



## A comparative and conceptual intellectual study of environmental topic in economic and finance

Meilan Yan<sup>a,\*</sup>, Youwei Li<sup>b</sup>, Athanasios A. Pantelous<sup>c</sup>, Samuel A. Vigne<sup>d</sup>, Dalu Zhang<sup>e</sup>

<sup>a</sup> Loughborough Business School, Loughborough University, UK

<sup>b</sup> Hull University Business School, University of Hull, UK

<sup>c</sup> Department of Econometrics & Business Statistics, Monash University, Australia

<sup>d</sup> Luiss Business School, Luiss University, Italy

<sup>e</sup> School of Business, University of Leicester, UK

### ARTICLE INFO

#### JEL classification:

A10  
A12  
C88  
F64  
Q01  
Q40  
Q56

#### Keywords:

Environmental finance (EF)  
Environmental social and governance (ESG)  
Financial innovations  
Bibliometric analysis  
ESG disclosure and investment

### ABSTRACT

We aim to provide a comprehensive overview of the past, present, and future development of environmental related topics in Economics and Finance. In this regard, Environmental Finance (EF)- and Environmental, Social, and Governance (ESG)-related literature is collected and analysed. The paper draws chronological pictures of the topic development in these two recently developed fields by applying bibliometric methods. Then, we provide a novel systemic comparison on their main differences. Reviewing the top journal publications, we identify literature gaps for a future research agenda. In particular, on the one hand, for EF, we suggest exploring various financial innovations to generate environmental benefits research, and thus building up efficient regulatory framework for addressing major regional and/or global environmental issues. On the other hand, for ESG, we respectively provide potential research directions to conduct the cost-benefit study on the real impact of ESG disclosure and to evaluate how ESG investment strategy efficiently deliver sustainable development.

### 1. Introduction

Since the Industrial Revolution of 19th century, economists started to discuss that unsustainable human enterprises could lead to negative externality for society (e.g., Malthus, 1878; Marsh, 1864; Mill, 1849). However, society has just recently begun to recognize the severity of the industrial actions impact on ecological systems. Especially, the concept of planetary boundary as a safe space for sustainable human development (Rockström et al., 2009) has been widely acknowledged recently by the research communities.<sup>1</sup> (Stern, 2007; Young & Steffen, 2009). The frequent adverse environmental changes as consequences of our transgression of the safe operating space have also presented substantial economic and financial repercussions for society as a whole.

The broad range of problems arising from environmental challenges, such as climate change, air pollution, and biodiversity loss, have far-

reaching effects on economy. The heightened frequency of extreme weather events has led to extensive reduction in economic output. For example, between 1992 and 2013, the world lost an estimated \$16 trillion, on average, because of extreme heat fuelled by the climate crisis (Callahan & Mankin, 2022). The impact of air pollution brings about substantial healthcare costs. Lin et al. (2023) shed light on the ramifications of short-term exposure to air pollution on Atrial fibrillation (AF) inpatients in China. Their findings reveal that excessive exposure to PM2.5 and PM10 corresponds to hospitalization expenses totalling 13.98 million CNY and 6.68 million CNY, respectively. Furthermore, the decline in biodiversity bears a direct impact on agricultural productivity. Zhao et al. (2023) indicate a negative relationship between biodiversity loss and the growth of oil production in Indonesia. Their analysis underscores that in the absence of well-structured replanting cycles, the annual palm oil production could potentially experience a decrease of

\* Corresponding author.

E-mail addresses: [m.yan@lboro.ac.uk](mailto:m.yan@lboro.ac.uk) (M. Yan), [Youwei.Li@hull.ac.uk](mailto:Youwei.Li@hull.ac.uk) (Y. Li), [Athanasios.Pantelous@monash.edu](mailto:Athanasios.Pantelous@monash.edu) (A.A. Pantelous), [svigne@luiss.it](mailto:svigne@luiss.it) (S.A. Vigne), [dz101@leicester.ac.uk](mailto:dz101@leicester.ac.uk) (D. Zhang).

<sup>1</sup> The planetary boundary identifies the nine thresholds as a safe operating space of humanity. Nine safe operating space includes climate change, biosphere integrity, land-system change, freshwater use, biochemical flows, ocean acidification, atmospheric aerosol loading, stratospheric ozone depletion.

