THE VALUE OF VALUES

MEASURING THE FINANCIAL IMPACT OF ESG PRACTICES

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The Value of Values: Measuring the Financial Impact of ESG Practices

Abstract:
This study examines the long- and short term relationship between ESG performance and financial performance, focusing on companies in the S&P 500 and S&P 500 ESG indices. Our findings suggest that there is no significant relationship between ESG- and financial performance, neither in the long- nor short term. However, when observing the individual components of ESG, firms with higher E scores perform worse financially, while firms with higher S scores perform better financially, in the long term. Also, firms in the S&P 500 ESG index generally have larger market capitalizations and outperform financially in the short term but not in the long term. Hence, the ESG index superior financial performance in the short term can partly be attributed to larger market capitalization, rather than ESG performance. However, the same cannot be concluded for the long term since larger market capitalization does not necessarily mean better financial performance, as proven by the comparison of the two indices.

Keywords:
ESG, ROA, Financial Performance, S&P 500, Market capitalization, Sustainable investments

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1. Introduction

1.1 Background

The introduction of socially responsible investing (SRI) in the 1970s enabled investors to align their investment portfolios with their moral beliefs. Subsequently, SRI was progressively replaced by a model more like modern corporate social responsibility (CSR). In contrast to SRI, CSR focused more on social issues (Krantz, 2024). The term ESG came into use as late as 2004, when the Global Compact released the article "Who Cares Wins". The report was a collaborative effort by several major companies and global banks to encourage the financial industry to better integrate ESG factors in investment decisions (The Global Compact, 2004). Before, ESG considerations were frequently overlooked in traditional investment strategies. As they began to be integrated, asset managers created ESG-focused strategies and measures to assess how their investment choices might impact society and the environment.

The creation of the S&P 500 ESG Index is a natural next step for ESG investing. The index preserves a historical risk/return profile similar to the S&P 500, while offering better sustainability representation (S&P Global, 2019). S&P DJI ESG evaluates financially significant sustainability signals within certain industries, computed by S&P Global ESG Research, to create an ESG adjusted benchmark. Since its launch in 2019, the S&P500 ESG index has consistently outperformed its broader base index by ~2% annually on average. Further, ESG scores have improved by 7.65% amongst constituents since 2019, enhancing the sustainability profile of the index.

The superior returns of the S&P 500 ESG index is part of the trend in recent years where green stocks have outperformed brown stocks, despite having lower expected returns (Pástor, Stambaurgh and Taylor, 2022). A growing concern for sustainability has meant that stakeholders have put additional pressure on companies to demonstrate strong ESG performance, in order to stay competitive and relevant in the market. This raises the question of whether the abnormal returns from green stocks in recent years are justified by stronger financial performance, or if they are rather a result of a shift in investor preferences.

The relationship between ESG performance and financial performance is a widely studied topic, yet there is no consensus on the actual relationship, because of conflicting findings. However, based on an analysis that summarized the results of over 2000 studies that have been released on the topic since 1970, it was found that there is a positive relationship between ESG performance and financial performance, and that this relationship is stable over time (Friede, Busch and Bassen, 2015).

1.2 Research question

Our analysis further explores the relationship between ESG performance and financial performance by investigating the link in a developed market, using the S&P 500 as the basis for our comparison. By comparing the financial performance of companies included in the S&P 500 index with those selected into the ESG index, we seek to answer the question of whether higher ESG index returns are backed up by stronger financial performance. Also, we inspect how the individual

components; E, S and G, relate to financial performance. Lastly, we investigate whether a company's market capitalization could be moderating the effect between ESG performance and financial performance. More specifically, this study aims to answer the following question:

How does a firm's ESG performance relate to its financial performance?

1.3 Contribution

Although many similar studies have analyzed the relationship between ESG- and financial performance in developed markets, primarily in the US, our analysis focuses on comparing the S&P 500 index to the newly launched S&P 500 ESG index. Thus, we aim to capture the relationship between ESG- and financial performance among the 500 largest companies traded on the New York Stock Exchange. As the demand for sustainable investments is continuously increasing, it becomes necessary to analyze whether the relationship between ESG- and financial performance changes based on new market characteristics. Furthermore, we explore the impact company size may have on the relationship between ESG score and financial performance. Also, we chose to include two different time horizons to explore whether ESG investments have different implications for financial performance in the short- and long term.

2. Related literature

2.1 Literature review

The study "Dissecting Green Returns" by Pástor, Stamburgh, and Taylor explores the financial performance of green versus brown stocks and investigates the reasons behind the higher realized returns of green stocks. The study suggests that higher returns for green stocks are not necessarily driven by superior company performance in traditional financial terms. Instead, the returns are largely attributed to external factors such as changes in investor preferences and regulatory environments favoring green investments. When adjusting realized returns by removing shocks attributed to climate concerns and earnings surprises, the study concludes that the expected returns for green stocks are lower than those for brown stocks. This indicates that while green stocks may currently enjoy higher market valuations and investor interest, this might not be sustained by underlying financial performance (Pástor et al. 2022).

Similarly, Gantchev, Gianetti and Li examined the impact of ESG scores on mutual fund flows and stock returns. The researchers found that the introduction of Morningstar's sustainability ratings led mutual funds to increase their investments in stocks with high sustainability ratings, driven by expectations that higher ESG scores would attract more flows due to growing interest in SRI . This strategy initially led to a trade-off between sustainability and performance. The increased demand for high-ESG stocks created buying pressure, which in turn made these stocks overvalued, leading to underperformance compared to less sustainable stocks (Gantchev et. al, 2024).

Duque-Grisales and Aguilera-Caracuel draw a similar conclusion since they find a negative relationship between high ESG scores and financial performance for multilatinas, suggesting that ESG investments may initially pose financial strains on companies. This relationship between ESG scores and financial performance, proxied by ROA, is moderated by factors like financial slack and geographic international diversification. Hence, broader resource availability and market reach can enhance the capacity of companies to leverage ESG investments more effectively for financial returns (Duque-Grisales and Aguilera-Caracuel, 2018). While the study contributes to important insight into the relationship between ESG scores and financial performance for companies in an emerging market, the same conclusions are not automatically applicable for companies in a developed market, which are subject to other characteristics. The nuance of access to capital impacting a firm's possibility to increase their ESG scores is to be investigated in our study by considering whether a firm's market cap may elevate the chance for index inclusion into the S&P 500 ESG index.

In summary, previous literature acknowledges that abnormal returns of green stocks are likely driven by an increase in demand for sustainable investments, rather than superior financial performance. Also, when adjusting for these demand shocks, the expected returns from green stocks are lower than for brown stocks. Building upon the study by Pastor et.al, our study further examines whether superior performance of ESG focused firms is justified by underlying financial performance in a longer time-horizon of 10 years. To account for the effect of shocks mentioned by the authors, Covid-19 years 2020-2021 are excluded from the analysis. We add to this literature by using a more recent sample of ESG data in a current time horizon. Furthermore, by building out a

hypothetical index back to 2011, we strive to minimize investor preferences being attracted to stocks included in the ESG index.

2.2 Theoretical Framework

The S&P 500 is a stock market index covering 500 leading companies, listed on NYSE and Nasdaq. The index includes companies from the 11 GICS sectors, selected on market capitalization, liquidity, and tradability. As of December 2022, the S&P 500 represents 49% of the global equity market capitalization, and 80% of the U.S. equity market capitalization. In 2019, the S&P 500 ESG index was launched and includes companies that demonstrate strong ESG performance relative to their industry peers (S&P Global, 2023).

The methodology of the S&P 500 ESG Index incorporates ESG criteria into its constituent selection process, aiming to replicate the risk and return profile of the traditional S&P 500 (S&P Global, 2019). Initially, all constituents of the S&P 500 are assessed using ESG scores from the Corporate Sustainability Assessment (CSA), which evaluates companies on industry-specific ESG factors. Companies involved in tobacco, controversial weapons, or other business noncompliant with the UN Global Compact (UNGC) are excluded. The index includes 75% of the market capitalization in each S&P 500 GICS industry group. Firms falling within the lowest quartile of S&P DJI ESG Scores within their industry groups are excluded. The index is rebalanced annually to only include companies upfilling the criteria each year. Even though it targets 75% of the capitalization of S&P 500 this is not mandatory, meaning that if enough companies do not classify as eligible, the index will have fewer constituents that year.

