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School of Economics and Management

Do ESG scores matter in the market?

Environmental, Social and Governance performance in relation to stock returns and profitability in European Market

by

Yea Eun Jang

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Abstract

This paper examines the effect of European corporates' sustainability performance on their economic and financial performance. The sustainability performance is represented by ESG scores in this paper. ESG evaluates the sustainability performance in environmental, social and governance aspects. The financial performance is measured as the average monthly stock return from January 2002 to July 2018. For the economic performance, sales, operating margin and return on invested capital (ROIC) are employed. To evaluate the significance of the effect of ESG ratings on economic and financial performance, econometric analyses based on capital asset pricing model is conducted as main methodologies: cross-sectional regressions and multifactor model using factor mimicking portfolios according to Fama and French (1992; 1993). The main result of the first analysis extrapolates that ESG score has a significant and negative influence on both economic and financial performance of European corporations. The results from second analysis asserts that ESG can contribute to generate risk adjusted returns.

Keywords Sustainability · ESG score · Stock performance · Profitability · Fama-French risk factors · CAPM · Multifactor model · European stock market

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1. Introduction

Since European Climate Change Program (ECCP) launched in 2002, the focus on climate change and depletion of resources has increased and spread rapidly. This consequently drew the attention of shareholders and investors to corporate social responsibility and responsible investing with regard to the commission in UN Principles for Responsible Investment (PRI) in 2006. This global trend has led into reporting and evaluating corporate sustainability performance in detail, more specifically environmental (e.g. resource management, emission, energy saving, etc.), social (e.g. policies for employee, product responsibility, etc.) and governance (e.g. board management, shareholder rights, etc.) aspects, collectively ESG performance (Amel-Zadeh & Serafeim, 2018).

As a result, nearly 92 % of the world's largest companies have reported their sustainability performance according to GRI reports (2018) [1]. Furthermore, this influenced financial institutions significantly and broadened the use of ESG for credit assessment by banks and credit rating agencies. While this accentuates the importance of ESG ratings worldwide, the question arises regarding its effect on economic value of corporations. The possible economic consequences from ESG can be either positive or negative. Positive effect may be caused by factors such as, reputational management, developing new technology, saving cost of energy and earning market share. Nevertheless, implementation cost of sustainable development and low expectation towards market rewards may induce the negative effect of ESG.

The purpose of this paper is to conduct an empirical study to investigate the effect of ESG implementation on firms' economic and financial performance in developed European market. The paper aims to achieve new results that contribute to the research field related to sustainable finance, specifically to relatively new ESG ratings.

Research regarding sustainability index and its relation to financial performance has increased along with rising importance of ESG to mainstream investors. However, most of the preceding literature focused on the single aspect of environmental, social and governance performance and the results were contradictory (Hamilton, 1995; Klassen & McLaughlin, 1996; Cohen et al., 1997; McWilliams & Siegel, 2000; Konar & Cohen, 2001; Lorraine et al., 2004; Core et al., 2006; Godfrey et al., 2009). Accordingly, few prior research has been conducted

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[1] Global Reporting Initiative, https://www.globalreporting.org/information/sustainability-reporting/pages/gri-standards.aspx G&A, Inc. also provides supporting evidence of increasing sustainability reporting, using an example of S&P 500 listed firms. (see *Figure A1* in Appendix)

specifically examining available ESG scores on the financial performance of corporations (Mănescu, 2011).

While ESG evaluation is measured by an extensive number of rating providers such as, Bloomberg, Dow Jones and MSCI, this paper uses Thomson Reuters ESG Score as an indicator of a firm's ESG performance. Furthermore, to evaluate the value of ESG effect in a company's economic and financial performance, average stock return, net sales, operating margin and ROIC of European corporations from 2002 to 2018 are selected in our analysis. The choice of stock performance is motivated from the valuation principle that stock price represents the present value of a firm's discounted future cash flows. Moreover, net sales and operating margin represent economic performance, and ROIC stands for the most representative profitability measure of corporations following valuation principle. It is worthy to note that the main analyses of this paper focus on stock performance.

Using this dataset, the econometric analyses are employed based on capital asset pricing model (CAPM). The main methodologies applied in this paper are mainly inspired by Ziegler et al. (2007) and Mănescu (2011). Firstly, cross-sectional regressions are exercised on average monthly stock returns and selected economic performance indicators with ESG scores and risk-related control variables based on methodology applied by Fama and French (1992). By regressing with such control variables, it is possible to deduce the effect of ESG scores on economic / financial performance and its significance. As the second approach, Fama and French (1993) multifactor model is implemented by time-series regression. To establish the model, a stock portfolio is fabricated based on the ranking of ESG scores and is regressed on two estimated risk factors along with market returns. In this paper, a momentum factor from Carhart (1997) is treated as an additional explanatory variable in the model. In addition to these methodologies, pooled regression with dummy variables is conducted to study if the effect differs across industries or countries. This paper uniquely explores regressing stock returns on three pillar scores, i.e. environmental, social and governance scores to separately examine the effect of these pillar scores. This additional methodology enables to see which score has the most significant impact on firms' stock performance.

The main results of the analyses show a significant and negative effect of ESG scores on the average monthly stock returns of European corporations from January, 2002 to July, 2018. This suggests that firms with lower ESG scores tend to outperform in the stock market compared to those with higher ESG scores. Furthermore, by plotting the estimated coefficients from the cross-sectional regressions, we can infer that ESG may negatively react to potential shock from the financial crisis. Furthermore, by controlling industry effect of ESG data, it is possible to conclude that market does not reward ESG performance. This is consistent with the result of risk mimicking portfolio analysis using Fama and French (1993), which implies that high ESG portfolio has negative risk-adjusted returns. Moreover, by controlling country level of ESG effect, we could confirm that negative impact of ESG scores is consistent overall European countries. However, it is interesting to note that Nordic companies except Finnish firms, show that there are insignificant, yet positive ESG effect. Finally, from the regressions with economic variables, a positive effect on sales and operating margin is confirmed, which may show that ESG helps to gain market share. On the other hand, the result with ROIC contradicts to these results. We found that there may be cost of implementing ESG performance, which results in a negative effect on ROIC.

The structure of this paper is organised as follows. A literature review provides the fundamental framework of the research, particularly concerning methodological approaches and measures for the sustainability and financial performance in chapter 2. Chapter 3 clarifies used data and variables and why they were used in following methodologies. Chapter 4 presents the theoretical framework applied on this study, while explaining the econometric analysis in detail. The results using the discussed methodologies are presented and used in further discussion regarding the main findings in chapter 5. Finally, in the last and sixth chapter, the summary of the results and the conclusion are drawn.

2. Literature Review

In this chapter, a detailed literature review, in respect of prior research examining the effect of sustainability criteria of corporations explicitly on their financial performance, is evaluated to supplement a rationale behind methodological approaches and specific data choices.

2.1 Methodological Approaches

Two main methodological approaches in this paper are cross-sectional regressions and factor mimicking portfolio. These methods are mainly inspired by Ziegler et al. (2007) and by Mănescu (2011) who analysed the correlation between corporates sustainability performance and financial performance. The cross-sectional regressions are based on time-series regression of asset pricing models and are further improved for other risk factors than undiversifiable risks. The portfolio analysis is based on factor mimicking portfolio to test if sustainability performance can contribute to generate risk adjusted return. Alternative approaches are also discussed, and the discussion supports to understand why the applied approaches are selected.

2.1.1 Event Study Approach

One of the most common approaches to analyse the effect of environmental, social and governance performance on financial performance is event study. Event study methodology is a statistical method to investigate the announcement effect of an economic event or news on the value of a firm. The basic mechanism of this method is to first define specific dates of the events and then to construct a measure of economic impact of the events, using asset prices observed over relatively short amount of period, mostly a couple of days. Additionally, the method is implemented by assuming efficient stock market in respect of reflecting current information and expectations.

Through this methodological approach, it is possible to examine how market, investors, and shareholders react to certain economic news or announcements. Some prior research has been carried out using this methodology, mainly focusing on the relationship between environmental performance and financial performance. For example, Hamilton (1995) implements an event study to evaluate the stock market reaction regarding Toxics Release Inventory (TRI) pollution information. The study concludes that there is a statistical significance, and abnormal return is negatively related with TRI pollution. Similarly, Klassen and McLaughlin (1996), Konar and Cohen (1997) and Lorraine et al. (2004) provide the study regarding the relationship between environmental performance and stock performance through event study. The results from Konar and Cohen (1997) indicate that public announcement of TRI emissions significantly relates to negative abnormal returns. Furthermore, Klassen and McLaughlin (1996) insinuate that strong environmental performance is relevant to significantly positive abnormal stock returns, which directs similar inference with Konar and Cohen (1997). Lorraine et al. (2004), however, deduce that there are only weak connection between abnormal returns and an announcement of Environmental Agency (EA). While a number of researches has been conducted to evaluate the effect of environmental performance, there is only few research concerning overall corporates social responsibility (CSR) and its value for shareholders, using an event study approach (Godfrey et al., 2009).

Other papers such as, Reddy and Gordon (2010), Cheung (2011) and Obendorfer et al. (2013) focus on relatively more integral aspect of sustainability performance and its relationship with stock index. Reddy and Gordon (2010) suggest that sustainability reporting, especially CSR type of report, has a significant explanatory power for abnormal returns. On the other hand, both Cheung (2011) and Obendorfer et al. (2013) conduct a comparative analysis to scrutinize the impact of inclusion and exclusion of sustainability index. Both studies find a weak significance on stock returns and risk, nevertheless, each concludes opposite direction of one another. While Cheung (2011) maintains that the event announcement causes a temporary increase on stock return, Obendorfer et al. (2013) highlight a presence of negative effect with sustainability indices inclusion.

In spite of the fact that these papers delve in to effect of sustainability with more comprehensive prospects, the conclusions are contradicting each other. The similar issue is found in other researches that analyse one aspect of sustainability performance, e.g. TRI emission. Furthermore, Mcwilliams et al. (1999) point out another weakness of the event study approach. The study criticises the sensitiveness of event study to minor changes in research design and implementation, with respect to assessing the overall impact of CSR on stakeholders. The paper suggests that the methodology could cause false inference for the significance of events and draw inappropriate conclusions.

Since event study method mostly operates daily observations, the method mainly captures a short-term reaction of market towards new information. This implies that the significant effect on stock prices found with this methodology could potentially decay over time. As a result, event study has a shortcoming that it does not account for the long-term reaction of market. Concerning this limitation, alternative methodologies are rather implemented in this paper to evaluate a longer observation of accumulated effects on firms' economic and financial performance.

