LUND UNIVERSITY

SCHOOL OF ECONOMICS AND MANAGEMENT

Department of Economics

Master Thesis NEKN01

Fall 2020

Responsible Investing: Costs and Benefits

A Cross-Country Study in Europe

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Abstract

This study employs the ESG-Sharpe Ratio frontiers framework and the ESG-adjusted CAPM model, introduced by Pedersen et al. (2020), to identify the costs and benefits of responsible investing and investigate the relationship between the environmental, social, and governance (ESG) issues and portfolio performance in different countries across Europe. In this paper, we explain the cross-country differences in the empirical results to draw a better picture of ESG integration for responsible investors.

Our cross-country comparison of the ESG-SR frontiers shows that the investors pay a higher cost for being ESG-motivated in the United Kingdom and Sweden than other countries and regions. In other words, for choosing a portfolio with the same ESG characteristics, ESG-motivated investors would sacrifice a higher percentage of their Sharpe Ratio in the United Kingdom and Sweden. These frontiers also reveal that ESG-aware investors earn a maximum ex-ante Sharpe Ratio higher than that of the ESG-unaware investors or equal to it, in all countries and regions, indicating that using the ESG information in the portfolio selection process can benefit the investors, even when they do not care about ESG issues.

Moreover, we construct a mimicking portfolio for ESG factor to analyse the relationship between stocks' ESG scores and their expected returns. The estimated alphas obtained from asset pricing models show that ESG scores predict future returns positively only in Switzerland, and negatively in the United Kingdom, France, and the Europe region. Further, we show that these perceived alphas can be explained by the ESG-adjusted CAPM model for all countries and regions, except for the Netherlands.

Keywords: Responsible investing, Environmental awareness, Portfolio performance, ESG-Sharpe Ratio frontier, ESG-adjusted CAPM.

Acknowledgment

First of all, I would like to express my sincere gratitude to my research supervisor Prof. Hossein Asgharian for the continuous support of my study and research as well as for his patience, motivation, enthusiasm, kindness, and immense knowledge. His guidance helped me in all the time of research and writing of this thesis. I could not have imagined having a better advisor and mentor for my master program. It was a great privilege and honour to work and study under his guidance and supervision.

Also, I would like to thank Zahra Hashemzadeh for guiding me during the course of my research and sharing with me her invaluable knowledge and expertise on the subject of this research.

Foremost, I would like to thank my caring, loving, and supportive wife, Saba. Honestly, the completion of this master program could not have been accomplished, without her endless support. Her encouragement, assistance, companionship, understanding, and patience when the times got rough were much appreciated and duly noted. It was a great comfort and relief to know that she was always there to support me. I am heartfully grateful for all she has done and for being the best friend I needed in my whole life.

Finally, I cannot forget to thank my family, my friends, and all the faculties of the school of economics and management at Lund University for all the unconditional support during this very intense academic program.

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1. INTRODUCTION

This study aims to identify the costs and benefits of responsible investing (RI)[1] and investigates the relationship between the environmental, social, and governance (ESG) issues and portfolio performance in different countries. In this paper, we try to explain the cross-country differences in empirical results to draw a better picture of ESG integration into investment decisions, for responsible investors.

Although the Principles for Responsible Investment (PRI) was launched with 63 signatories having $6.5 trillion in assets under management (AUM) in 2006, the growing interest in incorporating ESG issues during the past decade led to the commitment of 2,981 signatories representing $103.4 trillion AUM to responsible investing all over the world at the end of March 2020[2]. This significant growth in the sustainable investment assets, which is also documented by several surveys and reviews[3], makes it reasonable to expect an upward trend towards responsible investing and emphasises the importance of investigating the effects of incorporating ESG consideration into the investment process.

In recent years, there have been disagreements among academics and practitioners about how to incorporate ESG measures into portfolio selection and how it would affect portfolio performance. According to 2017 CFA Institute ESG Survey, one-third of the portfolio managers and research analysts, who did not take ESG into account in their analysis or decisions, blamed the insufficient knowledge of how to consider these issues and the inability to integrate ESG in their quantitative models. Based on Kim and Yoon (2020) findings, most of the PRI signatories do not make notable improvements to their fund-level ESG scores post-signing PRI while benefit from a significant increase in their fund flow and exhibit a decrease in return. Moreover, previous empirical studies about the effect of ESG integration on assets returns present an ambiguous relationship (Statman and Glushkov, 2009; Hvidkjær, 2017). In fact, it is evidenced by some scholars that the portfolios with better ESG performance have lower expected returns; while, others argue that considering ESG measures can

[1] Responsible investing has also been referred to as socially responsible investing, sustainable investing, and ethical investing amongst academics and practitioners.

[2] Numbers are based on the PRI Q4 2020 Signatory Relationship Presentation and PRI 2019 Annual Report.

[3] For example, check the ESG Global Survey 2019 conducted by BNP Paribas or the 2018 global sustainable investment review carried out by the Global Sustainable Investment Alliance (GSIA).

enhance the portfolio performance, or report no significant relationship between ESG criteria and asset returns.

Many studies confirm that responsible investors are willing to forego some return for purchasing green assets. Hong and Kacperczyk (2009) and Luo and Balvers (2017) show that ‘‘sin stocks’’ have statistically significant positive alphas and higher expected returns than comparable non-sin stocks. Baker et al. (2018) and Zerbib (2019) illustrate that green bonds are issued at a premium and yield lower returns than comparable regular bonds. Bolton and Kacperczyk (2020) and Hsu et al. (2020) indicate that firms having lower levels of total carbon emissions or toxic emission intensity have lower risk-adjusted excess returns. El Ghoul et al. (2011), Chava (2014), and Giese et al. (2019) find that firms with higher ESG scores have a lower cost of equity capital.

On the other hand, some scholars illustrate that responsible investors can enjoy a better portfolio performance while considering ESG measures. Gompers et al. (2003) show that portfolios which buy and sell stocks with the high and low level of corporate governance, respectively, generate high abnormal returns. Edmans (2011,2012) indicate that the portfolios of firms with the highest employee satisfaction yield higher future excess returns. In et al. (2017) findings demonstrate that a strategy which buys carbon-efficient and sells carbon-inefficient firms generates positive and statistically significant alphas. Eccles et al. (2014) show that high sustainable firms have higher risk-adjusted returns than low sustainable firms. Kempf and Osthoff (2007), Ashwin Kumar et al. (2016), and Verheyden et al. (2016) find that implementing ESG ratings for positive screening and best-in-class screening leads to positive and statistically significant alphas.

In addition to both positive and negative views, there are also studies exhibiting a neutral relationship between ESG measures and asset returns. Kempf and Osthoff (2007), Statman and Glushkov (2009), and Blitz and Fabozzi (2017) provide evidence that the sin stocks premium disappears when controlling for risk factors and estimated alphas from negative screens of non-sin stocks are not different from zero. Kumar (2019) show that none of the MSCI USA ESG Broad Indexes generates statistically significant alphas. Halbritter and Dorfleitner (2015) and Geczy et al. (2018) demonstrate that the four-factor alphas from high minus low ESG portfolios are insignificant. Halbritter and Dorfleitner (2015) argue that these contradictory relationships between responsible investment and portfolio performance are due to the differences in ESG-scores across rating providers, and the choices of the ESG pillars, sample periods, and included companies.

Many researchers have proposed theoretical frameworks to explain these opposing views regarding the effect of ESG integration on asset returns and valuation. These theoretical models mostly follow the methodology presented by Merton (1987) assuming that in addition to regular investors who invest freely in all assets, a fraction of the economy are ESG-sensitive investors refusing to invest in certain non-green assets. As a result, these two types of investors choose different portfolios since their investment opportunity sets are not identical, which leads to market segmentation. It is evidenced by many authors such as Heinkel et al. (2001), Luo and Balvers (2017), and Zerbib (2020) that in the existence of such an exclusionary screening assumption, green assets may have lower expected return compared to brown ones in equilibrium.

Furthermore, there are studies considering preferences or tastes for high ESG assets amongst ESG-sensitive investors instead of the segmentation assumption or in parallel with it. These studies generally take the investors' ESG preferences into account through the investor's utility function. For example, Fama and French (2007), Baker et al. (2018), and Pastor et al. (2020) employ an exponential (CARA) utility function allowing a linear effect of ESG characteristics on the expected utility maximization (nonpecuniary utility). In other words, they assume all investors have mean-variance preferences, where ESG-sensitive ones also have preferences for green assets. All these papers demonstrate that based on their models, the expected return of green assets necessarily should be lower than or equal to brown assets in equilibrium. More specifically, Fama and French (2007) and Pastor et al. (2020) show that green assets have negative CAPM alphas in contrast to brown assets having positive alphas.

Although these models explain the negative or neutral relationship between the expected return and the ESG characteristics of assets, they lack predicting any possible equilibrium state in which green assets have higher expected returns, specially over a long period. The only model that reconcile all these different relationships is introduced by Pedersen et al. (2020), and it has other distinctive features as well.

First, Pedersen et al. (2020) explicitly consider two ways of using ESG information by the investors in their model, where investors are allowed to have preferences over ESG and also to use ESG scores for estimating the risk and expected return of assets. In this way, they define three types of investors having mean-variance preferences. However, ESG-unaware (Type-U) investors are unaware of ESG scores and only maximize their unconditional mean-variance utility. ESG-aware (Type-A) investors also use assets' ESG scores in their estimation of risk and expected return. ESG-motivated (Type-M) investors use ESG information in the same way ESG-aware investors do while having preferences for high ESG scores. Further, in contrast to other similar models assuming a linear effect of ESG on utility, authors consider more general ESG preferences.

Second, similar to the separation property of the mean-variance frontier[4], they introduce the "ESG-Sharpe Ratio frontier" depending only on security characteristics. This ESG-SR frontier is computed as the highest attainable Sharpe Ratio (SR) for each level of ESG, which allows investors to choose a portfolio on the frontier based on their ESG preferences. The authors show that each portfolio on the frontier follows a four-fund separation and is a combination of the risk-free asset, the standard mean-variance tangency portfolio, the minimum-variance portfolio, and the "ESG-tangency portfolio". In this way, they illustrate a tradeoff between ESG and the risk-adjusted return to resolve the portfolio selection problem for people caring about risk, return, and ESG integration.

Finally, Pedersen et al. (2020) derive the security prices and returns in equilibrium by building an ESG-adjusted CAPM model in cases that all investors are type-U, type-A, or type-M. They show that in case of a positive correlation between the securities ESG scores and future profits[5], high-ESG stocks can have a high, low, or insignificant expected return, depending on the type of investors dominant in the economy. In the case of type-U investors dominancy, green stocks profitability is not completely reflected in their prices since these investors do not incorporate this information. Therefore, green stocks are undervalued and have high future returns. However, if type-A investors are the dominant ones in the market, the expected profitability of high-ESG stocks is completely exploited, and this information no longer predicts future returns. On the other hand, when there are many type-M investors, the prices of green stocks are bided up to even more than which exactly reflects their expected profitability since these investors prefer high-ESG portfolios. In this way, the higher demand for green stocks leads to accepting a lower expected return for high-ESG stocks by the type-M investors.

Pedersen et al. (2020) provide a practical framework for integrating ESG scores into portfolio selection while explaining the pricing and expected returns of the stocks, at the same time. Therefore, this study employs this framework to identify the costs and

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[4] First, all the investors compute the same efficient frontier based on the assets' characteristics and then choose their preferred portfolio on the frontier concerning their level of risk aversion.

[5] The future profitability refers to the corporate financial performance (CFP) measured by the future fundamentals (such as accounting profit, free cash flow, dividend, etc.) affecting the security's valuation. The literature on the relationship between ESG and profitability is available in corporate social responsibility (CSR) studies, e.g., Friede et al. (2015).

benefits of responsible investing and investigate the relationship between the securities ESG scores and expected returns in different countries across Europe, separately and as a whole. In this way, by considering a sample of European stocks and their total ESG scores provided by SustainalyTics over the period from January 2010 to December 2019, this study calculates ex-ante and ex-post empirical ESG-Sharpe Ratio frontiers for the United Kingdom, Germany, France, Sweden, Switzerland, and Netherlands as well as for Nordic Countries[6] and European Countries[7].

The cross-country comparison of the ESG-SR frontiers shows that the investors pay a higher cost for being ESG-motivated in the United Kingdom and Sweden than other countries and regions. In other words, for choosing a portfolio with the same ESG characteristics, ESG-motivated investors would sacrifice a higher percentage of their Sharpe Ratio in the United Kingdom and Sweden. These frontiers also reveal that ESG-aware investors earn a maximum ex-ante Sharpe Ratio higher than that of the ESG-unaware investors or equal to it, in all countries and regions, indicating that using the ESG information in the portfolio selection process can benefit the investors, even when they do not care about ESG issues.

Moreover, this study applies an ESG-mimicking portfolio approach for analysing the relationship between stocks' ESG scores and expected returns. The estimated alphas obtained from asset pricing models (CAPM, Fama and French three-factor, Fama French five-factor, and Fama French five-factor plus a momentum factor) show that ESG scores predict future returns positively only in Switzerland, and negatively in United Kingdom, France, and the Europe region. Further, we show that these perceived alphas can be explained by the Pedersen et al. (2020) ESG-adjusted CAPM model for all countries and regions, except for the Netherlands.

In this way, this paper contributes to responsible investing literature by conducting the first cross-country empirical study calculating the ESG-Sharpe Ratio frontiers and explaining the various outcomes of ESG integration in different markets across the Europe.

The remaining part of this paper is structured as follows. Section 2 presents the background theory and framework for ESG-SR efficient frontier and the equilibrium ESG-adjusted CAPM pricing model. Section 3 describes the applied methodology and data for empirical estimations of ESG-SR efficient frontiers and asset pricing

[6] The Nordic countries sample consists of companies from Sweden, Norway, Denmark, and Finland.

[7] The European countries sample consists of companies from The United Kingdom, Germany, France, Sweden, Switzerland, Norway, Netherlands, Italy, Spain, Austria, Finland, Denmark, and Belgium.

regressions. Section 4 presents the empirical results and analytical interpretations and discussions about them, and section 5 concludes the research findings.

2. LITERATURE REVIEW

This section first provides background literature on ESG integration and its effects on portfolio performance. Then, introduces the theoretical frameworks for the ESG-Sharpe Ratio efficient frontier and the equilibrium ESG-adjusted CAPM pricing model, proposed by Pedersen et al. (2020).

