Socially Responsible and Financially Rewarding: The Relationship Between ESG and Stock Market Returns

Kristian Eklund* Felix Freiherr von Uslar-Gleichen†

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Abstract

We study the link between the ESG-performance of 20 OECD countries and the excess returns of their major stock indices between 2005 and 2015. Our research shows a significant positive relationship between the two metrics. Deeper analysis suggests that social factors are the main drivers of this relationship while we find no significance for environmental and governance factors. We further measure the relationship between the ESG-performance and market risk expressed as volatility and skewness of excess returns. Our findings show no significant relationship with volatility and a significant positive relationship with skewness. We find a significant positive relationship between risk-adjusted returns, expressed as the Sharpe ratio, and ESG-performance.

Keywords: ESG Performance, ESG Index, Index Returns, Sustainable Finance, Systematic Risk.

Supervisor: Gualtiero Azzalini, Assistant Professor, Department of Finance, Stockholm School of Economics.

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*24666@student.hhs.se.

†42404@student.hhs.se.

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1 Introduction

The scientific community has been able to reach a consensus on at least two important questions on the topic of climate change. First, the reality of it, and second, the main driver of sequential, temperature-record-breaking summers is mankind and its emission of greenhouse gasses. An environmental research article published by Lynas et al. (2021) establishes a 99% consensus on human-caused climate change in peer-reviewed scientific literature concerning the subject. International agreements on political measures addressing these findings, like the European Green Deal, have set a new precedent for developed countries to address these challenges on a national level, with countries representing 70% of the global GHG emissions pledging to reach climate neutrality by 2050 (European Parliament, 2022). With an even tighter deadline of 2045, Sterchele et al. (2020) estimate that the costs of the necessary transition in the fields of energy, construction, mobility and food production for Germany alone, lie somewhere between 1 and 3.3 trillion euros (Bundesregierung, 2021). While the European Green Deal rests on the assumption that the prevention of severe climate disruptions through these necessary changes will have a positive net present value in the long run, it emphasizes that an essential part of the strategy will be to preserve economic growth and stability throughout the transitional period. The resulting policies will require major shifts in the essential industries of the countries in question, raising concerns about the profitability and international competitiveness of the countries' biggest industries and thus, its most financially significant companies during the transitional period (European Commission, 2020). The fundamental question becomes whether this transitional period will be a two-front battle, where increased focus on sustainability on a macro-scale leads to declining returns on the stock market, or if the market will value the shift of essential industries toward more sustainable practices in the short to medium term.

One side of the debate prominently argues that to fulfill goals pertaining to ESG, investors will have to give up returns. Examples of prominent figures convinced of this negative relation between the pursuit of ESG goals and stock market returns include United States Governor Ron DeSantis. Mr. DeSantis has made it illegal in his home state of Florida to make investment decisions with public money that promote ESG goals (Reuters, 2023b). Furthermore, cities

in Florida can no longer sell ESG related bonds to finance green projects. Governor DeSantis is not alone in promoting policies that limit the influence of ESG in investment decisions. According to S&P Global Market Intelligence (S&P Global Market Intelligence, 2023) there were at least 165 bills and resolutions in the United States against ESG investment criteria introduced between January and June 2023. The notion that one has to give up returns to achieve ESG objectives is not unique to the United States. In May of 2023, some of Europe's largest insurers including AXA, Allianz, and SCOR left the Net-Zero Insurance Alliance, which is a UN-backed climate alliance for insurance companies (Reuters, 2023a).

The essence of the opposing political view can most accurately be reflected by a point Greta Thunberg made in a passionate speech addressing the United Nations on September 23rd, 2019:

> *"We are in the beginning of a mass extinction and all you can talk about is money and fairytales of* ***eternal economic growth****. How dare you?"* — Greta Thunberg (2019)

This highlights Thunberg's opposition to the view of policymakers like Governor DeSantis and stresses the urgency of the climatic issues we are facing and the sacrifices societies should be willing to make to combat these issues. Ironically one could make the inference that the two sides of the debate seem to agree on the view that persistent economic growth and the pursuit of ESG large-scale measures are mutually exclusive.

Larcker et al. (2022) highlight that there are traditionally two views on the relationship between the pursuit of ESG goals and profitability. A company can improve its ESG-performance by, for instance, ceasing activities that negatively impact stakeholders. The costs associated with this are incurred by the shareholder. Thus, this view builds upon investor preferences and values. Investors are willing to bear an extra cost for their investment to align with their personal preferences and values, which would be good or at least better ESG-performance.

The opposing view is that the pursuit of ESG goals is a way for companies to mitigate potential future risks. By adapting or changing the activities of a company, these ESG risks can be mitigated and thus have a long-term positive financial impact on the company, even if shareholders incur a cost today. Regardless of which view on ESG one might have, the existing

academic literature does not indicate an undisputed relationship between ESG and financial performance.

Our research aims to add to this discussion by studying the relationship between macro-level ESG-performance and the excess returns of a country's major stock index. We do this by studying the relationship between the ESG-performance of a country and the short to medium term performance of that country's major stock index. To assess ESG-performance, we construct four indices based on 18 ESG factors obtained from the World Bank on a sample of 20 OECD countries. We construct an aggregate ESG index based on all 18 factors by conducting a principal component analysis and selecting the component explaining the most amount of variance across the factors. We construct an Environmental index, a Social index, and a Governance index using the same methodology but we only select factors relating to the corresponding index (only governance factors are selected for the Governance index etc.). To verify the robustness of the obtained results, we remove outliers such as Greece from the sample. We also remove the period of the Global Financial Crisis to minimize the effect of a highly volatile time period. Lastly, we use country-specific risk-free rates to calculate the excess returns of the stock indices. We also examine the potential relationship between ESG-performance and volatility. Furthermore, a potential causal link between ESG-performance and excess returns is investigated through an instrumental variable regression where the ESG news index from Engle et al. (2020) is used as an instrumental variable. We conclude by studying the link of other performance metrics, such as tail risk and risk-adjusted returns and ESG-performance.

The results show that ESG is positively related to excess returns and that the relationship remains robust across the sensitivity analyses. When extending the regression model to the sub-indices, we find that the Social index is positively related to excess returns while the Environmental and Governance indices are not statistically significant. We conclude that it could be relevant to consider ESG factors, specifically factors related to human capital when making investment decisions and designing ESG policies. We do not find any robust and statistically significant relationship between ESG and the volatility of excess returns. Furthermore, we find that ESG is positively related to risk-adjusted returns and negatively related to tail risk. We do not find any causal relationship between ESG-performance and excess returns.

The rest of the thesis is structured in the following way. Section 2 describes the existing literature and how our study will contribute to this field of research. Section 3 gives an overview of the data used in the study. Section 4 describes how we constructed the variables used in the analysis and the methodology for constructing the ESG indices. It also shows the structure of the regressions used to obtain the results. Section 5 presents the findings and discusses the economic implications. Section 6 concludes the findings.

2 Literature Review

Prior related research has mainly focused on two areas. The first, and more researched area examines ESG-performance at the microeconomic level and any potential effects on firm-specific metrics. The second strand of literature focuses on ESG-performance at the macroeconomic level and its potential effects on country- or company-specific metrics such as GDP growth or cost of debt. This section gives an overview of the existing literature and highlights how this study contributes to and further develops the empirical findings in the field. Existing research on ESG-performance has thus far mainly been conducted on the microeconomic level, meaning firm-specific evaluation of a company's ESG-performance on company-specific financial metrics like firm valuation, financial risk, financing, financial performance, and strategy.

Firm Valuation

Research conducted by Dowell et al. (2000) focuses on the effect of company-specific environmental standards on stock market performance and finds a significant correlation between the adoption of stringent environmental standards and higher market values. It should be noted that the dependent variable in this study is not defined as the return on stock prices but *Tobin's q*, a quotient of the company's market value and the replacement cost of its assets. Deng et al. (2013) focus on the effect of Corporate Social Responsibility on realized returns in a merger setting, specifically on the US market. The paper finds a statistically significant link between high CSR and higher merger announcement returns, as well as higher returns on long-term stock performance. Their findings suggest that increased focus on stakeholder interests is positively related to higher long-term profitability and efficiency.

Financial Risk

Oikonomou et al. (2014) research the effect a firm's social performance has on its cost of debt and its credit rating, finding a negative correlation between social performance and bond yield spreads. Furthermore, they find a positive correlation between a company's social performance and its bond's credit rating.

Financial Performance

In their study Chen and Metcalf (1980) re-evaluate the results of research conducted by Spicer (1978) on the effect of pollution indices on various financial indicators of a firm, namely profitability, size, total risk, systematic risk, and the Price/Earnings ratio. Chen et al. suggest that the results obtained by Spicer, showing a correlation between the various dependent variables used and the pollution index, are not as strong as suggested by the initial research. Peer reviews like this highlight the challenge of obtaining definitive results when researching the effects of ESG-performance on financial performance on a microeconomic level. Jo et al. (2015) focus specifically on firms in the financial services sector and analyze the effect of corporate environmental responsibility on their operating performance. Their results reveal a positive effect of better environmental performance on the Return on Assets with a time lag of one or two years. A robustness test reveals that the immediate positive effect of better environmental performance on the firm's RoA is more profound within well-developed financial markets compared to less-developed financial markets. In summary, the literature examining ESG-performance on the micro-level overall points toward a positive relationship between ESG-performance and various firm-specific metrics such as share price and financial performance. However, several studies find no or a negative relationship, highlighting the challenge of obtaining definite results.

Superior country-level ESG-performance has been linked to improvements in economic growth. Wang et al. (2023) find in their study of 109 countries between 2010 and 2017, that improvements in environmental protection, social protection, and governance components of a country are positively related to economic growth. The authors state that the growth is mainly driven by environmental and governance factors and that the effect is more profound for high-income countries. The paper connects ESG-performance with cultural traits. It is found that in cultures with low power distance and a high level of individualism, the economic effects of ESG-performance are stronger. The authors conclude their findings by emphasizing significant potential policy implications. Sustainability initiatives have a positive effect on economic prosperity, which contrasts the concern that sustainability policies are economically costly. Other papers examining the link between ESG-performance and economic growth also find a positive relationship between the factors. Diaye et al. (2022) find a long-term positive relationship

between ESG-performance and GDP per capita growth in their study of 29 OECD countries between 1996 and 2014. However, they do not find any such relationship in the short-term. Similarly to Wang et al. (2023) the authors conclude by emphasizing the implications of their findings for countries' economic policies. They highlight that the management of natural resources will play an essential role in future economic growth, as it will ensure the production of products and services while minimizing negative externalities on these resources. Tanjung (2021) further contributes to the literature on macro-level ESG-performance by examining the effects on a subset of emerging markets economies. The study examines the relationship between the MSCI ESG leaders index, GDP, and Human Development Indicators (HDI) between the years 2010 and 2018. The results show a significant positive relationship between ESG and GDP growth while exhibiting no evidence of a relationship between ESG and HDI. The author emphasizes the need for further cross-country studies on sustainable economic development. Given the findings presented above, we believe that economic growth and well-being should be positively correlated with the excess returns of a country's major stock index. Hence we develop our first hypothesis:

Hypothesis 1 *There is a positive relationship between a country's ESG-performance and the excess return of its major stock index.*

The hypothesis above has not yet been tested in existing literature. Hence, our research will introduce the study between macroeconomic ESG-performance and excess returns of a major stock index. Hopefully, these insights can be useful in investment decisions and policy-making decisions in the future.

