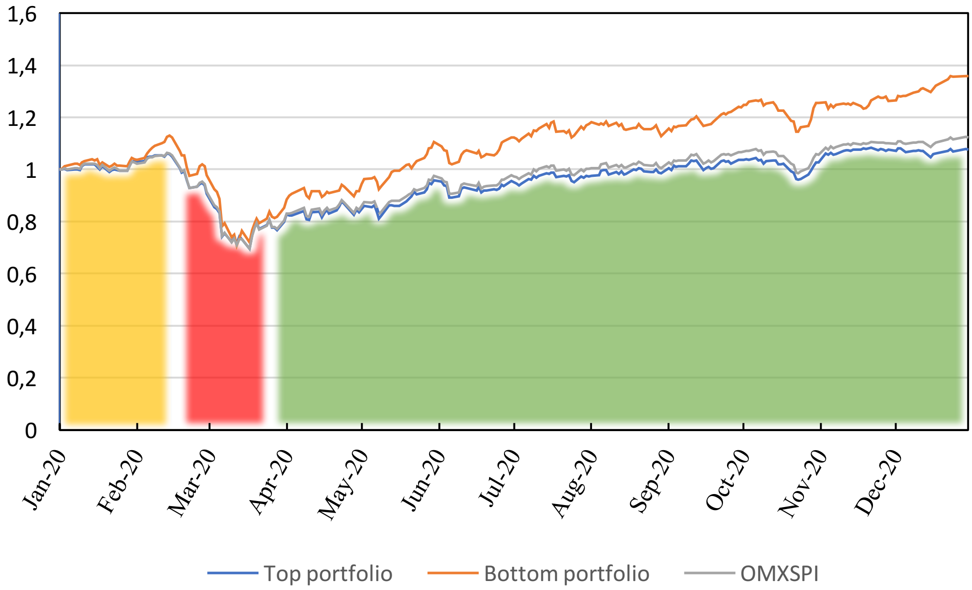
21, 2020). Panel C compares the statistics during the crash (February 24, 2020 – March 31, 2020) and panel D examines the recovery period (April 1, 2020 – January 7, 2021).

In Panel A, the summary statistics for the entire sample period is presented, where the bottom portfolio appears to exhibit a higher positive daily return relative to the top, as well as the benchmark. As can be seen, the bottom portfolio also reports the highest daily standard deviation while OMXSPI has the lowest. Similar results are also observed for Panel B suggesting that in the pre-crash period (Jan 7, 2020 – Feb 21, 2020), the bottom portfolio outperforms the top portfolio and OMXSPI.

Panel C presents the summary statistics of the COVID-19 market crash (Feb 24, 2020 – Mar 31, 2020), obtaining negative daily returns for both portfolios, as well as the benchmark. In contrast to the other sub-periods, results reveal that the top portfolio exhibits a less negative mean return relative to the bottom portfolio. Additionally, the top portfolio exhibits a lower standard deviation in all sub-periods, except for in Panel D. This might be an indication of a less volatile portfolio, which will further be tested in the following section. Furthermore, the descriptive data in all periods are negatively skewed, meaning that the mean is lower than the median and the data are left-skewed. Consequently, this can be observed in all portfolios in each sub-period, presenting highly left-skewed data. In summary, the daily mean return is higher for the bottom portfolio. To further examine the empirical question of whether ESG has a positive effect on portfolio returns, both a univariate and multivariate analysis will be conducted and presented in section 6.2.

Moreover, before conducting a multiple regression model such as the three-factor model, it is important to test for intercorrelation between the independent variables within the model (Field, 2014). Multicollinearity can occur when the independent variables are highly correlated. We conducted a correlation matrix, testing the degree of multicollinearity between the variables (see Appendix 6). Since correlation matrix does not detect any multicollinearity between the variables, we find it valid to continue with the regression models.

Figure 2: The cumulative raw return for the top and bottom portfolios - 2020



Notes: The light-yellow shaded area illustrates the pre-crash period (January 7, 2020 – February 21, 2020). Red shaded area illustrates crash period (February 24, 2020 – March 31, 2020) and green the recovery period (April 1, 2020 – January 5, 2021).

Table 4. Cumulative raw return, standard deviation, Sharpe ratio and paired t-test for respective portfolio

	Full period	**Pre-crash**	**Crash**	**Recovery**
Panel A: ***Cumulative raw return (%)***				
Top ESG portfolio	7.70	4.88	-23.11	38.64
Bottom ESG portfolio	35.80	12.38	-23.80	66.20
OMXSPI	12.29	5.28	-20.03	44.22
Panel B: ***Standard deviation (%)***				
Top ESG portfolio	28.70	4.79	19.68	19.89
Bottom ESG portfolio	30.78	5.18	22.36	19.78
OMXSPI	27.82	4.73	21.63	18.81
Panel C: ***Sharpe ratio***				
Top ESG portfolio	0.41	0.11	-1.09	1.56
Bottom ESG portfolio	1.17	1.00	-1.05	2.57
Panel D: ***Paired T-test***				
Diff. return Top - OMXSPI	-0.0003**	-0.0002	-0.0002	-0.0003**
	(0.0172)	(0.3766)	(0.7586)	(0.0150)
Diff. return Bottom- OMXSPI	0.0005	0.0018**	-0.0016	0.0005
	(0.2771)	(0.0281)	(0.4683)	(0.2311)
# Of Trading days	251	33	27	191

Notes: Column 1 examines the full period (January 7, 2020 – January 5, 2021). Column 2 examines the period before the market crash (January 7, 2020 – February 21, 2020). Column 3 compares the statistics during the crash (February 24, 2020 – March 31, 2020) and column 4 examines the recovery period (April 1, 2020 – January 5, 2021). Diff. return equals the difference in daily log return between top and bottom portfolio and the benchmark. In Panel D, p-values are in parentheses. ***, **, * demonstrate that the coefficient is significant at the 10, 5 and 1% levels.

Figure 2 shows how the cumulative raw returns for the top portfolio (in blue), the bottom portfolio (in orange), and the OMXSPI (in gray), evolve over the period January 7, 2020 – January 5, 2021. Table 4 presents the cumulative raw returns (Panel A), standard deviation (Panel B), Sharpe ratio (Panel C) and paired t-test (Panel D) for both the portfolios in each sub-period. As illustrated in Panel A, the largest distinction in return series between the portfolios appears in the recovery phase, where the bottom portfolio obtains a cumulative raw return of remarkably 66.20 %. As seen in Panel B, the top portfolio appears to be less volatile in terms of standard deviation relative to the bottom portfolio. Panel C presents the Sharpe ratios for each sub-period and is conducted by deriving the ratio of the excess return of our two portfolios to its standard deviation or volatility, which makes it possible to determine the return in relation to the taken risk (Kidd, 2011; Sharpe, 1966).[10] A better risk-adjusted return can be attributed to the bottom portfolio in all sub-periods, as observed in Panel C. However, both Sharpe ratios are negative in the crash period. Noteworthy, the interpretation of negative the Sharpe ratio requires more caution since high volatility will increase the Sharpe ratio. Consequently, making it an inefficient risk-adjusted measurement when handling negative returns. For instance, this is illustrated in Table 4, where the bottom portfolio has a less negative Sharpe ratio due to higher volatility in the crash period

Lastly, Panel D presents the differences in market-adjusted returns, confirming that the bottom portfolio outperforms the benchmark in the full, pre-crash and recovery period, being statistically significant, at the 5% level, in the pre-crash period. In contrast, the top portfolio underperforms the benchmark in all sub-periods and is statistically significant, at the 5% level, in the recovery period.

6.2 Empirical results

In order to examine the performance of ESG stocks during COVID-19, we decomposed our sample into a top and a bottom portfolio. By doing this we can compare the performance differences between the top and bottom portfolios in each of the sub-periods. To empirically answer our research questions, we performed both univariate and multivariate analyses. The univariate analysis consists of a two paired t-test, for research questions I and II, testing for significant differences in mean in return and risk-adjusted return (i.e., simplified Sharpe Ratio).

[10] The greater the Sharpe ratio, the better the portfolio has performed in relation to its volatility. Further, the length of the time period will affect the result and can be a way of manipulating the ratio. A longer time period will result in a lower ratio due to less variability, whereas a shorter period tends to result in higher risk measures. Therefore, shorter time periods are recommended (Sharpe, 1966: Kidd, 2011).

Moreover, the multivariate analysis consists of several OLS regression models for research questions I and III. Following the methodology of Omura, Roca and Nakai (2020) and Diaz, Ibrushi and Zhao (2020), the Fama-French three-factor model; market (MKT), size (SMB) and value (HML) is used to describe the return after controlling for risk factors.[11] The benchmark OMXSPI was used for the market (MKT) factor. Using daily log returns, regression models for top and bottom portfolios were conducted for each sub-period. This approach enables us to analyze the influence of the Fama-French risk factors on each portfolio.

6.2.1 Research Question I - Is there a significant difference in the stock performance between high and low ESG scoring firms in Sweden during COVID-19?

Table 5 presents the paired t-tests [12] comparing the performance differences between top and bottom ESG portfolios for each sub-period. The choice of using paired t-test follows the methodology of Diaz, Ibrushi and Zhao (2020), who conducts a paired t-test to determine performance differences between the top portfolio and the benchmark.[13] The statistical approach of using a t-test for the purpose of comparing performance differences before and during COVID-19 can also be found in studies from Omura, Roca and Nakai (2020) and Ferriani and Natoli (2020).

Table 5. Paired t-tests comparing differences in return between the top and bottom portfolios

	Full period	Pre-crash	Crash	Recovery
Diff. Return top-bottom (%)	– 0.078	– 0.202**	0.1447	– 0.089***
	(0.1554)	(0.0398)	(0.6176)	(0.0058)
# Of Trading days	251	33	27	191

Notes: Table 5 presents the results of the paired t-tests comparing differences in return between the top and bottom portfolios (value-weighted). Column 1 examines the full period (January 7, 2020 – January 5, 2021). Column 2 examines the period before the market crash (January 7, 2020 – February 21, 2020). Column 3 examines the difference in return during the crash (February 24, 2020 – March 31, 2020) and column 4 examines the recovery period (April 1, 2020 – January 5, 2021). Diff. return equals the difference in daily log returns in percentage between top and bottom firms. P-values are presented in parentheses. ***, **, and * demonstrate that the coefficient is significant at the 10, 5 and 1% levels.