2.1 Background

The concept of social responsibility within the context of business was born in the late eighteenth century and evolved to the modern definition of corporate social responsibility (CSR) in the 1950s (Carroll, 2008; Agudelo et al., 2019). However, the foundation for responsible investing (RI)[8] considering environmental, social, and governance (ESG) issues in practice was firstly laid by the former UN Secretary-General Kofi Annan. In 2000, he launched a corporate responsibility initiative named "the Global Compact" aimed to implement universal principles in business. Later, in January 2004, he invited the CEOs of 55 of the world's leading financial institutions to join in this initiative, which led to the development of a report entitled "Who Cares Wins," authored by Ivo Knoepfel in that year. This report highlighted the relationship between ESG issues and investment decisions to contribute to a better integration of these factors in the investment process. One year later, in 2005, the United Nations Environmental Program's Finance Initiative (UNEP-FI) published a report known as "Freshfield Report," indicating the relevance of ESG issues information to financial valuation and investment decisions. In this way, these two reports are considered as the cornerstone of the Principles for Responsible Investment (PRI) launched at the New York Stock Exchange in 2006.

Although PRI started with 63 signatories including asset owners, asset managers, and service providers having $6.5 trillion in assets under management (AUM), the growing interest in incorporating ESG issues during the past decade led to the commitment of 2,981 signatories representing $103.4 trillion AUM to responsible investing all over the world at the end of March 2020[9]. The ESG Global Survey 2019 conducted by BNP Paribas also suggests a similar growth that the proportion of asset owners and asset managers investing at least a quarter of their funds in ESG or RI funds increased from

[8] Responsible investing has also been referred to as socially responsible investing, sustainable investing, and ethical investing amongst academics and practitioners.

[9] Numbers are based on the PRI Q4 2020 Signatory Relationship Presentation and PRI 2019 Annual Report.

48 per cent and 53 per cent in 2017 to 75 per cent and 62 per cent in 2019, respectively. Moreover, the 2018 global sustainable investment review, carried out by the Global Sustainable Investment Alliance (GSIA), documented a 34 per cent growth in the sustainable investing assets in five major markets[10] between 2016 and 2018. According to the review, total sustainably invested assets increased from approximately $22.8 trillion in 2016 to $30.7 trillion at the start of 2018. In this way, it is reasonable to expect an upward trend towards incorporating ESG consideration into the investment process, which makes it crucial to identify the costs and benefits of responsible investing from the investors' perspective.

2.2 ESG and Portfolio Performance

Previous empirical studies about the effect of ESG integration on assets returns present an ambiguous relationship (Statman and Glushkov, 2009; Hvidkjær, 2017). In fact, it is evidenced by some scholars that the portfolios with better ESG performance have lower expected returns; while, others argue that considering ESG measures can enhance the portfolio performance, or report no significant relationship between ESG criteria and asset returns. Some of these earlier studies are classified based on their findings and presented in the following subsections.

2.2.1 Negative Relationship

One of the most cited empirical studies providing evidence that green assets underperform brown assets is Hong and Kacperczyk (2009). They investigate the social norms' effects on markets by studying U.S. stocks over the period of 1962 to 2006 and also consider stocks from other international markets from 1985 to 2006. Their results show that ''sin stocks'' (publicly traded firms producing alcohol, tobacco, and gaming) have statistically significant positive alphas and higher expected returns than comparable non-sin stocks. Fabozzi et al. (2008) also consider a sample covering 21 national markets throughout 1970 to 2007, and show that sin portfolio outperforms market benchmarks in terms of both absolute and CAPM risk-adjusted excess returns. Luo and Balvers (2017) also confirm the existence of sin stock premium for U.S stocks from 1963 to 2012. Although they illustrate that conventional risk factors do not explain the sin stock premium, they argue that this premium relates to a systematic risk named "boycott risk", which is resulted by the nonpecuniary preferences of responsible investors.

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[10] These markets consist of Europe, the United States, Canada, Japan, and Australia and New Zealand.

Baker et al. (2018) study a sample of U.S. corporate and municipal bonds from 2010 to 2016. They illustrate that green bonds are issued at a premium and yield lower returns than comparable regular bonds. Similarly, Zerbib (2019) analysis the Euro and USD bonds from 2013 to 2017 and draws the same conclusion as Baker et al. (2018), that environmentally concerned investors are willing to forego some return for purchasing green bonds. Bolton and Kacperczyk (2020) indicate a significantly positive cross-sectional relationship between the returns and the level of total CO2 emissions of U.S. firms over the sample period starting in 2005 .and ending in 2017. Their results indicate that firms having lower levels of total carbon emissions have lower risk-adjusted returns. Another recent study reporting a positive cross-sectional relationship between industrial pollution and stock returns is conducted by Hsu et al. (2020). They use a sample of U.S. stocks from 1991 to 2016 and show that a zero-cost portfolio buying and selling firms with high and low toxic emission intensity, respectively, yields a statistically significant risk-adjusted excess return.

El Ghoul et al. (2011) find that U.S. firms with higher corporate social responsibility (CSR) scores have a lower cost of equity capital during the sample period of 1992 to 2007. Their results are significant even after controlling for industry and firm-specific determinants. In parallel with El Ghoul et al. (2011), by using a sample period of 1992 to 2007, Chava (2014) concludes that stocks excluded by environmental screens have a higher implied cost of equity and debt capital compared to green stocks. Giese et al. (2019) illustrate that for the 2007 to 2017 time period, ESG information affects the performance of global companies through a multichannel process, where companies with higher ESG scores have lower costs of capital, higher valuations, higher profitability, and lower exposures to downside risk.

Riedl, and Smeets (2017) investigate the investors' motivations for holding socially responsible mutual funds. They consider administrative data, from 2006 to 2012, and conduct surveys and incentivized experiments in June 2011. They demonstrate that the financial motives are taken into consideration after social preferences by socially responsible investors expecting lower returns and higher management fees on SRI funds compared to conventional funds. Barber et al. (2018) find that the ex-post financial returns earned by social and environmental Impact funds are lower than that of traditional venture capital funds between 2005 and 2017. Kanuri (2020) compares the ESG ETFs performance with that of the U.S. (Russell 3000 ETF) and global (SPDR Global Dow ETF) equity markets and demonstrates that over the sample period from 2005 to 2019, ESG portfolios underperform both the U.S. and global ETFs in terms of both lower absolute and risk-adjusted performances. He also employs several asset pricing models indicating significantly negative alphas during the study period for both the equal and value weighted ESG portfolios.

2.2.2 Positive Relationship

Gompers et al. (2003) use a sample of large U.S. firms during the 1990s and introduce a corporate governance index indicating the level of shareholder rights. They show that portfolios which buy and sell stocks in the lowest and highest deciles of the ascending ordered index generate high abnormal returns. Edmans (2011,2012) investigates the link between employee satisfaction (as a social dimension measure) and long-run stock returns from 1984 to 2011[11]. His findings indicate that both equal and value weighted portfolios of the top 100 firms with highest employee satisfaction[12], yield higher future excess returns which are statistically significant after controlling for risk factors and industry characteristics. Further, Edmans et al. (2014) extend the same study to include 14 countries during the period from 1998 to 2013. They demonstrate that employee satisfaction leads to statistically positive alphas only in countries having highly flexible labour markets. In et al. (2017) study the effect of carbon intensity level[13] on characteristics of U.S. firms between 2005 and 2015 and show that a strategy which buys carbon-efficient and sells carbon-inefficient firms, generates positive and statistically significant alphas after 2009. In parallel with In et al. (2017) findings, Halcoussis and Lowenberg (2019) show that during the period from 2010 to 2018, low-carbon portfolio formed by shunning the fossil-fuel oriented stocks generates higher return than the S&P 500 stock market.

Dorfleitner et al. (2014) investigate the effect of U.S. and Canadian firms' ESG scores on their long-term performance from 2002 to 2013. They indicate that portfolios formed by buying and selling stocks respectively belonging to the top and bottom quintiles of descending sorted ESG scores, generate mid and long-term abnormal returns. They show that this abnormal return is statistically significant for all three ESG dimensions, even after considering risk factors, accounting items, and industry fixed effects. Eccles et al. (2014) use a sample of U.S. firms classified to high sustainable and low sustainable companies based on the voluntary adoption of sustainability policies by 1993 and show that high sustainable firms (adopted all) have higher risk-adjusted returns than the low sustainable firms (adopted non) for the long period of

[11] Edmans (2011) covers the sample period of 1984 to 2011, while Edmans (2012) considers a data sample from1984 and 2009.

[12] Firms listed in the "100 Best Companies to Work for in America".

[13] The level of carbon intensity is calculated as the amount of a firm's greenhouse gas emission per unit of revenue.

1993 and 2010. Furthermore, Khan et al. (2016) take the materiality classifications of sustainability issues presented by the Sustainability Accounting Standards Board (SASB) into account. They indicate that through the period of 1991 to 2013, there is a significant positive relationship between firms' ratings on material sustainability issues and their excess return, even after considering common risk factors.

Considering U.S. stocks during the sample period from 1992 to 2004, Kempf and Osthoff (2007) show that implementing ESG ratings for positive screening[14] and best-in-class screening leads to significant positive alphas. Ashwin Kumar et al. (2016) present a screening strategy similar to the best-in-class approach by selecting stocks from the Dow Jones Sustainability Index, over the period of 2014 to 2015, and indicate that firms with higher ESG score have higher returns and lower volatility in each industry. Verheyden et al. (2016) also employ best-in-class screening strategy for a global sample of stocks (23 developed and 23 emerging countries) between 2010 and 2015. Their results indicate that compared to their unscreened sample, the ESG-screened portfolios earn higher returns while having lower volatility, tail risks, and Conditional Value at Risk (CVaR). Sherwood and Pollard (2018) consider MSCI Emerging Markets ESG Indices and non-ESG MSCI Emerging Markets Indices of specific regions and countries during the period between 2007 and 2016, and Similar to Verheyden et al. (2016), they illustrate that ESG integration provides emerging markets' investors with higher risk-adjusted returns and lower downside risk than that of the non-ESG Indices do.

2.2.3 Neutral Relationship

Kempf and Osthoff (2007) investigate the effects of ESG integration on portfolio performance. Their findings show that during the sample period from 1992 to 2004, estimated alphas from negative screens of non-sin stocks are not different from zero. Statman and Glushkov (2009) analyse the returns of portfolios constructed on socially responsible scores of U.S. firms over the period from 1992 to 2007. They indicate that the equally weighted portfolios formed as long and short of the top and bottom stocks, based on their sorted best-in-class ESG scores, have positive and statistically significant alphas. However, the alphas estimated for the value weighted top-bottom portfolios are not significant for the sample period of 2000 to 2007. They also show that both equal- and value weighted portfolios which long non-sin stocks and short sin stocks have insignificant Carhart four-factor alphas. Blitz and Fabozzi (2017) also study the performance of sin stocks in the United States, Europe, Japan, and a global

[14] A simple long-short value weighted portfolio of stocks with high-low ESG ratings.

sample, between 1963 and 2016. They employ several asset pricing regressions and different sample periods to show that the sin stocks premium disappears when controlling for risk factors, especially the profitability and investment factors (from Fama and French five-factor model).

Halbritter and Dorfleitner (2015) consider different ESG rating providers for the U.S. stocks, for the sample period from 1991 to 2012, and employ an ESG portfolio approach as well as cross-sectional regressions. Based on the cross-sectional regression results, they indicate that the relationship between ESG scores and returns is significantly dependent on the ESG rating provider, the ESG pillar, and the sample period. However, they show that the four-factor alphas from high and low ESG portfolios are not statistically different from zero. Geczy et al. (2018) also examine the performance of portfolios long stocks having high ESG scores and short the ones with low ESG scores. They demonstrate that for the whole sample period of 1992 to 2015 and the two subperiods before and after 2004, these long-short portfolios do not generate abnormal returns and all the estimated four-factor alphas are insignificant. Kumar (2019) analyses four MSCI USA ESG Broad Indexes, including Universal, Focus, Select, and Leaders. He implements different asset pricing regressions and shows that none of these indexes generates statistically significant alphas.

2.3 A Theoretical Framework for ESG Integration

Many researchers have proposed theoretical frameworks to explain the opposing views regarding the effect of ESG integration on asset returns and valuation. These theoretical models mostly follow the methodology presented by Merton (1987) assuming that in addition to regular investors who invest freely in all assets, a fraction of the economy are ESG-sensitive investors refusing to invest in certain non-green assets. Heinkel et al. (2001), Luo and Balvers (2017), and Zerbib (2020) show that this market segmentation leads to an equilibrium condition where green assets have lower expected return compared to brown ones.

Furthermore, there are studies considering preferences or tastes for high ESG assets amongst ESG-sensitive investors instead of the segmentation assumption or in parallel with it. These studies generally take the investors' ESG preferences into account through the investor's utility function and assume all investors have mean-variance preferences, where ESG-sensitive ones also have preferences for green assets. Fama and French (2007), Baker et al. (2018), and Pastor et al. (2020) demonstrate that based on such assumptions, the expected return of green assets necessarily should be lower than or equal to brown assets in equilibrium.

Although these models explain the negative or neutral relationship between the expected return and the ESG characteristics of assets, they lack predicting any possible equilibrium state in which green assets have higher expected returns, specially over a long period. Pedersen et al. (2020), however, introduce a model that reconcile all these different relationships.

Pedersen et al. (2020) explicitly consider two ways of using ESG information by the investors in their model. Specifically, investors are allowed to have preferences over ESG measures and are also free to use ESG scores for estimating the risk and expected return of assets. Therefore, Pedersen et al. (2020) define three types of investors having mean-variance preferences. However, ESG-unaware (Type-U) investors are unaware of ESG scores and only maximize their unconditional mean-variance utility. ESG-aware (Type-A) investors also use assets' ESG scores in their estimation of risk and expected return. ESG-motivated (Type-M) investors use ESG information in the same way ESG-aware investors do while having preferences for high ESG scores. Based on these assumptions, Pedersen et al. (2020) introduce the "ESG-Sharpe Ratio frontier" resolving the portfolio selection problem for ESG-motivated investors and derive the security prices and returns in equilibrium by building an ESG-adjusted CAPM model.