Research on country-level ESG-performance is not limited to its effects on GDP growth. The study by A. Hoepner et al. (2016) examines the relationship between a country's sustainability and the cost of bank loans for firms in that country. They find that country sustainability, relating to both environmental and social aspects, has a significant impact on the cost of debt. More specifically, they find that on average a one unit increase of a country's sustainability score leads to a 64 basis point decrease in the cost of debt. They also find that improvements in environmental aspects of a country's sustainability score have twice the effect compared to

social aspects in determining the costs of corporate loans. However, the authors do not find any significant relationship between firm-specific sustainability performance and the firm-specific cost of debt. The authors use country-specific sustainability scores determined by third-party data providers, which introduces a dependence on subjective judgments of the data provider in the ESG-performance assessment. Furthermore, Hoepner et al. discuss the role of trust and culture as drivers of economic decisions. They point toward the study by Bottazzi et al. (2016) that investigates how venture capitalists' funding decisions are dependent on cultural traits, and the study by Siegel et al. (2011) which examines the effect of cross-country differences on international equity and debt flows. Both studies find that culture and trust have a significant impact on financial decisions. A potential interpretation could be that sustainability serves as an indicator of soft characteristics, such as trust and integrity, and is thus associated with lower costs of debt. One of the most influential papers in the field is the study by Capelle-Blancard et al. (2019) who investigate the link between country-specific ESG-performance and sovereign borrowing costs for 20 OECD countries between 1996 and 2014. In their study, the authors find that there is a significant negative relationship between the ESG score of a country and the spread of its sovereign bond. They conclude that high ESG-performance is associated with less default risk and subsequently lower spreads. Furthermore, they extend their regression model by breaking down ESG into sub-components to obtain an Environmental index, a Social index, and a Governance index. They find that the Governance index is more significant than the Environmental and Social indices and argue that financial market participants value improvements related to governance more. They conclude that the effects of an improvement in the governance dimension are more immediate and thus not discounted to the same extent that environmental and social factors are, the effects of which might take longer to materialize. The authors conclude that bond markets price a country's ESG-performance when assessing risk and that their findings are relevant for constructing strategic international asset allocation. The research by Capelle-Blancard et al. (2019) is focused on developed economies. To further investigate the topic, Margaretic and Pouget (2018) study the relationship between ESG-performance and sovereign bond spreads between 2001 and 2010 in emerging economies. The authors' findings suggest there is a negative relationship between ESG factors and sovereign

bond spreads. The effects of governance factors seem to be contemporaneous while the environmental and social factors exhibit a long-term negative relationship. This contrasts the findings of Capelle-Blancard et al. (2019) to the extent that the environmental factors exhibit a significant relationship with spreads. Furthermore, the authors find that spreads are positively associated with environmental and social factors in the short-term. They argue that a reason for this could be that financial markets evaluate policies aimed at improvement in these factors as a cost in the short-term and hence, the positive contemporaneous association between the two metrics. In light of the findings by Capelle-Blancard et al. (2019) we suspect the different sub-components of ESG to have differing levels of correlation with the excess returns of a country's major stock index. Capelle-Blancard et al. (2019) reference to the paper by Edmans (2011) and mention that social factors may have a positive influence on the stock performance of a company. Hence, we will test the following:

Hypothesis 2 *The different components of ESG exhibit different levels of co-movement with the excess returns of a stock index, with the social component showing the most significant positive correlation.*

A strand of this literature also tries to investigate causal links between ESG performance and macroeconomic variables. For instance, Ho et al. (2019) investigate the relationship between ESG-performance and economic growth. What differentiates their research is that they try to establish a causal relationship. They test their hypothesis on a dataset of 118 countries between 1999 and 2015. To assess ESG-performance, the authors use three indicators for the environmental, social, and governance factors namely CO2 emissions, life expectancy at birth and control of corruption. The results show that there is a positive bidirectional relationship between the environmental and social factors and GDP per capita. The governance factor exhibits a significant positive unidirectional relationship with GDP per capita. The authors conclude that their findings could be relevant for investors who use ESG as a factor in their investment decision-making process. They also highlight the importance of their findings for policymakers as ESG factors are evidently a significant determinant of economic growth. In light of the findings by Ho et al. (2019), we test the potential causal effect between ESG-performance and

the excess returns of a stock index. Therefore, the third hypothesis is:

Hypothesis 3 *There is a positive causal relationship between ESG-performance and the excess returns of a country's major stock index.*

Testing causality is important to reinforce the implications of our findings for investors as ESG-performance measures could potentially become more important in determining asset allocation and evaluating investment opportunities. Proving a causal relationship between the two metrics could also help policymakers in designing and implementing efficient sustainability measures.

Further focusing on the volatility of excess returns will enable us to make inferences about the relationship between ESG-performance and systematic risk in the stock markets we analyze. Considering the negative relationship between excess returns and the associated risk[1] we observe in Figure 1, we expect ESG-performance to be negatively related to volatility.

Hypothesis 4 *There is a significant negative relationship between ESG-performance and the volatility of excess returns of a country's major stock index.*

By studying this hypothesis we hope to give novel insights into the potential relationship between ESG-performance and the volatility of excess returns which will potentially help investors in their investment decision-making processes.

[1] Expressed as the standard deviation of logarithmic excess returns: σ.

3 Data and Main Variables

To analyze the relationship between macroeconomic ESG-performance and the excess returns and their volatility of corresponding country indices over time, we require a dataset that combines stock index values, macroeconomic factors, and ESG factors into a panel dataset. To compare the stock index performances against a common benchmark we use the excess returns of the indices as a performance measure. The benchmark is the yield on the 10-year US treasury notes. Comparable to Capelle-Blancard et al. (2019), we use it as a proxy for the risk-free interest rate. To measure the ESG-performance of a country we construct an index of 18 different performance measures, six for each of the following three dimensions: Environmental, Social, and Governance. Our sample consists of the following countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. All of the countries are members of the OECD. The time period we examine includes the years between 2005 and 2015. In total, we obtain 220 country-year observations per variable.

3.1 Data Gathering

3.1.1 Index Price Data and Treasury Notes

We gather index price data from Yahoo Finance. This database provides market data for assets like stocks, indices, mutual funds, and ETFs. For the period of study, there are only five indices that Yahoo Finance does not have full coverage on. These indices include the OMX30 (Sweden), OMXC20 (Denmark), OMXHPI (Finland), Oslo OBX (Norway), and the PSI All Share (Portugal). For these indices, we compile the index data from other sources. For OMX30, OMXC20, and OMXHPI we gather the data from the website of Nasdaq. Nasdaq is an electronic exchange company that acts as a marketplace for investors to buy and sell securities. For Oslo OBX and the PSI All Share we gather the data from Investing.com which is a financial markets platform that provides real-time data from more than 250 exchanges around the world.

The selected indices are the major stock indices of each country. In some countries, there is a stock index that represents the largest companies in the country as well as an all-share index that has a broader base. In these cases, the selection is primarily based on data availability. We obtain data for the daily yield on the 10-year US treasury notes from the Federal Reserve Bank of St. Louis. We obtain the yield on the country-specific 10-year government bonds from the databank of the OECD.

3.1.2 ESG-Performance Measures

We retrieve data for ESG factors from various databases of the World Bank. These include the World Development Indicators (WDI), World Governance Indicators (WGI), and environmental, social and governance databases (ESG). We construct our own ESG indices based on these ESG factors. We do not use ESG ratings as their reliability has been questioned. For example, a study performed by the CFA Institute (2021) found that rating providers such as MSCI, S&P, and Sustainalytics had relatively low levels of correlation in their ESG ratings. Furthermore, these ratings do not necessarily reflect improvement in the underlying ESG aspects but rather shifts in policy and thus not actual change. The factors we have used to construct the ESG indices are inspired by Capelle-Blancard et al. (2019). To assess the environmental performance of a country we examine variables such as air quality, renewable energy, CO2 emissions, and forest area. These factors are used to construct the environmental sub-index and measure how well a country takes care of its natural resources. For the air pollution variable, we observe missing data in the WDI databank for all countries between the years 2006 and 2009. To address this, we use data for the same measure from the OECD Databank. To assess a country's social performance, we include variables such as demography, health, employment, and gender equality. These variables are used to construct the social sub-index which should reflect a country's efforts to improve human capital. To assess governance performance, we consider variables that are based on the data from Kaufmann et al. (2005). This data includes estimates on variables such as control of corruption, government effectiveness, political stability and absence of violence, regulatory quality, rule of law, and voice and accountability. These variables are used to construct the governance sub-index which aims to reflect a country's legal quality.

In total, we have 18 factors that explain ESG-performance (6 factors for each dimension of ESG).

3.1.3 Control Variables

Following Capelle-Blancard et al. (2019) we include several control variables in the analysis. GDP per capita growth, annual inflation rates, the real effective exchange rate, trade in relation to GDP, and international reserves in months of import are obtained from the World Development Indicators database provided by the World Bank. The total gross debt in relation to GDP, the primary balance in relation to GDP, and current account in relation to GDP are all gathered from the Fiscal Monitor database provided by the International Monetary Fund. We denominate GDP per capita growth, Inflation, the real effective exchange rate, trade in relation to GDP, gross debt in relation to GDP, primary balance in relation to GDP, and current account in relation to GDP in percent. Hence, the original data for these variables is multiplied by 100.

3.1.4 ESG News Index

To perform an instrumental variable regression, we obtained a variable that should be significantly correlated with our ESG index. We use the Climate Risk News index constructed by Engle et al. (2020) as our instrumental variable. The index aims to capture events concerning changes in climate risk that are likely to be mentioned in newspapers. Engle et al. study the correlation of a fixed climate change vocabulary with the contents of the Wall Street Journal on a monthly basis. The authors state that increased media coverage is associated with a heightened concern for climate risk as media attention is often related to climate concerns rather than positive progress. Hence, spikes in the index indicate an increased correlation between the vocabulary and media coverage which is likely due to climate risk shocks. Thus, we believe this index should be negatively correlated with our ESG index.

4 Empirical Framework

4.1 Assumptions

Our models rest on a set of assumptions concerning the pricing of assets, the efficiency of the markets in which they are traded, and the distribution of the returns that they generate. These include the principles of Modern Portfolio Theory (MPT), the Efficient Market Hypothesis (EMH), and the Lognormal Model. MPT states that with an increasing level of diversification in an asset portfolio, the exposure to the risk any particular asset adds to that portfolio decreases. Our models assume that the major stock indices of the sample countries represent sufficiently diversified portfolios, which eliminates idiosyncratic risks that any particular stock represented in the index might add. We thus assume that we do not have to control for idiosyncratic risk in our models. The EMH states that in an efficient market, all available information is incorporated into stock prices, which necessitates the conclusion that some markets are more efficient under this definition than others. Since the sample does not include emerging markets economies, we will assume that all markets in the sample exhibit market efficiency (Bodie et al., 2021). Additionally, we work with the assumption that the continuously compounded daily excess returns (see equation 4.5) are normally distributed enabling us the express the lognormal returns as

$$r_{it} \sim \mathcal{N}(\mu_i, \sigma_i) \tag{4.1}$$

with the mean of the logarithmic excess returns defined as μ_i and the standard deviation of excess returns defined as σ_i. Described as the "workhorse of the financial asset pricing literature" (Campbell et al., 1997, p. 16) this assumption offers several advantages.

4.2 Variable Construction

This section is meant to illustrate the definition and calculation of the dependent variables and control variables used in the various models we introduce.

4.2.1 Dependent Variables

Log Returns

We measure the performance of the countries' major stock indices as the logarithmic excess return of the respective stock index. Taking the natural log of the returns is a common practice when analyzing the performance of stocks or indices as it entails several useful advantages. It is defined as:

$$R_{\log} = \ln\left(\frac{P_t}{P_{t-1}}\right) \tag{4.2}$$

With $\ln()$ as the natural logarithm, P_t as the price at the end of the time period over which the return is being calculated and P_{t-1} the price at the beginning of that time period. Using the log returns allows us to continuously compound the returns over the time period of interest, meaning that when we calculate the yearly return of the indices, we can add the logarithmic daily returns, which is much simpler than dealing with the exponents that emerge when we use discrete period compounding (Bodie et al., 2021). Working with logarithmic returns also reduces the relevance of outliers in a panel data regression model.

Excess Returns

Another part of our calculation is taking a risk-free rate into account, which will serve as a performance benchmark for all stock indices. This allows us to isolate the performance attributable to the index itself rather than focusing on the entirety of the return which might be driven by additional unobservable factors. We define the risk-free rate over the sample period as the daily yield of the 10-year US treasury note and thus calculate the daily excess log-return of the stock indices as

$$ER_{\log,t} = R_{\log,t} - R_{f,t} \tag{4.3}$$

with $R_{\log,t}$ as the log return for day t and $R_{f,t}$ as the risk-free rate for day t (Campbell et al., 1997). The yield on a 10-year US treasury note changes daily and is published by the Federal Reserve. It is only published as the yearly yield one would get over ten years if the bond was bought today. We thus calculate the daily yield by dividing the yearly yield by 365 as such:

$$R_{f,t} = \frac{R_{f,T}}{365} \tag{4.4}$$

with $R_{f,T}$ as the yearly yield on a 10-year US treasury note. The calculation of logarithmic excess returns on a daily level also enables us to compute the yearly volatility of those returns as well as the Sharpe Ratio, which is used as a measure of risk-adjusted return. The yearly logarithmic excess return is thus defined as

$$ER_{\log,T} = \sum_{t=1}^{T} ER_{\log,t} \tag{4.5}$$

Volatility

To introduce a risk measure for the excess returns we compute the annualized standard deviation of the logarithmic daily excess returns, a measure of the return's volatility. It is defined as

$$\sigma_T = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(ER_{\log,i} - \mu_{\log})^2} \times \sqrt{N} \tag{4.6}$$

with N as the number of trading days per year (252), $ER_{\log,i}$ as the logarithmic excess return for a day i and $\mu_{\log}$ as the mean of the logarithmic daily excess returns over the year. We further refer to logarithmic yearly excess returns as excess returns.

