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ESG SPILLOVER AND VOLATILITY

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Abstract. This study investigates the spillover effects of ESG scores from companies operating in the same industry and their impact on stock return volatility. For this purpose, I considered a sample of European listed companies from 2019 to 2022. The results provide evidence of a spillover effect of ESG scores on the ESG ratings of other companies belonging to the same industry. Furthermore, I observed direct spillover effects of the individual Environmental, Social and Governance pillars, with similar magnitudes. I also found that stock return volatility is directly related to ESG scores, including spillover effects.

JEL Classification: G30, M14.

Keywords: ESG, ESG spillover, industry, volatility.

1. Introduction

With the European Union's growing concerns about sustainable development and climate change, European companies have begun to consider environmental, social and governance issues. Moreover, the recent adopting of the European Sustainability Reporting Standards provides transparency, enabling companies to show their making efforts and investors can better evaluate companies' sustainability performance.

The connection between ESG and financial factors has generated a debate in academic literature and it remains uncertain whether the industry to which a company belongs influences the decision of companies on ESG activities. For instance, previous research has mainly examined the impact of ESG scores on the company itself. In this case, several studies investigate whether ESG influences stock return volatility in the context of specific industries (Jo and Na, 2012; Tasnia et al., 2020; Shakil, 2021) or specific countries (Sassen et al., 2016; Meher et al. 2020; Zhou and Zhou, 2022). Despite ESG factors vary by industry due to the specificities of the industries, there is not evident literature on the spillover effects of ESG scores from other companies belonging to the same industry. From this point of view, the companies

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with a competitive advantage due to ESG practices can have a direct influence on other companies (Li et al., 2023).

The aim of this study is to investigate the spillover effects of ESG scores from companies operating in the same industry and their impact on stock return volatility to fill the gaps in literature. For this purpose, I considered a sample of European companies from 2019 to 2022. The study is based on an approach divided into five levels: firstly, I tested if the ESG score of one company is impacted by the average ESG scores of companies belonging to the same industry; Secondly, I investigated the relationship between volatility and ESG scores, including spillovers effects of ESG; Thirdly, I examined whether the spillover effects of ESG impact the volatility through its effect on the ESG scores of a company; Then, the sample was divided according to the ESG scores into better ESG performers and poorer ESG performers; Finally, I explored the relationship between changes in ESG scores and changes in volatility. The results provide evidence of a spillover effect of ESG scores on the ESG ratings of other companies belonging to the same industry. Furthermore, I observed direct spillover effects of the individual Environmental, Social and Governance pillars, with similar magnitudes. I also found that stock return volatility is directly related to ESG scores, including spillover effects.

The remainder of the paper is structured as follows. Section 1 presents the theoretical background. The data and methodology are described in Section 2 and 3. Section 4 discuss the results. Section 5 concludes.

2. Literature review

Previous research has examined the impact of ESG scores on the company itself and suggest that companies benefit from investing in ESG. They report that companies with higher ESG scores have better financial performance (Gao and Zhang, 2015; Cornett et al., 2016; Ferrel et al., 2016; Buallay, 2018; Fatemi et al., 2018; Azmi et al., 2021; Wong et al.,2021) and better stock returns (Hong and Kacperczyk, 2009; Edmans, 2011; Ferrat et al, 2022; Li et al., 2023).

In terms of the topic of this study, several studies investigate whether ESG influences stock return volatility in the context of specific industries (Jo and Na, 2012; Tasnia et al., 2020; Shakil, 2021) or specific countries (Sassen et al., 2016; Meher et al. 2020; Zhou and Zhou, 2022). In this case, existing literature suggests that ESG is linked to lower volatility (Jo and Na, 2012; Sassen et al., 2016; Shakil, 2021; Zhou and Zhou, 2022).