2.3.1 ESG-Sharpe Ratio frontier

Pedersen et al. (2020) assume a set of n risky assets having excess returns and ESG scores represented by the vectors $r = (r^1, \dots, r^n)'$ and $s = (s^1, \dots, s^n)'$, respectively, and a risk-free rate of r^f. In this way, based on their definition of investor types, type-U investors utilize the unconditional expected excess return, $\mu_0 = E(r)$, and unconditional variance-covariance matrix, $\Sigma_0 = \mathrm{v}ar(r)$, for portfolio selection. In contrast, type-A and type-M investors use the conditional versions denoted by $\mu = E(r|s)$ and $\Sigma = \mathrm{v}ar(r|s)$. More importantly, since type-U and type-A investors do not have ESG preferences, they employ the mean-variance utility for their portfolio selection. However, type-M investors consider an extended mean-variance framework to take their ESG preferences into account for choosing a portfolio. In this way, by denoting the investors' current wealth and the weights of risky assets in the selected portfolio by W and $x = (x^1, \dots, x^n)'$ [15], respectively, the investors' future wealth, $\widehat{W}$, and expected utility, $E(U)$, for each type of investors are as follow:

$$\widehat{W} = W(1 + r^f + x'r) \quad (1)$$

[15] This vector shows the percentage of investors' wealth invested in each risky asset. In other words, $Wx'1$ is the amount invested in risky assets, and $W\,(1 - x'1)$ is the amount invested in the risk-free asset.

$$E(U_U) = E(\widehat{W}) - \frac{\gamma}{2W} Var(\widehat{W}) \tag{2}$$

$$E(U_A) = E(\widehat{W}|s) - \frac{\gamma}{2W} Var(\widehat{W}|s) \tag{3}$$

$$E(U_M) = E(\widehat{W}|s) - \frac{\gamma}{2W} Var(\widehat{W}|s) + Wf(\bar{s}) \tag{4}$$

In the above equations, γ is the relative risk-aversion, and $\bar{s},$ equal to $\frac{x's}{x'1}$, is the value weighted average of risky assets' ESG scores, where 1 is a column vector which all of its elements are one. Based on these equations, although type-U and type-A investors only maximize their expected utility over wealth, type-M investors also consider the average ESG score of risky assets when maximizing their expected utility. Nevertheless, they do not earn any "ESG utility" from investing in the risk-free rate. Pedersen et al. (2020) also assume that the sum of portfolio weights is positive ($x'1 > 0$) since, based on the definition of the average ESG score, it is difficult to interpret the ESG characteristics of an overall short portfolio. After replacing $\widehat{W}$ in the above equations, Pedersen et al. (2020) show that the expected utility maximization problem can be simplified into the following equations.

$$\max E(U_U) \equiv \max_{s.t.\ x'1>0} (x'\mu_0 - \frac{\gamma}{2} x'\Sigma_0 x)$$
$$\equiv \max_{\sigma_0} \left\{ \max_{\substack{s.t.\ x'1>0 \\ \sigma_0{}^2 = x'\Sigma_0 x}} \left(x'\mu_0 - \frac{\gamma}{2} \sigma_0{}^2 \right) \right\} \tag{5}$$

$$\max E(U_A) \equiv \max_{s.t.\ x'1>0} (x'\mu - \frac{\gamma}{2} x'\Sigma x)$$
$$\equiv \max_{\sigma} \left\{ \max_{\substack{s.t.\ x'1>0 \\ \sigma^2 = x'\Sigma x}} \left(x'\mu - \frac{\gamma}{2} \sigma^2 \right) \right\} \tag{6}$$

$$\max E(U_M) \equiv \max_{\substack{s.t.\ x'1>0 \\ \bar{s} = \frac{x's}{x'1}}} (x'\mu - \frac{\gamma}{2} x'\Sigma x + f(\bar{s}))$$
$$\equiv \max_{\bar{s}} \left[\max_{\sigma} \left\{ \max_{\substack{s.t.\ x'1>0 \\ \bar{s} = \frac{x's}{x'1} \\ \sigma^2 = x'\Sigma x}} \left(x'\mu - \frac{\gamma}{2} \sigma^2 + f(\bar{s}) \right) \right\} \right] \tag{7}$$

The maximization problem for both type-U and type-A investors can be solved by the Markowitz standard solution. In this way, for each level of standard deviation (σ_0 or σ) investors find the portfolio having the highest expected excess return ($x'\mu_0$ or $x'\mu$) and then maximize their expected utility over the standard deviation. In other words, investors first maximize the Sharpe Ratio (SR) and find the Tangency portfolio of risky assets and then choose the amounts that they invest in the Tangency portfolio and the risk-free asset, based on the level of risk aversion. Pedersen et al. (2020) also show that the maximization problem for type-M investors can be divided into two steps, where the first one is to identify the portfolio having the highest expected excess return ($x'\mu$) for each level of risk (σ) and ESG score ($\bar{s}$), and the second one is to maximize the expected utility over the σ and $\bar{s}$. They demonstrate that the first step is equivalent to finding the portfolio with the highest SR for each possible value of $\bar{s}$, which results in Equation (8) after inserting the optimal level of $\sigma = SR(\bar{s})/\gamma$.

$$\max E(U_M) \equiv \max_{\bar{s}} \left[\max_{\sigma} \left\{ SR(\bar{s})\sigma - \frac{\gamma}{2}\sigma^2 + f(\bar{s}) \right\} \right]$$

$$= \max_{\bar{s}} \left[SR(\bar{s})^2 + 2\gamma f(\bar{s}) \right] \quad (8)$$

Pedersen et al. demonstrate that the type-M investors can maximize their utility by a trad-off between the average ESG score and SR. They show that the expected utility of type-M investors is explained by the $SR(\bar{s})$ and $2\gamma f(\bar{s})$ terms, where the former one only depends on the security's characteristics, and the later one represents the investor's preferences. In this way, similar to the separation property of the mean-variance frontier[16], they show that investors can select their optimal portfolio by first computing the ESG-Sharpe Ratio frontier ($SR(\bar{s})$), and then choosing a portfolio of risky assets on this frontier, based on their ESG preferences and risk aversion, and finally deciding the amounts which they invest in each of the chosen risky portfolio and the risk-free asset, based on their level of risk aversion. In other words, the placement of investors' portfolio of risky assets on the ESG-SR frontier reveals the multiplication of their ESG preferences and risk aversion ($2\gamma f(\bar{s})$), and the amount invested in the risk-free asset only indicates their relative risk aversion (γ).

Pedersen et al. (2020) derive a mathematical solution for computing the ESG-SR frontier from the definition of the $SR(\bar{s})$ providing the highest attainable Sharpe ratio for each level of average ESG score. They also formulate the optimal portfolio weights

[16] First, all the investors compute the same efficient frontier based on the assets' characteristics and then choose their preferred portfolio on the frontier concerning their level of risk aversion.

(x) for a given average ESG score. The formulas for $SR(\bar{s})$ and x are as follow, where $c_{ab} = a'\Sigma^{-1}b$:

$$SR(\bar{s}) = \max_{\substack{s.t.\ x'1>0 \\ \bar{s} = \frac{x's}{x'1}}} \left(\frac{x'\mu}{\sqrt{x'\Sigma x}}\right) = \sqrt{c_{\mu\mu} - \frac{(c_{s\mu} - \bar{s}c_{1\mu})^2}{c_{ss} - 2\bar{s}c_{1s} + \bar{s}^2 c_{11}}} \quad (9)$$

$$x = \frac{1}{y}\,\Sigma^{-1}(\mu + \pi(s - 1\bar{s})) \quad (10)$$

where

$$\pi = \frac{c_{1\mu}\bar{s} - c_{s\mu}}{c_{ss} - 2c_{1s}\bar{s} + c_{11}\bar{s}^2} \quad (11)$$

Equation (9) reveals that the ESG-SR frontier is a convex function having a maximum value of $\mu'\Sigma^{-1}\mu$ equal to the SR attained by type-A investors' chosen portfolio. In other words, since the portfolio placed on the peak of ESG-SR frontier has the highest SR among all portfolios, it is the standard tangency portfolio given by the mean-variance frontier, hence, represents the optimal portfolio for ESG-aware investors. Moreover, the ESG-SR frontier is hump-shaped because restricting portfolios to have a different ESG score from the tangency portfolio leads to a lower attainable SR. In this way, type-A investors choose the portfolio on the peak of the frontier while type-M investors choose a portfolio with a higher ESG score than type-A investors due to their preference for higher ESG scores. Therefore, type-M investors pick portfolios placed on the right side of the peak representing the ESG-Efficient frontier. Furthermore, ESG-unaware investors may choose a portfolio below the ESG-SR frontier due to the fact that they ignore ESG information when finding the tangency portfolio.

Equation (10) shows that each portfolio on the frontier follows a four-fund separation and is a combination of the risk-free asset, the standard mean-variance tangency portfolio, $\Sigma^{-1}\mu$, the minimum-variance portfolio, $\Sigma^{-1}1$, and the "ESG-tangency portfolio", $\Sigma^{-1}s$. In other words, the portfolio weights are similar to that of the Markowitz standard solution in which the expected excess returns are adjusted by the desired average ESG score ($\bar{s}$) and a scale factor (π) . In this way, Pedersen et al. (2020) illustrate a trade-off between ESG and the risk-adjusted return to resolve the portfolio selection problem for people caring about risk, return, and ESG integration.

2.3.2 ESG-Adjusted CAPM

Pedersen et al. (2020) derive the security prices and returns in equilibrium by building an overlapping-generations (OLG) model in which new type-U, type-A, and type-M investors having the wealth equal to W_U, W_A, and W_M, respectively, are born each time period and only live for one period. The market-clearing condition leads to the equality of the total investors' wealth, $W = W_U + W_A + W_M$, and the total market capitalization ($p = Wx$). They assume that the risk-free rate is r^f , vectors $s = (s^1, \dots, s^n)'$ and $v_t = (v_t{}^1, \dots, v_t{}^n)'$ represent the ESG scores and the dividend payoffs of stocks, respectively, and the shares outstanding of each stock is normalized to one. For simplicity, they also consider a steady-state equilibrium, where stock prices denoted by the vector $p = (p^1, \dots, p^n)'$ are constant, and stock dividends are independent and identically distributed (IID) over time. Therefore, the one-period stock excess return vector $r = (r^1, \dots, r^n)'$ is given by $r_t^i = \frac{v_t{}^i}{p^i} - r^f$.

Pedersen et al. (2020) model the effect of ESG information on the securities fundamentals by considering a linear relationship between the expected dividends and ESG scores. They assume that $E(v_t\,|s) = \hat{\mu} + \lambda(s - s^m)$, where $s^m = \sum_i \left(\frac{p^i}{\sum_j p^j}\right) s^i$ is the weighted average ESG score of the market portfolio, and λ explains how ESG scores predict securities' profit. Based on this specification, the ESG-unaware investors (type-U), ignoring the ESG information, use unconditional expected value of dividends, $E(\mathcal{V}) = \hat{\mu}$, and unconditional payoff risks, $\mathrm{var}(\mathcal{V}) = \hat{\Sigma}$, for estimating the future profits of securities. However, ESG-aware and ESG-motivated investors (type A and M) employ the expected value of dividends and payoff risks conditional on the securities' ESG scores. In this way, since the coexistence of all types of investors in the economy makes it hard to explain the equilibrium implications of the model, Pedersen et al. consider three cases in which all the investors are the same type.

Considering the case in which all investors are type-U ($W = W_U$), the equilibrium prices follow the standard CAPM model. Thus, all the investors hold the market portfolio (unconditional tangency portfolio), and the unconditional CAPM betas, $\beta^i = \frac{cov(r_t^i, r_t^m)}{var(r_t^m)}$, explain the expected excess returns. As a result, the equilibrium price, unconditional expected excess return, and conditional expected excess return for each security i are as follow:

$$p^i = \frac{\hat{\mu}^i - \frac{\gamma}{W} cov(v^i, v^m)}{r^f} \tag{12}$$

$$E\left(r_t^i\right) = \beta^i E(r_t^m) \tag{13}$$

$$E\left(r_t^i | s\right) = \beta^i E(r_t^m) + \lambda \frac{s^i - s^m}{p^i} \tag{14}$$

Equation (12) shows that the equilibrium prices are independent of the ESG scores and determined by discounting the risk-adjusted expected cash-flow ($\hat{\mu}^i - \frac{\gamma}{w} cov(v^i, v^m)$) by the risk-free rate. Moreover, Equation (13) confirms that type-U investors estimate the expected excess returns by utilizing the unconditional CAPM betas. However, Equation (14) reveals that if investors exploit the ESG information, they may find CAPM alphas linearly linked to the ESG scores when estimating the expected excess returns. In this way, a positive relationship between the securities' ESG scores and profits ($\lambda > 0$) leads to positive CAPM alphas for the securities having an ESG score higher than the average ESG score and negative alphas for those with lower ESG scores than the average ESG score. In other words, in the presence of a positive λ, ESG scores predict the expected excess returns positively.

Pedersen et al. (2020) next consider the market in which all investors are type-A ($W = W_A$). Since ESG-aware investors exploit the ESG information of securities, this information is fully reflected in the securities' prices and no longer generates abnormal returns. In addition, Equation (15) indicates that the prices are related to the ESG scores by the λ parameter since the conditional expected cash-flows are incorporated into the securities' prices. In this way, the prices derived by the conditional CAPM equilibrium, and the expected excess returns explained by the conditional market beta, $\bar{\beta}^i = \frac{cov(r_t^i, r_t^m \mid s)}{var(r_t^m \mid s)}$, are presented as follow:

$$p^i = \frac{\hat{\mu}^i + \lambda(s^i - s^m) - \frac{\gamma}{w} cov(v^i, v^m | s)}{r^f} \tag{15}$$

$$E\left(r_t^i | s\right) = \bar{\beta}^i E(r_t^m | s) \tag{16}$$

Finally, for an economy populated by only type-M investors ($W = W_M$), the equilibrium is affected by both the ESG information and the investors' ESG preferences. By assuming identical ESG preferences for all investors, no one is more ESG-motivated than the others, leading to an equilibrium in which all type-M investors hold the market portfolio. However, the securities' prices and expected excess returns are affected by the ESG scores and investors ESG preferences. The following equations illustrate how security's price and required rate of return are dependent on its ESG scores and conditional market beta.

$$p^i = \frac{\hat{\mu}^i + \lambda(s^i - s^m) - \frac{\gamma}{w} cov(v^i, v^m | s)}{r^f - \pi_m(s^i - s^m)} \tag{17}$$

$$E\left(r_t^i | s\right) = \bar{\beta}^i E(r_t^m | s) - \pi_m(s^i - s^m) \tag{18}$$

Where π_m is computed by Equation (11) for the ESG score equal to the weighted average ESG score of the market portfolio ($\bar{s} = s^m$).

Comparing the Equation (17) with (15) shows that although in both cases the conditional expected cash-flow and the conditional payoff risk are incorporated into the price, the ESG preferences of type-M investors affects the discount rate through the ESG score, in contrast to the constant discount rate resulted when all investors are type-A. In other words, in such an equilibrium, the securities with a higher ESG score than that of the market portfolio, have a lower discount rate than the risk-free rate, and vice versa. Moreover, Equation (18) reveals that the conditional expected excess returns depend on both conditional CAPM betas and ESG sores. Specifically, the expected excess returns are lower than those estimated by the conditional CAMP when securities' ESG scores are above the market average. Hence, the more ESG friendly a company is, the lower its cost of capital is.