As can be seen in Table 5, the top portfolio produces lower daily average returns relative to the bottom portfolio for all sample periods, except for the crash period. The results are statistically supported at the 5% level for the pre-crash and recovery period, where the top portfolio on average produces a lower daily return by (–0.202%) and (-0.089%), respectively. Given that the return differences are not statically supported during the crash period, we are not able to

[11] The daily data for SMB and HML factors was downloaded from AQR Capital Management.

[12] Paired t-test formula (Kim,2015): $t = \frac{\overline{X_d}}{\frac{s}{\sqrt{n}}}$, Where: $\overline{X_d} =$ mean of differences, $s =$ standard deviation, $n =$ sample size, degree of freedom $= n - 1$

[13] According to Xu *et al.* (2017), when comparing two populations it is of high importance to distinguish whether the data samples are from two independent samples or paired samples. Kim (2015), elaborates on this topic and mentions that a two-sample t-test can only be used if the two independent samples are obtained from two separate populations or randomly divided into two groups from one population. Since the top and bottom portfolios are two measurements from the same subject group and are not randomly divided into two groups, the appropriate test for the thesis data is a paired t-test (Xu *et al.*, 2017; Kim, 2015: Skaik, 2015).

make a valid claim about ESG and stock performance during the crash period. However, due to the positive sign of the estimate, the results show some similarities with Nofsinger and Varma (2014), Broadstock *et al.* (2020), Diaz, Ibrushi and Zhao (2020) and Ferriani and Natoli (2020), all documenting an overperformance for high portfolios. In addition, our results are in line with Nofsinger and Varma (2014) and confirm that firms that engage in high ESG practices tend to underperform in non-crisis periods. One explanation for this can be that investors pay an additional cost for ethics in normal times, which may affect the observed results (Nofsinger and Varma, 2014).

Table 6. The results of the OLS regression using the Fama-French three-factor model

	Bottom portfolio				**Top portfolio**			
	Full period	**Pre-crash**	**Crash**	**Recovery**	**Full period**	**Pre-crash**	**Crash**	**Recovery**
Alpha	0.0001	-0.0015*	-0.0018	0.0003	– 0.0002*	-0.0001	-0.0007*	-0.0003***
	(0.868)	(0.098)	(0.212)	(0.399)	(0.093)	(0.643)	(0.082)	(0.009)
$\beta_1(MKT)$	1.0677***	1.0155***	1.1253***	1.0144***	0.9977***	0.9897***	0.9794***	1.0184***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\beta_2(SMB)$	0.2853***	0.2544	0.5163*	0.1168*	0.1022***	-0.0729	-0.1455*	-0.0659***
	(0.000)	(0.125)	(0.053)	(0.082)	(0.000)	(0.209)	(0.073)	(0.001)
$\beta_3(HML)$	-0.3602***	-0.2794	0.2992	-0.4370***	0.1292***	0.1408**	0.0000	0.1350***
	(0.000)	(0.135)	(0.555)	(0.000)	(0.000)	(0.013)	(1.000)	(0.000)
#Of Trading days	251	33	27	191	251	33	27	191

Notes: The dependent variables used in this regression are the log return for top portfolio and bottom portfolio (value-weighted). The regression uses robust standard errors. Column 1 examines the full period (January 7, 2020 – January 5, 2021). Column 2 examines the period before the market crash (January 7, 2020 – February 21, 2020). Column 3 examines the period during the crash (February 24, 2020 – March 31, 2020) and column 4 examines the recovery period (April 1, 2020 – January 5, 2021). MKT is the OMXSPI return, SMB is the size factor, and HML is the value factor. P-values are presented in parentheses. ***, **and * demonstrate that the coefficient is significant at the 10, 5 and 1% levels.

Table 6 presents the results of the following Fama-French three-factor model:

$$R_{i,t} - R_{f,t} = a_i + \beta_{1,i}\left(R_{M,t} - R_{f,t}\right) + \beta_{2,i}(SMB_t) + \beta_{3,i}(HML_t) + \epsilon_{i,t} \qquad (5)$$

Where $R_{i,t} - R_{f,t}$ is the excess return[14] of portfolio i (top or bottom) in period t. a_i is the return that is not explained by any of the risk factors. $\beta_{1,i}$ represents the market beta, i.e. the sensitivity of portfolio i to the market factor. $R_{M,t} - R_{f,t}$ is interpreted as the excess return of the market

[14] The thesis uses the three-month Swedish Treasury bill rate as a proxy for the risk-free interest rate. The bill rate was expressed in percentage and on a yearly basis. Following the methodology used by Swedish House of Finance, the daily risk-free interest rate is calculated by dividing the Treasury bill rate by 360 (FinBas, 2021).

in period t. $\beta_{2,i}$ and $\beta_{3,i}$ describes the sensitivity of portfolio i to SMB[15] and HML[16] factors in period t. Lastly, the $\epsilon_{i,t}$ factor is the firm-specific risk component.

The first thing that can be observed in Table 6 is that both portfolios yielded negative alpha values in all sub-periods, except in the recovery period for the bottom portfolio. The alpha estimates are significantly negative in the crash and recovery period for the top portfolio and in the pre-crash period for the bottom portfolio. The intercept, alpha, measures the risk-adjusted return for a portfolio and captures the excess return above the market return. A positive (negative) alpha value indicates an overperformance (underperformance) relative to the benchmark. As can be seen, the risk-adjusted returns or alphas for the top portfolio are (-1), (-7) and (-3) basis point per day or (-0.3%), (- 2.1%) and (-0.9%) per month. Whereas the alpha for the bottom portfolio is (-15), (-18) and 3 basis points per day or (-4.5%), (-5.4%) and 0.9% per month. In accordance with Nofsinger and Varma (2014), our results indicate that firms with high ESG scores generate less negative alpha values during crisis periods.

As illustrated in Table 6, a clear difference in the market beta can be distinguished between the two portfolios. The market coefficient (MKT) is significant at the 1% level for both portfolios in all periods, although the coefficient for the bottom portfolio is slightly greater than one. Indicating a greater sensitivity to systematic risk in comparison to the market, hence more volatile and riskier. Regarding the factor loadings, the results show that the bottom portfolio demonstrates significant positive SMB values for the crash and recovery period at the 10% level. While the top portfolio reports significant negative SMB values at the 10% level for the pre-crash and crash period and at the 1% level for the recovery period. According to Bernstein (2011), a coefficient value of zero signifies large-cap stocks and a value greater than 0.5 is an indication of small-cap stocks. Thus, our results imply that the top portfolio consists of large-cap stocks, whereas any strong conclusion cannot be drawn regarding the bottom portfolio. As a result of value-weighting the portfolios, the significant positive SMB coefficient of above 0.5 in the crash period may imply a minor bias towards stocks with smaller market cap within the bottom portfolios. One explanation provided by Wang and Sargis (2020) is that stocks with better ESG scores tend to be larger companies. Moreover, regarding the value factor, HML, Bernstein (2011) states that a coefficient value above 0.3 is an indication of a value firm, while

[15] SMB is defined by Small minus Big and is constructed as the difference between the performance of a portfolio consisting of small assets and a portfolio of big stocks. The factor explain the size effect, that small stocks outperform larger stocks in the long run (Fama and French, 1993).
[16] HML stands for High minus Low and is the difference between the performance of a portfolio with high-book-to-market and a portfolio with those with low. This factor captures the value effect, which indicates that firms with high book-to-market (i.e., value stocks), outperform those with low book-to-market values (growth stocks) (Fama and French, 1993).

a value of zero or below indicates a growth firm. Our results for the bottom portfolio are in line with Bernstein (2011), suggesting that the portfolio consists of growth stocks, apart from the crash period. However, since the coefficients for the top portfolio are not above 0.3, the results are not adequate enough to support this rule of thumb.

6.2.2 Research Question II - Is there a significant difference in the risk-adjusted return between high and low ESG scoring firms in Sweden during COVID-19?

Table 7 presents the difference in risk-adjusted return between the top and bottom portfolios. We calculated a simplified daily Sharpe ratio using equation (3) and (4) in section 5.3. In order to test for significant differences in risk-adjusted returns, a paired t-test was performed.

Table 7. Paired t-tests comparing the simplified Sharpe ratio of the top and bottom portfolios

	Full period	**Pre-crash**	**Crash**	**Recovery**
Diff. Sharpe	-0.0776**	-0.0461	0.1083	-0.1093***
	(0.0165)	(0.6846)	(0.2356)	(0.0021)
# Of Trading days	251	33	27	191

Notes: Table 7 presents the results of the paired t-test comparing the simplified Sharpe ratio of the top and bottom portfolio (value-weighted). Column 1 examines the full period (January 7, 2020 – January 5, 2021). Column 2 examines the period before the market crash (January 7, 2020 – February 21, 2020). Column 3 examines the market crash (February 24, 2020 – March 31, 2020) and column 4 examines the recovery period (April 1, 2020 – January 5, 2021). Diff. Sharpe equals the difference in the simplified Sharpe ratio between top and bottom portfolio. P-values are presented in parentheses ***. ** and * demonstrate that the coefficient is significant at the 10, 5 and 1% levels.

In line with research question I, Table 7 confirms a superior risk-adjusted return for the bottom portfolio in the recovery period, statistically significant at the 1% level. Even though the estimates are not statistically supported for the pre-crash and crash period, the signs of the estimates are in line with the results for research question I. Confirmative results are obtained by Omura, Roca and Nakai (2020), who finds that ESG ETFs fail to exhibit superior risk-adjusted returns before and during COVID-19. Similar to our results, the authors obtain negative results before the pandemic and positive results during the pandemic, although not statistically supported. In a similar fashion, Hoang *et al.* (2020) find no clear differences in performance spread[17] between high and low scoring firms both before and during the pandemic. However, the authors state that the volatility of the performance spread is higher for low-scoring firms. One explanation for the failed superior performance may be caused by a mixture of positive and negative screening methods used by managers (Omura, Roca and Nakai, 2020; Renneboog *et al.*, 2008b).

[17] Hoang *et al.* (2020) define performance spread as the spread between high and low ESG portfolio measured in daily Sharpe ratios.

6.2.3 ESG impact during COVID-19 versus 'normal' times

The following section compares the top and bottom portfolios over the equivalent sub-periods in 2019. This approach enables for a comparison of an ESG effect and its existence between normal market conditions and crisis periods. The observed results for 2019 are presented in Appendix 7-11. In 2019, the overall difference in raw return and risk-adjusted return between the top and bottom portfolios are negative in all sub-periods, however not statistically significant[18]. In contrast to existing ESG studies that find a positive or superior stock performance in non-crisis periods (e.g., Kempf and Osthoff, 2007; Derwell *et al.*, 2005; Callahan, 2019), our study cannot provide evidence of an ESG effect in normal times due to insignificant results.