Jo and Na (2012) examined the impact of corporate social responsibility on volatility in controversial industries from US (alcohol, tobacco, gambling, military, firearms, cement, oil, and biotech). The authors report that better social performance leads to lower volatility. Additionally, Sassen et al. (2016) observed that social performance had a significantly and inverse impact on volatility in Europe. Similarly, Shakil (2021) showed a significant inverse effect of ESG performance on volatility of oil and gas companies. Zhou and Zhou (2022) observed that the volatility of companies with good ESG performance is lower than that of companies with poor performance. In contrast, Tasnia et al. (2020) found a direct relationship between ESG score and stock price volatility for US banks. Furthermore, Krüger (2015) found that investors react negatively at negative CSR news, particularly for communities and environment news. Serafeim and Yoon (2022) demonstrated that stock prices react to ESG news classified as financially, and the reaction is larger for positive news.

Regarding the spillover effects of ESG, there is little evidence in the literature about the influence of ESG scores on other companies. Li et al. (2023) found a spillover effect of ESG scores on the ESG scores of other local companies. The authors provide evidence that Chinese companies face peer pressure from other companies' ESG scores in the same location.

Based on the prior literature, the following conclusions may be drawn. Firstly, the results regarding the impact of ESG on volatility are not conclusive. Secondly, the spillover effects of ESG scores are not sufficiently analyzed in the literature.

Data

A total of 10 industries, made up of European listed companies were selected for this study from Thomson Reuters database. After data filtration, the sample has 1094 companies with available ESG scores. The analysis covers the period from 2019 to 2022. As it can be seen from Table 1, the majority of the companies (20.11%) fall under the Industrials, followed by Financials (14.53%) and thereafter Consumer Cyclicals (14.44%).

Table 1. Frequency distribution of companies by industry

Industry	Frequency	Percentage (%)
Basic Materials	98	8.96
Consumer Cyclicals	158	14.44
Consumer Non-Cyclicals	75	6.86
Energy	48	4.39
Financials	159	14.53
Healthcare	103	9.41
Industrials	220	20.11
Real Estate	62	5.67
Technology	127	11.61
Utilities	44	4.02
Total	1094	100

Source: Authors' own research.

Variable selection and definition are shown in Table 2. Following the prior literature, the volatility is measured by the annual standard deviation of daily stock returns (Jo and Na, 2012; Shakil, 2021). The ESG scores and its pillars were provided by Thomson Reuters. The ESG score is an overall company score based on the self-reported information in the environmental, social and governance pillars. The Environmental pillar score measures a company's impact on living and non-living and living natural systems. The Social pillar score measures a company's capacity to generate trust and loyalty with its workforce, customers and society. The Governance pillar score measures a company's systems and processes, which ensure that its board members and executives act in the best interests of its long-term shareholders. Additionally, other company-specific variables (dividend yield, return on assets, leverage, size and market to book value of equity) are selected as control variables according to previous studies (Jo and Na, 2012; Sassen et al., 2016; Tasnia et al., 2020; Shakil, 2021).

Table 2. Variable selection

Variable	Code	Definition
Volatility	VOL	Annual standard deviation of daily stock returns
ESG score	ESG	Quantitative score provided by Thomson Reuters
Environmental pillar score	ENV	Quantitative score provided by Thomson Reuters
Social pillar score	SOC	Quantitative score provided by Thomson Reuters
Governance pillar score	GOV	Quantitative score provided by Thomson Reuters
Dividend yield	DY	Dividend per share/price per share
Return on assets	ROA	Income after taxes/total assets
Leverage	LEV	Long-term debt/total assets
Size	SIZE	Natural logarithm of total assets
Market to book value of equity	MTB	Market value of equity/book value of equity

Source: Authors' own research.

The descriptive statistics of the variables are shown in Table 3. The dataset contains 4376 year observations from 1094 companies from 2019 to 2022. Firstly, the average volatility is 33.2%. Secondly, the average ESG score is about 58.6. The average environmental score is 54.6, lower than the average governance score of 57.7, and both are lower than the average social score of 63.8.