2.1.2 Portfolio Analysis

Another methodological approach, which has been commonly used is the portfolio analysis. In previous research, this method has been implemented to study the relationship between sustainability and financial performance by building portfolios using sustainability criteria, such as pollution (Cohen et al., 1997), Social Responsible Investing (SRI) Funds (Schröder, 2004; Kempf & Osthoff, 2007) and ESG ratings (Mănescu, 2011). After building portfolios, the analysis can be continued by evaluating the performance of portfolios or by running time-series or cross-sectional regressions with other risk factors. Cohen et al. (1997) construct two portfolios of low and high polluter and examine the reaction of individual firms and stock markets using both accounting returns and stock returns. Similarly, Schröder (2004), Kempf and Osthoff (2007) and Mănescu (2011) build a portfolio based on the level of sustainability performance. Schröder (2004) tests the performance of SRI investment funds and indices, using Sharpe ratio and Jensen's alpha to compare the performance of SRI equity with traditional investments. Kempf and Osthoff (2007) divide SRI ratings in three different screens to form two-value weighted portfolios, high-rated and low-rated, and investigate whether investors can improve their investments by using these portfolios in the trading strategy. Mănescu (2011) uses risk factor mimicking portfolios inspired by Fama and French (1993). In the paper, the sample firms were arranged over different size, growth, value and sustainability criteria. After sorting samples, monthly average portfolio returns are value-weighted and regressed using time-series analysis.

Ziegler et al. (2007) also use similar method of constructing factor mimicking portfolios. In their analysis, the shortcoming of general portfolio analysis is pointed out, of which the methodology can only apply univariate statistical methods. Due to this weakness of the approach, the research further stresses the comparative advantage of multifactor model using factor mimicking portfolios. Unlike the research by Mănescu (2011), Ziegler et al. (2007) build portfolios based on the level of book-to-market value ratios and median of market capitalizations. Considering the drawback mentioned by previous research, we adopt a multifactor model with risk factor mimicking portfolios to examine the effect of ESG on risk-adjusted return.

2.1.3 Cross-sectional Regression Analysis

Ziegler et al. (2007) further apply cross-sectional regressions of the average monthly stock returns on sustainability performance variables using estimated parameters from above mentioned multifactor models. In the paper, the Sharpe-Lintner CAPM is implemented to capture non-diversifiable risk for each sample company. As mentioned in previous section, multifactor model from Fama and French (1993) is applied to supplement the weak explanatory power of the market-beta parameter in stock returns' cross-sectional variation. Through multifactor model, it is possible to examine additional risk factors, which have a relatively strong explanatory power than market risk and can supplement the limitation of CAPM. Factor mimicking portfolios are constructed based on the level of book-to-market and market capitalization (size of the corporations), which are defined as proxies for common risk factors in returns according to Fama and French (1993). The factor-based model is run as time-series regressions on stock portfolios and used for qualitative comparison of estimated parameters across the portfolios. However, Ziegler et al. (2007) use this approach to reallocate each sample firm to created portfolios and to compute value-weighted returns of corresponding portfolios for each company. Eventually, the final cross-sectional regression is performed, and the result indicates a positive effect of environmental performance and a negative effect of social performance on stock performance. By performing the OLS regression analysis with industry dummy variables, the effect for each firm is compared.

Similarly, Mănescu (2011) conducts cross-sectional regressions, however, the methodological approach differs from above. The research uses Fama and Macbeth (1973) month-by-month cross sectional regression while using three risk-factor in Fama and French (1992) and additional momentum factor. Mănescu (2011) further focuses on the importance of controlling the industry effects due to the industry specific characteristic of ESG factors, i.e. depending on certain industry the inference could mislead the conclusion. The industry effect was captured by placing industry dummy variables as a separate independent variable. Interestingly, the research further carries out using GARCH-in-mean estimation for the community-mimicking portfolio, which is found as an only portfolio has a significantly positive effect on risk-adjusted stock returns. The use of GARCH model is to identify the linear relationship between conditional mean and conditional variance in return of a mimicking portfolio. In addition, Mănescu (2011) addresses that use of Fama-MacBeth (1973) two step cross-sectional regressions may cause an estimation bias by measurement error and the errors-in-variables. Therefore, our research rather focuses on Fama and French (1992) cross-sectional regressions to avoid this problem.

Another interesting point regarding the cross-sectional regressions for this type of research is that the model should correctly specify the potential determinant of firm performance such as investment in research and development (R&D), which is originally proposed by McWilliams and Siegel (2000). The analysis further criticises that three-factor model should control R&D to avoid overestimation of the results.

2.2 Measures for Sustainability and Financial Performance

With regard to choosing the robust measures, a number of studies inspire this paper both in terms of sustainability performance (Ziegler et al., 2007; Mănescu, 2011) and financial performance (Cohen et al., 1997; Ziegler et al., 2007). Regarding sustainability performance measures, prior publications are categorised as individual aspects of Environmental, Social, and Governance performance and combined ESG aspects. Further for financial performance measures, accounting based measures are primarily discussed and are compared to stock performance to address why the stock performance are mainly used in this paper. Finally, to evaluate the effect on profitability measure, valuation measures are selected supported by Koller et al. (2015), which is also discussed in detail in the next chapter (see chapter 3).

2.2.1 Sustainability Performance Measures

Extensive amount of previous literature focus on environmental performance, mainly regarding pollution levels by toxic emissions or hazardous wastes. One of the most commonly selected indicators is Toxic Release Inventory data (Hamilton, 1995; Hart & Ahuja, 1996; Konar & Cohen, 1997; Cohen et al., 1997; King & Lenox, 2001; Konar & Cohen, 2001). TRI data is broadly used both in event study and econometric analysis. However, as Ziegler et al. (2007) explain, TRI data does not include all aspects of environmental performance. TRI also does not contain certain information such as pollution from non-toxic substances (carbon dioxide emissions) and environmental management system. Other publications improved the selection of environmental performance regarding this issue by including more general, comprehensive data (Klassen & McLaughlin, 1996; Cohen et al., 1997; Konar & Cohen, 2001). For instance, Cohen et al. (1997) perform an analysis on relatively objective data by incorporating environmental data with environmental litigation proceedings, noncompliance penalties, toxic chemical release and oil & chemical spills.

The publications that examine only social performance tend to focus on socially responsible funds such as SRI indices or Kinder, Lydenberg and Domini (KLD) ratings (Statman, 2000; Schröder, 2004; Kempf & Osthoff, 2007; Statman & Glushkov, 2009). Other studies focus on corporate social performance (CSP) which attributes employee relations, community relations and treatment of women and minorities (Waddock & Graves, 1997; Mcwilliams et al., 1999; McWilliams & Siegel, 2000). Regarding these criteria of sustainability performance, the methodologies such as, evaluating portfolio performance (Statman, 2000) or finding linkage through econometric analysis (Waddock & Graves, 1997) are implemented. However, similar to environmental performance studies, the conclusions for social performance research are mixed and some controversies arise concerning misspecification of the model (McWilliams & Siegel, 2000).

Before discussing prior research for the governance performance, it is important to understand the difference with social performance. While social performance refers to workforce, employee rights and community, governance performance accounts for corporate governance, such as ownership, board structure, agency problems and shareholder rights. Core et al. (1999) focus on seeking board and ownership structures to explain variation of CEO compensation across entities. The predicted excess CEO compensation is measured by accounting based (return on asset) and stock based financial performance. The paper concludes that there is a statistical significance between board and ownership structures and subsequent firm operating performance, i.e. return on asset. The study further finds a significantly negative relationship between governance performance and stock performance as well as operating performance, however, it also suggests that board and ownership predict better future operating performance than predicting stock performance.

Gompers et al. (2003) also address governance performance regarding agency problems, however rather draw attention to shareholder rights. Two extreme portfolios are drawn for the analysis: the firms with the weakest shareholder rights as "Dictatorship Portfolio" and the firms with the strongest shareholder rights as "Democracy Portfolio". These portfolios are driven from the changes in the distribution of constructed governance index (called G), which is mainly influenced by mergers, bankruptcies and additions of new firms. The study finalizes that firms with stronger shareholder rights have higher firm value, profits and higher sales growth. In other words, corporate governance is significantly correlated with the corporates stock performance. This finding influences a number of publications such as Core et al. (2006), Bhagat and Bolton (2008) and Paniagua et al. (2018), in respect of measuring governance performance and finding causality of the relationship between governance and financial performance. Yet, the publications that investigate individual aspect of environmental, social and governance performance have a limitation in terms of finding a holistic view of sustainability performance.

Although there is numerous research attempt to explain relatively integrated aspect of sustainability performance, most of the study found only short-term effect of sustainability index through event study (Reddy and Gordon, 2010; Cheung, 2011). This implies that only few studies explain the nature of the relationship between sustainability and financial performance.

One of the main benchmark papers, Ziegler et al. (2007) contribute to find a significant effect of environmental and social performance on stock returns, using econometric analysis. The sustainability performance is measured in two ways, average sustainability performance of the industry and relative sustainability performance of corporation within the assigned industry. While average sustainability performance assesses the environmental and social risks, relative sustainability performance compares environmental and social activities of companies within the industry. Both measures are based on Swiss bank Sarasin & Cie in Basel, where their criteria comply with the international standard of sustainability reporting. Nonetheless, in terms of missing governance performance, the study has a limitation to cover all aspects of ESG effect.

Mănescu (2011), which is another main inspiration of this paper, evaluates the corporate stock performance with ESG score data based on the Kinder, Lydenberg and Domini (KLD) Research & Analytics ratings. KLD data is the longest existing dataset that covers seven different dimensions of ESG concerns. The main finding of the paper is that only community relation ESG score positively correlates with risk-adjusted stock returns. Moreover, the study subsequently focuses on the causality of this correlation, which eventually concludes that the positive effect is caused by mispricing the benefits or costs of ESG.

Considering this prior research, this paper adopts ESG score data, to conduct relatively broader perspective of study regarding the effect of sustainability performance. The detailed explanation for the data selection is further described in the next chapter (see chapter 3).

2.2.2 Financial Performance Measures

Another contribution of prior research to this paper is the choice of a measure for the financial performance. Financial performance measure is carefully chosen, since it represents the dependent variable in both econometric analyses. The most popular measures considered in previous literature are stock performance and accounting based measures, i.e. return on asset, return on equity and Tobin's Q.

Hart and Ahuja (1996) use return on sales (ROS) and return on assets (ROA) as operating performance data and return on equity (ROE) as a financial performance indicator. These variables are regressed on environmental performance, specifically on reduction in emissions. While control variables such as R&D intensity, capital intensity and debt to equity ratio are arranged in both firm and industry specific level, the study limits the industry range with two criteria, i.e. manufacturing and mining industry. Waddock and Graves (1997) also use ROA, ROE and ROS as financial value measurements of corporations while motivating the choice with their common use in investment community. Furthermore, McWilliams and Siegel (2000) and Core et al. (2006) use ROA as an operating and profitability measure. Meanwhile, Cohen et al. (1997) compare stock performance and accounting returns, such as ROA and ROE. Other publications (Konar & Cohen, 2001; King & Lenox, 2001) use intangible assets or Tobin's Q for the firm-level financial performance to examine the effect of environmental performance on firm value. According to King and Lenox (2001), Tobin's Q reflects expected future gains and more complicated measure than Tobin's Q could cause qualitative difference. However, these accounting measures have a drawback that it is not directly realized by shareholders and is easy to manipulate by controlling financial statements differently (Cohen et al., 1997).

