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# Impact of E, S, and G Pillar Scores on Idiosyncratic Risk during Times of Crisis

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## **Abstract**

**Title:** Impact of E, S, and G Pillar Scores on Idiosyncratic Risk during Times of Crisis

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This study examines the impact of individual environmental (E), social (S), and governance (G) pillar scores on the idiosyncratic risk of 929 European and 2,450 US firms in a period between Q1 2000 and Q1 2023, determining if high ratings lead to lower idiosyncratic risk in times of crisis. Additionally, it demonstrates how the degree of firm-specific volatility varies depending on the industry a company operates in. To determine idiosyncratic risk, the Carhart (1997) four-factor model and additionally for robustness, the Fama and French (1993) three-factor model are applied. For the analysis, a panel regression is performed, controlling for size, return-on-assets (ROA), leverage, market-to-book value (MBV), and changes in the volatility index (VIX). Due to the difference in economic circumstances, policies, and locations in Europe and the US, the individual pillar scores show different impacts. On the one hand, the S pillar score exhibits a negative relationship with idiosyncratic risk in Europe. In contrast, the quality of governance is more important in the US. However, the overall level of the ESG scores did not significantly affect idiosyncratic risk during the period of 23 years. In addition, high-tech companies are most affected by high idiosyncratic risk due to their innovative company structure. In times of crisis, ESG scores are showing a significantly negative impact on firm-specific risk.

**Keywords** E, S, and G Pillar Scores • Idiosyncratic Risk • Sustainable Investments • Factor Models

## Sumário

**Título:** Impacto das notações dos pilares E, S e G no risco idiossincrático em tempos de crise

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Este estudo examina o impacto das pontuações individuais dos pilares ambiental, social e de governação no risco idiossincrático de 929 empresas da UE e de 2,450 empresas dos EUA no período entre o 1ºQ de 2000 e o 1ºQ de 2023, determinando se especialmente em tempos de crise - com enfoque na crise financeira global e na crise da Covid-19 - uma classificação elevada conduz a um menor risco idiossincrático. Para além disso, demonstra como o grau de volatilidade específica da empresa varia de acordo com o sector em que opera. Para determinar o risco idiossincrático, é aplicado o modelo de quatro factores de Carhart (1997) e, adicionalmente, para maior robustez, o modelo de três factores de Fama e French (1993). Para a análise, é efectuada uma regressão em painel, controlando a dimensão, a rendibilidade dos ativos, a alavancagem, o valor de mercado em relação ao valor contabilístico e as variações do índice de volatilidade. Devido à diferença de circunstâncias económicas, políticas e localizações na UE e nos EUA, as pontuações individuais dos pilares apresentam impactos diferentes. No entanto, o nível global das pontuações ESG não afectou significativamente o risco idiossincrático durante um período de 23 anos. Adicionalmente, as empresas de alta tecnologia, em particular, são afectadas por um elevado risco idiossincrático durante todo o período, devido à sua estrutura empresarial inovadora. Em tempos de crise, a influência das pontuações ESG tem um impacto negativo significativo no risco específico da empresa.

**Palavras-chave** Pontuações dos pilares E, S e G • Risco idiossincrático • Investimentos sustentáveis • Modelos de factores

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## **List of Abbreviations**

|        |   |
|--------|---|
| CBOE   | Chicago Board Options Exchange                            |
| CSR    | Corporate Social Responsibility                           |
| ESG    | Environmental, Social, and Governance                     |
| FF     | Fama and French   |
| GFC    | Global Financial Crisis                                   |
| HML    | High-minus-Low  |
| KLD    | Kinder, Lydenberg, and Domini Research and Analytics Inc. |
| MBV    | Market-to-Book Value                                      |
| MOM    | Momentum  |
| OLS    | Ordinary Least Squares                                    |
| R&D    | Research and Development                                  |
| ROA    | Return on Assets  |
| S&P500 | Standard & Poor's 500                                     |
| SMB    | Small-minus-Big   |
| SRI    | Social Responsible Investments                            |
| US     | United States   |

# **1. Introduction**

This thesis provides an insight into how environmental (E), social (S), and governance (G) pillar scores affect idiosyncratic risk in general as well as specifically during crisis periods and investigates the impact on different industries for companies from Europe and the United States (US). The Carhart (1997) four-factor model and the Fama and French (1993) three-factor model are used to examine the idiosyncratic risk in the period from 01.01.2000 to 31.03.2023.

## **1.1. Background**

In recent years ESG gained considerable momentum, leading an increasing number of portfolio managers, and institutional investors to incorporate sustainable responsible investing (SRI) in their investment portfolios to align with their values and support sustainable development (Bodhanwala & Bodhanwala, 2019). The Paris Climate Agreement in 2015 (United Nations, 2015) established new global standards for sustainable development and signaled the start of the financial system's change to support sustainability. More than 90% of the companies listed on the S&P500 have already disclosed ESG-related information, demonstrating a rising awareness among businesses for the significance of incorporating ESG factors into their operations to get more actively involved in sustainability projects (Pérez et al., 2022). Thereby, sustainable investing is practiced by 85% of individual investors with ESG integration as the most common investment strategy by systematically including E, S, and G factors into the financial analysis (Morgan Stanley, 2018). A study by the Global Sustainable Investment Alliance (2020) states that in early 2020, worldwide sustainable investments in five major markets reached USD35.3 trillion, an increase of 15% over the previous two years (2018-2020). Additionally, 35.9% of all assets under management are sustainable assets, with the US experiencing the second-largest absolute growth (42%) over the previous two years (Global Sustainable Investment Alliance, 2020).

Thus, there has been a considerable amount of research from the academic community as well as the asset management sector which investigates the relationship between a company's ESG profile and its financial risk and performance characteristics. Friede et al. (2015) conducted an in-depth analysis of 2,200 separate studies and discovered that a vast majority of them demonstrate a stable positive relation between ESG factors and financial performance. In particular, while conducting vote count research that focused on the various E, S, and G pillars, the G pillar score showed the highest proportion of positive outcomes for all cases with 62.3%, including studies with positive, negative, or non-significant results. The literature, however,

discovered both strong and weak relationships between ESG and financial performance. This ambivalent picture can be explained by the diverse ESG data and due to the different methodologies that were used (Friede et al., 2015).

Apart from the impact on financial performance, a positive relationship between ESG stocks and risk mitigation was found (Cardillo et al., 2023; Engelhardt et al., 2021) where corporate social responsibility (CSR) is especially beneficial, affording the possibility of significant downside protection during times of crisis. Thus, a low idiosyncratic risk is advantageous as it results in greater shareholder wealth due to the smaller volatility in the predicted future cash flows of the companies. Based on this, investors should not hold stocks with high idiosyncratic risk as their overall investment performance would suffer (Horn, 2023). According to Markowitz's portfolio theory, diversification can lead to a lower idiosyncratic risk of portfolios, which is in high demand during weak economic phases (Markowitz, 1952), whereas systematic risk (market risk) cannot be diversified as it affects all securities in the market equally, such as changes in inflation rates.

## **1.2. Purpose and Approach**

This thesis aims to investigate the idiosyncratic risk effect of the three different pillar scores of ESG from companies tested for the global financial crisis (GFC), which occurred from August 2008 to March 2009 as well as the Covid-19 crisis (from February 2020 to December 2020). The time frame of 23 years has been chosen to examine how companies experience idiosyncratic risk in different phases of the economic cycle, highlighting the effect of a crisis on risk exposure. Furthermore, I examine whether or not higher sustainability ratings lead to lower idiosyncratic risk overall and across industries.

The thesis is hereafter divided into a theoretical and an empirical section. In Section 2, I review the existing literature, discussing relevant studies on idiosyncratic risk in relation to sustainable investments during the economic cycle. Furthermore, studies investigating risk exposure during times of crises and across industries are mentioned. Data and Methodology are discussed in Section 3 and 4. Between 2018 and 2020, the US and Europe account for more than 80% of global sustainable investing assets (Global Sustainable Investment Alliance, 2020). Therefore, in the following empirical section, it is especially interesting to consider 929 European and 2,450 US companies in the analysis. In Section 5 the hypothesis of whether or not companies with higher E, S, or G pillar ratings show a lower idiosyncratic risk in a time horizon of 23 years is tested using different control variables distributed between Europe and the US.

Furthermore, different industry effects are shown and it is demonstrated if high ESG ratings have a substantial effect on risk during times of crisis in Europe.

## **2. Literature Review**

In this chapter, relevant previous research addressing idiosyncratic risk exposure and performance of SRI during periods of crisis is reviewed.

### **2.1. Idiosyncratic Risk and Sustainable Investments**

Risk research plays a significant part in portfolio and stock analysis, as SRI investors do not fully diversify their portfolios, due to the necessity of excluding certain companies that do not adhere to CSR norms. CSR, described as "communicated policies and practices of corporations that reflect business responsibility for some of the wider societal good", has emerged as a significant issue that businesses must handle to thrive in society (Matten & Moon, 2008, p. 405). Investors anticipate receiving a bigger reward for taking on greater overall risk, which is including ethical risk as well. According to this, Boutin-Dufresne and Savaria (2004) have established that a higher level of CSR means a lower ethical risk and hence reduces the total risk of the portfolio by using a sample of 225 firms in 1995 and 277 in 1999 to create portfolios built on the grouping technique implemented by Campbell et al. (2001). Moreover, the sustainable portfolio's average idiosyncratic risk is the lowest for all evaluated years between 1995 and 1999 and should be less exposed to residual volatility. These findings are intuitive as organizations with high ESG rankings typically have risk control and compliance standards that are above average both within the organization and in its supply chains. As a result, they manage corporate risks better, increase their value and experience less fraud, theft, and corruption than their lower-ranked peers within the same sector (Giese et al., 2019). This thesis examines a longer time frame showing effects on different economic cycles and different markets.

In another study, Mishra and Modi (2013) investigate the interaction between positive and negative CSR and idiosyncratic risk, which is based on both stakeholder theory and the resource-based view. By using company ratings supplied by Kinder, Lydenberg, and Domini Research and Analytics Inc. (KLD), Mishra and Modi (2013) develop indices for positive and negative CSR. The study offers empirical evidence that the CSR initiatives of organizations have a substantial influence on their idiosyncratic risk by analyzing 192 firms during the period from 2000-2009. Specifically, positive CSR initiatives mitigate a company's idiosyncratic risk, while negative CSR efforts amplify it. Nevertheless, the study notes that not all companies benefit from responsible CSR practices, as firms with high levels of financial leverage may

experience reduced risk-reduction advantages. Finally, the study finds that decreasing competitive intensity and increasing sales volatility in the industry may reduce companies' desire to prioritize the social aspect of their actions.

Horn (2023) conducted a study where he covered a sample of 898,757 company-month observations of US stocks in the period from 1991 to 2018 to analyze whether stocks of companies that received ESG ratings show lower idiosyncratic risk. Therefore, he employs a multivariate regression model to estimate the impact of ESG ratings on idiosyncratic stock risk while controlling for other firm-specific and macroeconomic factors. He discovered that receiving a high ESG rating, lowers the idiosyncratic risk on a significant level, however, even stocks with a low score show decreased risk exposure than stocks without an ESG score. Furthermore, negative screen stocks (businesses involved in the "sin," "vice", or "controversial" industries) exhibit lower idiosyncratic risk during recessions - like the GFC – compared to similar stocks obtaining an ESG grade but without a negative screen. This thesis adds a deeper understanding of the three different E, S, and G pillars as Horn (2023) only uses the overall ESG rating as an independent variable. Furthermore, the European market is analyzed in comparison to the US market which gives a broader analysis of markets with different economic circumstances while the aforementioned paper uses the Canadian market.

## **2.2. Risk Exposure of Sustainable Responsible Investments during Crisis**

Several studies find a positive relationship between ESG stocks and risk mitigation (Cardillo et al., 2023; Engelhardt et al., 2021), which is particularly beneficial in times of crisis to afford the possibility of significant downside protection.

