The Green Investing Illusion

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Abstract: This paper explores the relationship between Environmental, Social and Governance (ESG) Score and financial performance. To gain a comprehensive understanding of sustainability, the study investigates the ESG rating system and its definition of sustainability. The aim of the research is to determine the factors that contribute to a good ESG rating and good financial performance. The methodology employed involved a rigorous process of selecting reliable data sources, filtering markets for data abundance, and identifying an adequate dataset. The companies were then grouped based on their ESG scores. The study did not find any significant Granger causality between ESG scores and stock performance. However, a lagged correlation to volatility was observed, depending on the cluster. The results showed that higher ESG scores were associated with lower volatility, with the energy cluster and finance cluster displaying a higher mean ESG score. In conclusion, this research provides valuable insights into the link between ESG scores and financial performance, suggesting that ESG scores may impact volatility.

One-Sentence Summary: This study investigates the relationship between ESG scores and financial performance, finding a lagged correlation to volatility, depending on the cluster, and suggesting that ESG scores may impact volatility, but no significant Granger causality between ESG scores and stock performance was found.

Introduction: Environmental, Social, and Governance (ESG) scores have become increasingly important in the investment world as investors seek to incorporate non-financial factors into their decision-making processes (1,2). According to the Brundtland Report, sustainable development emphasizes the interdependence between economic development, social development, and environmental protection, calling for the integration of sustainable development principles into all aspects of decision-making (3,4). Therefore, it is important to evaluate a company's sustainability and ethical impact by measuring its performance on various non-financial factors to provide investors with a more comprehensive picture of a company's performance and risk profile (5,6). The Global Sustainable Investing Alliance reports that sustainable investing assets grew 15% in two years to reach $35 trillion in 2020, with Europe leading sustainable investments and the US market growing significantly in 2020 (7). The COVID-19 pandemic has also increased investor focus on ESG issues (8). ESG integration is the most popular sustainable investment strategy, accounting for 62% of assets under management (AUM), followed by impact investing, accounting for 23% of AUM. Negative screening and norms-based screening are also commonly used strategies (9). This paper's analysis provides insights into whether ESG factors have a positive or negative impact on firm performance, and the extent to which ESG scores are correlated with financial metrics. The findings of this study have important implications for investors, policymakers, and companies seeking to improve their ESG performance.

Sustainability:

The shift towards sustainability in business and investment practices reflects a growing awareness to balance economic growth with environmental protection. There are two contrasting approaches to sustainability: weak sustainability and strong sustainability (10). Weak sustainability assumes that natural capital is substitutable by other forms of capital, such as human-made or social capital, and that economic growth can continue indefinitely without degrading the natural environment (10). Weak sustainability practices focus on technological innovation, resource efficiency, and market-based mechanisms such as carbon or emissions taxes (11). On the other hand, strong sustainability recognizes that natural capital is not substitutable by other forms of capital and that economic growth must be limited by ecological constraints to ensure the well-being of current and future generations (12). Strong sustainability practices include the circular economy, ecosystem restoration, promotion of renewable energy, development of sustainable agriculture and forestry systems, and biodiversity conservation (10, 13). Both weak and strong sustainability prioritize economic growth and environmental protection, but weak sustainability prioritizes also economic indicators such as profitability, shareholder value, and market share (14). In contrast, strong sustainability tends to prioritize ESG factors such as social justice,

biodiversity conservation, and ecosystem health (15). However, strong sustainability can be challenging due to conflicting stakeholder interests and economic-environmental trade-offs. Therefore, a balance between the two approaches is essential to achieve sustainable development.

Understanding E, S, G:

The increasing focus on sustainability has led to the development of various frameworks and tools to assess the environmental, social, and governance (ESG) performance of companies. While these ESG scores can provide valuable information to investors and other stakeholders, there are also some criticisms and limitations to consider. The aim of an ESG score is to provide a standardized and objective measure of a company's environmental, social and governance performance. It is calculated by assessing a company's practices in the three areas. The three different pillars of the ESG consider different sustainability areas. The environmental factor considers a company's impact on the natural environment, including its efforts to reduce its carbon emissions, prevent pollution, and waste management practices. Social factors measure a company's performance in areas related to social responsibility and impact, such as labour practices, employee diversity and inclusion, and community engagement. Governance factors include board diversity, executive compensation, and transparency in financial reporting (16, 17). The following will provide a more in-depth analysis of the influence of ESG and its induvial factors on firm value and performance.

