



Research article

Crisis and environmental governance decisions amidst the COVID-19 pandemic: Lessons from European countries

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ABSTRACT

This study investigates the influence of the COVID-19 pandemic crisis on environmental governance decisions within publicly listed European companies. It utilizes a comprehensive analysis of publicly available data regarding these firms and check the environmental governance practices during the pandemic, informed by risk society theory which describes modern societies marked by ongoing risks and uncertainties primarily stemming from technological and scientific advancements. The regression and robustness analysis has been performed on how companies have responded to the crisis, specifically in terms of their approaches to environmental sustainability and governance. Covid-19 has a significantly positive impact on environmental governance (EG), with a coefficient of 18.73 and a p-value of .000. Other variables like human development (HD), size, and free cash flow (FCF) positively affect EG, while corruption (Corrupt) and leverage (Lev) have a negative influence. Robust analysis confirms the negative impact of Covid-19 on EG, with a coefficient of 18.46 and a p-value below .01, consistent across different subsamples. However, it also underscores the challenges companies have encountered in upholding their sustainability efforts amid the crisis. In sum, this research offers valuable insights into how the COVID-19 pandemic has affected environmental governance decisions, with potential implications for policymakers, regulators, and business leaders striving to advance sustainability in the post-pandemic landscape.

1. Introduction

The COVID-19 pandemic has had a profound impact on the world in multiple dimensions, ranging from health and economic to social and environmental aspects. The pandemic has led to changes in the way individuals, businesses, and governments operate, making it essential to understand the implications of the crisis on different domains. One of the areas that has received limited attention is the effect of the pandemic on environmental governance decisions [1] (see Table 7).

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Environmental governance decisions refer to the choices made by individuals, organizations, and governments to manage natural resources and protect the environment. The pandemic has created a unique situation in which governments have had to balance the need to protect public health while maintaining economic stability, which has resulted in potential trade-offs between public health and the environment [2]. This situation raises important questions about the impact of the pandemic on environmental governance decisions.

Economic growth is characterized by bursts of rapid expansion as well as lulls that could lead to crises. Crises vary in terms of the severity of their effects and what led to them. Businesses in the twenty-first century have faced numerous crises, including the COVID-19 pandemic's blow to the economy. Throughout the crisis, managers are faced with a variety of difficult decision-making situations, the bulk of which have an impact on the organization's overall directions and revolve around ensuring the firm's long-term existence [3].

Given its dramatic influence on humanity, the sudden dissemination of Covid-19 is a topic that receives a lot of attention in this research. Numerous studies show that the private sector suffered enormous losses as a result of the virus's propagation [4,5]. Whereas Covid-19 influenced a sizable portion of businesses globally (and still does in some cases), new research indicates that there is significant variation based on company and sector variables [5]. For instance, companies with greater financial reserves and lower debt incurred less damage from Covid-19 [6,7].

In both the service and production sectors, the COVID-19 epidemic has had a disruptive impact on business that has never occurred before. Numerous immediate difficulties had to be overcome, including putting health protocols into place, marketing, finding jobs, and so forth [8,9]. Generally, the shift of COVID-19 from the global health to an economic issue placed the onus of establishing new values or behaviors on employers, legislators, and personnel managers to ensure that businesses will keep going [10].

Although both practitioners and academics work to improve the management of ambiguity in global business, it needs to be highlighted that there are no set standards for crisis response [11]. This is a consequence of the fact that while the specifics of the various sectors vary, each firm has its own unique characteristics [11]. As a conclusion, it is the responsibility of managers to recognize the different sorts of uncertainty that exist within their organizations and choose the most effective responses to deal with the COVID-19 pandemic's impacts [11]. Globally, investment decisions are progressively being influenced by environmental, social, and governance (ESG) factors. Investors can use the ESG criteria as a set of guidelines to assess possible projects based on their operating practices [12].

Despite the commonalities among corporate social responsibility and ESG issues, there is a very slight difference between the two [13,14]. The impact of governance, social, and environmental factors on a company's financial and economic development has drawn more and more attention [13,14].

This study supporting risk society theory proposed by sociologist Ulrich Beck. According to this theory, contemporary societies are characterized by the constant presence of risks and uncertainties, which are largely the result of technological and scientific developments [15]. In the case of the COVID-19 pandemic, the risk is a global health crisis that has far-reaching implications for social, economic, and environmental systems. The motivation behind this study is to understand the impact of the COVID-19 pandemic on environmental governance decisions made by companies, specifically listed firms from Europe. The study aims to analyze the situation of these companies during the pandemic and compare it with the current situation in the time of research to determine whether the crisis has affected their environmental governance decisions. The study also seeks to demonstrate how environmental governance can improve the financial performance components of these companies that are directly linked to the COVID-19 crisis and compare it with the after state (current situation). The study provides insights into the relationship between the pandemic, environmental governance, and corporate decision-making through investigation of the listed companies as a case study to recognize this relationship.

The major difficulties and challenges addressed in our study include the unprecedented disruption caused by the COVID-19 pandemic to businesses and economies, the need for balancing public health with economic stability, the variation in the pandemic's impact on different companies and sectors, and the absence of standardized crisis response strategies. Overall, the objective of this study is to explore the impact of the COVID-19 pandemic on environmental governance decisions of European listed firms and provide insights into the challenges they faced in maintaining environmental sustainability efforts during the crisis, emphasizing our unique contributions in understanding this relationship through the lens of risk society theory.

The remainder of this paper is structured as follows. Section 2 illustrates the literature review and hypothesis development. Research methodology was discussed in Section 3. Section 4 describes the results and discussion. Finally, conclusions are presented in Section 5.

2. Literature review and hypotheses development

2.1. The impact of covid 19 pandemic crisis

The COVID-19 pandemic crisis has affected every aspect of life, including the environment. As the world shifted its focus to containing the virus and protecting public health, environmental governance decisions were put on hold or altered to accommodate the new circumstances. One of the primary impacts of the COVID-19 pandemic on environmental governance decisions is the shift towards a greener economy. The pandemic has highlighted the interdependence of economic and environmental sustainability, with many governments and organizations realizing the need for a sustainable recovery [16].

Disasters are behavioral phenomena that are socially produced either by individuals concerned instead of being a result of external environmental conditions [17]. According to theory, disaster management entails influencing participants' experiences and viewpoints in order to avoid, address, and educate during disasters [18]. The relationships across individuals within the firm, as well as

those among firms and key parties, are given focus, in addition to the effects that these relationships have on social views and experiences. Similar to this, Elliott et al. [19] found that interpersonal connections give a path to important resources including knowledge and emotional and physical abilities.

The preparation for prospective crises has received particular emphasis in the literature on disaster management [20,21]. The planning idea is essential for success with both people and companies was shared by a number of research [22,23]. In other phrases, businesses need to prepare for both good things and bad. Others have even claimed that businesses ought to be prepared to use hardship as an opportunity if they have a good plan in place. Regardless of the potential advantages from disaster strategies, various researches have shown that SMEs lack official plans for crises [24], as well as the preparation strategies used by businesses vary widely [21]. Just 29% of small enterprises, according to research by Woodman and Hutchings [25], used to have a disaster management strategy, whereas 49% of 1000 SME owners and directors according to an investigation by Herbane [24], claimed to have no preparations in place to handle against challenges to their company.

Bricolage is a term used to describe the kinds of improvising skills that involve the idea of trying to react to and accommodate to a novel occurrence, like the COVID-19 epidemic [26]. As a result, there seem to be two prevalent distinct strategies that were deemed successful, even though Williams et al. [27] claimed that effective crisis administration required striking a balance among hierarchy and elasticity depending on their evaluation of earlier research. Accordingly, the most severe and brutal public health disaster of the 20th century, is the COVID-19 pandemic which has had severe impact on both human health and society. The epidemic has exacerbated poverty and inequality in society while weakening businesses and posing a severe global economic risk [28]. But the epidemic urgent situation is also having a catastrophic impact on the global economy, harming shareholders and financial markets all over the globe [29].

The fluctuation of market returns has intensified as a result of the mounting anxiety brought by information of the COVID-19 epidemic, specifically in sectors that have been notably negatively impacted [30]. Likewise, as indicated by Diaz et al. [29], ESG participation and sustainable investments publicly increased across shareholders and regulators throughout the COVID-19 epidemic as a result of the high fluctuation in stocks. Additionally, the sudden and unanticipated manner of the epidemic encouraged businesses to concentrate on ongoing tasks rather than planned, since operational elasticity proved to be extremely crucial [31].

