Article

Environmental regulation and corporate environmental performance: A bibliometric analysis

Yu Zhang[1,2,*], Tze San Ong[1,3], Fakarudin Kamarudin[1]

[1] School of Business and Economics, Universiti Putra Malaysia, Serdang 43400, Malaysia

[2] Department of Accounting, School of Accounting, Nanfang College, Guangzhou 510970, China

[3] University of Religions and Denominations, Qom 37185-178, Iran

* Corresponding author: Yu Zhang, zhangyu831@foxmail.com

Abstract: Under the concept of green development, enterprises will face more environmental constraints. Whether government environmental regulation (ER) can effectively promote corporate environmental performance (CEP) has not yet been unified among scholars, and few studies have conducted bibliometric analysis on ER and CEP. Based on the above, this study has three purposes: first, to fill the research gap by analyzing and visualizing 72 articles on ER and CEP through Biblioshiny and VOSviewer; second, to help scholars easily understand the research development and quickly find promising research directions; and lastly, to enable the government and corporate managers gain a more comprehensive view of ER's impacts on CEP, which can assist in policy making and business management. The research found that: (a) the number of articles and citations in the field is on the rise. China is the most academically influential country in terms of publications, citations, and collaborations. Journal of Cleaner Production is the top-ranked journal. Ramanathan R, Testa F, and Zhang Y are the top three authors. Environmental management, sustainability, and China are the most popular keywords. Collaboration between authors, institutions, and countries is relatively weak and isolated. (b) ER and CEP have three emerging clusters: Climate Change, FDI, as well as Environmental Awareness, and three core clusters: Environmental Management, Data Envelopment Analysis, and Economic Analysis. The evolution of themes shows a trend from decentralized to centralized and then back to decentralized. (c) Future research can take the Regulatory Framework, Green Technological Innovation, and Environmental Management System as breaking points.

Keywords: environmental regulation; corporate environmental performance; bibliometric analysis; Biblioshiny; VOSviewer

1. Introduction

The trending subjects of business today differ greatly from the past. Previously there was too much focus on profits with much business literature focusing on the drivers of economic performance, which can lead to a neglect of the environment (Ngo, 2021). Research studies have shown that more than three thousand international corporations cause over two trillion dollars in negative social and environmental impacts each year (Dai et al., 2021; Sutherland et al., 2016). The problem of environmental pollution has attracted increasingly widespread attention, and problems such as air pollution, wastewater discharges, and climate warming need to be urgently solved (An et al., 2022). Therefore, realizing a double-win situation between environmental protection and economic development is a hot issue in the modern scientific community, and also a conflict that countries around the world are desperate

to resolve (Peng et al., 2020; Y. Zhang et al., 2022). Enterprises in modern society should concentrate not only on economic achievement but also on environmental performance.

Some scholars believe that social culture, government regulation, and technological progress contribute significantly to the implementation of green management by enterprises, and government environmental regulation (ER), in particular, is considered a key driver (Esfahbodi et al., 2017; Xu et al., 2013). ER refers to the continuous and centralized supervision by the government of behaviors of economic entities, mostly enterprises, through the establishment of laws and regulations, in order to constrain enterprises from damaging the natural environment in their operations (Dong et al., 2011; Tan, 2016). Regarding the relationship between ER and corporate environmental performance (CEP), there are mainly three views expressed by scholars. First, ER has a positive impact on CEP (Dong et al., 2014; Y. Zhang et al., 2022; Zhuo, 2023), represented by the "Porter hypothesis". This hypothesis argues that ER will stimulate companies to innovate, and the economic benefits of such innovation will not only generate an "innovation compensation effect" to offset the increased costs of environmental pollution control but also generate a "first mover advantage" effect, which will lead firms to adjust their strategic layout and solve the pollution problem at source (Porter, 1991). According to this theory, ER can significantly motivate firms to improve their environmental performance, but there is some controversy in the academic community (Saeed et al., 2018). The second argument is that ER negatively affects CEP (Niesten et al., 2017). The traditional view of the "compliance cost effect" proposes that ER generates a green paradox (Liu et al., 2020), which can be understood as the funds used for technological innovation are taken up by the cost of environmental management. This makes it impossible for enterprises to profit from technological research and development, which leads to long-term interests being jeopardized and is not conducive to improving productivity (Albrizio et al., 2017; Jaffe et al., 1995). Hence, ER reduces productivity (J. Zhang, 2016) which in turn weakens CEP. Finally, there is a third academic viewpoint of uncertainty. R. Li and Ramanathan (2018) concluded that the relationship between control-based as well as market-based ERs and CEP is non-linear and positive, while the relationship between informal ER and CEP is not significant.

There are very few literature review articles on the topic of ER and CEP. First, Aragón-Correa et al. (2020) provided an in-depth analytical review of literature on the relationship between different regulatory pressures and corporate environmental strategy and performance, which is the most relevant qualitative review article on ER and CEP. However, it was published in 2020, and the review covers publications up to 2019, nearly four years ago. Therefore, it remains to be seen what the latest scientific progress within the field has been. Second, Dechezleprêtre et al. (2019) qualitatively reviewed all the literature including both economic and environmental performance, and from a small number of articles dealing with ER, sorted out that ER tends to improve environmental performance without weakening economic performance. However, because the number of articles is limited, this result cannot be easily generalized (Dechezleprêtre et al., 2019). Finally, apart from all the qualitative reviews mentioned above, the abstracts or keywords of some bibliometric analysis articles may address ER or CEP but tend to focus on other elements as well, all of which are of low

relevance. For example, the literature review on green innovation, environmental and financial performance includes ER as a keyword (Borsatto and Bazani, 2023). Another example is the bibliometric analysis written by M. Li et al. (2022) on ER and green technology innovation (GTI) via CiteSpace software, where the abstract refers to performance as one of its three main research areas. These bibliometric articles do not relate well to ER and CEP and usually employ different analysis and visualization tools than this paper. In summary, qualitative review articles are the most relevant to this topic but with a research scope of only up to 2019; while quantitative bibliometric articles are relatively numerous and published in recent years, they have a lower relevance. Therefore, the quantitative bibliometric analysis and qualitative review of core articles on the latest research of ER and CEP in this paper will fill the gap. In addition, this paper is of great significance in enabling business managers, governments, and scholars to be well informed of the relationship between ER and CEP, which will facilitate business management, policy making and quick access to research.

The main objective of this study is to sort out and summarize the literature in ER and CEP through bibliometrics, systematically analyze the core elements, research trends, and knowledge structure of selected literature in this field, and present the findings to scholars in the form of visualization diagrams. To be specific, this paper primarily addresses the following six research questions (RQs):

RQ1: What is the current status of publication on ER and CEP?

RQ2: What are the top journals, publications, key words, authors, and most relevant institutions about ER and CEP?

RQ3: What is the degree of research collaboration concerning ER and CEP?

RQ4: What are the "hot spots" in ER and CEP and how about their evolution over time?

RQ5: What is the intellectual structure between ER and CEP?

RQ6: What are the future potential directions and avenues in ER and CEP research?

The rest of the paper is arranged as follows. Section 2 describes the research methodology. Section 3 conducts the bibliometric analysis and derives results, Section 4 summarizes and discusses the bibliometric findings, and Section 5 gives conclusions.

2. Methodology

2.1. Bibliometric analysis procedure

In this study, a comprehensive and detailed bibliometric workflow on publications in the field of ER and CEP was carried out according to the five steps recommended by H. Li et al. (2023) and Lei et al. (2022), as shown in **Figure 1**.
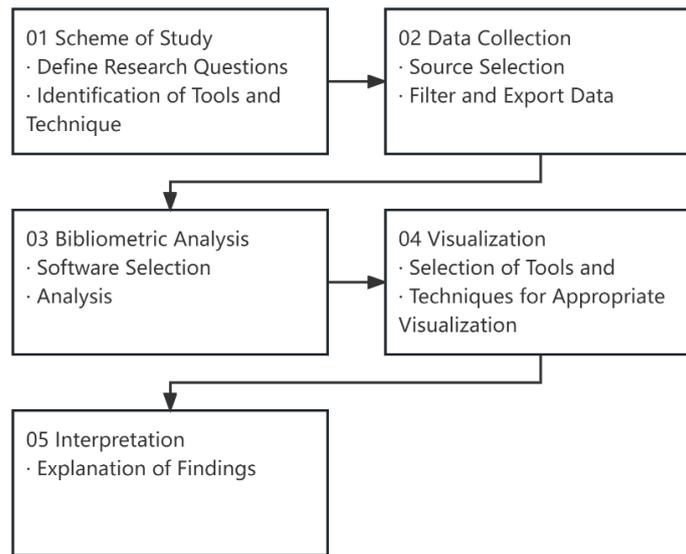
```
┌─────────────────────────────┐      ┌─────────────────────────────┐
│ 01 Scheme of Study          │      │ 02 Data Collection          │
│ · Define Research Questions │─────▶│ · Source Selection          │
│ · Identification of Tools   │      │ · Filter and Export Data    │
│   and Technique             │      │                             │
└─────────────────────────────┘      └─────────────────────────────┘

┌─────────────────────────────┐      ┌─────────────────────────────┐
│ 03 Bibliometric Analysis    │      │ 04 Visualization            │
│ · Software Selection        │─────▶│ · Selection of Tools and    │
│ · Analysis                  │      │ · Techniques for Appropriate│
│                             │      │   Visualization             │
└─────────────────────────────┘      └─────────────────────────────┘

┌─────────────────────────────┐
│ 05 Interpretation           │
│ · Explanation of Findings   │
│                             │
│                             │
└─────────────────────────────┘
```

Figure 1. Five main steps in the bibliometric analysis process.

2.2. Scheme of study

The main research objective of this study is to conduct a bibliometric review of the literature in ER and CEP. By using software such as Biblioshiny, VOSviewer, and Microsoft Excel, this paper attempts to answer and contribute to the six questions posed in the introduction section. The first objective is to clarify the current state of literature in ER and CEP through descriptive, quantitative, and three-field analysis. The second objective of the study is to contribute to the identification of core journals, articles, authors, keywords, and other aspects of the field using Biblioshiny and Microsoft Excel. Specifically, for influential sources and core authors we use H-Index, total citations (TC), and annual net publications (NP) to identify them (Arslan et al., 2022). In addition, Bradford's law is used to tri-categorize major journals. Zone 1 is the most active one, and Zone 2 is the intermediately active region, while Region 3 has virtually zero output compared to Zones 1 and 2 (Bashir, 2022). In the keyword analysis, author keywords and keywords plus were utilized for the analysis respectively. Third, collaboration network diagrams by Biblioshiny are used to visualize research collaborations among authors, institutions, and countries. Then, Biblioshiny is used to map themes and themes' evolution to identify hot topics and their evolutionary processes (Bashir et al., 2021). The fifth objective explores the intellectual structure of ER and CEP in the past and present through co-citation analysis based on cited references and bibliographic coupling analysis on citing literature in VOSviewer (Phan Tan, 2022). Finally, based on the analyses and findings of the first five objectives, potential future research agendas are explored in conjunction with the keyword co-occurrence analysis in VOSviewer (Donthu et al., 2021).

There are several bibliometric tools, and the Biblioshiny and VOSViewer software were adopted for the following reasons. Firstly, Biblioshiny has the advantage of enabling non-coders to process bibliographic data with the R-package (Ullah et al., 2022), which is suitable for basic statistics analysis (Aria and Cuccurullo, 2017; Gu et al., 2021). Secondly, VOSViewer allows the construction of network maps

in a highly user-friendly and easy-to-analyze way (Van Eck and Waltman, 2010), visualizing the relationships among selected items vividly and thus making them easier to comprehend and interpret (Gu et al., 2021). In addition, VOSviewer has useful features such as overlay visualization and density visualization, making it an excellent choice for visual mapping (Bosi et al., 2022). Therefore, in this paper, except for using VOSviewer for co-citation analysis, bibliographic coupling analysis, keyword co-occurrence analysis, and plotting the corresponding maps, the rest of the analyses are achieved by Biblioshiny.

2.3. Data collection

The data collection part of the bibliometric analysis was divided into two parts. The first is the selection of databases from which the literature is obtained. This paper uses the Scopus database to select relevant literature due to the following reasons. First, the Scopus database has been well accepted by a large number of scholars due to its broader, more inclusive, and comprehensive range of available publications (Caviggioli and Ughetto, 2019; Pham-Duc et al., 2023; Pranckutė, 2021). It is the largest "peer-reviewed" database worldwide (Karagiannopoulou et al., 2023), offering more citation records and more flexible and convenient data processing services (Aznar-Sánchez et al., 2019; Lima and Bonetti, 2020). Second, it also labels each publication included in its collection with author biographies and institutional affiliations, enabling a more user-friendly literature analysis process (Mongeon and Paul-Hus, 2016). Finally, it also has two major advantages over the Web of Science (WOS) database. On the one hand, Scopus makes it easier to extract data, whereas exporting more than 500 publications using WOS entails manual work (Gao et al., 2021); on the other hand, Scopus databases cover a wider range of publications in the business and management areas (Aksnes and Sivertsen, 2019; Farrukh et al., 2022).

The second part is screening the exported data. The final search query is "TITLE-ABS-KEY ("environment* regulation*" AND ("environment* performance" OR "green performance")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (SUBAREA, "busi")) AND (LIMIT-TO (LANGUAGE, "english"))". For efficiency, we limited the search to English-language publications. Though conference papers, books, and book chapters can all provide valued perspectives to some extent, only journal articles were selected for this paper. This is because firstly, journal articles must undergo a rigorous peer review process and thus have a higher level of quality assurance (Harsanto and Firmansyah, 2023); secondly, journals usually have well-established citations, which are more scholarly influential (Setiawan et al., 2023); and thirdly, journal articles are usually in a standardized format (Green and Cookson, 2012) and can provide comprehensive bibliographic data (Oliveira et al., 2019). The query was run on 23 August 2023 in the Scopus database. Initially, a total of 213 publications related to ER and CEP were retrieved. We then manually analyzed 213 documents according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, which are a set of proposals aimed at improving the clarity, completeness, reproducibility, and quality of systematic review and meta-analysis studies (Page et al., 2021). 141 out of 213 publications were excluded, which are 2 duplicate articles, 32 articles in unrelated fields such as environmental science and

ecology, industrial and systems engineering, and architectural engineering, and 107 articles in related fields but with less relevance (ER and CEP are mentioned only in the background or suggestion parts of the abstracts). Our final sample consisted of 72 articles from 34 journals that examined the relationship between ER and CEP from 2002 to 2023.

3. Data analysis and results

As stated earlier, the major analytical tools utilized to conduct big data analysis of 72 journal articles and draw conclusions were Biblioshiny software and VOSviewer software. Additionally, the Biblioshiny based on the R package and the JAVA-based VOSviewer differ from other bibliometric analysis tools in bibliometric features. **Table 1** shows the descriptive data using Biblioshiny for articles on ER and CEP, with a focus on research cooperation rather than single-author publications.