Broadstock et al. (2021) investigate the performance of Chinese stocks from the CSI300 in response to the Covid-19 global pandemic. Thereby, by comparing high-ESG portfolios with low-ESG portfolios focusing on the trading period around 03.02.2020, which caused the CSI300 to fall sharply because of the first lockdown in Wuhan during this time, the authors provide evidence that high ESG scores reduce downside risk. Furthermore, Albuquerque et al. (2020) construct a theoretical framework outlining that businesses with high CSR reduce systematic risk exposure and increase firm value to promote product differentiation and product portfolio diversification.

Moreover, Lins et al. (2017) found that stocks of companies with high CSR ratings earned a premium and performed significantly better by at least four percentage points during the GFC after controlling for a variety of firm characteristics and risk factors with a sample of 1,673

nonfinancial firms while this thesis provides a sample that also includes financial firms in the analysis. Furthermore, they show that the effect of CSR on returns is economically significant, as demonstrated by the estimation of various regression models of stock returns during the crisis with several control variables. When CSR increases by one standard deviation, abnormal returns during times of crisis rise by 4.15 percentage points and gross returns by 2.25 percentage points. Further evidence that CSR may be a strategic asset for businesses during economic downturns is provided by the fact that its beneficial impact on firm performance is stronger during the GFC than it is in normal times.

In addition, Bessler et al. (2015) analyzed the time-series systematic and unsystematic risk exposures of US bank holding companies and found that idiosyncratic risk plays a significant role in the state-level business cycle, especially in weak economic periods. Furthermore, Panousi and Papanikolaou (2012) discovered an increase in firm-specific uncertainty during the GFC in 2008 and 2009.

### **2.3. Risk Exposure of Sustainable Responsible Investments across Industries**

Giese et al. (2021) found that the G pillar score has the largest impact across all industries, and the outcome is most noticeable in short-term events and threats. In terms of industry, the financials and consumer discretionary sector is where this is particularly applicable, while the materials and energy sectors and the consumer discretionary sector are where the E and S pillars are more relevant (Giese et al., 2021). Additionally, Campbell et al. (2001) show that the telecommunications, computer, and retail sectors exhibit a particularly high rising trend in firm-specific volatility clustered in 49 industries by Fama and French (FF). According to the research, idiosyncratic risk has increased significantly at the corporate level since the 1960s because of several factors, including the speed of obtaining new information and going public impacted by the IT revolution.

These results are consistent with the findings of Mazzucato and Tancioni (2008), which indicate that innovative businesses have higher idiosyncratic risks due to higher uncertainty about their projected cash flows. Nevertheless, a significant effect on idiosyncratic risk is predominantly witnessed at the firm level, where entities with higher levels of research and development (R&D) intensity tend to have higher levels of risk. This phenomenon mainly affects innovative businesses operating in developing markets and creative businesses operating in sectors with constrained development potential.

### 3. Methodology

Based on the literature review and my own evaluations, it is assumed that companies with higher E, S, and G pillar ratings show a lower idiosyncratic risk in times of crisis. Furthermore, idiosyncratic risk tends to be higher in industries with higher R&D intensity. In the empirical study, the impact of different E, S, and G pillar scores on the idiosyncratic risk exposure of 929 European and 2,450 US companies is analyzed. The idiosyncratic risk per quartile is based on daily returns between 01.01.2000 and 31.03.2023 using the Carhart (1997) four-factor model and Fama and French (1993) three-factor model for robustness. The analysis was then repeated for both the GFC and Covid-19 crisis. First, the period from August 2008 to March 2009 according to Lins et al. (2017) was taken into consideration, along with the triggering moment of the financial crash by the bankruptcy of Lehman Brothers on 15.09.2008. Secondly, in alignment with Cardillo et al. (2023) a period between February 2020 to December 2020 is considered, when Covid-19 caused a sharp collapse in the US and Europe stock market. Furthermore, the FF 10 industry factors are used for clustering the firms in their associated sectors.

The extent of the influence of the individual ESG scores on the idiosyncratic risk of companies was further examined. For this purpose, panel regressions with the different E, S, and G pillar scores as independent variables were performed. The control variables are the size of a firm, leverage, market-to-book value (MVB), return-on-assets (ROA), and the changes in the volatility index ( $\Delta VIX$ ). Furthermore, a dummy variable was developed to measure if a company has an E, S, or G pillar score above the median. Therefore, the overall ESG Score rating was used, calculated with the average of the individual pillar scores. This produced the following model (1):

$$IVOL_{i,t} = \beta_{0,i} + \beta_{1,i} * high_{i,t} + \beta_{2,i} * ENSCORE_{i,t} + \beta_{3,i} * SOSCORE_{i,t} + \beta_{4,i} * CGSCORE_{i,t} + \beta_{5,i} * Size_{i,t} + \beta_{6,i} * Leverage_{i,t} + \beta_{7,i} * MBV_{i,t} + \beta_{8,i} * ROA_{i,t} + \beta_{9,i} * \Delta VIX \quad (1)$$

Where  $IVOL_{i,t}$  = Idiosyncratic Volatility of firm  $i$  at time  $t$ ,  $high_{i,t}$  = dummy variable indicating if firm  $i$  has a high ESG rating at time  $t$ ,  $ENSCORE_{i,t}$  = Environmental pillar score,  $SOSCORE_{i,t}$  = Social pillar score,  $CGSCORE_{i,t}$  = Governance pillar score,  $Size_{i,t}$  = Size of firm  $i$  at time  $t$ ,  $Leverage_{i,t}$  = Leverage of firm  $i$  at time  $t$ ,  $ROA_{i,t}$  = ROA of firm  $i$  at time  $t$ ,  $\Delta VIX$  = Delta of volatility index

It is crucial to first determine whether the prerequisites for Ordinary Least Squares (OLS) regressions are satisfied before analyzing idiosyncratic risk with regressions. While using panel data, the following requirements are used for empirical testing.

The Wald test was implemented to assess heteroskedasticity. As the result of the Chi-Square Statistics was 0.000, I utilized robust standard errors. By doing so, I was able to account for the presence of heteroskedasticity in the model and improve the accuracy of the estimated standard errors, coefficients, and significance levels.

The Hausman test is a statistical analysis used in econometrics to determine whether the fixed effects or random effects model is better for estimating panel data (Hausman, 1978). While the random effects model does, the fixed effects model does not consider time-varying independent variables. The Hausman test evaluates the significance of the difference between the fixed effects and random effects models by comparing the estimated coefficients of the two models. The fixed effects model is selected since the difference is significant with a P-Value of 0.000. Furthermore, the Hausman test was used in this thesis to examine endogeneity. In a regression model with endogenous independent variables, the expected error term is conditioned on the observed independent variable, resulting in correlations between the independent variable and the error term (Greene, 2020). As a result, the linear regression model's OLS estimators may be biased. Fixed effects for firm, time, and industry were incorporated into the analysis to account for this endogeneity and adjust for unobserved heterogeneity that might correlate with the endogenous variable.

The Wooldridge test, created by Wooldridge (2002) specifically for panel data to evaluate first-order serial correlation, was used to look into the existence of autocorrelation in the panel data regression model. When the error terms of a regression model are correlated with one another over distinct time periods, autocorrelation arises. This contradicts the OLS regression model's assumption that the error terms are uncorrelated (Drukker, 2003). The test's P-value of 0.000 suggests that the hypothesis that there is first-order autocorrelation cannot be rejected and therefore robust standard errors were used.

#### **4. Data**

Table 1 presents summary statistics on the sample including 929 European companies. Furthermore, 2,450 US stocks are included in the main analysis to derive potential implications for different countries, which are described in Table 2.

**Table 1: Descriptive Statistics Europe**

| N = 929  |        |        |           |        |        |
|----------|--------|--------|-----------|--------|--------|
| Variable | Obs    | Mean   | Std. Dev. | Min    | Max    |
| IdioC    | 55,195 | 0.021  | 0.011     | 0.006  | 0.067  |
| IdioFF   | 55,195 | 0.021  | 0.011     | 0.006  | 0.068  |
| ENSCORE  | 31,754 | 53.234 | 28.648    | 0.000  | 98.940 |
| SOSCORE  | 31,754 | 57.626 | 24.656    | 0.120  | 98.270 |
| CGSCORE  | 31,762 | 52.557 | 22.748    | 0.870  | 98.270 |
| ROA      | 70,890 | 0.031  | 0.082     | -0.387 | 0.261  |
| MBV      | 64,936 | 0.002  | 0.002     | 0.000  | 0.014  |
| Leverage | 70,779 | 0.834  | 1.258     | 0.000  | 8.225  |
| Size     | 70,655 | 6.300  | 1.045     | 4.121  | 8.925  |

**Table 2: Descriptive Statistics US**

| N = 2,450 |         |        |           |        |        |
|-----------|---------|--------|-----------|--------|--------|
| Variable  | Obs     | Mean   | Std. Dev. | Min    | Max    |
| IdioC     | 146,456 | 0.024  | 0.019     | 0.005  | 0.115  |
| IdioFF    | 146,456 | 0.024  | 0.019     | 0.005  | 0.114  |
| ENSCORE   | 73,883  | 24.804 | 27.140    | 0.000  | 98.550 |
| SOSCORE   | 73,883  | 41.897 | 20.957    | 0.450  | 97.880 |
| CGSCORE   | 73,883  | 48.433 | 22.190    | 0.160  | 99.620 |
| ROA       | 160,567 | 0.472  | 1.717     | -7.050 | 10.380 |
| MBV       | 156,374 | -0.477 | 0.288     | -1.940 | 0.280  |
| Leverage  | 171,850 | 4.933  | 2.470     | -0.110 | 8.440  |
| Size      | 162,237 | 6.077  | 0.972     | 3.330  | 8.390  |

Any companies without complete data were excluded. I provide summary statistics for the firm size, ROA, MBV, leverage, and the different E, S, and G pillar scores. Thereby, the E factor seeks to comprehend how several environmental challenges, including emissions, innovation, and resource consumption, are affected. The S pillar score explains human capital criteria such as community, human rights, product responsibility, and workforce. Moreover, the G Score, which includes company governance and behavior, is estimated by taking into account categories including CSR strategy, management, and shareholders (Refinitiv, 2022). To address the issue that outliers may drive the results, the values of ROA, leverage, and MBV are winsorized at the lowest (1%) and highest (99%) percentile each month. The analysis includes Refinitiv Eikon ESG ratings on an annual basis from 2000 until 2023 in an unbalanced panel. These ratings are based on publicly-reported data that incorporates the firm size and industry materiality biases (“ESG Scores,” 2023), which is shown in Table 3.

**Table 3: Refinitiv Eikon Criteria and Score Range**

| Score range | Description     |  |
|-------------|-----------------|--|
| 0 to 25     | First Quartile  | Score within this range indicates poor relative ESG performance and insufficient degree of transparency in reporting material ESG data publicly.     |
| > 25 to 50  | Second Quartile | Score within this range indicates satisfactory relative ESG performance and moderate degree of transparency in reporting material ESG data publicly. |
| > 50 to 75  | Third Quartile  | Score within this range indicates good relative ESG performance and above average degree of transparency in reporting material ESG data publicly.    |
| > 75 to 100 | Fourth Quartile | Score within this range indicates excellent relative ESG performance and a high degree of transparency in reporting material ESG data publicly.      |

In addition, Table 4 shows the 10 Industry Portfolio classifications from the Kenneth French Data Library, which was used to distribute the companies in different segments.

