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Does ESG Improve Crisis Resilience? Empirical Evidence of Global Emerging Equity Markets during the Covid-19 Crisis

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Abstract

We examine the role of Environmental, Social, and Governance (ESG) factors in explaining the crisis resilience of 1031 global emerging market (GEM) equities during the Covid-19 crisis downturn of Q1 2020. We use linear and quantile regressions (QR) and find a statistically significant negative relationship between a firm's ESG management score and crisis resilience as proxied by stock maximal drawdown. Our results suggest that companies with better ESG management were less crisis resilient, a finding consistent with agency-theory-based explanations found in the literature. Results are robust across all OLS and QR models.

Keywords

ESG investing, capital markets, crisis resilience, pandemic, quantile regression

1 Introduction

The Covid-19 pandemic induced crisis caused a severe shock to global equity markets on 31 January 2020, when the WHO issued a Global Health Emergency. The next three months saw a negative impact on global equities before central banks' liquidity injection aided the stock markets' swift recovery. This paper examines the relationship between equity ESG metrics and their market drawdown, taken as a proxy for crisis resilience, during the first wave of the Covid-19 crisis that hit markets between January 2020 and May 2020.

The literature on firm behaviour during financial crises is explored by Mallinguh and Zéman (2020). One may examine an economic crisis from different perspectives; the mainstream literature considers various aspects of corporate behaviour following a crisis event. Poór et al. (2012), for example, observed the impact of the 2008 financial crisis from an HR and knowledge management point of view; they examined what methods the companies applied to mitigate the effects of the crisis.

This research focuses on the relationship between a firm's financial performance and sustainability during the crisis period. The sustainability of companies is measured with ESG metrics. According to Morgan Stanley Capital International (MSCI), special performance indicators measure the sustainability and societal impact of an investment or a company's performance (MSCI, 2022a). Sustainable finance is an emerging branch of finance research nowadays, which as a field lags behind other social sciences in terms of its focus on sustainability (Naffa and Fain, 2020; 2022). In contrast, macroeconomists have previously addressed sustainability and climate risk (Naffa et al., 2021; Németh-Durkó, 2020). Several studies examine the relationship between environmental (E), social (S), and governance (G) factors (Berlinger et al., 2022; Primecz et al., 2019). Financial institutions also face ecological, societal, and governmental challenges that require rethinking their investment and risk management practices (Gyura, 2020; Mihálovits and Tapaszti, 2018; Walker et al., 2020).

An increasing body of literature on ESG factors examines the relationship between ESG performance and corporate performance. There is currently no consensus in the literature on the nature or direction of this relationship; Demers et al. (2021); Gantchev et al. (2021); and Liang and Renneboog (2021) summarise the different schools of explanations provided by the recent literature, which also covers the pandemic period. They distinguish between three groups of empirical findings:

1. Positive relationship

   Some researchers found evidence that more investments into ESG-aligned companies may make

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socially responsible firms less vulnerable in times of crisis. They argue that socially and environmentally responsible corporate behaviour deepens the essential bonds between the firm and its stakeholders, hence nurturing more loyal, longer-term investors. Accordingly, ESG investments serve as a form of insurance-like protection against downside risk. Several studies found evidence that ESG performance may offer downside risk protection in times of crisis, such as Albuquerque et al. (2020) or Ding et al. (2021).

2. Negative relationship
   Other studies contradict the previous group, and associate investments into ESG-aligned companies with higher crisis vulnerability, basing their explanation on the agency theory. This suggests that ESG investments are wasteful managerial self-serving expenditures funded from corporate coffers; that comes at the expense of shareholder value. Surroca and Tribó (2008) and Lys et al. (2015) are proponents of this view.
3. Neutral relationship
   According to Demers et al. (2021), there may be a third possibility when there is no association between ESG factors and stock performance, particularly not during this crisis period. This arises when ESG scores do not to reliably measure social capital, or when sustainability initiatives fail to improve resilience. Consequently, ESG metrics do not have a relationship with corporate crisis resilience; hence, more traditional indicators such as profitability, liquidity, and leverage are considered as determinants of a firm's resilience during economic downturns, according to Ramelli and Wagner (2020).

This paper's research question uncovers how ESG factors played a role in the resilience of firms during the first shock of the Covid-19 crisis from 1 January 2020 to 1 May 2020, and what relationship exists between ESG performance firms and their financial performance during this crisis period. We investigate the determinants of crisis resilience based on the relevant literature and find that stock market drawdown to be a suitable proxy for crisis resilience from the perspective of investors. The maximal drawdown captures a company's stock price decline from top to bottom during the defined crisis period. We consider companies with a lower drawdown as more resilient from an investment portfolio's perspective.

The contribution of this paper lies in its focus on global emerging markets (GEM). We created a unique database for 1000 global equities that form the universe for the MSCI Emerging Markets Index – a globally tracked benchmark for GEM investors. We assembled data from Bloomberg (2021) and Sustainalytics (2021), and linked that databases to cover both financial and non-financial (i.e. ESG related) metrics.