Despite the fact that the COVID-19 epidemic is a recent occurrence, previous research analyzing the function of ESG procedures and their effect on company performance among the epidemic situation produced contradictory conclusions. According to Albuquerque et al. [32], dividend payments during the epidemic crisis were positively correlated with both social and environmental outcomes. The researchers also emphasized the advantages of lower return fluctuation and larger operating profitability for longer sustainable enterprises [33].

Globally, COVID-19 is a serious health concern. From January 2020, over than seven million individuals have been given diagnoses globally, and the epidemic has spread to numerous nations and areas. Although COVID-19 is so contagious, nations are compelled to enact quarantine policies. These actions have a significant negative effect on overall demands, particularly on exporting and consumption. On only one side, individuals were urged to spend less time outside, and congested areas like shops were closed. However, in order to stop the spread of viruses, numerous nations placed trade restrictions, which had a significant negative impact on companies that focused on exports [34,35].

Many academics are interested in learning more about how the COVID-19 worldwide pandemic has affected the world [36]. Since individuals all over the globe, particularly in wealthy nations, are restricted to their homes due to the COVID-19 epidemic, there may be a complete standstill in economic activity, which might cause numerous of the world's most well-known firms to completely go out of business [37].

The real options model states that managers often postpone investment as ambiguities increase, which could result in missed opportunities for profitable ventures [38]. Greater external risks brought on by COVID-19 prompt management to raise their financial reserves in emergency situations. Higher cash holding uses up investment dollars and slows down businesses' progress toward sustained growth [39]. According to Maslow's needs hierarchy, customers' desire for health and security is more pressing in the near run than their need for social interaction during the crisis, which causes demanding to decline [40].

2.2. Environmental governance and COVID-19

Throughout this paper, we focus specifically across one aspect of municipal governance: environmental governance. This governance factor reflects the effectiveness of local governments in carrying out national policies aimed to safeguard the surrounding environment and enhance the quality of the air and waters, or in developing their own efforts to achieve these goals. Compared toward other governance factors like hierarchical responsibility and governmental administrative regulations, environmental governance seems to be more pertinent to the expansion of the tourism industry [41]. Cheval et al. [42] and Rume & Islam [43] found that the pandemic has led to improvements in air and water quality, reduced greenhouse gas emissions, and lessened pressure on tourist destinations. However, there have also been negative impacts, such as an increase in medical waste and haphazard disposal of disinfectants, masks, and gloves.

Particularly, the goal of environmental governance is to control person or group actions in support of common environmental goals and associated societal results. Understanding environmental governance is knowing how environmental choices are made, and ensuring that the outputs of the subsequent procedures and policies to be both socially and environmentally sustainable [44]. The ability, effectiveness, and consequences of environmental governance are all influenced by the organizational, architectural, and operational components of governance, which are recognized to exist at different sized, between localized to international regions [45].

Preserving or enhancing the capacity of environmental systems to operate and to deliver ecosystem functions via the survival of organisms, environments, or biodiversity is a key goal of environmental governance. Proper environmental governance has the following qualities: guidance, collaboration, ability, engaged, accountability, and efficiency. The precise expression of a perspective, objectives, and purposes, as well as the setting of clear parameters for behavior and extent, give proper path [46,47].

Effective management must lead the selection of management activities and the employment of public funds, and expenses and activities must be proportionate to systemic production in order to be considered effective governance [48]. Financial and investment experts have been dubious of and critical of corporate ESG data for many years. They contend that it is deficient in qualitative elements like trustworthiness, comparability, and relevancy of value, claiming that nothing about those aids in their capacity to make financial decisions [49].

Both study and practical experience have demonstrated the value that sustainability reporting and accounting contribute to an organization [50]. However, there is disagreement in the industry over the significance of corporate sustainability. While data on sustainability could be beneficial, it is frequently confusing and non-comparable [51]. Difficulties that are further made worse by the plethora of optional reporting systems and recommendations that tend to fragment behavior [52]. As a result, there are numerous issues with existing ESG disclosure and reporting processes that could work to reduce, rather than increase, credibility [53].

Environmental governance could involve decision-making activities and yield socioeconomic results that may be described as comprehensive, participative, transparent, and just in order to fulfill the goal of becoming social equitable. Regulations and procedures that acknowledge, appreciate, and include the viewpoints, philosophical systems, beliefs, cultures, and rights of various stakeholder groups are the foundation of equitable environmental governance [54].

This makes it easier for the distribution of authority, democratic decision-making, upholding of human decency, and developing strategies and initiatives that are representational. Arrangements for benefit- and power-sharing can assure that the socioeconomic gains and liabilities of environmental conservation and administration are dispersed fairly and that rights and duties are distributed and allocated according to the conditions [55]. Whenever there are statutes and regulations protecting localized interests and ownership, ensuring that participation is freely provided, and ensuring that populations have recourse to justice to fight opposing invasions or arrange restitution and/or recompense for prior injustices, equitable governance is preserved [56].

Becoming responsive as a goal makes environmental governance flexible to various situations as well as evolving factors both social and environmental. Environmental governance structures that are reactive to stakeholder needs demonstrate education, foresight, adaptation, creativity, and elasticity. Observation upon this ecological and social functioning of environmental governance, constant control and reporting, and interaction facilitate both institutional and societal education [57]. Activities include recording and exchanging knowledge gained, information coproduction, and creating practice communities to improve collective memory, and as a result, the capacity to handle and respond to change successfully [58].

In order to develop efficient management strategies, an innovation culture and a greater risk threshold promote testing with novel ideas as well as monitoring and documenting triumphs and mistakes [59]. Versatility in organizations and policies, as opposed to the promotion of one-size-fits-all strategies, enables the adaptation of environmental management and preservation paradigms to various local conditions [60].

The ultimate goal of environmental governance is to be strong, which means to have organizations that can endure throughout ages, operate well, and deal with turbulence and catastrophes. Legal, integrated, networked, and polycentric organizations provides strengthen environmental governance systems. A common vision, official legality which is granted by legislation or policy, and public perception as legitimate are all characteristics of legal organizations [46]. Cooperation, knowledge transfer, and the dissemination of advancements are made possible via functional networks (Blythe et al., 2017). There must be sufficient support and supervision from upper ranks to meet the authority and accountability at lower stages. In confederal governance systems there are largely autonomous decision- and execution centers spread over many places, territories, and sizes that collaborate and work together to achieve a single objective [61]. Polycentricity assists to withstand transition and prevent organizational failure in the face of difficulty by offering organizational variation and duplication in both function and purpose [62].

Therefore, improving corporations' reporting practices depends heavily on environmental governance structures [63]. Existing research indicates that a company's environmental disclosure will increase in proportion to how proactive and thorough its environmental governance performs [64]. To improve the disclosure of a business's environmental activities, Michelon et al. [65] finds that environmental governance practices like assurances, assurances of sustainability, and guidelines from the Global Reporting Initiative are largely ineffective. This finding raises the possibility that these procedures are endorsed merely symbolically instead of concretely to please the relevant parties.

Developing an environmental committee, represented in a sustainability committee, to control environmental actions that could assist businesses preserve their social mission and satisfy shareholders' requirements is one of the important environmental governance methods [66–68]. The sustainability board's duties often involve overseeing the effectiveness of the business' shareholder involvement procedure, sustainability regulations, and shareholder declarations [66]. Since a sustainability board is anticipated to discuss environmental protections and hazards, goals and strategic alternatives, and promises to constituents, its presence can boost the trustworthiness of integrated reporting [69]. The sustainability board, according to Cowen et al. [70], is essential for effectively responding to environmental and social stresses, raising a firm's degree of environmental accountability reporting, and controlling a business' reputation throughout its interactions on environmental plans and objectives. In this regard, the legality notion offers instructions for managers in addressing beneficiaries and their varied aspirations [66]. According to Rodrigue et al [71] investigation on the function of sustainability boards in environmental activity and reporting, the boards prioritize minimizing risk exposures and legal expenses, which has an impact on the caliber of environmental reporting.

In order to demonstrate their dedication for both society and the environment, corporations are advised to obtain unbiased external

party assurance regarding their sustainability reports. This will increase their credibility and foster trust across a variety of interested parties [65,67,72]. In order to increase shareholder trust in the accuracy and fullness of the sustainability assessment results, outside confirmation of the reporting is a crucial component [73]. This is also thought of as a method for gaining the audience's confidence in corporate environmental reporting on tactics and results [74].