Alternatively, stock market return is considered as a robust measure for financial performance. As explained by Cohen et al. (1997), stock return directly relates to true gains of shareholders since share price reflects the present value of corporates future cash flows. Furthermore, stock return benefits in terms of its comparability across firms and its independency from tax and depreciation. While Lorraine et al. (2004) investigate how stock price responds to sustainability related event announcements, other publications examine stock return (Cohen et al., 1997; Konar & Cohen, 1997; Kempf & Osthoff, 2007; Cheung, 2011; Obendorfer et al., 2013) or abnormal return (Hamilton, 1995; Godfrey et al., 2009; Reddy & Gordon, 2010). For the short-term reaction of market, stock price and abnormal returns are used, mainly through event study. However, following the purpose of our analysis, which evaluates long-term effect of sustainability performance, the stock market return is selected to measure financial performance.

In addition to stock performance, this paper includes net sales, operating margin and return on invested capital (ROIC) as dependent variables to examine the potential impact on firms' economic performance and profitability. While most of the prior research have used ROA and ROE as a profitability measure, ROIC is chosen in this paper. This is because ROIC measures solely operating performance and is comparable across firms. According to Koller et al. (2015), ROIC provides a better measure for analytical approach to firm's performance. ROA and ROE tend to mix non-operating performance with operating performance and disregard the benefits of operating liabilities, such as accounts payable. Thus, ROIC is regressed on ESG scores to confirm the effect on firms' profitability. Net sales and operating margin are chosen as economic performance and additional profitability measure, in addition to findings of previous research, which is further discussed in the next chapter (see chapter 3).

3. Data and Variables

In this chapter, the data used for the purpose of the research is briefly discussed. Starting with financial data category, average monthly stock returns are calculated from stock price index as a main financial performance measure. Moreover, net sales, operating margin and ROIC are used to examine ESG effect on firms' economic performance and their profitability. Next, regarding ESG data, a relatively inclusive and comprehensive rating system is required and therefore, Thomson Reuters ESG Score is used. Thomson Reuters ESG Score benefits in respect of integrating 10 different sustainability categories. The rating data covers how corporates respond to climate change (environmental performance), how they manage their health and safety policies in terms of treating their employees (social performance), and how effective and fair their commitment and treatment towards shareholders are (governance performance). The score further covers the entities culture for building trust and endorsing green innovation.

3.1 Financial Data and Variables

Stock performance is used for a robust financial performance measure as discussed in chapter 2. Since the purpose of this paper is to evaluate the effect of European corporations' ESG performance, STOXX Europe 600 index is selected. STOXX Europe 600, also known as STOXX 600, is designed by STOXX Ltd. and includes 600 European firms represent large, mid and small market capitalization. Initially, S&P EURO was considered as a sample equity index. However, to allow the broader coverage of 16 different countries without limiting in Eurozone, STOXX600 was preferred. The data includes corporations from Germany, United Kingdom, Denmark, Italy, Netherland, Switzerland, France, Belgium, Spain, Ireland, Norway, Sweden, Austria, Portugal, Poland and Finland. Moreover, these companies belong to 10 different industries: Telecommunications, Financials, Industrials, Utilities, Consumer Services, Consumer Goods, Basic Materials, Oil & Gas, Technology and Health Care.

From January 2002 to July 2018, 17 years of sample period is adopted to analyse the effect of ESG throughout the different business cycles. In other words, the period was intentionally selected to cover both before and after financial crisis. In addition, relatively long period is chosen to apply a multifactor time-series regression, since original methodology was applied to extensively long period of 29 years by Fama and French (1993). The motivation of choosing relatively longer period is also found in Ziegler et al. (2007).

For stock performance, average monthly price index is transformed into logarithmic returns as shown in equation 1 below:

$$r_{i,t} = \ln(\frac{P_{i,t}}{P_{i,t-1}}) \qquad (1)$$

where $P_{i,t}$ indicates the price index of stock of entity *i* = 1, …, *N*, at month *t* = 1, …, *T*.

For the economic performance of corporations, net sales and operating margin are used to evaluate market share of corporations. However, since the sales are shown in particular currency (in this case in Euro), this can potentially affect to the result of the analysis. Hence, logarithmic transformation of net sales is applied to capture the size effect in the variable and to enable a direct use in the regression. Operating margin is selected as an additional economic measure since it evaluates firms' operational efficiency and enables to compare their capital structures across industries.

Next, to investigate the impact of ESG score on firms' profitability, ROIC is used since it is a measure that relates to cost- and capital-efficiency ratios. Further following valuation principle, ROIC is considered as a superior measure for corporates' profitability than ROA or ROE, which were used in most of the previous research (see section 2.2). As Koller et al. (2015) also emphasises, ROIC stands for a key value driver of long-term operating performance of companies. The average monthly share price, net sales, operating margin and ROIC of sample companies are gathered from Thomson Reuters Datastream database.

3.2 ESG Score Data

ESG rating schemes vary over different rating systems and tend to be subjective in terms of insufficiency of credible data. Due to these features of the data, researchers have questioned its ambiguity, inconclusiveness and prevalence (Friede et al., 2015). Hence, it is important to choose robust ESG score data to represent the sustainability performance.

While the interests and demands towards firms' disclosure regarding sustainability have been increasing, most of the ESG reports and ratings have been issued and developed relatively recent years after global financial crisis. As mentioned above, there are various rating scale and methodology applied throughout the different rating providers, including Bloomberg ESG Data Service, Corporate Knights Global 100, DowJones Sustainability Index and MSCI ESG Research. Over these rating providers, Thomson Reuters ESG Scores are selected due to their relevancy and transparency with respect to the calculation metrics of the scores, and also for its accessibility. In 2009, Thomson Reuters acquired ASSET 4 agency, which was the first company to provide raw ESG data to investors (Huber & Comstock, 2017). This enabled Thomson Reuters ESG Scores to build a rating system with the original ASSET 4 Equal Weighted Ratings (EWR) as a foundation. The ESG database is further enhanced by reflecting strategic ESG framework. The purpose of designing ESG performance score is to provide an objective and structured measure for financial analysis. The ESG scores are calculated over 400 company-level ESG metrics and 178 comparable and relevant measures (see *Figure A2* in Appendix). These aggregated ESG measures are categorised as 10 different groups and proportionately weighted to three pillar scores, environmental, social and corporate governance scores.

Environmental score consists of resource use, emissions and innovation, while social score is composed of workforce, human rights, community and product responsibility. Finally, governance score comprises management, shareholders and CSR strategy. The data covers more than 7000 corporations globally since 2002 and more than 1200 firms are reported for European region. Moreover, it is continuously improving and expanding the data range, e.g. expanded coverage with more than 1000 corporations since 2017.

With this structure of the scores, percentile rank scoring methodology is applied to compute 10 category scores to compare across firms. Each category score is equally weighted based on the number of ESG framework indicators. Next, these weights are summed up as pillar weights, and percentile scores are calculated based on these weights and average category percentile scores. Finally, the percentile ranking score is also displayed as letter-based grades from A^+ to D^- assigned by the score range. Furthermore, to allow less subjective and comprehensive rating schemes, methodologies and each component of scores are carefully assessed in terms of comparability, availability and relevance. The ESG scores are also available in the form of separate pillar scores, i.e. environmental, social and governance scores. To understand which aspect of ESG scores affects the most on financial performance, these pillar scores are also used in our analysis.

Since the data is updated based on firms own ESG performance disclosure, seven companies are excluded from the sample due to unavailability. Furthermore, there are missing values for some months with regard to some companies. This results in estimations with different sample size of firms for each month, e.g. 251 firms are available for February, 2002 while 511 firms are available for November, 2013.

Additionally, it is worthy to mention that Thomson Reuters ESG score data tends to evaluate relative ESG performance of corporates than average sustainability performance, according to classification of sustainability performance by Ziegler et al. (2007). In other words, industry effects should be adjusted separately to control ESG performance in industry level due to characteristic of ESG data (Mănescu, 2011).

Finally, to understand how ESG data is allocated among the countries and industries, average of ESG scores for each country and each industry within 573 European corporations (see section 3.3 for an explanation of narrowing sample size) is displayed in *Table 1* and *Table 2* below. As we can confirm in *Table 1*, Spain has the highest country average of ESG scores, while Ireland has the lowest country average of ESG scores. This result may not be consistent with the effect of ESG in each country, since the data is not dispersed evenly throughout the countries.

Table 1 Allocation of countries to ESG scores

Country	*Number of Units*	*Country Average*
Germany	76	64.34
UK	142	62.78
Denmark	23	55.66
Italy	29	62.92
Netherlands	41	67.06
Switzerland	27	57.30
France	87	64.50
Belgium	14	52.89
Spain	26	68.84
Ireland	50	48.45
Norway	8	60.68
Sweden	15	59.88
Austria	15	58.21
Portugal	7	66.72
Poland	9	52.15
Finland	4	60.61
	573	

In *Table 2*, it is possible to confirm Industrials has the lowest industry average of ESG scores. However, unlike our expectations, Oil & Gas industry has the highest industry average of ESG scores. This result is potentially caused by the feature of ESG scores. As Mănescu (2011) explains, if the environmental strength and weakness of the industry are not reflected in ESG scores (which is generally the case for available ESG rating schemes), the inflated scores might be assigned to those firms irrelevant to the environmental strength or weakness. Hence, an additional analysis is conducted using industry dummy variables (also country dummies) for concerning this industry specific characteristic of ESG score data (see further details in section 4.3).

Table 2 Allocation of industries to ESG scores

Industry	*Number of Units*	*Industry Average*
Telecommunications	19	66.54
Financials	132	61.87
Industrials	118	58.49
Utilities	29	66.42
Consumer Services	60	64.60
Consumer Goods	70	62.05
Basic Materials	42	62.56
Oil & Gas	22	69.06
Technology	28	59.07
Health Care	53	60.80
	573	

As mentioned above, ESG scores are based on firms' disclosure of their ESG performances. In other words, companies with poor ESG performance may not have reported themselves, hence, their scores are not reflected on these allocations. For instance, Oil & Gas remained as highest average ESG industry while the proportion of the units to total number of observations is only less than 4%. Therefore, a careful interpretation for the further result is necessary since the data might have been affected by information asymmetry.