**Table 4: Industry Distribution of Firms**

| Industry sector   | No. of firms (US) | No. of firms (Europe) |
|---|-------------------|-----------------------|
| <b>Division 1:</b> Consumer Nondurables                                   | 152               | 51                    |
| <b>Division 2:</b> Consumer Durables                                      | 98                | 42                    |
| <b>Division 3:</b> Manufacturing  | 188               | 144                   |
| <b>Division 4:</b> Oil, Gas, and Coal Extraction                          | 67                | 18                    |
| <b>Division 5:</b> Business Equipment                                     | 618               | 154                   |
| <b>Division 6:</b> Telephone and Television Transmission                  | 29                | 25                    |
| <b>Division 7:</b> Wholesale, Retail, and Some Services                   | 216               | 82                    |
| <b>Division 8:</b> Healthcare, Medical Equipment, and Drugs               | 296               | 54                    |
| <b>Division 9:</b> Utilities  | 82                | 45                    |
| <b>Division 10:</b> Mines, Transportation, Hotels, Entertainment, Finance | 704               | 314                   |
| <b>TOTAL</b>  | 2,450             | 929                   |

#### 4.1. Control Variables

Luo and Bhattacharya (2009) argue that the MBV ratio (market value/common equity) is taken into consideration as a control variable<sup>1</sup> as it accurately reflects the value of intangible assets, which may also have some bearing on the idiosyncratic risk of a firm. Furthermore, leverage is

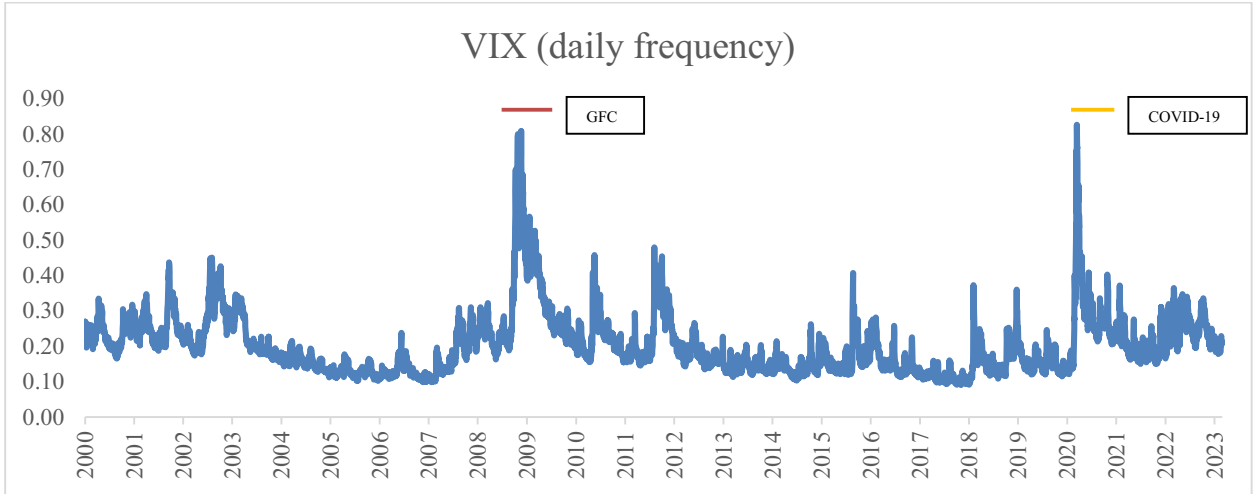
<sup>1</sup> All relevant data is extracted from Datastream.

measured by the long-term debt divided by common equity which is included among the regressors as showing a high value, the likelihood of default, and, consequently, the unique element of stock return volatility increase (Becchetti et al., 2015). As a measure of the profitability of a firm, ROA not only has an impact on the relationship between CSR and firm performance, but it also may influence the firm-specific risk (Sorescu & Spanjol, 2008). To examine the value of this ratio, net income before extra items and preferred dividends was divided by total assets at this point in time. Another control variable included is the size of a firm measured by the log of total assets to stabilize the variance of the errors.

#### **4.2. Volatility Index**

Since the start of measuring the metric in 1993, the VIX index has represented market expectations of short-term price fluctuations in the S&P500. Thereby, it illustrates the implied volatility of a synthetic at-the-money option contract with a one-month term (Ang et al., 2006). Figure 1 shows the VIX over an economic cycle between January 2000 and March 2023. In the sample years, the mean was 20% with a standard deviation of 8.67%. Furthermore, Figure 1 illustrates two outliers containing the GFC in 2009 and the Covid-19 outbreak in 2020, which is in line with the highest VIX during the entire period at 16.03.2020 (83%) and secondly at 20.11.2008 (81%). Moreover, other visible changes are the terrorist assault in September 2001, followed by the corporate scandals in 2002 and the Quants meltdown in the first week of August 2007, where several quantitative long/short equity hedge funds experienced unprecedented losses (Fernandes et al., 2014). In the panel data regression, the VIX is used as a proxy of innovations in volatility risk changes in the S&P500 (Horn, 2023). The data is extracted from the Chicago Board Options Exchange (CBOE).

**Figure 1: VIX between Q1 2000 to Q1 2023**



### 4.3. Measuring Idiosyncratic Volatility: Factor Models

To provide the dependent variable for the regression analysis, this section will discuss the measurement of the idiosyncratic risk of a firm using the Fama and French (1993) three-factor model and Carhart (1997) four-factor model. These models are complemented by three portfolios that generate positive alphas to form the market portfolio. In my analysis, I use returns and factors expressed in U.S. dollars and I compute excess returns using the one-month treasury bill rate extracted from Kenneth French Data Library.

Firstly, daily price indices were used to calculate the daily realized returns, using the following Equation (2). Individual price indices for the US and Europe are obtained from Datastream.

$$r_{t+1} = \frac{p_{t+1} - p_t}{p_t} \quad (2)$$

Where  $r$  = Return,  $t$  = Time, and  $p$  = Price Index, daily value

The FF model describes the relationship between average return and price ratios, by adding size risk and value risk factors, which is shown in Equation (3). First, Fama and French (1993) found that under the market capitalization strategy, small-cap stocks tend to outperform large-cap stocks. Firms with a market value below the mean are assigned to Portfolio S and their counterparts to Portfolio B, forming a small-minus-big (SMB) portfolio. According to the book-to-market ratio strategy, the factor high-minus-low (HML) represents the empirical return advantage of firms with high book-to-market value. The low portfolio includes all companies with a book-to-market value below the 30th percentile, and the high portfolio includes all companies with a book-to-market value beyond the 70th percentile.

$$r_p - r_f = \alpha + \beta_{MKT} * MKT_t + \beta_{SMB} * SMB_t + \beta_{HML} * HML_t + \varepsilon_t \quad (3)$$

Where  $r_p$  = Portfolio return,  $r_f$  = Risk-free rate,  $\alpha$  = Jensen's alpha,  $MKT_t$  = Market factor at time  $t$ ,  $SMB_t$  = Size factor at time  $t$ ,  $HML_t$  = Book-to-market factor at time  $t$ ,  $\varepsilon_t$  = Error term at time  $t$

The Carhart (1997) four-factor model, as a multi-factor model, is supplemented by another momentum (MOM) factor in addition to the Fama and French (1993) three-factor model. In the MOM strategy, stocks are ranked according to their return over the last year, where the best 30% of stocks are held long and the worst 30% are shorted. This portfolio is held for one year and then repeated based on new returns (Carhart, 1997). The following Equation (4) describes the model:

$$r_p - r_f = \alpha + \beta_{MKT} * MKT_t + \beta_{SMB} * SMB_t + \beta_{HML} * HML_t + \beta_{MOM} * MOM_t + \varepsilon_t \quad (4)$$

Where  $r_p$  = Portfolio return,  $r_f$  = Risk-free rate,  $\alpha$  = Jensen's alpha,  $MKT_t$  = Market factor at time  $t$ ,  $SMB_t$  = Size factor at time  $t$ ,  $HML_t$  = Book-to-market factor at time  $t$ ,  $MOM_t$  = Momentum factor at time  $t$ ,  $\varepsilon_t$  = Error term at time  $t$

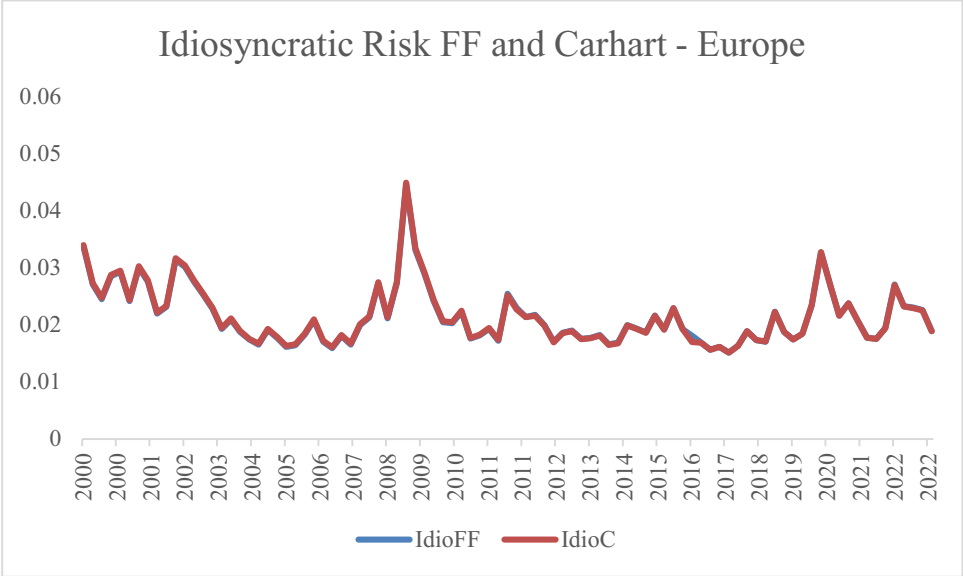
All benchmark values are obtained from Kenneth French Data Library. Appendix A shows the description of all relevant variables. In the next step, the residual standard error for each day was estimated for both models (Bali et al., 2016). To derive the idiosyncratic volatility per quartile, the following Equation (5) was used:

$$IVOL_i = \sqrt{\frac{\sum_{t=1}^n \varepsilon_{i,t}^2}{n - k}} \quad (5)$$

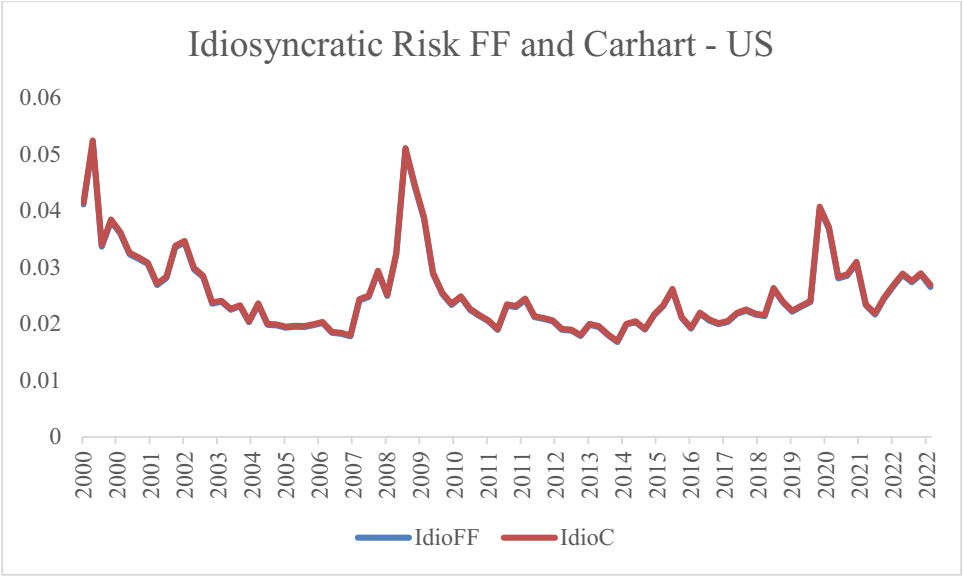
Where  $IVOL_i$  = Idiosyncratic risk of firm  $i$ ,  $n$  = Number of data points that are used to fit the regression,  $k$  = Number of parameters estimated by the regression,  $\varepsilon_{i,t}$  = Error term firm  $i$  at time  $t$

The development of firm-specific risk over a period of 23 years is shown in Figure 2 for Europe and in Figure 3 for the US, estimated using both the Carhart (1997) four-factor model and Fama and French (1993) three-factor model. According to both graphs, idiosyncratic risk rises during times of crisis. It is clear that both the GFC and Covid-19 crisis periods exhibit higher idiosyncratic risk. Furthermore, it is also evident that the Dotcom bubble burst of 2000 had a significant impact in the US.