ESG performance is positively and highly correlated with firm value, with social and governance scores exhibiting strong correlations with firm value. However, due to the longer time required for outcomes and high investment costs involved, the relationship between environmental scores and firm value is less clear. (18, 19) Several studies have shown that ESG factors have a non-negative impact on corporate financial performance (CFP), with most reporting positive findings. Approximately 90% of studies find a non-negative ESG-CFP relation, and the positive impact of ESG on CFP appears stable over time. (20, 21) While there is no consensus in the literature on the direct relationship between ESG and financial performance, evidence suggests that ESG directly impacts a company's financial performance. Multiple articles refer to a direct positive relationship and a bidirectional positive relationship between ESG and financial performance (22, 23). Additionally, there is a positive correlation between a company's ESG indices and its stock market performance, with a greater impact observed in non-state-owned enterprises than in state-owned enterprises (24). The stock market performance of the secondary industry is also much more affected by ESG indices than that of the tertiary industry (25).

Environmental activities can have positive effects and potential benefits. Studies suggest that high carbon emissions can negatively impact the financial

and market-based performance of emerging market firms (26), while reducing emissions may lead to competitive advantages (27). By implementing an Environmental Management System and controlling emissions, businesses can increase profits by stimulating demand and improving productivity (28).

5 Delmas and Nairn-Birch argue that investors tend to favour companies with proactive environmental strategies due to their perceived importance (29).

The impact of Corporate Social Responsibility (CSR) on financial performance has been extensively studied. The literature suggests that there is a positive correlation between Corporate Social Performance (CSP) and CFP,

10 although the effect size is small (30,31). However, the relationship between CSP and CFP is complex and multifaceted, as indicated by the research conducted by Margolis et al. (32). Similarly, the relationship between CSR and CFP is mixed, with some studies reporting a positive correlation, while others have found no significant relation or even a negative association (33).

15 Additionally, the positive relationship between job satisfaction and firm performance, as measured by return on assets and return on equity, has been reported in prior research. However, this relationship may take time to develop and manifest (34).

The relationship between the governance score and various financial

20 performance indicators has been examined. Results from several studies suggest that board independence has a significantly positive relationship with market value, indicating that companies with more independent boards have higher market values (35). Similarly, CEO duality is found to have a weak but positive relationship with return on assets (ROA) (35). On the other hand, the

25 percentage of women on the board is found to have a strong and positive linkage with both ROA and market value. This indicates that companies with a higher representation of women on their board tend to perform better financially (36). Adopting the right corporate governance mechanisms can help companies improve their financial market performance (37). However,

30 insider shareholding is found to have no influence on financial performance (38). Additionally, board size is positively and significantly related to Tobin's Q and ROA, suggesting that larger boards tend to perform better financially. While strong independent boards are found to improve financial performance, the market does not attach much value to board independence (39).

35 **ESG critics:**
ESG scores can provide a useful tool for investors seeking to incorporate non-financial metrics into their investment decisions. However, it is important to note that ESG scores have limitations. For example, ESG data can be subjective and rely heavily on self-reported information from companies,

40 which may not always be reliable. (39) Furthermore, companies may prioritize improving their ESG scores through superficial actions such as greenwashing, which involves making misleading or unsubstantiated claims about a company's environmental or social practices. This can make it difficult for

investors to accurately assess a company's true ESG performance. (40, 41) Despite these limitations, the increasing use of ESG scores in investment decisions highlights a growing recognition of the importance of sustainability and responsible corporate practices in achieving long-term value. (42)

Scope of study:

The motivation behind this paper is to address the lack of clarity around the sustainability of ESG scores. While companies with high ESG scores have been found to outperform their peers in terms of financial performance, including higher returns and lower volatility, the evidence is not completely clear as the positive impact may vary depending on factors such as industry, geography, and company size. Additionally, a positive correlation between ESG scores and financial performance does not necessarily imply causation. Therefore, investors need reliable information to make informed decisions about sustainable investing, and to avoid being misled into investing in companies which do not fit their sustainability criteria. By understanding the reasons for the correlation, investors can distinguish between sustainable and "greenwashing" companies. Thus, the central question of this paper is: Is the ESG score a reliable indicator of sustainable investing, or just profitable greenwashing?