Table 3. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
VOL	4376	.332	.171	.069	4.135
ESG	4376	58.611	19.38	1.417	95.422
ENV	4376	54.577	26.205	0	99.169
SOC	4376	63.814	21.309	.432	98.294
GOV	4376	57.738	21.531	2.422	98.733
DY	4376	.023	.041	0	.2
ROA	4376	.031	.122	-2.942	1.718
LEV	4376	.208	.158	0	1.125
SIZE	4376	22.373	1.963	.007	28.743
MTB	4376	3.144	3.883	.001	47.106
AENV	4376	54.577	6.557	38.649	66.825
ASOC	4376	63.814	3.827	54.829	70.49
AGOV	4376	57.738	5.784	46.592	67.513
AESG	4376	58.611	4.516	50.133	66.899

Source: Authors' own research, using Stata.

Table 4 display an overview of the ESG scores by industry. Companies affiliated with Energy, Utilities and Basic Materials have the highest average of ESG scores, while companies from Financials, Healthcare and Real Estate have the lowest average.

Table 4. ESG statistics by industry

Industry	Obs	Mean	Std.Dev.	Min	Max
Basic Materials	392	62.211	19.251	4.870	93.338
Consumer Cyclicals	632	59.915	19.362	1.417	93.826
Consumer Non-Cyclicals	300	60.153	16.658	15.801	91.384
Energy	192	62.829	17.484	16.184	92.231
Financials	636	56.658	21.392	1.742	95.422
Healthcare	412	56.653	19.779	3.770	95.043
Industrials	880	57.385	19.479	5.845	94.300
Real Estate	248	56.083	18.815	9.964	91.015
Technology	508	57.832	18.065	11.170	94.593
Utilities	176	62.273	18.941	9.009	92.845

Source: Authors' own research, using Stata.

3. Methodology

The purpose of this study is to investigate the spillover effects of ESG scores from companies operating in the same industry and their impact on stock return volatility. The research was divided into five levels:

1. (Spillover effects of ESG) Firstly, I tested if the ESG score of one company is impacted by the average ESG scores of companies belonging to the same industry. To examine the ESG spillover, I calculate the industry averages of the ESG scores and estimate their impact on the ESG score of a specific company using a fixed-effects model (Li et al., 2023). The regression model is given as:

(1) $ESG_{it} = \alpha + \beta_1 \times AESG_{it} + \beta_2 \times DY_{it} + \beta_3 \times ROA_{it} + \beta_4 \times LEV_{it} + \beta_5 \times SIZE_{it} + \beta_6 \times MTB_{it} + \varepsilon_{it}$

where AESG is the average ESG scores of companies belonging to the same industry.

2. (ESG, Spillover effects of ESG and volatility) Secondly, I investigated the relationship between volatility and ESG scores, including spillovers effects of ESG (Li et al., 2023). The regression models are as follows:

(2) $VOL_{it} = \alpha + \beta_1 \times ESG_{it} + \beta_2 \times DY_{it} + \beta_3 \times ROA_{it} + \beta_4 \times LEV_{it} + \beta_5 \times SIZE_{it} + \beta_6 \times MTB_{it} + \varepsilon_{it}$

(3) $VOL_{it} = \alpha + \beta_1 \times AESG_{it} + \beta_2 \times DY_{it} + \beta_3 \times ROA_{it} + \beta_4 \times LEV_{it} + \beta_5 \times SIZE_{it} + \beta_6 \times MTB_{it} + \varepsilon_{it}$

3. (Indirect spillover effects and volatility) Thirdly, I examined whether the spillover effects of ESG impact the volatility through its effect on the ESG scores of a company (Li et al., 2023). The regression model is given as:

(4) $VOL_{it} = \alpha + \beta_1 \times r\_ESG_{it} + \beta_2 \times DY_{it} + \beta_3 \times ROA_{it} + \beta_4 \times LEV_{it} + \beta_5 \times SIZE_{it} + \beta_6 \times MTB_{it} + \varepsilon_{it}$

where r_ESG is the predicted residuals of ESG.

