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Can good ESG performance help companies resist external shocks?

Xin Yang[a,b], Ahmad Fahmi Sheikh Hassan[b] and Yusuf Karbhari [c]

[a]School of Business, Nanfang College, Guangzhou, China; [b]School of Business and Economics, Universiti Putra Malaysia, Serdang, Malaysia; [c]Cardiff Business School, Cardiff University, Cardiff, UK

ABSTRACT
In order to validate the varied conclusions regarding the integration of corporate ESG practices by investors during external shocks, this study utilises the COVID-19 crisis as a specific external shock. The findings from our difference-in-differences methodology suggest that companies demonstrating strong ESG performance have succeeded in reducing idiosyncratic risk throughout the pandemic period. Additionally, we uncover that revenue growth acts as a critical pathway through which ESG performance reduces firm-specific risk, highlighting that firms with strong ESG practices achieved higher revenue growth, which in turn contributed to risk reduction. Further analysis shows that the political environment and dividend policy influence this relationship, as examined through heterogeneity analysis. By employing the quantile difference-in-difference technique in conjunction with the adaptive Markov Chain Monte Carlo method, we depict the dynamic evolution track of the marginal effect of ESG performance across various levels of idiosyncratic risk. Our results remain robust even after a series of rigorous robustness checks.

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ESG performance; idiosyncratic risk; COVID-19 pandemic; revenue growth; quasi-natural experiment

1. Introduction

Maintaining sustainable economic development and improving the green environment became the focus of policymakers in many countries, while the sudden outbreak of the global coronavirus pandemic galvanised concerns about the fragility of the world economy. The lockdown policies implemented to address the coronavirus pandemic significantly reduced economic freedom and had widespread negative impacts across most economic sectors (Miozzi & Powell, 2023). Relevant research has found that the pandemic caused harm to employment at the microeconomic level (Uribe Bohorquez & García Sánchez, 2023), a deterioration in firms' financial performance (Hu & Zhang, 2021), a reduction of stock liquidity (Chebbi et al., 2021), an increase in equity cost (Ke, 2022), and exacerbated the uncertainties of economic policy (Yang et al., 2021). In this context, the question of whether ESG performance can play a significant role in enhancing corporate resilience has garnered increasing attention (Cheng et al., 2024; Park et al., 2022; Trinh et al., 2023).

CONTACT Yusuf Karbhari karbhari@cardiff.ac.uk
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The COVID-19 pandemic, therefore, as a sustainability catalyst intensified the discussion about the interconnectedness of corporate ESG strategy and investment decision making. On the one hand, the pandemic created significant uncertainty for business investment activity, which caused financial resource constraints and the possible urge to avoid investing in ESG concerns (Pozzoli et al., 2022; Zhang et al., 2023). Demers et al. (2021) found that ESG activities could not provide immunisation from declining of stock prices through the pandemic period. D'Hondt et al. (2022) documented that investor's exhibited reduced exposure to environmental, social, and governance (ESG) factors in the financial crisis period and pointed out that investors are heterogeneous and time varying regarding ESG preference. Conversely, the coronavirus outbreak-related economic and social crises have increased the pressure on corporations to fulfil their sustainable obligations (Sachin & Rajesh, 2022). Prior researchers such as Mousa et al. (2022) demonstrate that strong ESG performance firms are expected to be less negatively impacted by the epidemic. Meanwhile, Gregory (2022) shows that firms with better environmental and governance performance enabled them to mitigate the negative impacts of fiscal policy statements made during the pandemic.

Given the lack of consensus in the literature, it is crucial for corporate managers and investors to understand whether ESG practices continue to provide tangible benefits – such as reducing firm-specific risk – or if they are merely perceived as luxury goods, particularly in the context of the COVID-19 pandemic. Thus, one key motivation for this study is to empirically investigate the impact of ESG performance on corporate idiosyncratic risk during the COVID-19 period, providing evidence on whether ESG performance can help companies withstand external shocks. Our focus on idiosyncratic risk is particularly relevant, as it more accurately captures firm-specific vulnerabilities, which have become increasingly important in discussions surrounding ESG. During the pandemic, firm-level governance, social practices, and environmental initiatives played a critical role in stabilising companies and mitigating their exposure to unpredictable shocks.

Companies with strong ESG performance typically have better governance structures, heightened social responsibility, and higher environmental standards. These firms are more likely to maintain stability during external shocks due to greater transparency and stronger stakeholder trust. Moreover, ESG strategies enhance firms' ability to manage supply chain disruptions and safeguard employee health and safety. In contrast, companies with weaker ESG performance may struggle with crisis management, facing greater operational disruptions, reputational risks, and challenges in maintaining stakeholder trust. As a result, the pandemic likely affected firms with high and low ESG performance differently, leading to varied responses in terms of idiosyncratic risk. This focus allows us to explore how firms with superior ESG performance mitigate risks that are not captured by broader market-wide systematic factors.

While addressing the mixed findings in the literature is an important motivation for undertaking this study, an equally significant aim is to leverage the COVID-19 pandemic as a quasi-natural experiment to examine the impact of exogenous shocks and uncover the underlying mechanisms through which ESG performance helps firms manage idiosyncratic risk during crises. Unlike the global financial crisis, which originated from internal failures within the financial system, the COVID-19 pandemic is a health catastrophe with severe economic repercussions driven by lockdowns and travel restrictions. Thus, the exogenous shock of COVID-19 serves as an effective quasi-natural experiment, providing clear advantages in reducing endogeneity issues and enabling more reliable causal inference (Meyer, 1995). By identifying the channel through which ESG practices enhance operational stability and financial strength, this research also aims to provide valuable perspectives for corporate leaders, investors, and policymakers interested in leveraging ESG for risk management. Additionally, we investigate how certain contextual factors may influence the relationship between ESG performance and idiosyncratic risk, especially during periods of crisis. By exploring these dynamics, the study deepens the discourse on ESG's role in risk management, expanding the current understanding of how external factors shape the ESG-risk relationship.

In a recent study, Ahmad et al. (2021) shows the COVID-19 pandemic significantly increases idiosyncratic risk. Therefore, we employ the difference-in-difference (DID) method to assess the impact of ESG performance on idiosyncratic risk during the COVID-19 period. We find strong ESG performance significantly reduced idiosyncratic risk over the course of COVID-19. Our mediation analysis reveals that ESG performance contributes to revenue growth, which in turn reduces idiosyncratic risk. Additionally, the results of heterogeneity analysis suggest that the political environment, such as whether a company is headquartered in a democratic state, and corporate dividend policies, play a significant role in this relationship. Our results are robust to the parallel trend test, placebo test, propensity score matching-difference in difference design (PSM-DID). By using quantile DID model, we further demonstrate that higher levels of idiosyncratic risk companies benefit more from reducing greater idiosyncratic risk by achieving better ESG performance.

This study contributes to the literature in several significant ways. Firstly, previous research indicates that corporate ESG practices only yield long-term benefits for firms under normal circumstances (Eliwa et al., 2021; Huang, 2021; Shin et al., 2022). Our study builds upon this foundation by revealing that despite the inherent costs associated with ESG implementation, and notwithstanding the disruptive impact of the COVID-19 pandemic, ESG practices still yield significant reductions in idiosyncratic risk. The DID method utilised in this study is widely employed in causal inference and offers certain advantages over general econometric regression. Significantly, our findings contribute to resolving previous contradictory assertions regarding the effectiveness of ESG investments in the backdrop of the COVID-19 pandemic. Our study specifically illustrates that investors persistently integrated ESG factors into their analytical paradigms throughout the crisis duration, highlighting the sustained significance of ESG integration for proficient risk mitigation strategies.

Secondly, we employ a quantile difference-in-difference (DID) model with the adaptive Markov Chain Monte Carlo (MCMC) method to explore the heterogeneous impact of ESG on firms at different levels of idiosyncratic risk. Consequently, responsible investors can enhance portfolio efficiency by stratifying corporate idiosyncratic risk levels into quantiles based on these insights. Unlike traditional models that assume a uniform effect across the risk distribution, our approach allows us to assess how firms with varying degrees of risk exposure benefit from ESG during the pandemic. This methodological innovation has not been fully explored in prior research, making our study distinct.

Thirdly, we contribute to the literature by investigating the mediating role of revenue growth in the relationship between ESG performance and firm-specific risk. Specifically, this finding reveals that revenue growth serves as a critical channel through which ESG performance indirectly reduces firm-specific risk. Firms that integrate ESG into their strategies are better positioned to maintain financial stability in uncertain environments, which in turn mitigates their idiosyncratic volatility. This mediation analysis provides novel insights into the mechanisms behind the relationship between ESG and firm risk during the COVID-19 pandemic, which have been underexplored in previous studies. Unlike prior research (He et al., 2022; Kim et al., 2024; Sabbaghi, 2023; Trinh et al., 2023), which focuses primarily on the direct relationship between ESG and firm risk, our study delves into the intermediary role of revenue growth, offering a more comprehensive understanding of how ESG performance impacts firm resilience.