**Figure 2: Idiosyncratic Risk Europe using the FF and Carhart Model**



**Figure 3: Idiosyncratic Risk US using the FF and Carhart Model**



**5. Results**

In this section, the results of the analysis with the presented panel regression model are discussed. Firstly, the main results showing a period from Q1 2000 to Q1 2023 for Europe and US are described. Furthermore, the impact of E, S, and G pillar scores on idiosyncratic risk in different industries and the effect during times of crisis focusing on Europe are presented.

**5.1. Main Results**

Table 5 shows the results for the panel regression on idiosyncratic risk using a time span from Q1 2000 until Q1 2023. Panel A displays panel regressions on idiosyncratic risk in Europe as

dependent variable calculated using the Carhart (1997) four-factor model. Furthermore, different fixed effects models were used in the four different columns. The S pillar score has a negative relationship with idiosyncratic risk as all models are significant at the 1% level, indicating that firms with better social policies decrease their firm-specific volatility. Whereas the quality of corporate governance and environmental policies do not seem to have a significant impact. However, in the firm fixed effects model, the E pillar score showed a significantly positive relation during the 23-year period where a 1 unit increase in the environmental pillar score increases idiosyncratic volatility by 0.003 percentage points. The positive relationship between the E and G pillar scores and idiosyncratic risk can also be attributed to the fact that the implementation of environmentally friendly and social measures is associated with costs and increased leverage, which can subsequently increase the idiosyncratic risk. In general, the findings indicate that businesses with above-median ESG scores have higher idiosyncratic risk as the dummy variable high shows a positive relation to the dependent variable, although this cannot be confirmed significantly.

The results also imply that larger firms have lower idiosyncratic risk as the coefficient is negative and showed a significance at the 1% level in the time-firm fixed effects model and the time-industry fixed effects model. This is explained by the fact that the business activities of larger companies are typically more varied, and they frequently work in many industries, serve a wider range of clients, and are present in various geographical areas. Higher leverage is also an indicator of higher idiosyncratic risk as the coefficient is positive and significant at the 1% level in the first specification (0.000752) and significant at the 5% level in the third (0.000280) and fourth (0.000277) specifications. Additionally, the findings indicate significantly at the 1% level that firms with a higher MBV and a higher ROA have lower idiosyncratic risk due to their financial performance and stronger operational efficiency. Additionally, the results demonstrate that there is a significantly positive relationship between idiosyncratic risk and the delta of VIX, demonstrating that when the change between the quartiles is high and positive, which indicates market instability, the firm-specific risk increases. In the firm fixed effects model, a 1 unit increase in the innovations of VIX leads to an increase of idiosyncratic risk of 0.825 percentage points.

In Panel B, the regression results using a different dependent variable are shown. For robustness purposes, the idiosyncratic risk is calculated using the Fama and French (1993) three-factor model, without taking the MOM factor into account. Analyzing it, the outcomes are consistent with those of the Carhart (1997) four-factor model, and therefore robustness is confirmed. In

the following parts, it is referred to the results using the idiosyncratic risk calculated with the Carhart (1997) four-factor model including the MOM factor (Panel A).

**Table 5: Panel Regression on Idiosyncratic Risk Europe Q1 2000 until Q1 2023**

| Panel A: Idiosyncratic Risk Europe using Carhart |                            |                            |                            |                            |
|--|----------------------------|----------------------------|----------------------------|----------------------------|
| VARIABLES  | (1)<br>IdioC               | (2)<br>IdioC               | (3)<br>IdioC               | (4)<br>IdioC               |
| high   | 0.000477<br>(0.000404)     | 0.000046<br>(0.000349)     | 0.000043<br>(0.000355)     | 0.000056<br>(0.000349)     |
| ENSCORE  | 0.000033***<br>(0.000012)  | 0.000011<br>(0.000009)     | 0.000015<br>(0.000010)     | 0.000012<br>(0.000009)     |
| SOSCORE  | -0.000059***<br>(0.000012) | -0.000039***<br>(0.000010) | -0.000041***<br>(0.000011) | -0.000040***<br>(0.000010) |
| CGSCORE  | 0.000012<br>(0.000009)     | 0.000004<br>(0.000008)     | 0.000001<br>(0.000009)     | 0.000003<br>(0.000008)     |
| Size   | -0.001450<br>(0.000890)    | -0.002440***<br>(0.000376) | -0.001860**<br>(0.000871)  | -0.002200***<br>(0.000404) |
| Leverage   | 0.000752***<br>(0.000184)  | 0.000261*<br>(0.000146)    | 0.000280*<br>(0.000158)    | 0.000277*<br>(0.000147)    |
| MBV  | -0.606000***<br>(0.105000) | -0.233000***<br>(0.085000) | -0.313000***<br>(0.098500) | -0.250000***<br>(0.085300) |
| ROA  | -0.025300***<br>(0.003550) | -0.018000***<br>(0.003050) | -0.016900***<br>(0.003230) | -0.017900***<br>(0.003060) |
| deltaVIX   | 0.008250***<br>(0.000259)  |                            | 0.601000<br>(0.433000)     |                            |
| Constant   | 0.031300***<br>(0.005830)  | 0.040900***<br>(0.002320)  | 0.128000**<br>(0.064700)   | 0.038300***<br>(0.002570)  |
| Time fixed effects                               | No                         | Yes                        | Yes                        | Yes                        |
| Firm fixed effects                               | Yes                        | No                         | Yes                        | No                         |
| Industry fixed effects                           | No                         | No                         | No                         | Yes                        |
| Observations                                     | 26,915                     | 26,915                     | 26,915                     | 26,915                     |
| R-squared  | 0.068                      | 0.386                      | 0.386                      | 0.386                      |
| Number of firms                                  | 927                        | 927                        | 927                        | 927                        |

**Table 5***(continued)*

| Panel B: Idiosyncratic Risk Europe using FF |                            |                            |                            |                            |
|---|----------------------------|----------------------------|----------------------------|----------------------------|
| VARIABLES                                   | (1)<br>IdioFF              | (2)<br>IdioFF              | (3)<br>IdioFF              | (4)<br>IdioFF              |
| high  | 0.000460<br>(0.000404)     | 0.000028<br>(0.000350)     | 0.000031<br>(0.000357)     | 0.000039<br>(0.000350)     |
| ENSCORE                                     | 0.000320***<br>(0.000012)  | 0.000012<br>(0.000009)     | 0.000015<br>(0.000010)     | 0.000013<br>(0.000009)     |
| SOSCORE                                     | -0.000059***<br>(0.000012) | -0.000039***<br>(0.000010) | -0.000040***<br>(0.000011) | -0.000040***<br>(0.000011) |
| CGSCORE                                     | 0.000012<br>(0.000009)     | 0.000004<br>(0.000008)     | 0.000002<br>(0.000009)     | 0.000003<br>(0.000008)     |
| Size  | -0.001450<br>(0.000886)    | -0.002400***<br>(0.000382) | -0.001850**<br>(0.000868)  | -0.002150***<br>(0.000411) |
| Leverage                                    | 0.000743***<br>(0.000184)  | 0.000258*<br>(0.000146)    | 0.000275*<br>(0.000158)    | 0.000275*<br>(0.000147)    |
| MBV   | -0.602000***<br>(0.105000) | -0.233000***<br>(0.085900) | -0.310000***<br>(0.099000) | -0.251000***<br>(0.086200) |
| ROA   | -0.025200***<br>(0.003570) | -0.017800***<br>(0.003070) | -0.016800***<br>(0.003250) | -0.017800***<br>(0.003080) |
| deltaVIX                                    | 0.008170***<br>(0.000259)  |                            | 0.601000<br>(0.430000)     |                            |
| Constant                                    | 0.031200***<br>(0.005810)  | 0.040500***<br>(0.002350)  | 0.128000**<br>(0.064300)   | 0.037800***<br>(0.002610)  |
| Time fixed effects                          | No                         | Yes                        | Yes                        | Yes                        |
| Firm fixed effects                          | Yes                        | No                         | Yes                        | No                         |
| Industry fixed effects                      | No                         | No                         | No                         | Yes                        |
| Observations                                | 26,915                     | 26,915                     | 26,915                     | 26,915                     |
| R-squared                                   | 0.067                      | 0.382                      | 0.382                      | 0.382                      |
| Number of firms                             | 927                        | 927                        | 927                        | 927                        |

Coefficients, Robust standard errors (in parentheses) clustered by company and R-squared are provided. The model covers the period between Q1 2000 and Q1 2023. The symbols \*\*\*, \*\*, \* denote significance at the 1%, 5%, and 10% level respectively.

Additionally, the US is taken into consideration. Table 6 provides the panel regression results using the US data set. In line with the European results, all different fixed effects models indicate that companies with an ESG rating ranked higher than the median, tend to have a higher idiosyncratic risk. The result is not statistically significant. This contradicts the analyses of other papers investigating US stocks as Giese et al. (2019) found that a higher level of firm responsibility leads to lower residual volatility and Horn (2023) discovered that being awarded with a high ESG rating has the same effect. Further, the E, S, and G pillar scores behave differently in the US and Europe as the US data shows a significant (10%), negative E Score coefficient, a positive S Score coefficient at the 1% significance level, and a non-significant

negative G pillar score at the firm fixed effects level. This difference can be explained by the fact that the results are driven by different economic areas with different policies in place and different investors.

**Table 6: Panel Regression on Idiosyncratic Risk US Q1 2000 until Q1 2023**

| Panel A: Idiosyncratic Risk US using Carhart |                            |                            |                            |                            |
|--|----------------------------|----------------------------|----------------------------|----------------------------|
| VARIABLES                                    | (1)<br>IdioC               | (2)<br>IdioC               | (3)<br>IdioC               | (4)<br>IdioC               |
| high   | 0.000444*<br>(0.000269)    | 0.000103<br>(0.000243)     | 0.000161<br>(0.000245)     | 0.000099<br>(0.000242)     |
| ENSCORE                                      | -0.000012*<br>(0.000007)   | -0.000004<br>(0.000006)    | -0.0000004<br>(0.000010)   | -0.000003<br>(0.000012)    |
| SOSCORE                                      | 0.000022***<br>(0.000009)  | -0.000007<br>(0.000008)    | -0.000010<br>(0.000008)    | -0.000012<br>(0.000008)    |
| CGSCORE                                      | -0.000008<br>(0.000006)    | -0.000023***<br>(0.000005) | -0.000016***<br>(0.000006) | -0.000022***<br>(0.000005) |
| Size   | -0.003030***<br>(0.000567) | -0.007990***<br>(0.000368) | -0.005110***<br>(0.000621) | -0.007180***<br>(0.000380) |
| Leverage                                     | -0.000020<br>(0.000058)    | -0.000197<br>(0.000121)    | -0.000081<br>(0.000125)    | -0.000179<br>(0.000120)    |
| MBV  | 0.000335**<br>(0.000164)   | 0.000190<br>(0.000145)     | 0.000265*<br>(0.000146)    | 0.000204<br>(0.000145)     |
| ROA  | 0.000247***<br>(0.000043)  | 0.000049<br>(0.000036)     | 0.000095**<br>(0.000039)   | 0.000051<br>(0.000036)     |
| deltaVIX                                     | 0.005780***                | -0.115000                  | 0.003850                   | -0.053800                  |
| Constant                                     | 0.040000***<br>(0.003520)  | 0.062500<br>(0.187000)     | 0.061400                   | 0.065200<br>(0.186000)     |
| Time fixed effects                           | No                         | Yes                        | Yes                        | Yes                        |
| Firm fixed effects                           | Yes                        | No                         | Yes                        | No                         |
| Industry fixed effects                       | No                         | No                         | No                         | Yes                        |
| Observations                                 | 50,514                     | 50,514                     | 50,514                     | 50,514                     |
| R-squared                                    | 0.013                      | 0.227                      | 0.229                      | 0.228                      |
| Number of firms                              | 2,391                      | 2,391                      | 2,391                      | 2,391                      |