Apart from South Africa or rather France amongst 45 nations questioned together in 2015 Report by KPMG, external party confirmation doesn't have commonly recognized criteria to instruct the approval procedure, as well as regulations regarding who must deliver this special package. This makes it different from a legislated financial auditing information, which is mandatory [75]. This same report states that 42% of Amounting organizations decided to guarantee their sustainability practices, 50% picked to assure of their entire reporting rather than just a few performance measures or segments, but also 64% among those choosing to assure their findings chosen for substantial accountancy firms to safeguard assurance services.

Recessions are a normal component of the economic cycle, but not all of them lead to crises. The COVID-19 epidemic has, nevertheless, created a case that fits the description of a disaster. A disaster is a full disrupting occurrence of partially disturbance wherever individuals, properties, machinery, or perhaps the surroundings are involved, based on the past research [76]. Throughout a disaster, managers are faced with a slew of new crucial choices which might determine the direction of a firm [77]. Despite disaster management strategies have been discussed in international literature for ages, every new threat is unique to the prior one [78]. It is difficult to have a disaster management plan that works for everyone [79].

The accounting processes seem too hazy to present a precise and comprehensive view of the overall functioning. While time goes on, governments, legislators, and standard-setters consider the impending usefulness of combining financial reporting with non-financial data to indicate enterprises' ESG actions [80]. The reliability of ESG ratings [81], financial results adequacy, and business internal vulnerabilities are the three primary issues that are up for debate [82]. Can ESG measures accurately capture the additional, unreported, hidden factors? the epidemic is used as a severe instance.

Another impact of the COVID-19 pandemic on environmental governance decisions is the recognition of the need for a more resilient and adaptive approach to environmental management. The pandemic has exposed vulnerabilities in current environmental governance systems, highlighting the need for more proactive and adaptive approaches to environmental management [83]. This has led to calls for increased investment in research and development aimed at improving the resilience of environmental systems. Our study is the first study to investigate COVID 19 pandemic crisis impact on the environmental governance. In particular, we fill this research gap by investigating whether environmental governance mechanisms have influence on the company performance before and after COVID 19 pandemic crisis.

The risk society and the COVID-19 pandemic highlight the blurring of boundaries between controllable and uncontrollable risks, as well as the global nature of the disease and the long-term economic, social, and political challenges it presents [84,85]. This argument is relevant to the impact of the COVID-19 pandemic crisis on environmental governance decisions because the pandemic has highlighted the importance of global cooperation and the need for a more comprehensive approach to addressing global challenges. The failure or abnormality of organizational interactions and its impact on the COVID-19 pandemic crisis is relevant to the impact of the COVID-19 pandemic crisis on environmental governance decisions. Environmental governance decisions are also made through organizational interactions, and the COVID-19 pandemic crisis has emphasized the need for effective collaboration and governance strategies between organizations to address global challenges.

The pandemic has highlighted the importance of public health and the environment, as they are closely interconnected [86]. The COVID-19 pandemic highlighted the importance of resilient governance and international cooperation, but it led to a halt in the global climate governance process, eroded mutual trust among countries, and disabled leadership in climate governance [87]. Therefore, investigating the interactions between organizations and the strategies used to govern and manage the pandemic can inform and improve the decision-making process for environmental governance as well. Environmental governance decisions are also global in nature, and the COVID-19 pandemic has emphasized the need for a coordinated global response to address environmental challenges. The pandemic presents an opportunity to rethink existing systems and embrace social solidarity, empathy, cooperation, and moralization, which are all essential values for effective environmental governance. Therefore, the hypothesis presented about the risk society and the COVID-19 pandemic is highly relevant to the impact of the COVID-19 pandemic crisis on environmental governance decisions.

H1. Covid 19 pandemic crisis has a significant impact on the environmental governance decisions.

3. Research methodology

We investigate the role of the Covid-19 crisis in enhancing the environmental governance from eleven European countries and listed in Reuters Eikon database. This is a financial data platform and analytics tool that provides real-time and historical market data, news, and financial information to assist professionals in making informed investment decisions. An initial sample contains all listed companies with available data on this database. The initial search into 2181 firms with relevant observations. After screening the data for firms with missing environmental governance data, the final sample contained 1672 firms from 2018 to 2022. The sample was categorized based on Industry Classification Benchmark into eleven Industries name among different industries, including Real Estate, Consumer Discretionary, Financials, Basic Materials, Industrials, Energy, Consumer Staples, Health Care, Technology, Telecommunications, and Utilities.

These firms are publicly listed companies and composed of different industries from 15 European countries, namely United Kingdom, Sweden, Germany, France, Switzerland, Italy, Spain, Norway, Portugal, Netherlands, Belgium, Denmark, Poland, Finland,

and Greece. Fig. 1 present the distribution of the sample based on these countries, Moreover, companies from these countries were actively listed and rated accordingly in the Thomson Reuters ESG database. Data on the country's control variables, GDP, human development, and corruption index were taken from the Global Financial Development, United Nations and Transparency International databases published on the World Bank's website. The data of firm-level variables were collected from Reuters Eikon database.

3.1. Variables measurement

The environmental governance was measured using an index developed based on similar literature (i.e. [88]). The strength of environmental governance of a firm, computed as a composite score by totaling the eight environmental governance components. As presented in Table 1, each component take value of 1 if it is true and 0 otherwise.

We employ multivariate regression to examine the impact of Covid-19 crisis on the environmental governance. As mentioned earlier, EG was measure by proxy of the relevant item while covid-19 was measure by dummies of the crisis time. We control several variables which influence this association, and provide additional explanation of these effects. Following Albitar et al. [88] and Al Amosh et al. [89], we include on return on assets (ROS), firm size (SIZE), leverage (Lev), systematic risk (Beta), firm age (Age), audit tenure score (ATS) and free cash flow (FCF) as firm level control variables. We also include GDP per capita (GDP), corruption index (Corrupt), and human development index (HD) as country level control variables. Lastly, dummies of the countries and sectors were included. Table 2 summarizes the dependent and independent variables along with their measurement proxies.

4. Results and discussion

4.1. Univariate analysis

Table 3 provides descriptive statistics for a set of variables used in an econometric analysis. The mean of environmental governance is 4.7, indicating that there is limited environmental monitoring mechanisms among European companies. For the firm-level control variables, the return on assets (ROA) has a mean of 0.039 and a standard deviation of 0.137. The minimum ROA is -2.942 , while the maximum is 2.368, indicating a wide range of values. The leverage (Lev) variable has a mean of 0.257 and a standard deviation of 0.209. The minimum leverage is 0.002, while the maximum is 4.113, suggesting a large range of values. The systematic risk (Beta) has a mean of 0.991 and a standard deviation of 0.571. The minimum and maximum values of Beta are -2.876 and 7.474, respectively, indicating a wide range of values. The firm size (Size) variable has a mean of 9.568 and a standard deviation of 0.846. The minimum size is 6.682, and the maximum size is 12.483, showing a moderate range of values. The firm age (Age) variable has a mean of 3.072 and a standard deviation of 1.613. The minimum age is 0.313, while the maximum is 6.871, suggesting a moderate range of values. The free cash flow (FCF) variable has a mean of 5.213 and a standard deviation of 2.564. The minimum value is -5.810 , while the maximum is 1.032, showing a wide range of values. The audit tenure score (ATS) variable has a mean of 50.453 and a standard deviation of 28.569. The minimum and maximum values of ATS are 0.078 and 99.077, respectively, indicating a wide range of values.