S&P DJI ESG Scores are primarily derived from CSA, which evaluates companies annually across various industry-specific sustainability criteria. Each industry has a set of tailored ESG factors that are weighted differently to reflect their relative importance within that industry. The scores aim to provide a comprehensive view of a company's sustainability practices and their effectiveness in managing associated ESG risks and opportunities.

LSEG ESG scores, managed by Refinitiv, incorporate over 450 metrics that capture a wide range of ESG practices and outcomes (LSEG, 2023). These scores are designed to reflect a company's relative performance, capacity, and effectiveness across different ESG aspects, normalized for industry and company size. The scores also consider the impact of ESG controversies derived from news and social media, providing a dynamic component that captures recent ESG-related events affecting the companies.

S&P DJI and LSEG ESG scores both incorporate industry-specific factors for ESG issues, but differ in data sources and score calculation methods. S&P DJI relies on surveys and direct company interactions via CSA, while LSEG uses public data adjusted for industry and size biases, including news and social media impact. LSEG and S&P DJI share similar methodologies, but differences arise in how they weight materiality issues within industry groups, potentially resulting in varied scores. LSEG adjusts scores based on materiality, while S&P DJI reassigns weights to other questions to avoid penalizing companies for missing data points.

3. Hypothesis

Investors tend to view highly ranked ESG stocks or portfolios as long term investments. A higher ESG score is often associated with large up-front investments, where increased financial returns will be lagging. In the long term, companies that incorporate ESG practices can "...avoid controversies and improve their reputations, better retain customers and employees, and maintain the trust of shareholders during periods of uncertainty and transition."(Boffo and Patalano, 2020). These are characteristics linked to superior financial performance, expected to become visible over the long-term once initial investments have been recovered. Thus, we introduce the following hypotheses:

Long term
H1: ESG score is positively associated with financial performance in the long term.

H1a: E score is positively related to financial performance in the long term.

H1b: S score is positively related to financial performance in the long term.

H1c: G score is positively related to financial performance in the long term.

Short term
H2: ESG score is negatively associated with financial performance in the short term.

H2a: E score is negatively related to financial performance in the short term.

H2b: S score is negatively related to financial performance in the short term.

H2c: G score is negatively related to financial performance in the short term.

4. Methodology

4.1 Data

The data used for this study was collected from the Refinitiv Eikon database. The first part of our data collection was to establish the yearly constituents of the S&P 500 and S&P 500 ESG indices. As we downloaded the data from the Refinitiv Eikon database in February 2024, the database only listed the companies that were included in the S&P 500 index, and S&P 500 ESG index, as of year-end 2023. This meant that we had to backtrack companies that have been added and removed each year from the S&P 500 index, from year-end 2011 to year-end 2023, and from the S&P 500 ESG index from year 2019 to 2023, to arrive at the yearly indices. The starting point for the panel data set was a full list of all companies currently included in the S&P 500 as well as all companies that have been added or removed since 2010. Historical constituents for the S&P 500 were taken from Refinitiv Eikon on quarterly basis, yet we consolidated the revisions into annual to better fit with revisions to the S&P 500 ESG that is revised once a year.

When backtracking the indices, two significant issues arose. Firstly, the Eikon output only includes companies with active tickers, i.e. currently listed within their current ownership structure. This is problematic for re-creating the index back to 2011, mainly because previously stand-alone companies have been acquired by, or merged with another constituent of the S&P 500. Also, companies that have changed names, gone private or bankrupt have led to their historical tickers expiring and thus not being included in the Eikon output. To account for these differences, companies mentioned in annual revisions to the S&P 500 but not included in the Eikon output were added to the data set to make the numbers of constituents correct. Secondly, when backtracking the ESG index, we used S&P 500's rebalancing reports as our basis. However, we discovered several inconsistencies in these reports. For example, some companies stated to be excluded from the initial 2019 index were reported to be removed in later years, even though not being added to the index in any year in between. Companies with this issue totaled to 20. Furthermore, 36 companies were included in the initial index given that the S&P reports did not state them to be excluded, but later added to the index even though not being removed in any year in between. In total, 56 companies were cleaned from our data set given the uncertainty of their inclusion, as it would not provide a reliable basis for subsequent analysis.

When having established the yearly S&P 500 constituents from 2011 to 2023, and the S&P 500 ESG constituents for 2019 to 2023, we collected company specific data. We retrieved data points for ROA, ESG score, environmental pillar score, social pillar score, governance pillar score, market capitalization, and GICS industry groups. The data cleaning process was done on a yearly basis since the availability of companies' financials changed over time. In practice, this means that a company could be excluded from the data set in one year due to missing data, while included in another year when data for that company was available. The major revision to the data is the tickers for missing companies from the Eikon output. These companies were removed since many financials were unavailable for the full period 2011-2023.

4.2 Predicting the S&P 500 ESG index inclusion for years 2011 to 2018

Since the ESG index was launched in 2019, we needed to predict the constituents of the S&P 500 ESG index from the year 2011 to 2018 to be able to make a long term comparison. The analysis was performed using a binary logistic regression. The dependent variable that we wanted to predict was S&P 500 ESG index inclusion. Since data for ESG index inclusion was available from the year 2019 to 2023, we used this data to train our model.

When selecting the independent variables to include in the training model, we used the ESG index selection criteria as our basis and concluded that relevant variables included: S&P 500 inclusion, ESG score, E score, S score, G score, and industry group weighted market cap. Since the S&P 500 index is weighted based on market cap, each industry group does not contribute equal weights to the index. For comparability when looking at the index, we rebased market caps within each GICS industry group as percentages of the total market cap within that group. This normalized the relative market caps so that the S&P ESG selection criteria would work across the full index and not only when looking at each industry group individually.

Firstly, we tested a model where all variables were included as independent variables. This model resulted in only S&P 500 inclusion, ESG-score, and S-score being significant at the 10% significance level (Appendix 1). To arrive at a final logistic regression model, we created five reduced models and compared them to the original complete model. To create the first reduced model, we removed the independent variables that were insignificant at the 10% significance level in the original regression (Appendix 2). In addition to the first reduced model, we created three additional reduced models by using the original model as our base and subsequently removing the insignificant variables one by one (Appendices 4, 6, 8). For our fifth reduced model, we tested the interaction effect between S&P 500 inclusion and ESG score (Appendix 10).

Model 0:

$$\text{logit}(P(\text{ESG inclusion}=1)) = \beta 0 + \beta 1 \times \text{S\&P 500 inclusion} + \beta 2 \times \text{E-score} + \beta 3 \times \text{S-score} + \beta 4 \times \text{G-score} + \beta 5 \times \text{ESG score} + \beta 6 \times \text{Weighted Market Capitalization}$$

Model reduced 1:

$$\text{logit}(P(\text{ESG inclusion}=1)) = \beta 0 + \beta 1 \times \text{S\&P 500 inclusion} + \beta 2 \times \text{S-score} + \beta 3 \times \text{ESG-score}$$

Model reduced 2:

$$\text{logit}(P(\text{ESG inclusion}=1)) = \beta 0 + \beta 1 \times \text{S\&P 500 inclusion} + \beta 2 \times \text{E-score} + \beta 3 \times \text{S-score} + \beta 4 \times \text{G-score} + \beta 5 \times \text{ESG score}$$

Model reduced 3:

$$\text{logit}(P(\text{ESG inclusion}=1)) = \beta 0 + \beta 1 \times \text{S\&P 500 inclusion} + \beta 2 \times \text{S-score} + \beta 3 \times \text{G-score} + \beta 4 \times \text{ESG score} + \beta 5 \times \text{Weighted Market Capitalization}$$

Model reduced 4:

$$\text{logit}(P(\text{ESG inclusion}=1)) = \beta 0 + \beta 1 \times \text{S\&P 500 inclusion} + \beta 2 \times \text{E-score} + \beta 3 \times \text{S-score} + \beta 4 \times \text{ESG score} + \beta 5 \times \text{Weighted Market Capitalization}$$

Model reduced 5:

$$\text{logit}(P(\text{ESG inclusion}=1)) = \beta 0 + \beta 1 \times \text{S\&P 500 inclusion} \times \beta 2 \times \text{ESG-score} + \beta 3 \times \text{S-score}$$

To identify which model is the best at predicting the dependent variable, we compared each reduced model to the original complete model by running five anova tests. The anova test assumes the null hypothesis that the two models are equivalently good at predicting the dependent variable. By using the reduced models in the first argument and the original model in the second argument, we tested whether the original model is better at predicting inclusion in the S&P 500 ESG index or not. If the anova test indicates significance for our original model at the 5% significance level, we can reject the null hypothesis and conclude that the original model is better at predicting the dependent variable than the reduced model. The results showed that all five tests came out as insignificant at the 5% significance level, meaning that for all the tests, we cannot reject the null hypothesis that the reduced models are equivalently good at predicting the dependent variable as the original model (Appendices 3, 5, 7, 9, 11) .