**Table 6***(continued)*

| Panel B: Idiosyncratic Risk US using FF |                            |                            |                            |                            |
|---|----------------------------|----------------------------|----------------------------|----------------------------|
| VARIABLES                               | (1)<br>IdioFF              | (2)<br>IdioFF              | (3)<br>IdioFF              | (4)<br>IdioFF              |
| high                                    | 0.000441*<br>(0.000267)    | 0.000102<br>(0.000241)     | 0.000160<br>(0.000243)     | 0.000098<br>(0.000240)     |
| ENSCORE                                 | -0.000012*<br>(0.000007)   | -0.000004<br>(0.000006)    | -0.0000004<br>(0.000006)   | -0.000003<br>(0.000006)    |
| SOSCORE                                 | 0.000022***<br>(0.000008)  | -0.000007<br>(0.000008)    | -0.000010<br>(0.000008)    | -0.000012<br>(0.000008)    |
| CGSCORE                                 | -0.000008<br>(0.000006)    | -0.000023***<br>(0.000005) | -0.000015***<br>(0.000006) | -0.000022***<br>(0.000005) |
| Size                                    | -0.003010***<br>(0.000562) | -0.007920***<br>(0.000365) | -0.005070***<br>(0.000616) | -0.007120***<br>(0.000377) |
| Leverage                                | -0.000019<br>(0.000058)    | -0.000193<br>(0.000120)    | -0.000078<br>(0.000124)    | -0.000175<br>(0.000119)    |
| MBV                                     | 0.000332**<br>(0.000163)   | 0.000188<br>(0.000144)     | 0.000263*<br>(0.000144)    | 0.000202<br>(0.000144)     |
| ROA                                     | 0.000244***<br>(0.000042)  | 0.000049<br>(0.000036)     | 0.000095**<br>(0.000039)   | 0.000050<br>(0.000036)     |
| deltaVIX                                | 0.005730***                | -0.110000                  | 0.002180                   | -0.048500                  |
| Constant                                | 0.039600***<br>(0.003490)  | 0.062700<br>(0.185000)     | 0.060600                   | 0.065400<br>(0.185000)     |
| Time fixed effects                      | No                         | Yes                        | Yes                        | Yes                        |
| Firm fixed effects                      | Yes                        | No                         | Yes                        | No                         |
| Industry fixed effects                  | No                         | No                         | No                         | Yes                        |
| Observations                            | 50,514                     | 50,514                     | 50,514                     | 50,514                     |
| R-squared                               | 0.013                      | 0.227                      | 0.229                      | 0.228                      |
| Number of firms                         | 2,391                      | 2,391                      | 2,391                      | 2,391                      |

Coefficients, Robust standard errors (in parentheses) clustered by company and R-squared are provided. The model covers the period between Q1 2000 and Q1 2023. The symbols \*\*\*, \*\*, \* denote significance at the 1%, 5%, and 10% level respectively.

## 5.2. Idiosyncratic Risk across Industries

Figure 4 illustrates the progression of the idiosyncratic risk in 10 different industries. Amongst these, Industry 5, namely the High-Tech Business Equipment Industry, exhibits the highest average idiosyncratic risk between 2000 and 2023. This can be attributed to the nature of this continuously evolving sector, where businesses must respond swiftly to new technology and market trends to remain competitive. Consequently, this leads to a climate of heightened uncertainty and ultimately to higher idiosyncratic risk. In addition, the intense competition for market share within the industry combined with the limited customer base further exacerbates

the risk profile. Furthermore, it is concentrated on a small number of large customers and firms depend heavily on highly qualified employees and effective management practices.

In 2000, Industry 5 witnessed a surge in idiosyncratic risk with a volatility of 0.04919, which can be explained by the Dotcom Bubble burst. The tech sector experienced a rapid expansion followed by a downturn because of the rapid rise in stock equity valuations that were propelled by investments driven by high expectations. The downturn occurred as a consequence of firms having unsustainable business plans and revenues. Additionally, Industry 6, which encompasses Telecommunications and Televisions Transmission, also experienced high idiosyncratic risk, as since in the 1990s, investors had begun to make significant investments in the infrastructure required for the transmission of data and media over the Internet. Investment in this sector experienced a significant fall once the bubble burst.

It is striking that during times of crisis, this distribution acts differently for a brief period. In 2009, the average firm-specific volatility of Industry 2 (Consumer Durables) with 0.0324 barely surpasses that of Industry 5 (0.0313). This may be tied to the GFC since the recession forced customers to change their demand and consumption patterns, which hurt sales of consumer goods including cars, televisions, furniture, and home appliances. The same effect occurs following the Covid-19 crisis in 2020, where the energy, oil, and gas industry shows an idiosyncratic risk of 0.0324. This phenomenon can be explained by the decrease in demand for oil and gas as well as the general slowdown in economic growth. The likelihood of a high overall firm-specific risk is increased due to the industry's structure and the dominance of a small number of firms.

The lowest overall average over the years between 2000 and 2023 is shown in the Utilities Industry with an overall average of 0.0171. Their corporate model, where pricing and profits are regulated, provides an explanation for this behavior. Since prices are typically predictable and stable, there is less uncertainty and volatility. Additionally, compared to other industries, this industry exhibits a lower idiosyncratic risk during times of crisis because utility consumption is less subject to seasonal or cyclical fluctuations.

**Figure 4: Idiosyncratic Risk Europe during 2000 and 2023 in 10 different FF industries**

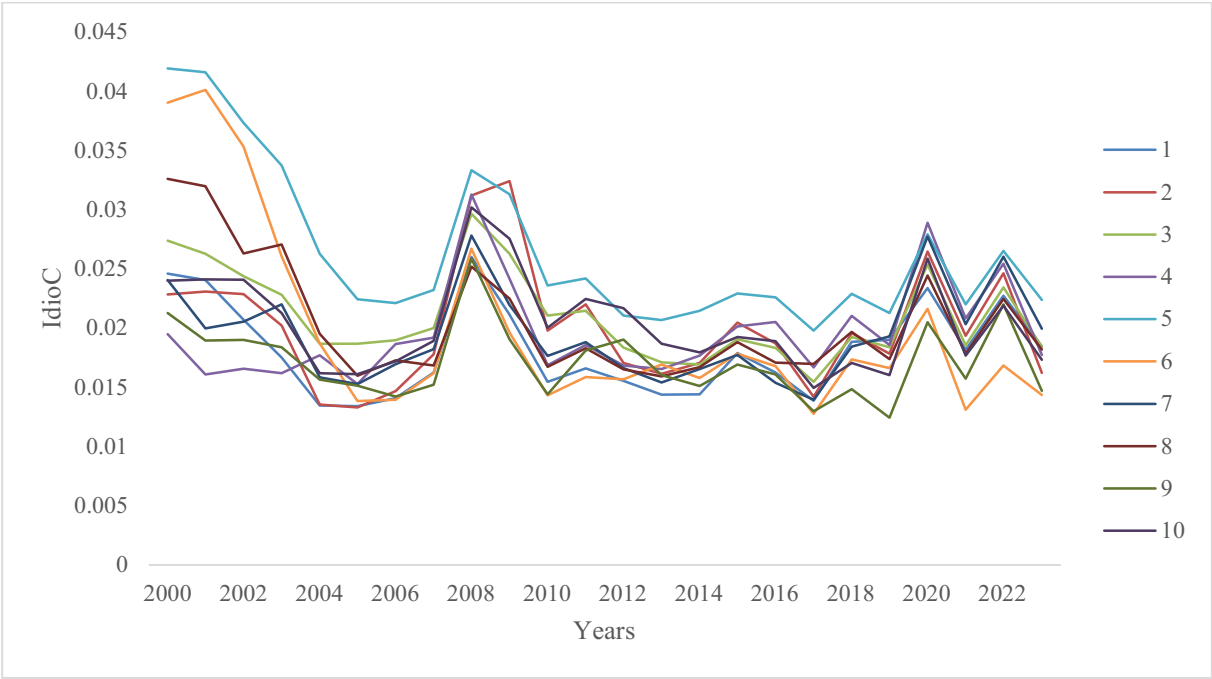


Table 7 shows the panel regression results for Europe of the full sample period of 23 years using a firm fixed effects model and the Carhart (1997) four-factor model as an idiosyncratic risk estimator. What is striking here is that different branches differ in their relationship between firm-specific risk and E, S, and G pillar scores. In general, it shows that the firm-specific volatility of some industries cannot be explained using sustainable ratings (Industry 1 and 3). A possible explanation for this phenomenon is that companies in this industry are generally not very susceptible to idiosyncratic risk, regardless of how well they perform on ESG factors. Industry 4, 7, and 8 show that higher ESG ratings lead to significantly higher idiosyncratic risk. Focused on the E pillar score, Industries 2, 6, and 10 exhibit a significantly positive relation as the adaption of environmental standards forces companies to reduce production or discontinue certain products due to environmental requirements or stricter regulations. This could lead to a lower production capacity or difficulties in providing the services and thus higher idiosyncratic risk, as the company becomes more vulnerable to changes in demand or unforeseen events such as supply chain disruptions or natural disasters. The results show that the S pillar score has different effects across industries as only Industries 2 and 10 show a negative coefficient at the 1% significance level. While for Industry 9 this coefficient is positive as an increase of 1 unit in the S pillar score, increases the idiosyncratic volatility by 0.0054 percentage points. This phenomenon could be explained by the fact that idiosyncratic risk may be more heavily influenced by social issues such as labor relations or customer attitude in the case of consumer durables than it is in other industries. Regarding the G pillar score Industries 5 and 6 show a

significantly positive impact at the 5% and 10% significance level, which means that an increasing governance score, indicating improved management practices, leads to a higher idiosyncratic risk.

As a comparison the same panel regression was performed using the US data set, which is displayed in Appendix B. Results show that a strong relationship between the term under review and the ESG qualification are, however, uncommon across industries. Only Industry 1 and 5 show a negative effect between the G pillar score and the idiosyncratic risk, which can be attributed to increased transparency and effective management practices. Furthermore, when examining the impact of the S pillar score, Industries 6 and 7 display a significantly negative coefficient that is consistent with the European results for these industries.