Unlike our results for 2020, we do not obtain any positive estimates for our raw returns and risk-adjusted returns in 2019. This is a noticeable difference since we observe a positive estimate during the crash period in 2020. This might suggest that high-scoring stocks are more responsive to unexpected market shocks. Confirming findings from Broadstock *et al.* (2020) suggest that high ESG firms are more resilient to the COVID-19 pandemic in terms of stock price reactions. Although our results show that that bottom portfolio performs better after the market crash, it seems that the bottom portfolio is more resilient.

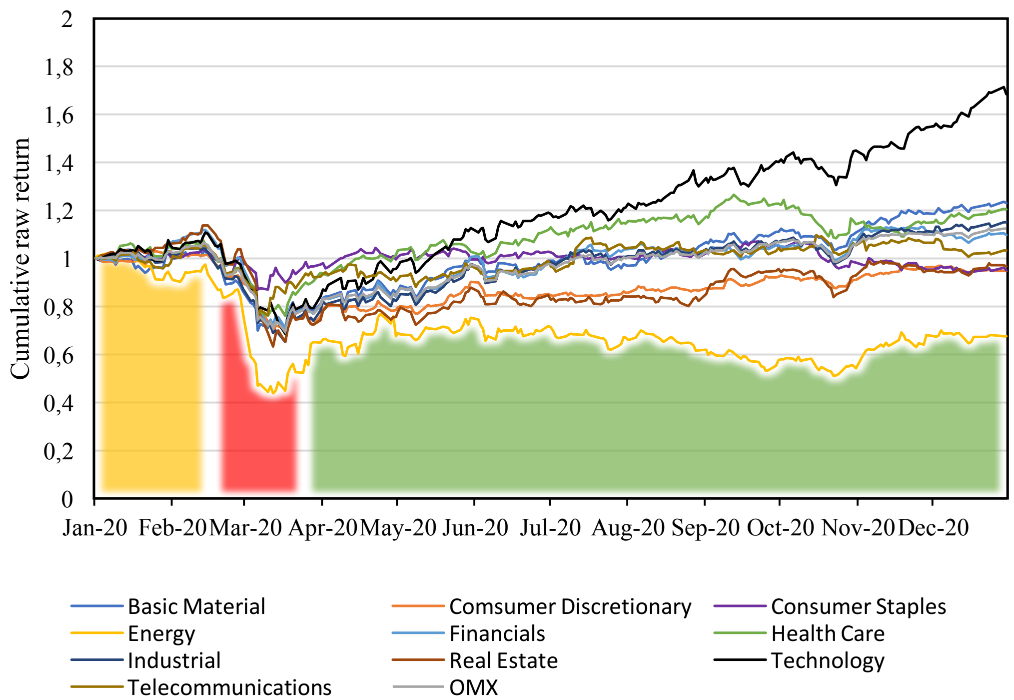
Furthermore, the factor loadings for 2019 are exhibiting insignificant or to some extent, a lower degree of statistical significance, compared to 2020 results. In addition, the bottom portfolio demonstrates positive alpha values for the entire sample period. Given the observed results, an ESG effect cannot be distinguished since the bottom portfolio has higher raw returns and appear to be more resilient during our sample period. The insignificant positive estimate in the crash period might suggest a tendency towards a positive ESG effect in terms of market shocks, however, this is not something we can confirm.

[18] With the exception for risk-adjusted returns in the recovery period, statistical negative significance at the 5% level.

6.2.4 Research Question III - Can any differences in ESG be attributed across industries? If so, which of the three pillars of ESG is the main driver of industry returns?

Figure 3 displays the cumulative industry raw returns for 2020. As can be seen in Figure 3, the energy industry (in yellow) exhibited the lowest cumulative raw return (-32.49%) and the technology industry (in black) obtained the highest (68.47%). In accordance with previous results, the largest difference between the industry portfolios occurs during the recovery period. In addition, technology and health care (in green) generated a higher return during the recovery period compared to the remaining industries. Whereas the energy, real estate (in brown) and consumer discretionary (in orange) sectors display a decrease in return for the full sample period.

Figure 3. The cumulative raw return for each industry - 2020



Notes: The light-yellow shaded area illustrates the pre-crash period (January 7, 2020 – February 21, 2020). Red shaded area illustrates crash period (February 24, 2020 – March 31, 2020) and green the recovery period (April 1, 2020 – January 5, 2021).

To empirically verify research question III, we followed the methodology of Callahan (2019) and Diaz, Ibrushi and Zhao (2020), constructing a new ESG factor, as the difference in returns between top and bottom portfolios. In equation 6, we regress daily industry log returns on the control variables from Fama-French three-factor model in addition to the newly constructed ESG factor. Regressing industry returns on the control variables, as well as the ESG factors, enables further analysis regarding the impact of ESG score across industries.

$$R_i - R_{f,t} = \alpha + \beta_1(R_{M,t} - R_{f,t}) + \beta_2 SMB + \beta_3 HML + \beta_4 ESG + \epsilon_i \quad (6)$$

Where $R_i - R_{f,t}$ is the excess industry[19] return of industry i in period t. a_i is the return that is not explained by any of the risk factors. $\beta_{1,i}$ represents the market beta, i.e., the sensitivity of industry i to the market factor. $R_{M,t} - R_{f,t}$ is interpreted as the excess return of the market in period t. $\beta_{2,i}$ and $\beta_{3,i}$ describes the sensitivity of industry i to SMB and HML factors in period t. ESG is the spread in daily return between the top and bottom portfolios. Lastly, the $\epsilon_{i,t}$ factor is the firm-specific risk component. Table 8 presents the results of the Fama-French three-factor model, with the additional ESG factor measuring the spread in return between the top and bottom portfolios.

Table 8. The effect of ESG factor on industry returns

	Alpha	β1(MKT)	β2(SMB)	β3(HML)	β4(ESG)
Panel A: Full period					
Basic Materials	0.0005	0.9965***	-0.2713***	0.2081***	-0.0133
	(0.282)	(0.000)	(0.002)	(0.009)	(0.857)
Consumer Discretionary	-0.0005	0.7281***	0.2458**	0.4492***	-0.0359
	(0.274)	(0.000)	(0.020)	(0.000)	(0.637)
Consumer Staples	-0.0008	0.5083***	-0.0116	-0.5927***	0.1908*
	(0.238)	(0.000)	(0.926)	(0.000)	(0.058)
Energy	-0.0020	1.5990***	0.3618	0,2782	0,4737
	(0.247)	(0.000)	(0.140)	(0.307)	(0.202)
Financials	-0.0001	1.1458***	0.1638**	0.3272***	-0.0019
	(0.733)	(0.000)	(0.016)	(0.000)	(0.969)
Health Care	-0.0005	0.7732***	0.0434	-0.8156***	-0.1266
	(0.334)	(0.000)	(0.718)	(0.000)	(0.263)
Industrials	0.0002	1.0504	-0.3058***	-0.0436	0.2609***
	(0.402)	(0.000)	(0.000)	(0.0486)	(0.000)
Real Estate	-0.0013*	1.1560***	0.5394***	0.2727**	-0.4857***
	(0.073)	(0.000)	(0.000)	(0.031)	(0.000)
Technology	0.0014*	0.9835***	-0.4048***	-0.3825***	-0.0878
	(0.035)	(0.000)	(0.002)	(0.001)	(0.581)
Communications	-0.0003	0.8015***	-0.0905	-0.1566	0,1475
	(0.726)	(0.000)	(0.568)	(0.231)	(0.146)
# Of Trading days	251	251	251	251	251
Panel B: Pre-crash					
Basic Materials	-0.0020	1.4669***	-0.5571**	0.8572***	-0.4253
	(0.069)	(0.000)	(0.019)	(0.004)	(0.129)
Consumer Discretionary	0.0005	0.3478	-0.2054	0.8224***	0.0944
	(0.790)	(0.140)	(0.533)	(0.001)	(0.628)
Consumer Staples	0.0007	0.4565***	-0.2750	-0.0635	0.2679
	(0.543)	(0.009)	(0.427)	(0.726)	(0.408)
Energy	-0.0050**	1.2192***	-0.8280**	0.0818	-0.7364
	(0.030)	(0.000)	(0.026)	(0.874)	(0.110)
Financials	0.0009	1.3092***	0.6189**	0.3434	0.0379
	(0.339)	(0.000)	(0.030)	(0.125)	(0.835)
Health Care	-0.0004	1.0586***	0.0746	-0.4451	0.0429
	(0.843)	(0.001)	(0.861)	(0.253)	(0.898)
Industrials	-0.0004	0.9330***	-0.5044***	-0.2414	0.1362
	(0.587)	(0.000)	(0.004)	(0.213)	(0.228)
Real Estate	0.0016	0.90058***	0.4591*	-0.0624	-0.3117
	(0.190)	(0.000)	(0.094)	(0.871)	(0.307)
Technology	0.0007	1.1982***	-0.4494	0.1087	-0.2591
	(0.783)	(0.000)	(0.405)	(0.699)	(0.469)

[19] The excess industry returns are calculated by taking the average daily log returns of each firm in the respective industry.