To continue our analysis for model selection, we measured each models' AIC and BIC , where a lower AIC and BIC score indicates stronger explanatory power. Model reduced 2 has the lowest AIC score, while Model reduced 1 has the lowest BIC score (Appendix 12). Proceeding, we decided to continue our analysis by comparing only Model reduced 1 and Model reduced 2.

In subsequent steps, we analyzed the quality of the two models by measuring accuracy, sensitivity, specificity, and precision, by predicting the models on our training data. This resulted in Model reduced 1 being superior to Model reduced 2 in all dimensions specified above (Appendices 13-16). More specifically, with the Model reduced 1, we arrived at an accuracy level of 71,6%. With the model having the worst score (51%) for specificity and the best score (86%) for sensitivity. This means that our model is better at predicting companies as included in the ESG index, when they were included in the real data, and worse at predicting companies as excluded from the ESG index, when they were excluded in the real data. We made attempts to increase specificity by increasing the cut-off value that was originally set to 0,5. A cut-off value of 0,5 means that all predictions that are 0,5 or above, will be classified as included in the ESG index, while predictions below 0,5 will be classified as excluded from the index. By increasing the cut-off value, the specificity level increased, however at the expense of the accuracy level decreasing. Thus, we decided to stick with 0,5 as the cut-off value, to not worsen the overall quality of the predictions.

Finally, before selecting Model reduced 1 as our final model, we tested the independent variables' multicollinearity by testing the Variance Inflation Factor on S&P 500 inclusion, S-score, and ESG score. The results from our test indicated that the independent variables in our model lay in the bound 1 to 5, thus, no corrective measures need to be taken and we can select Model reduced 1 as our final model to predict S&P 500 ESG inclusion for the years 2011 to 2018 (Appendix 17).

4.3 Comparing the S&P 500 to the S&P 500 ESG index

To begin our main analysis, we used our final binomial logistic regression model to predict S&P 500 ESG index inclusion for the years 2011 to 2018. When having finalized the predictions, we could divide the data into an S&P 500 index and an S&P 500 ESG index, where the S&P 500 index and S&P 500 ESG index were mutually exclusive. Thus, the S&P 500 index in our analysis does not refer to the real S&P 500 index since the real S&P 500 index is not mutually exclusive from the S&P 500 ESG index. To avoid confusion, we will henceforth refer to our predicted S&P 500 index as the S&P 500 index, and the actual S&P 500 index as the real S&P 500 index. Furthermore, we divided the data into long-term and short-term, and excluded the Covid-19 years 2020 and 2021, as these years are not representative of normal economic circumstances. Our long-term period includes the years 2011-2019 and 2022-2023, while our short-term period includes the years 2019, 2022, and 2023.

Dependent variable

The dependent variable is financial performance. To estimate financial performance, we will use return on assets (ROA) as a proxy. ROA is defined as net income divided by total assets and measures how efficient a company is at generating profits from its assets. Because ROA is a scale-independent metric, it has the advantage of facilitating comparisons between businesses of different sizes.

Independent variables

Our independent variables for measuring ESG performance are ESG score, E score, S score, G score. A company's ESG score is a measure of its relative ESG performance. ESG score is the weighted sum of the environmental-, social-, and governance pillar scores. While the G score is assigned the same weight across industries, the relative importance of E and S score differ between industries, meaning that the formula for calculating a company's ESG score is dependent on its industry inclusion. The environmental score reflects how a company uses its resources, and is based on information, such as CO2 emissions, water-, and energy usage. The social score instead demonstrates how successful a company is at handling social issues, such as, human rights, responsible marketing, health and safety, and diversity and inclusion. In contrast, the governance score reflects the company's overall compliance to regulations and is more focused on managerial issues, including compensation, shareholder rights, and reporting transparency (Refinitiv, 2022).

Our last independent variable is market capitalization. Market capitalization is defined as the current market price per share multiplied by the total number of shares outstanding, which is commonly used as a proxy for company size. The product reflects the market value of a company's shares outstanding in absolute terms. In our analysis we use absolute numbers for market capitalization to compare size differences between the indices. However, we also transform market capitalization to logarithmic scale to facilitate comparison with ESG score that ranges from 0 to 100, and ROA which is measured in percentage.

Regressions

Firstly, we wanted to test whether there exists a significant relationship between companies' ESG scores and their ROA. We thus began to look at if there was a difference between the size of ROA in the S&P 500 index and the S&P 500 ESG index, by calculating the mean, median, standard deviation, minimum value, and maximum value, for the two indices. Then, we tested a linear regression with the real S&P 500's ESG scores as our independent variable, and its ROA as the dependent variable. By using the real S&P 500 index, we include all companies in our datasets into one regression, to be able to make a general conclusion about how companies' ESG scores relate to their ROA.

$$ROA = \beta 0 + \beta 1 \times \text{ESG Score} + \varepsilon$$

To see if there are differences in how particular components of a company's ESG score relates to ROA, we also tested linear regressions against ROA for E-, S, and G scores separately.

$$ROA = \beta 0 + \beta 1 \times \text{E Score} + \varepsilon$$
$$ROA = \beta 0 + \beta 1 \times \text{S Score} + \varepsilon$$
$$ROA = \beta 0 + \beta 1 \times \text{G Score} + \varepsilon$$

Secondly, we wanted to test whether a company's market capitalization relates to its ESG score, and if market capitalization is significantly related to ROA. We began by comparing the size of market capitalization between the S&P 500 and the S&P 500 ESG index, by calculating the mean, median, standard deviation, minimum value, and maximum value. Thereafter, we tested two linear regressions, with market capitalization as the independent variable in both regressions, ROA as the dependent variable in the first regression, and ESG score as the dependent variable in the second regression.

$$ROA = \beta 0 + \beta 1 \times \text{Market Cap} + \varepsilon$$
$$\text{ESG score} = \beta 0 + \beta 1 \times \text{Market Cap} + \varepsilon$$

Thirdly, by reviewing the results from the interaction between the ESG components and ROA, we wanted to test whether market capitalization has a moderating effect on the relationship between the components and ROA, or not.

$$ROA = \beta 0 + \beta 1 \times \text{E score} + \beta 2 \times \text{Market Cap} + \beta 3 \times (\text{E score} \times \text{Market Cap}) + \varepsilon$$
$$ROA = \beta 0 + \beta 1 \times \text{S score} + \beta 2 \times \text{Market Cap} + \beta 3 \times (\text{S score} \times \text{Market Cap}) + \varepsilon$$

5. Results

Table 1: Summary statistics of ROA, long term

ROA	Long Term	
Measure	SP500	ESG Index
1st Quartile	0.0331	0.0332
Median	0.0705	0.0668
3rd Quartile	0.0793	0.0787
Mean	0.0793	0.0787
Standard Deviation	0.0809	0.1117
Minimum	-0.4042	-5.0200
Maximum	0.5174	0.7625

The table shows summary statistics for ROA of companies in the S&P 500 index and S&P 500 ESG index, measured in the long term (2011-2019, 2022-2023). ROA is obtained directly from Refinitiv Eikon.