**Table 7: Panel Regression on Idiosyncratic Risk Europe between 10 different Industries Q1 2000 and Q1 2023**

| VARIABLES          | (1)                       | (2)                        | (3)                        | (4)                        | (5)                       | (6)                        | (7)                       | (8)                        | (9)                        | (10)                       |
|--------------------|---------------------------|----------------------------|----------------------------|----------------------------|---------------------------|----------------------------|---------------------------|----------------------------|----------------------------|----------------------------|
|                    | 1                         | 2                          | 3                          | 4                          | 5                         | 6                          | 7                         | 8                          | 9                          | 10                         |
| high               | -0.000538<br>(0.000952)   | -0.000514<br>(0.000826)    | 0.000498<br>(0.000516)     | 0.006600*<br>(0.003470)    | -0.001440*<br>(0.000803)  | 0.000751<br>(0.000807)     | 0.002500**<br>(0.001190)  | 0.002100**<br>(0.000830)   | -0.001060<br>(0.000813)    | -0.000619<br>(0.000739)    |
| ENSCORE            | -0.000043<br>(0.000028)   | 0.000075***<br>(0.000013)  | -0.000011<br>(0.000015)    | 0.000027<br>(0.000040)     | -0.000032<br>(0.000030)   | 0.000104***<br>(0.000032)  | -0.000017<br>(0.000028)   | -0.000048<br>(0.000033)    | 0.000001<br>(0.000016)     | 0.000050***<br>(0.000019)  |
| SOSCORE            | 0.000035<br>(0.000039)    | -0.000070***<br>(0.000018) | -0.000015<br>(0.000015)    | 0.000026<br>(0.000041)     | 0.000022<br>(0.000028)    | -0.000060<br>(0.000040)    | -0.000037<br>(0.000035)   | -0.000024<br>(0.000029)    | 0.000054**<br>(0.000022)   | -0.000076***<br>(0.000022) |
| CGSCORE            | -0.000024<br>(0.000017)   | 0.000003<br>(0.000018)     | 0.000007<br>(0.000015)     | -0.000030<br>(0.000040)    | 0.000040**<br>(0.000018)  | 0.000034*<br>(0.000018)    | -0.000011<br>(0.000029)   | 0.000006<br>(0.000016)     | -0.000007<br>(0.000016)    | -0.000016<br>(0.000018)    |
| Size               | -0.004750*<br>(0.002760)  | 0.002150<br>(0.002350)     | 0.0000002<br>(0.002020)    | -0.017400***<br>(0.005650) | -0.004790**<br>(0.001930) | -0.008070***<br>(0.001500) | -0.003810<br>(0.003800)   | 0.003770**<br>(0.001750)   | 0.000814<br>(0.001720)     | 0.000759<br>(0.001590)     |
| Leverage           | 0.000191<br>(0.001090)    | -0.000311<br>(0.000617)    | 0.000241<br>(0.000573)     | -0.002750<br>(0.001840)    | 0.001070*<br>(0.000647)   | 0.000830**<br>(0.000355)   | 0.000992**<br>(0.000417)  | -0.001010<br>(0.000837)    | -0.000311<br>(0.000717)    | 0.000103<br>(0.000206)     |
| MBV                | -0.549000<br>(0.527000)   | -0.504000<br>(0.449000)    | -0.293000<br>(0.202000)    | -0.792000**<br>(0.326000)  | -0.244000*<br>(0.131000)  | -0.709000***<br>(0.171000) | -0.565000**<br>(0.258000) | 0.406000**<br>(0.191000)   | 0.479000<br>(0.555000)     | -0.405000<br>(0.269000)    |
| ROA                | 0.006060<br>(0.016500)    | -0.024400***<br>(0.008470) | -0.018400***<br>(0.004960) | 0.008880*<br>(0.004910)    | -0.007790<br>(0.005910)   | -0.027700**<br>(0.010200)  | -0.008270<br>(0.008920)   | -0.007160<br>(0.004720)    | -0.016900**<br>(0.007640)  | -0.026000***<br>(0.005280) |
| deltaVIX           | -0.137000**<br>(0.053600) | 0.054500***<br>(0.016300)  | -0.108000<br>(0.922000)    | -0.125000**<br>(0.049500)  | 0.134000**<br>(0.059300)  | 0.052000***<br>(0.011900)  | -0.002540<br>(0.036700)   | -0.030400***<br>(0.008210) | -0.142000***<br>(0.043900) | 0.006040<br>(0.009680)     |
| Constant           | 0.066900**<br>(0.025100)  | 0.000687<br>(0.017700)     | 0.008090<br>(0.135000)     | 0.151000***<br>(0.042900)  | 0.069800***<br>(0.011900) | 0.075600***<br>(0.009280)  | 0.051700*<br>(0.030300)   | 0.002780<br>(0.011500)     | 0.024800<br>(0.017500)     | 0.016600<br>(0.011400)     |
| Firm fixed effects | Yes                       | Yes                        | Yes                        | Yes                        | Yes                       | Yes                        | Yes                       | Yes                        | Yes                        | Yes                        |
| Observations       | 1,691                     | 1,198                      | 4,192                      | 641                        | 3,089                     | 1,295                      | 2,311                     | 1,641                      | 1,531                      | 9,326                      |
| R-squared          | 0.335                     | 0.607                      | 0.520                      | 0.617                      | 0.334                     | 0.565                      | 0.458                     | 0.430                      | 0.613                      | 0.420                      |
| Number of firms    | 51                        | 42                         | 144                        | 18                         | 154                       | 25                         | 82                        | 54                         | 45                         | 312                        |

Coefficients, Robust standard errors (in parentheses) clustered by 10 industries and R-squared are provided. The model covers the period between Q1 2000 and Q1 2023. The symbols \*\*\*, \*\*, \* denote significance at the 1%, 5%, and 10% level respectively.

### **5.3. Idiosyncratic Risk during Times of Crisis**

Table 8 shows the results of the panel regressions on idiosyncratic risk during the Covid-19 crisis between Q1 2020 and Q4 2020. Panel A examines the idiosyncratic risk using the Carhart (1997) four-factor model for calculation. It is striking that compared to Table 10, which presents the non-crisis periods, in all four different models the dummy variable shows a negative coefficient. However, even though is not significant, it shows that during the Covid-19 crisis, companies with higher ESG scores tend to show lower idiosyncratic risk. Factors such as increased vulnerability in times of crisis, show that the impact of ESG criteria becomes more relevant in order to ensure reputational protection, to maintain market confidence or to counteract a decline in demand for products and services. Times of crisis often require close collaboration with various stakeholders, including regulators, employees, customers and suppliers. Companies with a strong focus on the social and governance aspects may be better placed to build and maintain effective relationships with their stakeholders.

This finding can also be seen in the individual pillar scores, where the E pillar score has a negative coefficient with a significance at the 10% level, when focusing on the firm fixed effects model. In line with this, the S and G pillar scores show a negative relation as well. With a significance level of 1%, the idiosyncratic risk of a company during Covid-19 increases by 0.01 percentage points if the G pillar score increases by 1 unit. During the Covid-19 crisis, effective crisis communication and transparency were essential. Companies with sound governance procedures and transparent communication can keep the confidence of shareholders, clients, and other stakeholders while avoiding negative effects on stock price or brand reputation.

During times of crisis, it is also shown with high significance that the idiosyncratic risk can be explained by a positive change in the VIX. As mentioned in the previous section, Panel B is used to test for robustness and since the results align using the idiosyncratic risk determined with the Fama and French (1993) three-factor model, the results are robust.

**Table 8: Panel Regression on Idiosyncratic Risk Europe during Covid-19**

| Panel A: Idiosyncratic Risk during Covid-19 in Europe using Carhart |                            |                            |                           |                            |
|---|----------------------------|----------------------------|---------------------------|----------------------------|
| VARIABLES   | (1)<br>IdioC               | (2)<br>IdioC               | (3)<br>IdioC              | (4)<br>IdioC               |
| high  | -0.000209<br>(0.000991)    | -0.000037<br>(0.000636)    | -0.001050<br>(0.000833)   | -0.000058<br>(0.000638)    |
| ENSCORE   | -0.000069*<br>(0.000041)   | -0.000012<br>(0.000015)    | 0.000020<br>(0.000037)    | -0.000013<br>(0.000015)    |
| SOSCORE   | -0.000050<br>(0.000045)    | -0.000031*<br>(0.000018)   | -0.000009<br>(0.000041)   | -0.000031*<br>(0.000018)   |
| CGSCORE   | -0.000142***<br>(0.000029) | 0.000026*<br>(0.000013)    | -0.000002<br>(0.000025)   | 0.000027**<br>(0.000014)   |
| Size  | -0.011400<br>(0.007280)    | -0.002700***<br>(0.000380) | 0.001810<br>(0.007020)    | -0.002710***<br>(0.000383) |
| Leverage  | -0.000609<br>(0.000405)    | 0.000680***<br>(0.000232)  | -0.000683*<br>(0.000414)  | 0.000691***<br>(0.000233)  |
| MBV   | -0.871000***<br>(0.202000) | -0.153000<br>(0.095500)    | -0.003820<br>(0.192000)   | -0.161000*<br>(0.096600)   |
| ROA   | -0.005470<br>(0.007510)    | -0.022000***<br>(0.004410) | -0.006500<br>(0.006330)   | -0.021900***<br>(0.004400) |
| deltaVIX  | 0.006190***<br>(0.000440)  | 0.014100***<br>(0.000509)  | 0.013800***<br>(0.000576) | 0.014100***<br>(0.000511)  |
| Constant  | 0.118000**<br>(0.047900)   | 0.042000***<br>(0.002200)  | 0.012300<br>(0.046300)    | 0.043300***<br>(0.002480)  |
| Time fixed effects  | No                         | Yes                        | Yes                       | Yes                        |
| Firm fixed effects  | Yes                        | No                         | Yes                       | No                         |
| Industry fixed effects  | No                         | No                         | No                        | Yes                        |
| Observations  | 3,225                      | 3,225                      | 3,225                     | 3,225                      |
| R-squared   | 0.170                      | 0.368                      | 0.372                     | 0.3682                     |
| Number of firms   | 855                        | 855                        | 855                       | 855                        |

**Table 8***(Continued)*

| Panel B: Idiosyncratic Risk during Covid-19 in Europe using FF |                            |                            |                           |                            |
|--|----------------------------|----------------------------|---------------------------|----------------------------|
| VARIABLES  | (1)<br>IdioFF              | (2)<br>IdioFF              | (3)<br>IdioFF             | (4)<br>IdioFF              |
| high   | -0.000211<br>(0.000983)    | -0.000001<br>(0.000634)    | -0.001050<br>(0.000826)   | -0.000036<br>(0.000635)    |
| ENSCORE  | -0.000068*<br>(0.000041)   | -0.000010<br>(0.000016)    | 0.000020<br>(0.000037)    | -0.000009<br>(0.000016)    |
| SOSCORE  | -0.000049<br>(0.000045)    | -0.000029<br>(0.000018)    | -0.000009<br>(0.000040)   | -0.000029<br>(0.000018)    |
| CGSCORE  | -0.000141***<br>(0.000028) | 0.000022<br>(0.000014)     | -0.000002<br>(0.000025)   | 0.000023<br>(0.000014)     |
| Size   | -0.011300<br>(0.007220)    | -0.002660***<br>(0.000378) | 0.001790<br>(0.006970)    | -0.002680***<br>(0.000381) |
| Leverage   | -0.000606<br>(0.000401)    | 0.000673***<br>(0.000232)  | -0.000679*<br>(0.000411)  | 0.000677***<br>(0.000234)  |
| MBV  | -0.861000***<br>(0.200000) | -0.145000<br>(0.095100)    | -0.001530<br>(0.191000)   | -0.154000<br>(0.096100)    |
| ROA  | -0.005430<br>(0.007450)    | -0.021600***<br>(0.004390) | -0.006440<br>(0.006280)   | -0.021400***<br>(0.004380) |
| deltaVIX   | 0.006130***<br>(0.000438)  | 0.013900***<br>(0.000507)  | 0.013700***<br>(0.000573) | 0.013900***<br>(0.000509)  |
| Constant   | 0.117000**<br>(0.047500)   | 0.041600***<br>(0.002190)  | 0.012200<br>(0.045900)    | 0.042800***<br>(0.002470)  |
| Time fixed effects   | No                         | Yes                        | Yes                       | Yes                        |
| Firm fixed effects   | Yes                        | No                         | Yes                       | No                         |
| Industry fixed effects   | No                         | No                         | No                        | Yes                        |
| Observations   | 3,225                      | 3,225                      | 3,225                     | 3,225                      |
| R-squared  | 0.169                      | 0.366                      | 0.369                     | 0.366                      |
| Number of firms  | 855                        | 855                        | 855                       | 855                        |

Coefficients, Robust standard errors (in parentheses) clustered by company and R-squared are provided. The model covers the period between Q1 2020 and Q4 2020. The symbols \*\*\*, \*\*, \* denote significance at the 1%, 5%, and 10% level respectively.

Table 9 provides the results of the panel regression on the idiosyncratic risk between Q3 2008 and Q1 2009, while the GFC occurred. In general, during the GFC, results for the time fixed effects model and time-industry fixed effects model show that highly rated ESG companies have a lower idiosyncratic risk. In contrast, the G pillar score is positively related to the firm-specific risk in this model. Furthermore, the S pillar score shows that there is a negative relationship, where no firm effect is included, at a significance level of 5% for two different models. This shows that firm characteristics have a major impact on how the idiosyncratic risk is changing. Furthermore, what is striking in this panel regression is that the size of a firm plays a significant role in describing the effect as all coefficients show a positive value, meaning that

if the firm is growing in size the idiosyncratic risk is increasing. The GFC affected mostly big financial institutions like Lehman Brothers or Bear Stearns as well as large car manufacturers such as General Motors and Chrysler. In addition, many companies had difficulties repaying their debt and maintaining their business activities due to the general economic downturn as it is also shown by the highly significant and negative coefficient on leverage on the two models. Furthermore, delta VIX behaves very differently when compared to the Covid-19 period in this regression. The negative relationship shows that during this time the idiosyncratic risk increases if the VIX is decreasing, which is an indicator of increased stability. However, a strong decline in the VIX can also be interpreted as a warning signal for a possible overvaluation of the stock markets, as investors might become too carefree and underestimate risks. Panel B shows the results using idiosyncratic risk estimated by the Fama and French (1993) three-factor model as a comparison.