3.3 Control Variables

To capture the variation in average stock returns across companies, Fama and French (1992) cross-sectional model is regressed (further detail regarding methodological approach is described in chapter 4.). Accordingly, firm specific characterized variables are run as control variables along with ESG score. Unlike the original methodology in Fama and French (1992), earnings-price ratio (E/P) is excluded from the control variables. Instead, only market capitalization (as a size variable), book-to-market equity, leverage ratios and market betas are adopted in this paper. Since a combination of book-to-market and leverage ratios has a strong explanatory power, it absorbs the roles of leverage and E/P ratios (Fama & French, 1992). In our analysis, earnings-price ratio variable is excluded since it can explain expected returns, only when firms have positive earnings. Nonetheless, leverage ratio is not ruled out due to its relation to average returns.

Book-to-market ratios are computed by dividing common shareholder's equity with market capitalization, since common shareholder's equity represents a book value by reflecting firms' historical costs and accounting values. As suggested in Fama and French (1993), firms with negative book-to-market ratios are excluded from monthly observations. For the leverage ratios and market beta, total debt to total capital ratios and reported historical betas respectively are used. Additionally, firms with negative or relatively too high leverage ratios (i.e. over 100) are ruled out from the monthly observations. During this process, 20 more firms are excluded from the sample due to missing values. Therefore, the sample is narrowed as 573 firms listed STOXX 600 from January 2002 to July 2018. Historical market values (market capitalization), betas, leverage ratios and aforementioned components of book-to-market ratios are all collected from Thomson Reuters Datastream database.

To further implement Fama and French (1993) multifactor model, risk factor mimicking portfolios, i.e. size and value factors, are used as explanatory variables. Moreover, to measure the difference between market returns and risk-free securities, monthly European treasury bills are collected as excess market return factors. Finally, to include the risk factor related to firms' stock performance in market, Carhart (1997) momentum factor is added as an independent variable. All risk factor portfolios are collected from Kenneth R. French Data Library. Further details regarding the construction of the portfolios and methodology is discussed in the next chapter.

4. Methodology and Model

Two main methodologies, cross-sectional regressions and time-series analysis with portfolios are applied to understand how ESG score affects firms' economic and financial performance. These methodologies are inspired by Ziegler et al. (2007) and Mănescu (2011) as mentioned in section 2.1. Firstly, cross-sectional regression analysis, similar to Fama and French (1992), is applied to analyse if corporates with higher ESG scores have higher stock returns or have better profitability compared to corporates with lower ESG scores. Furthermore, a portfolio analysis is implemented by constructing portfolios based on the level of ESG scores. To focus on risk sensitivity, the factor mimicking portfolio approach is applied using Fama and French (1993) three-factor model, with additional Carhart (1997) momentum factor. In addition, to control industry and country specific effect, pooled regression is applied with constructed dummy variables. To confirm the robustness of the analyses, we analyse the effect of financial crisis by dividing the sample in three different business cycles. Finally, OLS assumption is appraised through diagnostic tests.

4.1 Cross-sectional Regression on Individual Stock Return

Since the objective of this paper is to find the effect of ESG implementation on economic and financial performance across European corporations, cross-entity variation of the ESG performance is examined by Fama and French (1992) cross-sectional regressions. Before discussing further details of the model, it is important to review and understand the standard capital asset pricing model (CAPM), which is a baseline model of Fama and French (1992). While CAPM implies market betas alone can explain cross-sectional variation in returns (Danthine & Donaldson, 2014), Fama and French (1992) contradict this statement and supports the idea of weak explanatory power in market betas. In their research, market value, book-to-market equity, leverage and earnings-to-price ratios are applied to explain the cross-sectional variation in average stock returns in addition to market betas. As described in chapter 3, due to strong explanatory power of combined variables (market value and book-to-market ratios), leverage and E/P ratios can be replaced by three other variables. Hence the time-series of monthly cross-sectional model for regression analysis is designed as:

$$R_{it} = \gamma_{0t} + \gamma_{1t}\beta_{it} + \gamma_{2t}MV_{it} + \gamma_{3t}BTM_{it} + u_{it} \tag{2}$$

where β_{it} represents market beta, MV_{it} is market capitalizations, which captures size effect and BTM_{it} for book-to-market equity ratios. Furthermore, Fama and French (1992) evidenced that there is a strong negative relation between average returns and size variables, while a significant and positive relation were found between average returns and book-to-market equity ratios. It is important to note that one of the main findings of Fama and French (1992) indicates that book-to-market equity has the most significant explanatory power for cross-sectional average of stock returns.

In this paper, aforementioned firm specific risk-related variables including market betas are used as control variables to capture the effect of ESG ratings on economic and financial performance. Moreover, as mentioned in chapter 3, leverage ratios are included as one of the control variables, since it is considered as an important proxy of financial distress and measurement of firm-specific risk. Consequently, a modified version of cross-sectional regression model is applied for the main analysis of this paper as shown in equation 3 below for each firm *i* = 1,…, 590 and each month *t* = 1,…, 199 (16 years and 7 months):

$$r_{i,t} = \gamma_{0,t-1} + \gamma_{1,t-1}ESG_{i,t-1} + \gamma_{2,t-1}\beta_{i,t-1} + \gamma_{3,t-1}MV_{i,t-1} + \gamma_{4,t-1}BTM_{i,t-1} + \gamma_{5,t}lev_{i,t-1} + u_{i,t-1} \quad (3)$$

where r_{it} reflects logarithmic transformed average monthly stock return (see equation 1), $ESG_{i,t-1}$ is ESG score variables, and lev_{it} is for leverage ratios. By running the regressions with these risk related control variables, it is possible to identify how significant ESG influences on the stock performance. Furthermore, it is important to note that one month lagged values of control variables are used for all the explanatory variables, e.g. ESG and control variables for January 2002 are used for log return for February 2002. This adjustment is necessary since it is reasonable to understand that investment decision and market reflect after ESG scores are announced, not at the same time. To confirm the effect on corporates' economic performance and their profitability, the log sales, operating margin and ROIC are regressed separately as a dependent variable. Then, above methodology is applied by replacing the stock return with each of them. After conducting the regression, the estimated gamma coefficients are evaluated with *t*-ratio test to evaluate their explanatory powers on cross-sectional variation of stock returns. The test statistic for *t*-test is as shown below:

$$t = {}^{\bar{x}}\Big/_{\frac{s}{\sqrt{n}}} \quad (4)$$

where $\bar{x}$ indicates a mean of the sample, s is a standard deviation of the sample and n is the sample size. The statistical significance is tested at 5% level.

Furthermore, the cross-sectional methodology is applied to examine the influence of three pillar scores, i.e. environmental, social and governance scores. Each score is regressed on average monthly stock returns as an independent variable instead of integrated ESG scores. As a result, it is possible to examine which of the pillar scores has the most significant influence on stock performance.

It is worthy to note that measurement error can occur in beta by regressing an individual stock return. To mitigate such problems and to supplement an evidence of the ESG effect on financial performance, the analysis continues with factor mimicking portfolio analysis.

4.2 Portfolio Analysis

As mentioned briefly in section 3.3, Fama and French (1993) multifactor model is used for the portfolio analysis. Since an alternative approach of arbitrage pricing theory does not provide any indication or specification of factors, Fama and French (1993) multifactor model is chosen with their constructed risk mimicking factors. The aim of applying the methodology is to examine whether ESG scores contribute to generate risk adjusted returns.

4.2.1 Portfolio Construction

As an extension of cross-sectional regressions, Fama and French (1993) tested size and book-to-market measures to explain average stock returns. However, they concluded that a large difference between the stock returns and one-month treasury bills cannot be explained only by these factors. Hence, market factors are additionally included, which connect the average stock returns and treasury bills.

Fama and French (1993) constructed these common risk factor portfolios by ranking the size and equity value of corporations into three value-weighted portfolios. Median of market value (size risk factor) is used to separate firms based on their size and to group them into small (S) and big (B). Next, firms are divided in three groups based on their book-to-market equity ratios, in lowest 30% (L), highest 30% (H) and medium 40% (M). Based on this approach, six different portfolios are constructed in their research. SMB, small minus big, imitates the size related risk factor in returns, which measures the difference between monthly returns on three small-stock portfolios and three big-stock portfolios. The HML portfolio captures the book-to-market equity related risk factor in stock returns and shows the difference between monthly returns in high- and low book-to-market portfolios. The process how Fama and French (1993) built SMB and HML portfolios is described below:

$$SMB = \frac{S/L + S/M + S/H}{3} - \frac{B/L + B/M + B/H}{3} \tag{5}$$

$$HML = \frac{S/H + B/H}{2} - \frac{S/L + B/L}{2} \tag{6}$$

By implementing this way of building risk factor portfolios, the estimated parameters, also known as factor loadings, are comparable across the portfolios. Finally, they constructed RM-RF, market factor based on excess market return portfolios, where RM is value-weighted portfolio of stock return in above mentioned six portfolios and RF indicates one-month bill rate.

4.2.2 Mimicking Factor Portfolio

Using above factors, Fama and French (1993) established a factor-based time-series model as below:

$$R_{i,t} = \alpha_i + \beta_{i,M}(Rm_t - Rf_t) + \beta_{i,S}SMB_t + \beta_{i,V}HML_t + \epsilon_{i,t} \tag{7}$$

In this paper, Carhart (1997) momentum factor is added in the model. By adding momentum factor as an additional risk factor, it is possible to capture the risk of upward or downward trend in asset price, e.g. when asset price increases, it tends to increase for the next period, vice versa for decreasing price. The momentum factor measures difference in returns between best and worst performing stocks and is illustrated as UMD, up minus down.

These risk mimicking portfolios are regressed on stock portfolio, however, in this paper, different adjustment is applied for constructing stock portfolio. Inspired by Fama and French (1993), particularly by their way of forming book-to-market ratio portfolio, we rank the ESG scores of the corporations in three value weighted portfolios. Similar to Fama and French (1993), the percentile-based methodology is applied to build these portfolios, i.e. lowest 30% (L), medium 40% (M) and highest 30% (H). After ranking the firms by the ESG scores, average monthly stock returns are grouped as high ESG returns and low ESG returns. Then, high ESG portfolios are subtracted by low ESG portfolios to define the difference between best ESG performing firms and worst ESG performing firms. It is important to note that each firm belongs to different rank of portfolio in each month as its ESG rating changes over time (mostly semi-annual or annual base). To evaluate the constructed ESG based portfolio, aforementioned *t*-test (see equation 4) is applied on this High-Minus-Low ESG stock portfolio. Finally, Fama-French three factors and momentum risk factor mimicking portfolios are regressed on the constructed stock portfolio. The modified version of time-series model is illustrated as:

$$R_{HML_{ESG},t} = \alpha_i + \beta_{i,M}(Rm_t - Rf_t) + \beta_{i,Size}SMB_t + \beta_{i,Value}HML_t + \beta_{i,Mom}UMD_t + \epsilon_{i,t} \tag{8}$$

After running the simple OLS regression, the estimated coefficients are tested at 5% significance level using *t*-tests same as estimated coefficients in cross-sectional regressions. If the estimated intercept, i.e. alpha, is significant, ESG adjusted HML portfolio has risk adjusted returns.