Results

After preparing our data, we analyzed if there is a general correlation between stock returns and ESG scores. If a large amount of data is viewed simultaneously, the correlations tend to follow a normal distribution almost perfectly (Fig. 3). To obtain more detailed results, we identified relevant clusters of the set of companies. Five clusters were identified that required further investigation. Clusters one and two mainly consists of companies from a single industry. Cluster one predominantly represents the energy sector, while cluster two mainly represents the finance sector (Fig. 1). These two clusters showed the most distinct results.

We found that the EBITDA (Earnings Before Interest, Taxes, Depreciation, and Amortization) margin is affected by ESG data (Fig. 4). But the differences in the effect of ESG data on EBITDA is higher between clusters than within a cluster. In general cluster 2 is influenced positively by a high social score.

In contrast, ESG data has a significant impact on the volatility of company's stock, with the environmental score showing a consistent positive correlation to it (Fig. 5). Except for cluster 1, where only small correlations are observed generally. A strong negative correlation of ESG data to volatility is observed for the Governance Score in cluster 2. Overall, a clear opposing trend of ESG data influencing volatility can be seen (Fig. 6), where the volatility gets lower the higher the ESG scores are.

Interpretation

The growing interest in sustainable investment (Fig. 2) has led to an increase in the use of ESG criteria to evaluate investment opportunities. ESG factors have been identified as critical components of sustainable investment and additionally that they play a role in company's long-term performance. One of the challenges in ESG analysis for investors is to comprehend the distinction between the three ESG pillars, as their definitions can be unclear at time. Although several studies have highlighted the positive relationship between a high ESG rating and the company long-term performance, there has not been enough research on the underlying reasons for this correlation. Especially how those ratings can influence a company's performance.

In our analysis we found that ESG score alone does not appear to impact stock returns, but it has been observed to influence EBITDA margin and volatility. As seen before, ESG data has almost no influence on the energy sector. The modest impact of ESG-related factors on performance may be attributed to Thomson Reuters' scoring methodology, particularly in terms of measuring carbon emissions within a given industry, as previously stated. In addition, a consistent demand of supply of energy could explain the resistance to external pressures of ESG aware investing.

On the other hand, cluster 2, which consists mainly of companies from the finance sector, seems to be highly influenced by the ESG data and the governance pillar of the ESG score. This could be the case because the finance sector is highly dependent on its workforce and therefore has a high sensitivity to changes in the work environment.

Notably, the influence of ESG score on company performance is significantly related to the industry to which the company belongs. Therefore, ESG criteria also aid in the classification of companies. This could simplify the process of sustainable investment for investors but does not guarantee a green investing strategy. It is important to note that the findings are consistent with Efficient Market Theory, by not significantly influencing the stock returns (43). But not with Efficient Frontier Theory, where a decrease in volatility should lead to an increase in stock valuation (44). Further study will be necessary to fully understand these findings.

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Supplementary Materials

Methods

For our analysis multiple ways of data collection and preparation were explored. First, we tried to work with the freely available Yahoo database via its API. Although the data was easily obtained, its quality was subpar. The specificity of the ESG categories was too low and the amount of data not sufficient for reliable analyses. And most importantly the calculation of ESG scores changes.

Then data was obtained from the Thomson Reuters Refinitiv Database via its Python API and selected by following criteria. The Thomson Reuters ESG score, which is measured relatively within each industry. It is justified by the fact that different industries have distinct operating models, risk profiles, and effect on the environment and society. The ESG score reporting scope of the company needed to exceed at least 50% over the past ten years to be considered. This ensures enough ESG data for reliable analysis. Although, after further inspection we found that the collected data was not complete. The loss of data resulted from the fragility of the API. Which does not have any self-checking build in to ensure lossless communication. An alternative is the Refinitiv screener. It basically provides all the same functionality but needs manual work to export the data.

This data was then used to test the Granger causality of the ESG data on financial data. Generally, the Granger Test is limited to long time series to provide significant results (45). Therefore, we had to modify the method to fit our needs. Specifically, instead of long time series, only short ones could be used in this analysis. This is dictated by the type of data, e.g., the relatively new occurrence of ESG scores and their yearly calculation cycle. So, to overcome this limitation a lot of these short time series needed to be combined.