**Table 9: Panel Regression on Idiosyncratic Risk Europe during GFC**

| Panel A: Idiosyncratic Risk during GFC in Europe using Carhart |                            |                            |                            |                            |
|--|----------------------------|----------------------------|----------------------------|----------------------------|
| VARIABLES  | (1)<br>IdioC               | (2)<br>IdioC               | (3)<br>IdioC               | (4)<br>IdioC               |
| high   |                            | -0.007110***<br>(0.002600) |                            | -0.007480***<br>(0.002670) |
| ENSCORE  | -0.000165<br>(0.000118)    | 0.000025<br>(0.000039)     | 0.000014<br>(0.000132)     | 0.000029<br>(0.000039)     |
| SOSCORE  | 0.000183<br>(0.001040)     | -0.000078**<br>(0.000036)  | 0.000458<br>(0.000794)     | -0.000077**<br>(0.000037)  |
| CGSCORE  | 0.000797**<br>(0.000387)   | 0.000089***<br>(0.000034)  | 0.000723*<br>(0.000395)    | 0.000089***<br>(0.000034)  |
| Size   | 0.010700***<br>(0.003840)  | 0.003070***<br>(0.001160)  | 0.006790*<br>(0.003500)    | 0.003050***<br>(0.001150)  |
| Leverage   | -0.000274<br>(0.000812)    | 0.000908**<br>(0.000406)   | 0.000046<br>(0.000925)     | 0.000870**<br>(0.000428)   |
| MBV  | 3.067000***<br>(0.603000)  | -0.868000**<br>(0.339000)  | -0.041000<br>(0.693000)    | -0.889000**<br>(0.352000)  |
| ROA  | 0.033000**<br>(0.016400)   | -0.032500***<br>(0.010600) | 0.011100<br>(0.014200)     | -0.031400***<br>(0.010600) |
| deltaVIX   | -0.069000***<br>(0.003410) | -0.031300***<br>(0.003900) | -0.036000***<br>(0.004860) | -0.031200***<br>(0.003910) |
| Constant   | -0.084100<br>(0.074400)    | 0.015000**<br>(0.007250)   | -0.076400<br>(0.062500)    | 0.015300**<br>(0.007380)   |
| Time fixed effects   | No                         | Yes                        | Yes                        | Yes                        |
| Firm fixed effects   | Yes                        | No                         | Yes                        | No                         |
| Industry fixed effects   | No                         | No                         | No                         | Yes                        |
| Observations   | 686                        | 686                        | 686                        | 686                        |
| R-squared  | 0.502                      | 0.537                      | 0.560                      | 0.538                      |
| Number of firms  | 229                        | 229                        | 229                        | 229                        |

**Table 9***(Continued)*

| Panel B: Idiosyncratic Risk during GFC in Europe using FF |                            |                            |                            |                            |
|---|----------------------------|----------------------------|----------------------------|----------------------------|
| VARIABLES   | (1)<br>IdioFF              | (2)<br>IdioFF              | (3)<br>IdioFF              | (4)<br>IdioFF              |
| high  |                            | -0.007050***<br>(0.002580) |                            | -0.007420***<br>(0.002650) |
| ENSCORE   | -0.000164<br>(0.000117)    | 0.000025<br>(0.000038)     | 0.000014<br>(0.000131)     | 0.000029<br>(0.000039)     |
| SOSCORE   | 0.000180<br>(0.001040)     | -0.000078**<br>(0.000036)  | 0.000455<br>(0.000787)     | -0.000076**<br>(0.000037)  |
| CGSCORE   | 0.000790**<br>(0.000384)   | 0.000089***<br>(0.000034)  | 0.000717*<br>(0.000392)    | 0.000088***<br>(0.000032)  |
| Size  | 0.010600***<br>(0.003810)  | 0.003040***<br>(0.001150)  | 0.006730*<br>(0.003470)    | 0.003030***<br>(0.001140)  |
| Leverage  | -0.000272<br>(0.000806)    | 0.000900**<br>(0.000403)   | 0.000046<br>(0.000917)     | 0.000862**<br>(0.000425)   |
| MBV   | 3.049000***<br>(0.598000)  | -0.860000**<br>(0.336000)  | -0.040400<br>(0.687000)    | -0.882000**<br>(0.350000)  |
| ROA   | 0.032800**<br>(0.016300)   | -0.032300***<br>(0.010600) | 0.011000<br>(0.014100)     | -0.031100***<br>(0.010500) |
| deltaVIX  | -0.068500***<br>(0.003380) | -0.030900***<br>(0.003870) | -0.035600***<br>(0.004820) | -0.030800***<br>(0.003870) |
| Constant  | -0.083500<br>(0.073800)    | 0.014900**<br>(0.007190)   | -0.075700<br>(0.061900)    | 0.015100**<br>(0.007320)   |
| Time fixed effects  | No                         | Yes                        | Yes                        | Yes                        |
| Firm fixed effects  | Yes                        | No                         | Yes                        | No                         |
| Industry fixed effects                                    | No                         | No                         | No                         | Yes                        |
| Observations  | 686                        | 686                        | 686                        | 686                        |
| R-squared   | 0.502                      | 0.5370                     | 0.560                      | 0.5381                     |
| Number of firms   | 229                        | 229                        | 229                        | 229                        |

Coefficients, Robust standard errors (in parentheses) clustered by company and R-squared are provided. The model covers the period between Q3 2008 and Q1 2009. The symbols \*\*\*, \*\*, \* denote significance at the 1%, 5%, and 10% level respectively.

Moving forward, the comparison of the different crises and non-crisis periods will refer to the firm fixed effects model as a baseline, which can be justified by the fact that certain companies consistently have higher or lower values for the dependent variable than other peers. In addition, it was discussed using the Hausman test that it is reasonable to consult this type of fixed effect.

To conclude, Table 10 provides all other regression results using non-crisis periods and therefore excluding the time periods in which Covid-19 and the GFC occurred. Despite the non-significant coefficients, it is noteworthy to mention that the correlation between highly rated ESG companies and idiosyncratic risk is positive in non-crisis times, which changed in comparison to crisis times, where I found a negative non-significant relation. However, while

using the GFC period, the highly ranked ESG companies showed a significant result at the 1% level using the time fixed effects model or time-industry fixed effects model. This supports the fact that companies with above-median ESG ratings tend to have lower idiosyncratic risk in times of crisis, even though the evidence is not statistically significant.

The impact of the E pillar score is significant and positive (0.000030), deviating from the coefficients observed while using crisis segments. The distinction between these two crises can be used to explain why the GFC's negative insignificant E pillar score was less explanatory than that of Covid-19. Certain environmental issues, such as the climate crisis and water management, received more attention during the Covid-19 pandemic than they did during the GFC. Additionally, ESG data has become more readily available and of higher quality recently, which may make it possible to better understand how ESG factors affect idiosyncratic risk than it was the case during the GFC. During non-crisis periods, the S pillar score has a statistically significant negative influence throughout all the different fixed effects models. The decrease in the S pillar score indicates that a company is performing worse concerning the people and communities in which it operates, which in turn exposes companies to higher reputational risk leading to an increase in idiosyncratic risk. This result is in line with the crisis times results, although there it shows no significance. Lastly, the impact of the G pillar score is examined. For non-crisis periods governance issues show a positive non-significant impact on idiosyncratic risk. This is in line with the GFC, where the coefficients are statistically significant (0.000797). Contrary to this, the relationship changes during the Covid-19 crisis (-0.000141). Regulatory changes, government support programs and political decisions can have specific effects on corporate governance and thus also influence the relationship with idiosyncratic risk.

**Table 10: Panel Regression on Idiosyncratic Risk Europe during Non-Crisis Periods**

| Panel A: Idiosyncratic Risk during Non-Crisis Periods in Europe using Carhart |                            |                            |                            |                            |
|---|----------------------------|----------------------------|----------------------------|----------------------------|
| VARIABLES   | (1)                        | (2)                        | (3)                        | (4)                        |
|   | IdioC                      | IdioC                      | IdioC                      | IdioC                      |
| high  | 0.000072<br>(0.000420)     | 0.000083<br>(0.000368)     | 0.000074<br>(0.000375)     | 0.000078<br>(0.000368)     |
| ENSCORE   | 0.000030**<br>(0.000012)   | 0.000012<br>(0.000009)     | 0.000015<br>(0.000010)     | 0.000012<br>(0.000009)     |
| SOSCORE   | -0.000058***<br>(0.000012) | -0.000040***<br>(0.000011) | -0.000041***<br>(0.000012) | -0.000040***<br>(0.000011) |
| CGSCORE   | 0.000011<br>(0.000009)     | 0.000006<br>(0.000008)     | 0.000004<br>(0.000009)     | 0.000006<br>(0.000008)     |
| Size  | -0.001580*<br>(0.000882)   | -0.002530***<br>(0.000397) | -0.002080**<br>(0.000906)  | -0.002520***<br>(0.000398) |
| Leverage  | 0.000376*<br>(0.000204)    | 0.000133<br>(0.000168)     | 0.000168<br>(0.000185)     | 0.000135<br>(0.000168)     |
| MBV   | -0.383000***<br>(0.113000) | -0.179000*<br>(0.094900)   | -0.273000**<br>(0.112000)  | -0.182000*<br>(0.095200)   |
| ROA   | -0.020700***<br>(0.003550) | -0.018200***<br>(0.003200) | -0.017100***<br>(0.003430) | -0.018200***<br>(0.003200) |
| deltaVIX  | 0.004520***<br>(0.000324)  | 0.428000<br>(0.386000)     | 0.003530<br>(2,438)        | 0.447000<br>(0.386000)     |
| Constant  | 0.030900***<br>(0.005880)  | 0.107000*<br>(0.058800)    | 0.039300<br>(403.9)        | 0.111000*<br>(0.058900)    |
| Time fixed effects  | No                         | Yes                        | Yes                        | Yes                        |
| Firm fixed effects  | Yes                        | No                         | Yes                        | No                         |
| Industry fixed effects  | No                         | No                         | No                         | Yes                        |
| Observations  | 23,004                     | 23,004                     | 23,004                     | 23,004                     |
| R-squared   | 0.038                      | 0.2581                     | 0.252                      | 0.2518                     |
| Number of firms   | 927                        | 927                        | 927                        | 927                        |

**Table 10***(Continued)*

| Panel B: Idiosyncratic Risk during Non-Crisis Periods in Europe using FF |                            |                            |                            |                            |
|--|----------------------------|----------------------------|----------------------------|----------------------------|
| VARIABLES  | (1)<br>IdioFF              | (2)<br>IdioFF              | (3)<br>IdioFF              | (4)<br>IdioFF              |
| high   | 0.000061<br>(0.000421)     | 0.000065<br>(0.000370)     | 0.000065<br>(0.000377)     | 0.000060<br>(0.000370)     |
| ENSCORE  | 0.000030**<br>(0.000012)   | 0.000013<br>(0.000009)     | 0.000015<br>(0.000010)     | 0.000013<br>(0.000009)     |
| SOSCORE  | -0.000057***<br>(0.000012) | -0.000040***<br>(0.000011) | -0.000041***<br>(0.000012) | -0.000040***<br>(0.000011) |
| CGSCORE  | 0.000011<br>(0.000009)     | 0.000006<br>(0.000008)     | 0.000004<br>(0.000009)     | 0.000006<br>(0.000008)     |
| Size   | -0.001570*<br>(0.000880)   | -0.002490***<br>(0.000401) | -0.002060**<br>(0.000904)  | -0.002470***<br>(0.000403) |
| Leverage   | 0.000367*<br>(0.000204)    | 0.000129<br>(0.000169)     | 0.000162<br>(0.000186)     | 0.000131<br>(0.000169)     |
| MBV  | -0.380000***<br>(0.114000) | -0.178000*<br>(0.096000)   | -0.271000**<br>(0.112000)  | -0.182000*<br>(0.096300)   |
| ROA  | -0.020500***<br>(0.003570) | -0.018100***<br>(0.003230) | -0.017000***<br>(0.003450) | -0.018000***<br>(0.003230) |
| deltaVIX   | 0.004450***<br>(0.000325)  | 0.440000<br>(0.383000)     | 0.007630<br>(1,006)        | 0.461000<br>(0.384000)     |
| Constant   | 0.030800***<br>(0.005860)  | 0.108000*<br>(0.058400)    | 0.039700<br>(125.9)        | 0.113000*<br>(0.058600)    |
| Time fixed effects   | No                         | Yes                        | Yes                        | Yes                        |
| Firm fixed effects   | Yes                        | No                         | Yes                        | No                         |
| Industry fixed effects   | No                         | No                         | No                         | Yes                        |
| Observations   | 23,004                     | 23,004                     | 23,004                     | 23,004                     |
| R-squared  | 0.038                      | 0.2479                     | 0.248                      | 0.248                      |
| Number of firms  | 927                        | 927                        | 927                        | 927                        |

Coefficients, Robust standard errors (in parentheses) clustered by company and R-squared are provided. The model covers the period between Q1 2000 and Q1 2023 with gaps. The symbols \*\*\*, \*\*, \* denote significance at the 1%, 5%, and 10% level respectively.

