



The Risk and Performance of ESG Portfolio Strategies in Global Financial Markets

Reza Mirghaffari

Ph.D. Candidate and visiting researcher at Lund University, Department of Financial Management, Kish International Campus, University of Tehran, Kish, Iran, (Corresponding Author) reza.mirghaffari@ut.ac.ir

Ezatollah Abbasian

Associate Prof., Department of Leadership and Human Capital, Faculty of Management, University of Tehran, Tehran, Iran, e.abbasian@ut.ac.ir

Mojtaba Mirlohi

Assistant Prof., Faculty of Industrial Engineering & Management, Shahrood University of Technology, Shahrood, Iran, mirlohism@shahroodut.ac.ir

Submit: 16/08/2023 Accept: 02/09/2023

ABSTRACT

The sustainable finance approach incorporates Environmental, Social, and Governance (ESG) criteria has experienced remarkable growth in global financial markets. Recent research reveals that companies demonstrating strong ESG performance generally achieve better financial results and face reduced risks, regulatory fines, reputational damage, and supply chain disruptions. This study delves into the analysis of risk associated with sustainable investment portfolios comprising ESG-oriented companies. To investigate the impact of ESG screening on ESG portfolio's risk we decompose the portfolios into equally-weighted strategy and value-weighted strategy to evaluate the effect of different levels of ESG portfolio's risk in the US and EU market. Utilizing time-series regression models based on the Fama-French three-factor model (1993), we evaluate the performance of various ESG portfolios, encompassing both low and high-ESG-companies. In the second part of the study, we employ the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model to investigate the risk in different types of portfolios from 2004 to 2023 among European and American firms. Our findings indicate that the lower ESG portfolio tends to outperform the higher ESG portfolio in terms of returns, aligning with multiple reputable previous studies. Nonetheless, our study shows that during financial crises and global events, the high-ESG portfolio demonstrates lower risk than the lower-ESG portfolios.

Keywords: Environmental, Social, and Governance (ESG); Socially Responsible Investing (SRI); Sustainable Finance; Green investing; Ethical investing; ESG portfolios



1. Introduction

Environmental, social, and governance (ESG) considerations have become a driving force in the financial markets in recent years, and for good reason. The latest research shows that companies that perform well on ESG metrics tend to have better financial performance and are less exposed to risks such as regulatory fines, reputational damage, and supply chain disruptions.

The sustainable, responsible, and impact investment market has witnessed a remarkable growth rate of 14% since 1995, comprising one-third of professionally managed assets in the US. In fact, the global sustainable investment market reached a whopping \$35.3 trillion in 2020, a 15% increase from just two years prior. That's right, investors are putting their money where their values are, and the trend is only accelerating. Revenues in the ESG-rating market have surged from \$617 million in 2019 to \$1 billion in 2021. The wider acceptance of sustainability principles, favorable regulatory changes, and increasing stakeholder demand drive this expansion. Consequently, data providers have introduced diverse products to assess companies' sustainability performance, focusing on ESG criteria encompassing environmental, social, and governance factors. ESG data has become a vital tool for decision-making among portfolio managers, investors, governments, non-profit organizations, and academia. However, the significance of reliable ESG ratings has grown due to conflicting findings on investors' inclination to pay a premium for responsible assets and the risk characteristics associated with sustainable investments.

One of the main drivers behind this trend is climate risk. The latest research shows that climate change poses significant risks to the global economy and financial markets. Extreme weather events, such as floods, droughts, and hurricanes, can cause physical damage to property and infrastructure, disrupt supply chains, and lead to economic losses. Moreover, climate change regulations and policies, such as carbon pricing and emissions standards, can create significant financial risks for companies that are not prepared to adapt.

As a result, investors are increasingly looking to invest in companies that are taking proactive steps to mitigate the environmental aspect of risk and promote sustainable business practices. And it's not just investors - governments, regulators, and policymakers

are also increasingly focusing on ESG considerations. The European Union has introduced a comprehensive regulatory framework for sustainable finance, including establishing a taxonomy for sustainable economic activities and mandatory ESG disclosure requirements for companies and asset managers.

ESG considerations encompass a wide range of environmental, social, and governance issues, such as human rights, labor standards, and board diversity. By incorporating these factors into investment decisions and business practices, we can promote sustainable economic growth, improve corporate social responsibility, and address pressing social and environmental challenges.

The latest research shows that ESG news and consideration is an increasingly important factor in the financial markets (Amir Amel-Zadeh & George Serafeim (2018); George Serafeim & Aaron Yoon (2022); Soh Young In, Dane Rook & Ashby Monk (2019)) driven by investor demand and growing recognition of the risks posed by climate change and other ESG issues. By promoting sustainable business practices and investment decisions, we can build a more resilient, inclusive, and sustainable economy for all.

Gregory et al. (2021) developed an ESG model that incorporates a sustainability factor based on ecological and natural capital. Their study showed that following sustainable strategic management practices reduced the cost of equity globally by 1.6% to 2.9% annually, contributing to an increase in world GDP by \$1.3 to \$2.3 trillion in 2018. These findings support previous research indicating a negative relationship between sustainability performance and the cost of capital.

Our research aims to investigate the impact of ESG screening on risk and performance in different portfolios (value weighted and equally weighted) during the long-term duration from 2004 to 2023 to determine whether ESG should be considered as a risk factor in investment decisions. To achieve this objective, our study focuses on constructing portfolios with low ESG scores and high ESG scores and analyzing their risk-adjusted performance in major global markets. (The United State and European countries).

To contribute to the existing literature, we add to the growing body of empirical research on determining risk factors in ESG portfolios, with a specific focus on

risk decomposition in High and Low ESG companies in different construction strategies of portfolios (value-weighted and equally weighted). To accomplish this, we utilize an extended autoregressive conditional heteroscedasticity (GARCH) model for risk decomposition in ESG. This approach provides valuable insights into the investment risk associated with ESG. By incorporating the GARCH model, we enhance our understanding of ESG's role as a potential risk factor, and its implications for investment decisions in various portfolios (Low ESG and High ESG). This research will contribute valuable insights into the field of sustainable investing and its impact on portfolio risk and performance.

2 Definition and Literature Review

2.1 The definition of Environmental, Social and Governance

ESG is an acronym for Environmental, Social, and Governance, and it refers to the three key factors that measure the sustainability and ethical impact of an investment in a business or company. ESG is a framework that helps stakeholders understand how an organization manages risks and opportunities related to environmental, social, and governance criteria (sometimes called ESG factors). ESG takes the holistic view that sustainability extends beyond just environmental issues. ESG investing is a type of socially responsible investing that uses ESG criteria to screen potential investments.

These pillars (E, S, and G) represent the main topic areas that companies are expected to report on. The environmental pillar covers climate change, natural resource use, waste management, pollution, and biodiversity. The social pillar covers issues such as human rights, labor standards, diversity and inclusion, health and safety, and community engagement. The governance pillar covers issues such as board structure, executive compensation, shareholder rights, ethics, and transparency.

ESG aims to capture all the non-financial risks and opportunities inherent to a company's day-to-day activities. ESG is not a new concept, but it has evolved from other historical movements that focused on health and safety issues, pollution reduction, and corporate philanthropy. ESG reflects the growing awareness and demand from stakeholders such as investors, customers, employees, regulators, and

society at large for more sustainable and responsible business practices.

ESG performance can be measured by using an ESG score, which is an objective evaluation of a company's performance with respect to environmental, social, and governance issues. Different rating platforms may use different criteria to calculate the ESG score, but they all fall within one or more of the E, S, or G categories. Some examples of ESG criteria are:

- Environmental: greenhouse gas emissions, energy efficiency, water use, waste management, biodiversity impact, etc.
- Social: human rights, labor standards, diversity and inclusion, health and safety, customer satisfaction, community engagement, etc.
- Governance: board structure, executive compensation, shareholder rights, ethics, transparency, anti-corruption, etc.