Finally, by incorporating heterogeneity analysis, we demonstrate that firms located in politically democratic states and those with proactive dividend policies experience differing degrees of ESG-related risk mitigation during crises like the COVID-19 pandemic. This nuanced understanding helps clarify how external political factors and internal financial strategies interact with ESG practices to influence firm-specific risk. By doing so, the study offers practical insights for policymakers and corporate managers looking to optimise ESG strategies in varying political and financial contexts.

The rest of this paper runs as follows. The next section presents the theoretical framework, reviews the relevant literature and derives the testable hypotheses. Section 3 introduces the data,

variables, and illustrates the methodology adopted. Empirical analyses are shown in section 4. In section 5, we provide a discussion of the robustness checks employed. Further discussion and analyses are presented in section 6. Section 7 provides the conclusion.

2. Literature review and hypothesis development

2.1. Theoretical framework

Stakeholder Theory (Freeman, 1984) posits that firms must consider the interests of all stakeholders – including employees, customers, suppliers, and the community – to ensure long-term sustainability. Companies with strong ESG performance are more likely to implement stakeholder-oriented practices that emphasise social responsibility, sound corporate governance, and environmental management. The COVID-19 pandemic heightened the significance of these practices, particularly in addressing health and safety concerns, adapting to remote work, and maintaining supply chain resilience. Firms with strong environmental practices often have more sustainable supply chains and greater resource efficiency, better positioning them to navigate disruptions. Similarly, robust governance structures support agile decision-making, transparency, and corporate resilience – key elements for managing uncertainties during crises and mitigating firm-specific risks.

The social dimension of ESG also played a pivotal role in addressing pandemic-specific challenges, such as safeguarding employee health and well-being, promoting workplace safety, and fostering strong relationships with local communities. By prioritising stakeholder well-being, firms with strong ESG performance were able to maintain operational stability and mitigate risk. This also aligns with *Human Capital Theory* (Becker, 1975), which underscores that employees' skills, knowledge, and health are among a company's most valuable resources. Investments in employee health and welfare, along with the establishment of safe working environments, significantly enhance productivity, foster innovation, and cultivate loyalty. During the COVID-19 pandemic, firms that focused on employee health and safety experienced reduced absenteeism and increased workforce trust, both of which were crucial for maintaining operations and achieving steady performance growth amid uncertainty (Hamouche, 2021).

Furthermore, *Contingency Theory* (Donaldson, 2001) asserts that organisational success is contingent on a firm's ability to adapt to specific environmental conditions. High-ESG firms are more likely to invest in their employees, equipping them with the flexibility and skills needed to respond effectively to external crises like the pandemic. Companies with established health management systems and strong community ties were better positioned to swiftly adjust their strategies during the pandemic, ensuring operational continuity. This operational stability and adaptability likely resulted in improved performance, which provided a buffer against firm-specific volatility. As a result, firms with strong ESG performance were better equipped to adapt to the challenges posed by the pandemic, leading to improved operational stability and reduced firm-specific volatility.

2.2. ESG performance and COVID-19 pandemic

During non-crisis periods, companies with strong ESG performance have gained advantages in various aspects such as valuation (Fatemi et al., 2018), capital costs (Chen et al., 2023; Eliwa et al., 2021), and risk mitigation (Bae et al., 2021a). This is because corporate ESG practices can foster positive relationships with stakeholders. However, the sudden outbreak of the COVID-19 pandemic has prompted doubts among some corporate managers, investors, and scholars regarding the necessity of adhering to ESG practices. Conclusions of current studies regarding whether investors still paid more attention to ESG issues during the COVID-19 pandemic are mixed.

On the one hand, Singh (2022) found a spillover effect that investors will reduce their investment in ESG stocks and turn to invest in safer investment-grade bonds throughout the pandemic period.

Specifically, Bae et al. (2021b) suggest that there is no connection between firms' ESG performances and their actual actions, as they find that pre-crisis ESG performance has no effect on protecting shareholders' interests from the adverse effects of crises. Moreover, Khanchel et al. (2024) discovered that the COVID-19 pandemic raised the probability of firms embracing a corporate social responsibility (CSR) decoupling strategy. From institutional investors' perspective, Glossner et al. (2022) have shown that institutional investors rebalance their portfolios towards firms with strong financial performances rather than firms with sustainable performances. Albuquerque et al. (2020) have shown that the association between the ESG preference of institutional investors and the resiliency of sustainable stock is weak. Regarding retail investors, Döttling and Kim (2022) have documented sharper declines in demand for sustainable investments by retail investors and in internet searches about sustainability. Park (2022) observed that institutional investors exhibit greater diligence in assessing climate risks compared to retail investors during the COVID-19 pandemic. Furthermore, Glossner et al. (2022) have analysed retail investors' trading behaviours through the online discount brokerage platform to show that the retail investors lost interest in stocks with better environmental and social performances during the COVID-19 period.

On the other hand, some scholars conclude that corporate ESG performance is more important for investors during the pandemic period (Broadstock et al., 2021). This may be due to ethical behaviour, such as ESG performance is viewed as insurance against corporate operation uncertainty, and it is positively correlated with COVID-19 pandemic (Al Amosh & Khatib, 2023). Similarly, Díaz et al. (2021) have also shown the significance of incorporating ESG performance into financial analytical process, as they have found that high ESG score companies outperform companies with low ESG score, and better ESG performance firms may be more resilient to the volatility caused by the uncertainty that was associated with the COVID-19 pandemic. In relation to stock markets, Yoo et al. (2021) have found that more sustainable firms had greater stock returns, and are less volatile over the course of the COVID-19 pandemic. These results are in line with Ng and Rezaee's (2020) finding that investors would focus more on ESG issues when firms' economic performance is weaker. Meanwhile, Díaz et al., (2021) found that in addition to the Fama-French three factors, the return spread of top ESG companies and bottom ESG companies provide clear explanations for the industry portfolio return during the pandemic. Similarly, by including the ESG elements in the Fama-French five factor equation, Pizzutilo (2023) found the companies that adhere to high ESG standards tend to perform better in the stock market. Specifically, these companies outperform those with lower ESG standards when adjusted for risk.

Trinh et al. (2023) extends ESG research to the financial industry, demonstrating that under the impact of the COVID-19 pandemic, banks with higher ESG ratings experienced lower idiosyncratic and systematic tail risks. This suggests that ESG activities help mitigate bank tail risks during crises. Using a sample of Korean firms, Kim et al. (2024) demonstrates that during the COVID-19 pandemic, the role of ESG performance in reducing idiosyncratic volatility became more pronounced, highlighting the critical importance of ESG in risk management during times of crisis. However, Sabbaghi, (2023) presents evidence on the differences in ESG investing and asymmetric volatility between emerging and developed markets. The study reveals that, in response to negative news, high ESG-rated firms in emerging markets experience a smaller increase in volatility compared to their counterparts in developed markets. He et al. (2022) show that CSR disclosure leads to lower idiosyncratic risk, particularly for firms mandated to disclose ESG information. They argue that CSR disclosure reduces information asymmetry and improves informational efficiency in the Chinese stock market. However, these studies have largely focused on financial institutions or emerging markets, leaving limited evidence on how ESG performance influences firm-specific risks in non-financial sectors within developed markets during the COVID-19 pandemic.

To reconcile the opposing viewpoints mentioned above, and considering Ahmad et al. (2021)'s study, which demonstrates that the COVID-19 pandemic significantly increased companies' idiosyncratic risk, this study aims to investigate whether ESG performance helps non-financial firms in

developed markets, specifically in the U.S., withstand external shocks. Accordingly, we formulate the following hypothesis:

Hypothesis 1: ESG performance can significantly reduce idiosyncratic risk over the course of the COVID-19 pandemic.

2.3. The mediating effect of revenue growth

One mechanism through which ESG practices may influence idiosyncratic risk during the COVID-19 pandemic is revenue growth. Firms with strong ESG profiles benefit from enhanced stakeholder trust, increased growth, and a greater capacity to navigate uncertainties (Lins et al., 2017). By integrating ESG considerations into their corporate sustainability frameworks, firms can achieve cost reductions, enhance customer satisfaction, and drive both revenue growth and gross margin defence (Eccles et al., 2013; Luo & Bhattacharya, 2006). Firms particularly committed to environmental sustainability often realise cost savings through resource efficiency and waste reduction (King & Lenox, 2002), which can be reinvested into growth initiatives. Similarly, companies with strong social practices are more likely to attract and retain talent, fostering a motivated workforce that enhances productivity and innovation (Flammer, 2015). During external crises such as the COVID-19 pandemic, firms with strong ESG performance may have been better positioned to maintain or even increase their revenue due to their enhanced reputation, stakeholder engagement, and adaptability.

However, the mechanisms through which revenue growth reduces firm-specific risk require further exploration. Jiang et al. (2009) suggest that a firm's past revenue growth can serve as a predictor of future earnings and returns, thereby influencing the firm's idiosyncratic volatility. Notably, Jiang et al. (2009) found that idiosyncratic volatility exhibits a U-shaped relationship with revenue growth. Specifically, once revenue growth surpasses a certain threshold, idiosyncratic volatility begins to increase with further revenue expansion. Conversely, at lower levels of sales growth, idiosyncratic volatility decreases as revenue growth increases.