4.3 Pooled Regression

As discussed in chapter 2, most of previous research highlights industry specific characteristic of ESG data, including Ziegler et al. (2007) and Mănescu (2011). For instance, it is inevitable to consume power and fuels for the manufacturing or freight industry related firms. Consequently, these companies may have low ESG ratings due to their business features. Because of this dependence on industry, false inference regarding the effect of ESG implementation can be made without any justification for industry effect. To confirm how this characteristic affects the main analyses of this paper, dummy variables are constructed for each industry. The methodology used in this section follows Mănescu (2011). In addition, to confirm any potential country level of difference in ESG effect on the dependent variables, country dummy variables are additionally formed.

As described in Chapter 3, the sample of STOXX600 is assigned to 16 different countries and 10 different industries. It is important to note that cross-sectional regressions cannot be implemented with dummy variables for the chosen sample in this paper, due to missing values. That is, several industries or countries do not have data for ESG in all months throughout the sample period. Thus, pooled regression is applied as an alternative approach of cross-sectional regressions.

Moreover, since pooled regression uses a different approach than cross-sectional regressions (pooled regression observes both time and cross-sectional units), the estimation results are expected to be different. Therefore, a pooled regression without dummy variables is performed and the results are compared. The model applied for pooled approach is same as cross-sectional regressions, i.e. equation 3. As well as other applied methodologies, the significance of each variable is tested at 5% level by using *t*-tests and the result comparisons are further discussed in chapter 5.

4.3.1 Pooled Estimation with Dummy Variables

As mentioned above, to control the industry or regional effect of the analysis, dummy variables are implemented. The original estimation model applied in Mănescu (2011) is to place industry dummy variables as independent control variables. However, in this paper, the dummy variables are applied on ESG to capture how ESG effects vary over different industries or countries. That is, the product of ESG and each dummy is implemented as an independent variable. The pooled regression model with each dummy is then illustrated as equation 9 and equation 10.

$$r_{i,t} = \gamma_0 + \sum_{n=1}^{10} \gamma_{1,n}\, ESG_{i,t} Ind_n + \sum_{k=2}^{5} \gamma_k\, Control_k + \varepsilon_{i,t} \quad (9)$$

$$r_{i,t} = \gamma_0 + \sum_{n=1}^{16} \gamma_{1,n}\, ESG_{i,t} Country_n + \sum_{k=2}^{5} \gamma_k\, Control_k + \varepsilon_{i,t} \quad (10)$$

where $Control_k$ represents a group of market value, book-to-market equity, leverage ratios and market beta. The industry and country dummies detect the corresponding firms, and take the value of one. In other words, the dummy variables are estimated as the parameter of the interaction between the industry (or country) and ESG ratings.

4.4 Robustness

Since the econometric analyses are implemented throughout the whole sample from January 2001 to July 2018, the subsamples are created to observe the impact of global financial crisis on our main analysis. The subsamples are divided into three different periods, 2002-01 to 2008-08, 2008-09 to 2009-03 and 2009-04 to 2018-07. The threshold between periods is selected due to significant difference in reaction of average stock return between September 2008 and June 2009, which is suspected as the consequence of negative shock from financial crisis (see *Figure* A3 in Appendix). This way of grouping the period is also supported by Lins et al. (2017). Lins et al. (2017) defined the period of financial crisis from August 2008 to March 2009. The rationale behind choosing this threshold was to consider preceding month of 2008 Lehman Brothers bankruptcy and lowest hit point of S&P 500 during the crisis. Similarly, our sample STOXX 600 hit the lowest point on March 2009 (see *Figure A4* in Appendix) and started recovering from March 2009. Finally, by comparing the estimated coefficients between these periods, it is possible to compare the periodical change of ESG effect in stock market in different business cycle.

Furthermore, since applied methodologies are run based on simple OLS regression, basic OLS assumptions are tested through several diagnostic tests. According to Brooks (2014), the violation of these assumptions implicates the bias estimates of coefficients or incorrect inference. Firstly, heteroscedasticity is tested through commonly used White test. If null hypothesis of homoscedasticity is rejected for our sample, Newey-West method can be used to correct biased standard errors. Next, a general test of Breusch-Godfrey approach is applied for testing serial correlation. Additionally, normality is tested through Jarque-Bera tests. Since the baseline model of two main models is CAPM, assumed linearity is also tested to confirm the relationship between dependent and independent variables. The formal Ramsey RESET test is used to detect non-linearity. Finally, multicollinearity is tested to confirm potential strong multicollinearity caused by dummy variables. The near multicollinearity is tested through correlation matrix. Namely, the inference is potentially wrong if the correlation between explanatory variables is higher than or equal to 0.8.

5. Results & Discussion

In this chapter, the estimated results using CAPM based methodologies, i.e. cross-sectional regressions and time-series regression of factor mimicking portfolios, are primarily presented and are discussed to understand how a firm’s ESG performance affects its economic and financial performance. The effect of three pillar scores on stock performance is also presented to analyse which pillar score has the most significant impact on the stock return. While we discuss the result of cross-sectional regressions, the periodic change of coefficients for each variable is compared over different cycles (see section 4.4). Additionally, the results of pooled regression without industry (or country) adjustment are compared with the results from cross-sectional regressions. Moreover, the estimated coefficients with industry and country dummy variables are compared with above results of pooled regression without dummies. Finally, diagnostic test results are discussed to evaluate the analyses.

5.1 Descriptive Statistics

Before discussing the estimated coefficients, it is important to understand the feature of each variable in applied models. Hence, the descriptive statistics is provided to allow a simple interpretation of the data. Firstly, the sample statistics of all variables for cross-sectional regressions, i.e. average stock returns, ESG scores, control variables across firms are shown in *Table A2* of Appendix. Next, *Table A3* in Appendix describes the descriptive statistics of ESG ranking based return portfolios and four risk factors: market (Rm-Rf), size (SMB), equity value (HML) and momentum (UMD).

5.2 Econometric Analyses

This section delineates the estimated results with each methodology mentioned in chapter 4 and compares the results over different methodologies.

5.2.1 Cross-sectional Regressions

To begin with, the estimation results of cross-sectional regressions using the modified model (see equation 3) is illustrated in *Table 3* below. According to *t*-tests result, it is possible to see that ESG, market value and leverage ratios are significant at 5% level. Furthermore, this result shows that these variables including ESG scores are negatively related to average stock returns. In other words, firms with high ESG performance have worse stock performance in the market. Interestingly, market capitalization variables are negatively significant as it was expected through Fama and French (1992). Book-to-market ratios also show the consistent result with the original finding.

Table 3 Estimation results for the cross-sectional regressions

	Coeff.	*Std. Error*	*t-tests*
Intercept	0.017^{***}	0.003	6.065
ESG	-0.009^{***}	0.003	-3.436
MV	-0.043^{***}	0.012	-3.704
BTM	0.003	0.002	1.524
LEV	-0.012^{***}	0.002	-5.265
Beta	-0.003	0.002	-1.175

Notes: *** (**,*) indicates a statistical significance at 1% (5%, 10%)

Additionally, the yearly average values of ESG coefficients are plotted in *Figure 1* to understand how ESG effect has been changed historically (see other variables' annual change from *Figure A5* in Appendix). The rationale behind choosing yearly average is supported by the trait of ESG scores, which changes annually (or semi-annually).

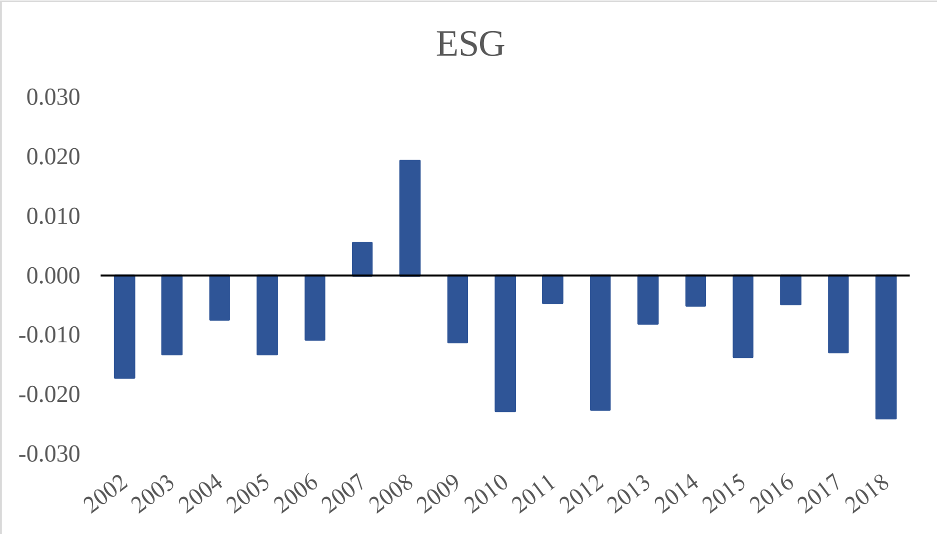

Figure 1 Annual time-variation in estimated ESG coefficients

Figure 1 illustrates that ESG coefficients increase marginally until 2006. Interestingly, ESG effect is extremely increased from 2006 to 2008 and the effect drastically decreases during financial crisis. Furthermore, ESG effect seems to increase back to the point where it was before financial crisis. Yet, it appears to repeat this pattern over time with a smaller magnitude than the change during financial crisis.

ESG effect on stock performance was also tested separately with three pillar scores, environmental, social and governance scores instead of integrated ESG. The coefficients and *t*-tests are shown in *Table 4* and the annual change in each score is illustrated in *Figure 2*.

Table 4 Estimation results comparison for three pillar scores

	Environmental		*Social*		*Corporate Governance*	
	Coeff.	*t-stats*	*Coeff.*	*t-stats*	*Coeff.*	*t-stats*
Intercept	0.015***	5.756	0.015***	5.756	0.015	5.639***
ESG	-0.005***	-2.909	-0.004***	-2.909	-0.005	-3.024***
MV	-0.048***	-3.905	-0.049***	-3.905	-0.049	-4.152***
BTM	0.003	1.505	0.003	1.505	0.003	1.385
LEV	-0.012***	-5.230	-0.012***	-5.230	-0.012	-5.329***
Beta	-0.003	-1.156	-0.0013	-1.156	-0.003	-1.074

Notes: *** (**,*) indicates a statistical significance at 1% (5%, 10%)

As we can observe in *Table 4*, there is no significant difference in the results of coefficients and *t*-tests among different scores compared to previous result in *Table 3*. There is only small decimal difference between the values of estimation results. This indicates that the influence of each pillar score is similarly applied on stock performance. Therefore, according to these estimation results, all environmental, social and governance performance appear to have a negative influence in the stock performance. However, in *Figure 2*, it is clearer to see the difference between the estimated coefficients.