Table 2: Summary statistics of ROA, short term

ROA	Short Term	
Measure	SP500	ESG Index
1st Quartile	0.0338	0.0353
Median	0.0697	0.0721
3rd Quartile	0.0782	0.0871
Mean	0.0782	0.0871
Standard Deviation	0.0857	0.0734
Minimum	-0.4029	-0.2147
Maximum	0.5125	0.7625

The table shows summary statistics for ROA of companies in the S&P 500 index and S&P 500 ESG index, measured in the short term (2019, 2022-2023). ROA is obtained directly from Refinitiv Eikon.

From table 1 and 2, we can see that companies in the S&P 500 index have higher ROA in the long term, but the companies in the ESG index have higher ROA in the short term.

Table 3: Long term relationship between ESG score and ROA

	Long term			
	Estimate	Std. Error	t-value	p-value
Intercept	0.075443	0.004930	15.301613	0.000000
ESG Score	0.000060	0.000082	0.730049	0.465397

The table reports estimate, standard error, t-value and p-value for the linear regression between the independent variable ESG score and the dependent variable ROA in the long term. The sample includes companies included in the real S&P 500 for the years 2011-2019, 2022-2023. ESG score and ROA are obtained directly from Refinitiv Eikon.

Table 4: Short term relationship between ESG score and ROA

	Short term			
	Estimate	Std. Error	t-value	p-value
Intercept	0.0820305	0.0084888	9.6633265	0.0000000
ESG Score	0.0000219	0.0001297	0.1689426	0.8658645

The table reports estimate, standard error, t-value and p-value for the linear regression between the independent variable ESG score and the dependent variable ROA in the short term. The sample includes companies included in the real S&P 500 for the years 2019, 2022-2023. ESG score and ROA are obtained directly from Refinitiv Eikon.

Table 3 and 4 indicate that, at the 5% significance level, there is an insignificant relationship between ESG score and ROA, both in the long term and in the short term. Hence, we fail to reject the null hypotheses that there is no relationship between a company's ESG score and ROA in the long term and in the short term.

Table 5: Relationship between E score and ROA, long term

	Long term			
	Estimate	Std. Error	t-value	p-value
Intercept	0.085214	0.003239	26.309605	0.000000
E score	-0.000124	0.000056	-2.211336	0.027061

The table reports estimate, standard error, t-value and p-value for the linear regression between the independent variable E score and the dependent variable ROA in the long term. The sample includes companies included in the real S&P 500 for the years 2011-2019, 2022-2023. E score and ROA are obtained directly from Refinitiv Eikon.

Table 6: Relationship between E score and ROA, short term

Short term				
	Estimate	Std. Error	t-value	p-value
Intercept	0.089948	0.005237	17.176565	0.000000
E score	-0.000113	0.000083	-1.351606	0.176705

The table reports estimate, standard error, t-value and p-value for the linear regression between the independent variable E score and the dependent variable ROA in the short term. The sample includes companies included in the real S&P 500 for the years 2019, 2022-2023. E score and ROA are obtained directly from Refinitiv Eikon.

From table 5, at the 5% significance level, we observe a negative and significant relationship between a company's environmental score and its financial performance. Hence we can reject the null hypothesis that there is no relationship between E score and ROA in the long term. However, when observing the results for the short term in table 6, the relationship is insignificant, meaning that we cannot reject the null hypothesis in the short term.

Table 7: Relationship between S score and ROA, long term

Long term				
	Estimate	Std. Error	t-value	p-value
Intercept	0.066516	0.004641	14.333575	0.000000
S score	0.000209	0.000074	2.813992	0.004914

The table reports estimate, standard error, t-value and p-value for the linear regression between the independent variable S score and the dependent variable ROA in the long term. The sample includes companies included in the real S&P 500 for the years 2011-2019, 2022-2023. S score and ROA are obtained directly from Refinitiv Eikon.

Table 8: Relationship between S score and ROA, short term

	Short term			
	Estimate	Std. Error	t-value	p-value
Intercept	0.071866	0.007764	9.255743	0.000000
S score	0.000175	0.000113	1.542086	0.123263

The table reports estimate, standard error, t-value and p-value for the linear regression between the independent variable S score and the dependent variable ROA in the short term. The sample includes companies included in the real S&P 500 for the years 2019, 2022-2023. S score and ROA are obtained directly from Refinitiv Eikon.

From table 7 and 8, at the 5% significance level, we can infer that the relationship between a company's social score is positive and significant in the long term, but insignificant in the short term. Hence we can reject the null hypothesis that there is no relationship between a company's S score and ROA in the long term, while we fail to reject the null hypothesis for the short term.

Table 9: Relationship between G score and ROA, long term

	Long term			
	Estimate	Std. Error	t-value	p-value
Intercept	0.081724	0.004543	17.988614	0.000000
G score	-0.000048	0.000072	-0.665661	0.505661

The table reports estimate, standard error, t-value and p-value for the linear regression between the independent variable G score and the dependent variable ROA in the long term. The sample includes companies included in the real S&P 500 for the years 2011-2019, 2022-2023. G score and ROA are obtained directly from Refinitiv Eikon.

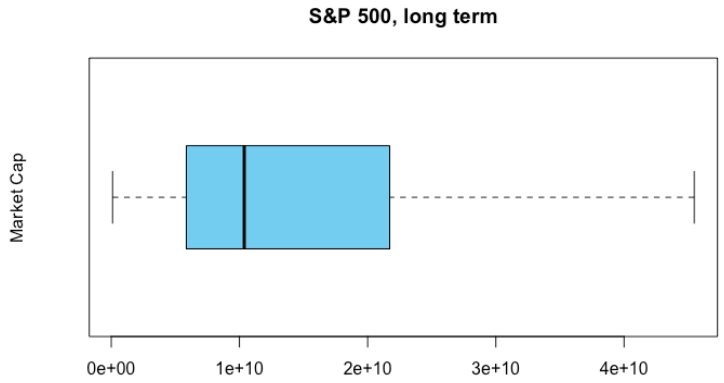
Table 10: Relationship between G score and ROA, short term

	Short term			
	Estimate	Std. Error	t-value	p-value
Intercept	0.080549	0.007053	11.420215	0.000000
G score	0.000045	0.000106	0.425512	0.670524

The table reports estimate, standard error, t-value and p-value for the linear regression between the independent variable G score and the dependent variable ROA in the short term. The sample includes companies included in the real S&P 500 for the years 2019, 2022-2023. G score and ROA are obtained directly from Refinitiv Eikon.

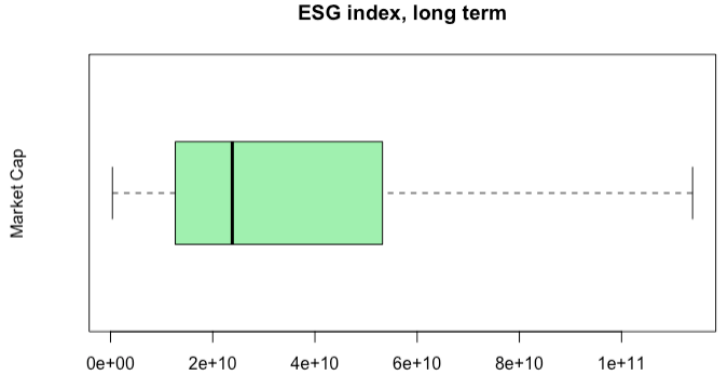
Table 9 and 10, tell us that, at the 5% significance level, the relationship between a company's governance score and its financial performance is insignificant in both the long- and short term. Hence, we fail to reject the null hypotheses that there is no relationship between a company's G score and its ROA, neither in the long term nor the short term. By reviewing each component of the ESG score, and their relation to financial performance, it becomes easier to understand why our regressions for measuring ESG score against ROA came out insignificant. While having a higher environmental score is associated with lower financial performance in the long term, a higher social score is associated with higher financial performance in the long term. And as for the governance score, we cannot infer whether a higher score is associated with lower or higher financial performance in the long term. In the short term, none of our regressions can give an answer to how each component is related to ROA. By having established an insignificant relationship between a company's ESG score and its ROA, we move to the second part of our analysis where we investigate the impact of market capitalization on financial- and ESG performance.