During the COVID-19 pandemic, most companies experienced significant adverse effects on their financial performance. Therefore, we hypothesise that, under such conditions, revenue growth will mitigate idiosyncratic volatility. Furthermore, in times of crisis, firms with higher revenue growth are likely to possess greater resources to manage unforeseen challenges, reduce debt exposure, and maintain operational stability, all of which contribute to lowering idiosyncratic risk.

Thus, building on the literature linking ESG performance, revenue growth, and idiosyncratic risk, this study examines the mediating effect of revenue growth on the relationship between ESG performance and firm-specific risk during the COVID-19 pandemic. The assumption is that firms with high ESG performance could sustain or increase their revenue during the pandemic due to their stakeholder-oriented strategies, which reduced firm-specific volatility. Our second hypothesis is therefore formulated as:

Hypothesis 2: Revenue growth mediates the relationship between ESG performance and firm-specific risk during the COVID-19 pandemic.

3. Methodology

3.1. Data and sample

Our data is drawn from US listed companies from 2013 to 2021. We extract ESG data from Refinitiv Eikon, and other relevant data are obtained from the center for Research in Security Price database (CRSP). The data for each of the variables used in this study are collected annually. Companies related to the finance sector were not included in the sample since they fall under various regulatory regimes and have distinctive features. Our analysis also eliminates the technology sector since

technology businesses tend to exhibit information asymmetry (Liao & Lin, 2017), causing substantial idiosyncratic volatility. This is because technology companies must invest heavily in research and development to innovate, but they face the risk of idea theft, preventing them from openly discussing strategies with potential investors. Moreover, efforts on ESG performance may worsen information asymmetry in the technology sector due to ESG efforts as an extra expenditure and in light of the risk awareness of the business (Nazir et al., 2022). We also eliminate firms from our sample with missing data, and the continuous variables are winsorised at the 1% or 99% level. Finally, an unbalanced panel of 9,409 firm-year observations is included in the final sample.

3.2. Variables

3.2.1. ESG performance

The ESG performance scores were collected from Thomson Reuters Refinitiv Eikon. Refinitiv's ESG scores are designed to assess a company's relative performance, commitment, and effectiveness across various ESG factors. It captures more than 400 company-level ESG metrics, including carbon emissions, social initiatives, and board structure. The score provides an aggregated assessment of these dimensions. The scores range from 0 to 100, with higher scores reflecting stronger ESG performance. The Refinitiv ESG score is widely used in academic and business analysis, as many financial studies have included it in their analysis (e.g. Bofinger et al., 2022; Lee & Raschke, 2023).

3.2.2. Idiosyncratic risk

The idiosyncratic risk refers to the risk component that is unique to the firm and is associated with its own characteristics. This paper uses the method of Ang et al. (2006) to measure the idiosyncratic risk by using the standard deviation of the regression residuals of Fama-French (1993) three-factor model. The equation is as follows:

$$r_{i,d} = \alpha_i + \beta_i r_{m,d} + h_i HML_d + s_i SMB_d + \varepsilon_{i,d} \tag{1}$$

where $r_{i,d}$ is the excess return for stock i on day d; $r_{m,d}$ is the market risk premium on day d. SMB is the difference in return of the portfolios of small market value companies and large market value companies, that is, the size-based risk premium factor. HML is the difference in return of the portfolios of companies with higher book-to-market ratio and the companies with lower book-to-market ratio, that is, book-to-market-based risk premium factor. $\varepsilon_{i,d}$ is the regression residual of the stock i. To get the standard deviation of the residuals for each company, the regression is run once a year. We annualised the standard deviation as a measure of idiosyncratic risk by multiplying it with the square root of the number of trading days of the relevant stock each year ($IR_{i,t} = \sqrt{Var(\varepsilon_{i,d})} * \sqrt{N_{i,t}} * 100\%$), where $IR_{i,t}$ is the idiosyncratic risk for firm i on year t, $N_{i,t}$ is the number of trading days of firm i on year t.

3.2.3. Control variables

According to prior literature, the firm characteristics variables that may affect the idiosyncratic risk are controlled in this study: the *profitability* ratio (ROA), defined as earnings to total assets and *leverage* ratio calculated as long-term debt divided by book value of total assets (Shan et al., 2014). We further include firm *size*, which is the natural logarithm of the end-of-fiscal-year total asset (Wang & Sarkis, 2017). The *age* of the company is calculated as the natural logarithm of one plus the number of years when the company was initially included in the Center for Research in Securities Prices (CRSP)'s coverage (Aabo et al., 2017). Controlling for the *growth* character, we include the Market-to-Book ratio (MB), calculated as market value of equity divided by the book value of equity. Additionally, we also control the *capital expenditures* (CapEx), measured as the ratio of capital expenditure to total asset (Titman et al., 2004). All variable definitions are provided

Table 1. Descriptive statistics.

	Mean	SD	Median	Min	Max	N
IR_t	36.999	25.116	29.154	10.881	236.947	9409
ESG_{t-1}	41.660	18.897	38.406	8.515	86.506	9410
ROA_{t-1}	0.000	0.165	0.037	−0.998	0.281	9409
$SIZE_{t-1}$	7.969	1.684	8.022	3.451	11.843	9410
LEV_{t-1}	0.283	0.197	0.276	0.000	1.013	9506
AGE_{t-1}	2.904	0.889	3.091	0.693	4.078	9525
MB_{t-1}	3.812	6.026	2.603	34.583	55.755	9408
$CAPEX_{t-1}$	−0.037	0.037	−0.026	−0.223	0.000	9504

Notes: The table presents descriptive statistics for the variables used in the analysis. "Mean" refers to the average value of the variable across all firm-year observations. "SD" denotes the standard deviation, reflecting the variability or dispersion of the variable from its mean. "Median" represents the middle value when the data is arranged in order, providing a measure of the central tendency less affected by extreme values. "Min" and "Max" show the minimum and maximum values observed for each variable, respectively, indicating the range of the data. "N" denotes the number of firm-year observations included for each variable in the sample, ranging from 2013 to 2021.

Table 2. Pearson correlation coefficients.

	IR_t	ROA_{t-1}	$SIZE_{t-1}$	LEV_{t-1}	AGE_{t-1}	MB_{t-1}	$CAPEX_{t-1}$
IR_t	1						
ROA_{t-1}	−0.496***	1					
$SIZE_{t-1}$	−0.456***	0.412***	1				
LEV_{t-1}	−0.063***	0.044***	0.300***	1			
AGE_{t-1}	−0.347***	0.348***	0.394***	0.003	1		
MB_{t-1}	−0.022**	0.008	−0.054***	−0.072***	−0.040***	1	
$CAPEX_t$	0.039***	−0.145***	−0.107***	0.012	−0.118***	0.001	1

Notes: This table displays the Pearson correlation coefficients among the variables of interest, The coefficients indicate the strength and direction of linear relationships between pairs of variables. *indicates significance at 10%, **indicates significance at 5%, ***indicates significance at 1%.

in Appendix 1. Table 1 shows the descriptive statistics of idiosyncratic risk, ESG performance, and control variables used in the baseline regression.

Table 2 presents the correlation coefficients matrix of the variables.

3.3. Model specification

3.3.1. Baseline model

This paper uses the Difference in Difference (DID) approach, and the occurrence of the coronavirus pandemic is taken as a quasi-natural experiment, to study its impact of ESG performance on the firms' idiosyncratic risk. We identify "firms with strong ESG performance" as the treatment group and "firms with weak ESG performance" as the control group. Consequently, we construct the following DID model:

$$IR_{i,t} = \delta_0 + \delta_1 TREAT_i * COVID_t + \delta_2 Control_{i,t-1} + Year\ FE + Firm\ FE + \varepsilon_{i,t} \quad (2)$$

wherein, equation (2) is a DID model including the year and firm fixed effects. $IR_{i,t}$ is the idiosyncratic risk of firm i at year t. We first calculated the average ESG score for all companies prior to the COVID-19 outbreak. Firms with an average ESG performance score exceeding this overall average were categorised as having strong ESG performance (TREAT=1), while firms with an average ESG performance score below the overall average were categorised as having weak ESG performance (TREAT=0), which serves as the control group. In total, the treatment group consists of 4,117 firm-year observations, while the control group includes 5,292 firm-year observations. The COVID-19 pandemic commenced in early 2020. Hence, this paper designates 2020 as the year when the pandemic initiated an exogenous shock. The second and subsequent waves of the pandemic heightened policymakers' anxiety and slowed the pace of economic recovery (Ahmad

et al., 2021). Thus, the dummy variable COVID is assigned a value of 1 in year 2020 and 2021, and 0 before year 2020. The parameter δ_1 is the estimated coefficient of most interest here, its economic meaning in this model is the difference in the effect of the ESG performance on firms' idiosyncratic risk over the course of the COVID-19 pandemic between strong and weak ESG companies. *Control* represents the control variables that may affect idiosyncratic risk.