The paper is structured as follows: we summarise the literature findings, define our research question, introduce our database and outline the applied methodology. We conclude with the results of our research and discussion.

2 Literature review

Several studies examine the impact of ESG performance on corporate crisis resilience with a special focus on this relationship during the Covid-19 crisis.

Broadstock et al. (2021) find empirical evidence that firms' ESG performance reduces financial risk during times of crisis. As a result, portfolios with a high ESG scores generally outperformed low ESG portfolios. Albuquerque et al. (2020) analysed the performance of firms with superior environmental and social (ES) ratings compared to other firms during the first Covid crisis in Q1 2020. They found evidence that high ES-rated stocks yield significantly higher returns, lower volatility, and have higher trading volumes than the other stocks. Companies with high ES ratings as well as those with increased advertising spending performed exceptionally well during the crisis.

Gianfrate et al. (2021) investigated whether higher ESG performance stock can serve as "rainy day assets". Their findings on more than 6,000 stocks from 45 countries showed no evidence of ESG performance correlating with crisis resilience, with the exception of US stocks, where better ESG ratings have shown a more significant degree of resilience during the Covid-19 crisis. Overall, they challenge the theory concerning the crisis resilience of ESG performers. Engelhardt et al. (2021) also analysed the same question focusing on European stocks, and reported that high ESG-rated European firms are associated with higher abnormal returns and lower stock volatility. They conducted a more refined analysis of ESG factors and found the social score to be the predominant driver of positive results. They find evidence that ESG performance has more explanatory power of stock performance in countries with lower-trust poor security regulations, and low disclosure standards.

Rubbaniy et al. (2022) applied the wavelet coherence approach and found a strong and positive co-movement between the leading ESG stock indices and the Covid-19 fear index (GFI) and the Infectious Disease Equity Market Volatility tracker (IDEMV), promoting the safe-haven attributes of ESG performer stocks. They underline that the safe-haven properties of ESG stocks are contingent upon the proxy of the Covid-19 crisis.

Gregory (2022) analysed the S&P 1500 stocks and the responses of the stocks to fiscal and monetary policy during the Covid-19 crisis. He found that non-financial firms that managed environmental and governance risks performed better during the pandemic. This was partly due to their high environmental and governance scores that allowing them to hedge the adverse effects of the announcements of fiscal policies during the pandemic. Zhou and Zhou (2022) also examined the relationship between ESG performance and stock performance during the Covid-19 crisis. They found that good ESG performance helps soften the increased volatility due to the Covid-19 crisis and enhances resilience and stabilises stock prices.

In contrast, Demers et al. (2021) did not find any evidence of ESG performance and stock returns. Their findings extend to the crisis of Q1 2020 and the full year of 2020. However, they found that intangible assets are an economically and statistically significant positive determinant of returns during both examined periods, the Q1 market implosion and the full year of 2020. They conclude that ESG did not immunise stocks during the Covid-19 crisis but that investments in intangible assets did. In addition, Folger-Laronde et al. (2022) examined the performance of ETFs during the Covid-19 crisis. They discussed the differences and relationship between the financial returns of ETFs and their Eco-fund ratings during the Covid-19 crisis-related financial market crash. Their results suggested that superior sustainability attributes do not safeguard ETFs from financial losses during a severe market downturn. This evidence highlights the weaknesses underlying current sustainability scores and rating methods. Pavlova and de Boyrie (2022) also corroborate evidence that higher sustainability ratings of ESG ETFs did not protect investors during the downturn; however, they did not underperform the market in relative terms. Chowdhury et al. (2022) examined Islamic equity markets and their conventional counterparts during the Covid-19 crisis via maximum drawdown-based risk measures. They found that during the Covid-19 crisis, Islamic markets outperformed their peers. Also, Islamic markets also boast healthier Calmar ratios. Feng et al. (2022) analysed ESG ratings and stock price crash risk for Chinese firms during the Covid-19 crisis, and report evidence of a statistically and economically significant negative relationship.

3 Theoretical frameworks

In this study, we examine stock price resilience during the Covid-19 crisis in relation to ESG performance. We apply the economic resiliency approach of Rose (2004) to capture a firm's performance during a crisis period. Rose defines resiliency as the ability or capacity of a company to absorb or cushion against damage or loss. He distinguishes two types of resilience, the adaptive and the inherent type. In this research, we examine the adaptive resilience of companies, i.e. we capture the ability of companies to resist crises due to ingenuity or extra effort (Rose, 2004).

The structure of financial regulation may exacerbate a crisis if it imposes risk-sensitive risk management on market participants, leading to reduced liquidity and further declines in market prices (Danielsson et al., 2001; 2013). New regulation aims to address this phenomenon by introducing anti-cyclical risk management techniques that may be optimal under shorter turbulences of the market but are not optimal in longer periods of deeper crisis (Berlinger et al., 2019a; 2019b). For this reason, the behaviour and resilience of a single companies is of greater importance. However, crisis resilience may be examined at country level as well. A country's sustainability is relevant for its resilience. Issakhova and Issakhova (2015) examined sustainability indicators of the local budget of the Republic of Kazakhstan (RK) for the period between 2002 and 2013.