In this way, Pedersen et al. (2020) derive the security prices and returns in equilibrium when all investors are type-U, type-A, or type-M. They show that in case of a positive correlation between the securities ESG scores and future profits, high-ESG stocks can have a high, low, or insignificant expected return, depending on the type of investors dominant in the economy. In the case of type-U investors dominancy, green stocks profitability is not completely reflected in their prices since these investors do not incorporate this information. Therefore, green stocks are undervalued and have high future returns. However, if type-A investors are the dominant ones in the market, the expected profitability of high-ESG stocks is completely exploited, and this information no longer predicts future returns. On the other hand, when there are many type-M investors, the prices of green stocks are bided up to even more than which exactly reflects their expected profitability since these investors prefer high-ESG portfolios. In this way, the higher demand for green stocks leads to accepting a lower expected return for high-ESG stocks by the type-M investors. Moreover, in order to investigate the effect of ESG scores on future earnings, Pedersen et al. (2020) empirically estimate the λ parameter by employing the following regression model, where A^i_{t-1} is the security's i total asset scaling the earnings for having more stationary variables.

$$\frac{v^i_t}{A^i_{t-1}} = \lambda\, s^i_{t-1} + \text{Control Variables} + \varepsilon^i_t \tag{19}$$

They show that the estimated λ from this regression is connected to their model in the same way as it is explained previously.

3. DATA AND METHODOLOGY

Pedersen et al. (2020) provide a practical framework for integrating ESG scores into portfolio selection while explaining the pricing and expected returns of the stocks, at the same time. Therefore, this study employs this framework to identify the costs and benefits of responsible investing and investigate the relationship between the securities ESG scores and expected returns in different countries across Europe, separately and as a whole. This study uses a sample of European stocks and their total ESG scores provided by SustainalyTics over the period from January 2010 to December 2019. First, we estimate ex-ante and ex-post empirical ESG-Sharpe Ratio frontiers, from the ESG-unaware and ESG-aware investors' perspective, for the United Kingdom, Germany, France, Sweden, Switzerland, and Netherlands, individually, as well as for combined groups of Nordic countries [17] and European countries [18]. Second, we construct a mimicking portfolio for ESG factor to analyse the relationship between stocks' ESG scores and their expected returns and try to explain the estimated alphas obtained from asset pricing models by employing the Pedersen et al. (2020) ESG-adjusted CAPM model, for all countries and regions. The following subsections describe the applied data and methods in details.

3.1 Data

This study uses the SustainalyTics' Total ESG score data averaging the environmental, social, and governance pillars' scores. These ESG scores are represented by integer values between 0 and 100, where a higher value indicates a better ESG performance. Based on the availability of ESG data for companies in the targeted countries and regions, 1306 companies are selected for this research across Europe. The number of selected companies in each country or regional samples are presented in Table A.1 in the appendix.

In addition to the ESG scores, monthly market variables including prices, total return[19], number of shares outstanding, and trading volumes and quarterly fundamentals including total assets, common equities, and gross profits are provided for each firm.

[17] The Nordic countries sample consists of companies from Sweden, Norway, Denmark, and Finland.

[18] The European countries sample consists of companies from the United Kingdom, Germany, France, Sweden, Switzerland, Norway, Netherlands, Italy, Spain, Austria, Finland, Denmark, and Belgium.

[19] The total returns are calculated as the percentage changes in prices adjusted by the Total Return Factor variable to include both dividends and capital gains.

These data are collected from the Compustat Global database at the Wharton Research Data Service (WRDS).

Moreover, for calculating the monthly market returns and estimating the securities' market betas[20], a market index representing the total market return (include dividends and capital gains) is employed, for each country. Table A.2 in the appendix shows the employed indexes and the data sources. Further, the short-term interest rates (mostly three-month treasury bills), available in the Organisation for Economic Co-operation and Development (OECD) database, are employed as the risk-free rate for each country for calculating the excess returns.

For estimating the asset pricing regressions, the monthly data of the Fama and French European five factors (including market, size, value, profitability, and investment factors) plus the European momentum factor are collected from the data library of the Kenneth R. French webpage[21], where all these monthly mimicking portfolio returns are in U.S. dollars.

Finally, since the currencies of the financial variables are not the same for all countries, the securities' and markets' excess returns are adjusted[22] by the monthly exchange rates of the corresponding currencies to U.S. dollar for drawing a meaningful comparison between countries. These monthly average exchange rates are collected from the PACIFIC Exchange Rate Service provided by the Sauder School of Business at the University of British Columbia.

3.2 Empirical ESG-Sharpe Ratio Frontiers

In order to compute the empirical ESG-Sharpe Ratio frontier, the analytical solution presented in section 2 (Equation (9)) is applied for calculating the highest attainable Sharpe Ratio for each given level of ESG score. Therefore, each month, the ex-ante ESG-SR frontier is calculated based on the estimated risk and expected excess returns of the securities available in the investment universe. Then, by utilizing the portfolio weights given by Equation (10) and the realized securities' excess returns over the following month, the ex-post (realized) ESG-SR frontier is computed. Finally, since

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[20] In each month, the security's market beta is calculated based on the last previous 36 monthly excess returns of the market and the security, where the market excess return is regressed on the security's excess return to estimate the security's beta coefficient.

[21] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

[22] Since the adjusted return is given by $R_t^* = ((1 + R_t)(Exchange\ rate_t / Exchange\ rate_{t-1}) - 1)$, the adjusted excess return is calculated as $R_t^* - {r^f}_t^* = \left(R_t - {r^f}_t\right)(Exchange\ rate_t / Exchange\ rate_{t-1})$.

these frontiers change through time, the average ESG-SR frontiers are calculated by averaging the annualized Sharpe Ratios for each level of ESG score.

In this way, the first step for computing the empirical ESG-SR frontiers is to estimate the securities' expected excess return and risk. In this study, similar to Pedersen et al. (2020) approach, we employ a factor model, where for simplicity, assume that both the ESG-aware and ESG-unaware investors use the same estimations of risk while utilizing different information when computing the expected excess returns. More specifically, type-U investors incorporate the market equity risk premium and the book-to-market value factor into their one-period ahead excess return estimation; however, type-A and type-M investors also consider ESG scores:

$$E_t^U\left(r_{i,t+1}\right) = \overline{MKT}_t + bm_{i,t}\overline{BM}_t \tag{20}$$

$$E_t^{A,M}\left(r_{i,t+1}\right) = \overline{MKT}_t + bm_{i,t}\overline{BM}_t + s_{i,t}\overline{ESG}_t \tag{21}$$

Equations (20) and (21) illustrate the investors' estimations of security's i excess return for the next period, where $\overline{MKT}_t$, $\overline{BM}_t$, and $\overline{ESG}_t$ are the time t expected returns of the equity, value, and ESG factors at time $t+1$, and $bm_{i,t}$ and $s_{i,t}$ are the security i's cross-sectional book-to-market and ESG score z-scores at time t, respectively. These z-scores are calculated by subtracting the cross-sectional means from the security's book-to-market ratio and ESG score and dividing them by the cross-sectional standard deviations. Therefore, to calculate the securities' expected excess returns, it is needed to estimate the expected factors' returns, where the realized excess returns are explained by a standard factor model as follow:

$$r_{t+1} = X_t F_{t+1} + \epsilon_{t+1} \tag{22}$$

In the above model, r_{t+1} is a column vector of all securities' excess returns, X_t is the securities' factor exposure matrix, F_{t+1} represents the vector of factors' returns, and ϵ_{t+1} is the vector of unexpected shocks. Although the ESG-aware investors use one more factor than the ESG-unaware investors, the same model notation is applicable for both types. In fact, from the type-U investors' perspective, X_t is a $N \times 2$ matrix, in which the first column is an all-one vector and the second column is a vector of the securities' book-to-market z-scores. However, type-A and type-M investors also add a third column vector containing the securities' ESG z-scores into the type-U investors' factor exposure matrix, X_t.

To estimate returns for the unobserved factors, F_{t+1}, each month a sample of securities for which the excess returns, book-to-market z-score, and ESG score z-score are available for the last 60 previous months, is identified. Then this sample is used to perform a GLS regression of securities' cross-sectional excess returns, r_{t+1}, on their characteristics, X_t, where the estimated coefficients of this regression are the factor returns, F_{t+1}. However, since the residuals covariance matrix, $\Sigma_t = Var(\epsilon_{t+1})$, is unknown, a Feasible Generalized Least Squares (FGLS) approach is applied to estimate the residuals' covariance matrix, $\hat{\Sigma}_t$, first. In this way, each month by performing an OLS cross-sectional regression of r_{T+1} on X_T, the $\hat{F}_{T+1}^{OLS}$ and $\hat{\epsilon}_{T+1}^{OLS}$ are estimated for the period from $T = t - 60$ to $T = t - 1$ as follow:

$$\hat{F}_{T+1}^{OLS} = (X_T{}' X_T)^{-1} X_T{}' r_{T+1} \tag{23}$$

$$\hat{\epsilon}_{T+1}^{OLS} = r_{T+1} - X_T \hat{F}_{T+1}^{OLS} \tag{24}$$

These estimated residuals, then, are used to estimate the covariance matrix, $\hat{\Sigma}_t = Diag(\hat{\sigma}_1^2, \dots, \hat{\sigma}_N^2)$, where $\hat{\sigma}_i^2$ is the security i's residual variance equal to $Var(\hat{\epsilon}_{i,T+1}^{OLS})$ for the period from $T = t - 60$ to $T = t - 1$. In this way, the GLS estimation of the factor returns, $\hat{F}_{T+1}^{GLS}$, and residuals, $\hat{\epsilon}_{T+1}^{GLS}$, are given by the following equations for the same period.

$$\hat{F}_{T+1}^{GLS} = (X_T{}' \hat{\Sigma}_t^{-1} X_T)^{-1} X_T{}' \hat{\Sigma}_t^{-1} r_{T+1} \tag{25}$$

$$\hat{\epsilon}_{T+1}^{GLS} = r_{T+1} - X_T \hat{F}_{T+1}^{GLS} \tag{26}$$

Now by having the factor returns and residuals, it is possible to calculated the securities' risk. In fact, the time t estimation of the securities' returns covariance matrix at time $t + 1$, $\hat{\Omega}_t^{GLS} = E_t((r_{t+1} - E_t(r_{t+1}))(r_{t+1} - E_t(r_{t+1}))')$, is computed by Equation (27), where $\hat{\Omega}_t^{F,GLS}$ and $\hat{\Sigma}_t^{GLS}$ are the estimated covariance matrix of factors returns and covariance matrix of securities' specific risk, respectively, calculated as follow:

$$\hat{\Omega}_t^{GLS} = X_t \, \hat{\Omega}_t^{F,GLS} \, X_t{}' + \hat{\Sigma}_t^{GLS} \tag{27}$$

$$\hat{\Omega}_t^{F,GLS} = \left(\frac{1}{59}\right) \sum_{T=t-60}^{T=t-1} \left(\hat{F}_{T+1}^{GLS} - \bar{F}^{GLS}\right)\left(\hat{F}_{T+1}^{GLS} - \bar{F}^{GLS}\right)' \tag{28}$$

$$\hat{\Sigma}_t^{GLS} = Diag(\bar{\bar{\sigma}}_1^2, \dots, \bar{\bar{\sigma}}_N^2) \tag{29}$$

where

$$\bar{F}^{GLS} = \left(\frac{1}{60}\right) \sum_{T=t-60}^{T=t-1} \hat{F}_{T+1}^{GLS} \tag{30}$$

$$\bar{\bar{\sigma}}_i^2 = \left(\frac{1}{59}\right) \sum_{T=t-60}^{T=t-1} (\hat{\epsilon}_{T+1}^{GLS} - \bar{\epsilon}^{\,GLS}) \tag{31}$$

$$\bar{\epsilon}^{GLS} = (\frac{1}{60}) \sum_{T=t-60}^{T=t-1} \hat{\epsilon}_{T+1}^{GLS} \tag{32}$$

Up to this point, the residuals' variance, $\hat{\Sigma}_t^{GLS}$, and the securities' risk, $\hat{\Omega}_t^{GLS}$, is estimated, however, for computing the ESG-SR frontiers, the expected securities' excess returns, for time $t+1$, are needed as well. Since $E_t(r_{t+1}) = X_t E_t(F_{t+1})$, the expected excess returns are obtained through estimating the factor returns for time $t+1$. Similar to Pedersen et al. (2020), by assuming a time-varying risk and a constant Sharpe ratio for each factor, the expected return of factor k is calculated as follow:

$$E_t(F_{k,t+1}) = \sigma_{k,t}^F \, SR_k^F \tag{33}$$

By denoting Equation (25) as $\hat{F}_{t+1}^{GLS} = \theta_t r_{t+1}$, where $\theta_t = (X_t' \hat{\Sigma}_t^{GLS^{-1}} X_t)^{-1} X_t' \hat{\Sigma}_t^{GLS^{-1}}$ represent the factor-mimicking portfolio weights, the factor k's volatility, $\sigma_{k,t}^F$, can be computed as $\sigma_{k,t}^F = \sqrt{\theta_{k,t} \hat{\Sigma}_t^{GLS} \theta_{k,t}'}$. Moreover, SR_k^F is estimated by averaging the $\hat{F}_{k,T+1}^{GLS} / \sigma_{k,T}^F$ for the full-sample period from $T = 1$ to $T = t - 1$.

In this way, based on the monthly estimations of the variance-covariance matrix, $\hat{\Omega}_t^{GLS}$, and the expected excess returns, $E_t(r_{t+1})$, this study computes the empirical ex ante and ex post ESG-SR frontiers from the perspective of ESG-unaware (type-U) and ESG-aware (type-A and type-M) investors for each month from January 2015 to December 2019. Then, by averaging the annualized ESG-SR frontiers for each country or region, over this period, the frontiers of ESG-aware and ESG-unaware investors are compared with each other and across different countries.

3.3 The Relationship Between ESG Scores and Future Returns

This study employs a mimicking portfolio approach to investigate the relationship between securities' ESG scores and their expected returns. Therefore, each month the securities are sorted in descending order, based on their ESG scores to form a portfolio which goes long in the securities placed in the top quantile and short sells the ones in the bottom quantile. Then, the equally weighted and value weighted returns of these portfolios are calculated during the next month after their construction by using the securities' realized excess returns. Finally, the performance of these high-ESG minus low-ESG portfolios are examined by estimating the one-factor CAPM alpha, α_{CAPM}, Fama-French (FF) three-factor alpha, α_{3f},controlling for the size (SMB) and value (HML) in addition to the market risk premium ($R_m - r_f$), Fama-French (FF) five-factor alpha, α_{5f}, adding the profitability (RMW) and investment (CMA) factors into the FF three-factor model, and six-factor alpha, α_{6f}, also considering a momentum factor (WML) in addition to the FF's five factors. The specifications of these asset pricing regressions are as follow:

$$R_{p,t} = \alpha_{CAPM} + \beta_1(R_{m,t} - r_{f,t}) + \varepsilon_t \quad (34)$$

$$R_{p,t} = \alpha_{3f} + \beta_1(R_{m,t} - r_{f,t}) + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_t \quad (35)$$

$$R_{p,t} = \alpha_{5f} + \beta_1(R_{m,t} - r_{f,t}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_5 CMA_t + \varepsilon_t \quad (36)$$

$$R_{p,t} = \alpha_{6f} + \beta_1(R_{m,t} - r_{f,t}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_5 CMA_t + \beta_6 WML_t + \varepsilon_t \quad (37)$$

The estimated alphas from the models above determine the existing relationship between securities' ESG scores and their expected returns. In other words, a negative alpha indicates that ESG scores predict future returns negatively, a positive alpha confirms that securities having higher ESG scores generate higher returns in the future, and an insignificant alpha shows that future returns are not dependent on ESG scores.