Sharpe Ratio

We utilize the Sharpe Ratio to compute a measure for the risk-adjusted returns of the indices. It is defined as the quotient of the excess return and the standard deviation of the excess return and is denoted as

$$SR = \frac{ER_{\log,T}}{\sigma_T} \tag{4.7}$$

and thus measures the trade-off between excess returns and volatility.

Skewness

The skewness of a distribution is a deviation from the normal bell-curve shape and is used in our study as a dependent variable to measure the impact of ESG-performance on the tail risk of the excess returns. A distribution with a positive skew has more mass in its positive tail side, while a distribution with a negative skew has more mass in its negative tail side and thus has a higher chance of extreme values on the negative side. We use Pearson's second measure of skewness defined as

$$\text{Skew} = 3 \times \frac{(\mu_{\log} - \text{med.})}{\sigma_T} \tag{4.8}$$

with med. as the yearly median of excess returns and $\mu_{\log}$ as the yearly mean of excess returns (Jambu, 1991). Figure 1 shows the behavior of the variables over time averaged across the countries in our sample.

Fig. 1. Dependent Variables across Time

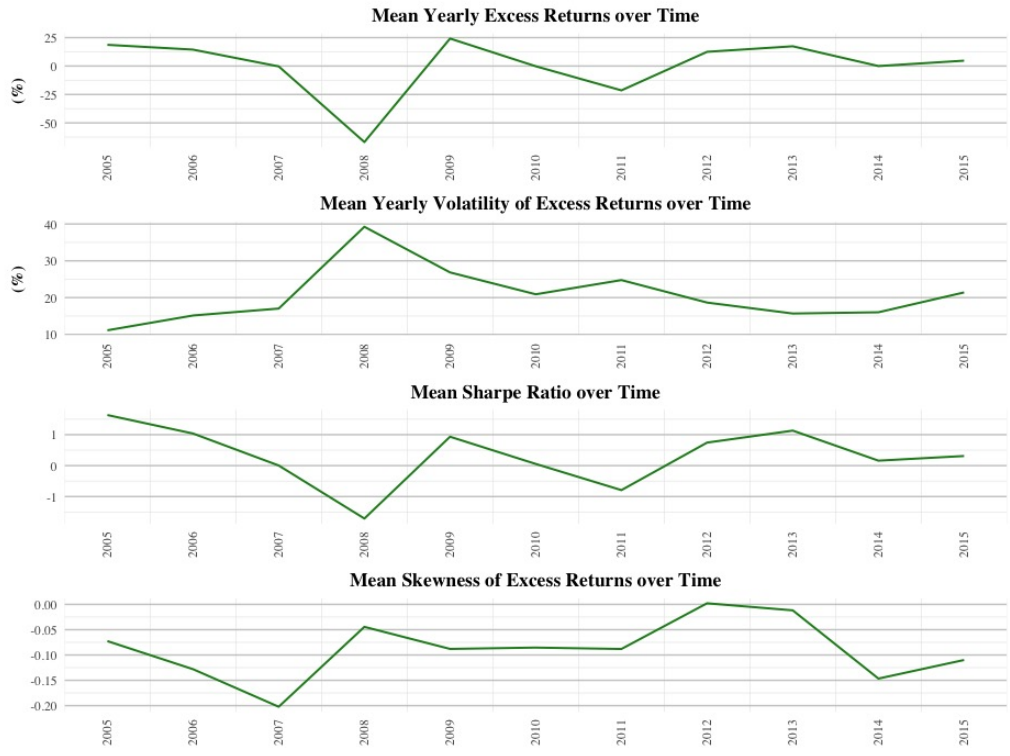
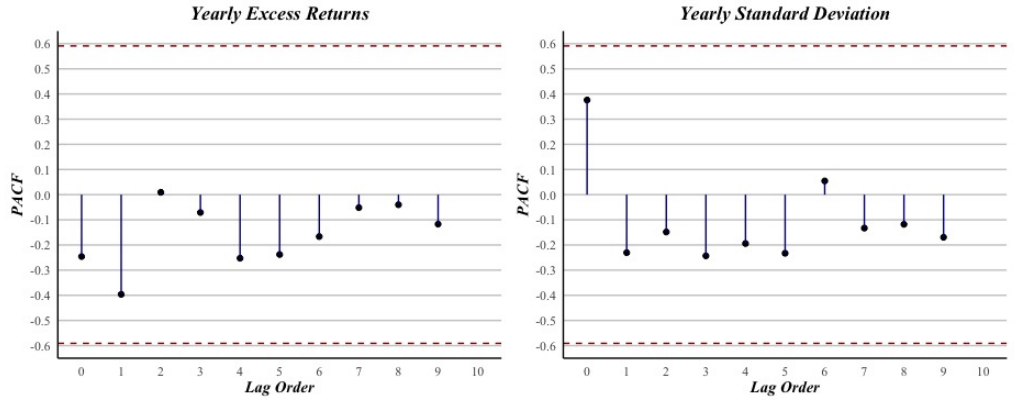


Figure 1 highlights the impact of the Great Financial Crisis of 2007 and 2008 and the sub-

sequent European debt crisis in 2009 and 2010 on the dependent variables. We can observe a large drop in mean excess returns for the sample countries in 2008. The mean volatility for the sample countries exhibits a strong negative correlation with the mean excess returns. The mean skewness of the returns rarely reaches a positive value pointing toward a large tail risk of excess returns over the entire sample period.

To address potential concerns about the autocorrelation of the excess returns and the standard deviation of excess returns, we plot the partial autocorrelation function with a lag order of 10 and a significance level of 5%. We do not find any statistically significant autocorrelation coefficient which is reassuring that the independence assumption is not violated. We use the MSCI World Index as a proxy for the stock indices. The partial autocorrelation plots are displayed in Figure 2.

Fig. 2. Partial Autocorrelation Function



4.2.2 Control Variables

First, we include GDP per capita growth as this is an indicator of the wealth of a country. Unlike Capelle-Blancard et al. (2019) we choose GDP per capita rather than GDP to better measure prosperity as GDP can be misleading. A high GDP per capita is a result of positive growth in a country which will likely have a positive financial impact on a country's most financially relevant companies. This will positively affect stock prices and thus, the index performance.

Second, we choose the inflation rate as a control variable to act as a proxy for a country's

monetary policy. There is considerable research that contradicts the traditional Fisher effect which implies a positive relationship between stock returns and inflation. Particularly, Nelson (1976), Bodie (1976), and Fama and Schwert (1977) all find a negative relationship between stock returns and both the expected and unexpected inflation rate. Hence, we expect the inflation rate to be negatively associated with the index performance.

Third, we include variables to control for the fiscal condition of a country. We include the total gross debt and primary balance of a country, both in relation to GDP. An increase in the national debt is associated with weaker stock price performance according to Wisniewski and Jackson (2021). Thus, we expect higher levels of government debt to be negatively related to index performance.

Fourth, we include the current account in relation to GDP as a measure of competitiveness. The larger the current account, the more competitive the businesses of that country are. Increased competitiveness is expected to be positively related to the index performance.

Fifth, we add a variable to control for the effect of exchange rate movements. We include the real effective exchange rate which measures the strength of a currency compared to a basket of currencies, adjusted for differences in inflation rates. It is defined as the nominal effective exchange rate of a country (where the domestic currency is in the denominator), multiplied by a cost index. The effect of an increase in the real effective exchange rate on the excess returns of an index is ambiguous. As the currency of a country appreciates, the fraction increases and it will be more expensive for international investors to buy stock denominated in the currency and cheaper for domestic investors to buy stocks in other currencies which should have a negative effect on excess returns. On the other hand a lower real effective exchange rate will make a country's exports more competitive, as they become cheaper for international buyers. This would lead to an increase in profitability and subsequently boost excess returns.

Sixth, we include a variable to control for the openness of a country. More specifically, we take into account trade in relation to GDP. An increase in trade leads to increased possibilities for companies within that country to export goods to a larger market and generate superior financial returns. Hence, we believe this variable should be positively related to index perfor-

mance.

Lastly, we use the liquidity ratio of a country. More specifically, we use the ratio of international reserves in months of import to measure how vulnerable a country is to a sudden liquidity crisis. We expect this variable to be positively related to index performance.

Table 1 shows the summary statistics for the dependent variables and control variables used in this study.

Table 1. Summary Statistics of Variables

Variable	Mean	Min	Max	SD
Excess Return	0.28	-111.06	51.06	27.53
Standard Deviation	20.62	7.29	56.49	9.26
Skewness	-0.09	-0.38	0.32	0.13
Sharpe Ratio	0.32	-2.79	3.11	1.07
Primary Balance	-0.64	-29.93	15.77	4.64
Current Account	0.90	-14.60	16.60	5.95
Debt	75.16	9.67	233.29	45.46
GDP/capita	0.62	-10.02	23.20	2.92
Inflation	1.65	-4.48	4.90	1.38
Reserves	2.63	0.03	18.38	3.56
Trade	82.49	24.39	215.43	38.09
Exchange Rate	99.96	69.42	128.27	6.77

4.3 Principal Component Analysis

To quantify the ESG-performance of a country in a way that is applicable for a panel data regression, we apply a statistical dimensionality reduction process to the 18 different performance measures. This also addresses the issue of the reliability of publicly available ESG scores (CFA Institute, 2021). This process, known as principal component analysis, addresses the problem of redundancy within those variables by weighing the respective variables according to how much they contribute to the variance in the original dataset. This practice has the advantage of not relying on subjective weighing criteria for a set of redundant variables which, in a critical analysis of any statistical research, can be seen as a weakness. The ultimate goal of dimensionality reduction is to extract the underlying factors driving the different performance measures. PCA focuses on the variance of the respective variables and identifies linear correlations of

those variables. During the process, variables that are highly correlated with one another are combined into groups.

Table 2 shows the summary statistics of the performance measures that are used to represent the ESG-performance of a country.

Table 2. Summary Statistics for ESG Performance Measures

	Type	Performance Measure	Mean	Min	Max	St. dev.
1	Environmental	CO2 Emissions	8.61	3.99	18.45	3.30
2	Environmental	Combustible renewables and waste	6.02	0.32	24.09	5.42
3	Environmental	Forest area	34.11	9.80	73.74	18.13
4	Environmental	Air pollution	12.09	5.63	23.35	4.20
5	Environmental	Renewable energy output	34.94	2.46	99.47	26.23
6	Environmental	Renewable energy consumption	18.99	1.35	58.56	14.60
7	Governance	Corruption	1.64	-0.19	2.46	0.64
8	Governance	Government Effectiveness	1.55	0.18	2.35	0.47
9	Governance	Political Stability	0.88	-0.47	1.59	0.43
10	Governance	Regulatory Quality	1.45	0.33	1.96	0.37
11	Governance	Rule of Law	1.56	0.27	2.12	0.45
12	Governance	Voice	1.35	0.62	1.74	0.23
13	Social	Health	72.99	30.61	85.51	11.34
14	Social	Demography	17.09	10.76	26.65	2.83
15	Social	Life expectancy	80.91	77.84	83.79	1.18
16	Social	Mortality	4.28	2.50	6.60	0.86
17	Social	Female to male labor participation	80.33	62.33	90.08	6.71
18	Social	Vulnerable employment	11.17	5.06	30.34	5.18

As these performance measures are denominated in different units, the first step of the index construction through PCA is to center and standardize the variables by subtracting the mean ($\bar{A}$) and dividing by the standard deviation (σ_A) of the respective variables A. Thus, the value of the standardized and centered variables is given by:

$$A_i^* = \frac{A_i - \bar{A}}{\sigma_A} \tag{4.9}$$

The result is that all the variables have a mean of zero and a unit standard deviation. This step is a standard procedure in PCA.