Table 1. Descriptive statistics by Biblioshiny.

Description	Results
Main Information About Data	
Timespan	2002:2023
Sources (Journals, Books, etc)	34
Documents	72
Annual Growth Rate %	8.91
Document Average Age	5.62
Average citations per doc	54.22
References	4638
Document Contents	
Keywords Plus (ID)	419
Author's Keywords (DE)	258
Authors	
Authors	201
Authors of single-authored docs	7
Authors Collaboration	
Single-authored docs	7
Co-Authors per doc	3.14
International co-authorships %	34.72
Document Types	
article	72

3.1. Volume analysis of publications, countries, and journals

In this part, a simple quantitative analysis of publications, countries, and journals related to the ER and CEP fields will be carried out using Biblioshiny, in addition, MS Excel was used for visualization in **Figure 2**.

As shown in **Figure 2**, we first investigate the trend of annual publications and citations about the topic of ER and CEP since 2002. The trend of articles and citations per year remained roughly consistent, both showing waves based on an overall upward

trend, with four peaks occurring successively and respectively. In terms of annual publications, 2004, 2013, 2018, and 2022 were more productive, with peaks emerging, while 2007, 2016, and 2020 hit rock bottom. The same applies to annual citations, with summits in 2004, 2011, 2018, and 2021, and troughs in 2007, 2015, and 2020. This suggests that scholars' attention to this field has shown an increasing and periodic trend and the topics are more innovative.
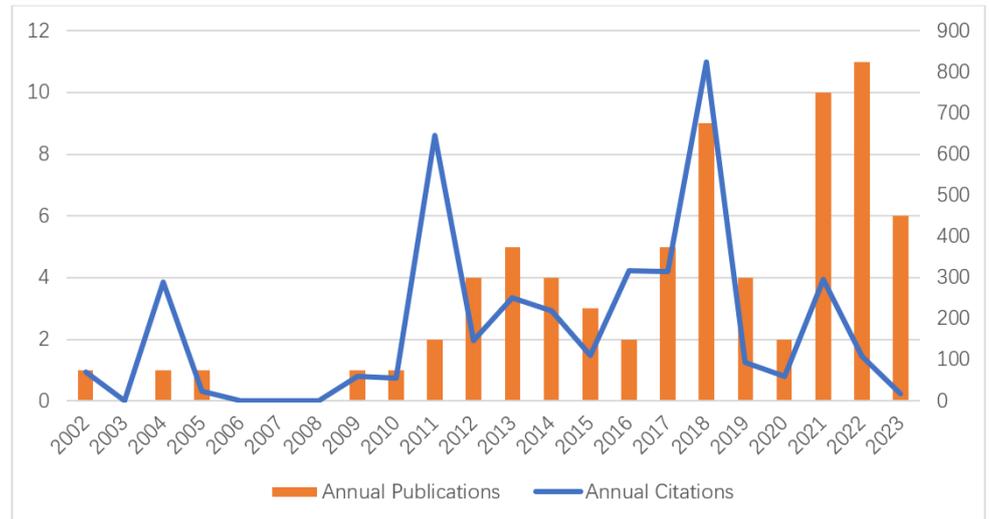

Figure 2. Annual publications and citations trend.

Next, the statistical analysis is further broken down into individual countries and ranked according to total publications, total citations, and SJR, as shown in **Table 2**. SCImago Journal & Country Rank (SJR) is a public website portal based on the Scopus database that provides free bibliometric information on different countries and a large number of specialized journals (Harsanto and Firmansyah, 2023). Its Country Rankings form a comprehensive assessment of the overall impact and relevance of scientific research in different countries. In **Table 2**, China, the United Kingdom, the United States, Italy, Canada, Spain, and Australia are included in both the publication and citation rankings. France, Ghana, and the Netherlands, on the other hand, feature only in the publication rankings, while Austria, Belgium, and Korea occur only in the citation rankings. Further, it can be found that the top ten countries in terms of publications and citations are also relatively close to each other in terms of SJR and do not fluctuate much within the top ten. The number of publications of Ghana is ranked 9th in ER and CEP, well ahead of its SJR ranking, which is its area of specialization. Austria and Belgium rank in the top ten in terms of citations in ER and CEP, but their SJR rankings are outside the twentieth place, suggesting that they have a large influence advantage in ER and CEP.

Table 2. Countries with the most publications and citations.

Countries/Regions	Publications	SJR (documents)	Countries/Regions	Citations	SJR (citations)
China	94	3	China	1336	5
UK	24	2	Canada	597	4
USA	24	1	UK	433	2

Table 2. (*Continued*).

Countries/Regions	Publications	SJR (documents)	Countries/Regions	Citations	SJR (citations)
Italy	15	9	USA	366	1
France	12	8	Spain	130	8
Canada	8	7	Austria	81	28
Spain	6	10	Australia	80	3
Australia	5	6	Belgium	70	21
Ghana	5	60	Italy	61	11
Netherlands	5	11	Korea	58	15

Note(s): SJR Rank (documents) means the ranking of each country based on the number of documents published according to SCImago. SJR Rank (citations) means the ranking of individual countries by the number of citations of published publications according to SCImago.

Figure 3 presents a deeper insight into the relationship among keyword plus, academic journals, and countries with the largest production concerning the topic of ER and CEP. It can be found that past research in this area has mainly focused on aspects such as environmental management, environmental regulations, environmental performance, sustainable development, and environmental economics, and has been largely published in the Journal of Cleaner Production, with the largest outputs of literature coming from China, UK, Italy, and USA in line with the previous analysis.
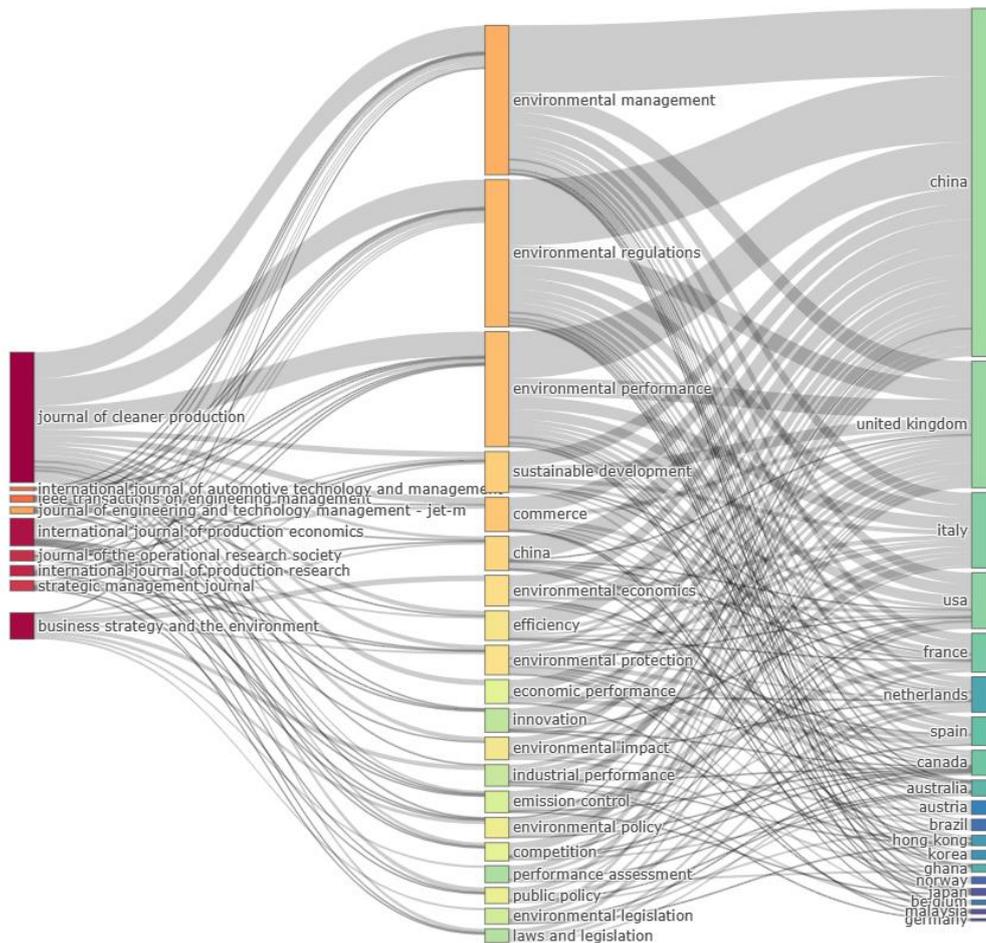

Figure 3. Three field analyses of ER and CEP.

3.2. Core aspects of ER and CEP literature

Next, in this part, the influential aspects of the selected 72 pieces of literature article will be analyzed separately, such as the influential research journals, core publications, trending keywords, top authors, and most relevant affiliations. All relevant analyses in this part are performed using Biblioshiny software and MS Excel

3.2.1. Influential journals and publications

Source impact and Bradford's law were applied in this section to assess the influence of academic journals on ER and CEP literature. According to the indexes, total publications, and citations, **Table 3** lists the top 10 influential journals in this field, while **Table 4** presents a different journal ranking of Zone 1 and Zone 2 based on Bradford's law, indicating higher research impact classified into Zone 1.

Table 3. Top 10 journals according to source impact.

Academic Journals	Scope	H-Index	G-Index	M-Index	TC	NP	PY_Start
Journal of Cleaner Production	Cleaner Production, Environmental, Sustainability	17	24	1.308	1350	24	2011
Business Strategy and the Environment	Environmental Management, Sustainable Development in Business	5	7	0.227	122	7	2002
International Journal of Production Economics	Interface Between Engineering and Management, Production & Operations Management, Production in General	4	5	0.364	438	5	2013
International Journal of Production Research	Decision Aid in Manufacturing, Operations Management & Logistics	2	2	0.333	65	2	2018
Strategic Management Journal	Strategic Management	2	2	0.182	290	2	2013
Accounting Review	Accounting Research & Related Research Methodology	1	1	0.05	290	1	2004
Business Ethics	Ethical Issues Related to Business	1	1	0.1	43	1	2014
China Journal of Accounting Studies	Management Accounting, Public Sector Accounting, Auditing, Corporate Governance, Financial Accounting, Financial Management	1	1	0.2	22	1	2019
Corporate Social Responsibility and Environmental Management	Social & Environmental Responsibilities, Sustainable Development, Cross-Country Surveys, Accountability	1	2	1	8	3	2023
Decision Sciences	Operations, Supply Chain and Information Systems	1	1	0.167	42	1	2018

Note(s): H-Index (h) = number of publications (h) with h citations or more, G-Index = number of papers that have accumulated g^2 number of citations, M-Index = H-Index per active year, TC = total citations, NP = number of publications, PY_Start = start of the publication year.

Table 4. Journal rankings.

Academic Journals	Rank	Freq	cumFreq	Zone
Journal of Cleaner Production	1	24	24	Zone 1
Business Strategy and the Environment	2	7	31	Zone 2
International Journal of Production Economics	3	5	36	Zone 2
Corporate Social Responsibility and Environmental Management	4	3	39	Zone 2
International Journal of Production Research	5	2	41	Zone 2
Journal of the Operational Research Society	6	2	43	Zone 2
Strategic Management Journal	7	2	45	Zone 2
Accounting Review	8	1	46	Zone 2
Business Ethics	9	1	47	Zone 2
China Journal of Accounting Studies	10	1	48	Zone 2

Journal of Cleaner Production is the most influential journal in the field, focusing on the impact of different ERs on CEP, the moderating effect of ER on relationships relating to CEP, the influence of ER on sustainable development, etc. The key articles in the journal with high citations (see **Table 5**) on ER and CEP are presented as follows. First, "Is environmental regulation effective in China? Evidence from city-level panel data" empirically analyzed 283 Chinese cities' panel data and four environmental quality indicators from 2003 to 2010 using a first-order difference GMM model (Hao et al., 2018). It was found that current ER does not meet the objective of reducing pollution. Furthermore, ER is effective only when foreign direct (FDI) investment is controlled. Second, drawing on panel data of Chinese listed companies from 2011 to 2017, Cao et al. (2021) revealed that digital finance greatly benefits China's energy-environmental performance. In addition, the positive impact of digital finance on energy-environmental performance is strengthened under conditions such as financial and environmental regulation by the Chinese government, and in regions with immature credit and capital markets. Third, R. Li and Ramanathan (2018) categorized ER into three types: command-and-control regulations, market-based regulations, and informal ones, in order to investigate the linear relationship between different ER and CEP, as well as the potential nonlinear relationship. It is found that there is a nonlinear positive relationship between command-and-control and market-based regulations, and CEP, whereas neither linear nor non-linear relationships were statistically significant in the case of informal regulations (R. Li and Ramanathan, 2018). Last, by examining Chinese companies in the pulp and paper industry in Shandong Province for the period 2001–2008, Y. Wang et al. (2011) discovered that, with stricter environmental regulation, indicators such as water efficiency, energy efficiency, and environmental efficiency (except for carbon dioxide emissions and energy consumption) have improved significantly, and the industry's overall environmental performance has become more sustainable.

Business Strategy and The Environment is the second leading journal, covering studies on the impact of ER in the forms of environmental labeling certification (ELC) or European Union Emission Trading Scheme (EU ETS) on CEP and the effect of ER on CEP in the context of outward foreign direct investment (OFDI). Typical articles on ER and CEP in this journal include the following. Firstly, using Chinese companies

as research objects Long et al. (2023) found that OFDI improves CEP. In addition, in their research CEP is further improved when OFDI is hosted in developed countries with stricter environmental regulations and where the national cultures focused on long-term development (Long et al., 2023). Secondly, He et al. (2022) took a sample of Chinese A-share listed companies in the manufacturing industry over the period of 2008 to 2016 and discovered that environmental labeling certification (ELC) enhances CEP while having no influence on financial performance. Lastly, using a sample of listed companies that have been penalized by the U.S. government for violating environmental regulations, Shevchenko (2021) found that being subject to environmental penalties is not linked to improved CEP. On the contrary, these penalties even lead to further deterioration of CEP (Shevchenko, 2021).

International Journal of Production Economics is followed by the third rank in this field, in which the published articles mainly study the influence of ER in terms of carbon tax or ecological civilization regulation on CEP, the moderating role of environmentally friendly product innovation on the relationship between ER and CEP, etc. "The moderating effect of environmental dynamism on green product innovation and performance" is the third most cited research article, see **Table 5**. It employs a questionnaire survey to investigate the relationship between ER and the performance of listed companies in China and the moderating role of green product innovation in it. Furthermore, the article also examines the relationship between environmental production innovation and corporate performance along with the moderating role of green dynamics (Chan et al., 2016).