<https://doi.org/10.1016/j.irfa.2023.103023>

Received 20 June 2023; Received in revised form 1 September 2023; Accepted 25 October 2023

Available online 28 October 2023

1057-5219/© 2023 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

10%–30% compared to the peak production levels observed in 2020.

Environmental issues also have extensive financial consequences, contributing to higher litigation expense, bigger insurance costs, greater volatility in stock prices, increased firm bankruptcy risk, and more. When companies and governments encounter legal actions and lawsuits from affected parties, significant legal fees can arise. For instance, [Sato et al. \(2023\)](#) reveal that an adverse court against corporations listed US and European between 2005 and 2021 lead to an average financial burden of \$163 million and can diminish the average firm value by 4%. Frequent environmental disasters have the effect of increasing insurance premiums for both individuals and businesses. [Mussio et al. \(2023\)](#) estimate the costs incurred from traffic accidents associated with climate-related incidents in the United Kingdom in 2021. Their study shows that instances of extreme weather events increase risk premium by up to 1.6 million. Companies implicated in environmental issues often experience a decline in investor confidence, leading to a subsequent drop in stock prices. [Guo et al. \(2023\)](#) document a strong negative relationship between air pollution and share premium in China. They argue that the temporary ‘derepress’ asset prices are result of investors' pessimistic feelings about the market developed by the sudden increased air pollution over time. Uncertain physical damages caused by climate-related events will elevate business cost. [Feng et al. \(2023\)](#) show the positive effect of climate change exposure on bankruptcy risk across 72 countries during the 2001–2021 period.

Considering the substantial influence that environmental problems wield over economics and finance, it becomes imperative for academics to deliberate on the interplay between economic and financial dimensions within the realm of environmental subjects. Given such fast-growing research interests and far-reaching economic implications ([Fan, et al., 2023](#); [Hong et al., 2020](#); [Li et al., 2023](#); [Linnenluecke et al., 2016](#)), we believe there is necessity to understand this topic in a systematic way to provide comprehensive review over the intellectual and conceptual structure in terms of topical development in Economics and Finance study. Both intellectual and conceptual study are useful tools to review the development of a scientific subject, while the former is based on citation statistics and latter is based on main context and/or keywords analysis.

In the Economics and Finance context, the two mainstreams of literature concerning environment could be categorised: *Environmental Finance* (EF) and *Environmental, Social and Governance* (ESG). In general, EF is an interdisciplinary study area connecting research in finance and the natural sciences to develop market trading mechanisms and/or financial products address some of humanity concerns, such as climate finance, carbon finance, green finance ([Linnenluecke et al., 2016](#)). The ESG study normally refers to use the three key factors, *environmental, social, governance*, to measure and contribute to the substantiality of a business model ([Friede et al., 2015](#)). ESG can also be considered as a framework to assess how a company create the long-term sustainable value in a rapidly changing world associated with environmental, social, and economic changes. Therefore, despite both area of research emphasizes environmental issues, EF tends to closely relate with financial economics and ESG is inclined with focus on financial management.

The aim of this paper is to assist academics understand better the fields of EF and ESG. Our contribution in the existing literature is three-fold. First, we systematically investigate how both topics have been developed, evolved, and expanded by applying bibliometric methods and comprehensive literature review. The second contribution of this paper is to provide the first comparative bibliometric-based analysis to visualize the development of environmental related topics in Economics and Finance. Because of the two-mainstream literature of EF and ESG, we have the opportunity to compare and explore those topics in terms of their intellectual and conceptual structures. Finally, the study identifies a few potential literature gaps of EF and ESG as well as suggests directions for future research.

The remainder of the paper is as follows: In [Section 2](#), the methodology and data description is delineated. [Section 3](#) provides the

intellectual structure of EF and ESG by applying bibliometrics analysis. [Section 4](#) describes and compares conceptual structure of ESG and EF in recent years. [Section 5](#) discusses future research questions and agendas in these areas. [Section 6](#) is the final conclusions.

## 2. Methodology and data

### 2.1. Methodology

*Bibliometrics* is a method to evaluate academic publications ([Pritchard, 1969](#)). The findings of Bibliometric study, based on quantitative statistical analysis, can be used to visualize the scope and structure of the discipline and discover the influential authors and main research clusters ([Broadus, 1987](#); [Fahimnia et al., 2015](#); [Zemigala, 2015](#)). This research technique is also more suitable for academic fields with enormous numbers of outputs, especially in the study of exploring the internal relationship of the literature ([Zhao et al., 2018](#)). Bibliometric has been used extensively in life science, operational research, engineering, medicine, and nursing subject areas, but just started to get exposure in Economics and Finance. In the UK, REF 2021 documents suggest this method will be a major and enhanced component in forming submission strategy making by review panels ([Corbet et al., 2019](#)).