In the dataset, we observe a high correlation between variables within the governance category (Appendix D, Table14) which suggests that these variables are driven by one or more

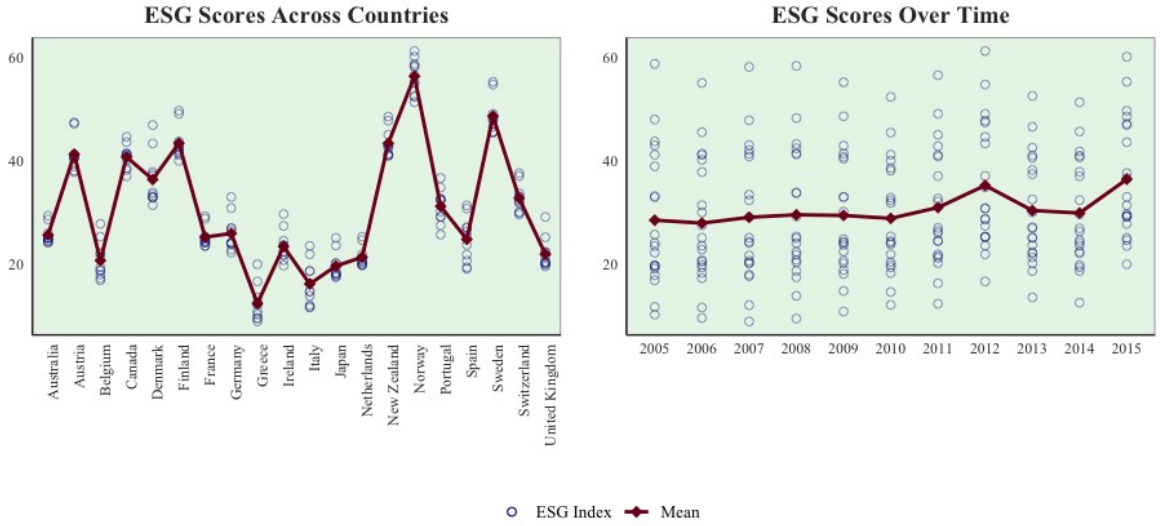
common underlying factors. The same is true for the variables in the environmental and social categories as they exhibit a high correlation with other factors within their corresponding index. To reduce the dimensions in the dataset, PCA creates principal components which are a linear combination of the variables for each country in the original dataset. The principal components are constructed, so that the variance within the resulting component is as big as possible while fulfilling the limitation that the sum of the weights of the variables is equal to one. The first principal component thus explains the largest amount of the variance present in the dataset. Each additional principal component explains less and less variance (Sanguansat, 2012). Compared to the method used by Capelle-Blancard et al. (2019) our approach for the ESG index and sub-index creation is simplified. We only focus on the first principal component, as it explains the most amount of variance. Hence, the ESG index we construct is based solely on the weight assigned to the performance measures by the first principal component of the PCA. The sub-indices are constructed by applying the same method solely to the respective performance measures that correspond to each sub-index (only environmental factors for the Environmental index, only social factors for the Social index, and only governance factors for the Governance index). The last step of PCA involves matrix multiplication, where the principal components are projected onto the original data. Here, the corresponding weight for a variable in the principal component is multiplied by the original data point. This process is repeated for the entire time period.

Table 3. ESG Index Scores Ranked

Country	ESG Avg.	Rank ESG	E Avg.	Rank E	S Avg.	Rank S	G Avg.	Rank G	ER Total	Rank ER
Norway	56.38	1	86.98	1	27.56	1	4.24	6	75.5%	2
Sweden	48.67	2	81.90	2	24.95	3	4.29	4	41.6%	4
Finland	43.44	3	69.81	3	23.98	4	4.53	1	7.3%	9
New Zealand	43.42	4	62.42	5	23.16	6	4.37	3	34.0%	5
Austria	41.30	5	67.32	4	19.45	12	3.83	10	-26.6%	18
Canada	40.77	6	52.55	6	23.89	5	3.98	8	11.9%	8
Denmark	36.40	7	35.19	9	26.26	2	4.46	2	101.1%	1
Switzerland	32.79	8	45.83	8	14.50	17	4.26	5	17.8%	7
Portugal	31.22	9	47.98	7	15.13	15	2.46	17	-12.6%	15
Germany	25.96	10	23.12	13	19.09	13	3.67	12	67.0%	3
Australia	25.65	11	12.52	16	20.38	9	3.93	9	2.0%	10
France	25.25	12	20.53	14	21.24	7	3.02	16	-5.6%	14
Spain	24.81	13	30.99	10	15.01	16	2.22	18	-19.3%	17
Ireland	23.46	14	11.02	18	19.81	10	3.71	11	-16.4%	16
United Kingdom	21.95	15	7.12	19	20.67	8	3.56	13	1.2%	11
Netherlands	21.36	16	5.52	20	19.48	11	4.10	7	-1.2%	12
Belgium	20.71	17	11.04	17	17.91	14	3.26	14	-2.0%	13
Japan	19.66	18	29.64	11	8.24	18	3.08	15	26.1%	6
Italy	16.18	19	25.49	12	4.66	19	1.38	19	-61.7%	19
Greece	12.40	20	19.98	15	3.13	20	1.11	20	-177.7%	20

As a result, we get a condensed performance measure for every country in every year, the ranked average for which can be seen in Table 3 along with the total logarithmic excess return over the sample period. Figure 3 depicts the heterogeneity of the obtained ESG index over the dimensions of time and country. The heterogeneity plots for the sub-indices are depicted in Appendix B, Figure 4. We observe very similar results to the analysis by Capelle-Blancard et al. (2019). For instance, Norway is the highest-performing country on the ESG index as well as the Environmental and Social indices. It ranks as the sixth best on the Governance index. Capelle-Blancard et al. (2019) obtain the same ranking for Norway. Further, we observe that the Nordic countries score high on the ESG index ranking which is in line with our expectations. We see that the variation in the ESG index is mainly across countries and not over time.

Fig. 3. ESG Index Scores across countries and time



4.4 Regression Specifications

Since the panel dataset has both time-series and cross-sectional dimensions we utilize a pooled OLS regression with country-fixed effects for our analysis. We estimate the fixed effects model using robust standard errors (Wooldridge, 2020). The basic model thus takes the following form:

$$\begin{aligned}\text{Excess Return}_{i,t} = {} & \beta_0 + \beta_1 \times \text{ESG}_{i,t-1} + \beta_2 \times \text{Inflation}_{i,t} \\ & + \beta_3 \times \text{Real Exchange Rate}_{i,t} + \beta_4 \times \text{Trade to GDP}_{i,t} \\ & + \beta_5 \times \text{GDP per Capita growth}_{i,t} + \beta_6 \times \text{Reserves in Months of Import}_{i,t} \\ & + \beta_7 \times \text{Debt to GDP}_{i,t} + \beta_8 \times \text{Primary Balance to GDP}_{i,t} \\ & + \beta_9 \times \text{Current Account to GDP}_{i,t} + \varepsilon_{i,t}\end{aligned} \tag{\textbf{Model 1}}$$

with $t = 1$ to T (number of years) and $i = 1$ to n (number of countries). We closely follow the method of Capelle-Blancard et al. (2019) in lagging the ESG variable by one period, thus addressing potential issues of endogeneity and potential bias from bidirectional causality where the excess return and the ESG-performance might impact each other within the same time period. We also introduce an extended model, focusing on the sub-components of the ESG index as individual independent variables in the model:

$$\begin{aligned}\text{Excess Return}_{i,t} = {} & \beta_0 + \beta_1 \times E_{i,t-1} + \beta_2 \times S_{i,t-1} + \beta_3 \times G_{i,t-1} \\ & + \beta_4 \times \text{Inflation}_{i,t} + \beta_5 \times \text{Real Exchange Rate}_{i,t} \\ & + \beta_6 \times \text{Trade to GDP}_{i,t} + \beta_7 \times \text{GDP per Capita growth}_{i,t} \\ & + \beta_8 \times \text{Reserves in Months of Import}_{i,t} + \beta_9 \times \text{Debt to GDP}_{i,t} \\ & + \beta_{10} \times \text{Primary Balance to GDP}_{i,t} + \beta_{11} \times \text{Current Account to GDP}_{i,t} \\ & + \varepsilon_{i,t}\end{aligned} \tag{\textbf{Model 2}}$$

The third model introduces the volatility of excess returns as an independent variable:

$$\begin{aligned}\text{Volatility}_{i,t} = {} & \beta_0 + \beta_1 \times \text{ESG}_{i,t-1} + \beta_2 \times \text{Inflation}_{i,t} \\ & + \beta_3 \times \text{Real Exchange Rate}_{i,t} \\ & + \beta_4 \times \text{Trade to GDP}_{i,t} + \beta_5 \times \text{GDP per Capita growth}_{i,t} \\ & + \beta_6 \times \text{Reserves in Months of Import}_{i,t} + \beta_7 \times \text{Debt to GDP}_{i,t} \\ & + \beta_8 \times \text{Primary Balance to GDP}_{i,t} + \beta_9 \times \text{Current Account to GDP}_{i,t} \\ & + \varepsilon_{i,t}\end{aligned} \tag{\textbf{Model 3}}$$

We examine **Model 4** and **Model 5** where we investigate the relationship between ESG-performance and the risk-adjusted return of an index. We continue applying the basic and the extended model to every dependent variable we introduce from here on, to reveal the individual link between those variables and the Environmental, Social, and Governance indices.

$$\begin{aligned}\text{Sharpe Ratio}_{i,t} = {} & \beta_0 + \beta_1 \times \text{ESG}_{i,t-1} + \beta_2 \times \text{Inflation}_{i,t} \\ & + \beta_3 \times \text{Real Exchange Rate}_{i,t} + \beta_4 \times \text{Trade to GDP}_{i,t} \\ & + \beta_5 \times \text{GDP per Capita growth}_{i,t} + \beta_6 \times \text{Reserves in Months of Import}_{i,t} \\ & + \beta_7 \times \text{Debt to GDP}_{i,t} + \beta_8 \times \text{Primary Balance to GDP}_{i,t} \\ & + \beta_9 \times \text{Current Account to GDP}_{i,t} + \varepsilon_{i,t}\end{aligned} \tag{\textbf{Model 4}}$$

$$\begin{aligned}\text{Sharpe Ratio}_{i,t} = {} & \beta_0 + \beta_1 \times E_{i,t-1} + \beta_2 \times S_{i,t-1} + \beta_3 \times G_{i,t-1} \\ & + \beta_4 \times \text{Inflation}_{i,t} + \beta_5 \times \text{Real Exchange Rate}_{i,t} \\ & + \beta_6 \times \text{Trade to GDP}_{i,t} + \beta_7 \times \text{GDP per Capita growth}_{i,t} \\ & + \beta_8 \times \text{Reserves in Months of Import}_{i,t} + \beta_9 \times \text{Debt to GDP}_{i,t} \\ & + \beta_{10} \times \text{Primary Balance to GDP}_{i,t} + \beta_{11} \times \text{Current Account to GDP}_{i,t} + \varepsilon_{i,t}\end{aligned} \tag{\textbf{Model 5}}$$

To gain a more comprehensive understanding of the relationship between ESG-performance and market risk we examine the tail risk, by using the skewness (see 4.8) of the excess returns

as a dependent variable in **Model 6** and **Model 7**. These additional models are partly motivated by the research conducted by Zhang et al. (2021) on the link between a company's ESG rating and the implied tail risk. We expect that there is a significant positive relationship between the ESG-performance of a country and the skewness of excess returns of a country's stock index.

$$\begin{aligned}\text{Skew. of Excess Returns}_{i,t} = {} & \beta_0 + \beta_1 \times \text{ESG}_{i,t-1} + \beta_2 \times \text{Inflation}_{i,t} \\ & + \beta_3 \times \text{Real Exchange Rate}_{i,t} + \beta_4 \times \text{Trade to GDP}_{i,t} \\ & + \beta_5 \times \text{GDP per Capita growth}_{i,t} + \beta_6 \times \text{Reserves in Months of Import}_{i,t} \\ & + \beta_7 \times \text{Debt to GDP}_{i,t} + \beta_8 \times \text{Primary Balance to GDP}_{i,t} \\ & + \beta_9 \times \text{Current Account to GDP}_{i,t} + \varepsilon_{i,t}\end{aligned}$$