4. (Subsample analysis of ESG and volatility) The sample was divided into a group with better ESG performance and a group with poorer ESG performance and it was introduced a dummy variable to distinguish groups. For this purpose, I sorted the ESG scores of all companies from high to low. Then, I extracted the top 25% and the bottom top 25% and I assigned the value 1 to the top and 0 to the bottom. Therefore, I changed the subsample to the top 25% and bottom 75% (Zhou and Zhou, 2022). The regression model is given as:

(5) $VOL_{it} = \alpha + \beta_1 \times d\_ESG_{it} + \beta_2 \times DY_{it} + \beta_3 \times ROA_{it} + \beta_4 \times LEV_{it} + \beta_5 \times SIZE_{it} + \beta_6 \times MTB_{it} + \varepsilon_{it}$

where d_ESG is the dummy variable equal to 1 for top ESG companies and 0 for bottom ESG companies.

5. (Changes in ESG scores and volatility) Finally, I explored the relationship between changes in ESG scores and changes in volatility (Jo and Na, 2012). The regression model is given as:

(6) $DVOL_{it} = \alpha + \beta_1 \times DESG_{it} + \beta_2 \times DY_{it} + \beta_3 \times ROA_{it} + \beta_4 \times LEV_{it} + \beta_5 \times SIZE_{it} + \beta_6 \times MTB_{it} + \varepsilon_{it}$

where DVOL is the current volatility subtracted from that of one year before and DESG is the current ESG score subtracted from that of one year before.

4. Results

The analysis begins with an investigation of the relationships between a company's ESG score and the ESG scores of companies in the same industry. Table 5 reports the findings. Column (1) displays the estimates using ESG scores, while columns (2), (3) and (4) use environmental, social and governance pillars. The results indicate that industry-average ESG score has a direct impact on the ESG score of a specific company. These results may suggest that European companies face peer pressure from other companies in the same industry. The spillover effects of environmental, social and governance pillars are similar to those of ESG scores. These results are similar to Li et al. (2023). The ESG score is also associated with company-specific variables, such as the leverage, size and market to book value of equity.

Table 5. Spillover effects of ESG scores

	(1) ESG	(2) ENV	(3) SOC	(4) GOV
AESG	.975*** (.022)			
AENV		.978*** (.031)		
ASOC			.982*** (.035)	
AGOV				.97*** (.028)

	(1) ESG	(2) ENV	(3) SOC	(4) GOV
DY	-2.329	-3.573	-.752	3.837
	(2.646)	(3.554)	(3.153)	(4.261)
ROA	.775	.398	-.06	1.52
	(1.224)	(1.644)	(1.458)	(1.971)
LEV	.998	4.274**	.465	3.926
	(1.505)	(2.024)	(1.792)	(2.43)
SIZE	.489***	.021	.611***	.567**
	(.178)	(.238)	(.212)	(.286)
MTB	-.198***	-.158*	-.037	-.295***
	(.068)	(.092)	(.081)	(.11)
_cons	-9.036**	.38	-12.468**	-10.97
	(4.233)	(5.664)	(5.278)	(6.698)
Observations	4376	4376	4376	4376
R-squared	.409	.256	.217	.301
FE	YES	YES	YES	YES

Standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Source: Authors' own research, using Stata.

Going further, the relationship between volatility and ESG scores, including spillovers effects of ESG is presented in Table 6. Column (1) investigates the impact of company's ESG scores on volatility, while columns (2), (3), (4) and (5) analyze the ESG spillover effects. The results show that the ESG score has a direct impact on volatility. These findings are in line with Tasnia et al. (2021), which explain that investors may not prefer excess concentration on ESG because of the additional costs. Similarly, the average ESG scores have a direct influence on volatility. Regarding the control variables, return on assets, leverage and market to book ratio have an inverse impact on volatility. However, dividend yield and size have a direct effect on stock return volatility.