After determining how ESG scores predict future returns in each country or region, we employ the Pedersen et al. (2020) ESG-adjusted CAPM to explain the results' differences across countries and regions. As explained in section 2, the Pedersen et al. (2020) framework demonstrates that ESG scores affect expected returns via two different channels depending on the type of investors dominant in the market. Specifically, in the presence of many type-U investors, a positive relationship between ESG scores and future fundamentals is not reflected in prices. In this case, securities with higher ESG scores have lower valuations leading to higher returns in the future. Moreover, the existence of many type-M investors in the economy increases the demand for high ESG securities. Hence, securities with higher ESG scores have higher valuations and lower expected returns, consequently. In this way, the discussed interplay between these channels can explain future returns. Hence, to reveal the dominant effect, we first identify the correlation sign between the ESG scores and future fundamentals by estimating the λ parameter in the Pedersen et al. (2020) model. Then, we investigate whether the estimated λ is incorporated into the securities' prices. Finally, we analyse the connection between the investors' demand and securities' ESG scores and its effect on securities' returns.

To estimate the λ a similar model to Equation (19) is employed, where the ratio of gross profit[23] over total asset is used as a measure of security's fundamental. In this way, the estimated model specification is as follow:

$$GPOA_{i,t+12} = \alpha_t + \lambda\, ESG_{i,t} + \beta_1\, Beta_{i,t} + \beta_2\, LnMarketCap_{i,t} + \varepsilon_{i,t} \quad (38)$$

Here, the dependent variable is the gross profitability ratio, $GPOA$, calculated by aggregating the monthly gross profits of the next 12 months, and ESG score (ESG) is the independent variable, and the market beta ($Beta$) and the logarithm of market capitalization ($LnMarketCap$) are control variables.

Furthermore, to investigate the link between securities' ESG scores and their valuation, similar to Pedersen et al. (2020), the valuation ratio (Tobin's Q), defined as the logarithm of the price-to-book ratio ($LnPB$), is regressed on the ESG score (ESG), with market beta ($Beta$) as a control variable. The regression's specification is as follow:

$$LnPB_{i,t} = \alpha_t + \beta_1\, ESG_{i,t} + \beta_2\, Beta_{i,t} + \varepsilon_{i,t} \quad (39)$$

Finally, the effect of the securities' ESG scores on the investors' demand is analysed by assuming a positive connection between the investors' interest in trading a stock and its trading activity. Therefore, the trading turnover, as the natural measure of trading activity (Lo and Wang, 2000), is considered as a proxy for investor's demand. In this way, the stocks' turnover ($TurnOver$), defined as the trading volume over the following month divided by the number of shares outstanding, is regressed on the ESG score (ESG), where the market beta ($Beta$) and the logarithm of the price-to-book ratio ($LnPB$) are considered as the control variables as is specified as follow:

$$TurnOver_{i,t+1} = \alpha_t + \beta_1\, ESG_{i,t} + \beta_2\, Beta_{i,t} + \beta_3\, LnPB_{i,t} + \varepsilon_{i,t} \quad (40)$$

[23] Gross profits are defined as revenue minus cost of goods sold.

4. Empirical Results and Discussions

In this section, based on the introduced data and methodology, we first present the empirical results for the computed ESG-SR frontiers and provide comparisons, analytical interpretations, and discussions about these frontiers. Then, we report the estimated alphas for the high minus low ESG portfolio returns and illustrate how ESG scores predict future returns. Finally, we present the coefficients estimated by regressing the fundamental (GPOA), valuation (LnPB), and demand (TurnOver) variables on ESG scores and explain the relationship between ESG scores and expected returns for each country or region.

4.1 Empirical ESG-Sharpe Ratio frontiers

The empirical ex-ante and realized ESG-SR frontiers, computed from the perspective of ESG-unaware (type-U) and ESG-aware (type-A and type-M) investors, are shown in Figure 1 for each country or region. The Sharpe Ratios (SRs) are plotted as a function of the ESG z-scores ranging from -7 to 5 representing the row ESG scores from 0 to 100 on average. Moreover, to compare the ESG-SR frontiers estimated for type-A investors with that of the type-U investors, a two-sample *t*-test is performed for checking the equality of the Sharpe Ratios for each level of ESG score, where the statistically different Sharpe Ratios are plotted by dashed lines, otherwise by solid lines. Furthermore, the Table A.3 in the appendix, also provides the ex-ante and realized Sharpe Ratios of the optimum portfolios and their ESG scores for both type-U and type-A investors.

The first thing illustrated in Figure 1 is the fact that there are no meaningful differences between the type-U and type-A investors' realized Sharpe Ratios, meaning that the type-U and type-A investors' chosen portfolios for each level of ESG score generate equal returns. However, the ex-ante ESG-SR frontiers for type-U and type-A investors are statistically different from each other, especially when moving from the average ESG score of zero. In fact, Figure 1 shows that type-U investors' frontiers are almost symmetrical, especially around the peak. However, type-A investors' frontiers are asymmetrical and follow different patterns for high and low ESG scores. In other words, these ESG-SR frontiers reveal that incorporating the ESG information into portfolio selection has profound impacts on the investors' choice of portfolio.

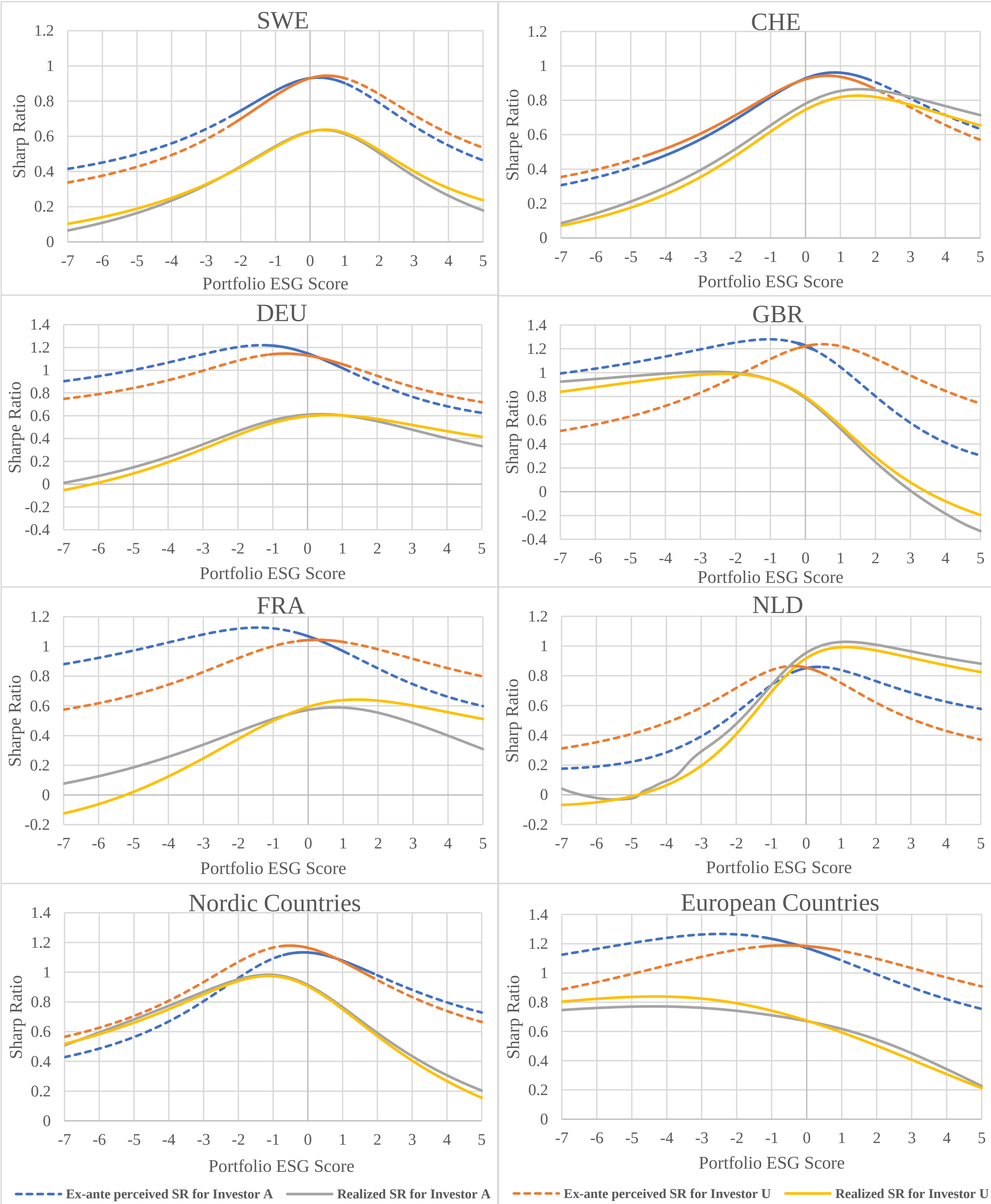

Figure 1-Empirical ESG-Sharpe Ratio Frontier: This figure depicts the empirical ESG-Sharpe Ratio Frontier for European countries, where Nordic countries consist of SWE, DNK, NOR, and FIN, and European Countries consist of SWE, DNK, NOR, FIN, GBR, FRA, DEU, CHE, NLD, ESP, AUT, BEL, and ITA. Moreover, a two-sample t-test is performed, where the null hypothesis is the equal SR for type A and U investors. For each level of ESG Score, if the null is rejected, the SRs are plotted by dashed lines, otherwise by solid lines.

By comparing the ex-ante ESG-SR frontiers of type-A investors with that of the type-U investors, one can see that for Sweden, United Kingdom, France, Germany, and the sample of European Countries, type-A investors predict higher Sharpe Ratios than type-U investors for ESG scores lower than zero, while the predicted Sharpe Ratios by type-A investors are lower than the type-U investors' predictions when ESG scores are higher than zero. In other words, it can be inferred that there is a positive relationship between ESG scores and expected returns in these countries and region since it is assumed that both ESG-aware and ESG-unaware investors use the same estimation of securities' risk. On the other hand, for the Switzerland, Netherlands, and Nordic Countries samples, the ex-ante Sharpe Ratios perceived by the type-A investors are lower than that of the type-U investors when ESG scores are lower than zero, and vice versa. It means that type-A investors estimate a positive relationship between ESG scores and expected returns, in these countries and region. Moreover, Figure 1 illustrates that the differences between ESG-SR frontiers computed by the type-U and type-A investors are minor for Switzerland and Sweden, medium for Germany and the sample of Nordic Countries, and significant for the United Kingdom, France, Netherlands, and the sample of European Countries. However, these relationships between the ESG scores and the expected returns are analysed more specifically in the following subsection.

Table A.3 shows that for Sweden, United Kingdom, France, Germany, and European Countries, the type-A investors' optimum portfolio has a lower ESG score than that of the type-U investors. However, for Switzerland, Netherlands, and Nordic Countries, the result is the opposite. Therefore, it seems logical to conclude that the sign of the relationship between the ESG scores and the expected returns is linked to the ESG scores of the optimum portfolios. In other words, when the type-U investors' optimum portfolio has a higher ESG score than that of the type-A investors, the relationship between the ESG scores and expected returns is negative, and vice versa.

One can see that the maximum attainable Sharpe Ratios for the type-U and type-A investors are obtained by the optimum portfolios placed on the peak of the ex-ante ESG-SR frontiers computed from the perspective of the type-U and type-A investors, respectively. However, type-M investors, willing to sacrifice a proportion of their Sharpe Ratio for holding a portfolio with higher ESG score, would choose portfolios placed on the right side of the type-A investors' optimum portfolio. In this way, similar to Pedersen et al. (2020), the benefit of utilizing the ESG information can be measured by the percentage changes in the optimum portfolio's Sharpe Ratio when an ESG-unaware investor becomes an ESG-aware one, and the cost of being a responsible investor can be defined as the percentage changes in Sharpe Ratio when an ESG-aware investor becomes ESG-motivated and pick a portfolio having a higher ESG score than that of the ESG-aware investor's optimum portfolio.

To identify the benefits of the ESG integration, the difference between the maximum Sharpe Ratios of type-A and type-U investors is calculated as a percentage of the type-U investors' maximum Sharpe Ratio for each country or region and are provided in Table 1.

Table 1- ESG Integration Benefit: This table presents the differences between the type-A and type-U investors' Sharpe Ratios in proportion to the type-U investors' Sharpe Ratios. Moreover, a two-sample t-test is performed, where the null hypothesis is that the Sharpe Ratios are equal, and these differences are no different from zero. Moreover, *, **, and *** represent the significance level of 10%, 5%, and 1%, respectively.

Country	SWE	GBR	FRA	DEU	CHE	NLD	Nordic Countries	European Countries
Ex-ante Sharpe Ratios	-1.1%	3.3%*	7.9%**	6.5%*	2.0%	-0.7%	-3.8%	6.6%**
Realized Sharpe Ratios	-0.6%	37.4%	-21.6%	-5.4%	5.9%	17.5%	-2.9%	5.0%

Table 1 shows that using the ESG information enhances the ex-ante Sharpe Ratios in the United Kingdom, France, Germany, and European Countries samples by 3.3%, 7.9%, 6.5%, and 6.6%, respectively, where all these increases are statistically significant. However, the observed changes in ex-ante Sharpe Ratios for the Sweden, Switzerland, Netherlands, and Nordic Countries samples, are statistically insignificant and no different from zero. Although all the calculated changes in realized Sharpe Ratios are not statistically significant, they are very different from those calculated for the perceived Sharpe Ratios. These differences indicate that the employed three-factor model in estimating the expected returns is unable to explain the realized returns in some samples. More specifically, for the United Kingdom and Netherlands samples, the increase in the realized SRs is higher than that of the perceived SRs. On the contrary, for the France and Germany samples, the changes are significantly negative. In other words, opposite to what theory suggests, in practice, type-A investors earn lower SRs than type-U investors and bear a cost while they choose a portfolio with worse ESG performance than that of the type-U investors.

To quantify the cost of being an ESG-motivated investor, Figure 2 presents the percentage changes in the ex-ante and realized Sharpe Ratios as a function of changes in the ESG scores, when moving from the optimum portfolios. Table A.4 in the appendix, also provides the changes in the Sharpe Ratios for one, two, and three standard deviation change in the ESG scores from the optimum portfolio's ESG scores.