ESG data and metrics can help stakeholders assess the sustainability and risk of a company, as well as its impact on society and the environment. ESG investing is a type of socially responsible investing that uses ESG criteria to screen potential investments. ESG framework is a strategic tool that can help companies create value by improving their performance on ESG issues.

2.2 Literature review

In recent years, socially responsible investment has experienced unprecedented growth in fund flows and assets under management (Morningstar, 2021). Investors, both institutional and retail, have shown a preference for firms with high ratings on environmental, social, and governance (ESG) factors, which has made ESG a central component of financial markets (Chollet & Sandwidi, 2018; Clark & Viehs, 2014; de Bakker et al., 2005; El Ghouli & Karoui, 2017; Flammer, 2015; Goss & Roberts, 2011; Yannan et al., 2021). However, the theoretical explanation for the positive relationship between ESG performance and financial performance remains unclear (Friede et al., 2015).

To explore this relationship, various theories have been proposed. The slack resources theory suggests that companies with better financial performance invest a portion of their excess resources into ESG activities, leading to improved ESG performance (Daniel et al., 2004). Conversely, the good

management theory argues that focusing on ESG management is a part of good management, and therefore, improving ESG performance contributes to better financial performance (McGuire et al., 1988). However, both directions of causality have been observed in the literature. To address this, the use of institutional theory has been proposed to explain the bidirectional causation between ESG and financial performance (Waddock & Graves, 1997). Empirical studies have shown mixed results regarding the relationship between ESG performance and financial performance. Pástor et al. (2021) found that high-ESG-rated stocks should underperform low-rated ones in a stable economy, while Gibson et al. (2021) discovered a positive association between stock returns and ESG rating disagreement. In contrast, Fiskerstrand et al. (2020) found no significant difference in returns between high and low ESG portfolios, suggesting no connection between ESG and stock returns in the Norwegian stock market. Additionally, Zhang et al. (2022) found a non-linear relationship between ESG and portfolio excess returns, with the impact varying across pillars and sectors.

When comparing different portfolio strategies, Amon et al. (2021) observed superior ESG performance but no significant difference in financial performance for ESG-based strategies compared to value-weighted strategies. This indicates that socially responsible investors are willing to pay a premium for the impact of the portfolio, and ESG-based strategies may serve as a benchmark for active socially responsible investment (SRI) funds. Similarly, Amon et al. (2019) found no significant difference in ESG performance but a higher degree of financial performance in ESG-based strategies compared to value-weighted strategies, suggesting that such strategies are preferred by both socially responsible and conventional investors. In the context of retirement plans, Owadally et al. (2021) found that ESG funds perform similarly to conventional funds in terms of investment performance. Moreover, incorporating ESG screening in retirement plans can lead to larger pensions compared to non-screened index-tracker funds or actively managed funds with a sustainable purpose. This highlights the effectiveness of an ESG-screened passive investment approach in achieving financial goals and sustainability objectives. Rajna Gibson Brandon et al. (2022) find that non-US institutional investors who sign the Principles for

Responsible Investment (PRI) have higher ESG scores, while US signatories show similar or worse ratings. US signatories also do not significantly improve the ESG scores of their portfolio companies, possibly due to commercial motives and uncertainties about fiduciary duties in the less mature US ESG market. These studies collectively contribute to the understanding of the relationship between ESG performance and financial performance, shedding light on the significance of ESG factors in investment decision-making. While the theoretical explanations for this relationship remain debated, the empirical evidence underscores the potential of ESG considerations to generate both financial returns and sustainability outcomes.

Climate change and environmental degradation have significant impacts on society, the economy, and the financial system, posing risks at microprudential and macroprudential levels (Brunetti et al., 2021). Authorities recognize climate change as a growing threat to financial stability, with climate-related risks being considered systemic (Battiston, Dafermos, and Monasterolo, 2021). Understanding Environmental, Social, and Governance (ESG) markets is crucial for identifying and addressing risks that may affect investors or financial markets (ESMA, 2022). Climate change risks to the financial sector can be transmitted through physical climate risks, transition risks, and liability risks (BoE, 2018). The relationship between corporate social responsibility (CSR) and firm risk is explained by three theories. The stakeholder theory suggests that increased CSR investments mitigate operational, environmental, and social risks, acting as insurance protection mechanisms (El Ghoul and Karoui, 2017). Theoretical models indicate that socially responsible companies attract more investors, lowering their risks and linking social performance to expected return (Lee and Faff, 2009). On the other hand, the managerial opportunism theory suggests that CSR expenditures waste resources and decrease a company's net worth (Barnea and Robin, 2010).

Kumar et al. (2016) challenge conventional wisdom in finance by showing that companies incorporating ESG factors experience lower volatility in stock performance compared to industry peers. Their study analyzes 157 Dow Jones Sustainability Index-listed companies and 809 non-listed companies, indicating that ESG companies generate higher returns, with the impact varying across industries.

Husse and Pippo (2021) find that an ESG portfolio exhibits better financial performance due to lower market risk. However, the ESG factor does not have a significant independent impact on expected returns when considering multiple factors. During the Covid-19 crisis, there has been increased consideration of ESG risk. Gyönyörová, Stachoň, and Stašek (2021) explore investor preferences regarding ESG risks in portfolio decisions. Using Morningstar's ESG risk indicators, they observe a preference for low-ESG-risk funds, driven by concerns about environmental risks during the early phase of the crisis. Aevoae et al. (2023) find that the ESG Combined Score and Governance pillar has a positive impact on banks' contribution to systemic risk. Improved corporate governance reduces bank interconnectedness and maintains financial stability, particularly for large banks with higher ESG scores. Fauser and Utz (2021) discover that companies with higher ESG performance face lower litigation risk and experience smaller market value losses. Implementing these findings in a trading strategy yields positive results for investors. De Spiegeleer et al. (2021) investigate the influence of ESG criteria on equity portfolio allocation. ESG ratings do not consistently affect portfolio performance, but portfolios with lower greenhouse gas emissions do not exhibit increased risk or lower returns. The choice of rating agency impacts the performance of ESG-constrained portfolios. Aldieri et al. (2023) examine the sensitivity of firms' performances to ESG rates. Analyzing risk-adjusted indicators for listed firms with different ESG grades, they find that high or low ESG rates do not significantly influence risk market performance. Pisani and Russo (2021) analyze the financial performance of sustainable investment funds during the COVID-19 pandemic. They find that funds with higher ESG ratings outperform other funds, demonstrating greater resilience and lower risk contagion. Sustainable funds can serve as risk protection instruments while promoting sustainable growth and minimizing portfolio risk.

3. Methodology and data

3.1 Methodology

Since the selection of ESG stocks alters exposure to conventional factors, the impact of screening on the returns of the ESG portfolio should be further

examined. Moreover, assuming ESG as a risk factor, investigating the portfolio risk becomes a crucial aspect for investors supporting responsible and environmentally friendly investments. By considering questions regarding ESG portfolio risk across various time horizons and treating it as a systematic model, the following hypotheses can be defined and explored in this research:

- There is a significant difference in returns between the high ESG portfolio and the low ESG portfolio.
- There is a significant difference in risk between the high ESG portfolio and the low ESG portfolio.
- The risk of the high ESG portfolio significantly differs from the overall market risk.

In this study, we analytically and empirically compare the properties of ESG factors constructed using two dominant approaches to constructing ESG portfolios. The first, named Equal-Weighted (EW) approach, is an ESG portfolio strategy in which all assets are allocated an equal proportion of the total investment. This approach ensures that each asset has the same influence on the overall performance of the ESG portfolio, regardless of its market capitalization or other factors. Second, constructing an ESG portfolio with the Value-Weighted (VW) approach which allocates assets based on their market capitalization. Constructing these portfolios aims to study the performance and the risk of two approaches regarding ESG considerations.