Martin (2012) evaluated the economic resilience of British regions by building an economic resilience model based on flexibility and examined its use in understanding regional economies' response to significant recession shocks. Martin defines economic resilience as a shock-triggered process and distinguishes four phases: resistance, recovery, renewal, and diversion. Resistance refers to the first direct response to a recession and measures the intensity and extent of the decline. In comparison, it relates to the speed and volume of how an economy can recover from a downturn and return to its original growth trend (Martin, 2012). Gil Fombella et al. (2022) examined German companies' resilience. They found that "the most resilient firms had well-defined processes in place, adaptable employees who were well-led, and had (digital) technologies that could be quickly implemented".

4 Research design

4.1 Research question and database

We formalise the following research question (RQ) based on the literature: Were GEM companies with better ESG management more resilient during the Covid-19 crisis?

4.1.1 Research focus

The focus of our research is the examination of crisis resilience of companies included in the Morgan Stanley Capital International (MSCI) Emerging Markets World Index. We chose a global emerging markets universe as the pandemic was also a global one. We focus on EM to fill the void in the empirical literature. MSCI has calculated this index since 1988. Constituents are defined by MSCI's market classification framework that assesses economic development, size and liquidity, and market accessibility (MSCI, 2022b).

The universe covers 1031 companies from 32 emerging market counties, covering 11 sectors. Top weighted countries include China that accounts for 36% of index, followed by South Korea (10%) and Taiwan (8%). Regrading sector split, the three largest are the financials (21%), industrials (14%), and consumer staples (11%). Fig. 1 and Fig. 2 depict the index's main characteristics.

During the examined period, the Covid-19 crisis caused a nearly uniform hit to capital markets, as Fig. 3 shows the market drawdown rate. Recovery from the bottom of March 2020, however, was varied across different regions and sectors. For illustration purposes, we depict relative performances from different regions globally including the USA (NYSE AMEX), Europe (Euronext 100), China (Shenzhen Component) and Mexico (IPC Mexico).

We source financial data from Bloomberg (2021) and non-financial ESG data from Sustainalytics (2021). The examined period covers 1 January 2020 and 1 May

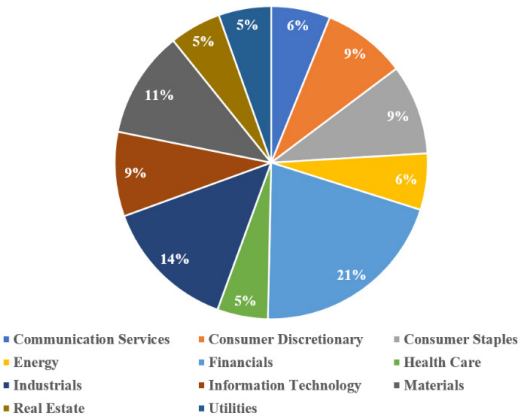

Fig. 1 Distribution of sectors in our sample

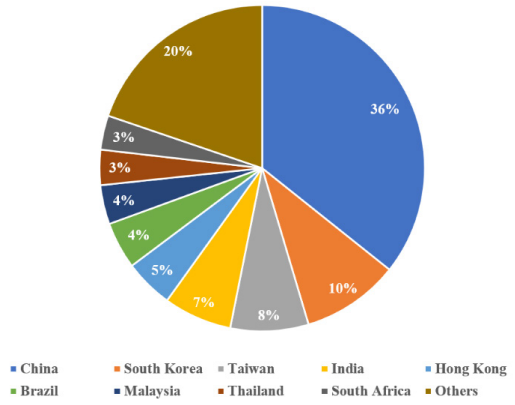

Fig. 2 Distribution of countries in our sample

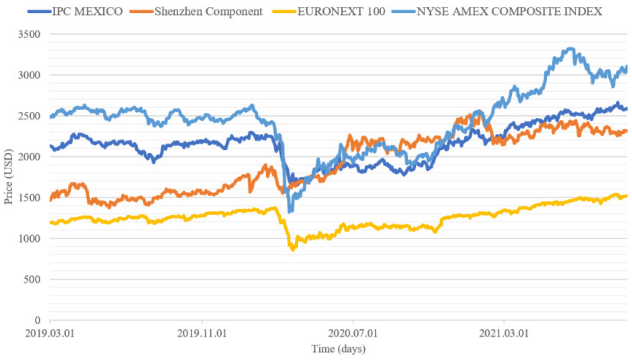

Fig. 3 Indices worldwide between March 2019–March 2021 (based on Yahoo Finance (2021))

2020. We include variables based on the relevant literature, detailed in Table 1 including variable definitions, the calculation method, and references to literature. We cover the Fama-French five factors (Fama and French, 2015), common investment style factors following Naffa and Fain (2020), resilience and ESG factors.

4.1.2 ESG data

We are among the few in the literature to use ESG data from Sustainalytics (2021), whereas their market presence among investors is significant. We included two ESG indicators from Sustainalytics in this study, the ESG Risk Rating score and the Overall management score. Ferriani and Natoli (2021) also used ESG data from Sustainalytics.