Then, the yearly scientific output of the top five research journals can be seen in **Figure 4**. The major source of ER and CEP literature is Journal of Cleaner Production. Business Strategy and the Environment and Corporate Social Responsibility and Environmental Management both played significant roles in the development of literature recently, especially the past three years. International Journal of Production Economics has steadily produced related articles in this field since 2013. The above analyses not only provide an understanding of research trends and limitations of ER and CEP but also promote policy reforms to better environmental performance further.
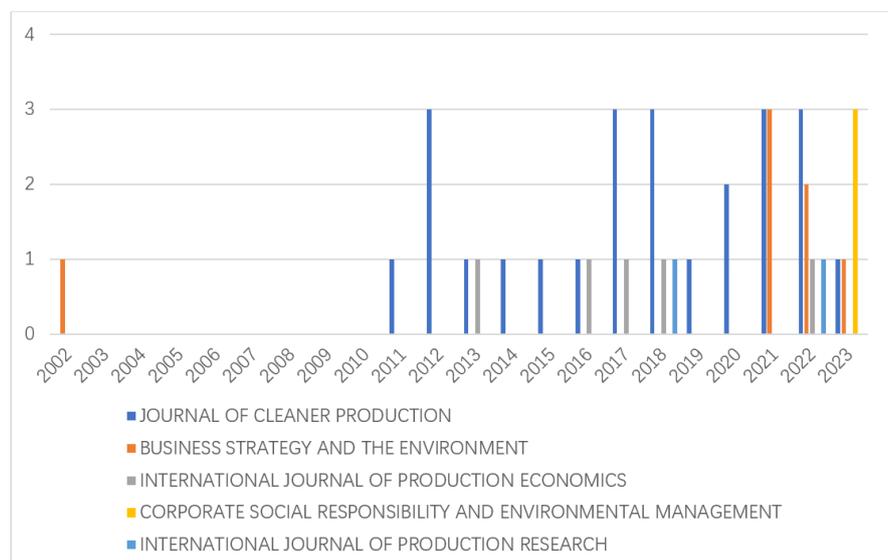

Figure 4. Publication trend per year in top 5 journals.

Next, this paper counts the top 10 articles in ER and CEP and their impact. **Table 5** provides statistics on global citations, a metric that reflects the overall citation trend of an article worldwide (Lei et al., 2022). "Environmental policy, innovation and performance: New insights on the porter hypothesis" by Lanoie et al. (2011) is the most globally cited study in the field. It tests the implications of different versions of the Porter hypothesis by analyzing data on environmental policy, R&D, environmental performance, and business performance from a sample of about 4,200 factories in seven OECD countries (Lanoie et al., 2011). The second-ranked publication by Clarkson et al. (2004) discovered that environmental investments by low-polluting firms that over-comply with current ER result in incremental economic benefits, whereas high-polluting firms that meet only minimal environmental requirements do not. The study by R. Wang et al. (2018) drew from panel data and insight interviews that CEP exhibits an inverted U-shape as the control over environmental behavior is decentralized from the central government to the administrative level. There is also a positive moderation of this relationship by the stringency of ER and a negative moderation of environmental supervision capacity (R. Wang et al., 2018). Yu et al. (2017) validated the relationship between environmental pressures, namely ER and stakeholder pressures, and firm performance, along with the environmental innovation strategy as a mediator and marketing capabilities as a moderator, using primary data from 121 UK manufacturers and secondary data about financial performance. Lastly, Dong et al. (2014) performed a regression analysis on 245 Chinese firms and found that both eco-innovation and ER can significantly affect CEP and competitiveness, whereas firm size and the enforcement of ER only exert a strong effect on CEP. The other top ten articles in **Table 4** are summarized in detail in the previous section 4.2.1 Core research journals.

Table 5. Most globally cited articles.

Title	Authors	Type of Study	Academic Journals	Global Citations
Environmental Policy, Innovation and Performance: New Insights on the Porter Hypothesis	Lanoie et al. (2011)	Quantitative	Journal of Economics and Management Strategy	500
The Market Valuation of Environmental Capital Expenditures by Pulp and Paper Companies	Clarkson et al. (2004)	Quantitative	Accounting Review	290
The moderating effect of environmental dynamism on green product innovation and performance	Chan et al. (2016)	Quantitative	International Journal of Production Economics	267
Is environmental regulation effective in China? Evidence from city-level panel data	Hao et al. (2018)	Quantitative	Journal of Cleaner Production	212
Digital finance, green technological innovation and energy-environmental performance: Evidence from China's regional economies	Cao et al. (2021)	Quantitative	Journal of Cleaner Production	189
Government's green grip: Multifaceted state influence on corporate environmental actions in China	R. Wang et al. (2018)	Quantitative	Strategic Management Journal	188

Table 5. (*Continued*).

Title	Authors	Type of Study	Academic Journals	Global Citations
Exploring the relationships between different types of environmental regulations and environmental performance: Evidence from China	Li & Ramanathan (2018)	Quantitative	Journal of Cleaner Production	165
Environmental pressures and performance: An analysis of the roles of environmental innovation strategy and marketing capability	Yu et al. (2017)	Quantitative	Technological Forecasting and Social Change	153
Implementing stricter environmental regulation to enhance eco-efficiency and sustainability: a case study of Shandong Province's pulp and paper industry, China	Y. Wang et al. (2011)	Quantitative	Journal of Cleaner Production	146
Effects of eco-innovation typology on its performance: Empirical evidence from Chinese enterprises	Dong et al. (2014)	Quantitative	Journal of Engineering and Technology Management - JET-M	114

3.2.2. Keywords

Table 6 illustrates the most frequently used terms in the literature related to ER and CEP, which is further manually filtered based on the statistical results of Biblioshiny software. Words with low relevance to ER and CEP, such as China, and duplicate words, such as environmental regulations, were excluded, displaying only highly relevant non-repeated words to the topic. For keywords plus, besides the topic terms CEP and ER, the most frequently occurring words are environmental management with a high frequency of 40 times, followed by commerce, sustainable development, environmental economics, and so on. The most common keywords used by the authors are sustainability, followed by economic performance, data envelopment analysis, etc. All of these keywords are related to ER and CEP and to a certain extent demonstrate the relationship between these two variables.

Table 6. Most frequent keywords.

Authors' Keywords	Frequency	Keywords Plus	Frequency
environmental performance	27	environmental management	40
environmental regulation	15	environmental regulation	40
sustainability	5	environmental performance	32
economic performance	3	commerce	11
data envelopment analysis	3	sustainable development	11
environmental policy	3	environmental economics	8
green technological innovation	3	environmental protection	8
sustainable development	3	efficiency	7
environmental strategy	2	environmental impact	6
institutional theory	2	public policy	5

According to related literature (Arslan et al., 2022; H. Li et al., 2023), the word cloud created in the paper is based on the frequent occurrence of keywords plus, see **Figure 5**, where larger words mean more frequent usage. Keyword Plus goes beyond author-supplied keywords, which is determined using a unique algorithm designed to enhance the power of cited reference searching and broaden the scope of search results

(Garfield and Sher, 1993). From **Figure 5**, Commerce and sustainable development appear most frequently because the subject regulated by ER is the business behavior of companies, which seek better environmental performance to achieve sustainable development. Furthermore, the terms China, environmental economics, environmental protection, and efficiency have received special attention from scholars, and these studies aim to explore the initiatives and effectiveness of China, as the largest developing country, in the process of balancing economic development and environmental governance issues. Some of the literature also studied keywords such as environmental policy, environmental legislation, emission control, and innovation, focusing environmental performance on emission reduction and improving environmental problems through relevant policy legislation and innovation. In short, all the keywords in **Figure 5** have been studied in the context of ER and CEP, and researchers can use them as a reference in the future to select the niche areas of interest for their research.

Figure 5. Word cloud using keywords plus.

Figure 6 portrays the development of occurrences of keywords plus in related literature over time. As can be seen from the figure, the top ten keywords all started their initial development around 2011. Among them, ER, CEP, and environmental management are the most popular keywords among authors and have the strongest momentum, rising sharply; the rest of the terms enjoy relatively weaker popularity and have developed relatively gradually, with a slow and steady rise, such as sustainable development and environmental economics.
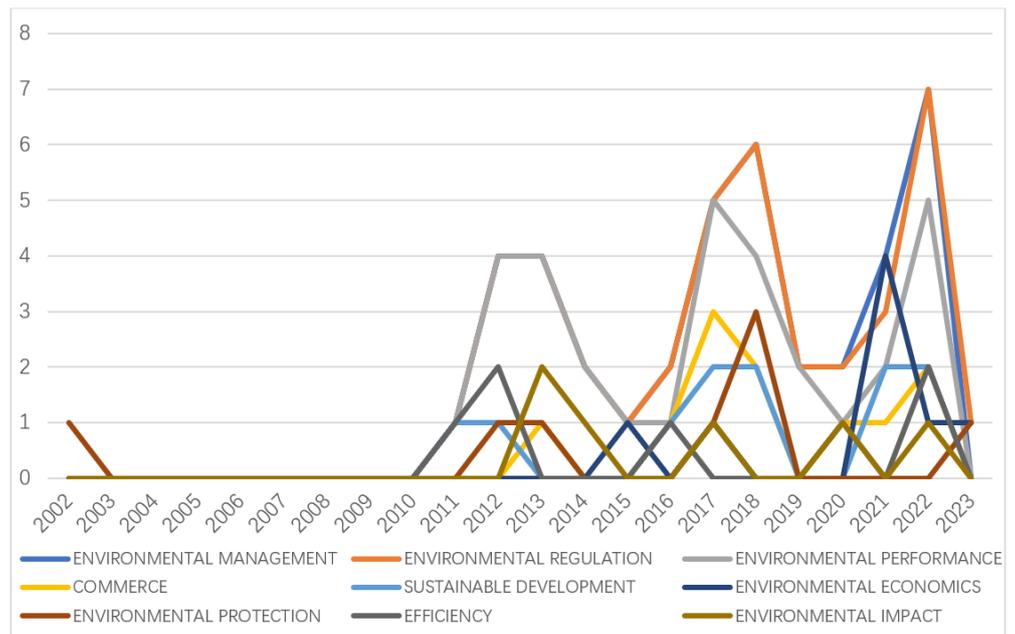
Figure 6. Word dynamics (Annual Occurrences).

3.2.3. Top authors and relevant affiliations

To take the research further, it was investigated which researchers and research organizations contribute the most to the literature on ER and CEP. The top ten authors are initially reported on the basis of h-index, total citations, and total publications, as shown in **Table 7**. The h-index (h) denotes that a researcher has h articles that have been cited at least h times, and is an indicator of both productivity and citation impact (Dhiaf et al., 2021). From the table, Ramanathan R has played the most pivotal role in the field by focusing on the effects of different ERs, environmental pressures, and organizational stresses on environmental performance, respectively (R. Li and Ramanathan, 2018; Ramanathan et al., 2014; Yu et al., 2017). Zhang Y has been a rising star in this field in the past two years, ranking second, mainly studying the two major influences on environmental performance, ER & media attention, the environmental performance of carbon emission policies, and the impact of different ERs on energy environmental performance, etc. (H. Li and Zhang, 2022; Y. Zhang et al., 2022; Y. Zhang and Song, 2021). Testa F, a predecessor in the field, is ranked third as his research was mainly conducted 10 years ago. Although the total number of citations is slightly higher, his articles are lagging in terms of timeliness. He mainly empirically studied the impact of different environmental regulations, such as Integrated Pollution Prevention Control regulation and Environmental Agreement (EA), on performance in some European Union (EU) countries and also conducted case studies (Gusmerotti et al., 2012; Testa et al., 2012, 2014).

Table 7. Top 10 authors.

Authors	H-Index	G-Index	M-Index	TC	NP	PY_Start
Ramanathan R	3	3	0.3	361	3	2014
Testa F	3	3	0.25	99	3	2012
Zhang Y	3	3	1	62	3	2021

Table 7. (*Continued*).

Authors	H-Index	G-Index	M-Index	TC	NP	PY_Start
Chen H	2	2	0.333	218	2	2018
Chen Y	2	2	0.4	35	2	2019
Frein Y	2	2	0.333	49	2	2018
Frey M	2	2	0.167	57	2	2012
Iraldo F	2	2	0.167	75	2	2012
Jin J	2	2	0.2	137	2	2014
Li Y	2	2	0.1	311	2	2004

Next, the performance of each research institute is further analyzed in **Figure 7**, as most scholars tend not to be stand-alone, but rely on the resources provided by their institutes for research innovation. In the field of ER and CEP, as indicated in the figure, the Sant'anna School of Advanced Studies dominates. It is followed by Central South University and Jiangsu University in a tie for second place. Hunan University, Rennes School of Business, University of Pisa, and University of Zaragoza are tied for third. The analysis shows that the influential affiliations in this field are relatively decentralized and also points potential directions for seeking strong alliances between academic institutions.
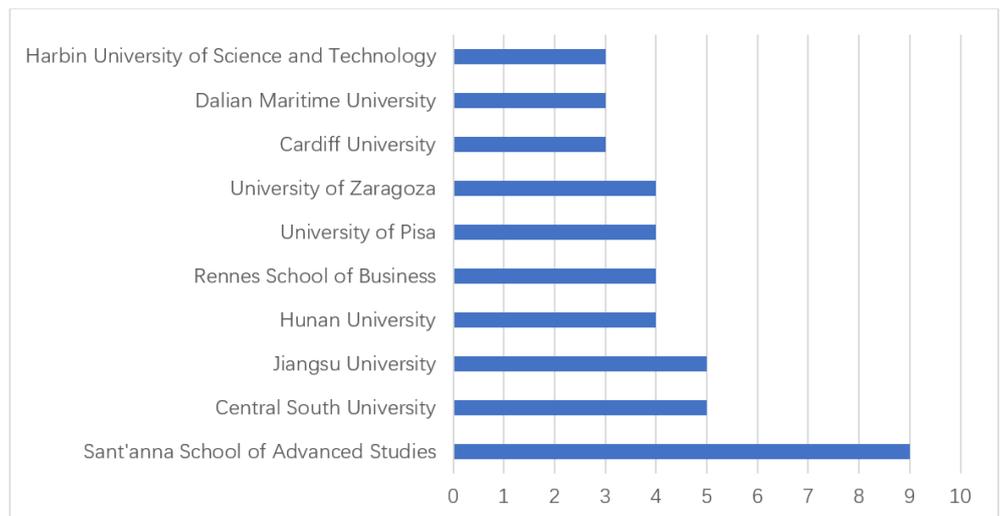
Figure 7. Most relevant affiliations.