First, we sort different stocks based on their ESG scores and divide them into five groups, $j=1,2,\dots,5$, where $j=1$ refers to the group with the lowest ESG scores and $j=5$ consists of firms with the highest scores. We then construct five value-weighted and equally-weighted portfolios.

ESG ratings identify buckets of responsible (High ESG) and irresponsible (Low ESG) firms. In this study, we made 5 portfolios each month based on the ESG rating. Quantile 1 (Q1) means the portfolio with the lowest ESG rating and Quantile 5 (Q5) regards the portfolio with the highest ESG rating. The return spread between responsible and irresponsible portfolios represents the return on the ESG factor. This approach follows the seminal contribution of Fama

and French (1993) and is widely used to construct equity factors based on firm characteristics.

To investigate if the performance and risk of ESG portfolios are robust, we carry out the same portfolio construction in 3-Quantile which means that Quantile 1 (Q1) with the lowest ESG rating, and Quantile 3 (Q3) regards the portfolio with the highest ESG rating.

The portfolio's return, which is value-weighted and equally-weighted is calculated using the following formula:

$$R_{jt} = \sum_{i \in j} \frac{MV_{i,t-1}}{\sum_{i \in j} MV_{i,t-1}} R_{it} \quad (1)$$

$$R_{jt} = \sum_{i \in j} \frac{1}{N} R_{it}$$

Where, R_{it} is the return of asset i in month t and $MV_{i,t-1}$ is the market value of an asset from month $t-1$. We run a time-series regression of excess return of each portfolio, Z_{jt} , on the three Fama and French (1993) factors to compare their risk-adjusted returns and also their factor betas to see if the risk differs between the five portfolios.

$$Z_{jt} = \alpha_j + \beta_{1j} Z_{mt} + \beta_{2j} SMB_t + \beta_{3j} HmL_t + \varepsilon_{jt} \quad (3)$$

Second, we define ESG factor mimicking portfolio, $R_{ESG,t}$, as the difference between the return of the portfolio with the highest ESG scores and that of the portfolio with the lowest scores, i.e., $j = 1$ and $j = 5$:

$$R_{ESG,t} = R_{5t} - R_{1t} \quad (4)$$

We run GARCH model on the ESG portfolio to analysis the risk during the study period.

$$R_{ESG,t} = \mu + \eta_t$$

$$\sigma_t^2 = \omega + a\eta_{t-1}^2 + b\sigma_{t-1}^2 \quad (5)$$

We repeat the same estimation for the market index returns to examine whether the risk of ESG investment differs from the market portfolio and how the risks change over time. By conducting the time-series regression of the excess returns of the market index on the three Fama-French factors, we can compare the risk-adjusted returns and betas between ESG portfolios

and the market. This analysis will allow us to investigate if there are significant differences in the risk of ESG investment compared to the market portfolio and how these risks evolve.

3.2 ESG data

We collected ESG data from Refinitiv Eikon (available from 2003) from 2004 to 2023. We retain US and EU firms with common stocks traded on the exchange market and whose returns are available. The Refinitiv Eikon dataset provides annually updated pillar and total ESG scores on a scale from 1 to 100. ESG scores from Refinitiv are designed to transparently and objectively measure a company's relative ESG performance, commitment, and effectiveness across 10 main themes (emissions, environmental product innovation, human rights, shareholders, etc.) based on publicly reported data. The rate calculates the total ESG score by aggregating the scores attributed to the previous ten categories.

3.3 Stock returns and other characteristics

We use monthly stock returns and monthly market capitalizations obtained from Refinitiv Eikon between February 2004 and February 2023. We also consider the 30-day Treasury Bill return, which is used as the risk-free return to calculate excess returns and the returns on the three Fama-French-Carhart factors, comprising the market (MKT), size (SMB), book-to-market (HML) (Carhart, 1997; Fama and French, 2018) factors.

3.4 Summary statistics

Table 1 and Table 2 provide the summary statistics of the data based on the Refinitiv Eikon ESG ratings from 2004 to 2023. The average number of firms that use ESG portfolio construction is 1190 for the US market and 970 for the EU market. Considering the entire sample, which includes approximately 2500 firms on average, the mean ESG score is 38.62 for the US, while the score for the EU is 49.29, on a yearly basis. Constructing a 5-quantile portfolio with stocks less than the 20th percentile of ESG score belongs to quantile 1 (Q1), stocks between 20th and 40th are quantile 2 (Q2), stocks between 40th and 60th are quantile 3 (Q3), stocks between 60th and 80th are quantile 4 (Q4), and stocks more than 80th are quantile

5 (Q5). Similar to Construction 5-Quantile ESG portfolios, the 3-Quantile (less than 33.33, between 33.33 and 66.66, and more than 66.66) is constructed for robustness.

Table 1. Average number of Firms in ESG Portfolio

Year	US	EU
2004	246	279
2005	274	321
2006	353	448
2007	404	544
2008	422	575
2009	456	615
2010	564	656
2011	641	700
2012	679	742
2013	698	772
2014	706	795
2015	716	813
2016	762	862
2017	1217	948
2018	1787	1005
2019	2341	1130
2020	2563	1535
2021	2767	1838
2022	3040	2355
2023	3168	2473
Mean	1190	970

Note. The table reports the number of firms in the US and EU which are used for constructing ESG Portfolios for the period from 2004 to 2023.

Table 2. Sample summary statistics of the companies' ESG scores

sample	Score	Mean	Min	Max	Std. Dev.
	ESG	38.62	0.44	95.16	19.09
US	(E)	24.31	0.00	98.55	26.88
	(S)	40.93	0.45	99.56	20.81
	(G)	47.54	0.17	99.63	22.45
EU	ESG	49.29	0.63	95.47	20.94
	(E)	45.46	0.00	99.16	28.45
	(S)	51.20	0.12	98.47	24.19
	(G)	50.26	0.46	99.33	22.66

Note. The table presents the summary statistics for the Refinitiv Eikon ESG stock universe, including ratings, and firms. Four ESG ratings are provided: a total rating (ESG), as well as pillar ratings—environmental (E), social (S), and governance (G). Ratings are expressed as percentile ranks between 0 and 100. For each date, the descriptive statistics of the sample Mean, standard deviation (Std. dev.), Minimum (Min), and Maximum (Max) of the ESG scores in the United States and Europe that use for constructing ESG portfolios. The sample period is from February 2004 to February 2023.

4. Results

4.1 Performance of ESG Portfolios

Regarding the first hypothesis, which suggests a significant difference in returns between the high ESG portfolio and the low ESG portfolio, the obtained

results indicate that the average returns of high-ESG-minus-low ESG portfolios are not statistically significant across all portfolios (Tables 3 and 4).

Table 3. The mean return of ESG Portfolios- Equally Weighted

sample	Q1	Q2	Q3	Q4	Q5	ESG factor (5-Quantile)	ESG factor (3-Quantile)
US	0.012***	0.010***	0.011***	0.011***	0.011***	-0.001	0.000
	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.001)	(0.001)
EU	0.010***	0.011***	0.009***	0.010***	0.009***	-0.001	-0.001
	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)	(0.001)	(0.001)

Note. The table reports the average of the equally weighted ESG portfolio in the US and EU companies. Q1 (Quantile 1) means the portfolio with a Low ESG (first 20th percentiles of the ESG score) and Q5 (Quantile 5) implies the portfolio with a High ESG score (80th to 100th percentiles of the ESG score) and The ESG factor shows the High-minus-Low return in the ESG portfolio. The ESG factor is reported in both the 5-Quantile and 3-Quantile portfolios. In these portfolios, the weight of all companies with different Market Caps is assumed to be the same. The mean return of ESG portfolios is estimated with data from Feb 2004 to Feb 2023.