3.3.2. Mediating effects models

To examine the mediation effect of revenue growth in the relationship between ESG performance and idiosyncratic risk, we employ a three-step approach (Baron & Kenny, 1986). First, as in the baseline regression (Equation (2)), we assess the direct effect of ESG performance on idiosyncratic risk. Second, we evaluate the impact of ESG performance on revenue growth, hypothesising that firms with higher ESG scores will exhibit stronger revenue growth during the COVID-19 pandemic. The following model captures this relationship:

$$RG_{i,t} = \delta_0 + \delta_1 TREAT_i * COVID_t + \delta_2 Control_{i,t-1} + Year\ FE + Firm\ FE + \varepsilon_{i,t} \quad (3)$$

Here, $RG_{i,t}$ represents the revenue growth rate of firm i in year t, calculated as the percentage change in revenue over the past year.

In the third step, we examine the effect of revenue growth ($RG_{i,t}$) on idiosyncratic risk and whether revenue growth mediates the relationship between ESG performance and idiosyncratic risk. The mediation analysis is captured by the following model:

$$IR_{i,t} = \delta_0 + \delta_1 TREAT_i * COVID_t + \delta_2 RG_{i,t} + \delta_3 Control_{i,t-1} + YearFE + FirmFE + \varepsilon_{i,t} \quad (4)$$

In this model, $RG_{i,t}$ is included as the mediator. The control variables in models (3) and (4) are consistent with those in model (2). The coefficient δ_1 measures the direct effect of ESG performance on firm-specific risk, while δ_2 captures the influence of revenue growth on firm-specific risk. If revenue growth significantly reduces firm-specific risk and the inclusion of this mediator diminishes the direct effect of ESG performance (represented by δ_1), it would suggest a partial mediation effect. If the direct effect of ESG performance on firm-specific risk becomes non-significant after including revenue growth, this would indicate full mediation.

4. Empirical results

4.1. The baseline results

This section examines the effect of the ESG performance on idiosyncratic risk throughout the COVID-19 pandemic by building the difference-in-difference model (DID) to estimate equation (2). The estimated results are shown in Table 3. Column (1) and column (2) of table 3 do not control the year and individual effects, but only include TREAT and COVID, as well as the interaction term. Column (2) also includes control variables. The results show a significant negative ($\beta = -6.454$ and -2.942, respectively) causal relationship between better ESG performance companies and idiosyncratic risk at a significant level of 1% , indicating that companies with better ESG performance have lower idiosyncratic risk during the pandemic. Column 3 and column 4 control for both year and individual effects, and the empirical conclusions are still like those of column 1 and column 2 ($\beta = -1.647$ and -1.570, respectively). However, the value of estimated coefficients of column 1 differs significantly from the other three columns, therefore, the results of column 1 may be biased. Therefore, our results are in line with the conclusion of Broadstock et al. (2021) that ESG performance is more important for investors during the pandemic period. Even though Demers et al. (2021) concludes that corporate ESG practice cannot immunise the risk caused by COVID crisis, however, our finding shows corporate ESG performance can resilient idiosyncratic risk over the course of the pandemic.

Table 3. Baseline regression results.

	IR_t	IR_t	IR_t	IR_t
$TREAT_i$*$COVID_t$	−6.454***	−2.942***	−1.647**	−1.570**
	(−6.56)	(−3.35)	(−2.13)	(−2.09)
$COVID_t$	18.062***	13.369***		
	(24.57)	(20.70)		
$TREAT_i$	−11.515***	(0.70)		
	(−22.72)	(−1.33)		
ROA_{t-1}		−48.117***		−19.939***
		(−25.20)		(−5.89)
$SIZE_{t-1}$		−3.291***		(0.34)
		(−18.10)		(−0.35)
LEV_{t-1}		3.214***		11.006***
		(2.66)		(4.23)
AGE_{t-1}		−3.019***		(0.22)
		(−11.01)		(−0.10)
MB_{t-1}		−0.187***		−0.121***
		(−6.15)		(−3.01)
$CAPEX_{t-1}$		−59.227***		(10.21)
		(−10.53)		(−0.89)
_cons	35.914***	64.505***	30.942***	31.109***
	(84.70)	(48.18)	(39.03)	(3.49)
Year FE	NO	NO	Yes	Yes
Firm FE	NO	NO	Yes	Yes
N	9409.00	8689.00	9409.00	8689.00
r2_a	0.20	0.38	0.27	0.29

Notes: This table presents the regression results for the baseline model of equation (2). The dependent variable is idiosyncratic risk (IR). The key independent variable is the interaction term TREAT*COVID, where TREAT equals 1 for firms with strong ESG performance and COVID is assigned a value of 1 for the years 2020 and 2021, and 0 for the years prior. Column (1) and (2) show the ESG performance effect without fixed effect, we add firm and year fixed effects in Column (3) and (4). The time period for the data spans from 2013 to 2021. ESG performance data is sourced from Refinitiv Eikon, and financial data are from the Center for Research in Security Prices (CRSP) database. Introducing the treatment group dummy variable in conjunction with fixed effects would lead to multicollinearity, as the fixed effects for individual firms and time periods provide more granular control than group-level and time dummy variables. As a result, TREAT and COVID dummy variables are not included in Column (3) and (4) to prevent multicollinearity. Robust standard errors are clustered at the firm level, with t-statistics reported in parentheses. *indicates significance at 10%, **indicates significance at 5%, ***indicates significance at 1%.

4.2. The results of mediating effects

The results of the mediation analysis are presented in table 4, illustrating the impact of revenue growth on the relationship between ESG performance and firm-specific risk. In the first column, we observe the relationship between ESG performance (proxied by the interaction term TREAT*-COVID) and revenue growth (RG), while the second column presents the full mediation model, incorporating both revenue growth and idiosyncratic risk (IR).

In the first column, the coefficient for the interaction term TREAT*COVID is positive and highly significant ($\beta = 4.985$, $p < 0.01$). This suggests that firms with strong ESG performance exhibited significantly higher revenue growth during the COVID-19 pandemic compared to those with weaker ESG practices. This finding aligns with previous studies that highlight the resilience of high-ESG firms, which tend to benefit from stronger stakeholder engagement and customer loyalty during times of crisis (Lins et al., 2017). These companies may have been able to adapt more swiftly to the pandemic's disruptions, securing stronger revenue performance due to their long-term orientation and sustainable practices.

In the second column, the negative and highly significant coefficient for revenue growth ($\beta = -0.078$, $p < 0.01$) confirms that revenue growth effectively reduces idiosyncratic risk. This result is consistent with the theoretical expectation that firms with stable and growing revenues are perceived as less volatile by investors, providing a buffer against firm-specific shocks (Lundmark et al., 2020). The stronger financial position and operational flexibility associated with higher revenue growth likely contribute to reducing firm-specific volatility during crises like the COVID-19

Table 4. mediating effects of revenue growth.

	RG_t	IR_t
RG_t		−0.078***
		(−7.63)
$TREAT_i$*$COVID_t$	4.985***	−1.196*
	(4.72)	(−1.66)
ROA_{t-1}	−26.331***	−24.644***
	(−4.31)	(−6.91)
$SIZE_{t-1}$	−11.842***	−1.506
	(−7.91)	(−1.56)
LEV_{t-1}	3.17	10.813***
	(0.72)	(4.05)
AGE_{t-1}	−11.139***	−1.639
	(−4.59)	(−0.77)
MB_{t-1}	0.178***	−0.099**
	(2.61)	(−2.54)
$CAPEX_{t-1}$	74.331***	−8.236
	(3.48)	(−0.72)
_cons	132.195***	44.403***
	(10.48)	(4.82)
Year FE	YES	YES
Firm FE	YES	YES
N	8698	8536
r2_a	0.107	0.297
P(Bootstrap)		0.000***

Notes: This table presents the results of the mediation analysis examining the role of revenue growth in the relationship between ESG performance and idiosyncratic risk. Column (1) illustrates the effect of ESG performance on revenue growth, while Column (2) highlights the regression results incorporating both revenue growth and ESG performance, thereby facilitating the assessment of the mediation effect. The p-value from the Bootstrap test for the mediation effect is reported as 0.000, indicating strong evidence supporting the mediation hypothesis. Significance levels are denoted by ***, **, and * for 1%, 5%, and 10%, respectively, with robust t-statistics clustered by firm displayed in parentheses.

pandemic. Importantly, the inclusion of revenue growth in the full mediation model changes the significance and magnitude of the ESG interaction term's coefficient. In the baseline model, ESG performance was associated with a negative and significant direct effect on idiosyncratic risk ($\beta = -1.536$, $p < 0.05$). However, after including revenue growth as a mediator, the coefficient of TREAT*COVID becomes smaller and marginally significant ($\beta = -1.196$, $p < 0.10$). This indicates a partial mediation effect, suggesting that a portion of the reduction in firm-specific risk attributed to ESG performance can be explained by revenue growth during the pandemic. This finding is further supported by a bootstrap analysis, which yields a p-value of 0.000, indicating strong statistical significance for the mediation effect.

This partial mediation effect highlights the pathway through which ESG performance contributes to firm resilience by indirectly influencing revenue growth. Firms that integrate ESG factors into their strategies are better equipped to maintain financial stability in uncertain environments, which, in turn, reduces their idiosyncratic risk. This finding is consistent with the broader literature, suggesting that ESG practices enhance operational resilience and promote long-term value creation (Eccles et al., 2014).