Regarding the country-level control variables, the Gross Domestic Product (GDP) per capita has a mean of 202.194 and a standard deviation of 290.38. The minimum and maximum values of GDP are 1.02 and 914.04, respectively, suggesting a wide range of values. The corruption index (Corrupt) has a mean of 74.81 and a standard deviation of 12.428. The minimum and maximum values of the

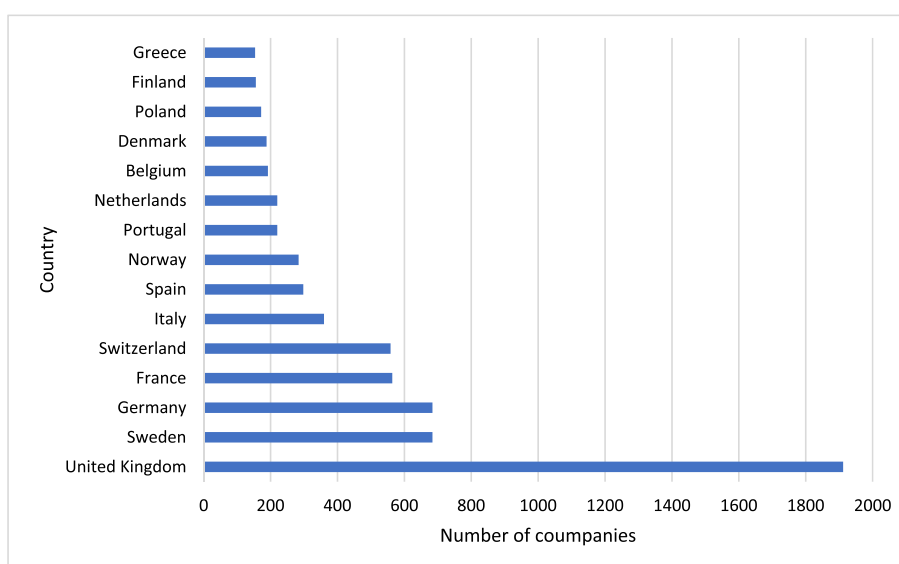


Fig. 1. The distribution of the sample.

Table 1
Measurement of environmental governance.

No. Item	Environmental Governance Components
1	Does the firm board level sustainability committee exist?
2	Does the company publish sustainability report?
3	Does the firm follow Global Reporting Initiative?
4	Does is sustainability report is externally assured?
5	Does the firm have environmental management team?
6	Does the firm report sustainability global activities?
7	Does the sustainability committee score of a firm is higher than av industry?
8	Does the sustainability external audit score of the firm is higher than av industry?

Table 2
Variables and measurements.

Variable	Symbol	Measurement
Environmental governance	EG	Developed index as shown in Table 1
Covid-19	Covid	Dummies of the covid-19 time
Gross domestic product	GDP	natural logarithm of gross domestic product
Corruption index	Corrupt	Corruption index of the country
Human development index	HD	Value of human development index of the country
Return on assets	ROA	The percent of return to total assets
Leverage	Lev	Total debt to total asset
Beta	Beta	The value of systematic risk of a firm
Size	Size	The natural logarithm of total assets of the firm
Age	Age	Number of years since incorporate
Free Cash Flow	FCF	Percentage of free cash flow to total assets
Auditor Tenure Score	ATS	The score of audit tenure of a firm
Country	Country	Country dummies
Industry	Industry	Industry dummies

Table 3
Descriptive statistics.

Variable	Year observations	Mean	Std. Dev.	Min	Max
EG	6676	4.703	2.8	3	8
Covid	6676	.5	.5	0	1
GDP	6676	202.194	290.38	1.02	914.04
Corrupt	6676	74.81	12.428	28.000	88.00
HD	6676	.926	.027	.822.000	.962
ROA	6642	.039	.137	−2.942	2.368
Lev	6663	.257	.209	.002	4.113
Beta	6550	.991	.571	−2.876	7.414
Size	6663	9.568	.846	6.682	12.483
Age	5924	3.072	1.613	0.313	6.871
FCF	5393	5.213	2.564	−5.810	1.032
ATS	6384	50.453	28.569	.078	99.074

corruption index are 28.000 and 88.000, respectively, showing a moderate range of values. The human development index (HD) has a mean of 0.926 and a standard deviation of 0.027. The minimum and maximum values of HD are 0.822 and 0.962, respectively, suggesting a narrow range of values.

In the given matrix in [Table 4](#), it can be observed that the variables Covid, HD, ROA, Lev, Beta, and FCF have a weak correlation with the variable EG, with values ranging from −0.148 to 0.162. The variable GDP has a moderate negative correlation with EG with a value of −0.138. On the other hand, the variable Corrupt has a moderate negative correlation with EG with a value of −0.103. The variables Size and FCF have a moderate positive correlation with EG, with values of 0.544 and 0.162, respectively. The variables Age and ATS have a weak correlation with EG, with values of −0.056 and 0.022, respectively. The variance inflation factor (VIF) is used to detect multicollinearity among the independent variables. A VIF value of 1 indicates no multicollinearity, while a VIF value above 10 indicates a serious problem of multicollinearity. Based on the results, it can be seen that none of the independent variables has a VIF value above 5, indicating that there is no serious problem of multicollinearity among the independent variables.

4.2. Environmental governance before and after Covid-19

The result in [Table 4](#) is a two-sample *t*-test with equal variances, comparing the means of the variable Environmental governance before and after the Covid-19 pandemic. The two categories are Before Covid-19 and After Covid-19, each with 3338 observations. The

Table 4
Matrix of correlations.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	VIF
(1) EG	1.000												1.040
(2) Covid	0.110	1.000											1.074
(3) GDP	−0.138	0.023	1.000										1.229
(4) Corrupt	−0.103	−0.009	0.302	1.000									3.132
(5) HD	−0.148	−0.061	0.392	0.921	1.000								2.664
(6) ROA	0.020	−0.064	−0.035	−0.036	−0.036	1.000							1.166
(7) Lev	0.069	0.037	−0.035	−0.103	−0.088	−0.318	1.000						1.145
(8) Beta	0.059	0.209	−0.004	0.079	0.048	−0.193	0.079	1.000					1.143
(9) Size	0.544	0.018	−0.111	−0.194	−0.196	−0.010	0.107	0.008	1.000				1.232
(10) Age	−0.056	0.002	−0.006	−0.012	0.016	−0.019	0.049	0.093	−0.048	1.000			1.022
(11) FCF	0.162	0.040	−0.025	−0.039	−0.029	0.059	−0.021	−0.013	0.334	−0.025	1.000		1.143
(12) ATS	0.022	−0.009	−0.020	−0.006	−0.014	−0.017	−0.023	−0.006	−0.003	0.017	0.009	1.000	1.003

mean for the “before the crisis category is 4.244 and after Covid-19 pandemic category is 5.162. The difference in means is calculated as $5.162 - 4.244 = 0.918$. The standard error of the difference in means is calculated as 0.068. The t-value is calculated as -13.6 , and the p-value is .000. This result indicates that there is a statistically significant difference between the means of “Environmental governance” before and after the Covid-19 pandemic, and this in line with Liu et al. [90] Demonstrate that following the outbreak, companies that have more advanced environmental management systems tend to make more effective investments. This trend is particularly evident in privately owned businesses, companies not classified as major pollution monitoring units, and companies facing greater financial constraints. This is supported by Fan et al. [91] findings, the greater the spread of pollutants across regions, the more notable the impact of local environmental protection spending on inter-regional governance. The result can be interpreted from the theory of risk society perspective which proposes that modern societies are characterized by an increasing awareness of risks and a blurring of boundaries between controllable and uncontrollable risks. The COVID-19 pandemic, being a disease of the risk society, has highlighted this phenomenon as it has spread globally and affected countries worldwide. The finding that companies with more advanced environmental management systems tend to make more effective investments following the outbreak of COVID-19 is in line with the idea that societies are increasingly focused on managing risks. with the mean after the pandemic being higher. Based on these results, one can conclude that the environmental governance has improved after the Covid-19 pandemic compared to before. The t-value of -13.6 and p-value of .000 indicate a strong level of statistical significance, meaning that it is highly unlikely that the difference in means between the two categories is due to random chance. The standard error of the difference in means being small further supports the validity of the result.

4.3. Regression analysis

The Hausman test is a commonly used statistical test to determine whether a fixed effects or random effects model is more appropriate for a panel data regression analysis. The test compares the difference in the estimates obtained from a fixed effects model and a random effects model, and if the difference between the estimates is statistically significant, it indicates that a fixed effects model is more appropriate. In this case, the test result indicates that the fixed effects model is more appropriate, with a p-value of .000, which is less than the commonly used significance level of 0.05 (see Table 5). This means that the difference in the estimates obtained from the fixed effects and random effects models is statistically significant, suggesting that the fixed effects model is a better fit for the data (see Table 6).