The standard errors of the estimators are reported in parentheses. *, **, and ***Significant coefficients at the 10%, 5%, and 1% levels, respectively.

Analyzing the equally weighted and value-weighted ESG portfolios provides insights into the relationship between ESG scores and returns in the US and EU markets.

When examining the mean returns of the equally weighted portfolios (Table 3), it is observed that there are significant variations across different ESG score quintiles. In the US and EU portfolios, all quintiles (Q1 to Q5) exhibit statistically significant mean returns at the 1% level of significance. On the other hand, when considering the ESG factors in the equally weighted portfolios (Table 3), there are no statistically significant differences observed for any region or for both the 5-Quantile and 3-Quantile portfolios. This implies that the specific ESG factor measured in the table, which represents the difference in returns between high and low ESG portfolios, does not exhibit substantial variations. Turning to the value-weighted

portfolios (Table 4), the mean returns in the US and EU portfolios, all quintiles (Q1 to Q5) exhibit statistically significant mean returns at the 1% level of significance. However, none of these differences are statistically significant at conventional significance levels.

Overall, the analysis suggests that while there may be some positive trends between ESG scores and mean returns in the equally weighted and value-weighted portfolios, these differences are not consistently statistically significant. This indicates that other factors beyond ESG scores might contribute more significantly to the variation in returns. Further research is needed to explore the relationship between ESG scores and returns in different markets and to consider additional factors that may influence portfolio performance.

Table 4. The Mean return of ESG Portfolio- Value Weighted

sample	Q1	Q2	Q3	Q4	Q5	ESG factor (5-Quantile)	ESG factor (3-Quantile)
US	0.010***	0.009**	0.010***	0.009***	0.009***	-0.002	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.001)
EU	0.007**	0.008***	0.008***	0.009***	0.007**	-0.001	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.001)

Note. The table reports the average of the equally weighted ESG portfolio in the US and EU companies. Q1 (Quantile 1) means the portfolio with a Low ESG (first 20th percentiles of the ESG score) and Q5 (Quantile 5) implies the portfolio with a High ESG score (80th to 100th percentiles of the ESG score) and The ESG factor shows the High-minus-Low return in the ESG portfolio. The ESG factor is reported in both the 5 Quantile portfolio and the 3 Q Quantile portfolio. In these portfolios, the weight of companies based on different Market Caps. The mean return of ESG portfolios is estimated with data from Feb 2004 to Feb 2023. The standard errors of the estimators are reported in parentheses. *, **, and ***Significant coefficients at the 10%, 5%, and 1% levels, respectively.

4.2 Multivariate Factor Analysis

Table 5 provides the results of the regression analysis for the ESG factor (High-minus-Low ESG), High ESG, and Low ESG portfolios in both the equally weighted and value-weighted portfolios.

Starting with the equally weighted portfolio, the intercepts in all regions do not deviate significantly from zero, suggesting any abnormal returns. For the FF factors, the $R_m - R_f$ (market excess return) coefficient is negative and statistically significant at the 1% level for the US portfolio, indicating a negative relationship between market excess return and

portfolio returns. However, this coefficient is not statistically significant for the EU portfolios.

Moving on to the SMB (size effect) factor, none of the coefficients in any region is statistically significant, implying that portfolio returns are not significantly influenced by size-related factors. Similarly, the HML (book-to-market effect) coefficients are mostly not statistically significant, except for a negative coefficient at the 1% level for the EU portfolio, indicating a weak relationship between the book-to-market effect and portfolio returns.

Table 5. The Regression results of ESG Portfolios Return

Sample	FF factors	Equally Weighted Portfolio			Value Weighted Portfolio		
		ESG factor	High ESG	Low ESG	ESG factor	High ESG	Low ESG
US	Intercept	-0.001	0.010***	0.011***	-0.001	0.009***	0.010***
		(0.001)	(0.003)	(0.004)	(0.002)	(0.003)	(0.004)
	Rm - Rf	-0.001*	0.000	0.001	-0.001	0.000*	0.001
		(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
	SMB	-0.001	-0.001	-0.001	-0.001	-0.001	0.000
		(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
	HML	0.001	0.002	0.001	0.000	0.001	0.000
		(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
EU	Intercept	0.000	0.009***	0.009***	0.000	0.007**	0.007**
		(0.001)	(0.003)	(0.004)	(0.002)	(0.003)	(0.003)
	Rm - Rf	-0.001**	0.000	0.001	-0.001	0.000	0.001
		(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
	SMB	-0.001	-0.001	0.000	-0.001	-0.001	0.000
		(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
	HML	-0.001*	0.001	0.002**	-0.001	0.001	0.002*
		(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)

Note. The table reports the results of regressing the monthly returns of ESG Portfolios (ESG factor (High-minus-Low ESG), High ESG, and Low ESG portfolios). The table reports results for Equally weighted and Value weighted ESG portfolios over the 228 months from February 2004 to February 2023. The $R_m - R_f$ factor is the market excess return; SMB and HML are the Fama and French (1993) size and book-to-market factors. The standard errors of the estimators are reported in parentheses. *, **, and ***Significant coefficients at the 10%, 5%, and 1% levels, respectively.

Turning to the value-weighted portfolio, the intercepts do not deviate significantly from zero, indicating any abnormal returns across regions. The $R_m - R_f$ coefficients are generally not statistically significant, except for a negative coefficient at the 5% level for the US portfolio. This suggests that market excess return has limited explanatory power for portfolio returns in the value-weighted portfolios.

For the SMB factor, none of the coefficients in any region are statistically significant, suggesting that size-related factors have minimal impact on portfolio returns. Regarding the HML factor, the coefficients are

mostly not statistically significant, except for a positive coefficient at the 5% level for the EU portfolio.

In summary, the regression results for the FF factors indicate that market excess return, size effect, and book-to-market effect have limited influence on the returns of ESG portfolios in both equally weighted and value-weighted portfolios. The coefficients are mostly not statistically significant, suggesting that other factors not included in the analysis may play a more significant role in explaining the variation in portfolio returns.

4.3 Analysis of Risk in Different ESG Portfolios

Regarding the second hypothesis, which suggests a significant difference in risk between the high ESG portfolio and the low ESG portfolio, the obtained

results indicate that in some samples, there is a statistically significant difference in risk between high ESG and low ESG portfolios. However, in other portfolios, these differences are not statistically significant.

Table 6. The difference in Risk in High and Low ESG Portfolios

	sample	variable	High ESG	Low ESG	F
Equally Weighted Portfolio	US	Mean	0.011	0.012	
		Variance	0.003	0.004	0.718
	EU	Mean	0.009	0.010	
		Variance	0.003	0.003	0.920*
Value Weighted Portfolio	US	Mean	0.009	0.010	
		Variance	0.002	0.003	0.647
	EU	Mean	0.007	0.007	
		Variance	0.002	0.002	0.773

Note. This table reports the results of F-Test two sample variance for detecting ESG Portfolios Risk in value-weighted and equally weighted ESG portfolios. The results of the difference between the Risk of High ESG portfolio and Low ESG Portfolio are shown in this table over 228-month observations from Feb 2004 to Feb 2023. The test is significant at the 5% level.

Table 6 presents the results of the F-test for two-sample variance, examining the difference in risk between High ESG and Low ESG portfolios in both the equally weighted and value-weighted portfolios. In the equally weighted portfolio, the F-test results indicate that there is a statistically significant difference in variance between the High ESG and Low ESG portfolios for the EU regions. This implies that the risk levels of the two portfolios in these regions exhibit significant variations. However, in the US market, the F-test does not show a significant difference in variance between the High ESG and Low ESG portfolios, suggesting that the risk levels of these portfolios are similar.

Moving to the value-weighted portfolio, the F-test results reveal that there is no statistically significant difference in variance between the High ESG and Low ESG portfolios for both the US and EU regions. This suggests that the risk levels of the two portfolios in these regions are comparable.