Figure 11: Market capitalization, S&P 500 index, long term



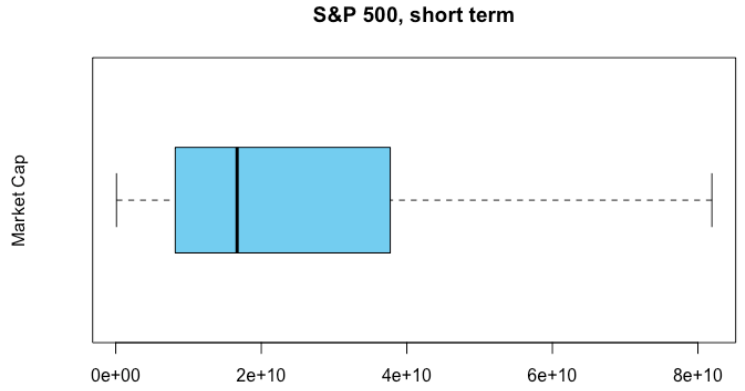
The figure shows a boxplot of companies in the S&P 500's market capitalization in the long term. The sample includes companies included in the S&P 500 for the years 2011-2019, 2022-2023. Market capitalization is measured in absolute values (USD) and obtained directly from Refinitiv Eikon.

Figure 12: Market capitalization, ESG index, long term



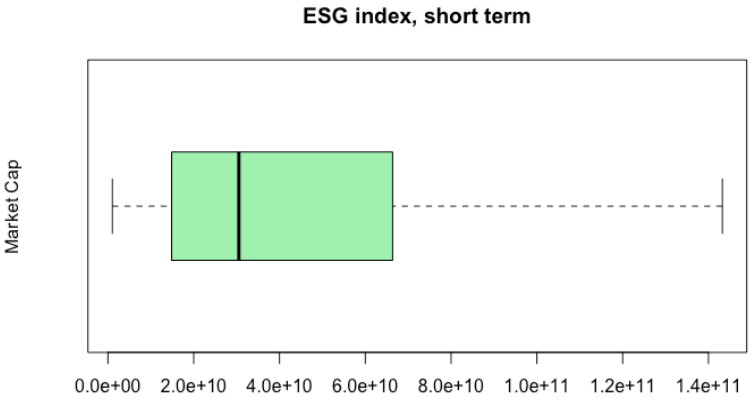
The figure shows a boxplot of companies in the ESG index's market capitalization in the long term. The sample includes companies included in the ESG index for the years 2011-2019, 2022-2023. Market capitalization is measured in absolute values (USD) and obtained directly from Refinitiv Eikon.

Figure 13: Market capitalization, S&P 500 index, short term



The figure shows a boxplot of companies in the S&P 500's market capitalization in the short term. The sample includes companies included in the S&P 500 for the years 2019, 2022-2023. Market capitalization is measured in absolute values (USD) and obtained directly from Refinitiv Eikon.

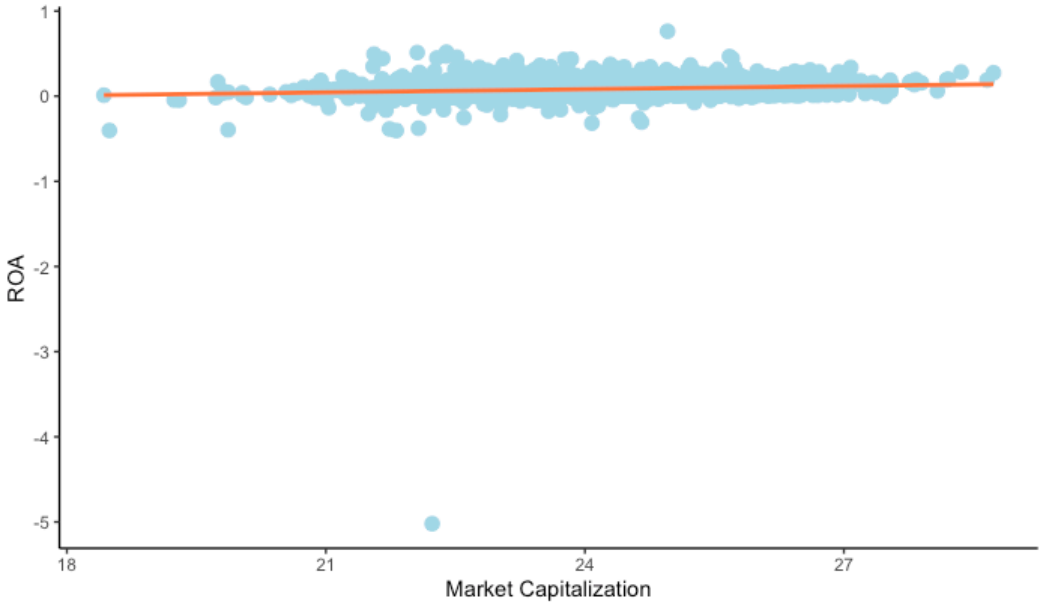
Figure 14: Market capitalization, ESG index, short term



The figure shows a boxplot of companies in the ESG index's market capitalization in the short term. The sample includes companies included in the ESG index for the years 2019, 2022-2023. Market capitalization is measured in absolute values (USD) and obtained directly from Refinitiv Eikon.

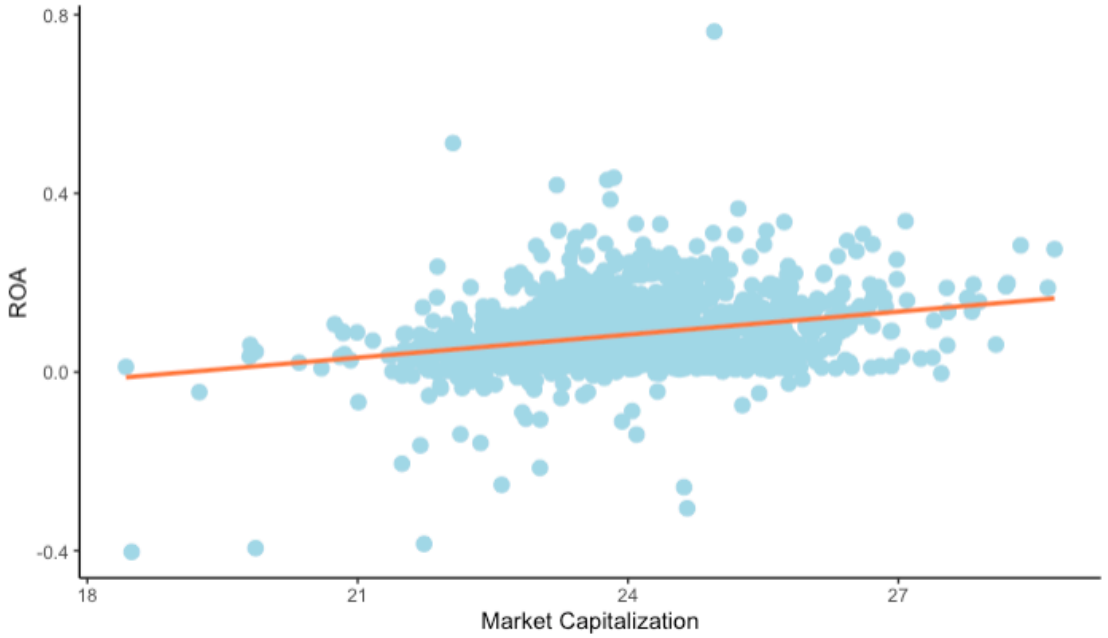
By comparing figures 11 to 12, and 13 to 14, we can clearly see that the companies of the ESG index have significantly higher market capitalization than the companies of the S&P 500, both in the long term and short term (Appendices 18-19).

Graph 15: Relationship between market capitalization and ROA, long term



The graph plots the linear regression between the independent variable market capitalization and the dependent variable ROA in the long term. The sample includes companies included in the real S&P 500 index for the years 2011-2019, 2022-2023. Market capitalization is obtained in absolute values (USD) from Refinitiv Eikon, and then scaled to logarithmic values in R studio, using the log() function. ROA is obtained directly from Refinitiv Eikon.