(**Model 6**)

$$\begin{aligned}\text{Skew. of Excess Returns}_{i,t} = {} & \beta_0 + \beta_1 \times E_{i,t-1} + \beta_2 \times S_{i,t-1} + \beta_3 \times G_{i,t-1} \\ & + \beta_4 \times \text{Inflation}_{i,t} + \beta_5 \times \text{Real Exchange Rate}_{i,t} \\ & + \beta_6 \times \text{Trade to GDP}_{i,t} + \beta_7 \times \text{GDP per Capita growth}_{i,t} \\ & + \beta_8 \times \text{Reserves in Months of Import}_{i,t} + \beta_9 \times \text{Debt to GDP}_{i,t} \\ & + \beta_{10} \times \text{Primary Balance to GDP}_{i,t} + \beta_{11} \times \text{Current Account to GDP}_{i,t} + \varepsilon_{i,t}\end{aligned}$$

(**Model 7**)

To test **Hypothesis 3** we introduce a first- and second-stage instrumental variable regression model. The purpose of the first stage is to predict the behavior of the main independent variable in **Model 1** (ESG-performance) through the instrumental variable, the ESG news index:

$$\begin{aligned}\text{ESG}_{i,t} = {} & \gamma_0 + \gamma_1 \times \mu_{\text{ESG News Index},i,t-1} + \gamma_2 \times \text{Inflation}_{i,t} \\ & + \gamma_3 \times \text{Real Exchange Rate}_{i,t} + \gamma_4 \times \text{Trade to GDP}_{i,t} \\ & + \gamma_5 \times \text{GDP per Capita growth}_{i,t} + \gamma_6 \times \text{Reserves in Months of Import}_{i,t} \\ & + \gamma_7 \times \text{Debt to GDP}_{i,t} + \gamma_8 \times \text{Primary Balance to GDP}_{i,t} \\ & + \gamma_9 \times \text{Current Account to GDP}_{i,t} + \varepsilon_{i,t}\end{aligned}$$

(**Model 8: First Stage**)

The purpose of the second stage is to use the predicted values of the ESG-performance obtained during the first stage in the main regression equation (**Model 1**). The second stage thus assesses the impact of the potentially endogenous ESG-performance variable on the main dependent variable (Excess Returns).

$$\begin{aligned}\text{Excess Return}_{i,t} = {} & \delta_0 + \delta_1 \times \widehat{\text{ESG}_{i,t-1}} + \delta_2 \times \text{Inflation}_{i,t} \\ & + \delta_3 \times \text{Real Exchange Rate}_{i,t} + \delta_4 \times \text{Trade to GDP}_{i,t} \\ & + \delta_5 \times \text{GDP per Capita growth}_{i,t} + \delta_6 \times \text{Reserves in Months of Import}_{i,t} \\ & + \delta_7 \times \text{Debt to GDP}_{i,t} + \delta_8 \times \text{Primary Balance to GDP}_{i,t} \\ & + \delta_9 \times \text{Current Account to GDP}_{i,t} + \varepsilon_{i,t}\end{aligned}$$

(**Model 8: Second Stage**)

with $\widehat{\text{ESG}_{i,t-1}}$ denoting the predicted ESG-performance from the first stage in the second stage, γ and δ representing the coefficients for the first and second stages, respectively, and $\mu_{\text{ESG News Index},i,t-2}$ representing the mean of the ESG news index, used as the instrumental variable, lagged by two periods $(t-2)$ in the first stage[2].

[2]One period with respect to the other variables.

5 Results

The following section presents our empirical findings using the data and methodology described above and is divided into five subsections. The first subsection covers the relationship between ESG and excess returns of stock indices followed by a sensitivity and robustness analysis. The second subsection presents our findings concerning the relationship between ESG and volatility of stock indices. The third subsection examines any relationship between ESG, tail risk, and risk-adjusted returns. The fourth section presents our findings relating to the causality between ESG-performance and excess returns. The final section presents the limiting factors of the study and introduces suggestions for further research.

5.1 Relationship Between ESG-Performance and Excess Returns

5.1.1 Model 1 Results

We estimate **Model 1** for the entire sample period and all countries and present the results from the panel data regression in Table 4. **Model 1** shows that the ESG index is positively correlated with the excess returns on a 1% significance level. More specifically, the coefficient of ESG is 2.008 which means that a 1 unit increase in the ESG index corresponds to an increase in the excess returns of a stock index by approximately 2%. Furthermore, we see statistically significant coefficients for the rate of inflation, real effective exchange rate, trade, GDP per capita, and reserves. The coefficient of inflation is noticeably greater than that of i.e. GDP per capita. A possible explanation could be that we are studying a time period during which the change in inflation rates has been relatively low for the countries we have in our sample, with some countries even experiencing deflation (see 4.2.2). At the same time, the period is characterized by large downturns in the stock markets through the GFC and the European debt crisis (We control for the GFC by conducting a robstuness test in section 5.1.3). Thus, the relative effect of a unit increase in inflation (which would be the same as a 100 basis point increase) would be of great magnitude. In Table 4 we observe for **Model 1**, that a 100 basis point increase

in inflation would correspond to a decrease in the excess returns of approximately 9.5%. The GDP per capita coefficient is significant and positively correlated with excess returns which is in line with our expectations. As the economy grows, the companies within that economy reap the benefits of increased growth through improved financial performance and subsequently, improved share performance which drives the excess returns. The coefficient of GDP per capita growth is 1.617 which means that a 100 basis point increase in GDP growth corresponds to an increase in excess returns of approximately 1.6%. The real effective exchange rate is significantly negatively associated with the excess returns. As the currency of a country appreciates, foreign investors might perceive the shares on the main index as more expensive relative to similar assets denominated in different currencies. Hence, they might choose to invest elsewhere. Furthermore, domestic investors might perceive foreign assets as cheap relative to domestic assets as their own currency has appreciated. This might lead them to invest in stocks of companies based abroad rather than investing in stocks on the major domestic index. We find that the international reserves, measuring the liquidity of a country are positively related to excess returns of the major stock index in **Model 1**. This is in line with expectations and a possible explanation could be that large reserves signal the stability of an economy and thus promote investors' confidence which leads to increased investments into the stock index and subsequently higher excess returns. The coefficient for trade is negative which is the opposite of what we expect. A possible explanation could be found in the study by Silva et al. (2023). The authors found that stocks in countries that had a higher level of trade openness were more exposed to the shock of the GFC. They conclude that trade dependence was a factor in explaining a country's vulnerability and thus lower returns. Since a significant part of the variation in the sample is explained by the GFC, it seems reasonable that the trade coefficient is negative. We conclude that these results are in line with **Hypothesis 1** that there is a positive relationship between ESG-performance and excess returns.

5.1.2 Model 2 Results

Table 4 also allows us to further analyze the effect of different sub-components of ESG on excess returns through the extended model (**Model 2**). We find the social index is positively

related to excess returns and statistically significant at 5%. This is the only significant sub-component of the ESG index. This leads us to conclude that social factors are driving the effects measured in **Model 1**. Furthermore, these findings are in line with the research by Edmans (2011) which finds that social factors, such as employee satisfaction, are positively correlated with shareholder returns. We conclude that these findings support **Hypothesis 2** that the sub-components of the ESG index are heterogeneously correlated with excess returns, with the social index having the most significant correlation with excess returns.

Looking further into the social index, we examine certain factors that could explain the positive association with excess returns. First, an improvement in the female-to-male labor participation ratio could result in a larger talent pool available for companies in a country. Not only would increased female labor participation likely improve efficiency by offering a larger talent pool for high-quality jobs. It would also mean businesses and organizations could engage in activities and projects that they could not do before by having access to a larger total labor force. This would in turn increase the economic expansion of a country. In an article by Gunzberg et al. (2018), the authors examine women's labor participation in the United States and state that if these levels were in line with other advanced economies, it would translate to an average of 20 basis points increase in GDP. Furthermore, they state that on average, a 100 basis points increase in GDP growth translates to 340 basis points in return on the S&P 500. Thus, an increase in female labor participation could boost the S&P 500 by roughly 70 basis points. Since we do not include the United States in the sample and we investigate these effects on cross-country levels, we cannot translate the exact estimations made by the authors. However, we suspect similar dynamics could be driving the relationship between ESG-performance and excess returns in our sample. We see that the countries that score the highest on the social index (Norway, Denmark, and Sweden) are also the countries with the highest female-to-male labor market participation rate. Next, we investigate the demographic factor of the social index. In the study by Goyal (2004), the author investigates the relationship between age structure, net outflows, and returns on the stock market. The existing literature is largely derived from the lifecycle theory of consumption. In the article, Goyal (2004) states that consumers invest differently depending on their life stage since their financial wealth differs greatly. At a young age,

consumers do not have considerable means left for investing, and at an older age, consumers will not reap the benefits of their investments. Hence, consumers invest less during these life stages compared to middle-aged consumers who invest the most due to increased wealth and greater willingness to save. The author's findings suggest that the lifecycle theory of consumption holds. The results show that there is a positive relationship between outflows from the stock market and an increase in the share of the elderly population. Furthermore, Goyal finds a decrease in stock returns following an increase in the elderly population. Brunetti and Torricelli (2010) obtain similar results in their study of dynamics between asset returns and an aging population. Their research is focused on an investigation of Italy between 1973 and 2004 due to the country's high ratio of elderly population. The findings from the research presented above seem to be in line with the data we use in our models. The countries scoring the worst on the social dimension (Italy, Japan, and Greece) are also the countries with the largest share of elderly population. We believe this could be one of the potential factors in explaining the positive relationship between ESG-performance and excess returns.

Finally, we examine the vulnerable employment factor pertaining to the Social index. A study by Yerrabati (2022) examines the relationship between vulnerable employment and economic growth. The author suggests that the relationship is non-linear. More specifically, Yerrabati states that the relationship is U-shaped and thus, there is a negative relationship at lower levels of vulnerable employment and a positive relationship at higher levels. Furthermore, it is suggested that the inflection point for vulnerable employment in this dynamic is at approximately 51%. Since our sample mainly includes developed economies, we conclude that there is likely a negative relationship between vulnerable employment and economic growth for the countries in our sample. Decreased vulnerable employment would thus be associated with increased economic growth which in turn, is most likely associated with higher excess returns. To conclude, we suggest that our findings are in line with previous literature suggesting that factors focused on human capital are positively related to excess returns.

The Environmental index shows no significant relationship with excess returns. A potential explanation for this could be that environmental issues take considerably longer to materialize than governance issues. As a result, the lagged environmental variable in the analysis is

potentially mismatched with the performance measurement of returns and thus, no significant relationship can be established. In the study by Capelle-Blancard et al. (2019) the authors find similar results when investigating the relationship between a country's ESG-performance and sovereign bond spreads. They find no significant relationship between spreads and the Environmental sub-component of ESG and point toward the long-term nature of the variable. To contrast this, Margaretic and Pouget (2018) did find the Environmental sub-component (and Social) of ESG to be significantly positively related to sovereign bond spreads in the short-term and negatively related in the long-term. They explain this by financial markets potentially interpreting green policies as a cost in the near term, as these issues take many years to materialize. Different from our sample, Margaretic and Pouget (2018) perform their analysis on a sample of emerging market economies while we focus on developed economies, like Capelle-Blancard et al. (2019). It is possible that our Environmental index would be significantly related to excess returns if we included emerging market economies in our sample and propose this as a reference for future studies. Additionally, it is entirely possible that the factors which our Environmental index consists of are not valued by investors in the short-term. Including a different set of environmental factors in our analysis would perhaps yield a different result. In conclusion, the Environmental index does not have a significant relationship with the excess returns of a country's most financially significant companies.