3.3. Research collaboration analysis

This section turns its attention to the situation of research synergies and analyzes them with respect to three dimensions: author collaboration network, institutional collaboration network, and national/regional collaboration map. This is because fostering collaboration among different scholars, different institutions, and various countries/regions will contribute not only to solving the ongoing challenges in ER and CEP but also to uncovering the shortcomings of existing literature and generating new sparks. Collaborative network analysis demonstrates networks of cooperation among authors, institutions, and countries aimed at contributing to the evolution of knowledge in a particular research domain (Rocio et al., 2023). All of the related analyses in this

part are conducted with Biblioshiny software.

Figure 8 illustrates the collaborative network diagram between authors, and it can be noticed that the scholars are divided into a total of 11 clusters, with no connection among the clusters. The orange group, led by Testa F, has the most members of six authors and is more closely interconnected, followed by the pink and green groups. The red and blue clusters also have a large number of members, but the links between members are more singular. The remaining six groups have very few members, two or three, and have a homogenous association.
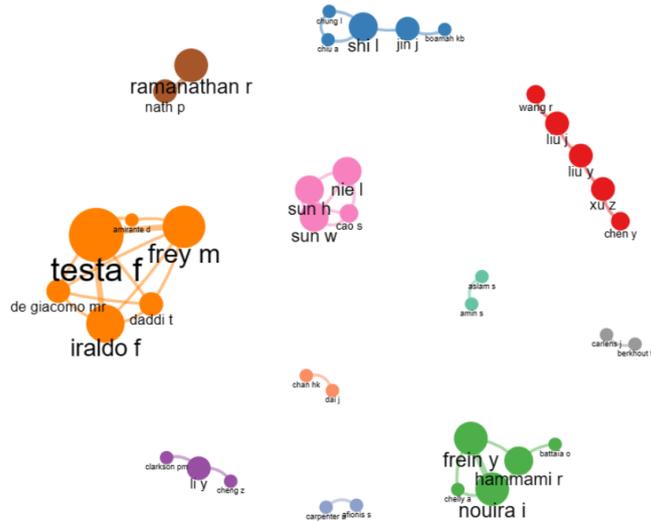
Figure 8. Authors' collaboration network.

Figure 9 demonstrates the inter-institutional collaborative network, with the institutions concerned divided into 8 clusters in total, and again there is no connection across the clusters. The red-colored cluster, with Nanjing University as its core, has the largest members, consisting of four institutions, with closer links within its members. The remaining five clusters all have two members. In addition, inter-institutional cooperation is often limited to the same country or even the same province or city, and transnational institutional cooperation needs to be further strengthened.
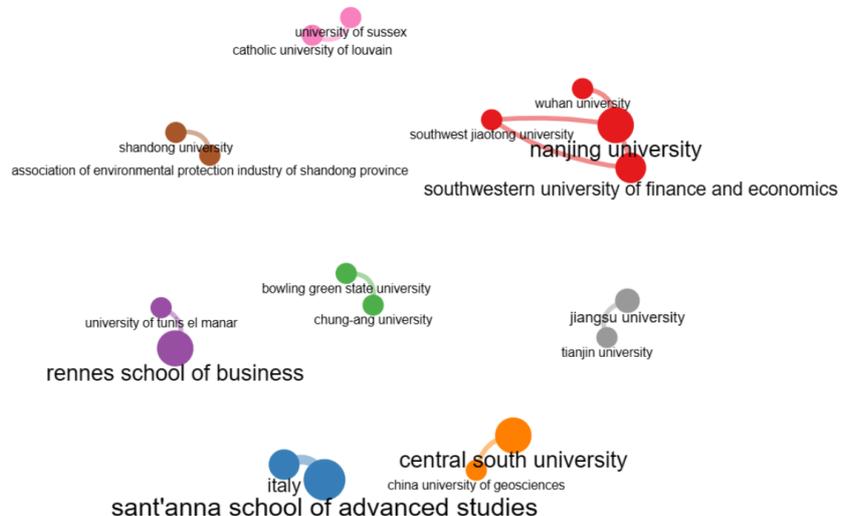

Figure 9. Institutional collaboration network.

Figure 10 shows the network of cooperation between countries/regions. It can be found that China Australia, the United Kingdom, and the Hong Kong region of China have carried out the largest number of joint research programs, while academic cooperation between China and the USA has also achieved major scientific results. Precisely, China plays the most important role in scientific research activities compared to other countries and regions.
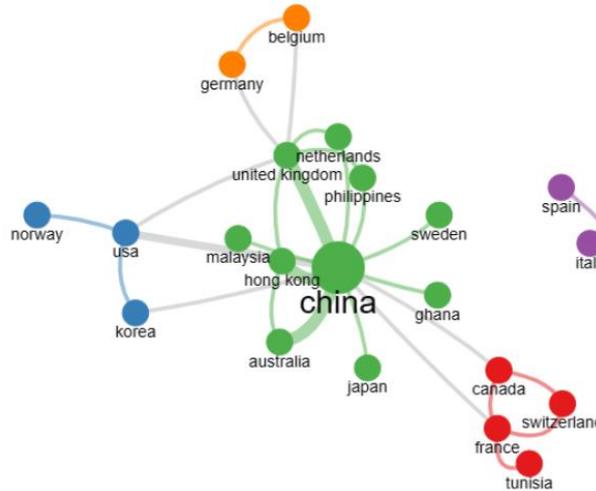

Figure 10. Country/region collaboration network.

Figure 11 shows the cooperation in ER and CEP between 2002–2023 for each country. The intensity of the shades of blue denotes how many articles have been published, and the thickness of the red line shows the extent of cooperation between countries. The figure shows that China is at high levels both in terms of publications and the scale of cooperation, followed by the UK, France, and the USA.
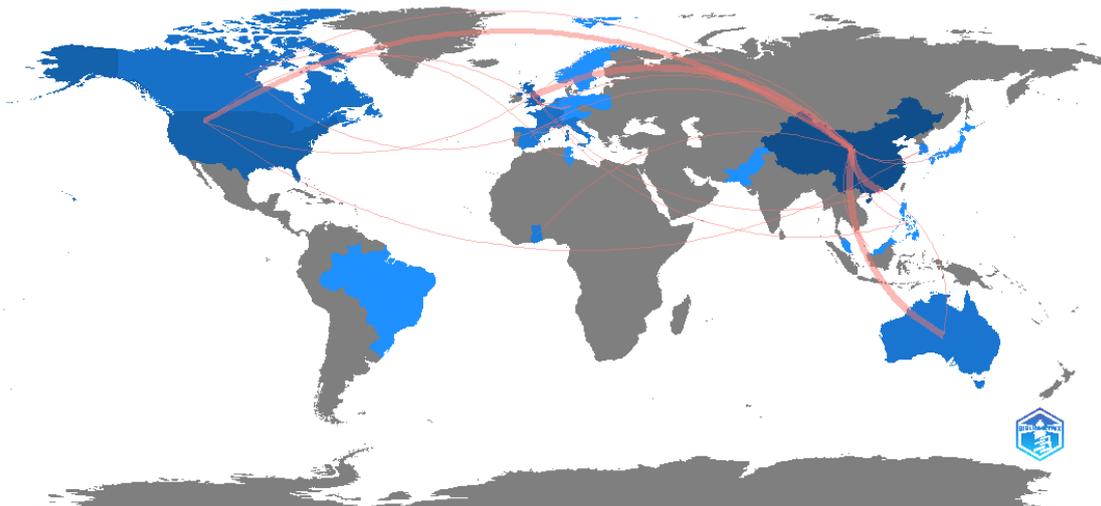

Figure 11. Collaboration world map.

3.4. Thematic map and evolution

3.4.1. Thematic map

As a further extension of the systematic literature review, this section analyzes

the hot topics in ER and CEP and their evolution over the last two decades by means of thematic maps and thematic evolution diagrams through Biblioshiny.

To assess the significance of themes and the development of their creation, the themes of selected 72 documents in this paper were grouped into a strategic map through the Biblioshiny software, see **Figure 12** Thematic Map. The value of the selected themes is measured by the horizontal axis indicator of relevance (centrality), and the growth of the themes is measured by the Y-axis indicator of the development degree, i.e., density (Arslan et al., 2022). For the purpose of drawing conclusions, the min cluster frequency and number of labels were limited to five and three, respectively. **Figure 12** is delineated into four categories of themes, and the detailed information of each cluster is shown in **Table 8**. The lower left portion of the coordinate chart implies that both the relevance and development degrees are low, so it depicts emerging or declining themes in the field of study. Four clusters in the figure fall into this region, and only the Surveys Cluster is classified as a declining theme because most of the articles under this theme were published 10 years ago and nothing relevant has been published in the last three years. Highlighted in the lower right are basic themes, which are less dense but more central. Topics clusters such as Environmental Economics, Emission Control, and Environmental Policy, for example, fall into this category and require more academic attention. Next, the upper left section shows themes with high density and low centrality. This means that they are developed and isolated and are segmented themes, i.e., Industrial Performance, Innovation, Ecology, etc. Subsequent scholars could avoid these segmented topics and choose other unstudied niches when conducting their research, having obtained better essay innovativeness. Finally, the research themes with higher density and centrality are the motor themes located in the upper right part, which are crucial in the scientific literature, such as Data Envelopment Analysis, Environmental Management, and Economic Analysis. Therefore, this paper suggests that scholars who want to delve deeper into the field of ER and CEP should carefully study these literature to build a good foundation. The above analysis will help readers to identify basic dynamics of the existing literature in ER and CEP.
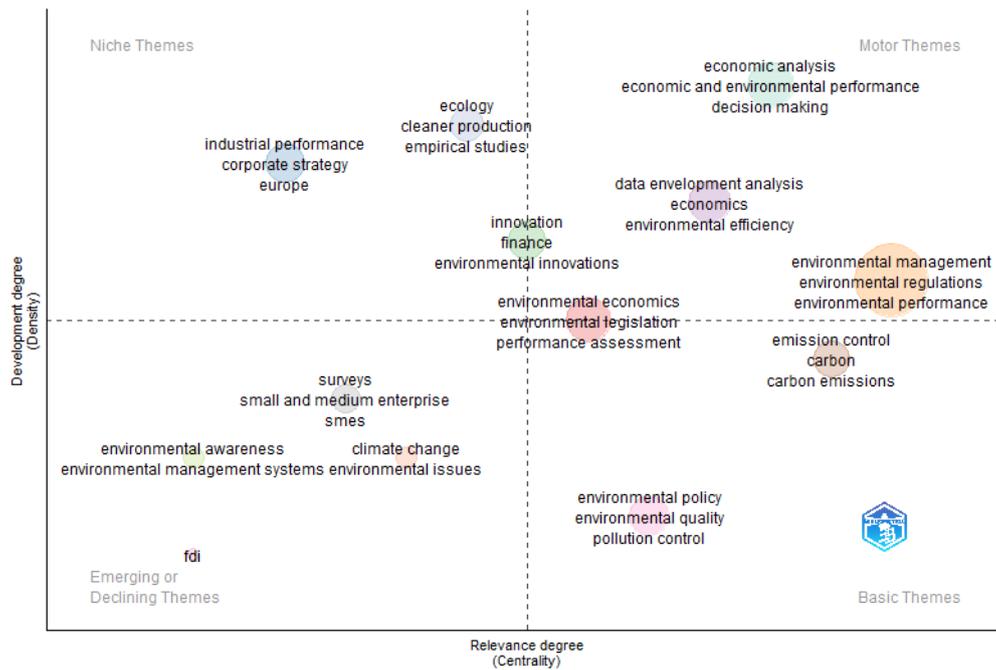
Figure 12. Thematic map.

Table 8. Themes and keywords of the thematic map.

Themes	Clusters	Keywords (occurrences)
Basic Themes	Environmental Economics	Environmental economics (8), Environmental legislation (5), Performance assessment (5), Regulatory framework (3), Manufacturing (2), Sustainability (2)
Niche Themes	Industrial Performance	Industrial performance (5), Corporate strategy (2), Europe (2), European union (2), Industrial practice (2), Regulatory approach (2)
Niche Themes	Innovation	Innovation (4), Finance (4), Environmental innovations (2), Financial performance (2), Performance (2)
Motor Themes	Data Envelopment Analysis	Data envelopment analysis (4), Economics (3), Environmental efficiency (3), Taxation (3), Benchmarking (2), Command and control (2), Costs (2), Managers (2)
Motor Themes	Environmental Management	Environmental management (40), Environmental regulations (40), Environmental performance (32), Commerce (11), Sustainable development (11), China (8), Environmental protection (8), Efficiency (7), Environmental impact (6), Public policy (6), Competition (5), Economic performance (5), Laws and legislation (5), Industry (4), Economic and social effects (3), Environmental technology (3), Government regulation (3), Manufacture (3), Technological innovation (3), Firm size (2), Green products (2), Iso 14001 (2), Managerial implications (2), Mediating effect (2), Operational efficiencies (2), Regression analysis (2), Regulation (2), Societies and institutions (2)
Basic Themes	Emission Control	Emission control (5), Carbon (4), Carbon emissions (2), Difference-in-differences models (2)
Basic Themes	Environmental Policy	Environmental policy (6), Environmental quality (4), Pollution control (3), Developing countries (2), Industrial emissions (2)
Declining Themes	Surveys	Surveys (3), Small and medium enterprise (2), SMEs (2)
Motor Themes	Economic Analysis	Economic analysis (4), Economic and environmental performance (4), Cost effectiveness (2), Decision making (3), Greenhouse gases (2), Investments (3), Profitability (3), Carbon dioxide (2), Gas emissions (2), Supply chains (2)
Emerging Themes	Climate Change	Climate change (2), Environmental issues (2)
Niche Themes	Ecology	Ecology (2), Cleaner production (2), Empirical studies (2), Energy (2), Energy efficiency (2)
Emerging Themes	FDI	FDI (2)
Emerging Themes	Environmental Awareness	Environmental awareness (2), Environmental management systems (2)

3.4.2. Thematic evolution

Furthermore, this paper investigates the evolution of themes in the ER and CEP domains by Biblioshiny, see **Figure 13**. We categorized the literature using keywords plus, with 2014 and 2019 as time points and finally generated **Figure 13** with the help of the R package. The year 2014 was chosen because environmental regulation and supervision became particularly stringent from 2015 onwards, while 2019 was picked because of the global outbreak of the COVID-19 epidemic from 2020 onwards, both of which will have a huge impact on ER and CEP research (Chowdhury et al., 2023). The evolution of themes is implemented through three phases: phase 1 (2002–2014), phase 2 (2015–2019), and phase 3 (2020–2023). Overall, the evolution of the themes has taken the form of decentralization-centralization-decentralization, reflecting the continuous integration and changes in the fields of ER and CEP.