According to the Sustainalytics methodology, the ESG Risk Ratings measure the degree to which a company's economic value is at risk driven by ESG factors i.e. it measures the magnitude of a company's unmanaged ESG risks. A company's ESG Risk Rating comprises a quantitative score and a risk category. The measure is on an absolute scale comparing firms across industries. This is opposite to the other popular ESG rating methodology followed by MSCI, which applies a best-in-class approach,

Table 1 List of dependent and independent variables, detailing the calculation method and references to literature

Factors	Name of variable	Definition	Reference to literature
Size	Size	The natural logarithm of company market capitalisation. (million USD)	Broadstock et al. (2021); Demers et al. (2021); Engelhardt et al. (2021); Gianfrate et al. (2021); Gregory (2022)
ESG	ESG Risk Rating Score	The natural logarithm of Overall Risk ESG Rating score of a company based on the methodology of Sustainalytics (2021), where the lower figure reflects lower risk, i.e., better ESG performance.	Broadstock et al. (2021); Demers et al. (2021); Engelhardt et al. (2021); Gianfrate et al. (2021); Gregory (2022); Naffa and Fain (2020)
	Overall management score	The natural logarithm of ESG risk management score indicates the portion of total manageable risk exposure that a company is managing.	
Leverage	Financial Leverage	The natural logarithm of average assets to average equity.	Broadstock et al. (2021); Demers et al. (2021); Engelhardt et al. (2021); Gianfrate et al. (2021); Gregory (2022)
Value	Tobin's *Q* ratio	The natural logarithm of the ratio of firm market value to asset replacement cost. The calculation method follows Bloomberg (2021).	Gianfrate et al. (2021)
	P/*E* ratio (*z*-score)	Monthly standardised company blended forward *P*/*E* ratio. For standardisation, we consider the past three years average.	Broadstock et al. (2021); Demers et al. (2021); Engelhardt et al. (2021); Gianfrate et al. (2021)
Volatility	Volatility	The natural logarithm of annualised standard deviation of the relative price change for the 360 most recent trading days.	Engelhardt et al. (2021); Gregory (2022)
Profitability	Calmar ratio	A ratio of the average annual compounded rate of return and the maximum drawdown risk.	Chowdhury et al. (2022)
Resilience	Maximal drawdown	The decline in share price from the highest point to the lowest during the examination period which was the Covid-19 crisis period (1st January – 1st May, 2020)	Chowdhury et al. (2022); de Melo Mendes and Lavrado (2017)

therefore measurement of ESG performance is relative within each industry. In the Sustainalytics methodology, the Overall Management Score is part of the ESG Risk rating score calculation. It describes the set of company commitments, actions, and outcomes that demonstrate how well a company manages the ESG risks it is exposed to. The overall management score is derived from management indicators, such as policies, and outcome-focused indicators, such as CO_2 emissions (Garz and Volk, 2018).

4.1.3 Dependent variable

The dependent variable is the maximal drawdown, a measure widely used in the investment industry (Chowdhury et al., 2022; de Melo Mendes and Lavrado, 2017); however, the literature extends to other measures of firm crisis resilience as well. One measure is the raw return and abnormal return as a level of measurement, used by Broadstock et al. (2021); Demers et al. (2021); Engelhardt et al. (2021) and Gianfrate et al. (2021). Cheema-Fox et al. (2021) used the difference between total corporate stock returns and national stock returns as an explanatory variable. Albuquerque et al. (2020) used three different dependent variables in their work, quarterly abnormal returns, return volatility (total and idiosyncratic volatility) and operating performance (measured by return on assets, using profit, and asset turnover). Markman and Venzin (2014) developed a proprietary metric to measure crisis resilience called VOLARE, combining both volatility and ROE. The VOLARE measure emphasises the efficiency of capital allocation and spending, since risky expenditures or strategies are penalised, while less risky initiatives are rewarded.

4.2 Methodology

We apply quantile regression to explore how ESG performance affects a company's crisis resilience proxied by maximal drawdown. Quantile regression is widely used for resilience studies in the literature (Lippai-Makra et al., 2021; Teng et al., 2021). However, we argue that OLS is often used to test a hypothesis in sustainability research, as it captures the relationships at the mean. According to Teng et al. (2021), it could lead to misstatements and omitting information at the tail of the distribution. We applied the quantile regression to examine the full range of conditional quantile functions; this approach lends robustness to results and yields more efficient estimates.