## 6. Limitations and Further Research

The results of my thesis are subject to certain limitations, which are outlined below. Following these limitations, further research needed will be proposed.

Firstly, the different E, S, and G pillar scores are extracted using Thomson and Reuters databases. To improve the accuracy and completeness of the analysis, it may be beneficial to consult other databases as they may use different methods and criteria for estimating the scores.

Therefore, it is crucial to take into account a variety of sources to get a more comprehensive and in-depth picture of an organization's ESG performance. Furthermore, it is assumed for measuring the high dummy variable that the overall ESG Score is an average of the three different individual scores as the data for Europe could not be obtained using the data sources. In addition, the ESG information used in this study is also based on publicly available data, which might not accurately reflect a company's true ESG performance or practices. In some cases, businesses might present information that is erroneous, lacking, or inconsistent with their actual operations.

This study only focuses on specific time periods and specific companies, which are unevenly distributed in 10 different industries. In particular, it is crucial for ESG data as in earlier years most of the companies did not obtain an ESG rating at all. Therefore, it would be interesting to estimate the differences between businesses with no ESG rating and those with a low or high rating in comparison. Furthermore, further research could explore if the disclosure of the individual E, S, and G pillar scores lead to a decreasing idiosyncratic risk.

Moreover, while focusing on Europe the VIX was used as a market instability estimator. As this factor focuses on the S&P500 an European equivalent should be taken into consideration. Furthermore, to estimate the idiosyncratic risk using the Carhart (1997) four-factor and Fama and French (1993) three-factor model, the excess return was calculated using the risk-free rate obtained from Kenneth French Data Library as a subtractor. It can be discussed, if, particularly for the European data, interest rates of European government bonds should be used as a risk-free rate.

As this study only refers to individual companies, future studies could investigate how the idiosyncratic risk behaves when the individual companies become part of a sustainable mutual fund. Due to the high entry criteria resulting from the high ESG score required, a positive relationship between ESG rating and idiosyncratic risk could emerge due to the possible lack of diversity.

## **7. Conclusion**

This thesis provides empirical support for the influence of E, S, and G pillar ratings on the idiosyncratic risk distributed across industries and during times of crisis.

First, I find that using a time span of 23 years, the level of ESG ratings has no significant impact on idiosyncratic risk. Nevertheless, for Europe the improvement of social responsibility and

employee welfare reflected in the S pillar score has a decreasing impact on the firm-specific volatility. In contrast, the G factor has a significant influence in the US as poor governance practices such as mismanagement and poor decision-making can lead to higher idiosyncratic risk. Second, by splitting the sample into 10 different industries, High Tech Businesses show the highest idiosyncratic risk during the sample period because of their innovative corporate nature. Third, after presenting the different effects that occurred during two different crises, the results show that the individual E, S, and G pillars have an increasingly negative relation to idiosyncratic risk focusing on the Covid-19 crisis. Moreover, especially during the GFC, above-median ESG-rated companies perform significantly better in terms of risk.

In conclusion, SRI measured through ESG ratings is expected to maintain a significant influence on investment decisions. However, a valid concern is the methods of estimating the E, S, and G pillar scores and the potential for divergent ratings to create challenges in making uniform investment decisions. To conclude, it is to mention that idiosyncratic risk can be impacted by many different variables and ESG is only one factor determining the risk exposure.

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## Appendices

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### Appendix A: Variable Description

| Variable   | Description  | Source                                     |
|--|--|--|
| Idiosyncratic Risk<br>( $IVOL_{i,t}$ )           | Standard deviation of daily stock returns represented by the residuals of Fama and French (1993) three-factor model and the Carhart (1997) four-factor model.  | Datastream and Kenneth French Data Library |
| Environment Pillar Score<br>( $EnvScore_{i,t}$ ) | Refinitiv's Environment Pillar Score is the weighted average relative rating of a company based on the reported environmental information and the resulting three environmental category scores (Refinitiv, 2022). | Datastream                                 |
| Social Pillar Score<br>( $SoScore_{i,t}$ )       | Refinitiv's Social Pillar Score is the weighted average relative rating of a company based on the reported social information and the resulting four social category scores (Refinitiv, 2022).                     | Datastream                                 |
| Governance Pillar Score<br>( $GovScore_{i,t}$ )  | Refinitiv's Governance Pillar Score is the weighted average relative rating of a company based on the reported governance information and the resulting three governance category scores (Refinitiv, 2022).        | Datastream                                 |
| VIX ( $VIX$ )                                    | CBOE volatility index.   | CBOE Indexes                               |
| Market to Book Value<br>( $MBV_{i,t}$ )          | Market value of equity to book value of equity (Luo & Bhattacharya, 2009).   | Datastream                                 |
| Leverage<br>( $Leverage_{i,t}$ )                 | Ratio of long-term debt of firms to their common equity (Becchetti et al., 2015).  | Datastream                                 |
| Return on Assets<br>( $ROA_{i,t}$ )              | Ratio of net income before extra items and preferred dividends to total assets (Sorescu & Spanjol, 2008).  | Datastream                                 |

**Appendix B: Panel Regression on Idiosyncratic Risk US using Carhart between 10 different Industries Q1 2000 and Q1 2023**

| VARIABLES          | (1)                       | (2)                      | (3)                       | (4)                       | (5)                        | (6)                       | (7)                        | (8)                        | (9)                       | (10)                       |
|--------------------|---------------------------|--------------------------|---------------------------|---------------------------|----------------------------|---------------------------|----------------------------|----------------------------|---------------------------|----------------------------|
|                    | 1                         | 2                        | 3                         | 4                         | 5                          | 6                         | 7                          | 8                          | 9                         | 10                         |
| high               | -0.000989<br>(0.000755)   | 0.000463<br>(0.000778)   | 0.000082<br>(0.000689)    | 0.003370*<br>(0.001740)   | 0.000468<br>(0.000638)     | 0.001910<br>(0.003000)    | -0.000255<br>(0.000696)    | -0.000479<br>(0.001010)    | -0.001190<br>(0.000980)   | 0.000224<br>(0.000374)     |
| ENSCORE            | -0.0000004<br>(0.000015)  | -0.000026<br>(0.000034)  | -0.000019<br>(0.000015)   | -0.000017<br>(0.000042)   | -0.000007<br>(0.000020)    | 0.000128<br>(0.000077)    | 0.000028<br>(0.000021)     | -0.000028<br>(0.000021)    | 0.000018<br>(0.000019)    | -0.000006<br>(0.000009)    |
| SOSCORE            | 0.000006<br>(0.000015)    | 0.000024<br>(0.000027)   | 0.000013<br>(0.000024)    | -0.000025<br>(0.000052)   | 0.000006<br>(0.000023)     | -0.000193**<br>(0.000094) | -0.000068**<br>(0.000028)  | 0.000026<br>(0.000029)     | -0.000030<br>(0.000028)   | -0.000020<br>(0.000014)    |
| CGSCORE            | -0.000020*<br>(0.000011)  | 0.000014<br>(0.000020)   | 0.000001<br>(0.000015)    | -0.000018<br>(0.000033)   | -0.000041**<br>(0.000016)  | 0.000010<br>(0.000055)    | -0.000012<br>(0.000013)    | -0.000010<br>(0.000023)    | 0.000007<br>(0.000019)    | -0.000004<br>(0.000010)    |
| Size               | -0.002030<br>(0.001910)   | -0.000560<br>(0.002600)  | -0.002140<br>(0.001590)   | -0.010300**<br>(0.004700) | -0.006860***<br>(0.001340) | -0.006090<br>(0.004160)   | -0.006750***<br>(0.001700) | -0.006030***<br>(0.001800) | 0.006450***<br>(0.002000) | -0.003400***<br>(0.001080) |
| Leverage           | -0.000551*<br>(0.000305)  | -0.00072**<br>(0.000301) | -0.000339<br>(0.000473)   | -0.002650**<br>(0.001100) | 0.000528<br>(0.000328)     | -0.001100<br>(0.000790)   | -0.000189<br>(0.000187)    | -0.000242<br>(0.000306)    | -0.000714*<br>(0.000426)  | 0.000061<br>(0.000214)     |
| MBV                | 0.000130<br>(0.000317)    | 0.000089<br>(0.000443)   | 0.000156<br>(0.000341)    | -0.000555<br>(0.000866)   | -0.000021<br>(0.000413)    | -0.000986<br>(0.000997)   | -0.000286<br>(0.000340)    | 0.001260**<br>(0.000579)   | 0.000015<br>(0.000319)    | 0.000499*<br>(0.000272)    |
| ROA                | -0.000010<br>(0.000069)   | 0.000149<br>(0.000109)   | 0.000231*<br>(0.000129)   | -0.000270<br>(0.000295)   | -0.000047<br>(0.000105)    | 0.000267<br>(0.000319)    | 0.000171<br>(0.000121)     | 0.000063<br>(0.000145)     | -0.000045<br>(0.000101)   | 0.000186***<br>(0.000065)  |
| deltaVIX           | -0.020000<br>(0.014700)   | 0.072300<br>(0.056900)   | -0.045600<br>(0.032000)   | 0.108000***<br>(0.033500) | -0.060300***<br>(0.017200) | 0.220000**<br>(0.088600)  | -0.003580<br>(0.019800)    | 0.103000<br>(0.093300)     | 0.023400*<br>(0.013000)   | 0.066700<br>(0.050100)     |
| Constant           | 0.037700***<br>(0.012700) | 0.033500**<br>(0.014300) | 0.041800***<br>(0.012200) | 0.114000***<br>(0.034300) | 0.066900***<br>(0.008370)  | 0.045200<br>(0.031600)    | 0.070900***<br>(0.011900)  | 0.072900***<br>(0.014300)  | -0.024600*<br>(0.013000)  | 0.051400***<br>(0.009610)  |
| Firm fixed effects | Yes                       | Yes                      | Yes                       | Yes                       | Yes                        | Yes                       | Yes                        | Yes                        | Yes                       | Yes                        |
| Observations       | 3,798                     | 2,263                    | 4,805                     | 1,572                     | 9,542                      | 599                       | 5,210                      | 5,216                      | 2,612                     | 14,897                     |
| R-squared          | 0.329                     | 0.333                    | 0.300                     | 0.463                     | 0.134                      | 0.288                     | 0.337                      | 0.099                      | 0.442                     | 0.406                      |
| Number of firms    | 149                       | 97                       | 185                       | 66                        | 596                        | 28                        | 214                        | 277                        | 81                        | 698                        |

Coefficients, Robust standard errors (in parentheses) clustered by 10 industries and R-squared are provided. The model covers the period between Q1 2000 and Q1 2023. The symbols \*\*\*, \*\*, \* denote significance at the 1%, 5%, and 10% level respectively.