Among all data visualization software for bibliometric analysis, Citespace, Gephi, R package Bibliometrix, and VOSviewer can access almost all databases and are friendly users. We use R package Bibliometrics which is developed by [Aria and Cuccurullo \(2017\)](#). The Bibliometrix in R language is flexible tool which is often being upgraded and interreacts nicely with other statistical R-packages. It is therefore very useful in a constantly changing science such as bibliometrics. [Corbet et al. \(2019\)](#) use R package bibliometrix to surface the main trends and research networks of the financial economics of precious metals from a bibliometric and sociometric perspective. For visualizing the intellectual structure of this topic area, we use graphic network models to present *author collaboration patterns*, *journal citation linkages*, and *keyword connections*. Nodes and edges are two important aspects in graphic network models, where the nodes are individual units of analysis (e.g., authors, countries, journals) and the edges are the links between each node. In this study, the bigger the nodes the higher the degree of centrality of the individual units of analysis, and the thicker the edges the higher weight of correlation between individual units in the networks. For capturing the dynamic conceptual structure of a topic, we use a combination of approaches in bibliometrics including word clouds, evolution of trend topics, occurrence frequency of keywords, and keyword co-occurrence analysis.

### 2.2. Data selection

The validity of bibliometric analysis for research evaluation largely depends on database selection. Google Scholar (GS), Web of Science (WOS), and Scopus are three major reference and citation-enhanced indexing databases. Even though there is a long debate regarding the choice of data source, each of them has its own advantages and disadvantages. But within Economics and Finance topics, Scopus provides more metrics that leads to richer results due to its broad and inclusive journal coverage nature ([Corbet et al., 2019](#)). Comparing with Google Scholar and Web Science, Scopus offers a more comprehensive reference set and consistent form of author profiles as well as institutional and national affiliation information. Therefore, all data used in this paper are sourced from Scopus. In addition, our data starts at 1990, since data before 1990 is scattered and provides limited impact to the analysis ([Harzing & Alakangas, 2016](#); [Michels & Schmoch, 2012](#)). We also keep self-citation information in the dataset, because it does not misrepresent our findings as long as the sample is large enough ([Corbet et al., 2019](#); [Waltman, 2016](#)).

In both areas, we select final published articles stage (PUBSTAGE, “final”; DOCTYPE, “ar”; SRCTYPE, “j”) between 1990 and 2022 (i.e.,

PUBYEAR >1989 AND PUBYEAR (2023). All documents are limited in Business, Management and Accounting & Economics (SUBJAREA, "BUSI"), and Econometrics and Finance subject areas SUBJAREA,"ECON"). Following the literature definition of EF, our search strategy of 'title-abstract-keyword' includes *environmental finance*, *climate finance*, *green finance*, and *carbon finance*. Based on the description of ESG, we choose environmental, social, and governance as well as ESG for "title-abstract-keyword" (see Table 1).

### 2.3. Overview of the statistics

Table 2 shows the descriptive statistic for our sample. Over the period from 1990 to 2022, the sample consists of 2114 EF papers and 2734 ESG articles. ESG has larger sample of publications. Those papers are published in a broad selection over 690 of journals respectively. The average citation per documents in EF (24.73) is higher than in ESG (22.4), and the average citations per year per documents between two areas are quite similar (EF is 3.647 and ESG is 3.656). It is also worth noting that the average citation per document is ESG (21.12) is much higher than in EF (6.69) although the average citation per year per documents between two areas are unchanged if we exclude publish year of 2022. This interesting fact suggests that work in ESG might start earlier than in EF while they have similar popularity over the time. The higher terms of author's keywords in ESG (6666) than in EF (5669) reflect the fact that research in ESG is more developed than in EF.<sup>2</sup> The higher terms of Keyword plus in EF (5231) than in ESG (4164) show keywords in EF have been used more in various scientific areas than in ESG.<sup>3</sup> The average numbers of co-authors per documents in EF is 2.6 and in ESG is 2.73, which are higher than mean number of co-authors in the top economics journals standing at 2.2 (Card & DellaVigna, 2013). This indicates high collaborations in EF and ESG related topic areas in economics and finance.