First a vector auto regression was performed on the full dataset (46).

$$X_t = \sum_{\tau}^{L} A_\tau X_{(t-\tau)} + \epsilon_t$$

$with\ L\ as\ the\ number\ of\ lags,\ A\ as\ the\ coefficient$

$matrix\ and\ the\ error\ \epsilon$

On this basis a clustering was performed with the K-Means algorithm (47). This algorithm clusters datapoints regarding their geometric distance to each other. In this case the previously selected companies were clustered.

$$Min\, J \;=\; \sum_{i=1}^{k} \sum_{x \in S_j} \left|\left| x_y - \mu_i \right|\right|^2$$

$$\mu_i \;is\; mean\; of\; set\; S_i \;=\; [S_1, \dots, S_k], x_j = [x_1, \dots, x_n]$$

The number of clusters was chosen to be five. This number of clusters enabled the following methods to be specific enough to see differences in the clusters, while also not being too specific. This is especially reflected by the fact that the two clusters almost exclusively contain companies of one single industry.

To further improve the model, each cluster was then fine-tuned with the gradient descent method (48). This algorithm uses the previously generated VAR model and increases its cosine similarity.

$$\cos ine\; similarity \;=\; \cos(\theta) = \frac{a \cdot b}{||a|| \cdot ||b||}$$

By an iterative approach, of stepping in the direction with the biggest gradient with a step size relative to the gradient itself, a local minimum of the similarity will be found.
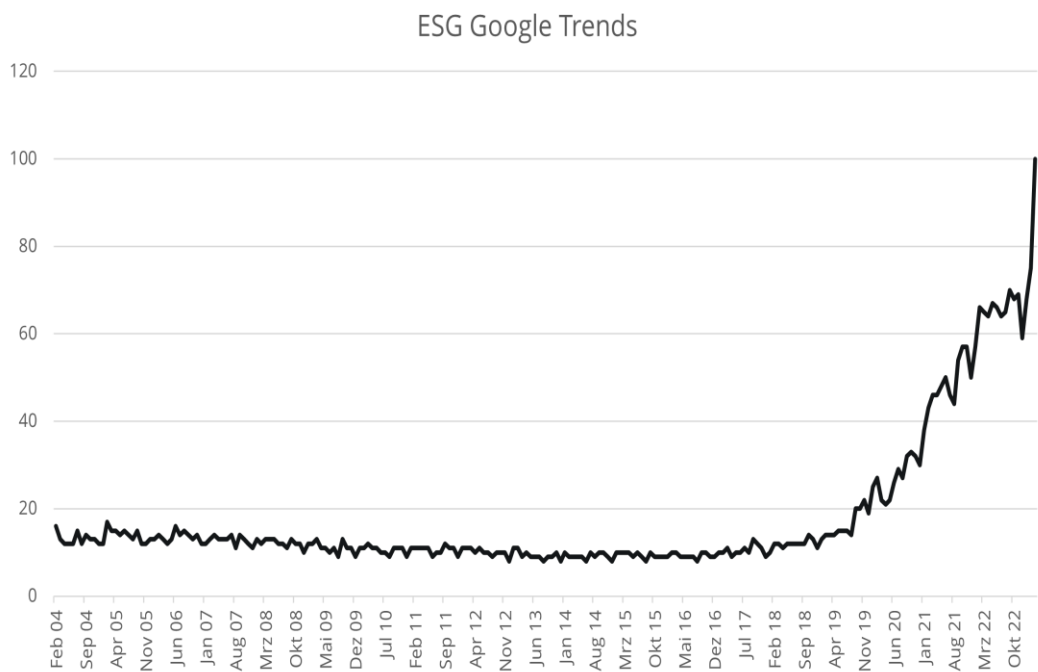
Finally, the F-test then provided us with a significance value of difference between the data without and the data with ESG (49).