The Governance index does not exhibit any significant relationship with excess returns. We believe that a possible explanation could be found in the findings by Capelle-Blancard et al. (2019) and Margaretic and Pouget (2018). In both articles, the authors suggest that the financial markets value the governance factors more than the other ESG sub-components, as their effects are more short-term. Therefore, we suspect that the governance factors might be significantly associated with excess returns in a contemporaneous study or one where the time lag on the sub-components could be reduced to one month. Furthermore, we see that there is relatively little variation in the Governance index over time for our sample countries (Figure 4). The limited variation could be the reason for the insignificant relationship with excess returns. As our sample mainly consists of relatively well-governed countries, it is not surprising that there is limited variation in the Governance index. This further suggests that the study should be

expanded to include emerging market economies. Another potential explanation for why the Governance index is not significantly related to excess returns could be that governance captures the overall legal and political stability of a country which is not well captured when examining excess returns. A potentially better measure to capture the effects of the Governance index is to study its relationship with risk-adjusted returns for which the results will be presented below.

We would also like to highlight the difference in the magnitude of the coefficients across the sub-indices. The principal component analysis does not give standardized values across the sub-indices, meaning the scaling of e.g. the Governance index is not the same as the Social and Environmental indices. As a result, the coefficients of the sub-indices are not comparable unless they are adjusted for scaling[3].

[3]The highest-scoring country for the Environmental index is Norway with 86.98 and the lowest scoring is the Netherlands with 5.52. The average highest-scoring country for the Social index is Norway with 27.56 and the lowest scoring is Greece with 3.13. The average highest-scoring country for the Governance index is Finland with 4.53 and the lowest scoring is Greece with 1.11.

Table 4. Model 1 & 2 Regression Results

	Dependent variable:	
	Excess Return	
	Model 1	Model 2
	(1)	(2)
ESG (lagged)	2.008**	
	(0.637)	
E (lagged)		−0.785
		(0.472)
S (lagged)		1.234*
		(0.544)
G (lagged)		26.434
		(17.650)
Inflation	−9.523***	−11.510***
	(0.965)	(1.053)
Exchange Rate	−1.040***	−1.338***
	(0.179)	(0.280)
Trade	−1.101***	−1.150**
	(0.319)	(0.360)
GDP/capita	1.617*	1.949
	(0.644)	(0.996)
Reserves	3.733***	4.939***
	(0.928)	(1.446)
Debt	−0.039	0.365
	(0.225)	(0.189)
Primary Balance	−0.073	0.293
	(0.548)	(0.532)
Current Account	−0.080	0.464
	(0.867)	(1.010)
Number of Observations:	200	200
R-squared:	0.353	0.382
Adjusted R-squared:	0.247	0.272
Note:	*p<0.05; **p<0.01; ***p<0.001	

5.1.3 Sensitivity and Robustness Analysis

We conduct several sensitivity analyses and robustness checks to verify the validity of our results. First, we start by excluding Greece from the sample. As can be seen in Figures 3 and 5 (Appendix B), Greece is an outlier, both in terms of ESG-performance, excess returns, and volatility. The results produced by this analysis can be seen in Table 5 and show that the coefficient of ESG has the same sign and significance level when Greece is excluded from the sample. We observe that the coefficients of all independent variables, except for inflation,

decrease when performing the robustness test. The R^2 increases slightly, which is to be expected when outliers are excluded.

Next, we conduct a second robustness check and exclude the Global Financial Crisis from our sample and the years leading up to it. As can be seen in Figure 1, the years between 2005 and 2008 have some of the greatest variation in the excess returns. Hence, these years might be driving the variation for the entire sample, and by excluding them, we decrease the effect of the financial crisis. The results from this analysis can be seen in Table 5 which shows that the coefficient of the ESG index has the same sign and significance level, indicating that ESG is significantly positively correlated with excess returns in the years following the GFC. Furthermore, we observe that the magnitude of the coefficient of the ESG index increases when excluding the GFC. This is not surprising as the years excluded from our sample included significant movement in the excess returns. Hence, a unit increase in the ESG index would have a larger relative effect in the wake of the financial crisis and thus, the magnitude of the coefficient increases. Additionally, we observe that the coefficient of trade becomes insignificant when removing the GFC from the sample. A possible reason for this could be that trade openness is correlated with excess returns during economic shocks. When removing the time period of the GFC, trade openness becomes insignificant as the sample no longer includes the most volatile time period. As expected, we observe a decline in the coefficient for inflation when removing the GFC from our sample period. The rates of inflation for this time period now coincide with less volatile stock market returns. The R^2 for this robustness check increases relative to **Model 1**.

The final robustness test involves using the country-specific risk-free rates in the calculation of the excess returns. Potentially, some investors are not able to invest in the 10-year US treasury notes for various reasons, but would still like to receive a risk-free return. They would thus have to invest in domestic government debt such as the domestic 10-year government bond. We see the issues of using country-specific bonds as a proxy for risk-free rates as sovereign bonds of all countries are not risk-free, which the European debt crisis showed. However, for domestic investors, the potential inability to purchase foreign debt, the increased currency exposure from investing abroad, and home bias might limit them to investing domestically. Hence, a more

realistic proxy for the risk-free rate might be the country-specific 10-year sovereign bonds. In Table 5 we present the findings from this analysis. We observe that the ESG index stays significantly positively related to excess returns. Here, the R^2 also increases relative to **Model 1**. From the sensitivity analyses and robustness checks presented above, we conclude that the estimations of our model are robust to both changes in the model and adjustments in the sample composition.

Table 5. Robustness Test Results

	Dependent variable: Excess Return			
	Model 1	Excluding Greece	Excluding GFC	Individual RFR
	(1)	(2)	(3)	(4)
ESG (lagged)	2.008^{**}	1.609^{**}	3.143^{***}	2.162^{**}
	(0.637)	(0.556)	(0.456)	(0.659)
Inflation	-9.523^{***}	-10.162^{***}	-2.736^{**}	-9.916^{***}
	(0.965)	(0.890)	(1.018)	(0.949)
Exchange Rate	-1.040^{***}	-0.988^{***}	-0.699^{***}	-1.054^{***}
	(0.179)	(0.182)	(0.177)	(0.191)
Trade	-1.101^{***}	-1.028^{***}	-0.384	-1.126^{***}
	(0.319)	(0.291)	(0.263)	(0.333)
GDP/capita	1.617^{*}	1.431^{*}	-0.522	1.946^{**}
	(0.644)	(0.662)	(0.876)	(0.669)
Reserves	3.733^{***}	3.513^{***}	2.296	3.869^{***}
	(0.928)	(0.940)	(1.369)	(0.957)
Debt	-0.039	0.098	-0.174	-0.078
	(0.225)	(0.193)	(0.321)	(0.233)
Primary Balance	-0.073	0.290	0.607	-0.104
	(0.548)	(0.485)	(0.454)	(0.609)
Current Account	-0.080	-0.220	1.476	-0.276
	(0.867)	(0.891)	(1.216)	(0.860)
Number of Observations:	200	190	120	200
R-squared:	0.353	0.38	0.404	0.367
Adjusted R-squared:	0.247	0.277	0.22	0.263
Note:				*p<0.05; **p<0.01; ***p<0.001

5.2 Relationship Between ESG-Performance and Volatility

Model 3 aims to examine the nature of the relationship between the ESG-performance of a country and the volatility of the excess returns on its major stock index. The results in Table 6 appear to confirm **Hypothesis 4**. However, when controlling for excess returns ESG is no longer significant indicating that the results are not robust. This leads us to conclude that there is no significant correlation between ESG performance and volatility over our sample time period. These results are unexpected given the significant positive correlation between the ESG-performance and the excess return in Table 4 and the relationship between volatility and excess return. A possible explanation for why we fail to establish a relationship between ESG and volatility could be that any potential value placed on ESG-performance by the market is reflected in the excess returns and not in the volatility. This would mean that market participants do not view a good ESG-performance as a tool for mitigating risk as expressed by the volatility of excess returns. Another reason could be that volatility is not the appropriate measure for the markets' measurement of risk related to ESG.

Lastly, another reason for the observed results could be that our sample period is dominated by the GFC (see Figure 1) and the subsequent European debt crisis between the years 2009 and 2010. We observe a negative correlation between excess returns and stock market volatility which means that this time period exhibits a risk-return relationship which is likely not representative of average long-term market conditions, as increased risk should typically be rewarded through higher returns. The long-term underlying relationship between ESG-performance and volatility of excess returns might thus be distorted in our sample time period. Further research on an extended time period could mitigate these effects and lead to different and more insightful results. GDP growth is significant at the 0.1% level and seems to be negatively related to stock market volatility over our sample and time period. This negative relationship in our regression is supported by findings from Beetsma and Giuliodori (2012), who investigate the nature of the negative relationship between volatility shocks in the stock market and the economic growth rate.

Table 6. Model 3 Regression Results

	Dependent variable:	
	Standard Deviation With Excess Returns	Model 3
ESG (lagged)	−0.150	−0.574**
	(0.176)	(0.205)
Excess Return	−0.212***	
	(0.015)	
GDP/capita	−0.990***	−1.332***
	(0.199)	(0.195)
Current Account	0.551	0.568
	(0.317)	(0.328)
Inflation	−0.811	1.203*
	(0.494)	(0.602)
Exchange Rate	−0.164**	0.056
	(0.059)	(0.071)
Trade	−0.024	0.209
	(0.095)	(0.114)
Reserves	−0.310	−1.100***
	(0.183)	(0.229)
Debt	−0.043	−0.034
	(0.044)	(0.067)
Primary Balance	−0.010	0.005
	(0.123)	(0.218)
Number of Observations:	200	200
R-squared:	0.585	0.238
Adjusted R-squared:	0.515	0.114
Note:	*p<0.05; **p<0.01; ***p<0.001	

5.3 Results for Other Measures

We now consider additional performance measures. More specifically, we examine **Model 4** and **Model 5** where we investigate the relationship between ESG-performance and the risk-adjusted return of an index. Since we find that the ESG index is positively associated with excess returns, and we cannot find any relationship between the ESG index and the volatility of an index, we expect that there is a significant positive relationship between ESG-performance and the Sharpe ratio of an index. We want to further develop this analysis and include the extended model when testing for potential effects on the Sharpe ratio. Hence, we test if the different components of ESG have different levels of impact on the Sharpe ratio of a stock index. We expect that the Social component has the most significant positive impact. The results for the

estimated coefficients can be seen in Table 7. Starting with the basic model, we observe that the ESG index is significantly positively related to the Sharpe ratio at the 0.1% significance level. The control variables exhibit similar behavior as in Table 4 which is expected. In Table 7 we see the results of **Model 4**, which show that the Social index is positively related to the Sharpe ratio at 0.1% significance level. Furthermore, we find that the Governance index is positively related to the Sharpe ratio at a 1% significance level. We find this particularly interesting, as this resonates well with the reasoning presented in the papers by both Capelle-Blancard et al. (2019) and Margaretic and Pouget (2018) who suggest that governance is a good indicator for the stability of a country. We find that the markets' appreciation of stable governance can be observed through risk-adjusted returns, as opposed to when the excess returns and volatility are examined independently. This leads us to conclude that risk-adjusted returns provide a better measurement of the financial markets' recognition of a country's stability. Overall, these results suggest that macro-level Social and Governance factors are positively related to the risk-adjusted stock performance of a country's major stock index.