This study uses the quantile regression model of Teng et al. (2021) formalised in Eq. (1):

$$Q_\theta\left(\text{Max. } drawdown_{qi}|X_i\right) = \beta_{0\theta} + \beta_{1\theta}SIZE_i + \beta_{2\theta}LEV_i + \beta_{3\theta}OVERALLMNGMT_i + \beta_{4\theta}PE\ RATIO_i + \beta_{5\theta}CALMAR_i + \beta_{6\theta}TOBIN\ Q_i + \beta_{7\theta}VOL_i + \beta_{8\theta}ESG\ RISK_i + \varepsilon_{\theta i}, \quad (1)$$

where Q_θ(Max. $drawdown_{qi}|X_i$) is the θ^{th} quantile regression function. Max. $drawdown_{qi}$ is the maximal drawdown of firm *i*; $SIZE_i$ is measured as the natural logarithm of the market capitalisation of firm *i*; LEV_i is the financial leverage of firm *i*; $OVERALLMNGMT_i$ is the logarithm of ESG risk management score, indicating the proportion of total manageable risk exposure that firm *i* is able to manage; $PE\ RATIO_i$ is the standardised monthly blended forward *P*/*E* ratio for firm *i* where we consider the last 3 years' average when standardising; $CALMAR_i$ is the ratio of the average annual compound rate of return and the maximum drawdown risk of firm *i*; $TOBIN\ Q_i$ is the logarithm of the ratio of the market value of a firm to the replacement cost of the firm's assets of firm *i*; VOL_i is the annualised standard deviation of the relative price change for the 360 most recent trading days closing price of firm *i*; $ESG\ RISK_i$ is the overall Risk ESG score of a company based on the methodology of Sustainalytics, where the lower figure reflects lower risk, i.e., the better ESG performance of firm *i*; and $\varepsilon_{\theta i}$ represents error terms at the θ^{th} quantile.

The QR model examines the relationship between the firm's crisis resilience, captured by maximal drawdown and the firm's ESG performance, and the ESG Risk Score and Overall management score.

5 Results

Table 2 summarises the statistics for all model variables. The data shows that the average level of maximal drawdown was −0.37 during Q1 2020. The average ESG Risk score for companies is 29.84, while the average Overall Management score is 33.79; descriptive statistics indicate a right-leaning distribution. The normality test on the Maximal drawdown reports its Jacque–Bera statistics (= 26.1258, *p*-value < 0.001), rejecting the null hypothesis of the Maximal drawdown as normally distributed. The histogram of the Maximal drawdown (Fig. 4) illustrates the non-normal distribution and skewed and right-tailed distribution.

To uncover the relationship between the independent variables and to test the multicollinearity of the independent variables, we show the variance inflation factors (VIF) in Table 3. Teng et al. (2021) note that a VIF equal to or less than 0.2 and equal to or greater than 5 indicates the presence of multicollinearity. Table 3 verifies that the VIF values for all independent variables are less than two, confirming that there is no serious multicollinearity problem (Teng et al., 2021).

OLS and quantile regression results show estimated coefficients for the 5th, 25th, 50th, 75th, and 95th quantiles of the conditional distribution of Maximal drawdown. The 95th quantiles incorporate the most resilient companies, i.e. the ones with the lowest drawdown during the crisis. Analogously, the 5th includes the least resilient companies, that witnessed the highest drawdown during the crisis. Table 4 summarises results of the quantile regressions. Fig. 5–Fig. 12 show how each covariate's effect varies across quantiles and contrasts with the OLS estimates for each explanatory variable. OLS and QR estimates use a 95% confidence interval.

The OLS estimation reveals that the coefficient of ESG Risk score was not significant at the usual confidence levels and neither was this the case at any quantile model. On the other hand, the overall management score was

Table 2 Descriptive statistics of the variables

	Size	ESG Risk Score	Overall Mangement Score	Leverage	Tobin *Q*	*P*/*E* ratio	Max. drawdown	Volatility	Calmar ratio
Mean	19710	29.8	33.8	4.5	1.9	0.4	−0.4	41.8	0.8
Standard Error	1503	0.3	0.4	0.1	0.1	0.1	0.0	0.4	0.1
Median	8119	28.5	32.0	2.8	1.2	0.0	−0.4	40.8	0.1
Mode	47764	31.7	24.5	2.9	0.8	2.8	−0.3	48.0	1.8
Standard Deviation	48246	10.1	12.5	4.3	2.1	1.5	0.1	12.2	1.9
Kurtosis	113	0.5	0.0	24.8	45.4	−0.3	−0.2	2.2	16.3
Skewness	9	0.7	0.6	3.4	5.8	0.6	−0.4	0.8	3.3
Minimum	706	8.5	7.1	1.1	0.5	−2.8	−0.9	9.8	−1.0
Maximum	818563	67.8	76.7	57.5	25.2	4.5	−0.1	118.5	17.7