In Table 5, the regression result of the effect of Covid-19 on environmental governance (EG) suggests that Covid-19 has a positive and statistically significant effect on EG. There are also studies that suggest the pandemic has highlighted the importance of effective environmental governance in preventing future pandemics by addressing the root causes of zoonotic diseases and reducing human activities that contribute to habitat loss and wildlife trafficking [92]. Moreover, Severo et al. (2020) found that the pandemic has led to changes in people’s behavior, including increased sustainable consumption and environmental awareness. Additionally, Liu et al. [90] suggest firms with stronger environmental governance schemes exhibited improved corporate investment efficiency, particularly among non-state-owned enterprises, firms not listed as key pollution-monitoring units, and those facing higher financial constraints, highlighting the economic benefits and resilience associated with environmental governance during crisis periods. The coefficient for the Covid-19 variable is 18.73, with a standard error of 0.745, and a p-value of .000, which indicates that the relationship is statistically significant at the 1% level. The positive coefficient suggests that an increase in Covid-19 (the independent variable) is associated with an increase in EG (the dependent variable). In addition to Covid-19, the regression results show that other variables are also significant predictors of EG. For example, human development (HD), size, and free cash flow (FCF) have a positive relationship with EG, and this is in line with Singh et al. [93] suggest that economic development, human development, and social development have a significant and intricate relationship with Environmental Sustainability Index (ESI). It highlights the need for policymakers at global and national levels, government officials, and international development organizations to take appropriate measures to preserve environmental sustainability. Second, there is evidence to suggest that larger companies may have a greater ability to implement environmental policies and procedures due to their greater resources and economies of scale. A study by Schaper [94] found that larger companies tend to have better environmental performance than smaller companies.

While corruption (Corrupt) and leverage (Lev) have a negative relationship. For instance, a study by Pellegrini and Gerlagh (2008) found that corruption reduces the effectiveness of environmental policies, as corrupt officials are more likely to ignore environmental regulations and overlook environmental damage caused by businesses. Moreover, Wang [95] found that income inequality has a threshold effect on environmental regulation in the context of corruption, with corruption leading to a decline in environmental standards. Lv [96] found that corruption has a direct, indirect, and total negative effect on environmental performance, and that being surrounded by highly corrupt countries has a negative impact on a country’s environmental performance. Similarly, leverage has been found to have a negative impact on environmental performance, as highly leveraged firms may prioritize short-term financial gains over long-term environmental sustainability [97]. Thus, it is important for companies and governments to address issues of corruption and excessive leverage in order to improve environmental governance. The magnitude of the coefficients provides an estimate of the

Table 5
Two-sample t-test with equal variances.

Variable	Category	Obs.	Mean	Difference	St Err	t-value	p-value
EG	Before Covid-19	3338	4.244	-.918	.068	-13.6	0.000
	After Covid-19	3338	5.162				

Table 6

The effect of Covid-19 on the EG regression.

EG	Full sample	Fixed-effect	Random-effect
Covid-19	7.14*** (.44)	18.73*** (.745)	17.35*** (.568)
GDP	4.31*** (0.013)	0.39 (0.076)	1.85* (0.035)
Corruption	−5.75*** (−.041)	−0.33 (−.005)	−2.12** (−.016)
Human development	5.31*** (16.258)	7.32*** (36.505)	2.39** (7.738)
ROA	3.83*** (.988)	−0.04 (−.021)	1.11 (.239)
Leverage	1.69* (.283)	0.30 (.07)	0.73 (.136)
Beta	3.08** (.172)	2.24** (.107)	3.42*** (.15)
Size	39.12*** (1.751)	4.90*** (.867)	23.73*** (1.645)
Age	−2.56** (−.001)	(−0.856) −0.074	−1.86* (−.001)
Free Cash Flow	−1.67*** (−0.122)	−2.03** (−0.023)	−2.17** (−0.054)
Auditor Tenure Score	1.93* (.002)	0.27 (0.018)	0.93 (.001)
Constant	0.98*** (2.409)	7.43*** (37.072)	4.82*** (13.934)
Country ID	Included	Included	Included
Industry ID	Included	Included	Included
R-squared	0.334	0.177	0.319
F-test	176.868	71.306	–
Prob > F	0.000	0.000	0.000
Number of obs.	4590	4590	4590
Hausman (1978) specification test	Chi-square test value		91.119
	P-value		0.000

***p < .01, **p < .05, *p < .1. The coefficient reported between brackets.

Table 7

The regression result of the additional analysis.

	A	B		C	
	Additional control variable	Sub-sample (firm size)		Sub-sample (country development)	
		Large firms	Small firms	More Developed	Less Developed
Covid-19	18.46*** (.749)	2.89*** (.177)	2.89*** (.824)	15.98*** (.813)	6.48*** (.451)
GDP	.42 (0.021)	2.82*** (.011)	2.82 (0.032)	.03 (0.56)	1.12 (.003)
Corrupt	−0.48 (−.007)	−.29 (−.006)	−.290 (−.005)	−1.03 (−.027)	.62 (.012)
HD	7.28*** (37.148)	0.91 (6.695)	0.91*** (40.161)	5.48*** (48.986)	0.59** (4.401)
ROA	.16 (.038)	−.74 (−.597)	.76 (.064)	.06 (.018)	.08 (.051)
Lev	−.36 (−.084)	−1.03 (−.821)	−1.03 (−.066)	−0.86 (−.25)	2.29** (1.182)
Beta	2.30** (.111)	2.33*** (.305)	2.33 (.072)	2.76*** (.162)	−1.28 (−.156)
Size	4.92*** (.879)	1.25 (.575)	1.25*** (.82)	3.98*** (.868)	3.95** (1.376)
Age	(.12)	(.04)	(.06)	(.07)	(.012)
FCF	−2.41** (.032)	−1.13 (−.012)	−1.13** (−.065)	−2.35** (−.022)	−.38 (−.012)
ATS	.45 (.021)	−.30 (−.011)	−.30 (−.001)	.42 (.022)	.16 (.017)
Liquidity	−0.74*** (−.002)				
Constant	−7.37*** (−37.576)	−0.69 (−5.759)	−0.69*** (−40.157)	−4.92*** (−47.682)	−0.71 (−5.141)
Country ID	Included	Included	Included	Included	Included
Industry ID	Included	Included	Included	Included	Included
R-squared	0.178	0.118	(0.187)	0.209	0.161
F-test	63.379	3.980	68.627	56.549	15.297
Number of obs.	4460	445	4145	3106	1483
Prob > F	0.000	0.000	0.000	0.000	0.000

***p < .01, **p < .05, *p < .1. The coefficient reported between brackets.

strength of the relationship between the independent variables and EG. For example, the coefficient for HD is 7.32, which indicates that a one-unit increase in HD is associated with an increase of 7.32 units in EG, holding all other variables constant.

The regression analysis also reports a relatively low R-squared value of 0.177, which means that the independent variables explain

only 17.7% of the variation in EG. This suggests that other variables not included in the regression analysis may also have an important impact on EG. Finally, the F-test result of 71.306 and a p-value of .000 indicate that the overall regression model is statistically significant, which means that the independent variables as a group have a significant impact on EG. This provides evidence to support the claim that Covid-19, as well as other variables, play a role in shaping EG.

4.4. Robust analysis

The table shows the results of a robust analysis of the impact of the COVID-19 crisis on environmental governance. The analysis includes control variables (A) and the sample is divided into two subsamples based on firm size (B) and level of development of the country (C). The results show the coefficient estimates, standard errors, and p-values for each of the variables in the model. The coefficient values represent the estimated effect of each variable on the dependent variable (environmental governance). The standard errors and p-values are used to determine the significance of each coefficient.

The results of the fixed effect analysis show that the variable Covid-19 has a significant negative impact on environmental governance, with a coefficient of 18.46 and a p-value less than 0.01 (see Table 7). This finding is consistent across both subsamples based on firm size and level of development of the country. The other variables in the model, such as GDP, corrupt, HD, ROA, Lev, Beta, Size, Age, FCF, ATS, Liquidity, Constant, and Country ID and Industry ID, also have significant coefficient estimates and p-values. The R-squared and F-test statistics indicate that the model has a good fit and the results are significant, with a p-value of .000 for each subsample.

In summary, the outcomes of our rigorous analysis affirm that the COVID-19 crisis has indeed exerted an adverse influence on environmental governance, aligning with prior research that has underscored the detrimental consequences of the pandemic on environmental policies and regulations [98–100]. Importantly, this conclusion remains robust even when additional control variables are taken into account, and the sample is stratified into various subgroups based on factors such as firm size and the developmental status of the country. This robustness underscores the consistent adverse impact of the COVID-19 crisis on environmental governance across a spectrum of firm types and countries characterized by differing levels of development.