Graph 16: Relationship between market market capitalization and ROA, short term



The graph plots the linear regression between the independent variable market capitalization and the dependent variable ROA in the short term. The sample includes companies included in the real S&P 500 index for the years 2019, 2022-2023. Market capitalization is obtained in absolute values (USD) from Refinitiv Eikon, and then scaled to logarithmic values in R studio, using the log() function. ROA is obtained directly from Refinitiv Eikon.

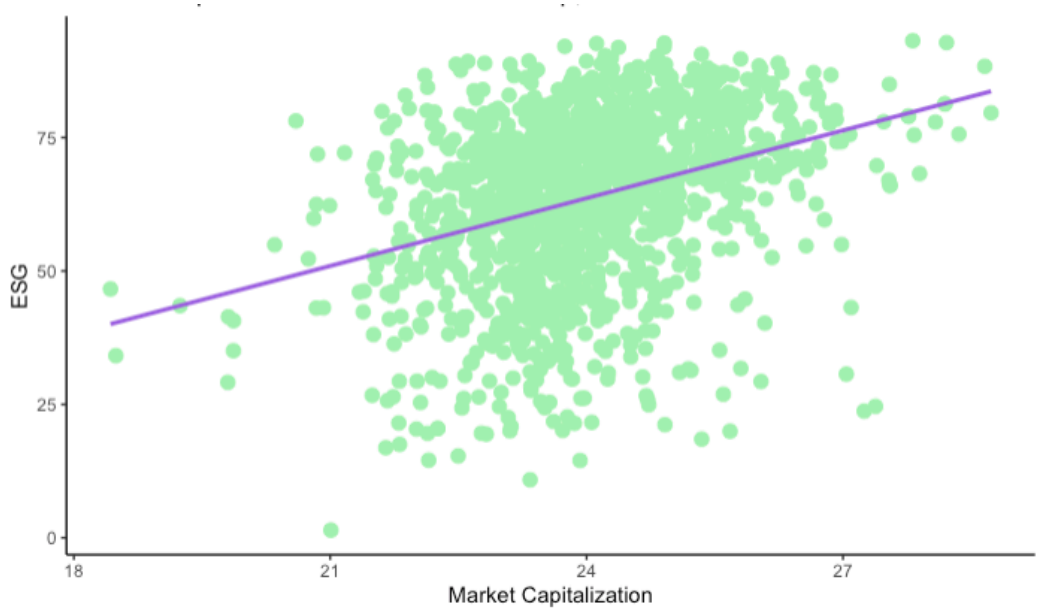
Furthermore from graph 15 and 16, we can infer that market capitalization is positively and significantly associated with financial performance, both in the long term and short term.

Graph 17: Relationship between market capitalization and ESG score, long term



The graph plots the linear regression between the independent variable market capitalization and the dependent variable ESG score in the long term. The sample includes companies included in the real S&P 500 index for the years 2011-2019, 2022-2023. Market capitalization is obtained in absolute values (USD) from Refinitiv Eikon, and then scaled to logarithmic values in R studio, using the log() function. ESG scores are obtained directly from Refinitiv Eikon.

Graph 18: Relationship between market capitalization and ESG score, short term



The graph plots the linear regression between the independent variable market capitalization and the dependent variable ESG score in the short term. The sample includes companies included in the real S&P 500 index for the years 2019, 2022-2023. Market capitalization is obtained in absolute values (USD) from Refinitiv Eikon, and then scaled to logarithmic values in R studio, using the log() function. ESG scores are obtained directly from Refinitiv Eikon.

Preceding, since the only significant relationships was found between E- and S scores and financial performance in the long term, we test whether market capitalization can be moderating the relationship, as larger companies tend to have higher ESG scores, as indicated in graph 17 and 18.

Table 19: Market capitalization as a moderating variable between E score and ROA

Long term				
	Estimate	Std. Error	t-value	p-value
Intercept	-0.273312	0.069720	-3.920160	0.000090
E score	-0.000727	0.001141	-0.636773	0.524304
Market Cap	0.015719	0.002997	5.244279	0.000000
Moderating effect	0.000013	0.000048	0.265784	0.790417

The table reports estimates, standard errors, t-values and p-values for the linear regression between the independent variables E score, market capitalization, and the moderating effect between E score and market capitalization, and the dependent variable ROA in the long term. The sample includes companies included in the real S&P 500 for the years 2019, 2022-2023. Market capitalization is obtained in absolute values (USD) from Refinitiv Eikon, and then scaled to logarithmic values in R studio, using the log() function. E scores are obtained from Refinitiv Eikon directly.

Table 20: Market capitalization as a moderating variable between S score and ROA

Long term				
	Estimate	Std. Error	t-value	p-value
Intercept	-0.052937	0.097096	-0.545204	0.585640
S score	-0.002863	0.001481	-1.932804	0.053321
Market Cap	0.005691	0.004151	1.371147	0.170396
Moderating effect	0.000117	0.000063	1.872396	0.061215

The table reports estimates, standard errors, t-values and p-values for the linear regression between the independent variables S score, market capitalization, and the moderating effect between S score and market capitalization, and the dependent variable ROA in the long term. The sample includes companies included in the real S&P 500 for the years 2019, 2022-2023. Market capitalization is obtained in absolute values (USD) from Refinitiv Eikon, and then scaled to logarithmic values in R studio, using the log() function. S scores are obtained from Refinitiv Eikon directly.

From table 19 we can conclude when measuring the moderating effect of market capitalization on the relationship between E score and ROA, only market capitalization is significant, while the E score and the moderating effect are insignificant. In table 20, none of the variables are significant.

6. Discussion

Similar to previous studies, the relationship between a company's ESG score and its financial performance remains uncertain when reviewing our results. However, we observe a negative relationship between a company's environmental score and its financial performance over the long term. Conversely, there is a positive relationship between a company's social score and its financial performance in the long term. When introducing market capitalization as a control variable, both the relationships between E score and financial performance and S score and financial performance become insignificant. Meanwhile, market capitalization is significantly related to financial performance when testing the moderating effect on the relationship between E score and financial performance, but becomes insignificant for the relationship between S score and financial performance.

Our results suggest that the relationship between E score and financial performance is not consistent across different levels of market capitalization. While larger companies tend to perform better financially, company size does not significantly alter the relationship between environmental- and financial performance. As for the relationship between S score and financial performance, neither S score nor market capitalization serve as explanation for the direction of a firm's financial performance. One possible explanation for the inconsistent findings could be to observe how market capitalization is associated with a firm's financial performance over time. Although there is a positive and significant relationship between company size and financial performance both in the long- and short term, the curve is rather flat in the long term, while being slightly steeper in the short term. Thus, company size seems to be more important for predicting financial performance in the short term than in the long term.

When comparing the characteristics of the S&P 500 index to the S&P 500 ESG index, we can see that the companies in the S&P 500 ESG index are larger on average than in the S&P 500 index, both in the long- and short term. However, the companies in the S&P 500 index perform better financially over the long term, while the companies in the ESG index perform better financially over the short term. Once again, company size seems to play a larger role for a firm's financial performance in the short term than it does in the long term. Thus, the superior financial performance of the ESG index in the short term can partly be attributed to larger market capitalization, rather than superior ESG performance since we cannot establish a significant relationship between ESG- and financial performance in the short term.

So, how come no significant relationship between ESG performance and financial performance could be established, neither for the long- nor short term? And why do the individual components E, S, and G, seem to relate differently to a firm's financial performance? One possible explanation for the non-existent relationship between ESG and financial performance could be that the ESG movement is too modern. Although the ESG framework has been around since the early 2000s, when The Global Compact released its "Who Cares Wins" report in 2004, widespread sustainability awareness and the demand for sustainable investments did not start to accelerate until recent years. For example, in the United Nations Millennium Declaration from 2000, the UN member states agreed on the United Nations Millennium Development Goals (MDGs), that

included eight goals aimed at reducing extreme poverty by 2015. In 2015, the MDGs were replaced by 17 Sustainable Development Goals (SDGs) to be achieved by 2030. The main difference between the two agreements is that the MDGs were primarily targeted towards fighting extreme poverty in developing countries, while the SDGs adopt a global perspective and highlights the importance of balancing social, economical, and environmental sustainability (UNDP, no date). This demonstrates that while the awareness for environmental, economical, and social sustainability has been a topic of discussion since the early 2000s, environmental sustainability issues have only recently caught attention in the political climate, whereas social and economical issues have already been prioritized since the implementation of the ESG framework.