Table 7. Model 4 & 5 Regression Results

	Dependent variable:	
	Sharpe Ratio	
	Model 4	Model 5
	(1)	(2)
ESG (lagged)	0.118***	
	(0.027)	
E (lagged)		−0.016
		(0.030)
S (lagged)		0.084***
		(0.020)
G (lagged)		1.825**
		(0.597)
GDP/capita	0.060**	0.081*
	(0.022)	(0.033)
Current Account	−0.019	0.007
	(0.031)	(0.034)
Inflation	−0.302***	−0.410***
	(0.033)	(0.040)
Exchange Rate	−0.028***	−0.045***
	(0.007)	(0.010)
Trade	−0.036**	−0.041**
	(0.013)	(0.013)
Reserves	0.123***	0.178***
	(0.024)	(0.041)
Debt	−0.006	0.016*
	(0.009)	(0.008)
Primary Balance	0.016	0.040*
	(0.019)	(0.019)
Number of Observations:	200	200
R-squared:	0.297	0.361
Adjusted R-squared:	0.182	0.247
Note:	*p<0.05; **p<0.01; ***p<0.001	

Since we are not able to observe a clear link between stock market volatility and ESG-performance, we conclude that the relationship between market risk and ESG-performance is more multifaceted. We further investigate these relationships through **Model 6** and **Model 7**, the results for which are displayed in Table 8. For **Model 6** we observe a positive relationship between the skewness of excess returns and the ESG-performance at a 0.1% significance level. The coefficient on the ESG-performance is 0.018, meaning a one-unit increase in ESG-performance corresponds to a 0.018-unit increase in skewness, meaning a reduction in the negative tail risk of excess returns. Further examination of the control variables speaks to

the complexity of analyzing tail risk comprehensively, with the only significant control variable being the current account to GDP ratio at a significance level of 5%. **Model 7** reveals a positive link between the Environmental performance and skewness of excess returns at a significance level of 5% as well as a positive link between the Social performance and skewness of excess returns at a significance level of 1%. The coefficients are to be interpreted as a 0.009 unit increase in skewness for every unit increase in Environmental performance and a 0.013 unit increase in skewness for every unit increase in Social performance. The results do not change significantly when additionally controlling for excess returns and volatility of excess returns. Our results are in line with the findings of Lööf and Stephan (2019) who suggest that reduced downside risk is not only valued by investors but also by debt holders. As the risk of the individual company is reduced, the cost of debt is reduced. The study by A. G. Hoepner et al. (2018) yield similar results. The authors find that shareholder engagement, particularly on environmental issues, results in the reduction of downside risk. Since our research focuses on indices rather than individual companies, we only examine systematic downside risk and hence, cannot draw any conclusions on company-specific levels. The Governance factor seems to be insignificant in modeling the skewness of excess returns. In light of our findings concerning **Model 3**, we conclude that market participants might see better ESG-performance as a risk mitigation tool when market risk is expressed through skewness as opposed to volatility. Overall, our results indicate that a country's performance regarding social and environmental issues is significantly related to reduced downside tail risk for that country's major stock index.

Table 8. Model 6 & 7 Regression Results

	Dependent variable: Skewness			
	ESG	E,S,G	ESG W/o Ret./Stdv.	E,S,G W/o Ret./Stdv.
	(1)	(2)	(3)	(4)
ESG (lagged)	0.018**		0.018**	
	(0.005)		(0.005)	
E (lagged)		0.009*		0.009*
		(0.004)		(0.004)
S (lagged)		0.013**		0.013**
		(0.004)		(0.004)
G (lagged)		0.051		0.054
		(0.079)		(0.075)
Excess Return	0.001	0.0004		
	(0.001)	(0.001)		
Yearly Stdev.	0.002	0.001		
	(0.002)	(0.002)		
GDP/capita	−0.003	−0.001	−0.005	−0.001
	(0.005)	(0.005)	(0.005)	(0.006)
Current Account	−0.008**	−0.010**	−0.007*	−0.009*
	(0.003)	(0.003)	(0.003)	(0.004)
Inflation	0.020*	0.013	0.017*	0.009
	(0.009)	(0.010)	(0.007)	(0.009)
Exchange Rate	0.001	−0.001	0.0002	−0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Trade	0.002	0.001	0.002	0.001
	(0.001)	(0.001)	(0.001)	(0.002)
Reserves	0.004	0.005	0.004	0.006
	(0.006)	(0.006)	(0.006)	(0.006)
Debt	−0.0002	0.001	−0.0003	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Primary Balance	−0.003	−0.002	−0.003	−0.002
	(0.003)	(0.003)	(0.003)	(0.003)
Number of Observations:	200	200	200	200
R-squared:	0.179	0.191	0.17	0.188
Adjusted R-squared:	0.034	0.036	0.034	0.044
Note:				*p<0.05; **p<0.01; ***p<0.001

5.4 Causal Relationship Between ESG-Performance and Excess Returns

We conduct an instrumental variable regression by testing **Model 8**. To establish causality between ESG-performance and the excess returns of a stock index the first stage regression (Table 13) would need to show a high correlation between the ESG-performance and the yearly mean of the ESG news index. The second stage regression would show a low correlation between the error term of **Model 1** and the yearly mean of the ESG news index, in addition to the exclusion restriction. The results for the second stage regression are displayed in Table 9. The output shows no statistically significant correlation between the ESG-performance and the ESG news index with a p-value of over 0.5. The results for the Weak Instruments test suggest that the ESG news index might not be a suitable instrumental variable in our case. This could be explained by the fact that the ESG news index by Engle et al. (2020) incorporates news coverage mainly focusing on the United States and thus, is not significantly correlated with the ESG-performance of the 20 OECD countries we observe. A news index pertaining to European ESG news would perhaps show a higher correlation with the ESG-performance measure. More precise results could be obtained by constructing country-specific news indices. Overall the findings of **Model 8** are not sufficient to support **Hypothesis 3**.

Table 9. IV Regression Results

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	151.010	127.562	1.184	0.238
ESG (lagged)	-1.008	1.704	-0.591	0.555
Inflation	-10.908	2.402	-4.542	9.4e-06 ***
Exchange Rate	-0.725	0.536	-1.352	0.178
Trade	-0.122	0.096	-1.269	0.206
GDP/capita	0.515	0.761	0.677	0.499
Reserves	-0.002	0.007	-0.289	0.773
Debt	-0.259	0.237	-1.091	0.277
Primary Balance	0.439	0.902	0.486	0.627
Current Account	0.712	1.038	0.686	0.493
Diagnostic tests:	Weak instruments df1 = 1, df2 = 210, statistic = 2.854, p-value = 0.0926 *			
	Wu-Hausman df1 = 1, df2 = 209, statistic = 0.315, p-value = 0.5754			
Number of Observations:				220
R-squared:				0.1568
Adjusted R-squared:				0.1206

Note: Significance levels: *** p < 0.001, ** p < 0.01, * p < 0.05

5.5 Limiting Factors and Further Research

As with most econometric research, data availability is a limiting factor for our analysis. A more comprehensive dataset in both the time dimension and country dimension, as well as the granularity of the data, would enable one to conduct a more insightful study about the underlying relationship between a country's ESG-performance and the performance of its stock market. The inclusion of emerging market economies would likely add more variability to the dataset for all variables, possibly revealing a dynamic between the ESG-performance and stock market performance different from the one in highly developed economies. Since those markets are generally perceived as higher risk environments this would also reinforce potential findings concerning the relationship between ESG-performance and the systematic risk present in those stock markets. This would add to the nuance of the findings concerning the link between ESG-performance and stock market performance. The increased pressure of consumers and investors on companies operating in those markets to improve their ESG-performance could enable future researchers to conduct event studies focusing on the impact of comprehensive ESG policies on stock market performance. Poor availability and unreliability of ESG related performance measures for those economies make the data collection a challenging and time-consuming task (Minsker, 2021). Better access to this data could be highly rewarding for future research but goes beyond the scope of this paper.

The expansion of the observed sample period would have several advantages to the robustness and to explain the nuances of the findings, enabling one to include several business cycles and thus, analyze the link in question during different economic conditions. It would enable analysis of the long-term dynamic between ESG-performance and excess returns, which might not be revealed in the timeframe observed in this paper. An expansion of the time lag of the ESG variable in the model could also reveal a possible delayed dynamic between ESG-performance and stock market performance. Given the likeliness of a delayed dynamic between ESG policy measures and their impact on a reduction in greenhouse gas emissions, the explanatory power of our model is also likely to benefit from including a greater time lag on the ESG factor. An increase in the granularity of the performance measures that constitute the ESG index would

most likely benefit this analysis. The possibility of analyzing the link between stock market performance and ESG-performance on a quarterly or monthly basis would further aid the goal of establishing the proper time link. An additional advantage of an extended sample period would be the possibility of computing, and thus analyzing the link between ESG-performance and more comprehensive measures of tail risk, like Value at Risk or Expected Shortfall over a longer time period. The aim of a study building on our findings could be to further investigate a potential causal relationship between the ESG-performance of a country and its stock market performance.

While our study addresses the endogeneity problem by lagging the ESG term and attempting to conduct an instrumental variable regression, reverse causality might be present in the observed relationship between ESG-performance and stock market performance. The line of argument for the reverse causality is that wealthier countries with a stable stock market and economic growth can afford to invest heavily in their ESG-performance. This would resonate with the perspective that good ESG is an investor preference as opposed to a risk management tool. The problem of reversed causality could be addressed by conducting an instrumental variable regression with an appropriate instrumental variable. Our efforts to conduct an instrumental variable regression provided no meaningful results. This is likely due to the ESG news index, used as the instrumental variable, capturing mainly ESG related news focused on the United States. Future research could be aimed at constructing a country-specific ESG-acceptance index quantifying the general acceptance of ESG measures within the general population. While cumbersome to compute, such a measure would perhaps exhibit a high correlation with an ESG-performance index.

6 Conclusion

In conclusion, our findings indicate that one should expect a better stock market performance and decreased downside tail risk in countries with a better ESG-performance. The insights gained by studies like this one will be important in formulating effective policies that permit economic growth through stable capital markets. This stability will be essential for enabling the strategic shift toward environmentally friendly practices in our essential industries which is desperately needed. Our study manages to establish a positive relationship between the ESG-performance of 20 OECD countries and the excess returns of those country's major stock indices between 2005 and 2015. Further analysis shows that this positive correlation is mainly driven by Social performance measures like gender equality, demography, job quality, and public health with Environmental and Governance factors showing no significant correlation.

While it is difficult to prove statistically that performance measures of the Social dimension drive stock market performance, an economic line of reasoning could still hold merit. Countries that plan to transition toward a green economy are prone to gain from investing in their human capital. Advancements in the performance measures represented in our Social index are likely to be beneficial for enacting substantial changes toward more sustainable practices. Given the economic consequences of these advancements, investors would likely benefit from incorporating factors pertaining to ESG in evaluating investment decisions.

This study also establishes a statistically significant relationship between the Environmental and Social dimensions and a decrease in the downside tail risk on stock markets. Finding statistical proof of a causal link between the tail risk of financial market returns and the Social and Governance performance of countries is difficult. An economic reasoning for a causal relationship could be that countries already performing better on the Environmental dimension are going to have an easier and less costly transition toward more sustainable practices. Thus, investors interested in investing in a country's major stock index might perceive good Environmental performance as a hedge against large downturns in the stock market.

We hope our findings will inspire future research that can further deepen the understanding

of these connections and enable policymakers, investors, and stakeholders to make decisions that will facilitate economic prosperity and sustainability.

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Appendix A Incremental Variable Loading and Further Regressions

Table 10. Excess Returns Incremental Variable Loading

	Dependent variable:								
	Excess Return Models Comparison								
	ESG	+ Inflation	+ Trade	+ GDP	+ Reserves	+ Debt	+ PB	+ CA	RER
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
lag(ESG, 1)	2.767***	1.225	1.619*	2.053*	2.071**	1.923*	1.942*	2.007*	2.008*
	(0.825)	(0.760)	(0.784)	(0.800)	(0.794)	(0.856)	(0.864)	(0.883)	(0.863)
Inflation		−10.216***	−10.182***	−10.161***	−9.587***	−9.372***	−9.317***	−9.453***	−9.523***
		(1.422)	(1.413)	(1.398)	(1.421)	(1.496)	(1.526)	(1.571)	(1.535)
Trade			−0.490	−0.786**	−0.876**	−0.943**	−0.941**	−0.925**	−1.101**
			(0.264)	(0.294)	(0.296)	(0.328)	(0.330)	(0.333)	(0.331)
GDP				1.490*	1.691*	1.759*	1.803*	1.834*	1.617*
				(0.674)	(0.677)	(0.694)	(0.731)	(0.737)	(0.724)
Reserves					2.927	2.947	2.917	2.977	3.733*
					(1.565)	(1.569)	(1.580)	(1.592)	(1.576)
Debt						0.067	0.063	0.079	−0.039
						(0.143)	(0.145)	(0.151)	(0.153)
PB							−0.120	−0.075	−0.073
							(0.606)	(0.619)	(0.605)
CA								−0.332	−0.080
								(0.873)	(0.857)
RER									−1.040**
									(0.346)
Observations	200	200	200	200	200	200	200	200	200
R^2	0.059	0.271	0.284	0.304	0.317	0.318	0.318	0.319	0.353
Adjusted R^2	−0.046	0.184	0.195	0.213	0.224	0.220	0.216	0.212	0.247
F Statistic	11.236*** (df = 1; 179)	33.004*** (df = 2; 178)	23.445*** (df = 3; 177)	19.195*** (df = 4; 176)	16.273*** (df = 5; 175)	13.538*** (df = 6; 174)	11.546*** (df = 7; 173)	10.071*** (df = 8; 172)	10.373*** (df = 9; 171)
Note:									*p<0.05; **p<0.01; ***p<0.001