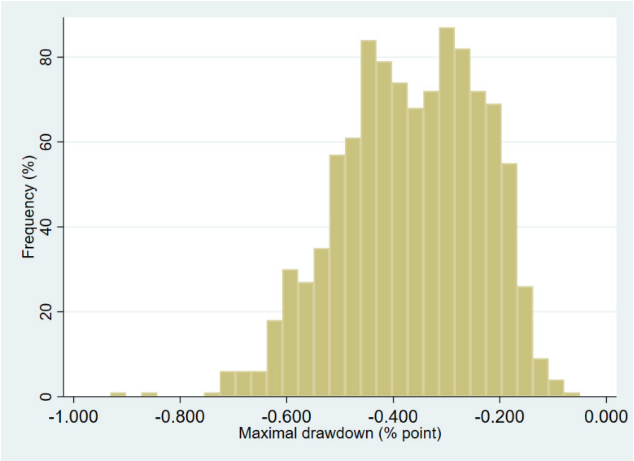

Fig. 4 Distribution of the dependent variable, Maximal drawdown. The histogram suggests that maximal drawdown has the non-normal distribution, skewed and right-tailed distribution

significant, and it had a significant negative impact on maximal drawdown. This result can be interpreted that for firms where the management of ESG risk was superior, the stock price was less resilient during the Covid-19 crisis. We observe the independent variables across the quantile regression models. We note that the coefficient of overall management score is significant and negative; moreover, in the case of the 75th QR model, the negative effect was most prominent. However, in the case of the least resilient firms (5th QR model), the effect is the lowest. Our results are robust across all models.

Among the control variables, OLS analysis shows that size factor is significant and positively affects the crisis resilience of companies, and the results for this are robust across all models. As expected, the Leverage factors shows

Table 3 Correlation and collinearity statistics of the variables in the research

	Size	ESG Risk Score	Overall Mgmt. Score	Leverage	Tobin *Q*	*P*/*E* ratio	Max.drawdown	Volatility	Calmar ratio	VIF
Size	1.00									1.3
ESG Risk Score	−0.01	1.00								1.4
Overall Mgmt. Score	0.05	−0.42	1.00							1.3
Leverage	0.05	−0.05	0.07	1.00						1.3
Tobin *Q*	0.09	−0.13	−0.03	−0.21	1.00					1.4
P/*E* ratio	0.07	−0.08	0.09	−0.08	0.07	1.00				1.1
Max. drawdown	0.15	0.07	−0.28	−0.04	0.17	−0.24	1.00			–
Volatility	−0.11	0.00	0.07	−0.12	0.00	0.20	−0.67	1.00		1.1
Calmar ratio	0.23	−0.05	−0.04	−0.14	0.24	0.19	0.22	0.14	1.00	1.3

Table 4 Results of the QR regression and the OLS regression. Below the coefficients there the *p*-values of each coefficient

	95th QR model	75th QR model	50th QR model	25th QR model	5th QR model	OLS model
Size	0.012	0.009	0.015	0.015	0.0152	0.013
p-values	0.057	0.000	0.000	0.000	0.000	0.000
ESG Risk Rating Score	0.013	−0.007	0.001	−0.006	−0.0012	−0.008
p-values	0.528	0.632	0.994	0.337	0.899	0.363
Overall Management Score	−0.073	−0.095	−0.079	−0.076	−0.037	−0.083
p-values	0.000	0.000	0.000	0.000	0.017	0.000
Leverage	−0.016	−0.010	−0.012	−0.011	−0.053	−0.013
p-values	0.04	0.031	0.012	0.01	0.132	0.001
Tobin *Q*	0.038	0.026	0.024	0.0203	0.028	0.025
p-values	0.000	0.005	0.000	0.000	0.018	0.000
P/*E* ratio	−0.021	−0.018	−0.015	−0.014	−0.009	−0.016
p-values	0.000	0.000	0.000	0.000	0.003	0.000
Volatility	−0.157	−0.267	−0.293	−0.310	−0.314	−0.286
p-values	0.000	0.000	0.000	0.000	0.000	0.000
Calmar ratio	0.017	0.018	0.016	0.017	0.016	0.016
p-values	0.000	0.000	0.000	0.000	0.000	0.000

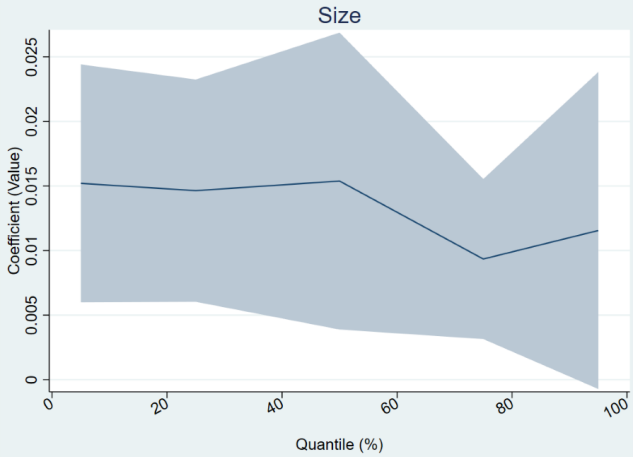

Fig. 5 Estimated coefficients of QR at 5%, 25%, 50%, 75%, and 95% quantiles. The figure shows that Size remains within the 95% confidence interval area for all quantile regressions