The most popular topics in the first phase were environmental protection and environmental management, followed by company size and efficiency. Regarding environment protection and environmental management, Clarkson et al. (2004) classified firms into low-polluting ones that excessively comply with ERs and high-polluting ones that only fulfill the minimum environmental requirements, and then verified the impact of different enterprises' environmental capital expenditures on their incremental economic performance. Lanoie et al. (2011) empirically discovered that ER stimulates firms' environmental innovation behavior and that flexible environmental policies facilitated corporate innovation more than prescriptive regulations to some extent. In addition, Dong et al. (2014) further validated the effects of different types of eco-innovation, firm size, ER, and its implementation on CEP and competitiveness. For efficiency, Y. Wang et al. (2011) examined whether stricter ERs can promote both environment and economic performance in terms of eco-efficiency (i.e., water, energy, and environmental efficiency).

By the second phase, the themes showed a trend of concentration. As the topic of environmental management matured and generalized, all of the popular topics from phase one were encompassed by it. Environmental economics followed as the second most popular and largest emerging topic in this phase. With regard to environmental management in phase II, studies have focused on the impacts of different types of ERs (R. Li and Ramanathan, 2018), corporate green product innovation (Chan et al., 2016), and supervision by different state administrative agencies (R. Wang et al., 2018) on CEP. As for environmental economics, researches mainly focused on the relationship between CEP and financial performance in the context of increasing ERs (Delmas et al., 2015), as well as the relationship between environmental pressures (from regulators & stakeholders, respectively) and performance (Yu et al., 2017). On greenhouse gases (GHGs), Delmas et al. (2015). measured CEP in terms of GHG emissions and then verified the impact of CEP on short- and long-term financial performance. Niesten et al. (2017) found that eco-innovation not only reduces GHG emissions but also helps companies cut down on the negative impacts of ER on CEP.

Lastly, since 2020 (Phase III), environmental management has shown a new sub-direction of sustainable development on the basis of Phase II and also cross-studied with environmental economics. Environmental economics has also been subdivided into performance assessment.   With respect to sustainable development, Lazzini et al.

(2021) found that regulation in the form of the European Union Emissions Trading Scheme (EU ETS) can promote sustainability in enterprises, but that the economic crisis may counteract that effect. Defining sustainable development through disclosure effectiveness, Zhou et al. (2023) found that there is a positive link between CEP and the readability of corporate environmental disclosures (CEDs), especially in the case of poor profitability, stringent ER, and high media attention. On performance assessment, Long et al. (2023) explored the OFDI on domestic CEP and the role played by ERs and national culture. He et al. (2022) examined the impact of Environmental Labeling Certification (ELC), as a voluntary ER, on corporate environmental and financial performance. In terms of environmental economics, Shevchenko (2021) observed that financial penalties not only fail to promote the environmental performance of firms violating ERs but even have the opposite effect of worsening it. In contrast, Ma et al. (2021) argued that a higher frequency of government inspections can improve CEP in the short run, and the long-term effect can be achieved by combining the frequency of inspections and the severity of penalties. In relation to environmental management, L. Wang et al. (2023) discussed in detail the factors affecting the implementation of ISO14001 and its impact on different corporate performances. Yu et al. (2021) focused on the different patterns of environmental management in family firms and their impact on CEP. For economic analysis, M. Wang et al. (2020) developed a Steckelberg game-theoretic model to analyze the impacts of different decision-making approaches and regulations on corporate economic performance and waste discharge. Chelly et al. (2022) compared the impacts of progressive carbon tax strategies on supply chain management, profits, and CEP through four multi-period technology choice models.
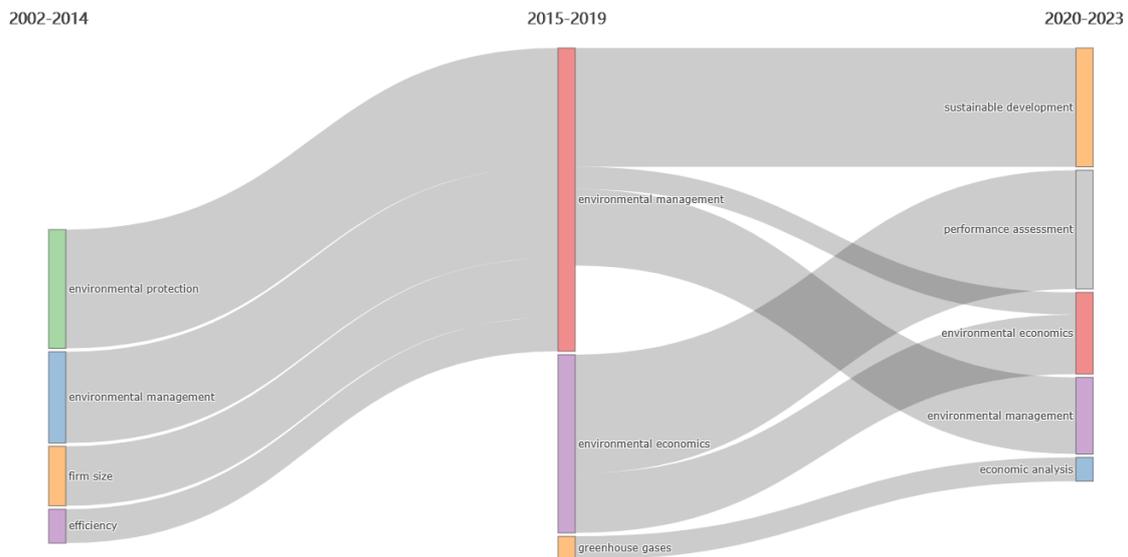

Figure 13. Thematic evolution.

3.5. Intellectual structure analysis

To gain an understanding of the previous and present development of the fundamental research themes, this section will use co-citation analysis and bibliographic coupling analysis in VOSviewer to further sort out the knowledge structure in the ER and CEP research areas.

3.5.1. Co-citation analysis

Co-citation analysis presumes that publications that are frequently co-referenced are similar in themes (Donthu et al., 2021). In a co-citation network, when two papers appear simultaneously in the references of a third paper, then the first two papers are linked together (Singhania et al., 2023). It is a scientific mapping analysis technique that is primarily used to reveal the development of knowledge structure in a particular field, the connections between co-cited references, and thematic clusters (Donthu et al., 2021; Sardana and Singhania, 2022). It focuses solely on the highly cited publications with two major benefits; one is to discover the most influential publications and the other is to locate thematic clusters from cited publications (Donthu et al., 2021).

Figure 14 is the network diagram of the co-citation analysis, which was generated by the VOSviewer software, with the unit of analysis being cited references and the counting method being full count. Among the 4602 cited references, 10 articles reached the minimum threshold of being co-cited at least 4 times each. The choice of having the threshold at least 4 times is mainly the result of a trade-off between the meaningfulness of the analysis and the robustness of the results (Khan et al., 2022). On the one hand, a lower threshold, e.g., 1 time, yields a richer set of potential connections among sub-themes (Janssens et al., 2020), whilst, on the other hand, a higher threshold ensures that the co-citation relationship is statistically significant, such as 5 times or more (Wan et al., 2023). Therefore, after testing, 4 times were finally chosen in this paper for the analysis. The size of the circular nodes in the figure indicates the number of co-citations of a given article, and the thickness of the line expresses the intensity of the citational relationships (Phan Tan, 2022). Different colors represent different subject clusters. Author information is labeled on each node. Based on **Figure 14**, we can identify three different colored clusters and then analyze the content of these co-cited references in each cluster to organize three different themes they represent, as presented in **Table 9**.
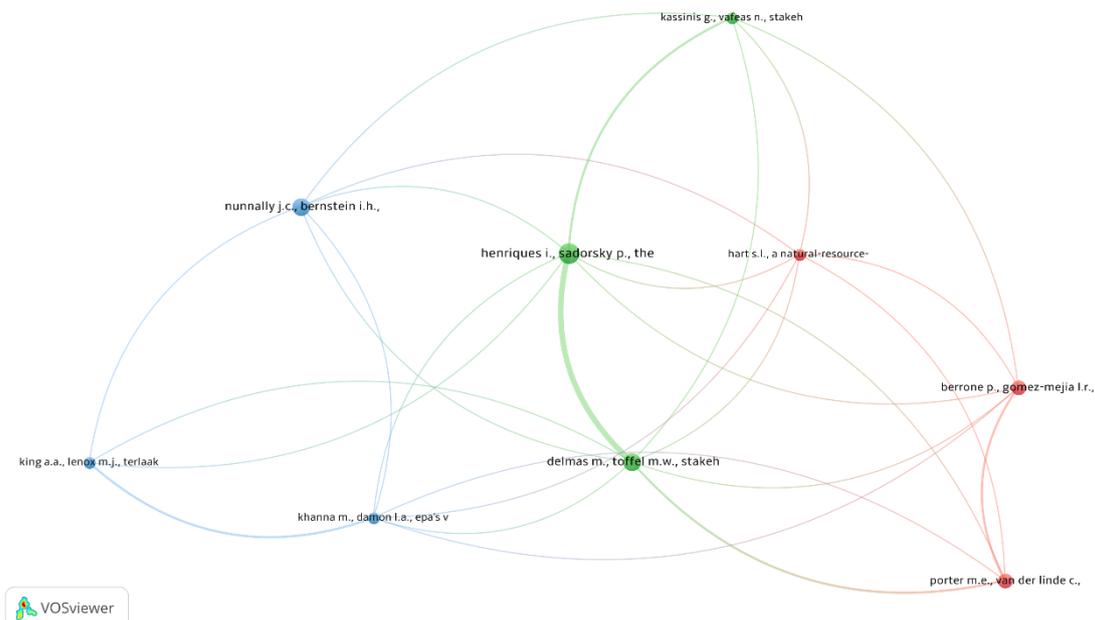

Figure 14. Co-citation analysis (cited references).

The authors carefully read the typical references in each cluster, summarized the themes, and made the following findings: first, the three clusters are evenly matched and of comparable size as can be seen from the charts. Second, all three clusters reflect to some extent the highly dense and highly centered motor theme of environmental management. Cluster 1, represented by the red color, focuses on the relationship between natural resource-based firms and the environment (Hart, 1995), the concept of environmental competitive advantage (Porter and Van Der Linde, 1995), and the relationship between executive compensation and CEP (Berrone and Gomez-Mejia, 2009), all of which are either motivational themes or basic themes of environmental policy. The green cluster focuses on the topic of the relationship between stakeholder pressures on the organization and their environmental management activities (Delmas and Toffel, 2004; Henriques and Sadorsky, 1996; Kassinis and Vafeas, 2006), covering the dynamics theme and the niche theme of corporate strategy. Finally, the third blue cluster describes the impact of environmental policies and standards on companies (Khanna and Damon, 1999; King et al., 2005), and also introduces relevant psychometric theory (Nunnally and Bernstein, 1994), while covering the motivational theme, the basic theme, and the niche theme.

Table 9. Co-citation clusters.

Clusters	Themes	Citations
1. Red	Environmental governance mechanisms, pollution prevention strategies, sustainable development, environment competitiveness	Porter & Van Der Linde, (1995), Hart (1995), Berrone & Gomez-Mejia (2009)
2. Green	Stakeholders' institutional pressures, environmental management practices, environmentally responsive firm	Kassinis & Vafeas (2006), Henriques & Sadorsky (1996), Delmas & Toffel (2004)
3. Blue	EPA's voluntary 33/50 program, toxic releases and economic performance, strategic motives of individual actors, ISO 14001 management standard	Nunnally & Bernstein (1994), King et al. (2005), Khanna & Damon (1999)

In summary, it can be seen that co-citation analysis examines the relationship between cited articles and helps scholars understand the development of the past underlying themes in ER and CEP (Donthu et al., 2021). This is because, on the one hand, the three major thematic clusters were derived from co-cited publications more than ten years ago; on the other hand, the co-citation analysis only centered on highly cited articles and excluded recent or niche publications from the clusters. Therefore, it is necessary to conduct further bibliographic coupling analysis to explore the topical clusters of recent and niche publications and improve the knowledge structure of ER and CEP (Donthu et al., 2021).

3.5.2. Bibliographic coupling analysis

Bibliographic coupling is also a common scientific mapping technique, as opposed to co-citation (Chhtrapati et al., 2023). It assumes that the contents of the two articles are similar if they share the same reference (Donthu et al., 2021; Kessler, 1963). The bibliographic coupling analysis allows for the classification of articles with shared references, i.e., citing publications rather than cited publications, into different thematic clusters (Donthu et al., 2021; Zupic and Čater, 2014). Thus, unlike the co-

citation analysis in the previous section, recent or niche articles can obtain visibility through bibliographic coupling analysis to reflect the current status of the research field (Donthu et al., 2021). This leads to its two main benefits, namely that it can be used to discover broader or even niche thematic clusters, and that it can reveal the latest research developments in each field (Donthu et al., 2021).

The bibliographic coupling visualization shown in **Figure 15** was generated via the VOSviewer software, with the unit of analysis being document and the counting method being full count. Out of 72 documents, 60 reached the minimum threshold of at least 4 citations per document. Similar to the co-citation analysis, four times were chosen as the threshold while weighing the meaningfulness of the analysis and the robustness of the results (Janssens et al., 2020; Khan et al., 2022; Wan et al., 2023). Each bubble in the graph represents an article, and its size indicates the number of citations per article. In general, the closer the position of the two articles in the figure, the stronger the bibliographic coupling-based relationship between them (Chhtrapati et al., 2023). Different colors represent different topics and literature information is labeled on each bubble. Based on **Figure 15**, we can identify seven clusters and then analyze the content of main literature in each category to organize the different themes they represent, as shown in **Table 10**.
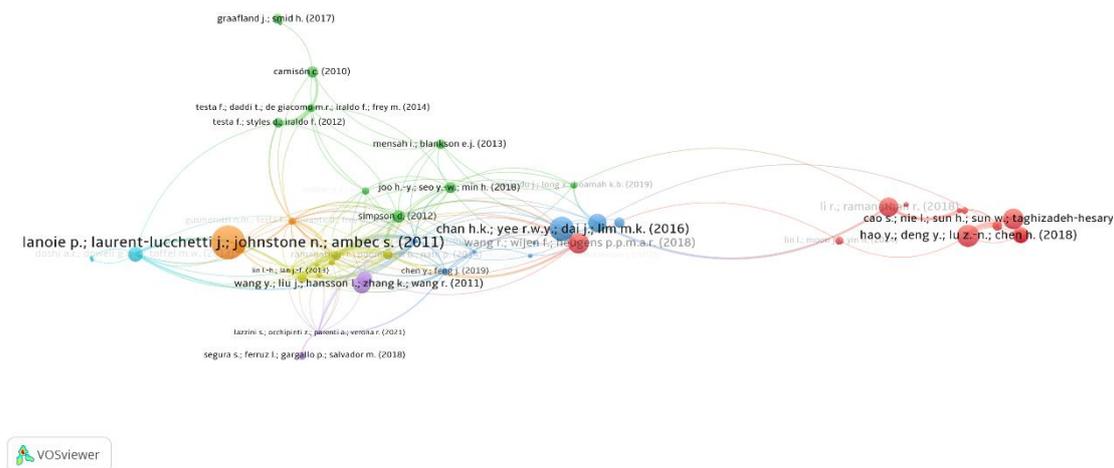

Figure 15. Bibliographic coupling analysis (documents).