5. Conclusion

The COVID-19 pandemic has exerted profound and far-reaching impacts across multiple facets of society, spanning the realms of economics, health, social dynamics, and environmental considerations. Its onset posed unique challenges for individuals, corporations, and governments worldwide, compelling them to navigate complex decision-making scenarios, especially within the sphere of environmental governance. The pandemic's repercussions on businesses have been substantial, with enterprises from diverse sectors facing varying degrees of adversity, contingent upon their financial health and debt obligations. Moreover, this global crisis underscored the essential need for adept crisis response management within organizations to ensure their sustained viability.

In line with the principles of the risk society theory, the study elucidates that the COVID-19 pandemic represents a global health crisis with profound implications for social, economic, and environmental systems. Particularly within the context of environmental governance decisions, the pandemic has accentuated the imperative of addressing uncertainties and risks in the decision-making process. It has brought to the fore the intricate interplay between human health and the well-being of ecosystems and the environment. Consequently, the "risk society" theory provides a valuable framework for comprehending the pandemic's impact on environmental governance decisions, emphasizing the significance of acknowledging uncertainties and risks in decision-making while promoting a holistic approach to environmental management.

The study's primary objective is to furnish insights into the pandemic's influence on environmental governance decisions and corporate decision-making, particularly within publicly listed companies. The study's key findings indicate that the COVID-19 crisis has had a significant and adverse impact on environmental governance, as reflected by a negative relationship with the pandemic (Covid-19) variable, aligning with prior research highlighting the detrimental consequences of the pandemic on environmental policies and regulations. This relationship holds across various firm sizes and countries with different developmental statuses, reinforcing the robustness of the results. The study contributes to new knowledge by providing empirical evidence of the pandemic's adverse effects on environmental governance, emphasizing its importance in shaping environmental policies, and highlighting the need for further research and action to address these challenges and improve environmental sustainability.

The study's practical implications extend to fostering a greater emphasis on environmental governance, embracing comprehensive environmental management approaches, incorporating risk awareness into decision-making processes, and formulating strategies for crisis response management within organizations to ensure their long-term resilience. Furthermore, the research contributes theoretically by employing the risk society theory to scrutinize the pandemic's impact on environmental governance decisions. Nevertheless, it is essential to acknowledge several theoretical limitations, including the need for a broader stakeholder perspective, a more extensive exploration of non-financial performance aspects, the incorporation of institutional factors, a comprehensive analysis of the pandemic's implications for social and environmental systems, and an examination of long-term consequences. These theoretical gaps underscore the importance of future research adopting a comprehensive and holistic approach to unravel the intricate relationship between COVID-19, environmental governance, and sustainable development while considering a diverse range of theoretical perspectives and stakeholder viewpoints.

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Declaration of competing interest

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References

- [1] H. He, L. Harris, The impact of Covid-19 pandemic on corporate social responsibility and marketing philosophy, *Journal of business research* 116 (2020) 176–182.
- [2] N.J. Bennett, T. Satterfield, Environmental governance: a practical framework to guide design, evaluation, and analysis, *Conservation Letters* 11 (6) (2018) e12600.
- [3] W. Dyduch, P. Chudziński, S. Cyfert, M. Zastempowski, Dynamic capabilities, value creation and value capture: evidence from SMEs under Covid-19 lockdown in Poland, *Plos One* 16 (6) (2021) e0252423.
- [4] A. Bartik, M. Bertrand, Z. Cullen, E. Glaeser, M. Luca, C. Stanton, The impact of Covid-19 on small business outcomes and expectations, *Proc. Natl. Acad. Sci.* 117 (2020) 17656–17666.
- [5] E. Carletti, T. Oliviero, M. Pagano, L. Pelizzon, M. Subrahmanyam, The Covid-19 shock and equity shortfall: firm-level evidence from Italy, *Rev. Corpor. Financ. Stud.* 9 (2020) 534–568.
- [6] Fahlenbrach R., Rageth K., Stulz R., How valuable is financial flexibility when revenue stops? Evidence from the Covid-19 crisis, *Rev. Financ. Stud.* 34(11) 2021, 5474–5521.
- [7] S. Ramelli, A. Wagner, Feverish stock price reactions to Covid-19, *Rev. Corpor. Finance Stud.* 9 (2020) 622–655.
- [8] N. Donthu, A. Gustafsson, Effects of COVID-19 on business and research, *Journal of Business Research* 117 (2020) 284–289, <https://doi.org/10.1016/j.jbusres.2020.06.008>.
- [9] F. Hao, Q. Xiao, K. Chon, COVID-19 and China's hotel industry: impacts, a disaster management framework, and post-pandemic agenda, *International Journal of Hospitality Management* 90 (2020) 102636, <https://doi.org/10.1016/j.ijhm.2020.102636>.
- [10] T.M. Alkadas, F. Alamarin, An integrative conceptual framework on employee performance during COVID-19 pandemic for Bahrain SMEs, *Psychology and Education* 58 (2) (2021) 3812–3817.
- [11] P. Sharma, T.Y. Leung, R.P.J. Kingshott, N.S. Davcik, S. Cardinali, Managing uncertainty during a global pandemic: an international business perspective, *Journal of Business Research* 116 (2020) 188–192.
- [12] Z. Umar, D. Kenourgios, S. Papathanasiou, The static and dynamic connectedness of environmental, social, and governance investments: international evidence, *Economic Modelling* 93 (2020) 112–124.
- [13] H. Garg, Digital twin technology: revolutionary to improve personalized healthcare, *The Science Progress and Research (SPR)* 1 (1) (2020) 31–34.
- [14] J. Xu, F. Liu, Y. Shang, R&D investment, ESG performance and green innovation performance: evidence from China, *Kybernetes* 50 (3) (2021) 737–756, <https://doi.org/10.1108/K-12-2019-0793>.
- [15] U. Beck, Ulrich Beck: Pioneer in Cosmopolitan Sociology and Risk Society, Springer International Publishing, Cham, 2014.
- [16] European Commission, A European Green Deal, 2020. Retrieved from, https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en.
- [17] J. Bundy, M.D. Pfarrer, C.E. Short, W.T. Coombs, Crises and crisis management: integration, interpretation, and research development, *Journal of Management* 43 (6) (2017) 1661–1692.
- [18] Y. Kim, H. Lim, Activating constructive employee behavioral responses in a crisis: examining the effects of pre-crisis reputation and crisis communication strategies on employee voice behaviors, *Journal of Contingencies and Crisis Management* 28 (2) (2020) 141–157.
- [19] J.R. Elliott, T.J. Haney, P. Sams-Abiodun, Limits to social capital: comparing network assistance in two New Orleans neighborhoods devastated by Hurricane Katrina, *The Sociological Quarterly* 51 (4) (2010) 624–648.
- [20] R. Doern, Entrepreneurship and crisis management: the experiences of small business during the London 2011 riots, *International Small Business Journal* 34 (3) (2016) 276–302.
- [21] J. Tyler, A.A. Sadiq, G.L. Chikoto-Schultz, Variations in employees' perceptions of organizational disaster preparedness, *Journal of Contingencies and Crisis Management* 28 (1) (2020) 2–18.
- [22] C.M. Corey, E.A. Deitch, Factors affecting business recovery immediately after Hurricane Katrina, *Journal of Contingencies and Crisis Management* 19 (3) (2011) 169–181.
- [23] I.I. Mitroff, M.C. Alpaslan, Preparing for evil, *Harvard Business Review* 81 (4) (2003) 109–115.
- [24] B. Herbane, Small business research: time for a crisis-based view, *International Small Business Journal* 28 (1) (2010) 43–64.