Table 6. ESG, Spillover effects of ESG and volatility

	(1) VOL	(2) VOL	(3) VOL	(4) VOL	(5) VOL
ESG	.002***				
	(0)				
AESG		.003***			
		(0)			
AENV			.002***		
			(0)		
ASOC				.003***	
				(.001)	
AGOV					.002***
					(0)
DY	.191***	.188***	.191***	.189***	.189***
	(.056)	(.056)	(.056)	(.056)	(.056)

	(1) VOL	(2) VOL	(3) VOL	(4) VOL	(5) VOL
ROA	-.174***	-.169***	-.17***	-.17***	-.17***
	(.026)	(.026)	(.026)	(.026)	(.026)
LEV	-.219***	-.231***	-.223***	-.225***	-.225***
	(.032)	(.032)	(.032)	(.032)	(.032)
SIZE	.008**	.009**	.009**	.009**	.009**
	(.004)	(.004)	(.004)	(.004)	(.004)
MTB	-.002	-.002	-.002	-.002	-.002
	(.001)	(.001)	(.001)	(.001)	(.001)
_cons	.113	.012	.072	-.017	.093
	(.086)	(.089)	(.089)	(.093)	(.088)
Observations	4376	4376	4376	4376	4376
R-squared	.042	.046	.039	.042	.039
FE	YES	YES	YES	YES	YES

Standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Source: Authors' own research, using Stata.

Next, I examined whether the spillover effects of ESG impact the volatility through its effect on the ESG scores of a company by replacing ESG scores with the predicted residuals. The results, presented in Table 7, suggest that the residual ESG is not significantly associated with the volatility. Specifically, the spillovers of ESG ratings at the industry level and the controlled financial variables explain the impact of ESG ratings on volatility.

Table 7. Indirect spillover effects of ESG scores and volatility

	(1) VOL	(2) VOL	(3) VOL	(4) VOL
r_ESG	.001	.001	.001	.001
	(0)	(0)	(0)	(0)
AESG	.003***			
	(0)			
AENV		.002***		
		(0)		
ASOC			.003***	
			(.001)	
AGOV				.002***
				(0)
DY	.192***	.195***	.193***	.194***
	(.056)	(.056)	(.056)	(.056)
ROA	-.169***	-.17***	-.17***	-.17***
	(.026)	(.026)	(.026)	(.026)
LEV	-.226***	-.219***	-.22***	-.22***
	(.032)	(.032)	(.032)	(.032)
SIZE	.012***	.012***	.012***	.012***
	(.004)	(.004)	(.004)	(.004)

	(1) VOL	(2) VOL	(3) VOL	(4) VOL
MTB	-.001	-.002	-.001	-.002
	(.001)	(.001)	(.001)	(.001)
_cons	-.056	.007	-.084	.027
	(.099)	(.099)	(.103)	(.098)
Observations	4376	4376	4376	4376
R-squared	.047	.04	.042	.04
FE	YES	YES	YES	YES
Standard errors are in parentheses **** p<.01, ** p<.05, * p<.1*				

Source: Authors' own research, using Stata.

The subsample analysis is presented in Table 8. In column (1), the classification of ESG scores is based on the 25% companies with the highest ESG score and the 25% with the lowest. Therefore, in column (2), the subsample was changed to the highest 25% and lowest 75% ESG score companies. The regression result is insignificant for the first subsample. For the second subsample, the dummy variable is significantly positive, indicating that the volatility of companies with excellent ESG performance is greater than that of companies with poor ESG performance. This result is contrary to Zhou and Zhou (2022).