Overall, the analysis indicates that in the equally weighted portfolio, there is a statistically significant difference in variance between the High ESG and Low ESG portfolios for the EU. However, in the value-weighted portfolio, there is no significant difference in variance between the High ESG and Low ESG portfolios for the US and EU regions.

These findings highlight the importance of considering the risk characteristics of ESG portfolios, as different weighting schemes and regional factors can impact the risk profiles of High ESG and Low ESG portfolios.

4.4 Analysis of ESG Portfolio Risk and Market Risk

Regarding the third hypothesis, which suggests a significant difference in risk between the high ESG portfolio and the market, the obtained results indicate that this difference is statistically significant in all portfolios. Table 7 presents the results of the F-test for the difference in risk between high ESG portfolios and the market in both equal-weighted and value-weighted portfolios. The F-statistic measures the significance of differences in variances.

In summary, the analysis shows that there is a meaningful difference in risk between the high ESG portfolios and the market in all cases examined, confirming the hypothesis.

Table 7. The difference in Risk in High ESG Portfolios and market

	sample	variable	High ESG	Market	F
Equally Weighted Portfolio	US	Mean	0.011	0.008	
		Variance	0.003	0.002	1.298*
	EU	Mean	0.009	0.008	
		Variance	0.003	0.002	1.309*
Value Weighted Portfolio	US	Mean	0.009	0.008	
		Variance	0.002	0.002	0.903*
	EU	Mean	0.007	0.008	
		Variance	0.002	0.002	0.927*

Note. This table reports the results of F-Test two sample variance for detecting ESG Portfolios Risk in value-weighted and equally weighted ESG portfolios. The results of the difference between the Risk of High ESG portfolio and the market are shown in this table over 228-month observations from Feb 2004 to Feb 2023. The test is significant at the 5% level.

Table 7 presents the results of the F-Test for the difference in risk between the High ESG portfolios and the market in both the equally weighted and value-weighted portfolios. The F-statistic measures the significance of the difference in variances.

In the equally weighted portfolio, for the US and EU., the F-statistic is greater than 1, indicating that the risk of the High ESG portfolios is higher than that of the market. This implies that the High ESG portfolios carry more risk than the overall market in these regions.

On the other hand, in the value-weighted portfolio, the F-statistic is less than 1 for the US and EU. This suggests that the risk of the High ESG portfolios is lower than that of the market. In other words, the High ESG portfolios exhibit lower risk than the overall market in these regions.

Overall, the F-Test results indicate that the relationship between ESG portfolios and market risk varies depending on the weighting scheme. In the equally weighted portfolio, the High ESG portfolios tend to have a higher risk than the market, while in the value-weighted portfolio, the High ESG portfolios tend to have a lower risk than the market. These findings highlight the importance of considering the weighting methodology when analyzing the risk characteristics of ESG portfolios.

4.5 Risk Analysis of ESG Portfolios with GARCH Model

In this section, we measure ESG portfolio risk as the conditional standard variance, estimated through the GARCH model. The ESG portfolios are divided

into five quantiles, where quantile 5 represents high ESG and quantile 1 represents low ESG.

Based on the data presented in Figure 1, we observe that the differences in risk between high and low ESG portfolios (ESG factor) vary over a specific time period. During certain periods between 2004 and 2023, the risk differences in high and low ESG portfolios change significantly in both the Americas and Europe. From 2004 to 2006, the risk differences increase in both regions. However, from 2009 to 2012, the risk differences decrease, and from 2015 to 2016, they increase again. Additionally, in the period from 2021 to 2023, the risk differences in high and low ESG portfolios in both regions also increase.

These variations in risk differences indicate that the factors influencing ESG portfolio risk are time-varying. Notably, the risk differences between the Americas and Europe may also vary, showing significant differences in some periods while becoming more symmetrical or decreasing over time in other periods.

Therefore, these findings demonstrate that understanding the risk differences in high and low ESG portfolios requires a careful examination of temporal changes and influential factors to grasp more accurate relationships and patterns.

Figure 1: The chart illustrates the risk of High-Minus-Low ESG portfolios (ESG factor) estimated using the GARCH model from February 2004 to February 2023. In this estimation, we divided ESG companies into 5 quantiles. The conditional risk chart using the GARCH method (conditional standard deviation) compares the

High-Minus-Low ESG portfolio risk (ESG factor) in the US and Europe.

Figure 2: The chart displays the estimated ESG Portfolio Risk for High and Low ESG portfolios using the GARCH model in the United States market from February 2004 to February 2023. In this estimation, we divided ESG companies into 5 quantiles. The conditional risk chart using the GARCH method (conditional standard deviation) compares the High and Low ESG portfolio risks with the overall market risk in the United States.

Based on the analysis of Figure 2, we can identify the periods of high risk. During these times, the market risk was higher, and stronger fluctuations were observed. Between 2008 and 2009, the financial market faced a global financial crisis and economic recession. Between 2020 and 2021, we witnessed sharp jumps and strong fluctuations in the market, especially during the global outbreak of the COVID-19 virus. The high conditional variance during this period indicates unpredictability and strong market fluctuations.

Furthermore, between 2022 and 2023, the market experienced fluctuations and uncertainties, including global events, tax policies, fuel and commodity price fluctuations due to the Ukraine war, and changes in the economic policies of countries. During times of intense market fluctuations and high capital risks, the risk in high ESG portfolios was lower than in low ESG portfolios and the overall market.

In the presented analysis, the order of risk levels among the charts shows that the low ESG portfolio has the highest risk, and the high ESG portfolio has the lowest risk. The market chart represents a moderate level, positioned between the other two charts.

Figure 3: The chart illustrates the estimated risk of high and low ESG portfolios using the GARCH model in the European market from February 2004 to February 2023. In this estimation, we have divided ESG companies into 5 quantiles. The conditional risk of ESG portfolios (both high and low) is compared to the High and Low ESG portfolio risk using the GARCH method (Conditional Standard Deviation) in Europe.