- [25] P. Woodman, P. Hutchings, Disruption and Resilience: the 2010 Business Continuity Management Survey, Chartered Management Institute, 2010.
- [26] A. Duarte Alonso, A. Bressan, S.K. Kok, N. Sakellarios, A. Koresis, M. O'Shea, M.A. Buitrago Solis, L.J. Santoni, Facing and Responding to the COVID-19 Threat – an Empirical Examination of MSMs. *European Business Review*, Advance online publication, 2021, <https://doi.org/10.1108/EBR-09-2020-0231>.
- [27] T.A. Williams, D.A. Gruber, K.M. Sutcliffe, D.A. Shepherd, E.Y. Zhao, Organizational response to adversity: fusing crisis management and resilience research streams, *Academy of Management Annals* 11 (2017) 733–769.
- [28] N. Raimo, A. Rella, F. Vitolla, M.I. Sanchez-Vicente, I.M. Garcia-Sanchez, Corporate social responsibility in the COVID-19 pandemic period: a traditional way to address new social issues, *Sustainability* 13 (12) (2021) 6561.
- [29] V. Díaz, D. Ibrushi, J. Zhao, Reconsidering systematic factors during the COVID-19 pandemic—The rising importance of ESG, *Finance Research Letters* 38 (2021) 101870.
- [30] O. Haroon, S.A.R. Rizvi, COVID-19: media coverage and financial markets behavior—a sectoral inquiry, *Journal of Behavioral and Experimental Finance* 27 (2020) 100343.
- [31] Y. Chernogorova, Z. Bliznakov, K. Bliznakova, Management challenges in implementing scientific projects during COVID-19 pandemic, *Polish Journal of Management Studies* 23 (1) (2021) 136–150.
- [32] R. Albuquerque, Y. Koskinen, S. Yang, C. Zhang, Resiliency of environmental and social stocks: an analysis of the exogenous COVID-19 market crash, *The Review of Corporate Finance Studies* 9 (3) (2020) 593–621.
- [33] S.F.A. Khatib, The role of share repurchases for firms' social and environmental sustainability, *Social and Environmental Accountability Journal* (2023) 1–3, <https://doi.org/10.1080/0969160X.2023.2281904>. In Press.
- [34] L.A. Gil-Alana, M. Monge, Crude oil prices and COVID-19: persistence of the shock, *Energy Research Letters* 1 (1) (2020) 13200, <https://doi.org/10.46557/001c.13200>.
- [35] P.K. Narayan, Oil price news and COVID-19 - is there any connection? *Energy Research Letters* 1 (1) (2020) 13176.
- [36] D. Zhang, W. Zheng, Does COVID-19 make the firms' performance worse? Evidence from the Chinese listed companies, *Econ. Anal. Policy* 74 (2022) 560–570.
- [37] H. Tucker, Coronavirus Bankruptcy Tracker. These Major Companies Are Failing amid the Shutdown, *Forbes*, 2020.
- [38] M. Zeng, P. Zhang, S. Yu, G. Zhang, Decision-making model of generation technology under uncertainty based on real option theory, *Energy Conversion and Management* 110 (2016) 59–66, <https://doi.org/10.1016/j.enconman.2015.12.005>.
- [39] S.F.A. Khatib, D.F. Abdullah, E. Hendrawaty, et al., A bibliometric analysis of cash holdings literature: current status, development, and agenda for future research, *Management Review Quarterly* 72 (2021) 707–744, <https://doi.org/10.1007/s11301-021-00213-0>.
- [40] S.L. Hagerty, L.M. Williams, The impact of COVID-19 on mental health: the interactive roles of brain biotypes and human connection, *Brain, Behavior, & Immunity-Health* 5 (2020) 100078, <https://doi.org/10.1016/j.bbih.2020.100078>.
- [41] Dung Le, Noel Scott, Susanne Becken, M. Rod, Connolly, Tourists' aesthetic assessment of environmental changes, linking conservation planning to sustainable tourism development, *Journal of Sustainable Tourism* 27 (10) (2019) 1477–1494.
- [42] S. Cheval, C. Mihai Adamescu, T. Georgiadis, M. Herrnegger, A. Piticar, D.R. Legates, Observed and potential impacts of the COVID-19 pandemic on the environment, *International journal of environmental research and public health* 17 (11) (2020) 4140.
- [43] T. Rume, S.D.U. Islam, Environmental effects of COVID-19 pandemic and potential strategies of sustainability, *Heliyon* 6 (9) (2020).
- [44] D. Armitage, R. de Loë, R. Plummer, Environmental governance and its implications for conservation practice, *Conservation Letters* 5 (2012) 245–255.
- [45] O.R. Young, *Global Governance: Drawing Insights from the Environmental Experience*, MIT Press, Cambridge, MA, 1997.
- [46] M. Lockwood, J. Davidson, A. Curtis, E. Stratford, R. Griffith, Governance principles for natural resource management, *Society and Natural Resources* 23 (2010) 986–1001.
- [47] C.A. Wyborn, Connecting knowledge with action through coproductive capacities: adaptive governance and connectivity conservation, *Ecology and Society* 20 (1) (2015) 11, <https://doi.org/10.5751/ES-06510-200111>.
- [48] L. Secco, R. Da Re, D.M. Pettenella, P. Gatto, Why and how to measure forest governance at local level: a set of indicators, *Forest Policy and Economics*, Assessing Forest governance – analytical concepts and their application 49 (2014) 57–71.
- [49] S. Abhayawansa, E. Eljido-Ten, J. Dumay, A practice theoretical analysis of the irrelevance of integrated reporting to mainstream sell-side analysts, *Accounting and Finance* 59 (3) (2019) 1615–1647, <https://doi.org/10.1111/acfi.12367>.
- [50] R. Mori Junior, P.J. Best, J. Cotter, Sustainability reporting and assurance: a historical analysis on a world-wide phenomenon, *Journal of Business Ethics* 120 (1) (2014) 1–11.
- [51] C. Searcy, R. Buslovich, Corporate perspectives on the development and use of sustainability reports, *Journal of Business Ethics* 121 (2) (2014) 149–169.
- [52] W. Bartels, T. Fogelberg, A. Hoballah, C.T. van der Lugt, Carrots & Sticks: Global Trends in Sustainability Reporting Regulation and Policy, KPMG; Global Reporting Initiative (GRI); United Nations Environment Programme; Centre for Corporate Governance in South Africa, 2016.
- [53] J. Dumay, M. La Torre, F. Farneti, Developing trust through stewardship: implications for intellectual capital, integrated reporting, and the EU Directive 2014/95/EU, *Journal of Intellectual Capital* 20 (1) (2019) 11–39, <https://doi.org/10.1108/JIC-06-2018-0097>.
- [54] G. Borini-Feyerabend, R. Hill, Governance for the conservation of nature, in: G.L. Worboys, M. Lockwood, A. Kothari, S. Feary, I. Pulsford (Eds.), *Protected Area Governance and Management*, ANU Press, Canberra, Australia, 2015, pp. 169–206.
- [55] N. Zafra-Calvo, U. Pascual, D. Brockington, B. Coolsaet, J.A. Cortes-Vazquez, N. Gross-Camp, N.D. Burgess, Towards an indicator system to assess equitable management in protected areas, *Biological Conservation* 211 (2017) 134–141.
- [56] N.J. Bennett, L. Teh, Y. Ota, P. Christie, A. Ayers, J.C. Day, T. Satterfield, An appeal for a code of conduct for marine conservation, *Marine Policy* 81 (2017) 411–418.
- [57] D. Armitage, R. Plummer, Adapting and transforming: governance for navigating change, in: D. Armitage, R. Plummer (Eds.), *Adaptive Capacity and Environmental Governance*, Springer Series on Environmental Management, Berlin, Heidelberg, 2011, pp. 287–302. Springer.
- [58] C.A. Maida, S. Beck, Towards communities of practice in global sustainability, *Anthropology in Action* 23 (2016) 1–5.
- [59] B.C. Chaffin, A.S. Garmestani, L.H. Gunderson, M.H. Benson, D.G. Angeler, C. A. (Tony) Arnold, C.R. Allen, Transformative environmental governance, *Annual Review of Environment and Resources* 41 (2016) 399–423.
- [60] G. Epstein, J. Pittman, S.M. Alexander, S. Berdej, T. Dyck, U. Kreitmaier, D. Armitage, Institutional fit and the sustainability of social-ecological systems, *Current Opinion in Environmental Sustainability* 14 (2015) 34–40.
- [61] K. Carlisle, R.L. Gruby, Polycentric systems of governance: a theoretical model for the commons, *Policy Study Journal* 47 (4) (2017) 927–952. <http://onlinelibrary.wiley.com/doi/10.1111/psj.12212/abstract>.
- [62] T.H. Morrison, Evolving polycentric governance of the great barrier reef, *Proceedings of the National Academy of Sciences* 114 (2017) E3013–E3021.
- [63] G.F. Peters, A.M. Romi, Does the voluntary adoption of corporate governance mechanisms improve environmental risk disclosures? Evidence from greenhouse gas emission accounting, *Journal of Business Ethics* 125 (4) (2014) 637–666, <https://doi.org/10.1007/s10551-013-1886-9>.
- [64] B. Jaggi, A. Allini, R. Macchioni, A. Zampella, Do investors find carbon information useful? Evidence from Italian firms, *Review of Quantitative Finance and Accounting* (2017), <https://doi.org/10.1007/s11156-017-0653-x>.
- [65] G. Michelon, S. Pilonato, F. Ricceri, CSR reporting practices and the quality of disclosure: an empirical analysis, *Critical Perspectives on Accounting* 33 (2015) 59–78, <https://doi.org/10.1016/j.cpa.2014.10.003>.
- [66] A. Helfaya, T. Moussa, Do board's corporate social responsibility strategy and orientation influence environmental sustainability disclosure? UK evidence, *Business Strategy and the Environment* 26 (8) (2017) 1061–1077, <https://doi.org/10.1002/bse.1960>.
- [67] G.F. Peters, A.M. Romi, The association between sustainability governance characteristics and the assurance of corporate sustainability reports, *Auditing: A Journal of Practice and Theory* 34 (1) (2015) 163–198, <https://doi.org/10.2308/ajpt-50849>.
- [68] S.F. Khatib, I.H. Ismail, N. Salameh, A.F. Abbas, A.H. Bazhair, H.G.H. Sulimany, Carbon emission and firm performance: the moderating role of management environmental training, *Sustainability* 15 (13) (2023) 10485.