Communications	-0.0000	0.6934**	0.3617	-0.3783	0.0330
	(0.976)	(0.015)	(0.429)	(0.316)	(0.976)
# Of Trading days	33	33	33	33	33
Panel C: Crash					
Basic Materials	0.0024	1.0654***	-0.4918	0.3082	-0.0198
	(0.319)	(0.000)	(0.025)	(0.417)	(0.926)
Consumer Discretionary	-0.0041	0.6739***	0.3279	-0.2339	-0.0928
	(0.198)	(0.000)	(0.408)	(0.595)	(0.679)
Consumer Staples	0.0061	0.6826***	0.0403	0.4463	0.3290
	(0.203)	(0.000)	(0.929)	(0.413)	(0.106)
Energy	0.0017	1.7693***	-0.5030	0.7118	-0.5199
	(0.848)	(0.000)	(0.389)	(0.608)	(0.542)
Financials	0.0020	1.1719***	0.3998**	0.5353**	0.1662**
	(0.315)	(0.000)	(0.018)	(0.040)	(0.020)
Health Care	-0.0014	0.7900***	-0.0443	-0.7871	-0.0397
	(0.694)	(0.000)	(0.925)	(0.215)	(0.913)
Industrials	-0.0038	0.9359***	-0.4775*	-0.4979	0.0924
	(0.154)	(0.000)	(0.051)	(0.148)	(0.504)
Real Estate	-0.0001	1.2099***	0.9569**	-0.0364	-0.3351**
	(0.973)	(0.000)	(0.020)	(0.946)	(0.040)
Technology	0.0000	1.0899***	-0.7317***	0.8334***	0.4017***
	(0.853)	(0.000)	(0.010)	(0.004)	(0.003)
Communications	0.0068	0.9565***	-0.0730	0.5845	0.2315
	(0.229)	(0.000)	(0.895)	(0.468)	(0.465)
# Of Trading days	27	27	27	27	27
Panel D: Recovery					
Basic Materials	0.0007	0.9194***	-0.2107**	0.2278**	-0.0088
	(0.206)	(0.000)	(0.018)	(0.014)	(0.916)
Consumer Discretionary	-0.0003	0.7208***	0.2052***	0.4522***	0.0415
	(0.430)	(0.000)	(0.006)	(0.000)	(0.610)
Consumer Staples	-0.0009	0.4311***	-0.0566	-0.6806***	0.2145**
	(0.143)	(0.000)	(0.604)	(0.000)	(0.024)
Energy	-0.0004	1.2362***	0.2647	0.1012	1.1024***
	(0.780)	(0.000)	(0.326)	(0.756)	(0.001)
Financials	-0.0005	1.1557***	0.0938	0.3301***	-0.0478
	(0.210)	(0.000)	(0.218)	(0.000)	(0.453)
Health Care	-0.0005	0.7583***	0.0758	-0.8071***	-0.1928**
	(0.353)	(0.000)	(0.444)	(0.000)	(0.040)
Industrials	0.0003	1.1310***	-0.1919***	-0.0473	0.2926***
	(0.293)	(0.000)	(0.000)	(0.418)	(0.000)
Real Estate	-0.0015*	1.0611***	0.3439***	0.3816**	-0.5331***
	(0.070)	(0.000)	(0.009)	(0.012)	(0.000)
Technology	0.0016**	1.0424***	-0.2142	-0.4329***	-0.2812**
	(0.029)	(0.000)	(0.219)	(0.000)	(0.012)
Communications	-0.0005	0.7178***	-0.1919	-0.1450	0.1707*
	(0.510)	(0.000)	(0.104)	(0.233)	(0.094)
# Of Trading days	191	191	191	191	191

Notes: Table 8 presents the coefficient estimates from equation 6, for each sub-period. Panel A, examines the full period (January 7, 2020 – January 5, 2021). Panel B examines the period before the market crash (January 7, 2020 – February 21, 2020). Panel C examines the period during the crash (February 24, 2020 – March 31, 2020) and Panel D examines the recovery period (April 1, 2020 – January 5, 2021). The first column present excess industry returns for each industry. MKT is the OMXSPI excess return, SMB is the size factor, and HML is the value factor. The last column presents the coefficients for the ESG factor. The regression uses robust standard errors. P-values are presented in parentheses. ***, ** and * demonstrate that the coefficient is significant at the 10, 5 and 1% level.

Panel B suggests that in the pre-crash period (Jan 7, 2020 – Feb 21, 2020), the ESG factor is insignificant for all industries, indicating no impact of ESG across industries. However, the ESG factor reports a positive sign in six out of ten industries (consumer discretionary, consumer staples, financials, health care, industrials, and communications. Out of these six industries only consumer discretionary, consumer staples and financial reported positive, non-significant, alpha values. Other industries reporting positive alpha values are real estate and technology. Consequently, in the pre-crash period, there is no evidence of ESG being mispriced or having a discount.

In Panel C, which observes the regression results in the crash period (Feb 24, 2020 – Mar 31, 2020), we obtain a clear ESG effect for three industries (financials, technology, and real estate). The ESG factor has a significantly positive impact on financials and technology at the 5% and 1% level, which can be viewed as a price discount for these industries. This is also supported by the positive alphas estimates for these two industries. In contrast, a lower discount can be observed for the real estate sector reporting a negative alpha and ESG factor. This result is in line with Diaz, Ibrushi and Zhao (2020), who also finds a significant positive and negative ESG impact for technology and real estate sectors. Conversely, the authors conclude a significant impact for a lot more industries. One explanation for these differences could be explained by the defined crash window of 27 trading days relative to Diaz, Ibrushi and Zhao (2020) four months sample period.

Furthermore, Panel D reports the results from the recovery period (Apr 1, 2020 – Jan 5, 2021), where seven out of ten industries demonstrate a significant ESG effect. The ESG factor has a significantly positive impact on consumer staples, energy, industrials and communications. In contrast, a significant negative impact of ESG can be attributed to health care, real estate and technology. As observed in Panel D, the number and magnitude of affected industries increase in the recovery period.

Significant changes from the crash period can be observed in the technology and financial sectors, who both change signs or turn insignificant. One explanation provided by Callahan (2019) is that industries are highly affected by market conditions and themes. Callahan (2019) further argues that cyclical sectors e.g., technology, consumer discretionary are beneficial during bull markets. As the industry's recovery from the COVID-19 market crash, the impact of ESG on industry returns increases. In turn, a potential discount can be observed in energy and industrials due to the significant impact and high magnitude of the coefficient. The opposite effect is true for the real estate sector.

Worth mentioning is that a statistically significant ESG effect does not appear to impact basic materials and consumer discretionary in any of the sub-periods. This result is in accordance with Callahan (2019), who finds that ESG stock selection for consumer discretionary and materials industries does not provide superior return performance. Similar to Callahan (2019) our result also shows that real estate has a recurring negative ESG factor, an indication of an inferior return performance in stock selection.

Regarding the loading factors, as seen in Appendix 6, the overall SMB coefficients demonstrate a negative correlation with the ESG factor. This indicates a potential size bias, where firms with larger market cap generally receive a higher ESG score. This size bias is also supported by the findings of Wang and Sargis (2019).[20] Similar to, Diaz, Ibrushi and Zhao (2020) we also observe a significant positive market factor across all industries and sub-periods. On the contrary, we find that the size and value factor affects a similar number of industries at an equivalent significance level at the presence of an ESG factor. It is worth noting that the distribution of firms in each industry varies (see Appendix 4).

Given our findings regarding the ESG factor, and that ESG pillar scores are de facto equally weighted, it is of interest to investigate the impact of each ESG pillar, and its magnitude on industry returns. Separate regressions for the Environmental, Social and Governance pillars is constructed similar to equation 6, where $\beta_4 ESG$ is replaced by each pillar individually. Table 9 presents the significant pillar signs for each industry and sub-period and the underlying regressions and results are presented in Appendix 12.

Table 9. The significant pillar signs

	Positive	**Negative**
Environmental		
Pre	Financials	Consumer Staples, Real Estate, Energy,
Crash	Industrials, Technology	Communications, Health Care
Recovery	Financials, Industrials	Consumer Staples, Energy, Health Care, Real Estate, Technology, Communications
Social		
Pre		Energy, Real Estate
Crash	Consumer Discretionary, Industrials	Health Care
Recovery	Energy, Financials, Industrials	Real Estate, Technology
Governance		
Pre	Communications	
Crash	Consumer Staples, Health Care, Communications	Consumer Discretionary, Industrials, Real Estate
Recovery	Consumer Staples, Energy, Communications	Consumer Discretionary, Real Estate, Technology

As previously shown in Table 8, which presents the effect of the ESG factor on industry returns, the lack of significant ESG factors in the pre-crash period can be attributed to the lack of significant pillars during the same period, as seen in Table 9. Noticeably, both the Environmental and Social pillars report significant negative coefficients for real estate in the

[20] Wang and Sargis (2019) obtain a large negative correlation of -0.41 between SMB and their ESG BMW factor. BMW is constructed by an ESG portfolio buying stocks with high ESG scores (better firms) and short-selling stocks with low ESG scores.

pre-crash period.[21] This indicates that the Governance pillar appears to be the sole driver of returns for real estate sector, which is also confirmed by the negative ESG factor in the crash period. With this in mind, the Environmental and Social pillars appear to have a positive correlation and drive the returns in a similar fashion, while an opposite effect is documented for the Governance pillar. Moreover, during the crash period Environmental can be seen as the sole driving pillar for the technology sector.

Furthermore, there is a clearer distinction of which pillar that drives the ESG factor in the recovery period. The overall negative ESG factor on health care can be attributed to the negative effects of Environmental. Further, industrials are positively affected by the Environmental and Social pillar, with the former having a slightly higher magnitude. The Governance and Environmental pillar affect consumer staples and communications, but with opposite signs. However, the high positive magnitude of Governance can be seen as the driver in the overall positive ESG factor for these two industries. Moreover, the negative ESG impact on technology and real estate are both negatively affected by all three pillars of similar magnitude. The energy sector is positively affected by all pillars, however, the Governance pillar has an impact of slightly higher magnitude. In agreement with Diaz, Ibrushi and Zhao (2020), we can conclude that the impact of ESG and each pillar vary across industries. Nonetheless, the Environmental and Governance pillars can be seen as the two primary pillars to affect industry returns, but in opposite directions. Our results are in line with Friede, Bush and Bassen (2014), which shows that studies focusing on Environmental, and Governance have a slightly higher positive relation to corporate financial performance relative to Social focused studies. On the other hand, our results contradict Diaz, Ibrushi and Zhao (2020), who find that the Environmental and Social pillars are the key drivers of industry returns.

6.2.5 Robustness Test

In this thesis, a value-weighting method was applied since the sample contained firms with various sizes i.e., market capitalizations. To test the robustness of the results and to investigate how the size of the firms influences the results, an alteration using equal-weighted portfolios instead of the initial value-weighted portfolios was executed. The tables for equal-weighted portfolios are presented in Appendix 13-15.

The results regarding the paired t-tests for equal-weighted portfolios only documents significant results in the recovery period, where superior return performance is observed for

[21] Both the Environmental and Social pillar report a significance at the 5% level for Real Estate in the pre-crash period, while Governance is positive and insignificant. Simultaneously, the overall ESG factor is insignificant for Real Estate.

the bottom portfolio.[22] Interestingly, the significant return performance documented in the recovery period for both methods indicates a quick recovery from the unexpected market crash for the bottom portfolio.[23] One explanation for the insignificant results in the other sub-periods could be that smaller firms with lower ESG scores receive higher weights under equal weighting than under value weighting, and in our case lowering the overall return performance. The paired t-test results regarding differences in risk-adjusted return documents a significant performance for the bottom portfolio in the recovery period. In contrast to the value-weighted results, we do not receive any positive estimates for raw returns and risk-adjusted returns in the crash period.