$$F = \frac{S_2^2}{S_1^2} = \frac{\dfrac{1}{n_2 - 1}\sum_{i=1}^{n_2}\left(X_{2,i} - \overline{X}_2\right)^2}{\dfrac{1}{n_1 - 1}\sum_{i=1}^{n_1}\left(X_{1,i} - \overline{X}_1\right)^2},$$
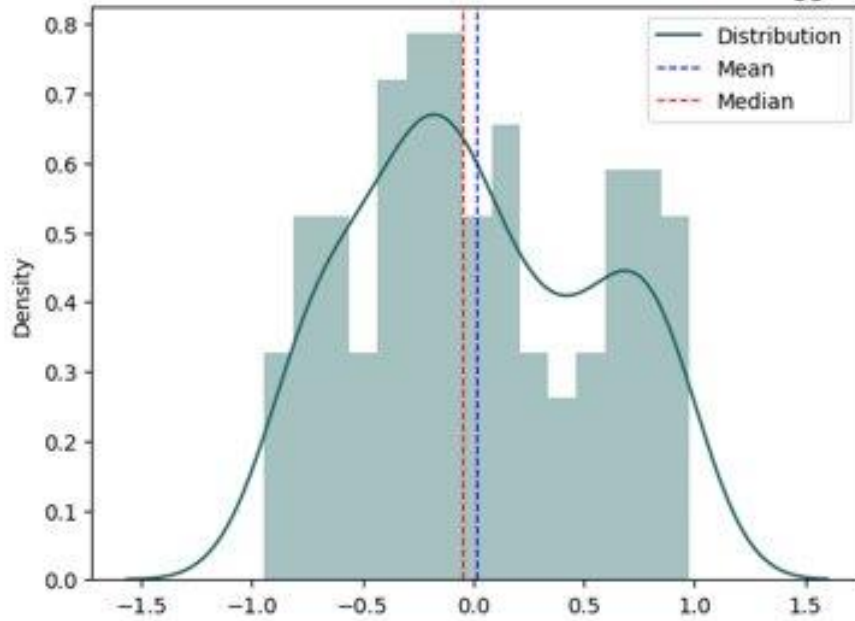
$$significance\; 5\%$$
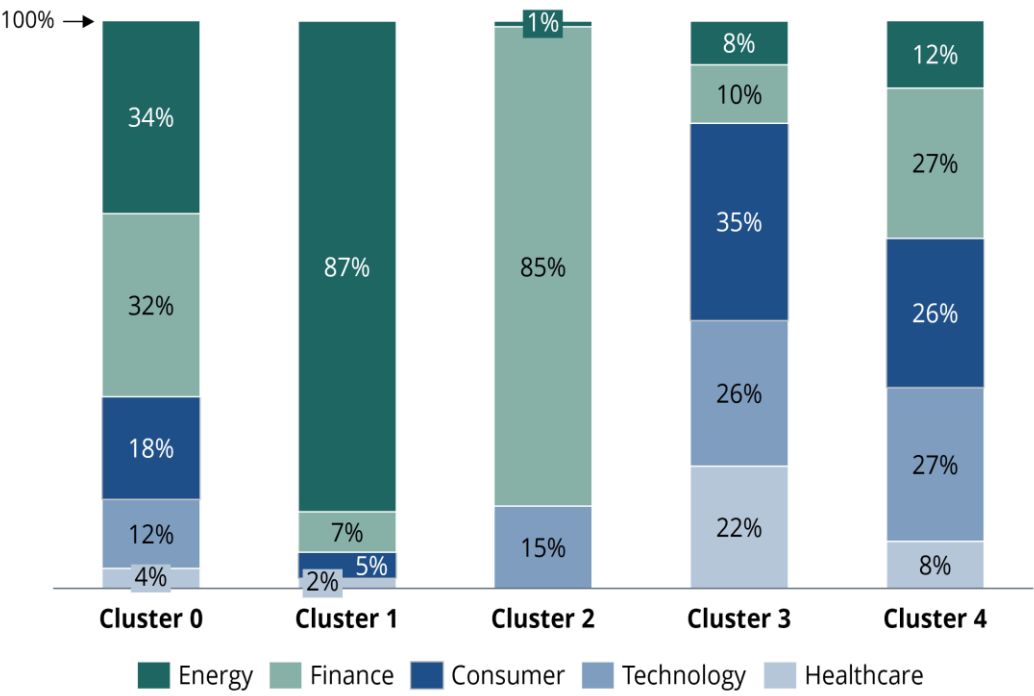
Fig. 1. Distribution of the selected companies in clusters by their respective industry sector (1)