Table 10. Bibliographic coupling clusters.

Clusters	Items	Themes	Representative Publications
1. Red	11	The effect of different forms of ER on CEP	Li & Ramanathan (2018), Hao et al. (2018), Y. Zhang et al. (2022), M. Wang et al. (2020), Y. Zhang & Song (2021)
2. Green	10	The impact of government pressure and the perception of ER on CEP with some mediating effect	Graafland & Smid (2017), Camisón (2010), Joo et al. (2018), Jin et al. (2019)
3. Blue	8	The moderating or mediating influence of innovation on ER and CEP	Chan et al. (2016), Yu et al. (2017)
4. Yellow	7	The influence of ER on the relationship between CEP and other variables, such as OFDI, chief sustainability officer (CSO), and green initiatives	Long et al. (2023), Kanashiro & Rivera (2019), Chen et al. (2018)

Table 10. (*Continued*).

Clusters	Items	Themes	Representative Publications
5. Purple	4	The impact of a particular regulation European Union Emissions Trading System (EU ETS) on CEP	Lazzini et al. (2021)
6. Cyan	3	Information disclosure regulations, institutional pressure and CEP	Doshi et al. (2013)
7. Orange	3	Environmental policy and CEP	Gusmerotti et al. (2012)

Based on the results of previous co-citation and bibliographic coupling analyses, this section further summarizes the similarities and dissimilarities between theme clusters under the two analyses, presented in **Table 11**. It can be seen that the first and third themes in the co-citation analysis are similar to the first and seventh themes in the bibliographic coupling analysis, respectively. The second theme in the co-citation analysis was linked to the second and sixth themes in the bibliographic coupling analysis. These topics are all motor or basic themes that have been the focus of research in ER and CEP from the past to the present. Also, there are three emerging themes at the current stage, all of which are derived from the bibliographic coupling analysis of the existing citing publications, and are hot topics in the current literature that deserve the attention of scholars.

Table 11. The comparison of co-citation and bibliographic coupling.

Themes	Co-citation Analysis	Bibliographic Coupling Analysis
Theme 1	Environmental governance mechanisms, pollution prevention strategies, sustainable development, environment competitiveness	The effect of different forms of ER on CEP
Theme 2	Stakeholders' institutional pressures, environmental management practices, environmentally responsive firm	The impact of government pressure and the perception of ER on CEP with some mediating effect
		Information disclosure regulations, institutional pressure and CEP
Theme 3	EPA's voluntary 33/50 program, toxic releases and economic performance, strategic motives of individual actors, ISO 14001 management standard	Environmental policy and CEP
		The moderating or mediating influence of innovation on ER and CEP
Emerging Themes	×	The influence of ER on the relationship between CEP and other variables, such as OFDI, chief sustainability officer (CSO), and green initiatives
		The impact of a particular regulation European Union Emissions Trading System (EU ETS) on CEP

3.6. Potential research directions

This part takes up the analysis of the intellectual network in the previous part, i.e., analyzing previous research through cited literature and studying current research through citing literature, then further reveals future directions of research development in ER and CEP through co-occurring keywords analysis utilizing VOSviewer (Dhiaf et al., 2021; Ohlan et al., 2022). This analysis supposes that there is a thematic relationship between words that frequently occur together, and then network is shown in **Figure 16** (Donthu et al., 2021). This graph is generated via VOSviewer, with the

unit of analysis being all keywords, and the counting method being full counts, where all keywords with 3 or more co-occurrences were included. Out of 570 keywords, 47 reached this threshold. Each circle in the graph represents a keyword, and the larger the circle, the higher the occurrence frequency of the keyword (Donthu et al., 2021). The links between circles indicate the co-occurrence of keywords, and the thicker the links, the higher the co-occurrence frequency (Donthu et al., 2021). Different colors represent different topic clusters (Donthu et al., 2021). Each circle is labeled with its corresponding key word.

Based on the keyword co-occurrence analysis in **Figure 16**, there are three findings: first, there are a total of five different clusters in the ER and CEP domains; second, among all co-occurring keywords, apart from the original search terms ER and CEP, environmental management, which belongs to the fourth/yellow cluster, has the highest number of occurrences (40) and the highest total connection intensity (240), making it the absolute core term in the field; finally, surprisingly the term environmental management systems, which is one word away from environmental management, also from Cluster 4, appears only 3 times and has the lowest total link strength (8). This means that this phrase has great space for improvement and could be a potential hot topic in the field.
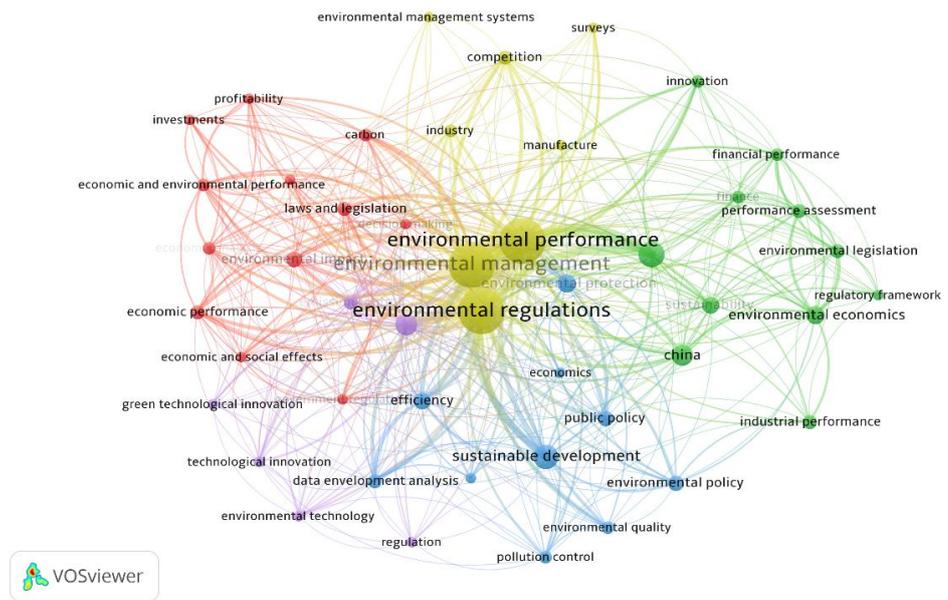

Figure 16. Co-occurrence analysis of keyword network visualization.

Next, the author would further analyze the core and borderline keywords within individual clusters to discover potential future research avenues. Cluster 1 "Performance" (red nodes) has core terms such as economic performance, economic analysis, environmental impacts, and carbon, which have high occurrences as well as high strength of linkage to other themes. The marginal terms are profitability, economic and social effects, taxation, and investments, none of which are linked to keywords in the green cluster. Future research could consider the integration between them to gain innovativeness. Cluster 2 "Regulation" (green) emphasizes ER, China, environmental economics, and environmental legislation. The edge vocabulary innovation is not associated with cluster 3; industrial performance does not co-occur

with purple and red clusters; and the term, regulatory frameworks, is the most isolated with only association with the yellow cluster. Future research could start with these terms, especially regulatory frameworks. The blue cluster "Sustainability", or Group III, focuses on keywords such as sustainable development, efficiency, environmental protection, data envelopment analysis, and public policy. The fringe vocabulary is solely pollution control, which does not intersect with the first cluster. Environmental management is the largest node in the fourth (yellow) cluster "Management", generating extensive links with other groups. Surveys and environmental management systems are edge terms, the former being unrelated to the purple and red clusters, and the latter unrelated to the green cluster. The last group "Technology" consists of purple nodes with technological innovation, environmental technology, and emission control as its core words. Green technological innovation as a boundary term has no intersection with the blue group. In summary, scholars can focus on the edge words in the above clusters and make collisions with other clusters with no co-occurrence relationship in order to explore new pathways for research in ER and CEP.

Finally, based on the analysis of the edge terms in each previous cluster combined with the overlay visualization analysis in **Figure 17** generated by VOSviewer, the most recent and cutting-edge possible directions of development in ER and CEP are filtered out. According to the legend, it can be seen that the color of the nodes represents the average publication year of relevant literature. The average year spans from 2016–2020 and the color also ranges from purple to blue to yellow. By comparison, it was found that the marginal keywords for each cluster, which are colored yellow in **Figure 17**, are the regulatory framework and green technological innovation, respectively, with an average year of publication in the literature of 2021.33, followed by environmental management systems (2020.33). They are emerging keywords in the field of ER and CEP, and the existence of unco-occurring clusters deserves scholars to highlight them, find potential research directions, and fill the gap in the literature. As regards green technological innovation, although its bridging role in the relationship between ER and CEP has been studied, the uncertainty of innovation has not been thoroughly researched (M. Wang et al., 2020). In addition, relevant studies have used data from China, and the circumstances of other developing and developed countries remain unknown (Cao et al., 2021). In terms of the relationship among ER, environmental management systems (EMS), and CEP, future research could further consider the contagion effects and regional characteristics of EMS implementation across enterprises, and in addition take into account the impact of EMS on corporate reputation along with their linkages to ER and CEP (L. Wang et al., 2023). The regulatory framework only appears in the index keywords with few mentions in the related literature, which creates more research prospects. Scholars interested in this area may search for relevant information on their own to establish its theoretical framework with ER and CEP.
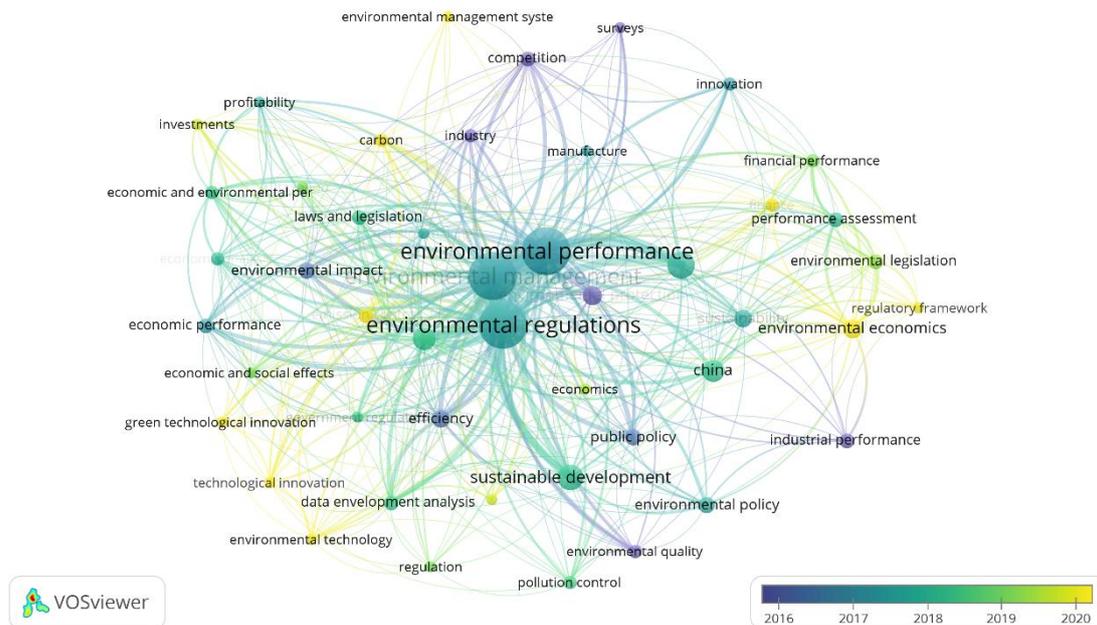
Figure 17. Co-occurrence analysis of keywords.

4. Discussion of findings

The present study differs significantly from past researches. First, the findings of past studies on the relationship between ER and CEP have not been consistent and unified. Second, past review article on ER and CEP used a qualitative method of analysis and only covered publications up to 2019. Finally, past studies have used the quantitative approach of bibliometric analysis, which tends to have poor thematic relevance, covering only one area of ER or CEP, and does not establish a link between the two. Based on this, this paper uses bibliometric analysis to examine articles quantitatively and qualitatively about ER and CEP from 2002 to 2023, aiming to fill the research gaps in the related fields.

The main objective of this study is to understand the current status of literature, level of research collaboration, hot topics, knowledge structure, and potential directions in the field of ER and CEP through a bibliometric analysis so as to identify research patterns. To this end, a comprehensive literature review of 72 articles retrieved from the Scopus database was performed through Microsoft Excel, Biblioshiny software, and VOSviewer software. In this section, we will summarize the findings and answer the 6 RQs proposed in the introduction section.

The first research question (RQ1) concerns the current status of ER and CEP publications. To answer this question, this paper uses Microsoft Excel and Biblioshiny software to quantitatively analyze publications, countries, and journals and reaches three findings. First, the annual numbers of publications and citations show an upward trend, especially after 2010. Second, China is the country with the most publications and citations in the field, followed by the UK and the US. Finally, articles in this field are most commonly found in the Journal of Cleaner Production, accounting for about one-third of the total.

Regarding the second question (RQ2), this paper analyzes each core aspect of the

ER and CEP literature, likewise using Microsoft Excel and Biblioshiny. As found in the first question, the Journal of Cleaner Production is the most influential journal in the field, followed by Business Strategy and The Environment and International Journal of Production Economics. Environmental Policy, Innovation and Performance: New Insights on the Porter Hypothesis is the most globally cited core article. Environmental management, sustainable development, and China are the most frequently used keywords. Regarding authors and institutions, Ramanathan R, Testa F, and Zhang Y are ranked among the top three in the field, while Sant'ana School of Advanced Studies is ranked first far ahead of other institutions.

In terms of research collaboration (RQ3), with the utilization of Biblioshiny, it can be seen by dividing it into authors', institutional, and countries': institutional collaboration is the most fragmented, with no links among the clusters, and mainly collaboration in pairs. Authors' collaboration was the second most fragmented, also with no links between clusters, but half of the groups had more than five members, with close intra-group collaboration. Global collaboration is relatively the strongest, with China leading the way, and there is also collaboration across clusters.

Next, this paper further investigates the hot topics and their evolution concerning ER and CEP (RQ4) through the use of Biblioshiny. It can be seen that there are three emerging topics in the field namely, Climate Change, FDI, and Environmental Awareness, and three motor themes which are Environmental Management, Data Envelopment Analysis, and Economic Analysis. The evolution of the themes shows a trend from decentralized to concentrated to decentralized, indicating that there is potential for further development of the field.

On intellectual structure (RO5), through co-citation analysis based on cited literature and number-coupling analysis based on citing literature, three themes about previous research and one emerging theme on current research in this field are derived using VOSviewer. The three themes are the effects of different kinds of regulation on CEP, the effects of institutional pressures and perceptions on CEP, and environmental policy and CEP. The emerging themes focus on ER and CEP, as well as some special moderating, mediating effects.