5. Robustness checks

5.1. Parallel trend test

The basic assumption established by the previous results of this study is that the treat group and control group pass the parallel trend test. This paper replaces the COVID ∗ TREAT variable in equation (2) with dummy variables for each year during the sample period for the regression to test the parallel trend of the impact of strong and weak ESG performance companies on

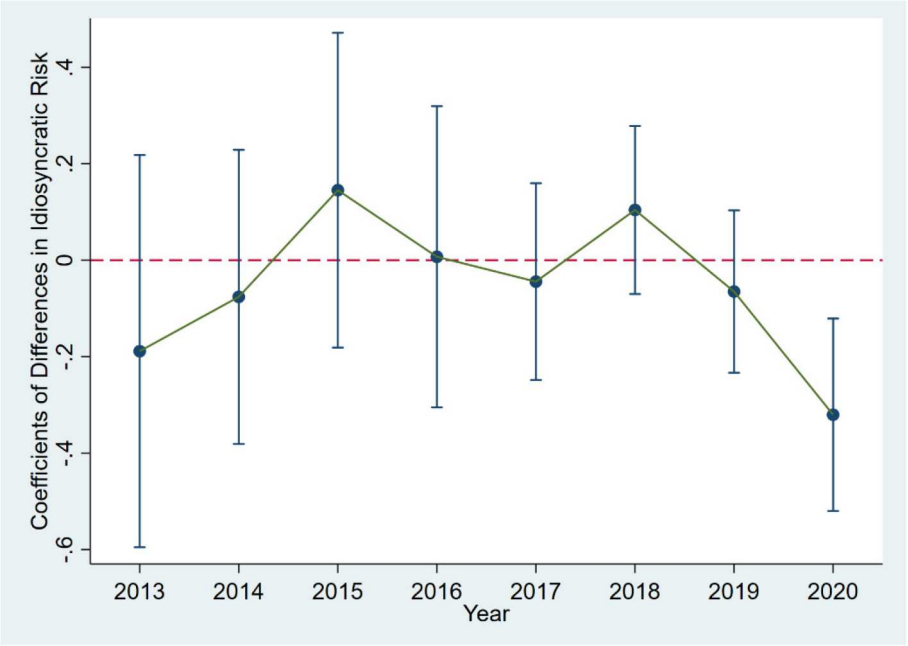

Figure 1. Parallel trend test.

Notes: This figure presents the estimated coefficients of the treatment variable (ESG performance) from a regression of firm-specific idiosyncratic risk on the interaction between the treatment and time dummies. The Y-axis represents the difference in pre-treatment trends between the treated and control groups. The red dashed line at zero indicates the null hypothesis of no pre-treatment differences, validating the parallel trends assumption if the coefficients are not statistically different from zero before 2020.

idiosyncratic risk before the outbreak of the pandemic. The regression estimation coefficients for each year are shown in Figure 1, where the dashed line represents a 95% confidence interval. It can be observed that before 2020, the coefficients of each year are not significant, implying that there is no significant difference between the treatment group and the control group before the pandemic. Moreover, the coefficient of 2020 is negative and significantly different from zero. Therefore, the result indicates that the results of this study satisfy the parallel trend hypothesis.

5.2. Placebo tests

In order to determine whether the missing variables and random factors would affect the results, in line with Ferrara et al. (2012) and Li et al. (2016), this paper randomly screens the strong ESG performance firms and also randomly generates the COVID-19 periods. Thus, we construct the crisis year-firm two-level random experiment accordingly and evaluate the validity of the conclusion according to the likelihood that the estimated coefficient of the main regression obtained from the false experiment. To increase efficiency of the placebo test, we repeat the above process 500 times, and finally draw the TREAT*COVID's estimated coefficient distribution diagram. Based on this, we can verify whether the effect of ESG performance reducing idiosyncratic risk is significantly affected by other factors besides the COVID-19 pandemic. As can be seen from Figure 2, the estimated coefficients of the randomised TREAT*COVID are concentrated around 0 and the coefficient of the baseline estimation result is outside the distribution. The result implies that after the two-level random treatment, virtual COVID-19 pandemic cannot generate treatment effect on the idiosyncratic risk. We can deduce that the impact of the pandemic on the idiosyncratic risk of strong ESG performance companies does exist. Therefore, no significant missing variable issue exists in the model setting, and the previous conclusion is still robust.

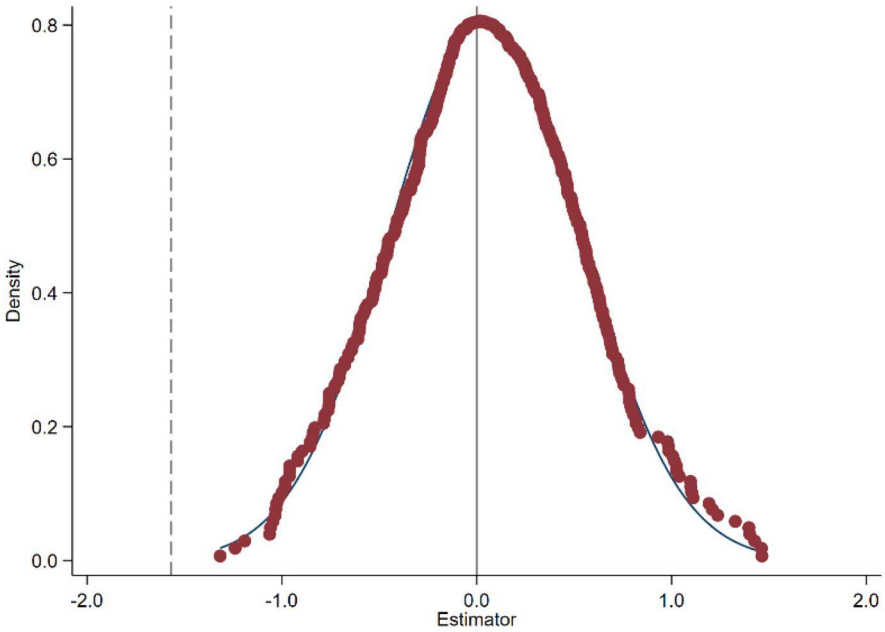

Figure 2. Placebo test.

Notes: The estimated coefficient displays an inverted U-shape, centered around zero, suggesting no significant treatment effect from the virtual shock. This result implies that the original external shock, rather than the placebo security, is responsible for the observed impact on the dependent variable.

5.3. PSM-DID tests

Since strong ESG performance companies may have less idiosyncratic risk due to their own better financial performance and efficiency of operation, the sample may have selection bias issues. To select the control group more efficiently, this study further uses propensity score matching (PSM) method to test the causal relationship between the ESG performance and idiosyncratic risk over the course of pandemic under other similar conditions. Because of controlling the firm characteristic variables, we build a Logit model of whether the company is a strong ESG performance company. Meanwhile, the nearest neighbour 1:1 matching with replacement approach is adopted. Finally, we obtained 1476 matched companies with 5218 observations for the baseline regression. This includes 2,411 treatment group observations and 2,807 control group observations, providing an adequate balance between the groups and ensuring the reliability of the results. The matching results in Figure 3 show that the standard deviation of most variables is drastically decreased. Panel A and panel B of Table 5 present the results of balancing test of propensity score matching. The regression results of equation (2) by using the matched sample are reported in panel C. The result shows that the coefficient of TREAT*COVID is significantly negative, which implies that after using more accurate matched samples, the impact of ESG performance on idiosyncratic risk during the pandemic is consistent with our previous results.

5.4. Alternative measure of idiosyncratic risk and regression method

To further investigate the robustness of our results, we employed a four-factor model and Generalised Method of Moments (GMM) estimation to assess the relationship between ESG performance and idiosyncratic risk. The results are presented in Table 6, with the first column reflecting the four-factor model estimates and the second column displaying the GMM results. In both the four-factor model and GMM estimation, the coefficient for the interaction term TREAT*COVID is negative

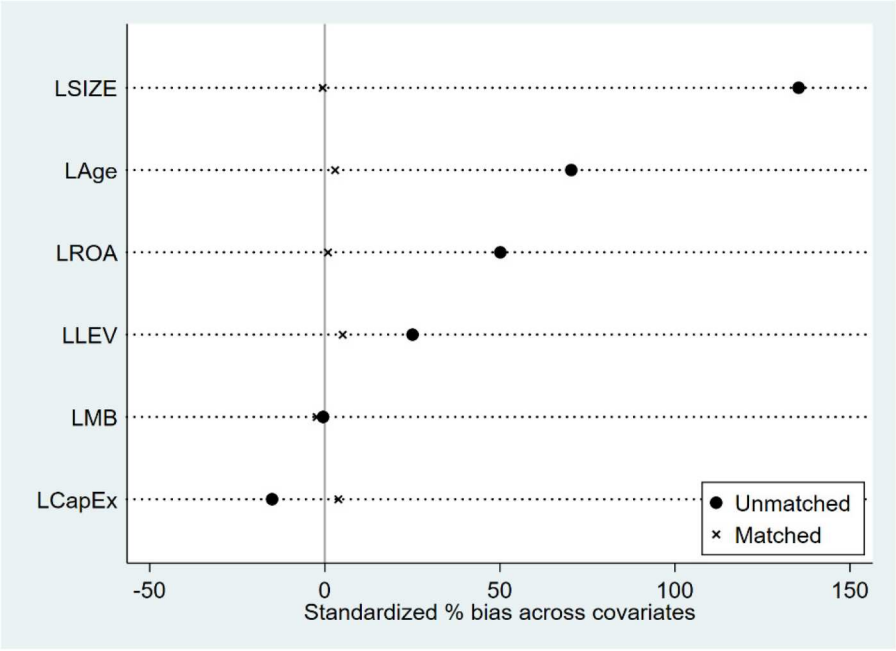

Figure 3. Matching results.