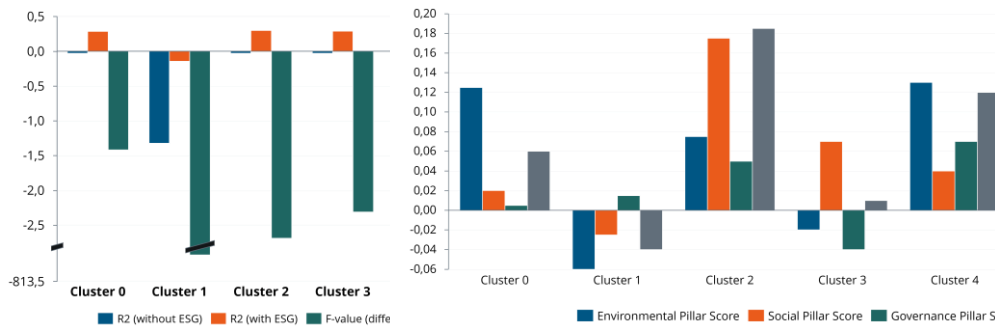**Fig. 2. Google Trend of the search term "ESG" relative to the popularity at the beginning of 2023 (2)**

Distribution of the correlation between the ESG Score and the lagged log return

Fig. 3. Distribution of the correlation between the ESG Score and the lagged logarithmic return of all samples in a density graph (3)

a) Granger testing of ESG data on EBITDA.

b) Correlation of ESG data on EBITDA in clusters by ESG pillar.

Fig. 4. Statistical influence and correlation of ESG on EBITDA for predefined clusters (4)
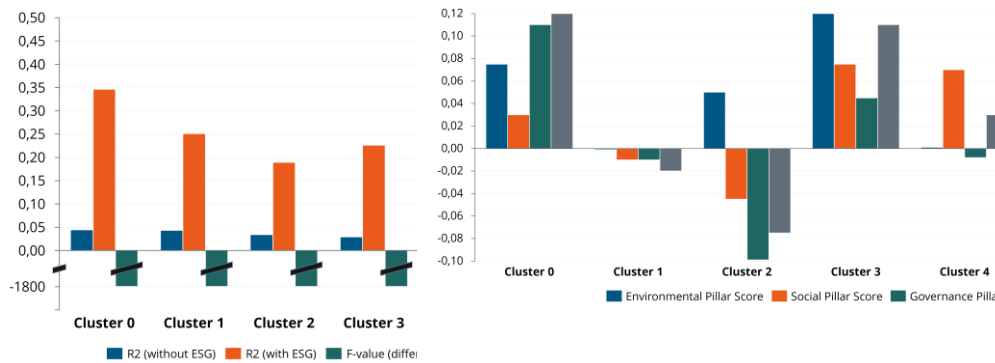
a) Granger testing of ESG data on volatility.

b) Correlation of ESG data on volatility in clusters by ESG pillar.

Fig. 5. Statistical influence and correlation of ESG on volatility for predefined clusters (5)
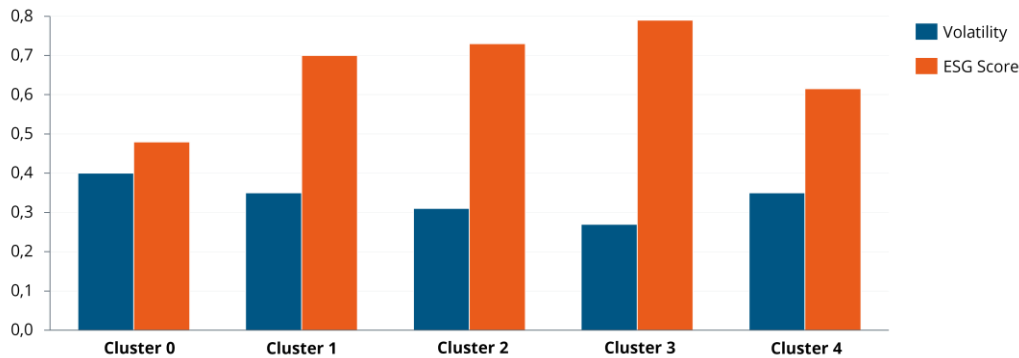
Fig. 6. Volatility of predefined clusters in comparison to their mean ESG scores (6)