- [69] H. Al-Shaer, M. Zaman, Credibility of sustainability reports: the contribution of audit committees, *Business Strategy and the Environment* 27 (7) (2018) 973–986, <https://doi.org/10.1002/bse.2046>.
- [70] S.S. Cowen, L.B. Ferreri, L.D. Parker, The impact of corporate characteristics on social responsibility disclosure: a typology and frequency-based analysis, *Accounting, Organizations and Society* 12 (2) (1987) 111–122, [https://doi.org/10.1016/0361-3682\(87\)90001-8](https://doi.org/10.1016/0361-3682(87)90001-8).
- [71] M. Rodrigue, M. Mangan, C. Cho, Is environmental governance substantive or symbolic? An empirical investigation, *Journal of Business Ethics* 114 (1) (2013) 107–129, <https://doi.org/10.1007/s10551-012-1331-5>.
- [72] J. Cohen, R. Simnett, CSR and assurance services: a research agenda, *AUDITING: A Journal of Practice & Theory* 34 (1) (2015) 59–74, <https://doi.org/10.2308/ajpt-50876>.
- [73] R. Birkey, G. Michelon, D. Patten, C. Deegan, Does assurance on CSR reporting enhance environmental reputation? An examination in the U.S. Context, *Accounting Forum* 40 (3) (2016) 143–152, <https://doi.org/10.1016/j.accfor.2016.07.001>.
- [74] D. Talbot, O. Boiral, GHG reporting and impression management: an assessment of sustainability reports from the energy sector, *Journal of Business Ethics* (2016), <https://doi.org/10.1007/s10551-015-2979-4>.
- [75] G. Michelon, D. Patten, A. Romi, Creating Legitimacy for Sustainability Assurance Practices: Evidence from Sustainability Restatements, *European Accounting Review*, 2018, <https://doi.org/10.1080/09638180.2018.14694240>.
- [76] P. Vardarlier, Strategic approach to human resources management during crisis, *Procedia - Social and Behavioral Sciences* 235 (2016) 463–472.
- [77] J. Wolbers, K. Boersma, P. Groenewegen, Introducing a fragmentation perspective on coordination in crisis management, *Organization Studies* 39 (11) (2018) 1521–1546.
- [78] J. Butler, J. Sullivan, Crisis response tactics: U.S. SMEs' responses to the Asian financial crisis, *Journal of Business and Entrepreneurship* 17 (2) (2005) 56–69.
- [79] T. Christensen, P. Laegreid, L.H. Rykkja, Organizing for crisis management: building governance capacity and legitimacy, *Public Administration Review* 76 (6) (2016) 887–897.
- [80] N. Nasrallah, R. El Khoury, Proxy measure for SMEs financial performance in opaque markets, *International Conference on Business and Technology* (2020) 1457–1473.
- [81] L. Györföröva, M. Stachon, D. Stasek, ESG ratings: relevant information or misleading clue? Evidence from the S&P Global 1200, *Journal of Sustainable Finance & Investment* (2021) 1–35, <https://doi.org/10.1080/20430795.2021.1922062>.
- [82] A. Cheema-Fox, B.R. LaPerla, H.S. Wang, G. Serafeim, Corporate resilience and response to COVID-19, *J. Appl. Corp. Finance* 33 (2) (2021) 24–40.
- [83] R.W. Kates, W.R. Travis, T.J. Wilbanks, Transformational adaptation when incremental adaptations to climate change are insufficient, *Proceedings of the National Academy of Sciences* 117 (12) (2020) 6493–6501.
- [84] G. Ritzer (Ed.), *Encyclopedia of Social Theory*, Sage Publications, London, 2004.
- [85] F. Mansouri, F. Sefidgarbaei, Risk society and COVID-19, *Canadian Journal of Public Health* 112 (1) (2021) 36–37.
- [86] L. Yang, X. Hu, J. Lou, Organizational interaction and dilemma governance strategies in response to the COVID-19 epidemic, in: *Proceedings of the 25th International Symposium on Advancement of Construction Management and Real Estate*, Springer Singapore, 2021, pp. 85–105.
- [87] Y. Chen, W. Shen, The impacts and implications of the COVID-19 pandemic on the global response to climate change, *Chinese Journal of Urban and Environmental Studies* 9 (2) (2021) 2150007.
- [88] K. Albitar, H. Borge, M. Khan, A. Zahra, Business environmental innovation and CO2 emissions: the moderating role of environmental governance, *Business Strategy and the Environment* (2022) 1–12, <https://doi.org/10.1002/bse.3232>.
- [89] H. Al Amosh, S.F.A. Khatib, H. Ananzeh, Environmental, social and governance impact on financial performance: evidence from the Levant countries, *Corporate Governance: The International Journal of Business in Society* (2022), <https://doi.org/10.1108/CG-03-2022-0105>.
- [90] H. Liu, J. Jiang, R. Xue, X. Meng, S. Hu, Corporate environmental governance scheme and investment efficiency over the course of COVID-19, *Finance Research Letters* 47 (2022) 102726.
- [91] W. Fan, L. Yan, B. Chen, W. Ding, P. Wang, Environmental governance effects of local environmental protection expenditure in China, *Resources Policy* 77 (2022) 102760.
- [92] W. Espejo, J.E. Celis, G. Chiang, P. Bahamonde, Environment and COVID-19: pollutants, impacts, dissemination, management and recommendations for facing future epidemic threats, *Science of the Total Environment* 747 (2020) 141314.
- [93] A.K. Singh, J. Issac, K.G.S. Narayanan, Measurement of environmental sustainability index and its association with socio-economic indicators in selected Asian economies: an empirical investigation, *International Journal of Environment and Sustainable Development* 18 (1) (2019) 57–100.
- [94] M. Schaper, Small firms and environmental management: predictors of green purchasing in Western Australian pharmacies, *International Small Business Journal* 20 (3) (2002) 235–251.
- [95] S. Wang, W. Zhang, H. Wang, J. Wang, M.J. Jiang, How does income inequality influence environmental regulation in the context of corruption? A panel threshold analysis based on Chinese provincial data, *International Journal of Environmental Research and Public Health* 18 (15) (2021) 8050.
- [96] Z. Lv, Z. Gao, The effect of corruption on environmental performance: does spatial dependence play a role? *Economic Systems* 45 (2) (2021) 100773.
- [97] K.Q. Zhang, H.H. Chen, Environmental performance and financing decisions impact on sustainable financial development of Chinese environmental protection enterprises, *Sustainability* 9 (12) (2017) 2260.
- [98] B.A. Mohamed, I.R. Fattah, B. Yousaf, S. Periyasamy, Effects of the COVID-19 pandemic on the environment, waste management, and energy sectors: a deeper look into the long-term impacts, *Environmental Science and Pollution Research* 29 (31) (2022) 46438–46457.
- [99] T. Ibn-Mohammed, K.B. Mustapha, J. Godsell, Z. Adamu, K.A. Babatunde, D.D. Akintade, S.C.L. Koh, A critical analysis of the impacts of COVID-19 on the global economy and ecosystems and opportunities for circular economy strategies, *Resources, Conservation and Recycling* 164 (2021) 105169.
- [100] S.J. Zhang, J. Guo, Political economy of global environmental governance institutions: future collaborations between China and USA, *Journal of Economic Science Research* 5 (1) (2022) 4365.