The last research question (RQ6) is the potential future direction of the field. By using the keyword co-occurrence network visualization and overlay visualization of VOSviewer, three keywords, regulatory framework, green technological innovation, and environmental management system, were found. They all are borderline terms with fewer connections with other clusters and are involved in publications with an average year of 2020 and beyond, which are emerging keywords at the present time. Therefore, they should be highly valued by scholars, from which new research directions can be found to fill the gaps in the discipline.

5. Conclusions

In recent years, there has been a rapid growth of articles about ER and CEP. This paper attempts to fill the research gap of bibliometric analysis on ER and CEP by analyzing and visualizing 72 articles in the field through Biblioshiny and VOSviewer. This research also contributes to helping scholars easily understand the research development and quickly find promising research directions in ER and CEP. In

addition, the study enables the government and corporate managers to gain a more comprehensive view of ER's impacts on CEP, which can assist in policy making and business management. To accomplish the above three purposes, this firstly study provides a quantitative and qualitative analysis of relevant publications, countries, and journals to provide a basic understanding of the field at the temporal and spatial levels using Microsoft Excel and Biblioshiny. Second, this paper identifies the core journals, influential articles, keywords, core authors, and relevant institutions in the field with MS Excel and Biblioshiny, all of which will help future scholars gain a deeper understanding of ER and CEP research. Next, this study reveals collaboration among authors, institutions, and countries through Biblioshiny software, providing guidelines for scholars to work together. Fourth, this paper identifies hot topics in the field and their evolutions also by Biblioshiny software. Fifth, with the use of VOSviewer this research provides scholars with insights into the knowledge structure of ER and CEP. Finally, this paper explores potential promising research orientations in ER and CEP utilizing VOSviewer, pointing scholars to research outlets and providing new perspectives. In conclusion, this paper argues that although research in ER and CEP has developed rapidly since 2002, it still has great potential for future research.

This research makes both theoretical and practical contributions. First, by providing a comprehensive and systematic overview of ER and CEP literature, this paper identifies knowledge structures and four major categories of research themes in the field. Second, this paper assists researchers in obtaining information about core publications, keywords, authoritative journals, and institutions in ER and CEP, so that they, especially newcomers, can accelerate their research progress. Thirdly, researchers in the field of ER and CEP can utilize the results of this study to identify promising areas for future research.

Nonetheless, there are some limitations. First, the source of the documents analyzed in this research is only the Scopus database. Searching in different databases (such as Web of Science, Google Scholar, etc.) would have made the study more convincing. Secondly, this study only analyzed articles written in English, and other non-English written articles could not be systematically evaluated. Thirdly, the bibliometric tools employed in this paper are Biblioshiny and VOSviewer, supplemented by Microsoft Excel. Other software that may be better suited for certain analyses was not considered. Therefore, future studies could obtain samples based on multiple databases by eliminating duplicates to draw more comprehensive and generalized research conclusions. In addition, future research could also explore other software for bibliometric visualization such as CiteSpace, Bib excel, and Gephi.

Author contributions: Conceptualization, YZ, TSO and FK; methodology, YZ; software, YZ; validation, YZ, TSO and FK; formal analysis, YZ; resources, TSO; data curation, YZ; writing—original draft preparation, YZ; writing—review and editing, TSO; visualization, YZ; supervision, TSO. All authors have read and agreed to the published version of the manuscript.

References

Aksnes, D. W., & Sivertsen, G. (2019). A Criteria-based Assessment of the Coverage of Scopus and Web of Science. Journal of Data and Information Science, 4(1), 1–21. https://doi.org/10.2478/jdis-2019-0001

Albrizio, S., Kozluk, T., & Zipperer, V. (2017). Environmental policies and productivity growth: Evidence across industries and firms. Journal of Environmental Economics and Management, 81, 209–226. https://doi.org/10.1016/j.jeem.2016.06.002

An, J., Yang, B., Liu, X., & Zhang, Y. (2022). Environmental regulation, green technology and environmental governance performance. Statistics & Decision, 38(13), 184–188. https://doi.org/10.13546/j.cnki.tjyjc.2022.13.037

Aragòn-Correa, J. A., Marcus, A. A., & Vogel, D. (2020). The Effects of Mandatory and Voluntary Regulatory Pressures on Firms' Environmental Strategies: A Review and Recommendations for Future Research. Academy of Management Annals, 14(1), 339–365. https://doi.org/10.5465/annals.2018.0014

Aria, M., & Cuccurullo, C. (2017). bibliometrix : An R-tool for comprehensive science mapping analysis. Journal of Informetrics, 11(4), 959–975. https://doi.org/10.1016/j.joi.2017.08.007

Arslan, H. M., Chengang, Y., Bilal, Siddique, M., & Yahya, Y. (2022). Influence of Senior Executives Characteristics on Corporate Environmental Disclosures: A Bibliometric Analysis. Journal of Risk and Financial Management, 15(3), 136. https://doi.org/10.3390/jrfm15030136

Aznar-Sánchez, J. A., Velasco-Muñoz, J. F., Belmonte-Ureña, L. J., & Manzano-Agugliaro, F. (2019). Innovation and technology for sustainable mining activity: A worldwide research assessment. Journal of Cleaner Production, 221, 38–54. https://doi.org/10.1016/j.jclepro.2019.02.243

Bashir, M. F. (2022). Discovering the evolution of Pollution Haven Hypothesis: A literature review and future research agenda. Environmental Science and Pollution Research, 29(32), 48210–48232. https://doi.org/10.1007/s11356-022-20782-1

Bashir, M. F., MA, B., Bilal, Komal, B., & Bashir, M. A. (2021). Analysis of environmental taxes publications: a bibliometric and systematic literature review. Environmental Science and Pollution Research, 28(16), 20700–20716. https://doi.org/10.1007/s11356-020-12123-x

Berrone, P., & Gomez-Mejia, L. R. (2009). Environmental Performance and Executive Compensation: An Integrated Agency-Institutional Perspective. Academy of Management Journal, 52(1), 103–126. https://doi.org/10.5465/amj.2009.36461950

Borsatto, J. M. L. S., & Bazani, C. L. (2023). Green innovation and environmental and financial performance: trends and challenges for future research. International Journal of Innovation and Sustainable Development, 17(1/2), 152. https://doi.org/10.1504/ijisd.2023.127951

Bosi, M. K., Lajuni, N., Wellfren, A. C., & Lim, T. S. (2022). Sustainability Reporting through Environmental, Social, and Governance: A Bibliometric Review. Sustainability, 14(19), 12071. https://doi.org/10.3390/su141912071

Camisón, C. (2010). Effects of coercive regulation versus voluntary and cooperative auto-regulation on environmental adaptation and performance: Empirical evidence in Spain. European Management Journal, 28(5), 346–361. https://doi.org/10.1016/j.emj.2010.03.001

Cao, S., Nie, L., Sun, H., Sun, W., & Taghizadeh-Hesary, F. (2021). Digital finance, green technological innovation and energy-environmental performance: Evidence from China's regional economies. Journal of Cleaner Production, 327, 129458. https://doi.org/10.1016/j.jclepro.2021.129458

Caviggioli, F., & Ughetto, E. (2019). A bibliometric analysis of the research dealing with the impact of additive manufacturing on industry, business and society. International Journal of Production Economics, 208, 254–268. https://doi.org/10.1016/j.ijpe.2018.11.022

Chan, H. K., Yee, R. W. Y., Dai, J., & Lim, M. K. (2016). The moderating effect of environmental dynamism on green product innovation and performance. International Journal of Production Economics, 181, 384–391. https://doi.org/10.1016/j.ijpe.2015.12.006

Chelly, A., Nouira, I., Hadj-Alouane, A. B., & Frein, Y. (2021). A comparative study of progressive carbon taxation strategies: impact on firms' economic and environmental performances. International Journal of Production Research, 60(11), 3476–3500. https://doi.org/10.1080/00207543.2021.1924410

Chen, F., Ngniatedema, T., & Li, S. (2018). A cross-country comparison of green initiatives, green performance and financial performance. Management Decision, 56(5), 1008–1032. https://doi.org/10.1108/md-08-2017-0761

Chhtrapati, D., Trivedi, D., Chaudhari, S. P., Sharma, A., & Bhatt, A. (2023). Global research performance on social media security: a bibliometric visualization analysis. Information Discovery and Delivery. https://doi.org/10.1108/idd-04-2022-

0029

Chowdhury, S. B., DasGupta, R., Choudhury, B. K., & Sen, N. (2023). Evolving alliance between corporate environmental performance and financial performance: A bibliometric analysis and systematic literature review. Business and Society Review, 128(1), 95–131. Portico. https://doi.org/10.1111/basr.12301

Clarkson, P. M., Li, Y., & Richardson, G. D. (2004). The Market Valuation of Environmental Capital Expenditures by Pulp and Paper Companies. The Accounting Review, 79(2), 329–353. https://doi.org/10.2308/accr.2004.79.2.329

Dai, Y., Peng, W., Song, H., & Liu, Z. (2021). Research on the Relationship between Government Environmental Regulation, Green Behavior of Enterprises and Enterprise Performance. Journal of Chongqing University of Technology(Social Science), 35(12), 72–82.

Dechezleprêtre, A., Koźluk, T., Kruse, T., Nachtigall, D., & de Serres, A. (2019). Do Environmental and Economic Performance Go Together? A Review of Micro-level Empirical Evidence from the Past Decade or So. International Review of Environmental and Resource Economics, 13(1–2), 1–118. https://doi.org/10.1561/101.00000106

Delmas, M. A., Nairn-Birch, N., & Lim, J. (2015). Dynamics of Environmental and Financial Performance. Organization & Environment, 28(4), 374–393. https://doi.org/10.1177/1086026615620238

Delmas, M., & Toffel, M. W. (2004). Stakeholders and environmental management practices: an institutional framework. Business Strategy and the Environment, 13(4), 209–222. Portico. https://doi.org/10.1002/bse.409

Dhiaf, M. M., Atayah, O. F., Nasrallah, N., & Frederico, G. F. (2021). Thirteen years of Operations Management Research (OMR) journal: a bibliometric analysis and future research directions. Operations Management Research, 14(3–4), 235–255. https://doi.org/10.1007/s12063-021-00199-8

Dong, M., Liang, Y., & Li, G. (2011). The Impact of Environmental Regulations on China's Export Competitiveness—An Analysis Based on Input-Output Tables. China Industrial Economics, 03, 57–67. https://doi.org/10.19581/j.cnki.ciejournal.2011.03.006

Dong, Y., Wang, X., Jin, J., Qiao, Y., & Shi, L. (2014). Effects of eco-innovation typology on its performance: Empirical evidence from Chinese enterprises. Journal of Engineering and Technology Management, 34, 78–98. https://doi.org/10.1016/j.jengtecman.2013.11.001

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. Journal of Business Research, 133, 285–296. https://doi.org/10.1016/j.jbusres.2021.04.070

Doshi, A. R., Dowell, G. W. S., & Toffel, M. W. (2013). How firms respond to mandatory information disclosure. Strategic Management Journal, 34(10), 1209–1231. Portico. https://doi.org/10.1002/smj.2055

Esfahbodi, A., Zhang, Y., Watson, G., & Zhang, T. (2017). Governance pressures and performance outcomes of sustainable supply chain management—An empirical analysis of UK manufacturing industry. Journal of Cleaner Production, 155, 66–78. https://doi.org/10.1016/j.jclepro.2016.07.098

Farrukh, M., Raza, A., Meng, F., & Wu, Y. (2021). CMS at 13: a retrospective of the journey. Chinese Management Studies, 16(1), 119–139. https://doi.org/10.1108/cms-07-2020-0291

Gao, S., Meng, F., Gu, Z., Liu, Z., & Farrukh, M. (2021). Mapping and Clustering Analysis on Environmental, Social and Governance Field a Bibliometric Analysis Using Scopus. Sustainability, 13(13), 7304. https://doi.org/10.3390/su13137304

Garfield, E., & Sher, I. H. (1993). KeyWords Plus™—algorithmic derivative indexing. Journal of the American Society for Information Science, 44(5), 298–299. https://doi.org/10.1002/(sici)1097-4571(199306)44:5<298:aid-asi5>3.0.co;2-a

Graafland, J., & Smid, H. (2017). Reconsidering the relevance of social license pressure and government regulation for environmental performance of European SMEs. Journal of Cleaner Production, 141, 967–977. https://doi.org/10.1016/j.jclepro.2016.09.171

Green, D., & Cookson, R. (2012). Publishing and communication strategies. Academic and Professional Publishing, 99–144. https://doi.org/10.1016/b978-1-84334-669-2.50005-6

Gu, Z., Meng, F., & Farrukh, M. (2021). Mapping the Research on Knowledge Transfer: A Scientometrics Approach. IEEE Access, 9, 34647–34659. https://doi.org/10.1109/access.2021.3061576

Gusmerotti, N. M., Testa, F., Amirante, D., & Frey, M. (2012). The role of negotiating tools in the environmental policy mix instruments: determinants and effects of the Environmental Agreement. Journal of Cleaner Production, 35, 39–49. https://doi.org/10.1016/j.jclepro.2012.05.036

Hao, Y., Deng, Y., Lu, Z.-N., & Chen, H. (2018). Is environmental regulation effective in China? Evidence from city-level panel data. Journal of Cleaner Production, 188, 966–976. https://doi.org/10.1016/j.jclepro.2018.04.003

Harsanto, B., & Firmansyah, E. A. (2023). A twenty years bibliometric analysis (2002 – 2021) of business economics research in ASEAN. Cogent Business & Management, 10(1). https://doi.org/10.1080/23311975.2023.2194467

Hart, S. L. (1995). A Natural-Resource-Based View of the Firm. The Academy of Management Review, 20(4), 986. https://doi.org/10.2307/258963

He, D., Ren, S., & Zeng, H. (2021). Environmental labeling certification and firm environmental and financial performance: A resource management perspective. Business Strategy and the Environment, 31(3), 751–767. Portico. https://doi.org/10.1002/bse.2915

Henriques, I., & Sadorsky, P. (1996). The Determinants of an Environmentally Responsive Firm: An Empirical Approach. Journal of Environmental Economics and Management, 30(3), 381–395. https://doi.org/10.1006/jeem.1996.0026

Jaffe, A., Peterson, S., Portney, P., & Stavins, R. (1995). Environmental Regulation and the Competitiveness of U.S. Manufacturing: What Does the Evidence Tell Us? Journal of Economic Literature, 33(1), 132–163.