Table 8. Subsample analysis of ESG and volatility

	Subsample 1	Subsample 2
	(1) VOL	(2) VOL
d_ESG	.024	.024***
	(.033)	(.009)
DY	.432***	.185***
	(.132)	(.056)
ROA	-.066**	-.176***
	(.032)	(.026)
LEV	-.171***	-.205***
	(.047)	(.032)
SIZE	.016***	.009**
	(.006)	(.004)
MTB	-.001	-.003**
	(.002)	(.001)
_cons	-.012	.182**
	(.131)	(.085)
Observations	2192	4376
R-squared	.027	.036
Standard errors are in parentheses **** p<.01, ** p<.05, * p<.1*		

Source: Authors' own research, using Stata.

To explore the relationship between changes in ESG scores and changes in volatility, I subtracted the current value of each variable from last year's value. The descriptive statistics for changes in variables are presented in Table 9. In this case, the analysis has been reduced to three years, respectively 2020-2022.

Tables 9. Descriptive statistics for changes in variables

Variable	Obs	Mean	Std. Dev.	Min	Max
DVOL	3282	.003	.146	-1.521	3.764
DESG	3282	3.433	6.057	-27.847	45.612
DENV	3282	3.283	8.112	-39.68	63.858
DSOC	3282	2.613	7.382	-34.214	53.45
DGOV	3282	4.32	10.76	-45.015	59.691
DDY	3282	-.001	.046	-.535	1.979
DROA	3282	-.002	.115	-2.91	2.636
DLEV	3282	.007	.081	-.661	.723
DSIZE	3282	.05	.7	-22.296	3.852
DMTB	3282	-.24	1.723	-27.427	23.703
DAENV	3282	3.283	1.128	-.123	5.352
DASOC	3282	2.613	.792	.919	3.958
DAGOV	3282	4.32	1.482	1.117	6.732
DAESG	3282	3.433	.952	.871	5.689

Source: Authors' own research, using Stata.

Table 10 summarizes the change regression results. Columns (1) and (2) show that there is no significant association between ESG changes and volatility changes. Columns (3) and (4) report that an increase in the industry-average ESG score is associated with an increase in volatility.

Table 10. Changes in ESG scores and volatility

	(1) DVOL	(2) DVOL	(3) DVOL	(4) DVOL
DESG	.001	.001		
	(.001)	(.001)		
DAESG			.028***	.029***
			(.003)	(.003)
DY		.167**		.17**
		(.084)		(.082)
ROA		-.133***		-.146***
		(.041)		(.04)
LEV		-.127**		-.129**
		(.055)		(.054)
SIZE		.008		.007
		(.006)		(.006)
MTB		-.003		-.003
		(.003)		(.003)
DDY	.278***		.26***	
	(.069)		(.068)	

	(1) DVOL	(2) DVOL	(3) DVOL	(4) DVOL
DROA	-.019		-.027	
	(.025)		(.025)	
DLEV	-.213***		-.212***	
	(.038)		(.038)	
DSIZE	.01*		.009*	
	(.005)		(.005)	
DMTB	.003		.004*	
	(.002)		(.002)	
_cons	.002	-.148	-.091***	-.224*
	(.003)	(.131)	(.011)	(.129)
Observations	3282	3282	3282	3282
R-squared	.025	.012	.059	.049
Standard errors are in parentheses				
*** p<.01, ** p<.05, * p<.1				

Source: Authors' own research, using Stata.

5. Conclusions

This study investigated the spillover effects of ESG scores from companies operating in the same industry and their impact on stock return volatility. For this purpose, I considered a sample of European companies from 2019 to 2022. Research findings indicate that industry-average ESG score has a direct impact on the ESG score of a specific company. The spillover effects of environmental, social and governance pillars are similar to those of ESG scores. Going further, the results show that the ESG score has a direct impact on volatility. Similarly, the industry-average ESG scores have a direct influence on volatility. These results may suggest that European companies face peer pressure from other companies in the same industry. These findings contribute to the literature by adding further evidence about ESG spillover effects, and its relationship with volatility in the European context. Furthermore, the results help investors in the investment decisions making to pay more attention to ESG scores and industry specifics. Future research may consider a longer time horizon to analyze these relationships.

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