In the multivariate analysis, the equal-weighted portfolios had several differences regarding the level of significance level. First, all alpha values for both ESG portfolios are insignificant, in comparison to significant negative alpha values for the value-weighted portfolios. The equal-weighted portfolios also demonstrate a higher magnitude of the market factor, an indication of slightly riskier portfolios than the benchmark. Second, the bottom portfolio demonstrates a higher magnitude of significant SMB coefficients in all periods. This can be attributed to firms with smaller market caps are given higher weights. Overall, the factor loadings for the equal-weighted portfolios are more statistically supported.

6.2.6 Discussion

In the following section, we will extend the analysis by discussing our empirical research question together with our empirical results, in order to further elaborate whether ESG has a positive effect on portfolio returns during COVID-19. In addition, we will also address the main limitations of our thesis.

As Stakeholder theory hypothesizes, there are advantages for firms to maximize the collective welfare for all stakeholders in order to generate long term value. Firms avoiding sustainable related projects could tarnish their reputation or face litigation costs, which in turn could damage shareholder value in the long run. Therefore, a firm will benefit financially by improving its ESG scores (Renneboog, Ter Horst, Zhang, 2008a). Even after having conducted this thesis, we question the stakeholder theory and believe that the link between ESG scores and stock performance is still not fully recognized by the stock markets, as well as understood by the investors and asset managers. This line of questioning is in line with advocates of EMH,

[22] See Appendix 5. The difference in return between the portfolios is only significant at the 10% level in the recovery period. Value-weighted results as seen in section 5.2.1 are negatively significant in the pre-crash and recovery period at the 5% and 1% level, respectively.
[23] As illustrated in Figure 2 in section 5.1

arguing that it should be impossible to generate a superior return by ESG investing since all the ESG information is considered as public information (Renneboog, Ter Horst, Zhang, 2008a). Even though ESG investing could generate shareholder value in the long run, stock markets tend to undervalue ESG stocks in the short run. This line of reasoning is reflected in our results covering a short sample period, where we find a significantly negative impact for the top portfolio in explaining stock performance, as well as the risk-adjusted returns relative to the bottom portfolio. Given this, another possibility we cannot dismiss is the fact that high-scoring ESG stocks might be overpriced to the extent that they underperform or that a potential ESG effect is already incorporated in the stock price (Renneboog, Ter Horst, Zhang, 2008b). This reasoning and findings are also in line with the no-effect scenario introduced by Manescu (2011), especially during the crash window where we find insignificant return performance differences between the top and bottom portfolios.

In regard to the risk-adjusted return, our results contradict previous empirical findings (Broadstock *et al.* 2020; Ferriani and Natoli, 2020; Hoang *et al.,*2020; Nofsinger and Varma, 2014), documenting that high-scoring firms tend to be less volatile during economic downturn even if outperformance is not found. We do not find any evidence supporting these findings since both our Sharpe Ratio and simplified Sharpe ratio, reveal that the bottom portfolio has a higher return relative to taken risk. Notably, as mentioned in earlier sections in this thesis, Sharpe Ratio requires some caution when handling negative returns since high volatility will increase the Sharpe ratio. Nonetheless, given that we observe similar standard deviations for our two ESG portfolios, we consider that our estimates still provide adequate information. As suggested by our test results for 2019, even in normal times, a risk-return strategy does not appear to be beneficial for investors due to the insignificant results (see Appendix 8, 11).

In regard to ESG ratings, it is important to remember that there are a wide variety of used data providers among the existing studies. In line with the discussion by Halbritter and Dorfleitner (2015), the influence of ESG rating on financial performance is significantly dependent on the data provider. Hence, it is reasonable that our empirical results differ from existing studies. Another possible explanation for these differences is the lack of a uniform definition of how to construct a comparable score. Currently, the data providers use different practices and methodologies in order to calculate an overall ESG score. Additionally, the limited number of available ESG stocks depending on data provider varies, which in turn could affect the portfolio performance.

With this in mind, if we had chosen a different data provider in this thesis, we would most likely to expect a different outcome. In order to test the validity of the results, one could extend this study by examining all the major data providers and compare the results. Consequently, to obtain more comparable results regarding ESG and stock performance, researchers require a uniform framework and definition regarding each of the pillars and their weight to construct an appropriate ESG score. Otherwise, investors will be incapable of proficiently determine the effect and value of the applied ESG approach (OECD, 2020). Additionally, as mentioned previously in this thesis we believe that current ESG scores might be biased towards larger. A possible reason for this could be due to the high cost of reporting ESG information (OECD, 2020). This is to some extent confirmed by our negative correlation between the size factor and the ESG factor (-0.28) for the full sample period, and (-0.46) during the pandemic. Our results are also in line with Wang and Sargis (2020), who find a correlation of (–0.41). Interestingly, the bottom portfolio had a significantly better recovery which potentially could be explained by the fact that smaller firms, in general, have higher growth potential and are able to generate higher returns in a short time horizon.

As Callahan (2019) describes there are sectors that are recession-proof (e.g., consumer staples and communication) or economically sensitive (e.g., technology and consumer discretionary), these sectors benefit differently depending on the market conditions. In regards to our industry returns, we find that the impact of ESG on industry returns tends to vary across industries and sub-periods. However, given our short sample period, it may not be enough to determine which sectors that are more beneficial during a crisis or non-crisis periods. Accordingly, a longer time period covering other market conditions could be conducted as a complement to our thesis, in order to analyze the persistence of industries over time. On the contrary, we still believe that our results regarding the pillars provide decent evidence to draw adequate conclusions of which pillar that drives industry returns. In line with most empirical studies (e.g., Friede, Bush and Bassen, 2015; Diaz, Ibrushi and Zhao, 2020), we also find the Environmental and the Governance pillar has more explanatory power than the Social pillar in terms of industry returns. In accordance with Broadstock *et al.* (2020), we believe that one possible explanation for the lower Social pillar could be that firms have laid off employees in order to manage cost during COVID-19, instead of focusing on the condition, environment and human rights for the employees.

Further, as highlighted in previous literature (e.g., Derwell, 2005; Kempf and Osthoff, 2007) the selected screening strategies have played a crucial role in the overperformance of ESG stocks. More specifically, researchers have argued that a positive Best – in – Class screening strategy yielded higher alpha values for ESG assets compared to negative screening strategies. Even though we used a Best-in-class screening strategy for the thesis methodology, we do not find any evidence of an overperformance or positive alphas for the top portfolio. With this in mind, the observed results are probably not due to our screening strategy, instead, there could be alternative factors for why our top portfolio underperforms, such as (I) selected data provider, (II) a short crash window or (III) ESG is already priced.

7. Summary and Conclusions

Although the rationale for managers investing in ESG is to generate long-term value for all the stakeholders, academics often refer to EHM and question whether it is possible to generate superior returns through ESG investing. Existing ESG literature documents mixed results on whether ESG has a positive effect on portfolio returns during COVID-19. This thesis, therefore, aims to fill the research gap by examining the Swedish stock market during 2020. In order to answer our research questions, we followed a Best-in-Class ESG screening strategy and constructed both value-weighted and industry-neutralized ESG portfolios for 153 listed stocks.

By conducting both univariate and multivariate analysis, we find that there is a significant negative difference in raw returns, as well as in risk-adjusted returns, between the top and bottom ESG portfolios. Our results suggest that the bottom ESG portfolio exhibits higher raw return relative to the top portfolio, both in the pre and recovery period at the 5% level. The same relationship is found for the risk-adjusted return but only in the recovery period. On the other hand, we do not find any statistically significant difference for raw returns and risk-adjusted returns between top and bottom portfolios in the crash period. Correspondingly, these findings also hold for normal market conditions since no statistical significance is observed in 2019.

Further, we expand research in this field by examining the impact of ESG and its pillar in explaining industry returns. Our results propose that ESG significantly explains industry returns, although, the ESG impact tends to vary between sub-periods and across industries. Additionally, our regression results also suggest that the Environmental and Governance pillars can be seen as the two primary pillars to affect the industry returns. Although our empirical results suggest that a complete ESG strategy does not lead to increased portfolio returns, we still believe an investor should consider ESG investing in the long run, at least for society. Nonetheless, without a uniform framework and methodology for the development of ESG scores, future research will only add to the line of ambiguous evidence. Therefore, the empirical question of whether ESG has a positive effect on portfolio return during market crises is still up for debate.

Lastly, we will end this thesis by providing avenues for future research. Considering that academic studies still provide mixed evidence of whether high ESG scores have a positive effect on stock performance, we believe there are considerable opportunities for future studies in this strand of research. First, it is possible to redo the same study by using a different data provider such as Bloomberg, Morningstar or MSCI, to evaluate the reliability of the ESG rating. Second, as Fama and French (2015) mention that the profitability of a firm is not reflected in the regression model, we believe that there are opportunities to implement additional factors, financial measures, such as return on assets (ROA), return on equity (ROE) or Tobin's q, to easier explain variability in returns. Third, although we did not obtain significant results during the COVID-19 market crash, the estimates were still positive. Therefore, it would be interesting if future research investigates inflows and outflows of ESG assets during COVID-19. Finally, it would be interesting to analyze a longer sample period or other stock markets to determine if our findings are general or specific to the Swedish stock market.

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Appendix

Appendix 1. A summary of literature examining the relationship between ESG and Financial Performance prior to COVID-19

Literature	Rating Agency	Period	Assets observed	Geographical area	Key Findings	Relationship*
Nofsinger and Varma (2014)	Morningstar	2000-2011	240 funds	U.S.	Overall alphas for SRI & conventional funds are significantly negative. In non-crisis periods, conventional funds outperform SRI with annual 0.67-0.95%. In crisis period, SRI funds outperform conventional ones (1.61-1.70%).	Mixed
Hartzmark and Sussman (2019)	Morningstar	2016-2017	34,000 mutual funds	U.S.	High-rated U.S. sustainable funds in comparison to low-rated sustainable funds, had a net inflow of money. No evidence of high-rated sustainable fund outperforming low-rated ones.	Insignificant
Lins *et al.* (2017)	MSCI ESG Database	2005-2013	1,673 stocks	U.S.	High CSR firms outperform low CSR with 4-7 percentage points during the financial crisis. No evidence of differences in stock return performance during the recovery period.	Mixed
Kempf and Osthoff (2007)	KLD ESG ratings	1992-2004	500-3,000 stocks	U.S.	Stocks with high ESG ratings yielded higher abnormal returns	Positive
Derwall *et al.* (2005)	CRSP Innovest Eco-effeciency scores	1995-2003	180-450 stocks	U.S.	A stock portfolio with high eco-efficiency scores outperforms a less eco-efficiency portfolio	Positive
Halbritter and Dorfleitner (2015)	Reuters, Bloomberg, KLD	1991-2012	Overall 6,452 stocks	U.S.	No differences in ESG portfolios consisting of high and low rated firms. Similar results for each pillar of ESG. The results vary depending on the use of ESG rating agency.	Insignificant
Renneboog, Ter Horst and Zhang. (2008b)	Bloomberg, Micropal & CRSP,	1991-2003	440 Equity mutual funds	U.S., U.K., Asia & Europe (17 countries)	SRI funds fails to exhibit superior alphas and strongly underperform their domestic benchmark (-2.2 to - 6.5%). No statistically differences in risk-adjusted return.	Negative
Callahan (2019)	Sustainanlytics	2014-2018	S&P 1500 (top 40, 30, 20% ESG firms)	U.S.	ESG factor contributes to a superior performance. However, 80% of the performance could be attributed to industry selection. Performance is industry-tilted (i.e. varies across industries)	Positive
Friede, Bush and Bassen (2015)	n/a	mid 1970-2014	Review study of 2,200 studies	Global	A clear evidence of positive ESG investing holds true for North America, Emerging markets and in particularly in non-equity assets	Mixed - 50% positive, 40% neutral and 10% negative

Notes: * demonstrates the relation of ESG with financial performance.