Since environmental issues have only recently begun to take up space in media, it is likely that consumption patterns that reflect environmental sustainability awareness have not yet significantly impacted companies' financial performance. In a study that measures public opinion on climate change, it was revealed that about 48% of people globally worry about climate change regularly, 68% of people believe that it is important that their government and companies take action, while 70% believe that individual responsibility is necessary. However, when asked about the attitude towards changing their own behavior, 54% said they would avoid buying new goods, 46% would avoid flying, and 44% would eat less meat (Bailey, 2022). This suggests that people are less inclined to change their consumption patterns, although expressing environmental sustainability concerns. In turn, it is likely that companies do not experience significantly higher revenues as a result of strong environmental performance, since consumers do not align their climate concerns with their purchasing behavior.

Furthermore, it is also possible that the investments in environmental and social sustainability are associated with different investment horizons. A company that invests in social sustainability is likely to experience reduced costs shortly thereafter. In a study that measures health and productivity strategies' link to financial results, they found that companies that are highly effective in their health and productivity programs experience 40% higher revenues per employee, annual healthcare cost savings of $1000 per employee, fewer unplanned absence days, and lower turnover rates, compared to low effectiveness companies (National Business Group on Health and Tower Watson, 2011/2012).

While the benefits of social sustainable investments derive from within the company, the benefits of environmental sustainable investments are more dependent on external factors, such as energy prices. Historically, fossil fuels have been significantly cheaper than renewable energy, which has not incentivized companies to switch to green alternatives, since it has been associated with additional expenses. However, in the last decade the price of renewable energy has decreased drastically. Between the years 2009 to 2023, the price for solar power decreased by 84%, while the price for onshore wind power decreased by 66% (Lazard, 2023). Conversely, fossil fuels have become more expensive, and especially peaked in price as a result of the Russo-Ukrainian war (IRENA, 2022). Consequently, by 2021, solar power was cheaper than fossil fuels (IRENA, 2022). Thus, while strong environmental performance has historically been associated with worse financial performance, recent cost trends may cause a shift in the relationship, as the usage of green energy will be a means to reducing expenses.

7. Conclusion

In conclusion, when comparing the characteristics of the S&P 500 to the S&P 500 ESG index, we conclude that the companies in the S&P 500 perform better financially in the long term, while the companies of the ESG index perform better in the short term. Thus, the superior returns of the ESG index in the short term are backed by superior financial performance. Also, the companies in the ESG index are larger than the companies of the S&P 500 index when observing both the long- and short term. Larger companies also tend to have higher ESG scores and perform better financially, which raises the question of whether company size can be an important determinant for the relationship between ESG- and financial performance.

Furthermore, we cannot establish a significant relationship between ESG- and financial performance, neither for the long term, nor the short term, when measuring the ESG scores for companies in the real S&P 500 to ROA. However, we find a negative and significant relationship between a company's environmental performance and its financial performance, and a positive and significant relationship between a company's social performance and its financial performance in the long term, while no relationship can be established between a company's governance score and financial performance in either time horizon. Also, we conclude that company size does not moderate the relationship between E score and financial performance, nor S score and financial performance.

Lastly, we seek alternative explanations for our findings and suggest that the insignificant relationship between ESG- and financial performance can partly be attributed to environmental- and social performance relating differently to financial performance. We suggest that social sustainability awareness has been emphasized for a longer time, while environmental awareness is a more modern political discussion, as a result of a growing climate concern in recent years. Thus, consumption patterns reflecting environmental concerns have not yet had a sustained impact on companies' financial performance. Also, it has not been financially justifiable for a company to invest in renewable energy, since it until recently has been significantly more expensive than fossil fuels. Hence, while strong environmental performance has been associated with worse financial performance in the time horizon analyzed in this study, it is likely that shifting characteristics, such as changing consumption patterns and energy prices will benefit environmentally strong companies in coming years. In contrast, we argue that companies that invest in social sustainability, such as extensive employee health programs, can realize the upsides from their investments in a much shorter time period since strong social performance has been proven to reduce expenses.

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AI-disclosure:
We have used Chat GPT as a tool for writing code in R studio.

Appendices

Appendix 1: Training model to predict ESG index. "Model 0"

	Estimate	Std. Error	z-value	p-value
Intercept	-1.221	0.140	-8.698	0.000
S&P 500 inclusion	1.871	0.149	12.558	0.000
E score	0.047	0.127	0.369	0.712
S score	0.279	0.166	1.676	0.094
G score	-0.145	0.132	-1.101	0.271
ESG score	0.557	0.298	1.869	0.062
GICS market cap	0.002	0.048	0.038	0.969

The table shows estimates, standard errors, z-value and significant codes for the independent variables of a binomial logistic regression. The dependent variable is ROA. The independent variables are S&P 500 inclusion, E-score, S-score, G-score, ESG score and GICS-industry group weighted market capitalization. ROA, S&P 500 inclusion, E-score, S-score, G-score and ESG score and market cap are obtained directly from Refinitiv Eikon. GICS industry group weighted market capitalization is calculated as market capitalization (USD)/total market capitalization of associated GICS industry group (USD). The sample includes companies included in the real S&P 500 index from the years 2019-2023.

Appendix 2: Training model to predict ESG index. "Model reduced 1"

	Estimate	Std. Error	z-value	p-value
Intercept	-1.234	0.139	-8.854	0
S&P 500 inclusion	1.887	0.148	12.761	0
S score	0.417	0.084	4.972	0
ESG score	0.396	0.085	4.645	0

The table shows estimates, standard errors, z-value and significant codes for the independent variables of a binomial logistic regression. The dependent variable is ROA. The independent variables are S&P 500 inclusion, S-score and ESG score. All variables are obtained directly from Refinitiv Eikon. The sample includes companies included in the real S&P 500 index from the years 2019-2023.

Appendix 3: Comparing the prediction quality of Model reduced 1 to Model 0

```
Analysis of Deviance Table

Model 1: depESG ~ SP + S + ESG
Model 2: depESG ~ SP + E + S + G + ESG + mcap
  Resid. Df Resid. Dev Df Deviance Pr(>Chi)
1      2416     2704.5
2      2413     2698.9  3   5.5791    0.134
```

The output shows an anova test with Model reduced 1 in the first argument, and Model 0 in the second argument. It tests the null hypothesis that Model 0 is better at predicting the dependent variable ROA.

Appendix 4: Training model to predict ESG index. "Model reduced 2"

	Estimate	Std. Error	z-value	p-value
Intercept	-1.221	0.140	-8.751	0.000
S&P 500 inclusion	1.872	0.148	12.636	0.000
E score	0.047	0.127	0.370	0.711
S score	0.279	0.166	1.677	0.094
G score	-0.145	0.132	-1.103	0.270
ESG score	0.557	0.298	1.873	0.061

The output shows estimates, standard errors, z-value and significant codes for the independent variables of a binomial logistic regression. The dependent variable is ROA. The independent variables are S&P 500 inclusion, E-score, G-score, S-score and ESG score. All variables are obtained directly from Refinitiv Eikon. The sample includes companies included in the real S&P 500 index from the years 2019-2023.

Appendix 5: Comparing the prediction quality of Model reduced 2 to Model 0

```
Analysis of Deviance Table

Model 1: depESG ~ SP + E + S + G + ESG
Model 2: depESG ~ SP + E + S + G + ESG + mcap
  Resid. Df Resid. Dev Df  Deviance Pr(>Chi)
1      2414     2698.9
2      2413     2698.9  1 0.0014796   0.9693
```

The output shows an anova test with Model reduced 2 in the first argument, and Model 0 in the second argument. It tests the null hypothesis that Model 0 is better at predicting the dependent variable ROA.