Janssens, A. C. J. W., Gwinn, M., Brockman, J. E., Powell, K., & Goodman, M. (2020). Novel citation-based search method for scientific literature: a validation study. BMC Medical Research Methodology, 20(1). https://doi.org/10.1186/s12874-020-0907-5

Jin, J., Du, J., Long, X., & Boamah, K. B. (2019). Positive mechanism of foreign direct investment enterprises on China's environment: Analysis of host country regulation and parent company management. Journal of Cleaner Production, 227, 207–217. https://doi.org/10.1016/j.jclepro.2019.04.143

Joo, H. Y., Seo, Y. W., & Min, H. (2018). Examining the effects of government intervention on the firm's environmental and technological innovation capabilities and export performance. International Journal of Production Research, 56(18), 6090–6111. https://doi.org/10.1080/00207543.2018.1430902

Kanashiro, P., & Rivera, J. (2017). Do Chief Sustainability Officers Make Companies Greener? The Moderating Role of Regulatory Pressures. Journal of Business Ethics, 155(3), 687–701. https://doi.org/10.1007/s10551-017-3461-2

Karagiannopoulou, S., Sariannidis, N., Ragazou, K., Passas, I., & Garefalakis, A. (2023). Corporate Social Responsibility: A Business Strategy That Promotes Energy Environmental Transition and Combats Volatility in the Post-Pandemic World. Energies, 16(3), 1102. https://doi.org/10.3390/en16031102

Kassinis, G., & Vafeas, N. (2006). Stakeholder Pressures And Environmental Performance. Academy of Management Journal, 49(1), 145–159. https://doi.org/10.5465/amj.2006.20785799

Kessler, M. M. (1963). Bibliographic coupling between scientific papers. American Documentation, 14(1), 10–25. Portico. https://doi.org/10.1002/asi.5090140103

Khan, A., Goodell, J. W., Hassan, M. K., & Paltrinieri, A. (2022). A bibliometric review of finance bibliometric papers. Finance Research Letters, 47, 102520. https://doi.org/10.1016/j.frl.2021.102520

Khanna, M., & Damon, L. A. (1999). EPA's Voluntary 33/50 Program: Impact on Toxic Releases and Economic Performance of Firms. Journal of Environmental Economics and Management, 37(1), 1–25. https://doi.org/10.1006/jeem.1998.1057

King, A. A., Lenox, M. J., & Terlaak, A. (2005). The Strategic Use of Decentralized Institutions: Exploring Certification With the ISO 14001 Management Standard. Academy of Management Journal, 48(6), 1091–1106. https://doi.org/10.5465/amj.2005.19573111

Lanoie, P., Laurent-Lucchetti, J., Johnstone, N., & Ambec, S. (2011). Environmental Policy, Innovation and Performance: New Insights on the Porter Hypothesis. Journal of Economics & Management Strategy, 20(3), 803–842. Portico. https://doi.org/10.1111/j.1530-9134.2011.00301.x

Lazzini, S., Occhipinti, Z., Parenti, A., & Verona, R. (2021). Disentangling economic crisis effects from environmental regulation effects: Implications for sustainable development. Business Strategy and the Environment, 30(5), 2332–2353. https://doi.org/10.1002/bse.2749

Lei, J., Lin, S., Khan, M. R., et al. (2022). Research Trends of Board Characteristics and Firms' Environmental Performance: Research Directions and Agenda. Sustainability, 14(21), 14296. https://doi.org/10.3390/su142114296

Li, H., Arslan, H. M., Mousa, G. A., et al. (2023). Exploring sustainability disclosures in family firms: a bibliometric analysis. Economic Research-Ekonomska Istraživanja, 36(3). https://doi.org/10.1080/1331677x.2023.2188238

Li, H., & Zhang, Y. J. (2022). Environmental Performance of Carbon Emissions Trading Policy: Evidence From a New Comprehensive Analysis Model. IEEE Transactions on Engineering Management, 1–15. https://doi.org/10.1109/tem.2022.3216570

Li, M., Wang, X., Wang, Z., et al. (2022). Bibliometric Analysis of the Research on the Impact of Environmental Regulation on

Green Technology Innovation Based on CiteSpace. International Journal of Environmental Research and Public Health, 19(20), 13273. https://doi.org/10.3390/ijerph192013273

Li, R., & Ramanathan, R. (2018). Exploring the relationships between different types of environmental regulations and environmental performance: Evidence from China. Journal of Cleaner Production, 196, 1329–1340. https://doi.org/10.1016/j.jclepro.2018.06.132

Lima, C. O., & Bonetti, J. (2020). Bibliometric analysis of the scientific production on coastal communities' social vulnerability to climate change and to the impact of extreme events. Natural Hazards, 102(3), 1589–1610. https://doi.org/10.1007/s11069-020-03974-1

Liu, M., Chen, L., & Liao, J. (2020). A Study on the Impact of Environmental Regulation Tools on Regional Industrial Structure Upgrading—An Empirical Test Based on Provincial Panel Data in China. Ecological Economy, 36(02), 152–159.

Long, W., Luo, L., Sun, H., & Zhong, Q. (2022). Does going abroad lead to going green? Firm outward foreign direct investment and domestic environmental performance. Business Strategy and the Environment, 32(1), 484–498. https://doi.org/10.1002/bse.3156

Ma, X., Fan, D., Zhou, Y., & Yang, C. H. (2021). The impact of inspection on the sustainable production strategy: Environmental violation and abatement in emerging markets. Transportation Research Part E: Logistics and Transportation Review, 150, 102294. https://doi.org/10.1016/j.tre.2021.102294

Mongeon, P., & Paul-Hus, A. (2015). The journal coverage of Web of Science and Scopus: a comparative analysis. Scientometrics, 106(1), 213–228. https://doi.org/10.1007/s11192-015-1765-5

Ngo, Q. H. (2021). The impact of environmental regulation on environmental performance: A focus on third party logistics service providers in an emerging country. Uncertain Supply Chain Management, 9(4), 857–866. https://doi.org/10.5267/j.uscm.2021.8.003

Niesten, E., Jolink, A., Lopes de Sousa Jabbour, A. B., Chappin, M., & Lozano, R. (2017). Sustainable collaboration: The impact of governance and institutions on sustainable performance. Journal of Cleaner Production, 155, 1–6. https://doi.org/10.1016/j.jclepro.2016.12.085

Nunnally, J. C., & Bernstein, I. H. (1994). Psychometric Theory, 3rd ed. McGraw-Hill.

Ohlan, R., Ohlan, A., & Chhikara, S. (2022). Scholarly Research of Corporate Social Responsibility and Environmental Management: A Comprehensive Bibliometric Analysis. Serials Review, 48(1–2), 96–111. https://doi.org/10.1080/00987913.2022.2101756

José de Oliveira, O., Francisco da Silva, F., Juliani, F., César Ferreira Motta Barbosa, L., & Vieira Nunhes, T. (2019). Bibliometric Method for Mapping the State-of-the-Art and Identifying Research Gaps and Trends in Literature: An Essential Instrument to Support the Development of Scientific Projects. Scientometrics Recent Advances. https://doi.org/10.5772/intechopen.85856

Page, M. J., McKenzie, J. E., Bossuyt, P. M., et al. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ, n71. https://doi.org/10.1136/bmj.n71

Peng, B., Sheng, X., & Wei, G. (2020). Does environmental protection promote economic development? From the perspective of coupling coordination between environmental protection and economic development. Environmental Science and Pollution Research, 27(31), 39135–39148. https://doi.org/10.1007/s11356-020-09871-1

Pham-Duc, B., Tran, T., Huu Hoang, D., & Bao Do, C. (2022). Global scientific literature on human resource development: a bibliometric analysis using Scopus database. European Journal of Training and Development, 47(7/8), 846–861. https://doi.org/10.1108/ejtd-01-2022-0004

Phan Tan, L. (2022). Bibliometrics of social entrepreneurship research: Cocitation and bibliographic coupling analyses. Cogent Business & Management, 9(1). https://doi.org/10.1080/23311975.2022.2124594

Porter, M. E. (1991). America's Green Strategy. Scientific American, 264(4), 168–168. https://doi.org/10.1038/scientificamerican0491-168

Porter, M. E., & Linde, C. van der. (1995). Toward a New Conception of the Environment-Competitiveness Relationship. Journal of Economic Perspectives, 9(4), 97–118. https://doi.org/10.1257/jep.9.4.97

Pranckutė, R. (2021). Web of Science (WoS) and Scopus: The Titans of Bibliographic Information in Today's Academic World. Publications, 9(1), 12. https://doi.org/10.3390/publications9010012

Ramanathan, R., Poomkaew, B., & Nath, P. (2014). The impact of organizational pressures on environmental performance of firms. Business Ethics: A European Review, 23(2), 169–182. https://doi.org/10.1111/beer.12042

Rocio, H. G., Jaime, O. C., & Cinta, P. C. (2023). The Role of Management in Sustainable Tourism: A Bibliometric Analysis

Approach. Sustainability, 15(12), 9712. https://doi.org/10.3390/su15129712

Saeed, A., Jun, Y., Nubuor, S., Priyankara, H., & Jayasuriya, M. (2018). Institutional Pressures, Green Supply Chain Management Practices on Environmental and Economic Performance: A Two Theory View. Sustainability, 10(5), 1517. https://doi.org/10.3390/su10051517

Sardana, V., & Singhania, S. (2022). Fifty Years of Research in Deposit Insurance: A Bibliometric Analysis and Review. FIIB Business Review, 231971452211164. https://doi.org/10.1177/23197145221116455

Setiawan, D., Rahmawati, I. P., & Santoso, A. (2023). A bibliometric analysis of evolving trends in climate change and accounting research. Cogent Business & Management, 10(3). https://doi.org/10.1080/23311975.2023.2267233

Shevchenko, A. (2020). Do financial penalties for environmental violations facilitate improvements in corporate environmental performance? An empirical investigation. Business Strategy and the Environment, 30(4), 1723–1734. Portico. https://doi.org/10.1002/bse.2711

Singhania, S., Singh, J., & Aggrawal, D. (2022). Gender diversity on board and corporate sustainability: a quantitative review based on bibliometric mapping. International Journal of System Assurance Engineering and Management, 14(1), 267–286. https://doi.org/10.1007/s13198-022-01789-w

Sutherland, J. W., Richter, J. S., Hutchins, M. J., et al. (2016). The role of manufacturing in affecting the social dimension of sustainability. CIRP Annals, 65(2), 689–712. https://doi.org/10.1016/j.cirp.2016.05.003

Tan, B. (2016). The antinomial approach to environmental regulation. Peking University Law Journal, 28(6), 1512–1535.

Testa, F., Daddi, T., De Giacomo, M. R., Iraldo, F., & Frey, M. (2014). The effect of Integrated Pollution Prevention and Control regulation on facility performance. Journal of Cleaner Production, 64, 91–97. https://doi.org/10.1016/j.jclepro.2013.08.003

Testa, F., Styles, D., & Iraldo, F. (2012). Case study evidence that direct regulation remains the main driver of industrial pollution avoidance and may benefit operational efficiency. Journal of Cleaner Production, 21(1), 1–10. https://doi.org/10.1016/j.jclepro.2011.09.002

Ullah, R., Asghar, I., & Griffiths, M. G. (2022). An Integrated Methodology for Bibliometric Analysis: A Case Study of Internet of Things in Healthcare Applications. Sensors, 23(1), 67. https://doi.org/10.3390/s23010067

van Eck, N. J., & Waltman, L. (2009). Software survey: VOSviewer, a computer program for bibliometric mapping. Scientometrics, 84(2), 523–538. https://doi.org/10.1007/s11192-009-0146-3

Wan, G., Dawod, A. Y., Chanaim, S., & Ramasamy, S. S. (2023). Hotspots and trends of environmental, social and governance (ESG) research: a bibliometric analysis. Data Science and Management, 6(2), 65–75. https://doi.org/10.1016/j.dsm.2023.03.001

Wang, L., Shang, Y., & Li, C. (2023). How to improve the initiative and effectiveness of enterprises to implement environmental management system certification? Journal of Cleaner Production, 404, 137013. https://doi.org/10.1016/j.jclepro.2023.137013

Wang, M., Cheng, Z., Li, Y., Li, J., & Guan, K. (2020). Impact of market regulation on economic and environmental performance: A game model of endogenous green technological innovation. Journal of Cleaner Production, 277, 123969. https://doi.org/10.1016/j.jclepro.2020.123969

Wang, R., Wijen, F., & Heugens, P. P. M. A. R. (2018). Government's green grip: Multifaceted state influence on corporate environmental actions in China. Strategic Management Journal, 39(2), 403–428. Portico. https://doi.org/10.1002/smj.2714

Wang, Y., Liu, J., Hansson, L., Zhang, K., & Wang, R. (2011). Implementing stricter environmental regulation to enhance eco-efficiency and sustainability: A case study of Shandong Province's pulp and paper industry, China. Journal of Cleaner Production, 19(4), 303–310. https://doi.org/10.1016/j.jclepro.2010.11.006

Xu, L., Mathiyazhagan, K., Govindan, K., et al. (2013). Multiple comparative studies of Green Supply Chain Management: Pressures analysis. Resources, Conservation and Recycling, 78, 26–35. https://doi.org/10.1016/j.resconrec.2013.05.005

Yu, B., Zeng, S., Chen, H., Meng, X., & Tam, C. (2020). Doing more and doing better are two different entities: Different patterns of family control and environmental performance. Business Strategy and the Environment, 30(1), 1–20. Portico. https://doi.org/10.1002/bse.2605

Yu, W., Ramanathan, R., & Nath, P. (2017). Environmental pressures and performance: An analysis of the roles of environmental innovation strategy and marketing capability. Technological Forecasting and Social Change, 117, 160–169. https://doi.org/10.1016/j.techfore.2016.12.005

Zhang, J. (2016). Research on the differences in environmental performance of major urban agglomerations in China and their causes. Reform of Economic System, 1, 57–62.

Zhang, Y., & Song, Y. (2021). Environmental regulations, energy and environment efficiency of China's metal industries: A

provincial panel data analysis. Journal of Cleaner Production, 280, 124437. https://doi.org/10.1016/j.jclepro.2020.124437

Zhang, Y., Zhang, R., & Zhang, C. (2022). Insight into the driving force of environmental performance improvement: Environmental regulation or media coverage. Journal of Cleaner Production, 358, 132024. https://doi.org/10.1016/j.jclepro.2022.132024

Zhou, K., Jin, X., Li, X., & Tao, Y. (2023). Enhancing sustainable development through effective disclosure: Corporate environmental performance and readability. Corporate Social Responsibility and Environmental Management. Portico. https://doi.org/10.1002/csr.2569

Zhuo, W. (2023). Environmental regulation and corporate sustainability: Evidence from green innovation. Corporate Social Responsibility and Environmental Management, 30(4), 1723–1737. Portico. https://doi.org/10.1002/csr.2449

Zupic, I., & Čater, T. (2014). Bibliometric Methods in Management and Organization. Organizational Research Methods, 18(3), 429–472. doi: 10.1177/1094428114562629