Table 11. Volatility Incremental Variable Loading

	Dependent variable:									
	Volatility Return Models Comparison									
	ESG	+ YearlyLogRet	+ Inflation	+ Trade	+ GDP	+ Reserves	+ Debt	+ PB	+ CA	+ RER
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
lag(ESG, 1)	−0.365	0.158	0.070	0.212	−0.059	−0.066	−0.051	−0.061	−0.167	−0.152
	(0.244)	(0.188)	(0.189)	(0.195)	(0.188)	(0.188)	(0.202)	(0.204)	(0.204)	(0.203)
Yearly_Log_Return		−0.197***	−0.218***	−0.224***	−0.208***	−0.206***	−0.206***	−0.205***	−0.204***	−0.212***
		(0.017)	(0.019)	(0.018)	(0.017)	(0.018)	(0.018)	(0.018)	(0.017)	(0.018)
Inflation			−0.942**	−1.000**	−0.848**	−0.898**	−0.920**	−0.950**	−0.724*	−0.802**
			(0.399)	(0.394)	(0.367)	(0.370)	(0.385)	(0.391)	(0.394)	(0.393)
Trade				−0.167**	0.009	0.023	0.030	0.029	0.005	−0.028
				(0.066)	(0.069)	(0.071)	(0.078)	(0.079)	(0.078)	(0.079)
GDP					−0.845***	−0.875***	−0.883***	−0.907***	−0.959***	−0.978***
					(0.158)	(0.161)	(0.165)	(0.173)	(0.171)	(0.170)
Reserves						−0.384	−0.387	−0.371	−0.469	−0.335
						(0.367)	(0.368)	(0.371)	(0.366)	(0.370)
Debt							−0.007	−0.005	−0.030	−0.047
							(0.033)	(0.034)	(0.034)	(0.035)
PB								0.066	−0.006	−0.006
								(0.141)	(0.141)	(0.140)
CA									0.527***	0.563***
									(0.199)	(0.198)
RER										−0.156*
										(0.082)
Observations	200	200	200	200	200	200	200	200	200	200
R^2	0.012	0.449	0.466	0.485	0.557	0.560	0.560	0.561	0.578	0.587
Adjusted R^2	−0.098	0.384	0.400	0.418	0.497	0.497	0.494	0.492	0.509	0.516
F Statistic	2.229 (df = 1; 179)	72.568*** (df = 2; 178)	51.481*** (df = 3; 177)	41.426*** (df = 4; 176)	44.056*** (df = 5; 175)	36.916*** (df = 6; 174)	31.475*** (df = 7; 173)	27.445*** (df = 8; 172)	26.027*** (df = 9; 171)	24.143*** (df = 10; 170)
Note:										*p<0.1; **p<0.05; ***p<0.01

Table 12. Skewness of Excess Returns Incremental Variable Loading

	Dependent variable:										
	Skewness Models Comparison										
	ESG	+ YearlyLogRet	+ Yearly Stdev	+ Inflation	+ Trade	+ GDP	+ Reserves	+ Debt	+ PB	+ CA	+ RER
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
lag(ESG, 1)	0.014***	0.015***	0.014***	0.016***	0.016***	0.014***	0.014***	0.016***	0.016***	0.018***	0.018***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Yearly_Log_Return		−0.0004		0.001	0.001	0.0004	0.0004	0.0004	0.0004	0.001	0.001
		(0.0003)		(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.001)
Yearly_Stdev			0.002*	0.002*	0.002*	0.001	0.001	0.001	0.002	0.002	0.002
			(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Inflation				0.021***	0.021***	0.021***	0.022***	0.021**	0.023***	0.020**	0.020**
				(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Trade					−0.00000	0.001	0.001	0.001	0.002	0.002	0.002
					(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
GDP						−0.006*	−0.006*	−0.007*	−0.005	−0.004	−0.003
						(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Reserves							0.004	0.004	0.003	0.005	0.004
							(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Debt								−0.0005	−0.001	−0.0003	−0.0002
								(0.001)	(0.001)	(0.001)	(0.001)
PB									−0.004	−0.003	−0.003
									(0.003)	(0.003)	(0.003)
CA										−0.008*	−0.008*
										(0.004)	(0.004)
RER											0.001
											(0.002)
Observations	200	200	200	200	200	200	200	200	200	200	200
R^2	0.077	0.086	0.094	0.132	0.132	0.148	0.150	0.152	0.163	0.179	0.180
Adjusted R^2	−0.026	−0.022	−0.013	0.018	0.013	0.026	0.022	0.019	0.026	0.039	0.034
F Statistic	14.932*** (df = 1; 179)	8.365*** (df = 2; 178)	9.221*** (df = 2; 178)	6.683*** (df = 4; 176)	5.316*** (df = 5; 175)	5.056*** (df = 6; 174)	4.364*** (df = 7; 173)	3.868*** (df = 8; 172)	3.694*** (df = 9; 171)	3.705*** (df = 10; 170)	3.365*** (df = 11; 169)

Note: *p<0.1; **p<0.05; ***p<0.01

Table 13. First Stage Regression Results for Instrumental Variable

	Dependent Variable: ESG Performance (lagged = 1)
ESG News Index (lagged = 2)	0.110
	(0.065)
Inflation (lagged = 1)	-1.520**
	(0.576)
Exchange Rate (lagged = 1)	-0.288**
	(0.100)
Trade (lagged = 1)	-0.048*
	(0.019)
GDP/capita (lagged = 1)	-0.265
	(0.221)
Reserves (lagged = 1)	0.120
	(0.226)
Debt (lagged = 1)	-0.141***
	(0.017)
Primary Balance (lagged = 1)	0.442*
	(0.171)
Current Account (lagged = 1)	0.526***
	(0.150)
Constant	83.825***
	(12.561)
Observations	220
R^2	0.459
Adjusted R^2	0.436
Residual Std. Error	8.964 (df = 210)
F Statistic	19.779*** (df = 9; 210)
Note:	*p<0.05; **p<0.01; ***p<0.001

Appendix B Additional Plots

Fig. 4. E, S and G Index Scores across countries and time

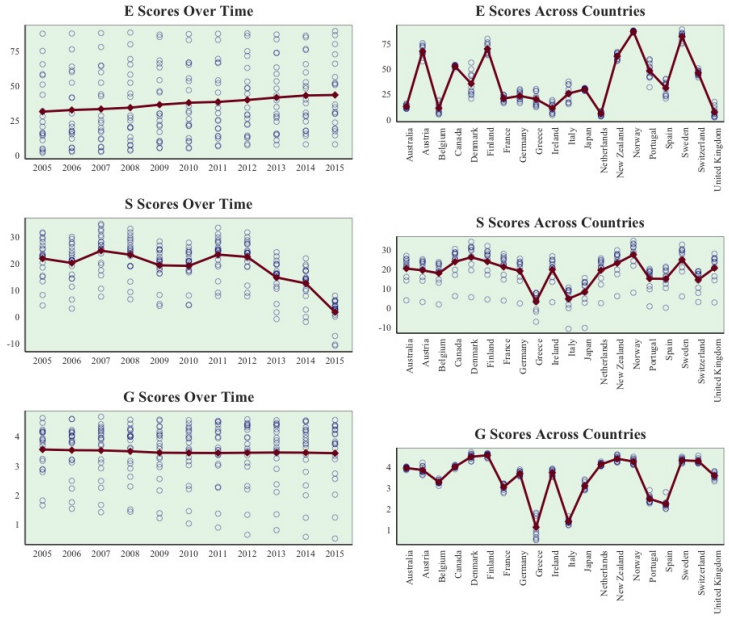
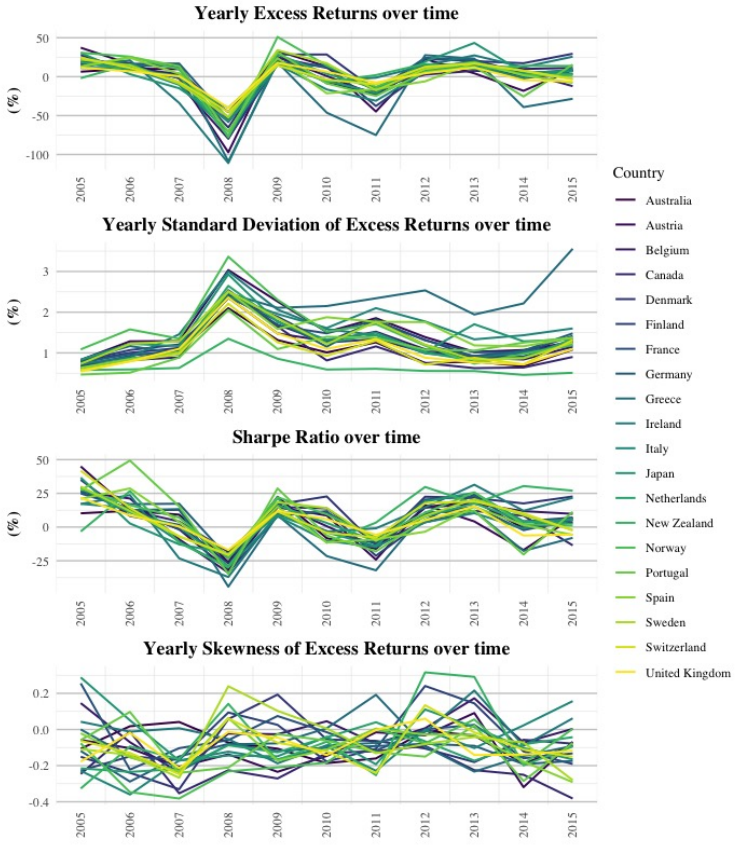


Fig. 5. Dependent Variables across time



Appendix C Additional Tables

Table 14. Correlation Matrix of Performance Measures

	CO2	Comb.ren.	Forest	Air	Ren. en.	Ren. en. con	Corr	Govern. Eff.	Pol. Sta.	Reg	Rule	Voice	Health	Demo	Life	Mort.	FtoM	Vul. emp.
CO2 Emissions	1.00																	
Combustable renewables and waste	-0.22	1.00																
Forest area	-0.14	0.61	1.00															
Air pollution	-0.21	-0.35	-0.27	1.00														
Renewable energy output	-0.19	0.38	0.30	-0.44	1.00													
Renewable energy consumption	-0.26	0.65	0.49	-0.50	0.87	1.00												
Corruption	0.24	0.24	0.09	-0.64	0.34	0.36	1.00											
Government Effectiveness	0.24	0.24	0.13	-0.57	0.29	0.32	0.94	1.00										
Political Stability	0.20	0.34	0.28	-0.49	0.48	0.47	0.73	0.72	1.00									
Regulatory Quality	0.34	0.16	-0.09	-0.53	0.19	0.18	0.89	0.82	0.63	1.00								
Rule of Law	0.24	0.25	0.06	-0.62	0.36	0.37	0.95	0.93	0.71	0.90	1.00							
Voice	0.15	0.27	-0.04	-0.52	0.43	0.45	0.89	0.84	0.72	0.84	0.87	1.00						
Health	0.13	0.19	0.17	-0.20	-0.03	0.17	0.14	0.10	0.01	0.15	0.14	0.07	1.00					
Demography	-0.37	0.15	0.46	0.41	-0.17	-0.05	-0.45	-0.37	-0.27	-0.54	-0.46	-0.51	0.04	1.00				
Life expectancy	-0.11	-0.17	0.25	-0.14	0.14	0.03	-0.12	-0.12	-0.08	-0.16	-0.11	-0.21	-0.18	0.33	1.00			
Mortality	0.37	-0.41	-0.48	0.01	-0.03	-0.35	0.15	0.09	-0.00	0.27	0.12	0.15	-0.19	-0.58	-0.31	1.00		
Femaletomale	0.03	0.47	0.08	-0.70	0.52	0.62	0.73	0.71	0.49	0.60	0.75	0.73	0.08	-0.39	-0.12	-0.01	1.00	
Vulnerable employment	-0.05	-0.16	-0.13	0.43	-0.27	-0.31	-0.80	-0.80	-0.52	-0.65	-0.78	-0.72	-0.28	0.19	-0.04	0.08	-0.60	1.00