Appendix 6: Training model to predict ESG index. "Model reduced 3"

	Estimate	Std. Error	z-value	p-value
Intercept	-1.221	0.140	-8.704	0.000
S&P 500 inclusion	1.872	0.149	12.564	0.000
S score	0.235	0.115	2.036	0.042
G score	-0.184	0.080	-2.310	0.021
ESG score	0.654	0.142	4.605	0.000
GICS market cap	0.002	0.048	0.047	0.963

The table shows estimates, standard errors, z-value and significant codes for the independent variables of a binomial logistic regression. The dependent variable is ROA. The independent variables are S&P 500 inclusion, S-score, G-score, ESG score and GICS-industry group weighted market capitalization. All variables except GICS market capitalization are obtained directly from Refinitiv Eikon. GICS industry group weighted market capitalization is calculated as market capitalization (USD)/total market capitalization of associated GICS industry group (USD). The sample includes companies included in the real S&P 500 index from the years 2019-2023.

Appendix 7: Comparing the prediction quality of Model reduced 3 to Model 0

```
Analysis of Deviance Table

Model 1: depESG ~ SP + S + G + ESG + mcap
Model 2: depESG ~ SP + E + S + G + ESG + mcap
  Resid. Df Resid. Dev Df Deviance Pr(>Chi)
1      2414     2699.1
2      2413     2698.9  1  0.13642   0.7119
```

The output shows an anova test with Model reduced 3 in the first argument, and Model 0 in the second argument. It tests the null hypothesis that Model 0 is better at predicting the dependent variable ROA.

Appendix 8: Training model to predict ESG index. "Model reduced 4"

	Estimate	Std. Error	z-value	p-value
Intercept	-1.222	0.140	-8.706	0.000
S&P 500 inclusion	1.873	0.149	12.569	0.000
E score	0.159	0.077	2.070	0.038
S score	0.437	0.085	5.157	0.000
ESG score	0.252	0.110	2.293	0.022
GICS market cap	0.004	0.048	0.082	0.935

The output shows estimates, standard errors, z-value and significant codes for the independent variables of a binomial logistic regression. The dependent variable is ROA. The independent variables are S&P 500 inclusion, E-score, S-score, ESG score and GICS-industry group weighted market capitalization. All variables except GICS market capitalization are obtained directly from Refinitiv Eikon. GICS industry group weighted market capitalization is calculated as market capitalization (USD)/total market capitalization of associated GICS industry group (USD). The sample includes companies included in the real S&P 500 index from the years 2019-2023.

Appendix 9: Comparing the prediction quality of Model reduced 4 to Model 0

```
Analysis of Deviance Table

Model 1: depESG ~ SP + E + S + ESG + mcap
Model 2: depESG ~ SP + E + S + G + ESG + mcap
  Resid. Df Resid. Dev Df Deviance Pr(>Chi)
1      2414     2700.2
2      2413     2698.9  1   1.2135   0.2706
```

The output shows an anova test with Model reduced 4 in the first argument, and Model 0 in the second argument. It tests the null hypothesis that Model 0 is better at predicting the dependent variable ROA.

Appendix 10: Training model to predict ESG index. "Model reduced 5"

	Estimate	Std. Error	z-value	p-value
Intercept	-1.210	0.142	-8.502	0.000
S&P 500 inclusion	1.862	0.151	12.362	0.000
S score	0.572	0.170	3.358	0.001
ESG score	0.423	0.084	5.019	0.000
Interaction SP:ESG	-0.204	0.169	-1.205	0.228

The output shows estimates, standard errors, z-value and significant codes for the independent variables of a binomial logistic regression. The dependent variable is ROA. The independent variables are S&P 500 inclusion, S-score and ESG. Also including an interaction effect between S&P 500 inclusion and ESG score. All variables are obtained directly from Refinitiv Eikon. The sample includes companies included in the real S&P 500 index from the years 2019-2023.

Appendix 11: Comparing the prediction quality of Model reduced 5 to Model 0

```
Analysis of Deviance Table

Model 1: depESG ~ SP * ESG + S
Model 2: depESG ~ SP + E + S + G + ESG + mcap
  Resid. Df Resid. Dev Df Deviance Pr(>Chi)
1      2415     2703.0
2      2413     2698.9  2   4.0688   0.1308
```

The output shows an anova test with Model reduced 5 in the first argument, and Model 0 in the second argument. It tests the null hypothesis that Model 0 is better at predicting the dependent variable ROA.

Appendix 12: AIC and BIC scores for the training models

	Criterion Values	
Model	AIC	BIC
Model 0	2712.950	2753.490
Model reduced 1	2712.529	2735.695
Model reduced 2	2710.951	2745.700
Model reduced 3	2711.086	2745.835
Model reduced 4	2712.163	2746.912
Model reduced 5	2713.018	2741.976

The output shows the AIC and BIC scores for our trained models.

Appendix 13: Confusion matrix for Model reduced 1

	Excluded prediction	Included prediction
Excluded real	512	490
Included real	197	1221

Confusion matrix that compares the predictions for Model reduced 1 from the years 2019-2023 to the real data for 2019-2023.

Appendix 14: Prediction quality of Model reduced 1

Metric	Value
Sensitivity	0.861
Specificity	0.511
Precision	0.714
Accuracy	0.716

The table shows the prediction quality of Model reduced 1, measuring sensitivity, specificity, precision and accuracy. Sensitivity = TP ÷ (TP+FN). Specificity = TN ÷ (TN+FP). Precision = TP ÷ (TP+FP). Accuracy = (TP + TN) ÷ (TP + TN + FP + FN).

Appendix 15: Confusion matrix for Model reduced 2

	Excluded prediction	Included prediction
Excluded real	509	493
Included real	197	1221

Confusion matrix that compares the predictions for Model reduced 2 from the years 2019-2023 to the real data for 2019-2023.

Appendix 16: Prediction quality of Model reduced 2

Metric	Value
Accuracy	0.715
Sensitivity	0.861
Specificity	0.508
Precision	0.712

The table shows the prediction quality of Model reduced 2, measuring sensitivity, specificity, precision and accuracy. Sensitivity = TP ÷ (TP+FN). Specificity = TN ÷ (TN+FP). Precision = TP ÷ (TP+FP). Accuracy = (TP + TN) ÷ (TP + TN + FP + FN).

Appendix 17: Multicollinearity test of Model reduced 1

Variables	VIF
S&P 500 inclusion	1.003
S score	2.673
ESG score	2.675

The table displays the VIF values of the independent variables S&P 500 inclusion, S-score, and ESG score.

Appendix 18: Comparison of market capitalization, long term

Market Cap	Long Term	
Measure	SP500	ESG Index
1st Quartile	5.857592e+09	1.267553e+10
Median	1.037426e+10	2.382247e+10
3rd Quartile	2.879226e+10	5.794401e+10
Mean	2.879226e+10	5.794401e+10
Standard Deviation	9.592830e+10	1.313552e+11
Minimum	1.008151e+08	3.682275e+08
Maximum	1.755459e+12	3.010059e+12

The table shows summary statistics of market capitalization of companies in the S&P 500 index and the ESG index in the long term. The sample includes companies in the S&P 500 index and companies in the ESG index for the years 2011-2019, 2022-2023. Market capitalization is stated in absolute numbers and obtained directly from Refinitiv Eikon

Appendix 19: Comparison of market capitalization, short term

Market Cap	Short Term	
Measure	SP500	ESG Index
1st Quartile	8.184896e+09	1.484632e+10
Median	1.667608e+10	3.052064e+10
3rd Quartile	4.950774e+10	7.954637e+10
Mean	4.950774e+10	7.954637e+10
Standard Deviation	1.449215e+11	2.062701e+11
Minimum	1.008151e+08	1.022180e+09
Maximum	1.755459e+12	3.010059e+12

The table shows summary statistics of market capitalization of companies in the S&P 500 index and the ESG index in the short term. The sample includes companies in the S&P 500 index and companies in the ESG index for the years 2019, 2022-2023. Market capitalization is stated in absolute numbers and obtained directly from Refinitiv Eikon