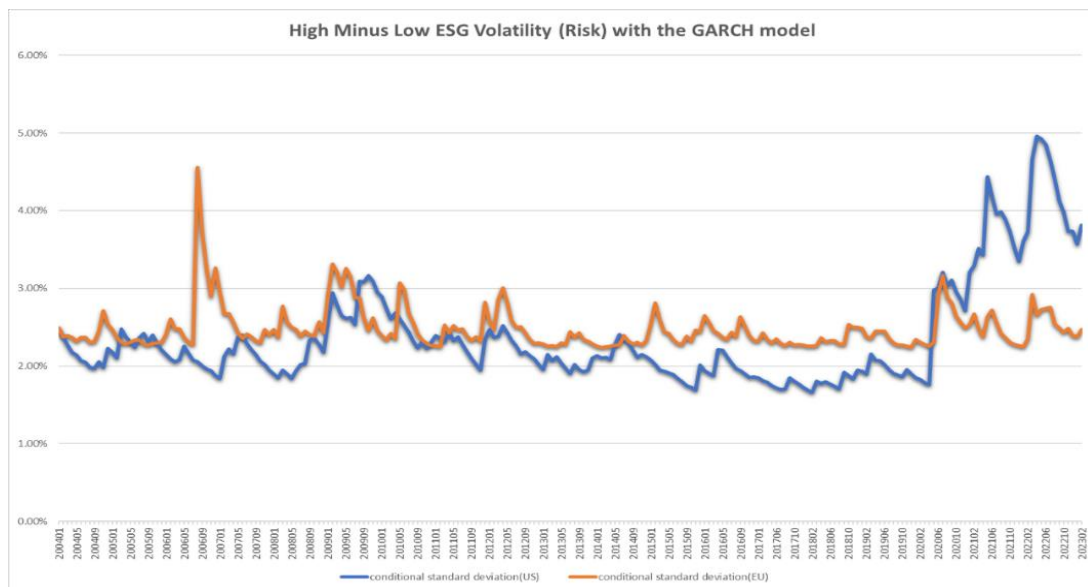


Figure 1. ESG Portfolio Risk in the Americas and Europe

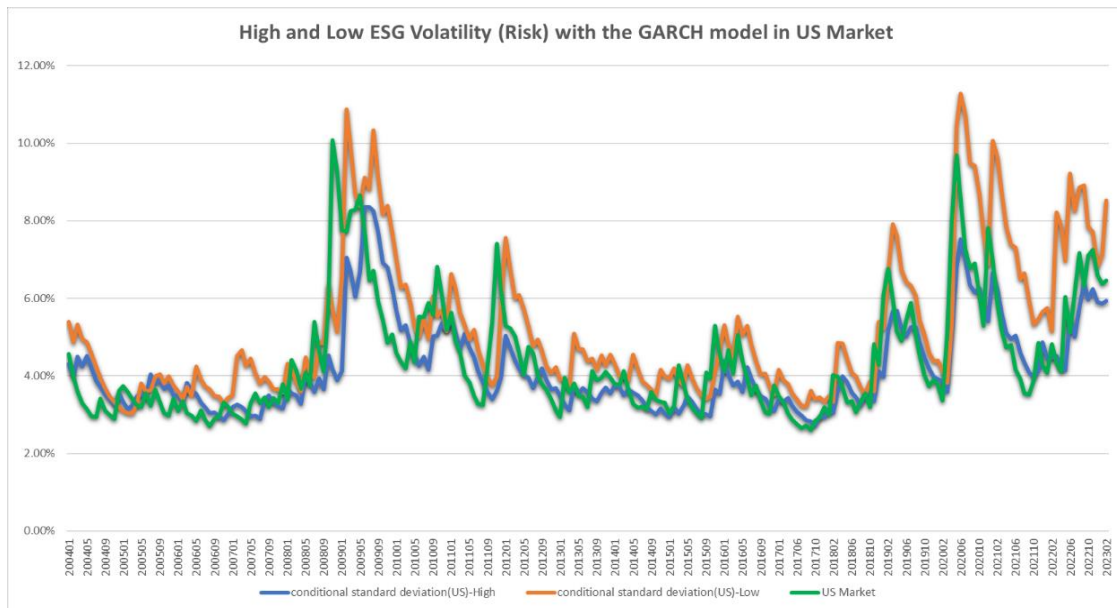


Figure 2. High and Low ESG Portfolio Risk with the GARCH model in the United States market

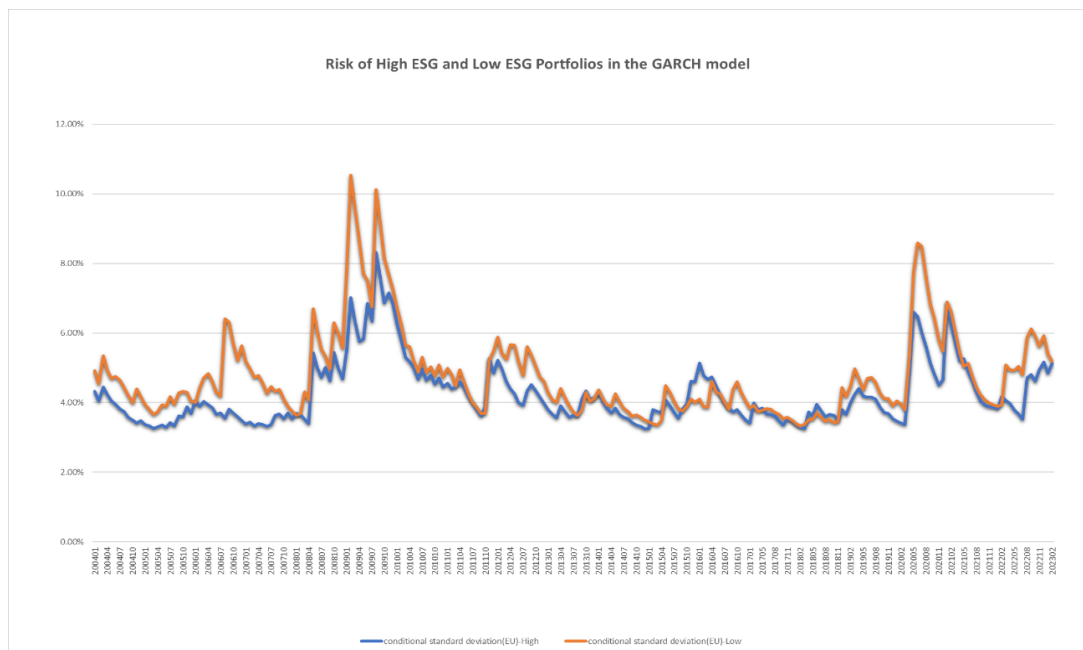


Figure 3. High and Low ESG Portfolio Risk with the GARCH model in the EU market

In the years 2008 to 2009, with the onset of the global financial crisis and economic recession, the European financial market experienced strong fluctuations and high conditional variance. During the years 2020 to 2021, with the global spread of the COVID-19 virus, the European financial market also faced severe

fluctuations and high conditional variance. In the years 2022 to 2023, due to global developments and fluctuations in fuel and commodity prices, the European financial market also experienced strong fluctuations and had a high conditional variance. In the years 2005 to 2007, the European financial market was

relatively stable, and the conditional variance was lower. From 2013 to 2019, the European financial market experienced sustained growth and lower conditional variance.

Overall, in Europe, times with high conditional variance include periods of global financial crises, the spread of the COVID-19 virus, and global developments, during which the risk of high ESG portfolios was lower than that of low ESG portfolios.

According to Table 8, the GARCH and ARCH factors are significant for all samples and factors.

Regarding the second hypothesis about the significant difference in risk between high ESG and low ESG portfolios, the results obtained using the GARCH method show that the difference is significant, and the risk of high ESG portfolios is lower than that of low ESG portfolios.

Similarly, for the third hypothesis regarding the significant difference in risk between high ESG portfolios and the market, this difference is also significant, and the risk of high ESG portfolios is lower than that of the market.

Table 8. The GARCH model results of 5-Quantile ESG portfolios

Sample	Variable	ESG factor	High ESG	Low ESG
US	Constant	0.000	0.000	0.000*
		(0.000)	(0.000)	(0.000)
	GARCH{1}	0.864***	0.786***	0.752***
		(0.090)	(0.087)	(0.063)
	ARCH{1}	0.094**	0.158***	0.207***
		(0.049)	(0.062)	(0.053)
EU	Constant	0.000	0.000*	0.000**
		(0.000)	(0.000)	(0.000)
	GARCH{1}	0.557**	0.772***	0.764***
		(0.300)	(0.104)	(0.070)
	ARCH{1}	0.091	0.125***	0.148***
		(0.064)	(0.051)	(0.050)

Note. The table reports the results of the GARCH model of ESG Portfolios (ESG factor (High-minus-Low ESG), High ESG, and Low ESG portfolios). The table reports shows the Value weighted ESG portfolios over the 228 months from February 2004 to February 2023. The Constant, GARCH {1} and ARCH {1} are reported in this table. The standard errors of the estimators are reported in parentheses. *, **, and ***Significant coefficients at the 10%, 5%, and 1% levels, respectively.

5. Discussion and conclusion

This study investigates the impact of ESG stock weight strategy in investment portfolios on their return patterns and associated risks. The study examines the ESG portfolios in different markets and weighting schemes and compares them with the market portfolio. The study uses the GARCH model to measure the risk of the portfolios, and tests the following hypotheses:

- H1: There is a significant difference in returns between the high ESG portfolio and the low ESG portfolio.
- H2: There is a significant difference in risk between the high ESG portfolio and the low ESG portfolio.
- H3: The risk of the high ESG portfolio significantly differs from the overall market risk.