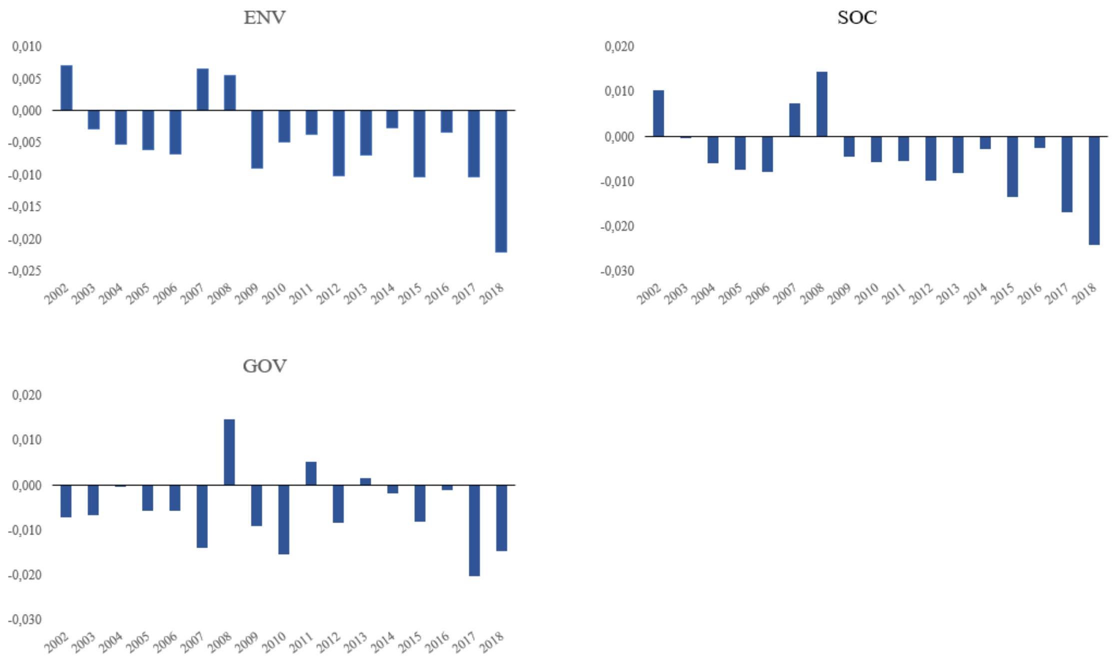

Figure 2 Yearly average of estimated coefficients for three pillar scores

The yearly average of each pillar score seems to also have a peak before the financial crisis and to follow the similar period trend as annual change in integrated ESG scores. While environmental and social scores tend to have a similar pattern over the sample period, governance score seems to move towards different direction than two scores in some years. The main findings from *Table 5* and *Figure 2* oppose the main results of Ziegler et al. (2007) that environmental performance have positive correlation with stock returns, while social performance have negative correlation with stock returns.

Next, cross-sectional regressions are implemented for the log sales, operating margin and ROIC to evaluate the effect of ESG on firms' economic performance and their profitability. The significance of estimated coefficients is tested by *t*-tests and the results are compared in the *Table 5* (see annual coefficient changes from *Figure A6* in Appendix).

According to the results shown in below table, ESG has a significant effect on sales, operating margin and ROIC. It is interesting to note that both log sales and operating margin are affected positively by ESG, while ROIC is affected negatively by ESG. Although the logarithmic transformation of sales is used to capture the size effect of sales, it is possible that the size effect might not have taken away entirely. As we can see in *t*-ratio of log sales and

ROIC, the *t*-ratios are extremely high compared to the results with operating margin or stock returns (see *Table 3*). This is possibly because net sales data we obtained is quarterly or yearly base, i.e. the sales data mostly change once a year. Hence, the monthly change in sales and ROIC might not have been captured and this might have affected to the result. The alternative approach to solve this problem is estimating yearly changes of sales and ROIC or using the ratio of the sale to total asset to correct for the size effect. However, these approaches are not used in this paper.

Table 5 *t*-test results comparison for firms' economic performance and profitability

t-stats	*ln sales*	*operating margin*	*ROIC*
Intercept	505.057	1.755	68.258
ESG	51.521	2.388	-7.11
MV	38.726	4.933	-1.372
BTM	22.417	-2.542	-28.403
Lev	31.573	-0.094	-26.915
Beta	19.296	-12.655	3.492

To summarise the results of cross-sectional regressions, ESG has significantly negative effect on average monthly stock returns. This result is consistent in all three pillar scores, while the magnitude of significance is slightly different from each other. However, there are positive ESG effect on sales and operating margin. This can extrapolate that high ESG performance contributes to gain market share. Interestingly, ESG influences ROIC negative and significant, similar to average returns. The negative effect on ROIC can be due to costs of implementing ESG performance. In next section, we focus on ESG effect on average returns while controlling potential industry and country effect by dummy variables. This can indicate which industry or which country is more significantly influenced by ESG.

5.2.2 Pooled Regression

As mentioned in section 4.3, pooled regression analysis is performed to control industry and country effect of our main analysis. Prior to the analysis with dummy variables, pooled OLS is regressed without any justification for industry or country. The results from this estimation are compared and shown in the below *Table 6*.

As we can see in *Table 6*, the pooled regression provides a similar result as cross-sectional regressions. While *t*-stats show that there is a significant negative effect of ESG on stock returns in both methodologies, the *t*-stats in pooled regression has greater magnitude than in cross-sectional regressions, e.g. *t*-stats for ESG -3.436 in cross-sectional, -3.525 in pooled regressions.

Table 6 Estimation results comparison between cross-sectional and pooled regression

	Cross-sectional		*Pooled*	
	Coeff.	*t-stats*	*Coeff.*	*t-stats*
Intercept	0.017^{***}	6.065	0.012^{***}	9.006
ESG	-0.009^{***}	-3.436	0.000^{***}	-3.525
MV	-0.043^{***}	-3.704	0.000^{***}	-5.154
BTM	0.003	1.524	0.009^{***}	14.675
LEV	-0.012^{***}	-5.265	0.000^{***}	-12.241
Beta	-0.003	-1.175	-0.001^{*}	-1.924

Notes: *** (**,*) indicates a statistical significance at 1% (5%, 10%)

Further to control the industry effect and regional impact of ESG scores, the pooled regression with each dummy variable is implemented. The results from each pooled regression are described in *Table 7* and *Table 8*.

Table 7 Pooled OLS parameter estimates with industry dummy variables

	Coeff.	*t-stats*
Intercept	0.009^{***}	6.054
MV	-0.035^{***}	-4.709
BTM	0.012^{***}	17.825
LEV	-0.013^{***}	-9.353
Beta	0.000	-1.574
Telecommunications	-0.010^{***}	-2.906
Financials	-0.017^{***}	-7.175
Industrials	-0.001	-0.448
Utilities	-0.009^{***}	-2.985
Consumer Services	-0.005^{**}	-2.200
Consumer Goods	-0.002	-0.767
Basic Materials	-0.006^{**}	-2.236
Oil & Gas	-0.008^{***}	-2.767
Technology	0.000	-0.037
Health Care	0.003	0.938

Notes: *** (**,*) indicates a statistical significance at 1% (5%, 10%)

To start with industry effect adjusted regression results, we can observe that Financials is the most negatively significant industry for ESG effect from *Table 7*. While Industrials, Consumer Goods, Technology and Health Care have no significant ESG effect, rest of the six industries are significantly affected by ESG, yet negatively. It is also important to note that Health Care is the only industry that have a positive effect of ESG. In respect of the results estimated with country dummies (*Table 8*), Italy and Ireland have the most negatively significant ESG effect on average returns. Moreover, it is interesting to note that only Nordic countries except Finland, i.e. Denmark, Norway and Sweden have positive ESG effect on the stock returns. However, the impact on these countries are still not significant.

Table 8 Pooled OLS parameter estimates with country dummy variables

	Coeff.	*t-stats*
Intercept	0.011^{***}	7.647
MV	-0.063^{***}	-7.334
BTM	0.009^{***}	14.932
LEV	-0.015^{***}	-11.136
Beta	-0.001^{**}	-2.036
Germany	-0.004^{*}	-1.814
UK	-0.005^{**}	-2.296
Denmark	0.005	1.329
Italy	-0.011^{***}	-3.464
Netherlands	-0.008^{***}	-2.589
Switzerland	-0.003	-1.227
France	-0.007^{***}	-2.887
Belgium	-0.009^{**}	-2.228
Spain	-0.007^{***}	-2.368
Ireland	-0.018^{***}	-3.085
Norway	0.001	0.238
Sweden	0.005	1.546
Austria	-0.007	-1.435
Portugal	-0.013^{***}	-2.384
Poland	-0.013^{**}	-2.020
Finland	-0.007^{**}	-1.997

Notes: *** (**,*) indicates a statistical significance at 1% (5%, 10%)

When comparing these results with the results from unadjusted pooled regressions, book-to-market ratios shows more positively significant results both in industry and country modified regressions than original pooled regression. Additionally, the coefficients of market betas become insignificant in industry adjusted model, compared to original and country adjusted regressions.

5.2.3 Portfolio Analysis

Finally, empirical results of time-series regression with risk factor mimicking portfolios are presented below in *Table 9*. Through this result, we can observe that alpha is negatively significant. This indicates that ESG based high minus low stock portfolio have risk adjusted returns. Furthermore, this may stipulate that market penalizes high level of ESG performance.

Table 9 Estimation results of portfolio time-series regression

	Coeff.	*Std. Error*	*t-stats*
Alpha	-0.005***	0.001	-4.525
Market	0.000	0.000	-0.588
SMB	-0.001	0.001	-1.168
HML	0.000	0.001	0.178
UMD	0.000	0.000	-0.627

Notes: *** (**,*) indicates a statistical significance at 1% (5%, 10%)

Through the results shown above *Table 9*, we can observe that alpha is negatively significant. This indicates that ESG based high minus low stock portfolio has negative risk adjusted return. Furthermore, this result can stipulate that market penalizes high level of ESG performance. While this result is consistent with both cross-sectional and pooled regressions, rest of the control variables, i.e. four risk factors shows insignificant result by the *t*-tests. In addition, since SMB portfolio has negative yet insignificant correlation with the constructed return portfolio, the inference of "small firms may have lower ESG scores" can be motivated. Interestingly, HML factor is positively, yet again insignificantly correlated with the stock portfolio. This may insinuate that high value firms have higher ESG scores. Furthermore, since the coefficients of control variables are insignificant, we may conclude that ESG has insignificant effect on common risk factors. The *t*-tests are also applied to ESG based HML stock portfolio to understand the nature of this newly built portfolio. The *t*-test result of $R_{HML_{ESG}}$ is -5.234, which is consistent with the result from time-series regression.