Appendix 2. A summary of literature examining the relationship between ESG and Financial Performance during COVID-19

Literature	Rating Agency	Period	Assets observed	Geographical area	Key Findings	Relationship*
Broadstock *et al.* (2020)	SynTao Green Finance	Jan 17, 2020 - Mar 31, 2020 (3, 5, 11 days event windows)	300	China	In general, high ESG portfolio outperforms low. ESG performance is mitigated during COVID-19, showing the importance of ESG during crisis. The E and G pillar have positive impact on the event window returns.	Positive
Diaz, Ibrushi and Zhao. (2020)	Bloomberg	Jan 2020–Apr 2020	n/a	U.S.	ESG performance significantly explains industry returns. Environmental and the Social pillar are the main drivers of industry returns. The impact of ESG varies across industries.	Positive
Ferriani and Natoli (2020)	Morningstar	Pre: Jan 20 – Feb 21, 2020 Crash: Feb 24 – Mar 27, 2020 Recovery: Mar 31 - May 1, 2020	2120 funds	Global	Low-ESG-risks funds outperforms their peers. Sustainable investing can be used as a valuable hedge during economic downturns.	Positive
Omura, Roca and Nakai (2020)	Refintiv DataScope	Pre: Jan 1, 2018 - Feb 1, 2020 Crash: Feb 1, 2020 - Jun 24, 2020	4 SRI indices, 24 funds	World, U.S., Japan, Europe SRI indices & U.S. ETFs	Greater performance of SRI funds and no outperforms regarding the ESG ETFs	Mixed – depending on SRI indices or ESG ETFs
Folger-Laronde *et al.* (2020)	Corporate Knights	Pre: Jan 11, 2019 - Feb 21, 2020 Crash: Feb 28, 2020 - Mar 3, 2020	278 ETFs	Canada	The ETFs do not outperform conventional funds. Sustainable investing does not guarantee resilience during crisis.	Negative
Hoang *et al.* (2020)	Bloomberg	Pre: August 2019 - Jan 2020 Crash: Feb 2020 – May 2020	197 stocks	U.K.	No evidence of over performance from high ESG rated portfolios. Howbeit, firms with high ESG scores are less volatile and more resilient to extreme shocks.	Negative

Notes: * demonstrates the outcome of the study and its relation with financial performance

Appendix 3. The stocks in the bottom and top ESG portfolios

Bottom ESG portfolio	Top ESG portfolio
AAK AB (publ)	AB SKF
Adapteo Oyj	AF Poyry AB
Alimak Group AB (publ)	Alfa Laval AB
Ambea AB (publ)	Arjo AB (publ)
Beijer Ref AB (publ)	Assa Abloy AB
Bergman & Beving AB	Atlas Copco AB
Betsson AB	Atrium Ljungberg AB
Bilia AB	Attendo AB (publ)
BioArctic AB	Avanza Bank Holding AB
Bonava AB (publ)	Axfood AB
Boozt AB	BillerudKorsnas AB (publ)
Bufab AB (publ)	Biogaia AB
Bure Equity AB	Biotage AB
Catena AB	Boliden AB
Catena Media PLC	Bravida Holding AB
CellaVision AB	Camurus AB
Cellink AB	Castellum AB
Cibus Nordic Real Estate AB (publ)	Coor Service Management Holding AB
Cloetta AB	Dometic Group AB (publ)
Collector AB	Dustin Group AB
CTT Systems AB	Electrolux AB
Dios Fastigheter AB	Elekta AB (publ)
Duni AB	Epiroc AB
Elanders AB	Essity AB (publ)
Eltel AB	Fabege AB
Eniro AB	Fastighets AB Balder
EQT AB	Getinge AB
Evolution Gaming Group AB (publ)	Granges AB
Fingerprint Cards AB	H & M Hennes & Mauritz AB
Fortnox AB	Hexagon AB
Haldex AB	Hoist Finance AB (publ)
Hansa Biopharma AB	Hufvudstaden AB
Hexpol AB	Humana AB
HMS Networks AB	Husqvarna AB
Holmen AB	ICA Gruppen AB
Industrivarden AB	Investor AB
Indutrade AB	Inwido AB (publ)
Instalco AB	JM AB
International Petroleum Corp	Kindred Group PLC
Intrum AB	Kinnevik AB
Investment AB Latour	Kungsleden AB
Investment Oresund AB	Lindab International AB
John Mattson Fastighetsforetagen publ AB	Lundin Energy AB
Kambi Group PLC	Mekonomen AB
Karo Pharma AB	MIPS AB
K-Fast Holding AB	Modern Times Group MTG AB
Klovern AB	Mycronic AB (publ)
L E Lundbergforetagen AB (publ)	NCC AB
LeoVegas AB (publ)	Nibe Industrier AB
Lifco AB (publ)	Nobia AB
Loomis AB	Nolato AB
Munters Group AB	Nordea Bank Abp
Nederman Holding AB	Nordic Entertainment Group AB
New Wave Group AB	Nyfosa AB
Oncopeptides AB	Pandox AB
Paradox Interactive AB (publ)	Ratos AB
Peab AB	Recipharm AB (publ)
Powercell Sweden AB (publ)	Saab AB
Probi AB	Sandvik AB
RaySearch Laboratories AB (publ)	Scandic Hotels Group AB
Resurs Holding AB (publ)	Securitas AB
Sagax AB	Skandinaviska Enskilda Banken AB
Samhallsbyggnadsbolaget I Norden AB	Skanska AB
Scandi Standard AB (publ)	Sweco AB (publ)
Sedana Medical AB (publ)	Swedbank AB
Sinch AB (publ)	Swedish Match AB
SkiStar AB	Swedish Orphan Biovitrum AB (publ)
SSAB AB	Svenska Cellulosa SCA AB
Stillfront Group AB (publ)	Svenska Handelsbanken AB
Storytel AB (publ)	Telefonaktiebolaget LM Ericsson
Svedbergs i Dalstorp AB	Telia Company AB
Tele2 AB	Thule Group AB
Troax Group AB (publ)	Tobii AB
VBG Group AB (publ)	Trelleborg AB
Volati AB	Wallenstam AB
	Wihlborgs Fastigheter AB
	Vitrolife AB
	Volvo AB

Appendix 4. Industry distribution

GICS Industry	N	Proportion in the sample (%)
Basic Material	8	5.23
Comsumer Discretionary	28	18.3
Consumer Staples	8	5.23
Energy	2	1.3
Financials	18	11.76
Health Care	21	13.73
Industrial	37	24.18
Real Estate	21	13.73
Technology	6	3.92
Telecommunications	4	2.61
SUM	153	100

Appendix 5. Industry-neutralized portfolio construction

I. Define m as the median for the ESG score within industry i
II. Rank each stock as top ($\overline{ESG}$) or bottom ($\underline{ESG}$) according to following rule:

$$\overline{ESG} = \begin{cases} 1 \ \forall \ ESG_i \geq m \\ 0 \ otherwise \end{cases}$$

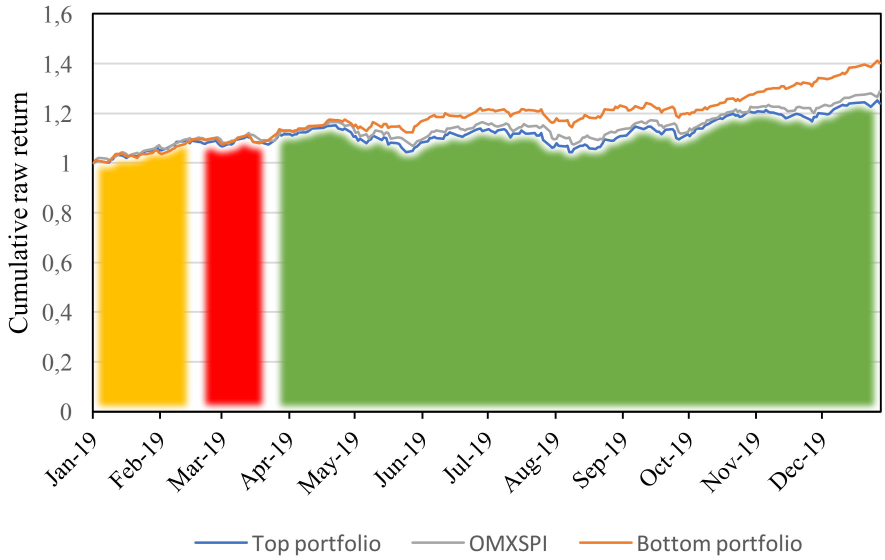
$$\underline{ESG} = \begin{cases} 1 \ \forall \ ESG_i \leq m \\ 0 \ otherwise \end{cases}$$

Appendix 6. Correlation matrix for Fama-French three-factor model 2020

Panel A: Full period	**MKT**	**SMB**	**HML**	**ESG**
MKT	1			
SMB	-0.35388	1		
HML	0.001299	0.001733	1	
ESG	-0.02509	-0.28026	0.392407	1
Panel B: Pre-crash	**MKT**	**SMB**	**HML**	**ESG**
MKT	1			
SMB	-0.60224	1		
HML	-0.23102	0.215491	1	
ESG	0.071593	-0.23225	0.361434	1
Panel C: Crash	**MKT**	**SMB**	**HML**	**ESG**
MKT	1			
SMB	-0.11559	1		
HML	-0.48662	0.11293	1	
ESG	-0.25741	-0.46658	-0.00167	1
Panel D: Recovery	**MKT**	**SMB**	**HML**	**ESG**
MKT	1			
SMB	-0.57115	1		
HML	0.13299	-0.06842	1	
ESG	0.167784	-0.20027	0.531969	1

Notes: The underlying assumption for no-multicollinearity is often considered to be violated if the correlation between two independent variables are above 0.9 or below (-0.9) (Field, 2014). The table suggests that the assumption is not violated and no alteration for multicollinearity is therefore considered in this thesis.