Notes: This figure presents the standardised percentage bias across covariates before and after propensity score matching. The black dots represent the unmatched covariates, while the crosses indicate the matched covariates. The closer the points are to zero on the horizontal axis, the more balanced the covariates are post-matching, indicating a successful propensity score matching process.

and statistically significant. Diagnostic tests for serial correlation reveal that first-order autocorrelation is significant, while second-order autocorrelation is not, indicating appropriate model specification. Furthermore, the Sargan and Hansen tests for over-identifying restrictions confirm the validity of the instruments used in the GMM estimation. Overall, these robustness checks confirm the stability of our main findings, demonstrating that ESG performance significantly reduces idiosyncratic risk during the covid-19 pandemic period across different methodologies. This consistency enhances the validity of our conclusions regarding the positive impact of ESG integration on firm resilience.

6. Additional Analyses and discussion

6.1. Quantile DID model analysis

To further depict the dynamic evolution track of the marginal effect of ESG performance with different levels of idiosyncratic risk, the quantile DID model is used to test the hypotheses of this study. The core notion of the quantile DID model is to take the explained variable as a distribution function and estimate the influence of the explained variable at the conditional quantile point based on the sum of the absolute value of the minimum weighted residual. By observing the trend of the corresponding coefficient, we can obtain the evolution trend of the impact of ESG performance on idiosyncratic risk during the COVID-19 period in the sample interval. Furthermore, we use quantile regression for panel data with nonadditive fixed effects (QRPD) to estimate the quantile panels into the instrumental variable method framework. Consequently, the random disturbance term includes fixed effect, ensuring the indivisibility of the random disturbance term (Powell, 2020, 2022). The inclusion of non-additive fixed effects in the QRPD model ensures that individual heterogeneity is effectively accounted for, enhancing the robustness and accuracy of the estimated

Table 5. PSM-DID tests.

Panel A: Balancing test of propensity score matching					
	Unmatched	Mean		T test	
Variable	Matched	Treated	Control	t	P>|t|
ROA	U	0.04464	−0.02699	22.37	0.000
	M	0.04061	0.03939	0.50	0.615
SIZE	U	9.0346	7.1922	62.24	0.000
	M	8.4779	8.4867	−0.27	0.788
LEV	U	0.30802	0.2608	11.47	0.000
	M	0.3036	0.29406	1.81	0.070
AGE	U	3.2288	2.6488	32.23	0.000
	M	3.0587	3.0347	1.11	0.269
MB	U	3.8266	3.8551	−0.23	0.819
	M	3.623	3.7599	−0.86	0.392
CAPEX	U	−0.04017	−0.03458	−6.91	0.000
	M	−0.03888	−0.0403	1.24	0.217

Panel B: PSM estimator					
Variables	Treated	Controls	Difference	S.E.	t-statistics
IR	29.983	33.008	−3.025	0.809	−3.74***

Panel C: Results of PSM-DID regression	
	IR_{t+1}
$TREAT_i$*$COVID_t$	−2.123**
	(−2.00)
ROA_{t-1}	−28.425***
	(−5.85)
$SIZE_{t-1}$	−0.349
	(−0.30)
LEV_{t-1}	9.065**
	(2.46)
AGE_{t-1}	0.702
	(0.21)
MB_{t-1}	−0.114**
	(−2.14)
$CAPEX_{t-1}$	4.576
	(0.41)
_cons	29.366***
	(2.61)
Year FE	Yes
Firm FE	Yes
N	5218
r2_a	0.329

Notes: The table presents the regression results for the matched sample, estimated using equation (2). The dependent variable is idiosyncratic risk (IR). The key independent variable is the interaction term TREAT*COVID, where TREAT equals 1 for firms with strong ESG performance and COVID is assigned a value of 1 for the years 2020 and 2021, and 0 for the years prior. The regression includes firm fixed effects and year fixed effects. The time period for the data spans from 2013 to 2021. ESG performance data is sourced from Refinitiv Eikon, and financial data are from the Center for Research in Security Prices (CRSP) database. Robust standard errors are clustered at the firm level, with t-statistics reported in parentheses. *indicates significance at 10%, **indicates significance at 5%, ***indicates significance at 1%.

coefficients. This approach allows the model to capture unique, unobserved characteristics of each entity that do not vary over time, thereby isolating the true impact of ESG performance on idiosyncratic risk. Therefore, compared with the conventional panel quantile model, higher accuracy and more robustness of the estimated coefficients are the advantages of QRPD model. We construct the panel quantile function of DID by investigating parameters that describe the 10% to 90% quantile of the conditional distribution and use the adaptive Markov Chain Monte Carlo method (Adaptive

Table 6. Idiosyncratic risk measured by four-factor model and GMM regression results.

	$IR4_t$	IR_t
IR_{t-1}		0.355
		(1.13)
$TREAT_i$*$COVID_t$	−1.650**	−4.964**
	(−2.21)	(−2.17)
ROA_{t-1}	−20.391***	−22.143
	(−5.91)	(−1.62)
$SIZE_{t-1}$	−0.596	−1.71
	(−0.62)	(−1.63)
LEV_{t-1}	11.060***	1.143
	(4.27)	(0.73)
AGE_{t-1}	−0.175	−2.303**
	(−0.08)	(−2.45)
MB_{t-1}	−0.119***	−0.153***
	(−3.00)	(−3.17)
$CAPEX_{t-1}$	−3.914	−47.863***
	(−0.34)	(−5.84)
_cons	33.150***	25.865
	(3.73)	(1.40)
Year FE	YES	YES
Firm FE	YES	YES
N	8691	8565
r2_a	0.287	
AR(1)(p)		0.012
AR(2)		0.6980
Sargan test statistic overid (p)		0.157
Hansen test statistic overid (p)		0.464

Notes: This table presents the results of the robustness checks using a four-factor model and Generalised Method of Moments (GMM) estimation. Column (1) displays the results from the four-factor model, while Column (2) shows the GMM estimation results. The coefficients for the interaction term TREAT*COVID are negative and statistically significant in both models, consistent with the main regression findings. Diagnostic tests indicate that the model is appropriately specified, with valid instruments used in the GMM estimation, thereby reinforcing the robustness of our results. Robust standard errors are clustered at the firm level, with t-statistics reported in parentheses. *indicates significance at 10%, **indicates significance at 5%, ***indicates significance at 1%.

MCMC) to estimate equation (5). The adaptive Markov Chain Monte Carlo (MCMC) method allows us to efficiently estimate the complex conditional quantile functions, enhancing the precision of our results. This method is particularly advantageous in our study, as it helps deal with the potential non-linearity in the relationship between ESG performance and idiosyncratic risk.

$$IR_{i,t} = \gamma(\tau)TREAT_i*COVID_t + \beta(\tau)X_{i,t-1} \ + \ Year\ FE \ + \ Firm\ FE + \varepsilon_{i,t} \tag{5}$$

where, τ denotes the corresponding quantile; $IR_{i,t}$represents the idiosyncratic risk in the corresponding quantile, X is a vector of control variables, which are the same as equation (2). The regression coefficient at the quantile τ describes the impact of the explanatory variable on the explained variable at the quantile τ, rather than the impact of the explanatory variable under the condition of the control variable.

Table 7 shows the results of quantile DID model. The estimated results of the interaction coefficient of treatment group and the COVID-19 period show that the stronger ESG performance is negatively correlated with idiosyncratic risk but has a heterogeneity impact on the different risk levels during the pandemic period. The absolute value of high percentiles' coefficients is larger than the other low percentiles, which indicates the effect of higher ESG performance reducing the idiosyncratic risk is more apparent for firms with greater idiosyncratic risk. However, at 40% and 50% quantiles, the negative effects of ESG performance on idiosyncratic risk are not significant. This is perhaps because the median level of idiosyncratic risk is not priced by investors, so that less ESG information is incorporated into stock price. This is consistent with Bali et al. (2005), as they

Table 7. Quantile regression.