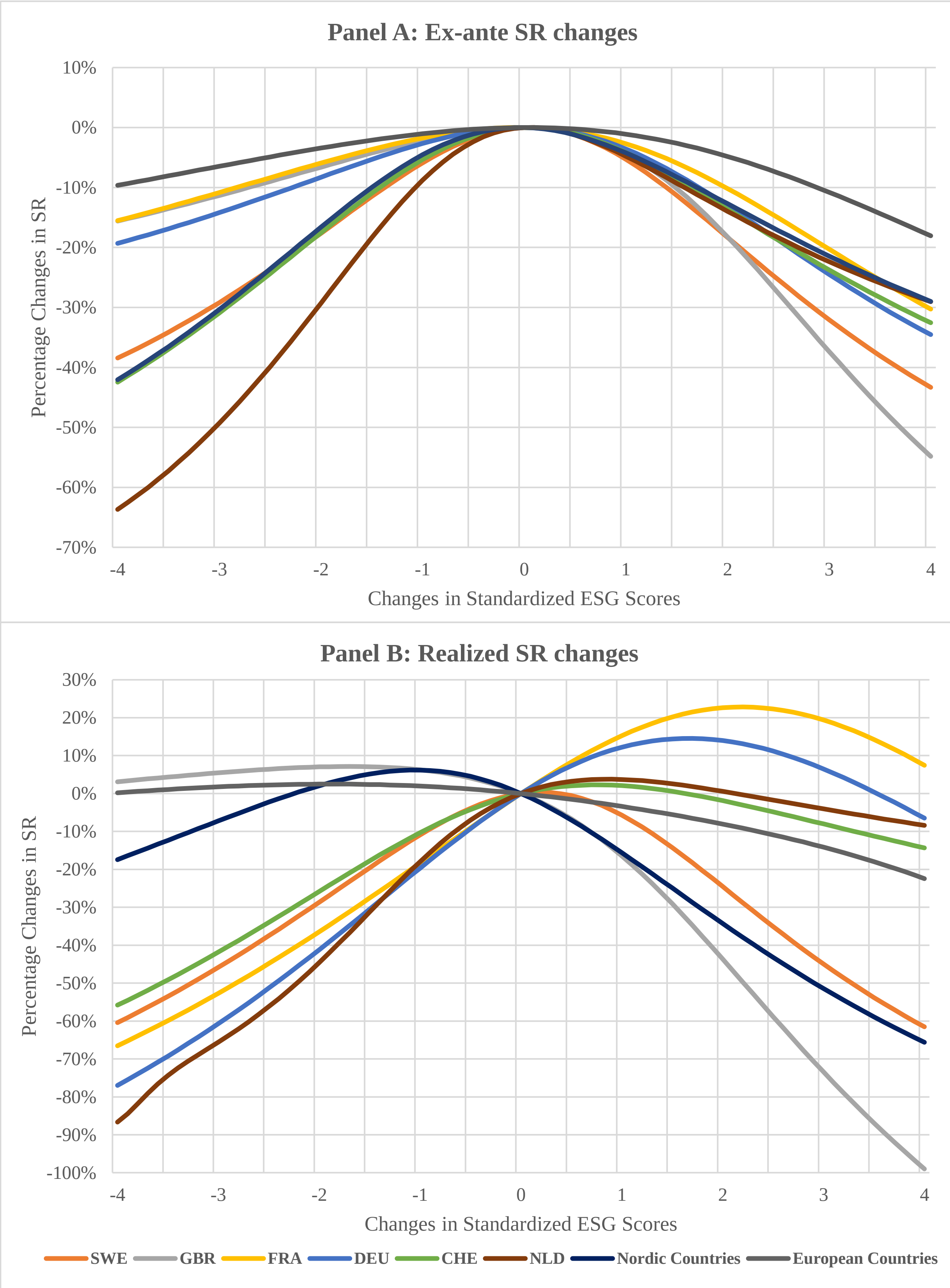

Figure 2- Cost of ESG preferences: This figure depicts the percentage changes in Sharpe Ratio when moving from the optimum portfolio on the ex-ante ESG-SR frontiers, where Panels A and B show the results for perceived and realized SRs, respectively.

Panel A in Figure 2 shows that although within a close range around the optimum portfolios, the ex-ante Sharpe Ratios decrease slowly and in the same rate for all the countries and regions, when moving further away from the optimum portfolios, the changes in the Sharpe Ratios become more distinguishable. In fact, a three-standard deviation increase in the ESG scores reveals that type-M investors in the sample of European Countries would expect the lowest decline in SR equal to 10.8%, in contrast, the investors in the United Kingdom and Sweden expect the highest drops in their SRs equal to 37.3% and 32%, respectively (Table A.4). Moreover, one can see that the type-M investors face a similar SR reduction pattern in France, Germany, Switzerland, Netherlands, and the sample of Nordic Countries. In fact, for having a portfolio with an ESG score three-standard deviation higher than that of the optimum portfolios, they would expect an SR drop ranging from 20.3% to 24.5 %.

Panel B in Figure 2 shows the changes in realized Sharpe Ratios and indicates different results compared to the ones presented in Panel A. Specifically, in some samples, type-M investors gain even higher SRs than those obtained by the optimum portfolios when targeting an ESG score higher than that of the optimum portfolios. For instance, moving one-standard deviation from the optimum portfolio increases the realized SRs by 15.2%, 12.2%, 3.7%, and 2.1% for France, Germany, Netherlands, and Switzerland, respectively (Table A.4). However, for the United Kingdom, Sweden, Nordic Countries, and European Countries, the changes in realized SRs are similar to the changes in ex-ante SRs but more significant. In this way, based on the results for the realized SRs, the United Kingdom, Nordic Countries, and Sweden have the top three highest realized SR's drops, equal to 73.5%, 51.4%, and 45%, for three-standard deviation increase from the optimum portfolios, respectively.

In this way, based on both the ex-ante and realized frontiers, it is possible to conclude that investors in the United Kingdom and Sweden, face the highest cost for investing in a portfolio with higher ESG scores than the market average. Moreover, Figure 2 illustrates that Sweden is the only sample in which the Sharpe Ratio changes are approximately symmetric around the maximum Sharpe ratio. In other words, for moving from the optimum portfolio in both directions, the Sharpe Ratio declines at the same rate. In other words, ESG-Motivated investors in the Sweden sample estimate equal costs to their Sharpe Ratio for increasing or decreasing the ESG score of their portfolio from the optimum portfolio, meaning that they are unable to predict the expected returns from the ESG information.

4.2 ESG Integration and Expected Returns

As it is explained in section 3, to investigate the relationship between securities' ESG scores and their expected returns, the performance of high-ESG minus low-ESG portfolios are examined. The monthly average excess returns for both the equally weighted and value weighted portfolios and the estimated alphas from asset pricing regressions, for the sample period from January 2010 to December 2019, are presented in Table A.5, in the appendix.

For the sample of European Countries, it is clear that both the equally weighted and value weighted portfolios generate negative abnormal returns since all the estimated alphas (except for the three-factor alpha estimated for equally weighted portfolio) are negative and statistically significant. Moreover, for the United Kingdom, the results are similar to that of the European Countries sample. In fact, the five-factor and six-factor alphas for both the equally weighted and value weighted portfolios, and the average excess return and CAPM alpha for the equally weighted portfolio are significantly negative. In addition to these two samples, for France, the average excess return, CAPM alpha, and six-factor alpha for the value weighted portfolio all show a negative and statistically significant relationship between ESG scores and future returns. Therefore, the estimated alphas confirm a strongly negative relationship between ESG scores and future returns in the United Kingdom and European Countries samples and a slightly negative one in the France sample. These results are in parallel with studies such as Hong and Kacperczyk (2009), El Ghoul et al. (2011), Chava (2014), Luo and Balvers (2017), Baker et al. (2018), Zerbib (2019), Giese et al. (2019), Bolton and Kacperczyk (2020) and Hsu et al. (2020), indicating that securities having higher ESG scores have lower expected excess returns.

In contrast to the United Kingdom, France, and European Countries samples, the average excess returns and the estimated alphas for the Switzerland sample are positive. However, only the CAPM, three-factor, and five-factor alphas of both the equally weighted and value weighted portfolios are statistically significant. The positive abnormal return of the ESG mimicking portfolios indicates that securities with higher ESG scores have higher expected returns in the Switzerland sample, which is consistent with the findings of Gompers et al. (2003), Kempf and Osthoff (2007), Edmans (2011,2012), Eccles et al. (2014), Ashwin Kumar et al. (2016), Verheyden et al. (2016), and In et al. (2017).

Finally, for Sweden, Germany, and Netherlands, the average excess returns and all the asset pricing alphas for both the equally weighted and value weighted portfolios are statistically insignificant, indicating a neutral relationship between ESG scores and future excess returns. In addition, for the Nordic Countries sample, although the five-factor and six-factor alphas for the value weighted portfolios are negative and statistically significant (at 10% level), the average excess returns and other estimated alphas are not statistically different from zero, suggesting a neutral relationship between ESG scores and future returns. These results are in line with the findings of Statman and Glushkov (2009), Halbritter and Dorfleitner (2015), Blitz and Fabozzi (2017), Kumar (2019), and Geczy et al. (2018), exhibiting a neutral relationship between ESG measures and asset returns.

In order to explain the differences in the result across the samples, this study employs the Pedersen et al. (2020) ESG-adjusted CAPM. In this way, first, the relationships between securities' ESG scores and their future fundamentals, valuation ratios, and trading turnovers are estimated. Then, these estimations are utilised for analysing the link between ESG scores and expected returns.

For determining the relationship between the ESG scores and the future fundamentals, the gross profit ratios are regressed on the ESG scores as specified by the Equation (38). In this way, for each sample, the unbalanced panel data are estimated by a pooled regression with period fixed effects and clustered standard errors at both period and firm levels. Table A.6, in the appendix, presents these regression results, showing that the ESG scores predict the future profits negatively in the United Kingdom, France, Germany, and European Countries samples, where the estimated coefficients for ESG score are statistically significant. In contrast, for the Switzerland, Netherlands, and Nordic Countries samples, the estimated coefficients for the ESG score variable are positive and statistically significant. In other words, in these three samples, securities with higher ESG scores generate higher profits in the future. Finally, for Sweden, although the estimated coefficient for the ESG score variable is positive, both of the calculated *t*-statistics confirm that this coefficient is statistically insignificant and no different from zero.

Moreover, the valuation regression specified in Equation (39) is also estimated by a pooled regression using period fixed effects and clustering standard errors at both period and firm levels, presented in Table A.7, in the appendix. The results indicate a negative relationship between the valuation ratios (logarithm of the price-to-book ratio) and the ESG scores for the United Kingdom, France, Germany, and European Countries samples, where the estimated coefficients are statistically significant. Furthermore, one can see that the estimated coefficients for the Switzerland and Nordic Countries samples are significantly positive, demonstrating that higher ESG scores lead to higher valuation of the securities in these samples. Finally, for the Sweden and Netherlands samples, the insignificant estimated coefficients for the ESG score variable indicate no meaningful connections between the valuation ratios and ESG scores.

Finally, based on Equation (40), the securities' trading turnover, as a proxy for investor's demand, is regressed on their ESG scores. The results for the pooled regressions with period fixed effects and clustered standard errors at both period and firm levels are presented in Table A.8, in the appendix. This table illustrates that for the United Kingdom, Sweden, France, Switzerland, and European Countries samples, the estimated coefficient for the ESG score variable is positive and statistically significant. In other words, in these countries and region, investors are more interested in purchasing securities with higher ESG levels; consequently, a higher ESG score leads to higher investors' demand. In contrast, for the Germany sample, the securities' turnovers are negatively related to their ESG scores, where the estimated coefficient is statistically significant. The results also suggest a neutral relationship between securities' turnovers and ESG scores for the Sweden and Netherlands samples, since the estimated coefficients are statistically insignificant.

Now, after identifying the extent to which ESG scores affect future fundamentals, valuations, and investor's demands, it is possible to draw a picture explaining how ESG scores predict future returns. In this way, based on these estimated effects and by employing the notion presented by Pedersen et al. (2020), we present the possible expected relationships between the securities' ESG scores and future returns for each sample and compare them with those realized from the ESG mimicking portfolios. To make the analysis as simple as possible, all the results from the fundamental, valuation, and demand regressions, and the estimated and realized relationships between the ESG scores and the future returns, are summarized and presented in Table 2.

For the European Countries sample, one can see that the ESG scores predict the future accounting profits negatively while having a highly significant negative relationship with the valuation ratios (both t-statistics clustered at period and firm levels are significant at 1% level of significance). In other words, the ESG information is reflected in the securities prices, indicating that there are some ESG-aware investors, exploiting the ESG information, in the economy. Moreover, the highly significant positive relationship between the ESG scores and the trading turnovers, suggest that there are a considerable number of ESG-motivated investors in the economy. Based on the above information, it is possible to consider two cases. First, assume that the type-A investors are the majority in the economy, where the ESG information, predicting future fundamentals negatively, is fully reflected in the securities prices. However, since there are many type-M investors in the economy, the prices of green stocks are bided up and are higher than the equilibrium prices when all investors are type-A (see Equation (17)). As a result, the future returns are expected to have a highly significant negative relationship with the ESG scores. Second, assume that the type-U investors are the majority in the economy, and the ESG information is partially priced. Hence, the green stocks' prices are even higher than that of the first case, and the type-M investors' demands for green stocks push their valuation ratio higher leading to lower expected future returns than that of the first case. In this way, the only possible expected relationship between the ESG scores and the future returns is a highly significant negative one, which is parallel with the results obtained from ESG mimicking portfolios.

Table 2- ESG and Future return: This table summarizes the estimation results for the regression of the future fundamentals (GPOA), valuation ratios (LnPB), and trading turnovers (TrunOver) on the ESG scores. For each of these variables, the first row gives the estimated coefficient of the ESG score variable, and the second row indicates the sign and the significance of the relationship between two variables. This table also provides the expected relationship between ESG scores and returns, predicted based on the Pedersen et al. (2020) ESG-adjusted CAPM model, as well as the realized relationship form the ESG mimicking portfolios. Here, (o), (- / +), and (- - / + +) means insignificant, significant, and highly significant relationships, where the highly significant means that both of the t-statistics clustered at period and firm levels are statistically significant and the significant means only one of the t-statistics is statistically significant.

	ESG							
Country	**SWE**	**GBR**	**FRA**	**DEU**	**CHE**	**NLD**	**Nordic Countries**	**European Countries**
GPOA	0.00114	-0.00074	-0.00305	-0.00127	0.00301	0.00597	0.00279	-0.00030
	o	-	- -	-	+	+ +	+	-
LnPB	0.0016	-0.0078	-0.0181	-0.0095	0.0147	0.0016	0.0016	-0.0055
	o	-	- -	- -	+ +	o	+	- -
TrunOver	0.00059	0.00057	0.00019	-0.00032	0.00037	0.00019	0.00003	0.00033
	+	+ +	+	-	+	o	o	+ +
Expected Relationship with Return	o	- -	-	o / -	- / o / +	+ +	o / +	- -
Realized Relationship with Return	o	- -	-	o	+ +	o	o	- -

For the United Kingdom and France samples, an analysis similar to the one presented for the European Countries sample shows that the possible expected alphas are negative. However, since the investors' demand for green stocks is higher in the United Kingdom sample than the France sample, the negative relationship between ESG scores and future returns is expected to be highly significant and significant, respectively.