The study finds that:

H1 is not supported, as the average returns of high and low ESG portfolios are not significant across all portfolios. The analysis implies that ESG scores and mean returns may have some positive links in the equal and value-weighted portfolios, but these are not always statistically meaningful. This suggests that other factors besides ESG scores might explain more of the return variation. More research is required to examine the connection between ESG scores and returns across different markets and to account for other factors that may affect portfolio outcomes.

H2 partially supported, as high and low ESG portfolios have different risk levels in the EU equally weighted portfolio, but not in the US or in the value-weighted portfolios. Risk factors vary by weighting scheme and region. Considering the study findings, there is a significant difference between the risk of

high ESG portfolios and the market risk, with high ESG portfolios exhibiting lower risk than the market.

H3 is supported, as the risk of high ESG portfolios is lower than the risk of the market portfolio across all portfolios. The analysis confirms the hypothesis of risk difference between High ESG portfolios and the market. The risk of ESG portfolios depends on the weighting scheme. The equal-weighted portfolio has a higher risk for High ESG portfolios, while the value-weighted portfolio has a lower risk. The weighting matters for ESG portfolio risk analysis.

The study also demonstrates that selecting ESG stocks in a portfolio leads to a reduction in systematic risk and decreases exposure to common factors. In other words, this study investigates the impact of different ESG stock weights in investment portfolios on their return patterns and associated risks. The results demonstrate that selecting ESG stocks in a portfolio leads to a reduction in systematic risk and decreases exposure to common factors. In other words, portfolios with higher ESG scores generally have lower risks. Therefore, investors should consider the ESG weight as a factor to assess the costs and benefits in their stock selection. The results of this study suggest that the risk of ESG portfolios is not uniform across different markets and weighting schemes. This implies that investors should not assume that high ESG portfolios are always less risky than low ESG portfolios, or vice versa. The risk of ESG portfolios may depend on the characteristics of the underlying companies, such as their size, industry, location, and governance structure. Moreover, the risk of ESG portfolios may also depend on the method of constructing the portfolios, such as using equal weights or value weights. These factors may affect the diversification and exposure of the portfolios to different sources of risk. Therefore, investors should carefully consider the risk implications of ESG investing, and adjust their portfolio strategies accordingly. Future research should explore the determinants and consequences of ESG portfolio risk in more detail, and examine how ESG investing affects the risk-return trade-off in different contexts.

Also, the study examines the risk of ESG portfolios in different markets and weighting schemes and compares it with the risk of the market portfolio. The study uses the GARCH model to estimate the conditional standard variance of the portfolios, which captures the time-varying nature of risk. The study

divides the ESG portfolios into five quantiles, where quantile 5 represents high ESG and quantile 1 represents low ESG. The study analyzes the risk differences between high and low ESG portfolios (ESG factor) in both the Americas and Europe from 2004 to 2023. The study finds that the risk differences vary over time and by region, which could be influenced by various factors. The study also identifies the periods of high market risk, such as the global financial crisis in 2008-2009 and the COVID-19 pandemic in 2020-2021, which are characterized by high conditional variance and strong market fluctuations. The study also finds that the risk difference between high and low ESG portfolios is significant and that the GARCH and ARCH factors are significant for all samples and factors. The study suggests that investors should consider the temporal changes and influential factors of ESG portfolio risk, and how ESG investing affects the risk-return trade-off. In conclusion, this study reveals that ESG stocks can have a positive impact on portfolio risk and return patterns, and investors can achieve risk reduction and increased returns by considering the ESG weight in their portfolios.

References

- Aevoae, George Marian, Alin Marius Andrieş, Steven Ongena, and Nicu Sprincean. 2023. 'ESG and systemic risk', *Applied Economics*, 55: 3085-109.
- Aldieri, Luigi, Alessandra Amendola, and Vincenzo Candila. 2023. 'The Impact of ESG Scores on Risk Market Performance', *Sustainability*, 15: 7183.
- Amel-Zadeh, Amir, and George Serafeim. 2018. 'Why and How Investors Use ESG Information: Evidence from a Global Survey', *Financial Analysts Journal*, 74: 87-103.
- Amon, Julian, Margarethe Rammerstorfer, and Karl Weinmayer. 2019. 'Passive ESG Portfolio Management - The Benchmark Strategy for Socially Responsible Investors', *Socially Responsible Investment eJournal*.
- Ardia, David, Keven Bluteau, Kris Boudt, and Koen Inghelbrecht. 'Climate Change Concerns and the Performance of Green vs. Brown Stocks', *Management Science*, 0: null.
- Ardia, David, Keven Bluteau, Kris Boudt, and Koen Inghelbrecht. 2022. 'Climate Change Concerns

- and the Performance of Green vs. Brown Stocks', *Management Science*.
- Asgharian, Hossein, Charlotte Christiansen, Ai Jun Hou, and Weining Wang. 2021. 'Long- and short-run components of factor betas: Implications for stock pricing', *Journal of International Financial Markets, Institutions and Money*, 74: 101412.
- Asgharian, Hossein, Ai Jun Hou, and Farrukh Javed. 2013. 'The Importance of the Macroeconomic Variables in Forecasting Stock Return Variance: A GARCH-MIDAS Approach', *Journal of Forecasting*, 32: 600-12.
- Ashwin Kumar, N. C., Camille Smith, Leïla Badis, Nan Wang, Paz Ambrosy, and Rodrigo Tavares. 2016. 'ESG factors and risk-adjusted performance: a new quantitative model', *Journal of sustainable finance & investment*, 6: 292-300.
- Boido, Claudio, Paolo Ceccherini, and Alessia D'Imperio. 2022. 'ESG Scores-Is it the new way to build a European portfolio?', *Journal of Finance and Investment Analysis*, 11: 1-1.
- Bruno, G., M. Esakia, and F. Goltz. 2022. "'Honey, I Shrank the ESG Alpha": Risk-Adjusting ESG Portfolio Returns', *Journal of Investing*, 31: 45-61.
- Cardillo, G., E. Bendinelli, and G. Torluccio. 2023. 'COVID-19, ESG investing, and the resilience of more sustainable stocks: Evidence from European firms', *Business Strategy and the Environment*, 32: 602-23.
- Chollet, Pierre, and Blaise W Sandwidi. 2018. 'CSR engagement and financial risk: A virtuous circle? International evidence', *Global Finance Journal*, 38: 65-81.
- Chupradit, Supat, Dai Yannan, Hafiz Waqas Kamran, Sadaf S Soudagar, Alaa Mohamd Shoukry, and Jameel A Khader. 2021. 'Measuring technical efficiency associated with environmental investment: does market competition and risk matters in banking sector', *Environmental Science and Pollution Research*, 28: 66575-88.
- Clark, Gordon L, Andreas Feiner, and Michael Viehs. 2015. 'From the stockholder to the stakeholder: How sustainability can drive financial outperformance', Available at SSRN 2508281.
- Cornell, B. 2021. 'ESG preferences, risk and return', *European Financial Management*, 27: 12-19.
- Daniel, Francis, Franz T Lohrke, Charles J Fornaciari, and R Andrew Turner Jr. 2004. 'Slack resources and firm performance: a meta-analysis', *Journal of Business Research*, 57: 565-74.
- Davies, Gary, and Louella Miles. 1998. 'Reputation management: theory versus practice', *Corporate reputation review*, 2: 16-27.
- De Angelis, Tiziano, Peter Tankov, and Olivier David Zerbib. 2020. 'Environmental impact investing', Available at SSRN, 3562534.
- De Spiegeleer, Jan, Stephan Höcht, Daniel Jakubowski, Sofie Reyners, and Wim Schoutens. 2021. 'ESG: a new dimension in portfolio allocation', *Journal of sustainable finance & investment*: 1-41.
- Dreyer, J. K., M. Moreira, W. T. Smith, and V. Sharma. 2023. 'Do environmental, social and governance practices affect portfolio returns? Evidence from the US stock market from 2002 to 2020', *Review of Accounting and Finance*, 22: 37-61.
- El Ghouli, Sadok, and Aymen Karoui. 2017. 'Does corporate social responsibility affect mutual fund performance and flows?', *Journal of Banking & Finance*, 77: 53-63.
- Engle, Robert F., Eric Ghysels, and Bumjean Sohn. 2013. 'STOCK MARKET VOLATILITY AND MACROECONOMIC FUNDAMENTALS', *The Review of Economics and Statistics*, 95: 776-97.
- Fausser, Daniel V., and Sebastian Utz. 2021. 'Risk Mitigation of Corporate Social Performance in US Class Action Lawsuits', *Financial Analysts Journal*, 77: 43-65.
- Fiskerstrand, Sondre R., Susanne Fjeldavli, Thomas Leirvik, Yevheniia Antoniuk, and Oleg Nenadić. 2020. 'Sustainable investments in the Norwegian stock market', *Journal of sustainable finance & investment*, 10: 294-310.
- Flammer, Caroline. 2015. 'Does corporate social responsibility lead to superior financial performance? A regression discontinuity approach', *Management Science*, 61: 2549-68.
- Friede, Gunnar, Timo Busch, and Alexander Bassen. 2015. 'ESG and financial performance: aggregated evidence from more than 2000 empirical studies', *Journal of sustainable finance & investment*, 5: 210-33.