Appendix 7. The cumulative raw return for the portfolios - 2019



Notes: The Figure illustrates the cumulative raw return for the top and bottom portfolios and OMXSPI. The light yellow shaded area illustrates the pre-crash period (January 8, 2019 – February 21, 2019), red shaded area illustrates crash period (February 22, 2019 – March 29, 2019) and green the recovery period (April 1, 2019 – January 3, 2020).

Appendix 8. The Sharpe ratios for top and bottom portfolios - 2019

	Full period	Pre-crash	Crash	Recovery
Sharpe ratio				
Top portfolio	1.78	2.22	0.20	1.58
Bottom portfolio	3.03	2.56	0.51	2.29

Notes: The table presents the Sharpe ratios for the top and bottom portfolio (value-weighted). Column 1 examines the full period (January 8, 2019 – January 3, 2020). Column 2 examines the period before the market crash (January 8, 2019 – February 21, 2019). Column 3 examines the crash period (February 22, 2019 – March 29, 2019) and column 4 examines the recovery period (April 1, 2019 – January 3, 2020).

Appendix 9. The difference in return between top and bottom portfolios - 2019

	Full period	Pre-crash	Crash	Recovery
Diff. Return top-bottom (%)	-0.045	-0.013	-0.045	-0.051
	(0.1001)	(0.8510)	(0.5589)	(0.1174)
# Of Trading days	247	33	25	189

Notes: The table presents the t-tests comparing the differences in return between the top and bottom portfolios (value-weighted). Column 1 examines the full period (January 8, 2019 – January 3, 2020). Column 2 examines the period before the market crash (January 8, 2019 – February 21, 2019). Column 3 examines the crash period (February 22, 2019 – March 29, 2019) and column 4 examines the recovery period (April 1, 2019 – January 3, 2020). Diff. return equals the difference in daily log returns in percentage between the top and bottom portfolios. P-values are presented in the parenthesis. ***, ** and * demonstrate that the coefficient is significant at the 10, 5 and 1% levels.

Appendix 10. The results from the Fama-French three-factor model for top and bottom portfolios - 2019

	Bottom ESG portfolio				**Top ESG portfolio**			
	Full period	**Pre-crash**	**Crash**	**Recovery**	**Full period**	**Pre-crash**	**Crash**	**Recovery**
Alpha	0.0006***	0.0006	0.0003	0.0007***	-0.0003***	--0.0005*	-0.0003	-0.0003***
	(0.005)	(0.417)	(0.663)	(0.008)	(0.000)	(0.069)	(0.281)	(0.000)
$\beta_1(MKT)$	0.8550***	0.7786***	1.0051***	0.8545***	1.0683***	1.1192***	1.0367***	1.0683***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\beta_2(SMB)$	-0.0458	-0.2421**	0.0194	-0.0235	0.0202*	0.1078*	0.0485	0.0078
	(0.217)	(0.034)	(0.909)	(0.559)	(0.096)	(0.052)	(0.487)	(0.518)
$\beta_3(HML)$	-0.0256	-0.0571	0.2518	-0.0693	0.1228	-0.0047	-0.0396	0.0219
	(0.646)	(0.623)	(0.250)	(0.265)	(0.417)	(0.852)	(0.708)	(0.188)
# Of Trading days	247	33	25	189	247	33	25	189

Notes: The dependent variables used in this regression are the log return for the top portfolio and bottom portfolio (value-weighted). The regression uses robust standard errors. Column 1 examines the full period (January 8, 2019 – January 3, 2020). Column 2 examines the period before the market crash (January 8, 2019 – February 21, 2019). Column 3 examines the crash period (February 22, 2019 – March 29, 2019) and column 4 examines the recovery period (April 1, 2019 – January 3, 2020). MKT is the OMXSPI return, SMB is the size factor, and HML is the value factor. P-values are presented in parentheses. ***, ** and * demonstrate that the coefficient is significant at the 10, 5 and 1% levels.

Appendix 11. The difference in Sharpe ratio between the top and bottom portfolios 2019

	Full period	**Pre-crash**	**Crash**	**Recovery**
Diff. Sharpe	-0.0953***	-0.0757	-0.0693	-0.1023**
	(0.0068)	(0.3373)	(0.5809)	(0.0128)
# Of Trading days	247	33	25	189

Notes: The table presents the t-tests comparing the differences in simplified Sharpe between the top and bottom portfolio (value-weighted). Column 1 examines the full period (January 8, 2019 – January 3, 2020). Column 2 examines the period before the market crash (January 8, 2019 – February 21, 2019). Column 3 examines the crash period (February 22, 2019 – March 29, 2019) and column 4 examines the recovery period (April 1, 2019 – January 3, 2020). Diff. return equals the difference in daily log returns in percentage between the top and bottom portfolio. P-values are presented in the parenthesis. ***, ** and * demonstrate that the coefficient is significant at the 10, 5 and 1% levels.

Appendix 12. The regression equations and results for each of the E, S and G pillar

$$R_i = \alpha + \beta_1 MKT + \beta_2 SMB + \beta_3 HML + \beta_4 E + \epsilon_i \quad (7)$$

$$R_i = \alpha + \beta_1 MKT + \beta_2 SMB + \beta_3 HML + \beta_4 S + \epsilon_i \quad (8)$$

$$R_i = \alpha + \beta_1 MKT + \beta_2 SMB + \beta_3 HML + \beta_4 G + \epsilon_i \quad (9)$$

Where R_i is the excess return of industry i. a_i is the return that is not explained by any of the risk factors. $\beta_{1,i}$ represents the market beta, i.e. the sensitivity of industry i to the market factor. MKT is interpreted as the excess return of the market. $\beta_{2,i}$ and $\beta_{3,i}$ describes the sensitivity of industry i to SMB and HML factors in period t. E, S and G is the spread in daily return between the top and bottom portfolios for each pillar. Lastly, the $\epsilon_{i,t}$ factor is the firm-specific risk component

	Alpha	$\beta 1(MKT)$	$\beta 2(SMB)$	$\beta 3(HML)$	$\beta 4(E)$
Panel A: Full period					
Basic Materials	0.0005	1.0037***	-0.2778***	0.2272***	-0.0483
Consumer Discretionary	-0.0005	0.7015***	0.3130***	0.3139***	0.2218**
Consumer Staples	-0.0008	0.5613***	-0.2070	-0.2310*	-0.5057***
Energy	-0.0019	1.4699***	0.3538	0.1223	0.7331**
Financials	-0.0001	1.1292***	0.1952***	0.2586***	0.1275***
Health Care	-0.0006	0.8258***	0.0012	-0.7011***	-0.3326***
Industrials	0.0002	0.9769***	-0.3059***	-0.1391**	0.4208***
Real Estate	-0.0012	1.1229***	0.6556***	0.1939	-0.2998**
Technology	0.0014**	1.0186***	-0.4238***	-0.3084***	-0.2207***
Communications	-0.0003	0.8325***	-0.2234	0.0827	-0.3152
Panel B: Pre-crash					
Basic Materials	-0.0015	1.4629***	-0.5321**	0.7434**	-0.4018
Consumer Discretionary	0.0004	0.3384	-0.1827	0.8316***	0.1887
Consumer Staples	0.0009	0.4665***	-0.4922*	0.1226	-0.4554*
Energy	-0.0042**	1.2736***	-0.8578**	-0.0738	-0.9523**
Financials	0.0010	1.2948***	0.7086***	0.3014	0.3592*
Health Care	-0.0006	1.0664***	-0.0762	-0.3883	-0.2400
Industrials	-0.0006	0.9285***	-0.5376***	-0.1883	0.0258
Real Estate	0.0017	0.9374***	0.3813*	-0.0913	-0.6324**
Technology	0.0008	1.2293***	-0.5093	0.0820	-0.5090
Communications	-0.0001	0.6739**	0.4936	-0.4455	0.5018
Panel C: Crash					
Basic Materials	0.0025	1.0667***	-0.4624**	0.3279	0.0504
Consumer Discretionary	-0.0027	0.6736***	0.5317	-0.0848	0.4428
Consumer Staples	0.0031	0.6611***	-0.4480	0.1172	-0.8420
Energy	0.0046	1.8267***	0.0299	1.0284	0.5877
Financials	0.0020	1.1423***	0.3440	0.5318**	0.1688
Health Care	-0.0026	0.8118***	-0.1813	-0.9143	-0.5079**
Industrials	-0.0027	0.9069***	-0.3794*	-0.3898	0.4953**
Real Estate	0.0013	1.2506***	1.2625***	0.1352	0.2606
Technology	0.0009	1.0180***	-0.8624***	0.8293**	0.4203*
Communications	0.0036	0.9543***	-0.5489	0.2402	-1.0039*
Panel D: Recovery					
Basic Materials	0.0006	0.9233***	-0.2105**	0.2335**	-0.0173
Consumer Discretionary	-0.0002	0.6880***	0.2246***	0.3375***	0.1466
Consumer Staples	-0.0012	0.5035***	-0.1217	-0.3587***	-0.3213***
Energy	-0.0004	0.9808***	0.1575	0.0090	1.1657***
Financials	-0.0004	1.1248***	0.1137	0.2172***	0.1379*
Health Care	-0.0006	0.8190***	0.0887	-0.7462***	-0.2761**
Industrials	0.0003	1.1051***	-0.2160***	-0.1046**	0.3624***
Real Estate	-0.0015*	1.1654***	0.4027***	0.3729**	-0.4777***
Technology	0.0016**	1.1226***	-0.1923	-0.3676***	-0.3648***
Communications	-0.0007	0.7419***	-0.2316**	0.0177	-0.1052*