For Germany, the ESG scores correlate negatively with the future profits and valuation ratios; hence, similar to the European countries sample, there are ESG-aware investors in the economy. However, the slightly negative relationship between the ESG scores and the trading turnovers indicates that a small number of type-M investors exist in the economy. Therefore, the prices of green stocks are not affected by the type-M investors' demands. In this way, it is possible to expect two outcomes. First, assume that the type-A investors are the majority in the economy. In this case, the ESG information is completely reflected in the valuation ratios, and the green stocks' prices are given by Equation (17). Therefore, the expected future returns are explained by the conditional CAPM betas and have a neutral relationship with the ESG scores. Second, assume that the type-A investors are the majority in the economy, and the ESG information is partially priced. In this case, the prices of green stocks are even higher than that of the previous case leading to a lower expected return for these stocks. In this way, based on the theory, the relationship between the ESG scores and the future returns is expected to be neutral or negative.

For the Netherlands, one can see that the ESG scores predict future profits positively while having neutral relationships with the valuation ratios and trading turnovers. In this way, there is no demand for green stocks and the ESG information does not affect stocks' valuation. Hence, it is logical to conclude that the economy is populated by the ESG-unaware investors, where the green stocks are underpriced from the perspective of an ESG-aware investor and generate positive future returns (see Equations (14) and (15)). In this way, the theory expects that ESG scores only have a positive relationship with future returns.

For the sample of Nordic Countries, the ESG scores have a positive relationship with both the future fundamentals and valuation ratios, which indicates that there are some ESG-aware investors in the economy. However, the results of regressing the turnovers on the ESG scores show that there is no considerable demand for the green stocks, meaning that there are few type-M investors among ESG-aware investors. Consequently, it is possible to draw two possibilities in such a situation. First, consider that the type-A investors are the majority in the economy, hence, the ESG information is fully priced, and the expected returns follow the conditional CAMP betas and have no relationship with ESG scores (see Equations (15) and (16)). Second, consider the case in which the type-U investors are the majority. As a result, the ESG information is partially reflected in the prices, and green stocks have a lower price than that of the first case. This means that the expected returns of green stocks are higher than those given by the CAPM betas (see Equation (14)). In this way, the theory suggests that the relationship between the ESG scores and the future returns is either neutral or positive.

For Switzerland, the analysis is more complicated than that of the others because the ESG scores correlate positively with the future returns, valuation ratios, and trading turnovers. In fact, these results show that all three types of investors exist in the economy, and it is not possible to know which type is the dominant one. In this way, all three attainable cases of the neutral, positive, and negative relationships between ESG scores and future returns could happen. First, consider that the type-M investors are the majority in the economy. In this case, the ESG information is completely priced, and the type-M investors bid up green stocks' prices to a higher amount than those derived by the conditional CAPM equilibrium, leading to lower expected returns for green stocks (see Equations (17) and (18)). Second, assume that the type-A investors are the majority in the economy; hence, the ESG information is completely priced. However, the type-M investors' demand for green stocks is not strong enough to affect the prices. In such a condition, the equilibrium prices and expected returns are given by the conditional CAPM betas, leading to a neutral relationship between the ESG scores and the future returns (see Equations (15) and (16)). Finally, for the case in which the type-U investors are the majority, the ESG information is not reflected in the prices. Hence, the green stocks' prices are lower than that of the previous case. Therefore, if the type-M investors' demand for green stocks is not strong enough to push their prices up to those given by conditional CAPM equilibrium (see Equation (15)), the green stocks' expected returns would be higher than those estimated by conditional CAPM betas (see Equation (16)). In this way, ESG scores may predict future returns neutrally, negatively, or positively, depending on the interplay between the forces caused by different types of investors.

For the Sweden sample, one can see that the ESG scores have neutral and positive relationships with future profits and trading turnovers, respectively. Therefore, since there is no ESG information to be exploited for valuation, only the type-M investors' demand for green stocks affects the prices. However, since the regression of the valuation rations on the ESG scores shows an insignificant connection between these two variables, it seems that the type-M investors' demand for green stocks is not strong enough to change the prices from those given by conditional CAPM equilibrium (see Equation (15)). In this way, no matter which type of investor is the dominant one in the economy, the only possible relationship between ESG scores and future returns is a neutral one.

Finally, Table 2 reveals that the expected possible relationships between ESG scores and future returns are aligned with the realized ones for all the samples except for Netherlands and Switzerland. More specifically, for the former one, the theory predicts a highly significant positive relationship while the realized relationship is a neutral one; however, for the latter one, the theory is unable to narrow down the possibilities for providing a specific prediction. Although many reasons may lead to such a contradiction; in the Netherlands case, the low number of observations used in the regression analyses and the small sample of companies used for constructing ESG mimicking portfolios seems to be the most important ones.

5. CONCLUSION

This study employs the Pedersen et al. (2020) framework to identify the costs and benefits of responsible investing and investigate the relationship between the environmental, social, and governance (ESG) issues and portfolio performance in different countries across Europe. In this paper, we explain the cross-country differences in the empirical results to draw a better picture of ESG integration for responsible investors.

In this way, by considering a sample of European stocks and their total ESG scores provided by SustainalyTics over the period from January 2010 to December 2019, the ex-ante and ex-post empirical ESG-Sharpe Ratio frontiers are calculated for the United Kingdom, Germany, France, Sweden, Switzerland, and Netherlands, individually, as well as for combined groups of Nordic Countries[24] and European Countries[25]. Then, based on the computed frontiers, the benefit of considering the ESG information is measured by identifying the improvements in the optimum portfolio's Sharpe Ratio when an ESG-unaware investor becomes an ESG-aware one, and the cost of being a responsible investor is measured by calculating the percentage changes in Sharpe Ratio when an ESG-aware investor becomes ESG-motivated and picks a portfolio having a higher ESG score than that of the ESG-aware investor's optimum portfolio.

Moreover, a high-ESG minus low-ESG portfolio approach is adopted for analysing the relationship between securities' ESG scores and their future returns, where the performance of the ESG mimicking portfolios is examined by estimating asset pricing alphas. Further, the Pedersen et al. (2020) ESG-adjusted CAPM is applied to explain the result differences between the samples. In this way, first, the relationships between securities' ESG scores and their future fundamentals, valuations, and investors' demand are estimated by panel data regressions. Then, these estimations are employed to demonstrate how ESG scores predict expected returns for each sample.

The cross-country comparison of the ESG-SR frontiers shows that the investors pay a higher cost for being ESG-motivated in the United Kingdom and Sweden than that of the other countries and regions. In other words, for choosing a portfolio with the same ESG characteristics, ESG-motivated investors would sacrifice a higher percentage of their Sharpe Ratio in the United Kingdom and Sweden. These frontiers also reveal that the ESG-aware investors earn a maximum ex-ante Sharpe Ratio higher than that of the

[24] The Nordic countries sample consists of companies from Sweden, Norway, Denmark, and Finland.

[25] The European countries sample consists of companies from United Kingdom, Germany, France, Sweden, Switzerland, Norway, Netherlands, Italy, Spain, Austria, Finland, Denmark, and Belgium.

ESG-unaware investors or equal to it, in all countries and regions, indicating that using the ESG information in the portfolio selection process can benefit the investors, even when they do not care about ESG issues.

Moreover, the estimated alphas for the high-ESG minus low-ESG portfolios show that ESG scores predict future returns positively, only in Switzerland, and negatively in the United Kingdom, France, and Europe region. In addition, based on the estimated coefficients of regressing the ESG scores on the future fundamentals, valuation ratios, and trading turnovers, it is concluded that the realised relationship between the ESG scores and future returns can be explained by the Pedersen et al. (2020) ESG-adjusted CAPM model for all countries and regions, except for the Netherlands.

In this way, this paper contributes to the responsible investing literature by conducting the first cross-country empirical study calculating the ESG-Sharpe Ratio frontiers and explaining the various effect of ESG integration on portfolio performance in different markets across Europe.

Although this study tries to present a complete analysis, it has its limitations and drawbacks. First, the small number of companies, for which the ESG data is available, leads to an insufficient number of observations for estimating robust expected returns and regression coefficients. This limitation also makes it impossible to investigate severe cases such as Belgium, Denmark, Finland, Austria, Spain, and Italy, separately. Moreover, since this study only considers the Total ESG scores of the securities, there is a chance that the results be incomparable across the samples. More specifically, since in practice each investor has different preferences for each of the environmental (E), social (S), and governance (G) pillars, the relationship between expected returns and each pillar's scores can be different compared to other ones. Hence, the Total ESG scores, which are the average of pillars' scores, may not predict expected returns when pillars predict returns in opposite directions. In this way, using the Total ESG scores may lead to capturing different ESG preferences (E, S, or G) in different samples, making the results incomparable across samples. Finally, in this study, for computing the ESG-SR frontiers, the securities' returns and risks are estimated by a simple three-factor model. However, based on the results, it seems that, in some samples, this model cannot predict future returns accurately.

Therefore, to overcome these drawbacks and limitations, we present three suggestion for further studies. The first suggestion is to consider a range of different ESG data providers to expand the data sample for improving the estimations. The second one is to analyse the impact of ESG pillars (E, S, or G) on ESG-SR frontiers and portfolio performance, separately. The last one is to employ more accurate models considering more factors for estimating the risks and returns.

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7. APPENDIX

Table A.3- Company Sample: This table presents the number of companies included in the data sample for each country and region.

Country	Number of Companies
United Kingdom (GBR)	363
Germany (DEU)	171
France (FRA)	137
Sweden (SWE)	109
Switzerland (CHE)	108
Norway (NOR)	88
Netherlands (NLD)	83
Italy (ITA)	59
Spain (ESP)	58
Austria (AUT)	37
Finland (FIN)	37
Denmark (DNK)	30
Belgium (BEL)	26
Nordic Countries	264
European Countries	1306

Table A.4- Market Indexes: This table presents the employed market index for each country and provide the sources from which indexes' data is collected.

Country	Index Name	Data Source	Data Source Website
United Kingdom (GBR)	FTSE All Share TR	Investing	https://www.investing.com
Germany (DEU)	DAX-TR	WRDS	https://wrds-www.wharton.upenn.edu
France (FRA)	CAC-ALL-TRADE GR	Euronext	https://www.euronext.com
Sweden (SWE)	OMX-Stockholm-GI (OMXSGI)	Nasdaq OMX Nordic	https://www.nasdaqomxnordic.com
Switzerland (CHE)	Swiss Performance Index (SPI)	WRDS	https://wrds-www.wharton.upenn.edu
Norway (NOR)	Oslo Bors All-Share Index (OSEAX)	Oslo Bors	https://www.oslobors.no
Netherlands (NLD)	AEX GR	Euronext	https://www.euronext.com
Italy (ITA)	FTSE MIB TR	Investing	https://www.investing.com
Spain (ESP)	IBEX Total Return (IBEX35)	Investing	https://www.investing.com
Austria (AUT)	ATX TR	Wiener Borse	https://www.wienerborse.at
Finland (FIN)	OMX-Helsinky-GI (OMXHGI)	Nasdaq OMX Nordic	https://www.nasdaqomxnordic.com
Denmark (DNK)	OMX-Copenhagen-GI (OMXCGI)	Nasdaq OMX Nordic	https://www.nasdaqomxnordic.com
Belgium (BEL)	Belgium General Index	WRDS	https://wrds-www.wharton.upenn.edu

Table A.5- Optimum Portfolios: This table provides the ex-ante and realized Sharpe Ratios of the optimum portfolios and their ESG scores for both type-A and type-U investors.

Country	**SWE**				**GBR**			
Investor Type	**Type-A**		**Type-U**		**Type-A**		**Type-U**	
Frontier Type	Ex-ante	Realized	Ex-ante	Realized	Ex-ante	Realized	Ex-ante	Realized
Optimum Portfolio Sharpe Ratio	**0.93**	**0.63**	**0.94**	**0.64**	**1.28**	**0.94**	**1.24**	**0.68**
Optimum Portfolio ESG Score	**0.20**		**0.50**		**-1.00**		**0.50**	
Country	**FRA**				**DEU**			
Investor Type	**Type-A**		**Type-U**		**Type-A**		**Type-U**	
Frontier Type	Ex-ante	Realized	Ex-ante	Realized	Ex-ante	Realized	Ex-ante	Realized
Optimum Portfolio Sharpe Ratio	**1.13**	**0.48**	**1.04**	**0.61**	**1.22**	**0.54**	**1.15**	**0.57**
Optimum Portfolio ESG Score	**-1.40**		**0.30**		**-1.30**		**-0.60**	
Country	**CHE**				**NLD**			
Investor Type	**Type-A**		**Type-U**		**Type-A**		**Type-U**	
Frontier Type	Ex-ante	Realized	Ex-ante	Realized	Ex-ante	Realized	Ex-ante	Realized
Optimum Portfolio Sharpe Ratio	**0.96**	**0.85**	**0.94**	**0.80**	**0.86**	**0.99**	**0.87**	**0.84**
Optimum Portfolio ESG Score	**0.80**		**0.60**		**0.30**		**-0.40**	
Region	**Nordic Countries**				**European Countries**			
Investor Type	**Type-A**		**Type-U**		**Type-A**		**Type-U**	
Frontier Type	Ex-ante	Realized	Ex-ante	Realized	Ex-ante	Realized	Ex-ante	Realized
Optimum Portfolio Sharpe Ratio	**1.13**	**0.93**	**1.18**	**0.95**	**1.27**	**0.75**	**1.19**	**0.72**
Optimum Portfolio ESG Score	**-0.10**		**-0.50**		**-2.50**		**-0.60**	

Table A.6- Cost of ESG Preferences: This table presents the percentage changes in the ex-ante and realized Sharpe Ratios when moving from the optimum portfolio on the ESG-SR frontiers perceived and realize by ESG-aware investors.