5.3 Diagnostic Test Results

According to conducted diagnostic test for the portfolio time-series regression, there was no significant violation detected from the evaluation except heteroscedasticity. The White test result for heteroscedasticity is described in *Table A4* of Appendix. The null hypothesis of homoscedasticity is rejected at 1% significance level, which indicates the presence of heteroscedasticity in our model. Therefore, Newey-West approach is implemented to adjust biased standard errors. The improved standard errors with Newey-West method are compared in *Table A5* of Appendix. *Table A6* in Appendix displays the Breusch-Godfrey test results, which show that there is no autocorrelation in portfolio analysis. *Table A7* shows the Jarque-Bera test results for normality, which confirmed there was no evidence of non-normality in the modified multifactor model (see equation 8). The histogram of the residuals is displayed in *Figure A7*. Furthermore, the Ramsey RESET test is implemented to confirm the linearity assumption in our CAPM based model. The result shown in *Table A8* of Appendix proves that non-linearity is not detected. Finally, multicollinearity is tested using correlation matrix and the test result is shown in Appendix *Table A9*. According to the presented result, we can make sure that surmised multicollinearity does not present in our model.

6. Conclusions

As mentioned in the beginning of this paper, the research question arises from the possible economic effect of ESG and for the possibility of market rewards towards high ESG. This paper examines the effect of ESG scores on the economic and financial performance of European corporations from January 2002 to July 2018. To allow relatively large sample size, STOXX 600 is used as a sample equity index. Due to its relevance and transparency of metrics, Thomson Reuters ESG Score is used to regress with average monthly stock returns, sales, operating margin and ROIC. While main purpose of this research is to evaluate the positive or negative influence on stock performance, economic and profitability measures are used additionally to supplement an evidence of ESG effect in market. The econometric analyses based on Fama and French (1992; 1993) are implemented as the main methodologies.

First methodology, Fama and French (1992) cross-sectional regressions with firm-specific risk related control variables, are exercised to capture whether the level of ESG scores affects stock performance. To understand the significance of each aspect of ESG scores, environmental, social and governance scores are individually regressed in the same model. Using this method, ESG score is also regressed on economic and profitability performance of corporations. Additionally, since ESG data has characteristic of industry dependence, pooled regression approach with dummy variables is implemented. This methodology is also applied to investigate country specific effect in ESG. Finally, to evaluate the ESG effect in risk management perspective, a portfolio analysis is conducted using ESG ranking based constructed portfolio with Fama and French (1993) and Carhart (1997) factor portfolios measuring the sensitivity to common risks.

The main finding from the first analysis indicates that ESG has a significant and negative impact on average stock returns. Consequently, it can be deduced that corporations with lower ESG scores have better stock performance in market than those with higher ESG scores. While ROIC holds the consistent result with stock returns, the estimation results with sales and operating margin contradict to these, i.e. positive effect of ESG on them. However, this might be caused by the size effect of variables, if we consider how large the *t*-stats are. The results from economic and profitability measures can be interpreted as ESG may assist to gain market share for the companies by increasing their revenues. However, the negative impact on profitability may direct that firms can be suffered due to implementation costs of ESG performance. Next, industry and country effect controlled pooled regressions are run and overall results are consistent with the result of original pooled regression. Interestingly, size risk factor (market value) exceptionally becomes insignificant and positive after capturing industry effects. Another interesting point to note is that only Nordic firms except Finnish firms, are positively influenced by ESG. From factor mimicking portfolio analysis, significant and negative intercept was obtained. In other words, market may not reward ESG level adjusted portfolio. In fact, this might potentially indicate that market punishes firms with better ESG performance. Furthermore, we can conclude that a stock portfolio with high ESG has negative risk-adjusted returns.

As a limitation of this paper, it is worthy to note that the econometric analyses evaluate the effect on the average monthly stock returns of European corporations listed in STOXX 600 from 2002 to 2018. In other words, the estimation results might have been affected by this regional and periodical settings. Furthermore, compared to prior research using similar methodological approach by Ziegler et al. (2007) and Mănescu (2011), the main results were inconsistent with both of the papers. This can potentially be caused by using different stock performance or ESG scores than previous studies. Although the methodological approach was inspired by aforementioned studies, there were modification of model to fit in selected data. Hence, the results may not be directly compared to one another. Furthermore, while we focus on finding the nature of ESG effect on economic and financial performance of corporations, the research did not stretch to define a causality of this relationship. This paper assumes the relationship between ESG ratings and economic / financial performance is from one way, i.e. ESG affects economic / financial performance. Nevertheless, it is also possible to have reverse effect, i.e. stock influences ESG scores according to Ziegler et al. (2007).

To finally answer the foremost research question of this paper, through applied empirical analyses, we can deduce that the European stock market seems to penalise high ESG performing firms. Overall, the main results extrapolate that there is a negative effect of ESG performance on firms' financial performance. Additionally, the main finding concludes that firm specific ESG scores can be used for generating risk adjusted return.

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Appendix

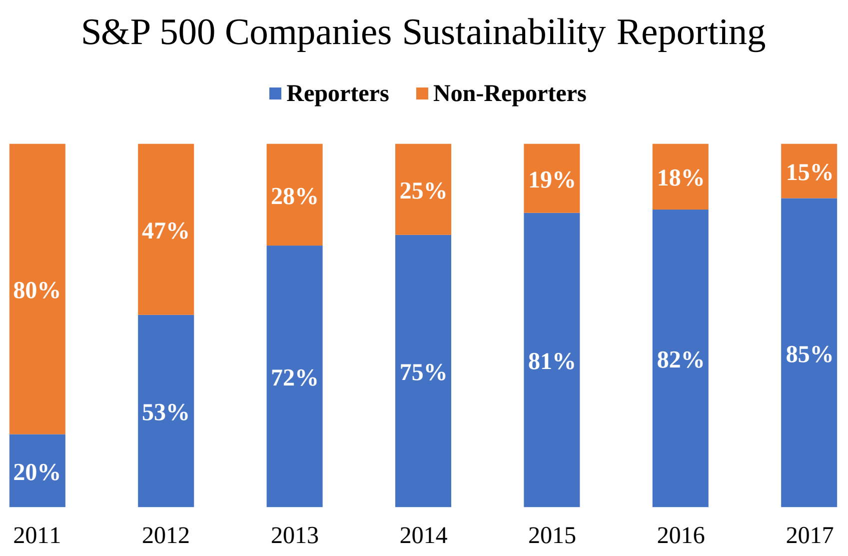

Figure A1 Increasing Sustainability Reporting evidenced by S&P 500 listed firms

Source: Governance & Accountability Institute, Inc. 2017 Research – www.ga-institute.com