	Alpha	β1(MKT)	β2(SMB)	β3(HML)	β4(S)
Panel A: Full period					
Basic Materials	0.0005	1.0026***	-0.3060***	0.2550***	-0.1139
Consumer Discretionary	-0.0005	0.7244***	0.3074***	0.3677***	0.1364
Consumer Staples	-0.0008	0.5036***	-0.1523	-0.4098***	-0.1911
Energy	-0.0019	1.5322***	0.4366*	0.1638	0.7398**
Financials	-0.0001	1.1393	0.2153***	0.2583***	0.1450**
Health Care	-0.0006	0.7961***	-0.0151	-0.7332***	-0.3084***
Industrials	0.0002	1.0158***	-0.2813***	-0.0842	0.3596***
Real Estate	-0.0012	1.2120***	0.5584***	0.2616**	-0.4844***
Technology	0.0014**	1.0044***	-0.4842***	-0.2735***	-0.3248**
Communications	-0.0003	0.7934***	-0.1646	-0.0617	-0.0484
Panel B: Pre-crash					
Basic Materials	-0.0015	1.4742***	-0.4904**	0.7560***	-0.4148
Consumer Discretionary	0.0003	0.3457	-0.2295	0.8548***	0.0391
Consumer Staples	0.0003	0.4489***	-0.3569	0.0428	0.0332
Energy	-0.0041*	1.2320***	-0.7083*	-0.0980	-0.6935**
Financials	0.0010	1.3103***	0.6440***	0.3161	0.3216
Health Care	-0.0005	1.0568***	0.0475	-0.4131	-0.0746
Industrials	-0.0006	0.9301***	-0.5317***	-0.1983	0.0758
Real Estate	0.0018	0.9088***	0.4611*	-0.0865	-0.5720**
Technology	0.0009	1.2017***	-0.4268	0.0662	-.03557
Communications	0.0001	0.6968**	0.4342	-0.4534	0.4760
Panel C: Crash					
Basic Materials	0.0021	1.0637***	-0.5304**	0.2847	-0.0986
Consumer Discretionary	-0.0025	0.7150***	0.6982	-0.0309	0.5884*
Consumer Staples	0.0041	0.6092***	-0.4625	0.1860	-0.5431
Energy	0.0034	1.8537***	-0.0632	0.9217	0.1822
Financials	0.0020	1.1574***	0.4002	0.5482**	0.2103
Health Care	-0.0029	0.7631***	-0.3857	-0.9838	-0.7004***
Industrials	-0.0030	0.9436***	-0.3015	-0.3910	0.4516**
Real Estate	0.0013	1.2721***	1.3272***	0.1481	0.2828
Technology	0.0005	1.0441***	-0.8533***	0.7960**	0.2746
Communications	0.0041	0.8795***	-0.7107	0.2403	-0.9229
Panel D: Recovery					
Basic Materials	0.0006	0.9295***	-0.2215**	0.2619***	-0.0713
Consumer Discretionary	-0.0003	0.7189***	0.2148***	0.4218***	0.0120
Consumer Staples	-0.0011*	0.4347***	-0.0992	-0.5471***	-0.0196
Energy	-0.0003	1.0594***	0.2864	0.0262	1.2853***
Financials	-0.0003	1.1331***	0.1302*	0-2153***	0.1592**
Health Care	-0.0006	0.7886***	0.0728	-0.7963***	-0.2205
Industrials	0.0003	1.0904***	-0.1938***	-0.0427	0.2966***
Real Estate	-0.0016*	1.1587***	0.3184**	0.4654***	-0.7081***
Technology	0.0015**	1.1083***	-0.2452	-0.3330***	-0.4750***
Communications	-0.0005	0.6911***	-0.1894	-0.1540	0.1941

	Alpha	$\beta 1(MKT)$	$\beta 2(SMB)$	$\beta 3(HML)$	$\beta 4(G)$
Panel A: Full period					
Basic Materials	0.0005	0.9979***	-0.2653***	0.2017***	0.0052
Consumer Discretionary	-0.0005	0.6683***	0.1507***	0.4186***	-0.6612***
Consumer Staples	-0.0008	0.5529***	0.0156	-0.4872***	0.6187***
Energy	-0.0020	1.6740***	0.3673	0.5325**	1.1553**
Financials	-0.0001	1.1455***	0.1639**	0.3261***	-0.0044
Health Care	-0.0006	0.8087***	0.1390	-0.8720***	0.2844**
Industrials	0.0002	1.0295***	-0.4114***	0.0835	-0.0274
Real Estate	-0.0011	1.1335***	0.6288***	0.0232	-0.6036***
Technology	0.0014**	0.9498***	-0.4404***	-0.4338***	-0.4257**
Communications	-0.0003	0.9073***	0.0552	-0.0603	1.2402***
Panel B: Pre-crash					
Basic Materials	-0.0016	1.4841***	-0.4472**	0.6594***	-0.3970
Consumer Discretionary	-0.0007	0.3546*	-0.2797	0.8339***	-0.5860
Consumer Staples	0.0006	0.4418***	-0.3260	0.0728	0.4961
Energy	-0.0037	1.2369***	-0.5808*	-0.2236	0.0835
Financials	0.0010	1.3060***	0.6170**	0.3662*	0.1423
Health Care	0.0001	1.0443***	0.1227	-0.3867	0.8403
Industrials	-0.0006	0.9302***	-0.5486***	-0.1865	-0.0488
Real Estate	0.0018	0.9189***	0.5373**	-0.2089	0.3218
Technology	0.0006	1.2159***	-0.4164	-0.0338	-0.7011
Communications	0.0006	0.6765***	0.4270	-0.3151	1.0287*
Panel C: Crash					
Basic Materials	0.0024	1.0699***	-0.4779**	0.3171	0.0148
Consumer Discretionary	-0.0035	0.5990***	0.3444	-0.3756	-0.8274***
Consumer Staples	0.0048	0.7383***	-0.1247	0.5464	0.9693**
Energy	0.0028	1.8894***	-0.1365	0.9520	0.4134
Financials	0.0015	1.1787***	0.3056**	0.5451*	0.2910
Health Care	-0.0016	0.8729***	0.0210	-0.6276	0.7206*
Industrials	-0.0039	0.8793***	-0.5605***	-0.6080*	-0.4128*
Real Estate	0.0010	1.1716***	1.1344***	-0.1031	-0.8154***
Technology	-0.0003	1.0805***	-0.9725***	0.8085**	0.4604
Communications	0.0055	1.1004***	-0.1360	0.8555	1.6617***
Panel D: Recovery					
Basic Materials	0.0007	0.9243***	-0.1995**	0.2225***	0.0499
Consumer Discretionary	-0.0003	0.6574***	0.0878	0.4319***	-0.6498***
Consumer Staples	-0.0011*	0.4876***	0.0140	-0.5609***	0.5714***
Energy	-0.0012	1.3986***	0.3754	0.7232***	1.6234**
Financials	-0.0004	1.1414***	0.0746	0.3035***	-0.1453
Health Care	-0.0004	0.7662***	0.1282	-0.9179***	0.0890
Industrials	0.0001	1.1424***	-0.2252***	0.1194**	0.1046
Real Estate	-0.0011	0.9993***	0.3236**	0.0799	-0.6122***
Technology	0.0019***	0.9847***	-0.2745	-0.5907***	-0-5811***
Communications	-0.0007	0.8316***	0.0001	-0.0535	1.1617***

Appendix 13. The difference in return between top and bottom portfolios (equal-weighted)

	Full period	Pre-crash	Crash	Recovery
Diff. Return top-bottom (%)	-0,052	0,000	-0,035	-0,063*
	(0.1152)	(0.9994)	(0.7939)	(0.0939)
# Of Trading days	251	33	27	191

Notes: The table presents the results of the paired t-tests comparing differences in return between the top and bottom portfolio (equal-weighted). Column 1 examines the full period (January 7, 2020 – January 5, 2021). Column 2 examines the period before the market crash (January 7, 2020 – February 21, 2020). Column 3 examines the difference in return during the crash (February 24, 2020 – March 31, 2020) and column 4 examines the recovery period (April 1, 2020 – January 5, 2021). Diff. return equals the difference in daily log returns in percentage between top and bottom firms. P-values are presented in parentheses. ***, **, and * demonstrate that the coefficient is significant at the 10, 5 and 1% levels.

Appendix 14. The results from the Fama-French three-factor model for top and bottom portfolios (equal-weighted)

	Bottom ESG portfolio				Top ESG portfolio			
	Full period	**Pre-crash**	**Crash**	**Recovery**	**Full period**	**Pre-crash**	**Crash**	**Recovery**
Alpha	0.0000	-0.0005	-0.0007	0.0005	-0.0002	-0.0001	-0.0019	0.0002
	(0.882)	(0.562)	(0.687)	(0.137)	(0.439)	(0.789)	(0.184)	(0.385)
$\beta_1(MKT)$	1.0489***	1.0320***	1.0653***	1.0132***	1.0564***	1.0071***	1.0501***	1.0321***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\beta_2(SMB)$	0.5749***	0.4795*	0.6759***	0.4843***	0.2241***	0.0441	0.2960**	0.1709***
	(0.000)	(0.005)	(0.002)	(0.000)	(0.000)	(0.680)	(0.046)	(0.000)
$\beta_3(HML)$	-0.1782***	-0.1246	0.0575	-0.2179***	0.0944**	0.0549	0.0838	0.0843*
	(0.003)	(0.474)	(0.888)	(0.000)	(0.017)	(0.611)	(0.703)	(0.064)
# Of Trading days	251	33	27	191	251	33	27	191

Notes: The dependent variables used in this regression are the log return for top portfolio and bottom portfolios (equal-weighted). The regression uses robust standard errors. Column 1 examines the full period (January 7, 2020 – January 5, 2021). Column 2 examines the period before the market crash (January 7, 2020 – February 21, 2020). Column 3 examines the period during the crash (February 24, 2020 – March 31, 2020) and column 4 examines the recovery period (April 1, 2020 – January 5, 2021). MKT is the OMXSPI return, SMB is the size factor, and HML is the value factor. P-values are presented in parentheses. ***, **and * demonstrate that the coefficient is significant at the 10, 5 and 1% levels.

Appendix 15. The difference in Sharpe ratio between top and bottom portfolios (equal-weighted)

	Full period	Pre-crash	Crash	Recovery
Diff. Sharpe	-0.0480*	-0.0392	-0.0180	-0.0537*
	(0.0588)	(0.7014)	(0.7270)	(0.0518)
# Of Trading days	251	33	27	191

Notes: The table presents the results of the paired t-test comparing the simplified Sharpe ratio of the top and bottom portfolios (equal-weighted). Column 1 examines the full period (January 7, 2020 – January 5, 2021). Column 2 examines the period before the market crash (January 7, 2020 – February 21, 2020). Column 3 examines the market crash (February 24, 2020 – March 31, 2020) and column 4 examines the recovery period (April 1, 2020 – January 5, 2021). Diff. Sharpe equals the difference in the simplified Sharpe ratio between top and bottom portfolio. P-values are presented in parentheses ***. ** and * demonstrate that the coefficient is significant at the 10, 5 and 1% levels.