τ	[0.1]	[0.2]	[0.3]	[0.4]	[0. 5]	[0.6]	[0.7]	[0.8]	[0.9]
$COVID_t$*$TREAT_i$	−1.064***	−2.585***	−2.634*	−1.500	−2.003	−3.190***	−1.853**	−5.160***	−3.121***
	(−2.96)	(−2.64)	(−1.86)	(−1.28)	(−1.13)	(−5.78)	(−2.04)	(−12.63)	(−3.69)
ROA_{t-1}	−8.004	−13.595*	−26.678***	−21.87	−51.561***	−43.289***	−8.896***	−49.209***	−52.843***
	(−0.64)	(−1.89)	(−5.07)	(−1.10)	(−17.78)	(−16.68)	(−2.87)	(−39.87)	(−15.34)
$SIZE_{t-1}$	−1.424***	−3.399***	−2.300***	−2.547	−1.908***	−2.043***	−6.604***	−5.122***	−7.087***
	(−6.56)	(−13.93)	(−4.67)	(−1.02)	(−3.47)	(−5.98)	(−42.02)	(−19.59)	(−18.90)
LEV_{t-1}	5.479***	−0.064	2.952	6.619*	−1.908	−10.205***	18.875***	11.399***	22.945***
	(4.28)	(−0.02)	(1.14)	(1.79)	(−0.99)	(−9.31)	(11.59)	(9.27)	(5.84)
AGE_{t-1}	0.002	4.716***	−2.799***	−9.336	−3.252***	−5.892***	−0.521	−3.481***	−7.634***
	0.000	(2.96)	(−8.20)	(−1.11)	(−19.79)	(−25.46)	(−1.33)	(−25.19)	(−5.01)
MB_{t-1}	0.008	−0.168	−0.002	−0.045	−0.023	0.042	−0.096**	−0.142***	−0.218***
	(0.52)	(−1.29)	(−0.09)	(−0.35)	(−1.54)	(1.58)	(−2.10)	(−4.15)	(−3.01)
$CAPEX_{t-1}$	4.452	−32.416***	−25.020***	−26.418	5.507	4.532	−19.033**	−31.259***	−91.678***
	(0.76)	(−4.71)	(−6.59)	(−1.12)	(1.60)	(0.21)	(−2.04)	(−4.87)	(−5.35)
N	8689	8689	8689	8689	8689	8689	8689	8689	8689
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents the results from the panel quantile regression with non-additive fixed effects (QRPD). The dependent variable is [Idiosyncratic Risk], and the independent variables include the interaction term of the treatment group (TREAT=1) and the COVID-19 period (COVID=1). The model is estimated at the 10th percentile using the Markov Chain Monte Carlo (MCMC) optimisation method. 1,000 draws are used, with 100 "burn-in" draws discarded at the beginning of the MCMC chain. t statistics in parentheses, *indicates significance at 10%, **indicates significance at 5%, ***indicates significance at 1%.

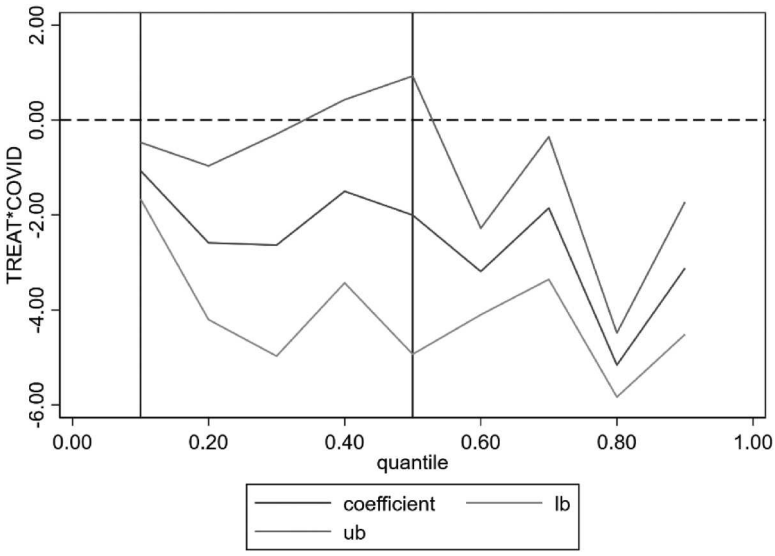

Figure 4. Quantile regression.

Notes: This graph presents the quantile regression estimates for the interaction term between treatment (TREAT) and the COVID-19 period (COVID). The x-axis represents quantiles of the dependent variable distribution, while the y-axis shows the estimated coefficient for the interaction term. The solid black line represents the coefficient estimates, and the grey lines depict the lower (lb) and upper bounds (ub) of the confidence intervals. The dashed horizontal line at zero indicates no effect.

document that portfolio returns are not correlated with median and average idiosyncratic risk. Figure 4 shows this more intuitively that there is a downward trend of the interaction coefficients of ESG performance in the COVID-19 period (Y-axis) as idiosyncratic risk level increases (X-axis).

6.2. Heterogeneous analysis

After the outbreak of COVID-19, the impact of the pandemic on ESG performance may be influenced by the political environment of the state where the corporation is located. Rubin (2008) has shown that socially responsible firms are more inclined to locate their headquarters in democratic states, suggesting that the political affiliations of stakeholders – such as shareholders, community members, customers, workers, and suppliers – are associated with geographic proximity to the headquarters. The pandemic amplified public demand for corporate responsibility, particularly in health, safety, and social welfare. Firms in democratic states, being under greater stakeholder scrutiny and with policies that favor such initiatives, were likely more proactive in managing these challenges. Thus, considering that the political views of voters can effectively reflect the attitudes of stakeholders towards ESG performance, we conduct a heterogeneity analysis by grouping firms based on whether their headquarters are located in democratic states. We introduce a variable 'Demo'. Firms are grouped into two categories: those headquartered in democratic states for the Presidential election for the current and subsequent years (Demo = 1) and those headquartered in Republican states (Demo = 0). This heterogeneity analysis examines how ESG performance influences idiosyncratic risk in different political environments.

A company's commitment to its stakeholders is also indicated by its dividend payments, alongside its strong ESG performance (Benlemlih, 2019), as both suggest a willingness to share proportionally stable profits. Based on signalling theory, maintaining or increasing dividends conveys positive information to stakeholders about the company's future profitability during crises. In contrast, dividend omission sends a pessimistic signal about a company's financial prospects (Baker et al., 2016). According to agency theory, dividend policy can alleviate information asymmetry

and reduce agency costs (Athari et al., 2016). To avoid managers engaging in 'empire building' by overinvesting excess cash flow in ESG projects, companies can use their short-term cash flow to distribute dividends, ensuring that long-term cash flow is reinvested to improve ESG performance over time (Dhaliwal et al., 2011; Zahid et al., 2022). Prior studies also show that dividend payments are positively associated with ESG performance (Benlemlih, 2019; Cheung et al., 2018). Thus, dividend policies can be seen as a tool for preventing excessive investment in ESG initiatives and alleviating agency concerns. During the pandemic, firms that paid dividends were likely more disciplined in their financial management and better equipped to balance ESG investments with shareholder expectations. The heterogeneous analysis on dividend payments explores whether firms that distributed dividends were better at leveraging ESG performance to mitigate firm-specific risks during the COVID-19 crisis. For this heterogeneity analysis, firms are grouped into those that pay dividends in year t (DIDV = 1) and those that do not (DIDV = 0).

The results of the heterogeneous analysis are presented in Table 8, which explores the impact of ESG performance on firm-specific risk across different groups. In Columns 1 and 2, the firms are grouped based on their political environment – whether they are headquartered in democratic or non-democratic states. The results show that for firms headquartered in democratic states, the interaction term TREAT*COVID is significantly negative ($\beta = -3.095$, $p < 0.05$), indicating that ESG performance has a stronger effect in reducing firm-specific risk in these states. This aligns with previous literature suggesting that democratic states tend to pressure firms to adopt stronger ESG practices, likely contributing to their enhanced resilience during the pandemic. In contrast, for firms headquartered in non-democratic states, the interaction term TREAT*COVID is negative but not statistically significant ($\beta = -1.671$), suggesting that ESG performance does not play as substantial a role in mitigating firm-specific risk in these areas.

Columns 3 and 4 present the results of firms grouped based on whether they paid dividends in the year of analysis. The interaction term TREAT*COVID is significantly negative for dividend-

Table 8. Heterogeneous analysis.