### 3. The intellectual structure of EF and ESG

The intellectual structure of a knowledge domain is a powerful tool for tracking the development of scientific subject based on citation analysis (Chen & Paul, 2001). Following Ramos-Rodríguez and Ruíz-Navarro (2004), we explore the intellectual structures of EF and ESG study by conducting both citations and co-citations analysis on authors, countries, and journals.

**Table 1**  
Search strategy.

Area of study	Search strategy
EF	(TITLE-ABS-KEY (environmental AND finance) OR TITLE-ABS-KEY (climate AND finance) OR TITLE-ABS-KEY (green AND finance) OR TITLE-ABS-KEY (carbon AND finance)) AND PUBYEAR >1989 AND PUBYEAR <2023 AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (SUBJAREA, "ECON")) AND (LIMIT-TO (SRCTYPE, "j"))
ESG	(TITLE-ABS-KEY (environmental AND social AND governance) OR TITLE-ABS-KEY (esg)) AND PUBYEAR >1989 AND PUBYEAR <2023 AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (SUBJAREA, "BUSI") OR LIMIT-TO (SUBJAREA, "ECON")) 2022 AND (LIMIT-TO (SRCTYPE, "j"))

<sup>2</sup> Author Keywords consist of a list of terms that authors believe best represent the content of their paper (Zhang et al., 2015).

<sup>3</sup> Keywords Plus are words that appear frequently in the titles of an article's references but not necessarily in the title of the article Keywords Plus terms capture an article's content with greater depth and variety of scientific fields, but less comprehensive than author keywords (Zhang et al., 2015).

**Table 2**  
Descriptive Statistic.

Measure	EF Count	ESG Count
Documents	2114	2734
Timespan	1990:2022	1990:2022
Sources (Journals, Books, etc)	693	727
Average citations per documents	24.73	22.4
Average citations per year per doc	3.647	3.656
Author's Keywords	5669	6666
Keywords Plus	5231	4164
Authors	4745	6269
Author Appearances	5502	7468
Authors of single-authored documents	481	571
Documents per Author	0.446	0.436
Co-Authors per Documents	2.6	2.73

Note: The above table presents the key characteristics of sample of analysed research articles.

Table 3 lists top ten authors in each of the filed in terms of production. Taghizadeh-Hesary F. appears to contribute most in terms of numbers of publications, while Zhang D.<sup>4</sup> is the top individual contributed author in EF. In ESG, Li Y. has highest number of publications and Buallay A. is the top individual contributed author. Comparing with the number of articles of top authors, we can observe that the average output of top author in EF study is 9.0 papers, however, the average output of top author in ESG study is 8.6 papers. From the numbers of article fractionalized, most top authors in EF have around 3.2, while in ESG have around 4.2 of outputs. This shows that those top authors' contribution to ESG is also higher than the contribution from top authors to EF.

Table 4 shows the top 10 journals of publication. It appears that outputs are concentrated in several journals. Majority articles of both areas are published in 5 journals: *Journal of Cleaner Production*, *Ecological Economics*, *World Development*, *Journal of Sustainable Finance and Investment*, *Business Strategy and the Environment*. Some distinctive publishing characteristics can also be shown. EF articles are published in economics journals (e.g., *Energy Economics*, *Environmental and Resource Economics*), while ESG papers are published in management policy related journals (e.g., *Marine Policy*, *Corporate Social Responsibility and Environmental Management*). The difference between choice for publication also indicates distinctive research themes in two areas. In addition, most these journals are not mainstream economics or finance journals, this suggests that the study of EF and ESG is an area that is somewhat scattered, in terms of number of publications and the choice of journals for publication. This may be due to the fact that those topical explorations might start in other scientific fields then merge into Economics and Finance in recent years.

Table 5 shows top 10 national concentrations of authorship. The dominant locations are developed countries and the US tops the list. Although China lists as the second most productive country in EF study and the third most productive country in ESG, it is not surprise that there is a lack of related research produced by other developing countries. Preference for rapid corporate growth over management quality in emerging markets as a potential reason for this research gap (Kurtz et al., 2012). Table 6 summarize top 10 national concentrations of citations. In terms of total citations, the US and UK are the top cited countries in both EF and ESG studies. With regard to average article citations in EF research, Turkey has the highest over 65 followed by Spain (44.11) and the US (38.14), which might suggest Turkey has produced several high popular papers. In respect of average article citations in ESG study, the US, the UK, Germany, and Netherland have number over 35.