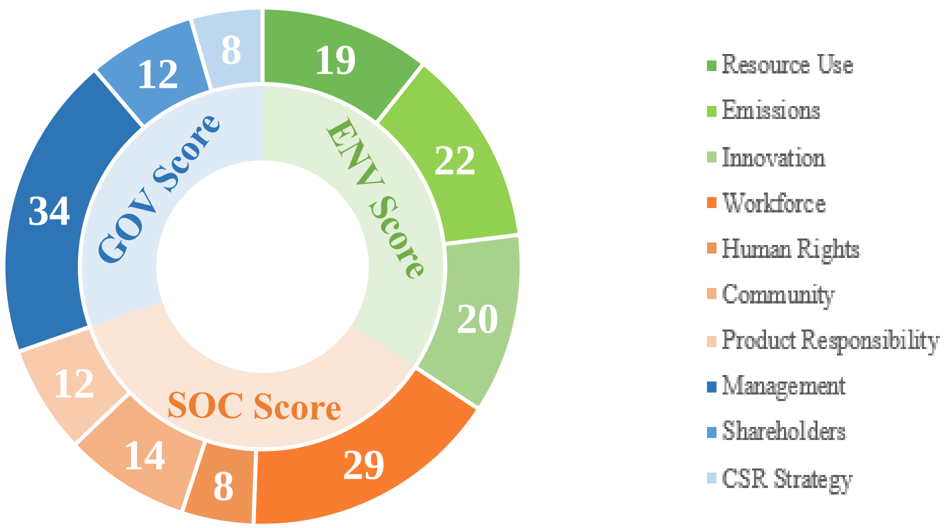

Figure A2 Properties of Thomson Reuters 178 ESG Metrics

Source: Thomson Reuters ESG Scores Methodology 2019

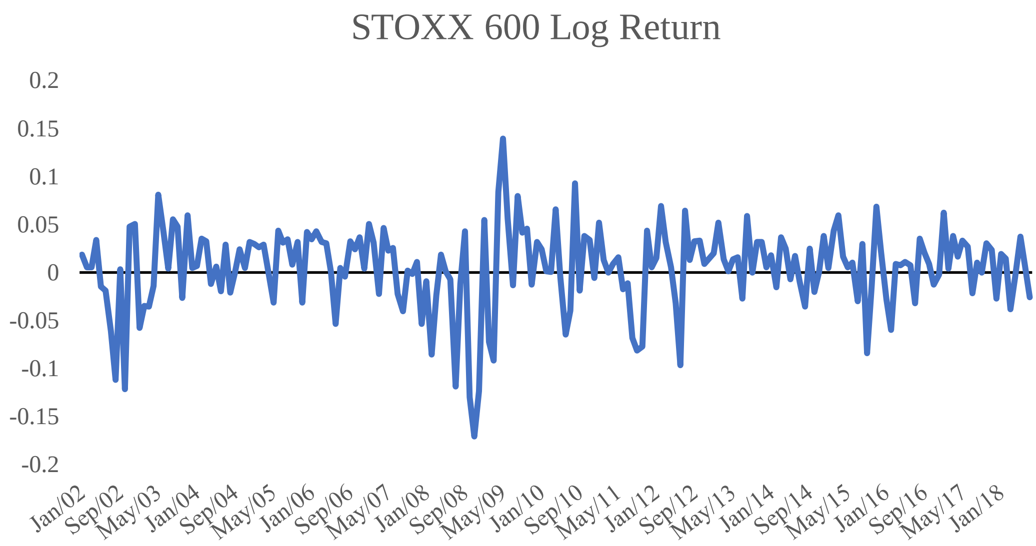

Figure A3 Average monthly stock returns from 2002 to 2018

Figure A4 STOXX 600 lowest peak during financial crisis

Source: STOXX Digital – https://www.stoxx.com

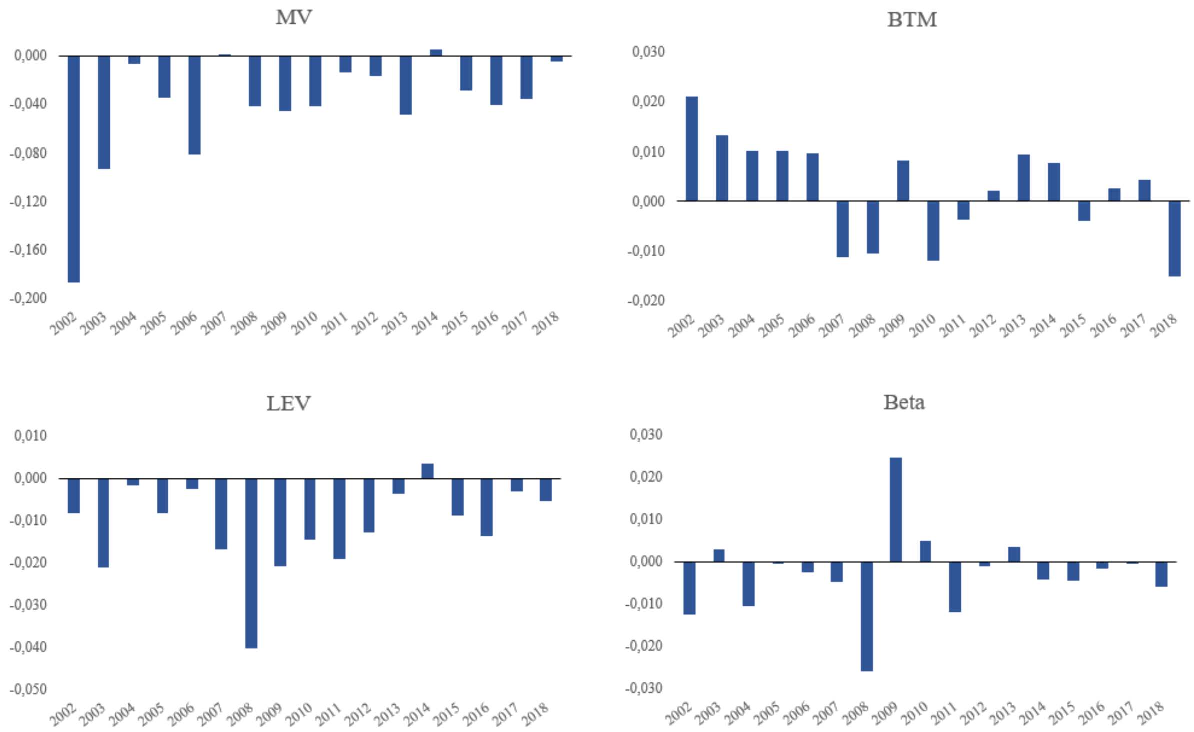

Figure A5 Annual change in estimated coefficients – cross-sectional regressions

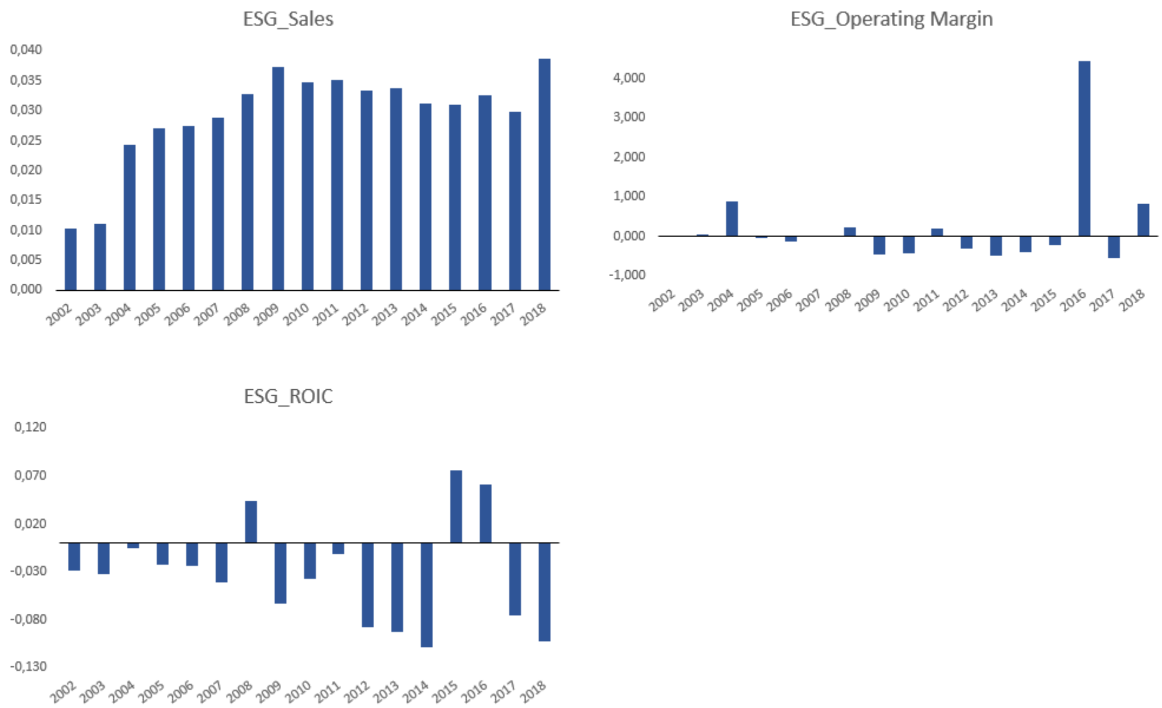

Figure A6 ESG effect on economic performance and profitability: sales, operating margin, ROIC

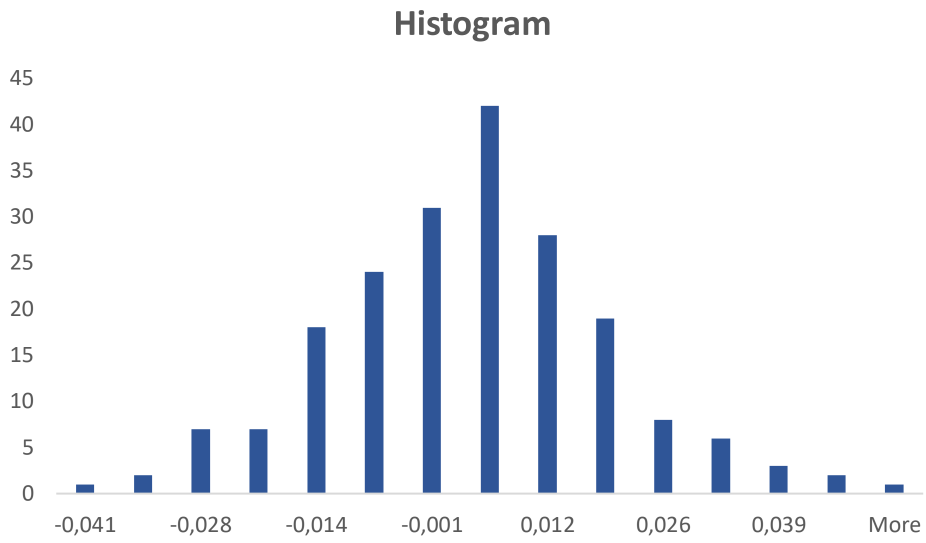

Figure A7 Residual Histogram for normality – Portfolio analysis

Table A1 Descriptive statistics of estimated coefficients in cross-sectional regressions

	Mean	*Std.Error*	*Std. Dev*	*Kurtosis*	*Skewness*	*Min*	*Max*
$\hat{\gamma}_{0,t-1}$	0.017	0.003	0.040	0.519	-0.675	-0.106	0.099
$\hat{\gamma}_{ESG,t-1}$	-0.009	0.003	0.039	0.690	0.060	-0.138	0.110
$\hat{\gamma}_{MV,t-1}$	-0.043	0.012	0.164	18.806	-2.697	-1.289	0.464
$\hat{\gamma}_{BTM,t-1}$	0.003	0.002	0.027	2.042	-0.428	-0.115	0.097
$\hat{\gamma}_{Lev,t-1}$	-0.012	0.002	0.032	3.159	-0.841	-0.139	0.093
$\hat{\gamma}_{\beta,t-1}$	-0.003	0.002	0.035	4.748	-0.221	-0.145	0.141

Table A2 Descriptive statistics of all variables in cross-sectional regression

	Mean	*Std.Error*	*Std.Dev*	*Kurtosis*	*Skewness*	*Min*	*Max*
ln return	0.006	0.000	0.090	12.029	-0.938	-1.633	1.144
ESG	61.989	0.055	15.785	-0.297	-0.444	11.170	96.230
MV	22981.302	158.525	45294.704	54.434	5.944	5.010	844620.100
BTM	0.623	0.002	0.524	113.378	5.442	0.000	25.000
Lev	40.447	0.083	23.804	-0.561	0.284	0.000	99.010
Beta	1.007	0.004	1.166	45391.336	184.377	-27.160	288.621

Table A3 Descriptive statistics of all variables in multifactor model

	Mean	*Std.Error*	*Std. Dev*	*Kurtosis*	*Skewness*	*Min*	*Max*
$R_{HML_{ESG}}$	-0.006	0.001	0.016	0.647	0.221	-0.043	0.049
Rm-Rf	0.657	0.373	5.263	1.859	-0.641	-22.060	13.740
SMB	0.242	0.133	1.881	0.731	-0.350	-6.820	4.860
HML	0.218	0.153	2.164	0.842	0.364	-4.720	8.290
UMD	0.877	0.285	4.014	11.616	-1.769	-26.270	13.690

Table A4 White heteroscedasticity test – Portfolio analysis

Dependent Variable: Squared Residuals			
Observations: 199			
F-statistic	3.279	Prob. F	0.012
Obs*R-squared	12.603	Prob. Chi-Square	0.013

Table A5 Standard Error difference after Newey-West application

Standard Error	*C*	*Rm-Rf*	*SMB*	*HML*	*UMD*
Oridinary	0.0012	0.0003	0.0006	0.0006	0.0003
Newey-West	0.0013	0.0003	0.0007	0.0006	0.0004

Table A6 Breusch-Godfrey serial correlation LM test – Portfolio analysis

Dependent Variable: Residuals			
Observations: 199			
F-statistic	1.108	Prob. F	0.357
Obs*R-squared	5.669	Prob. Chi-Square	0.340

Table A7 Jarque-Bera Normality test – Portfolio analysis

	Value	*t-stat*	*p-value*
Kurtosis	0.532	1.531	0.125
Skewness	0.111	0.641	0.522
Jarque-Bera	2.755		0.252

Table A8 Ramsey RESET Linearity test – Portfolio analysis

Omitted Variables:	*Squares of fitted values*		
Observations: 199	*Degrees of freedom: 193*		
F-statistic	0.397	Prob. F	0.851
Likelihood Ratio	0.002		

Table A9 Correlation matrix: Muliticollinearity test – Portfolio analysis

	$R_{HML_{ESG}}$	*Rm-Rf*	*SMB*	*HML*	*UMD*
$R_{HML_{ESG}}$	1.000				
Rm-Rf	-0.011	1.000			
SMB	-0.086	-0.110	1.000		
HML	0.007	0.443	0.024	1.000	
UMD	-0.043	-0.477	0.132	-0.332	1.000