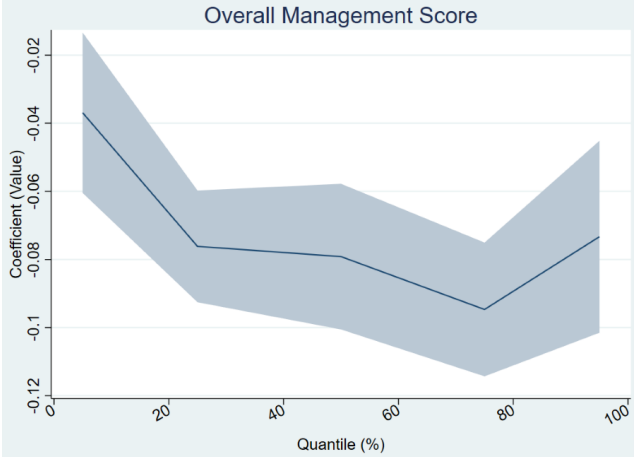

Fig. 8 Estimated coefficients of QR at 5%, 25%, 50%, 75%, and 95% quantiles. The figure shows that Overall Management Score remains within the 95% confidence interval area for all quantile regressions

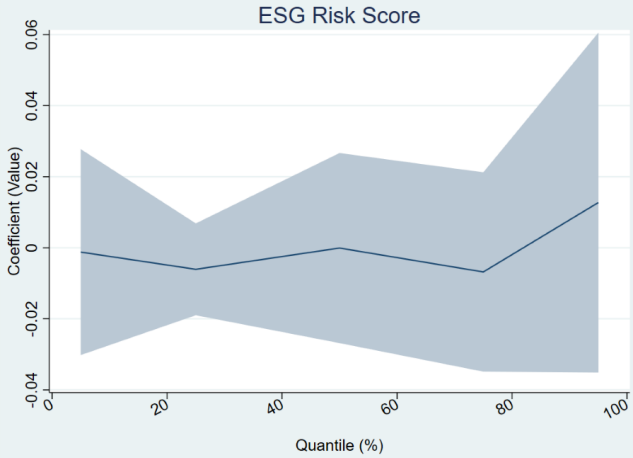

Fig. 6 Estimated coefficients of QR at 5%, 25%, 50%, 75%, and 95% quantiles. The figure shows that ESG Risk Score remains within the 95% confidence interval area for all quantile regressions

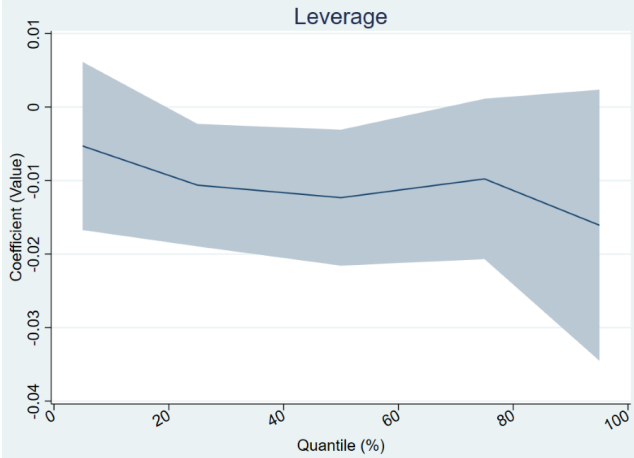

Fig. 9 Estimated coefficients of QR at 5%, 25%, 50%, 75%, and 95% quantiles. The figure shows that Leverage remains within the 95% confidence interval area for all quantile regressions

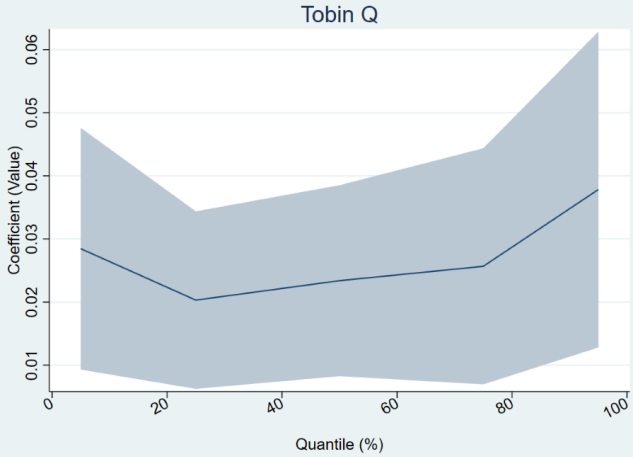

Fig. 7 Estimated coefficients of QR at 5%, 25%, 50%, 75%, and 95% quantiles. The figure shows that Tobin *Q* remains within the 95% confidence interval area for all quantile regressions

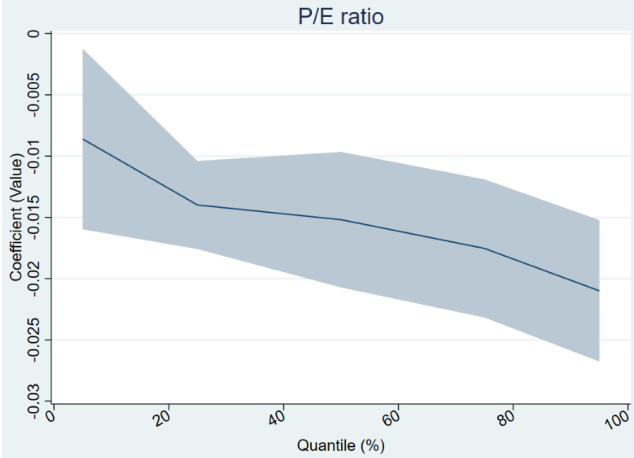

Fig. 10 Estimated coefficients of QR at 5%, 25%, 50%, 75%, and 95% quantiles. The figure shows that *P*/*E* ratio remains within the 95% confidence interval area for all quantile regressions