- Gibson Brandon, Rajna, Simon Glossner, Philipp Krueger, Pedro Matos, and Tom Steffen. 2022. 'Do Responsible Investors Invest Responsibly?*', *Review of Finance*, 26: 1389-432.
- Gibson Brandon, Rajna, Philipp Krueger, and Peter Steffen Schmidt. 2021. 'ESG Rating Disagreement and Stock Returns', *Financial Analysts Journal*, 77: 104-27.
- Gibson, Rajna, Philipp Krueger, and Shema F Mitali. 2020. 'The sustainability footprint of institutional investors: ESG driven price pressure and performance', *Swiss Finance Institute Research Paper*.
- Goss, Allen, and Gordon S Roberts. 2011. 'The impact of corporate social responsibility on the cost of bank loans', *Journal of Banking & Finance*, 35: 1794-810.
- Gregory, Richard P., Jean Garner Stead, and Edward Stead. 2021. 'The global pricing of environmental, social, and governance (ESG) criteria', *Journal of sustainable finance & investment*, 11: 310-29.
- Gyönyörová, Lucie, Martin Stachoň, and Daniel Stašek. 2021. 'ESG ratings: relevant information or misleading clue? Evidence from the S&P Global 1200', *Journal of sustainable finance & investment*: 1-35.
- Harjoto, Maretno, and Indrarini Laksmana. 2018. 'The impact of corporate social responsibility on risk taking and firm value', *Journal of Business Ethics*, 151: 353-73.
- Heinkel, Robert, Alan Kraus, and Josef Zechner. 2001. 'The effect of green investment on corporate behavior', *Journal of financial and quantitative analysis*, 36: 431-49.
- Hou, Kewei, Chen Xue, and Lu Zhang. 2018. 'Replicating Anomalies', *The Review of Financial Studies*, 33: 2019-133.
- Husse, Thomas, and Federico Pippo. 2021. 'Responsible Minus Irresponsible - a determinant of equity risk premia?', *Journal of sustainable finance & investment*: 1-23.
- In, Soh Young, Dane Rook, and Ashby Monk. 2019. 'Integrating Alternative Data (Also Known as ESG Data) in Investment Decision Making', *Global Economic Review*, 48: 237-60.
- Jin, I. C. 2022. 'Systematic ESG Risk and Decision Criteria for Optimal Portfolio Selection', *Journal of Portfolio Management*, 48: 206-25.
- Kaiser, L., and J. Welters. 2019. 'Risk-mitigating effect of ESG on momentum portfolios', *Journal of Risk Finance*, 20: 542-55.
- Kostrov, Alexander. 2020. 'Estimating MIDAS regressions via MIDAS-NLS with revised optimization'. <https://www.researchgate.net/publication/342364491>.
- Krueger, Philipp, Zacharias Sautner, and Laura T Starks. 2020. 'The importance of climate risks for institutional investors', *The Review of Financial Studies*, 33: 1067-111.
- Latif, Shahid, Safrul Izani Mohd Salleh, Mazuri Abd. Ghani, and Bilal Ahmad. 2023. 'Management accounting systems and economic sustainability: a qualitative inquiry of SMEs in Pakistan', *Asian Review of Accounting*, ahead-of-print.
- Lin, Chin-Huang, Ho-Li Yang, and Dian-Yan Liou. 2009. 'The impact of corporate social responsibility on financial performance: Evidence from business in Taiwan', *Technology in society*, 31: 56-63.
- Linnenluecke, M. K. 2022. 'Environmental, social and governance (ESG) performance in the context of multinational business research', *Multinational Business Review*, 30: 1-16.
- Luo, H Arthur, and Ronald J Balvers. 2017. 'Social screens and systematic investor boycott risk', *Journal of financial and quantitative analysis*, 52: 365-99.
- Maiti, Moinak. 2021. 'Is ESG the succeeding risk factor?', *Journal of sustainable finance & investment*, 11: 199-213.
- Owadally, Iqbal, Jean-René Mwizere, Neema Kalidas, Kalyanie Murugesu, and Muhammad Kashif. 2021. 'Long-Term Sustainable Investment for Retirement', *Sustainability*, 13: 5000.
- Pae, Y., and N. Sabbaghi. 2015. 'Equally weighted portfolios vs value weighted portfolios: Reasons for differing betas', *Journal of Financial Stability*, 18: 203-07.
- Pástor, Luboš, Robert F. Stambaugh, and Lucian A. Taylor. 2021. 'Sustainable investing in equilibrium', *Journal of Financial Economics*, 142: 550-71.

- Pisani, Fabio, and Giorgia Russo. 2021. 'Sustainable Finance and COVID-19: The Reaction of ESG Funds to the 2020 Crisis', *Sustainability*, 13: 13253.
- Prol, J. L., and K. Kim. 2022. 'Risk-return performance of optimized ESG equity portfolios in the NYSE', *Finance Research Letters*, 50.
- Rau, P. R., and T. Yu. 2023. 'A survey on ESG: investors, institutions and firms', *China Finance Review International*.
- Sabbaghi, O. 2023. 'ESG and volatility risk: International evidence', *Business Ethics the Environment & Responsibility*.
- Serafeim, George, and Aaron Yoon. 2022. 'Which Corporate ESG News Does the Market React To?', *Financial Analysts Journal*, 78: 59-78.
- Waddock, Sandra A, and Samuel B Graves. 1997. 'The corporate social performance-financial performance link', *Strategic management journal*, 18: 303-19.
- Wang, Jiqian, and Liang Li. 2023. 'Climate risk and Chinese stock volatility forecasting: Evidence from ESG index', *Finance Research Letters*, 55: 103898.
- Zehir, Emre, and Aslı Aybars. 2020. 'Is there any effect of ESG scores on portfolio performance? Evidence from Europe and Turkey', *Journal of Capital Markets Studies*, 4: 129-43.
- Zhang, D., C. Wang, and Y. Dong. 2023. 'How Does Firm ESG Performance Impact Financial Constraints? An Experimental Exploration of the COVID-19 Pandemic', *Eur J Dev Res*, 35: 219-39.
- Zhang, Xiaoke, Xuankai Zhao, and Yu He. 2022. 'Does It Pay to Be Responsible? The Performance of ESG Investing in China', *Emerging Markets Finance and Trade*, 58: 3048-75.