Despite China is one of the most productive countries, the popularity of those papers still quite low given the average citation of China in both

<sup>4</sup> We add first initials for authors mentioned in the paper with same surnames.

**Table 3**  
Top 10 Authors.

EF				ESG			
Authors	Articles	Authors	Articles Fractionalized	Authors	Articles	Authors	Articles Fractionalized
Taghizadeh-hesary F.	14	Zhang D.	4.92	Li Y.	12	Buallay A.	5.92
Wang Y.	10	Taghizadeh-hesary F.	4.18	Buallay A.	10	Camilleri M.A	5.00
Wang Z.	10	Lee C.C.	3.25	Crifo P.	9	Velte P..	5.00
Lee C.C.	9	Yoshino N.	3.00	Gallefo-Alvarez I.	8	Giannarakis G.	4.17
Li Y.	9	Zhang H.	2.95	Rezaee Z.	8	Galbreath J.	4
Wang X.	9	Wang Z.	2.80	Wang J.	8	Paavola J.	4
Moneva J.M.	8	Monasterolo I.	2.75	Wang Z.	8	Rezaee Z.	3.78
Yoshino N.	8	Wang X.	2.75	Zhang X.	8	Crifo P.	3.53
Zhang D.	8	Wang Y.	2.71	Zhang Y.	8	Jitmaneeerj B.	3.53
Zhang H.	5	Bergset L.	2.50	Gangi F.	7	Li Y.	3.37

Note: The above table illustrates the top authors in terms of outputs and contribution adjust for co-authorship.

**Table 4**  
Top 10 output journals.

Sources	EF-Articles
Journal of Cleaner Production	227
Energy Economics	65
Business Strategy and The Environment	54
Journal of Sustainable Finance and Investment	52
Ecological Economics	49
Resources Policy	39
Environmental and Resource Economics	37
Technological Forecasting and Social Change	30
World Development	29
Journal of Environmental Economics and Management	26
Sources	ESG-Articles
Journal of Cleaner Production	171
Marine Policy	118
Business Strategy and The Environment	77
Ecological Economics	70
Journal of Business Ethics	69
Corporate Social Responsibility and Environmental Management	61
Journal of Sustainable Finance and Investment	54
World Development	46
Sustainability Accounting Management and Policy Journal	42
Forest Policy and Economics	39

Note: The above table illustrates the top 10 Journal publication sources.

**Table 5**  
Author Countries.

Country	EF-Articles	Country	ESG-Articles
US	283	US	255
China	241	United Kingdom	213
United Kingdom	151	China	155
Australia	73	Australia	152
Germany	71	Italy	119
Italy	62	Spain	93
Spain	61	Canada	92
France	51	Germany	84
Canada	50	France	81
India	40	Netherlands	67

Note: The above table illustrates the countries in the author locations.

EF and ESG studies are below 20.

Table 7 lists the most cited papers in the field. Three papers Cheng et al. (2014), Terjesen et al. (2009), and Renneboog et al. (2008) have been listed in both research areas. The range of total citations and total citations per year in EF papers are higher than ESG paper. This suggest that although there are less EF papers published in the sample period, the popularity of EF articles might be higher than ESG papers. From the journals of the top cited papers, we can see the citation sources in both areas are quite mixed, combined with several management journals and economics journals.

Fig. 1 and Table 8 show bibliometric coupling for co-authorship

**Table 6**  
Top 10 citation countries.

Country	EF Total Citations	Average Article Citations	Country	ESG Total Citations	Average Article Citations
US	10,793	38.14	US	10,005	39.24
China	4768	19.78	United Kingdom	8029	37.69
United Kingdom	4550	30.13	Australia	4235	27.86
Spain	2691	44.11	Germany	3094	36.83
Australia	2304	31.56	Spain	2993	32.18
Canada	1757	35.14	Netherland	2567	39.31
Netherland	1579	39.48	Canada	2414	26.24
France	1278	25.06	China	2155	13.90
Germany	1134	15.97	Italy	2076	17.45
Turkey	1011	67.4	France	1264	15.60

Note: The above table illustrates the top ten citations count in countries.