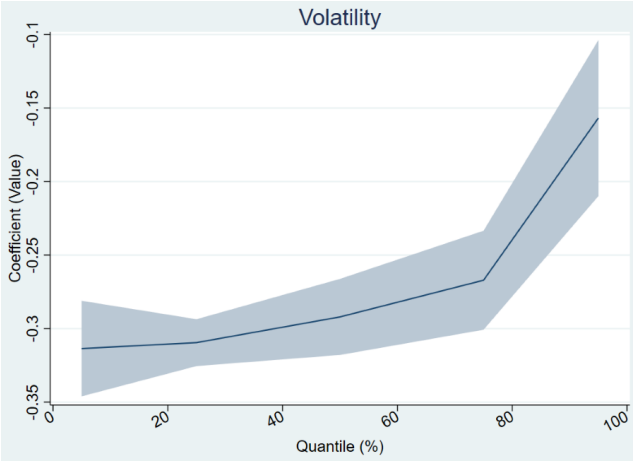

Fig. 11 Estimated coefficients of QR at 5%, 25%, 50%, 75%, and 95% quantiles. The figure shows that Volatility remains within the 95% confidence interval area for all quantile regressions

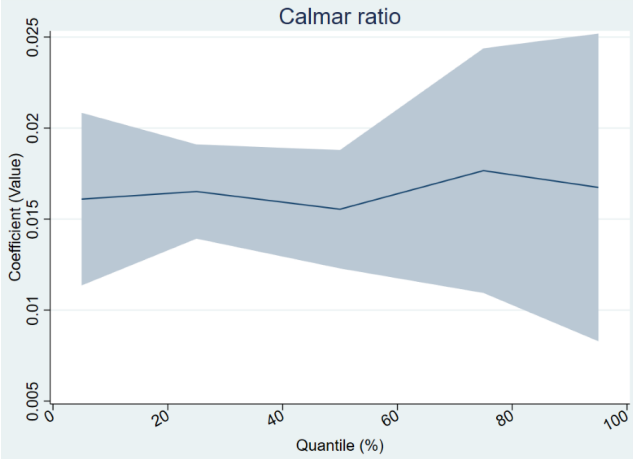

Fig. 12 Estimated coefficients of QR at 5%, 25%, 50%, 75%, and 95% quantiles. The figure shows that Calmar ratio remains within the 95% confidence interval area for all quantile regressions

a negative relationship with maximal drawdown, the variable is significant in all but one QR model. Tobin *Q* was significant and positive across all models.

Volatility also had a negative impact on maximal drawdown; however, it has the most negative impact in the fifth quantile, which means in the case of the least resilient companies. Calmar ratio had an overall positive effect on a firm's crisis resilience: it has the most positive impact in the 75th quantile, and its effect was not linear between the quantiles.

The models suggest that examined ESG factors are not associated with better crisis resilience. The results indicate that a company is less resilient if its stock is volatile and its financial leverage is higher. On the other hand, Tobin *Q* and Calmar ratio correlated positively with resilience. The main outcome is that Overall ESG management that reflects the ability of a company to manage ESG risk exposure is associated with lower crisis resilience. This result is robust across all model calibrations.

6 Summary

We examine the role of ESG factors in explaining the crisis resilience of companies during the Covid-19 crisis. The pandemic outbreak in February 2020 acted as an exogenous shock to global stock markets. Our findings suggest that companies with better ESG management were less crisis resilient. A possible explanation could be that ESG management reflects investor perception for corporate management quality. During market distress, such as the period examined in this paper, investors seeking to liquidate positions can do so sacrificing the higher quality stocks. Expert opinion suggests that low quality stocks would have thinner order books, lower liquidity and wider bid-ask spreads. Hence, the traded quality stocks in a sell-off register a higher drawdown. Another explanation could be consistent with agency-theory-based literature, in line with Feng et al. (2022), who reported a similar negative relationship between companies' ESG performance and stock performance. According to this theory, ESG performance is considered as a costly form of window-dressing that sacrifices shareholder value.

This paper also highlights the role of ESG factors as being suitable proxies for companies' crisis resilience. This aligns with Ferriani and Natoli (2021), highlighting that investors did consider ESG risk significantly during the Covid-19 crisis.

This paper highlights the shortcomings associated with a measurement error of an unobservable variable such as sustainability, not least since proxy data used to calculate ESG scores are often incomplete and unaudited. In addition, greenwashing may be challenging to detect, as Clements (2022) points out.

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