	(1) Demo = 1	(2) Demo = 0	(3) DIDV = 1	(4) DIDV = 0-
$COVID_t$*$TREAT_i$	−3.095**	−1.671	−6.953***	1.514
	(−2.15)	(−1.45)	(−4.76)	(0.66)
ROA_{t-1}	−28.100***	−20.424***	−21.367***	−30.827***
	(−4.17)	(−3.90)	(−4.70)	(−4.39)
$SIZE_{t-1}$	0.578	−1.935	1.756	−3.617
	(0.26)	(−1.48)	(1.20)	(−1.32)
LEV_{t-1}	12.113**	12.443***	9.457**	21.971***
	(2.51)	(3.48)	(2.07)	(4.43)
AGE_{t-1}	2.008	0.45	4.39	−3.415
	(0.49)	(0.15)	(1.10)	(−0.72)
MB_{t-1}	−0.144**	−0.146**	−0.084*	−0.162**
	(−2.19)	(−2.25)	(−1.73)	(−2.04)
$CAPEX_{t-1}$	−8.385	−8.266	−12.612	26.201
	(−0.30)	(−0.80)	(−0.89)	(1.07)
_cons	17.808	40.377***	−6.468	67.148***
	(0.79)	(4.07)	(−0.40)	(3.24)
Year FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
N	3882	4457	4613	2430
r2_a	0.279	0.350	0.300	0.284

Notes: This table presents the results of the heterogeneous analysis examining the impact of ESG performance on firm-specific risk, categorised by political environment (democratic vs. non-democratic states) and dividend payment status. In Columns (1) and (2), firms are grouped based on whether their headquarters are located in democratic states for the Presidential election. In Columns (3) and (4), firms are grouped based on whether they paid dividends during the year. The dependent variable is firm-specific risk (IR). The interaction term COVIDt*TREATi captures the effect of ESG performance during the COVID-19 pandemic. All models include firm and year fixed effects, with standard errors clustered by firm. ***, **, and *denote statistical significance at the 1%, 5%, and 10% levels, respectively.

paying firms ($\beta = -6.953$, $p < 0.01$), highlighting that these firms benefited more from strong ESG performance in reducing idiosyncratic risk during the pandemic. Dividend policies may act as a signalling mechanism to convey financial health to stakeholders, reinforcing the effects of ESG performance. On the other hand, for non-dividend-paying firms, the coefficient is positive but not significant ($\beta = 1.514$), indicating that the absence of dividends diminishes the potential benefits of ESG practices in reducing risk.

These results suggest that the effectiveness of ESG performance in mitigating firm-specific risk during the COVID-19 pandemic varies depending on both the political environment and dividend policies. Firms located in democratic states and those that pay dividends seem to derive greater risk reduction benefits from strong ESG practices, emphasising the role of external and internal factors in shaping the ESG-risk relationship.

6.3. Environmental, social, and governance components

Each individual pillar within ESG practices serves distinct stakeholder groups, potentially resulting in varied impacts on firm risk. Previous research has highlighted these distinctions (Girerd-Potin et al., 2014; Godfrey et al., 2009). Notably, potential conflicts among the pillars have been identified (Edmans,2023; Russo,2008). Given these complexities, it is essential to investigate how the performance of these specific ESG pillars can influence firm-specific risk, thereby shaping investment decisions. In light of these concerns and the potential complexities arising from the interplay of different ESG pillars, this study extends its analysis beyond overall ESG performance. Specifically, we disaggregate the analysis to evaluate the associations between the performance of each pillar and idiosyncratic risk during the COVID-19 period. To achieve this, we replace the ESG variable in Equation (2) with individual measures of environmental, social, and governance performance to capture these relationships.

Table 9. Individual environmental, social and governance factors and idiosyncratic volatility.

	IR_t	IR_t	IR_t
$TREAT_i$*$COVID_t$ (E)	−1.184		
	(−1.49)		
$TREAT_i$*$COVID_t$ (S)		−2.080***	
		(−2.60)	
$TREAT_i$*$COVID_t$ (G)			−0.083
			(−0.11)
ROA_{t-1}	−19.902***	−19.758***	−19.909***
	(−5.88)	(−5.82)	(−5.88)
$SIZE_{t-1}$	−0.323	−0.296	−0.26
	(−0.33)	(−0.31)	(−0.27)
LEV_{t-1}	10.843***	11.115***	10.879***
	(4.16)	(4.26)	(4.18)
AGE_{t-1}	−0.003	−0.013	0.368
	(−0.00)	(−0.01)	(0.17)
MB_{t-1}	−0.121***	−0.124***	−0.122***
	(−3.01)	(−3.09)	(−3.03)
$CAPEX_{t-1}$	−10.383	−10.796	−10.619
	(−0.91)	(−0.95)	(−0.93)
_cons	30.499***	30.192***	29.150***
	(3.40)	(3.41)	(3.26)
Year FE	YES	YES	YES
Firm FE	YES	YES	YES
N	8689	8689	8689
r2_a	0.290	0.291	0.290

Notes: This table summarises the results from robustness checks examining the impact of ESG performance on idiosyncratic risk across different specifications. The first column presents the results for the environmental (E) dimension, the second for the social (S) dimension, and the third for the governance (G) dimension of ESG performance. Robust standard errors are clustered at the firm level, with t-statistics reported in parentheses. *indicates significance at 10%, **indicates significance at 5%, ***indicates significance at 1%.

Table 9 presents the detailed results. When analysing the individual components of ESG, as illustrated in columns 1 through 3, it becomes evident that only firms demonstrating robust social performance (column 2) exhibit a significant reduction in idiosyncratic risk during the pandemic. In contrast, performance in the environmental and governance performance (column 1 and column 3) does not appear to significantly mitigate this risk. One potential explanation for this disparity may lie in the immediacy of social issues; the effects of the environmental pillar on idiosyncratic risk might not materialise within such a short time frame. Conversely, crises such as the pandemic tend to amplify adverse outcomes stemming from social issues. With economic challenges looming during this period, firms faced potential strains in their relationships with key stakeholders, including employees and suppliers. Consequently, social performance received heightened scrutiny. Furthermore, governance performance remains contentious in prior research, as it may diverge from the environmental and social pillars (Strine Jr et al., 2022; Yang et al., 2023). Additionally, governance transformations often entail complex and protracted processes, making rapid changes in governance performance during the COVID-19 period unlikely (Pozzoli et al., 2022). Overall, these findings contribute to the discourse on the intersections of ESG performance, idiosyncratic risk, and the prevailing conditions resulting from the COVID-19 pandemic.

7. Conclusion

This study leverages a quasi-natural experiment to address the critical issue of whether ESG performance helps firms mitigate idiosyncratic risk, particularly during crises like the COVID-19 pandemic, while also exploring the underlying mechanisms through which this effect occurs. The findings are as follows: Firstly, ESG performance significantly reduces idiosyncratic risk during the pandemic, underscoring the importance of ESG practices as a tool for corporate resilience against external shocks. Contrary to the idea that ESG is a luxury in times of crisis, this research shows that firms with strong ESG practices are better equipped to mitigate firm-specific risks. Furthermore, our analysis highlights the pathway through which ESG performance reduces idiosyncratic risk, with revenue growth serving as a critical mediating factor. Firms that demonstrated strong ESG performance-maintained revenue growth during the pandemic, which contributed to their ability to manage and reduce firm-specific volatility. This pathway suggests that ESG practices not only provide direct risk mitigation but also strengthen a firm's financial stability, offering an additional layer of protection during crisis periods.

In the heterogeneity analysis, we examined the effects of political environment and dividend policy on the ESG-idiosyncratic risk relationship. Firms headquartered in democratic states, where stakeholders are more inclined to support socially responsible practices, showed stronger reductions in idiosyncratic risk. Similarly, firms with consistent dividend payments also demonstrated a greater impact of ESG on risk reduction. This suggests that firms operating in socially responsible political environments or with disciplined financial policies benefit more from their ESG practices in times of crisis.

Interestingly, our results challenge the notion that ESG practices are ineffective during periods of external shock. In contrast, we show that ESG is a critical tool for firms in managing crises such as the COVID-19 pandemic. From a practical perspective, the quantile DID analysis suggests that investors can construct more efficient portfolios by targeting firms with high ESG performance, particularly those with higher levels of idiosyncratic risk, as these firms experience more significant risk reduction. Policymakers should encourage firms to strengthen their ESG practices, particularly in environments where political support for social responsibility is strong and financial policies are stable, such as through consistent dividend payments. This can enhance corporate resilience to external shocks, benefiting both firms and the broader economy.

While this research sheds light on the role of ESG in navigating a global health crisis, it does not fully explore the impact of technological disruptions on ESG integration during periods of crisis. As rapid technological advancements – such as digitalisation, automation, and artificial intelligence –

continue to transform industries, their intersection with ESG practices represents an emerging area for future research. How these technological disruptions might enhance or hinder the effectiveness of ESG strategies, particularly in crisis periods, remains underexplored. Future research could investigate how firms leverage technology to strengthen ESG practices, enabling them to respond more effectively to external shocks. This line of inquiry would offer a more comprehensive understanding of how firms can integrate ESG principles with technological advancements to build resilience in future crises.

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ORCID iD

Yusuf Karbhari http://orcid.org/0000-0003-4513-0928

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Appendix

Table A1. Description of variables used in the regression models.

Variable	Description
Dependent	
IR	Idiosyncratic Risk
Independent	
TREAT	Firms with an average ESG performance score greater than overall average ESG performance of all companies prior to the COVID-19 outbreak (TREAT=1), while firms with an average ESG performance score below the overall average (TREAT=0)
POST	It is assigned a value of 1 in year 2020 and 2021, and 0 before year 2020
Mediator	
RG	Revenue growth. The percentage change in revenue over the past year.
Control	
ROA	Return on assets. The ratio of net income to total assets.
SIZE	Firm size. Nature log of total asset.
LEV	Firm leverage. The ratio of long-term debt to total assets.
AGE	Nature log of one plus firm age, where the firm age equals the number of years since the stock inclusion in the CRSP database.
MB	Market to book equity ratio. The ratio of market value of equity divided by the book value of equity
CAPEX	Capital expenditure. The ratio of capital expenditure to total asset