Country	SWE	GBR	FRA	DEU	CHE	NLD	Nordic Countries	Europe Countries
	Percentage Changes in Ex-ante Sharpe Ratio							
One-SD increase in ESG score from that of the optimum portfolio.	**-5.3%**	**-4.3%**	**-2.7%**	**-3.6%**	**-4.1%**	**-4.8%**	**-4.2%**	**-1.1%**
Two-SD increase in ESG score from that of the optimum portfolio.	**-18.3%**	**-18.2%**	**-10.2%**	**-13.1%**	**-13.6%**	**-14.0%**	**-12.7%**	**-4.8%**
Three-SD increase in ESG score from that of the optimum portfolio.	**-32.0%**	**-37.3%**	**-20.3%**	**-24.5%**	**-23.7%**	**-22.4%**	**-21.4%**	**-10.8%**
One-SD decrease in ESG score from that of the optimum portfolio.	**-5.9%**	**-2.1%**	**-1.7%**	**-2.7%**	**-5.3%**	**-8.8%**	**-4.6%**	**-1.0%**
Two-SD decrease in ESG score from that of the optimum portfolio.	**-17.6%**	**-6.6%**	**-5.9%**	**-8.3%**	**-17.5%**	**-29.3%**	**-16.6%**	**-3.4%**
Three-SD decrease in ESG score from that of the optimum portfolio.	**-29.2%**	**-11.3%**	**-10.8%**	**-14.2%**	**-30.9%**	**-49.3%**	**-30.3%**	**-6.5%**
Country	**SWE**	**GBR**	**FRA**	**DEU**	**CHE**	**NLD**	**Nordic Countries**	**Europe Countries**
	Percentage Changes in Realized Sharpe Ratio							
One-SD increase in ESG score from that of the optimum portfolio.	**-5.7%**	**-16.4%**	**15.2%**	**12.2%**	**2.1%**	**3.7%**	**-15.6%**	**-3.4%**
Two-SD increase in ESG score from that of the optimum portfolio.	**-24.5%**	**-43.7%**	**22.6%**	**14.0%**	**-1.9%**	**0.6%**	**-34.3%**	**-8.1%**
Three-SD increase in ESG score from that of the optimum portfolio.	**-45.0%**	**-73.5%**	**19.4%**	**6.5%**	**-8.0%**	**-4.0%**	**-51.4%**	**-14.1%**
One-SD decrease in ESG score from that of the optimum portfolio.	**-10.9%**	**6.3%**	**-18.3%**	**-19.7%**	**-10.3%**	**-17.9%**	**6.2%**	**2.0%**
Two-SD decrease in ESG score from that of the optimum portfolio.	**-28.7%**	**7.0%**	**-36.4%**	**-41.2%**	**-25.8%**	**-44.6%**	**2.1%**	**2.5%**
Three-SD decrease in ESG score from that of the optimum portfolio.	**-45.8%**	**5.5%**	**-52.7%**	**-60.7%**	**-41.8%**	**-65.6%**	**-7.2%**	**1.8%**

Table A.7- The ESG Mimicking Portfolio's Performance: This table reports the monthly excess returns for both equally weighted and value weighted high-ESG minus low-ESG portfolios. These returns are also tested for abnormal returns by estimating the one-factor CAPM alpha, Fama-French three-factor alpha controlling for the size (*SMB*) and value (*HML*) in addition to the market risk premium ($R_m - r_f$), Fama–French five-factor alpha adding the profitability (*RMW*) and investment (*CMA*) factors into the FF three-factor model, and six-factor alpha also considering a momentum factor (*WML*) in addition to the FF's five factors. The standard errors are corrected for serial correlation and heteroscedasticity by Newey-West method. The *t*-Statistics are in parentheses and *, **, and *** represent the significance level of 10%, 5%, and 1%, respectively.

Country	**SWE**		**GBR**		**FRA**		**DEU**	
Portfolio Type	**EWR**	**VWR**	**EWR**	**VWR**	**EWR**	**VWR**	**EWR**	**VWR**
Average Excess Return	0.23%	-0.21%	**-0.77%***	-0.54%	-1.14%	**-0.60%***	1.91%	-0.37%
	(0.69)	(-0.62)	(-1.90)	(-1.49)	(-0.95)	(-1.96)	(0.86)	(-1.18)
CAPM Alpha	0.30%	-0.10%	**-0.90%***	-0.62%	-1.01%	**-0.64%****	2.07%	-0.47%
	(1.28)	(-0.33)	(-1.87)	(-1.60)	(-0.97)	(-2.10)	(0.83)	(-1.66)
Three-Factor Alpha	0.31%	-0.03%	-0.80%	-0.47%	-0.91%	-0.38%	2.50%	-0.24%
	(1.29)	(-0.09)	(-1.57)	(-1.20)	(-0.81)	(-1.34)	(0.99)	(-0.91)
Five-Factor Alpha	0.21%	-0.11%	**-1.13%***	**-0.84%****	-0.39%	-0.34%	1.97%	-0.17%
	(0.73)	(-0.37)	(-1.78)	(-2.06)	(-0.62)	(-1.20)	(0.92)	(-0.60)
Six-Factor Alpha	0.15%	-0.16%	**-1.17%***	**-0.99%****	-0.92%	**-0.49%***	1.56%	-0.09%
	(0.50)	(-0.54)	(-1.70)	(-2.24)	(-0.91)	(-1.73)	(0.83)	(-0.28)
Country	**CHE**		**NLD**		**Nordic Countries**		**European Countries**	
Portfolio Type	**EWR**	**VWR**	**EWR**	**VWR**	**EWR**	**VWR**	**EWR**	**VWR**
Average Excess Return	0.42%	0.43%	-0.38%	0.00%	-4.92%	-0.87%	**-1.53%***	**-0.91%*****
	(1.60)	(1.17)	(-0.64)	(0.00)	(-1.22)	(-1.53)	(-1.69)	(-3.21)
CAPM Alpha	**0.47%****	**0.65%****	-0.47%	-0.10%	-4.53%	-0.85%	**-1.55%***	**-0.91%*****
	(2.46)	(2.09)	(-0.77)	(-0.20)	(-1.30)	(-1.53)	(-1.86)	(-3.03)
Three-Factor Alpha	**0.40%****	**0.60%****	-0.04%	0.36%	-4.67%	-0.87%	**-1.23%**	**-0.76%****
	(1.99)	(2.09)	(-0.08)	(0.68)	(-1.20)	(-1.57)	(-1.50)	(-2.31)
Five-Factor Alpha	**0.37%***	**0.55%***	-0.11%	0.56%	-4.78%	**-0.90%***	**-1.64%***	**-0.91%****
	(1.70)	(1.74)	(-0.19)	(1.02)	(-1.18)	(-1.78)	(-1.70)	(-2.60)
Six-Factor Alpha	0.20%	0.34%	0.01%	0.49%	-4.77%	**-0.77%***	**-1.54%***	**-0.91%*****
	(0.83)	(0.97)	(0.01)	(0.88)	(-1.18)	(-1.66)	(-1.67)	(-2.65)

Table A.8- ESG Scores and Future Profits: This table presents the results for regressing the securities' future fundamentals on their ESG scores. Here, the dependent variable is the gross profitability ratio, $GPOA$, calculated by aggregating the monthly gross profits of the next 12 months and scaling it with the total assets. ESG score (ESG) is the independent variable, and the market beta ($Beta$) and the logarithm of market capitalization ($LnMarketCap$) are control variables. Since the monthly market betas are calculated based on the last previous 36 monthly excess returns of the market and the security, the actual estimation period is from January 2013 to December 2019. The regressions are estimated by a pooled regression with period fixed effects and clustered standard errors at both period and firm levels. The *t*-Statistics are in parenthesis and *, **, and *** represent the significance level of 10%, 5%, and 1%, respectively.

Dependent Variable	**GPOA**							
Country	**SWE**	**GBR**	**FRA**	**DEU**	**CHE**	**NLD**	**Nordic Countries**	**European Countries**
ESG	0.0011	**-0.0007**	**-0.0031**	**-0.0013**	**0.0030**	**0.0060**	**0.0028**	**-0.0003**
(clustered at firm-level)	(0.40)	(-0.36)	(-2.09) **	(-0.70)	(1.35)	(1.69) *	(1.64)	(-0.40)
(clustered at period-level)	(1.58)	(-4.37) ***	(-16.92) ***	(-8.50) ***	(11.78) ***	(8.57) ***	(12.82) ***	(-2.61) ***
Beta	0.0110	-0.0163	-0.0138	-0.0011	-0.0998	-0.1033	-0.0027	-0.0046
(clustered at firm-level)	(0.23)	(-1.46)	(-2.00) **	(-0.24)	(-2.64) ***	(-1.70) *	(-0.98)	(-2.29) **
(clustered at period-level)	(1.18)	(-9.26) ***	(-7.78) ***	(-1.82) *	(-14.89) ***	(-11.20) ***	(-5.00) ***	(-7.75) ***
LnMarketCap	-0.0138	-0.0336	0.0139	-0.0067	-0.0505	-0.0435	-0.0077	-0.0215
(clustered at firm-level)	(-0.61)	(-2.22) **	(1.18)	(-0.51)	(-3.15) ***	(-1.75) *	(-0.60)	(-3.92) ***
(clustered at period-level)	(-4.73) ***	(-18.21) ***	(10.93) ***	(-6.86) ***	(-22.25) ***	(-9.85) ***	(-4.19) ***	(-23.17) ***
Constant	0.53	1.14	0.15	0.54	1.42	0.95	0.32	0.81
(clustered at firm-level)	(1.19)	(3.70) ***	(0.62)	(2.21) **	(4.64) ***	(1.94) *	(1.30)	(7.40) ***
(clustered at period-level)	(10.42) ***	(30.72) ***	(5.62) ***	(25.97) ***	(32.50) ***	(15.21) ***	(10.38) ***	(40.86) ***
Observations	**3745**	**15727**	**7262**	**7628**	**5297**	**3026**	**10420**	**57880**
R-Squared	**0.014**	**0.028**	**0.043**	**0.018**	**0.115**	**0.085**	**0.015**	**0.020**

Table A.9- ESG Scores and Valuation: This table reports the results for a pooled regression of the valuation ratio (*LnPB*), defined as the logarithm of the price-to-book ratio, on the ESG score (*ESG*), in the presence of the market beta (*Beta*) as a control variable. Since the monthly market betas are calculated based on the last previous 36 monthly excess returns of the market and the security, the actual estimation period is from January 2013 to December 2019. The regressions are estimated with period fixed effects, and the standard errors are clustered at both period and firm levels. The *t*-Statistics are in parenthesis and *, **, and *** represent the significance level of 10%, 5%, and 1%, respectively.

Dependent Variable				**LnPB**				
Country	**SWE**	**GBR**	**FRA**	**DEU**	**CHE**	**NLD**	**Nordic Countries**	**European Countries**
ESG	0.0016	**-0.0078**	**-0.0181**	**-0.0095**	**0.0147**	0.0016	**0.0016**	**-0.0055**
(clustered at firm-level)	(0.23)	(-1.58)	(-3.71) ***	(-2.02) **	(2.28) **	(0.21)	(0.33)	(-2.54) **
(clustered at period-level)	(1.05)	(-10.00) ***	(-28.81) ***	(-20.72) ***	(18.51) ***	(1.16)	(2.02) **	(-14.86) ***
Beta	0.0623	-0.0675	-0.0899	0.0109	-0.1069	-0.3090	-0.0034	-0.0116
(clustered at firm-level)	(0.45)	(-2.30) **	(-3.23) ***	(0.83)	(-0.84)	(-2.20) **	(-0.41)	(-1.78) *
(clustered at period-level)	(1.55)	(-6.91) ***	(-7.67) ***	(3.65) ***	(-4.33) ***	(-9.97) ***	(-1.93) *	(-3.74) ***
Constant	0.63	1.47	1.94	1.34	0.18	0.84	0.68	1.12
(clustered at firm-level)	(1.23)	(4.76) ***	(5.97) ***	(4.63) ***	(0.45)	(1.63)	(2.12) ***	(8.14) ***
(clustered at period-level)	(7.09) ***	(29.48) ***	(46.14) ***	(43.49) ***	(4.53) ***	(10.36) ***	(12.54) ***	(43.00) ***
Observations	**3745**	**15727**	**7262**	**7628**	**5297**	**3026**	**10420**	**57880**
R-squared	**0.020**	**0.020**	**0.114**	**0.050**	**0.0581**	**0.086**	**0.010**	**0.015**

Table A.10- ESG Scores and Investors' Demand: This table presents the results for a pooled regression of the securities' turnover (*TurnOver*), defined as the trading volume over the following month divided by the number of shares outstanding, on the ESG score (*ESG*), in the presence the market beta (*Beta*) and the logarithm of the price-to-book ratio (*LnPB*) as control variables. Since the monthly market betas are calculated based on the last previous 36 monthly excess returns of the market and the security, the actual estimation period is from January 2013 to December 2019. The regressions are estimated with period fixed effects, and the standard errors are clustered at both period and firm levels. The *t*-Statistics are in parenthesis and *, **, and *** represent the significance level of 10%, 5%, and 1%, respectively.

Dependent Variable	**TurnOver**							
Country	**SWE**	**GBR**	**FRA**	**DEU**	**CHE**	**NLD**	**Nordic Countries**	**European Countries**
ESG	0.00059	**0.00057**	0.00019	-0.00032	0.00037	0.00019	0.00003	**0.00033**
(clustered at firm-level)	(1.17)	(3.48) ***	(0.75)	(-0.94)	(1.15)	(0.25)	(0.11)	(2.63) ***
(clustered at period-level)	(7.43) ***	(15.48) ***	(3.97) ***	(-5.50) ***	(6.94) ***	(0.99)	(0.58)	(9.85) ***
Beta	-0.0023	0.0022	0.0121	0.0006	0.0270	0.0103	0.0006	0.0016
(clustered at firm-level)	(-0.24)	(2.00) **	(10.45) ***	(0.51)	(4.33) ***	(1.43)	(0.96)	(3.93) ***
(clustered at period-level)	(-0.46)	(4.08) ***	(7.24) ***	(0.65)	(14.12) ***	(1.30)	(1.35)	(4.22) ***
LnPB	-0.0047	-0.0039	-0.0089	-0.0193	-0.0048	-0.0032	-0.0037	-0.0089
(clustered at firm-level)	(-0.82)	(-2.48) **	(-2.50) **	(-3.92) ***	(-1.10)	(-0.37)	(-1.06)	(-6.14) ***
(clustered at period-level)	(-4.09) ***	(-7.64) ***	(-9.44) ***	(-16.11) ***	(-5.37) ***	(-0.76)	(-5.39) **	(-15.04) ***
Constant	0.034	0.024	0.034	0.109	0.018	0.066	0.065	0.050
(clustered at firm-level)	(0.97)	(2.29) **	(1.88) *	(5.09) ***	(0.90)	(1.25)	(3.33) ***	(6.10) ***
(clustered at period-level)	(3.88) ***	(9.12) ***	(8.98) ***	(26.55) ***	(5.31) ***	(5.26) ***	(17.33) ***	(23.83) ***
Observations	**4413**	**18675**	**8559**	**8540**	**6197**	**3663**	**12049**	**66997**
R-squared	**0.028**	**0.074**	**0.144**	**0.067**	**0.074**	**0.029**	**0.014**	**0.024**