pattens across countries and country members of clusters. For limiting the amount of visual clutter, we also focus on countries that have published 5 or more papers.<sup>5</sup> Country members of co-authorship clusters are coloured in Fig. 1 and listed in Table 8. Fig. 1 illustrates the co-authorship pattern across countries. The largest clusters of co-authorship in EF research are centred in the US, then the UK and China. The largest clusters of co-authorship in ESG study are centred in the US and Italy. Table 8 presents the groups of country members clusters. In EF research, country collaboration has been split into 5 clusters. It is interesting to note that authors from three largest cluster centres, the US, the UK, China, do not collaborate much closely between each other. China (cluster 1) connects with Pakistan, New Zealand, and Ireland. The US (cluster 2) forms close link with Australia, Italy, and Netherlands. The UK (cluster 5) relates to Switzerland, and South Africa. In ESG study, country collaboration has been split into 2 clusters. The USA (cluster 1) closely works with the UK, China, and Australia. Italy (cluster 2) links with Germany, France, and Spain.

Fig. 2 shows the co-authorship patterns across individual authors, with the threshold set at the minimum of 4 publications. Comparing the collaboration pattern between two areas, the author collaboration in EF research is not only much closer than ESG but the link between each different cluster in EF is also quite closer than ESG. EF related topics have 5 research groups. The centre author in each group is also the top author listed in Table 3. One cluster closely around Taghizadeh-Hesary F.; the other one around Wang Y.; the third one around Li Y.; the fourth one around Moneva J. M.; the fifth one around Zhang D.. Although it is clear to see the collaboration network is more scattered in ESG study, there are still 4 high concentrate research groups. One cluster closely around Li Y.; the other one around Crifo P.; the third one around

<sup>5</sup> We follow Corbet et al. (2019) to analyse the most impactful trends.

**Table 7**  
Top 10 Cited papers.

EF-Paper	Year	Journal	Total Citation	Total Citation/Year
Klassen & McLaughlin	(1996)	Manage SCI Strategic Manage	1540	57.0
Cheng et al.	(2014)	J	1097	121.9
Terjesen et al.	(2009)	Corp Gov	707	50.5
Ozturk & Acaravci	(2013)	Energy Econ	701	70.1
Renneboog et al.	(2008)	J Bank Finance Strategic Manage	694	46.3
Barnett M.L.	(2006)	J	667	39.2
Jalil & Feridun	(2011)	Energy Econ Account Organ	614	51.2
Gray R.	(2010)	Soc	593	45.6
Tamazia & Bhaskara.	(2010)	Energy Econ	522	40.2
Hallikas et al.	(2004)	Int J Prod Econ	498	26.2
<b>ESG-Paper</b>				
		Strategic Manage		
Cheng et al.	(2014)	J	1097	121.9
Terjesen et al.	(2009)	Corp Gov	707	50.5
Renneboog et al.	(2008)	J Bank Financ	694	46.3
Jo & Harjoto	(2011)	J Bus Ethics J Sustain Finance	597	49.8
Friede G.	(2015)	Invest Strategic Manage	487	60.9
Walls et al.	(2012)	J	464	42.2
Post et al.	(2011)	Bus Soc	445	37.1
Foley et al.	(2010)	Mar Policy Bus Strategy	375	28.8
Kolk & Perego	(2010)	Environ	363	27.9
Paavola & Adger	(2006)	Ecol Econ	361	21.2

Note: The above table presents the top cited journal articles in the research sample.

Gallego-Alvarez I.; the fourth one revolving around Wang Z.; and fifth one around Gangi F..

Fig. 3 and Table 9 present journal coupling patterns. Bibliometric coupling describes the common reference sets between two articles or domains. There are two journal clusters in EF. “Journal of Cleaner Production” is the centre of first cluster (cluster 1 in Table 9, red cluster in Fig. 3A). It closely links with Ecology and Management journals such as “Business Strategy” and “The Environment and Ecological Economics”. “Energy Economics” is the centre of the second cluster in EF (it is the biggest cluster in EF, cluster 2 in Table 9 and blue cluster in Fig. 3A). It is coupled with majority members of Economics and Energy related journals, for example, “Journal of Sustainable Finance and Investment”, “World Development”, and “Forrest Policy and Economics”.

There are two journal clusters in ESG. “Journal of Cleaner Production” is the centre of the first cluster (cluster1 in Table 9 and red cluster in Fig. 3B). It connects with more Finance related journals such as “Business Strategy”, “the Journal of Business Ethics”, and “the Journal of Business Research”. “Journal of Sustainable Finance and Investment” is the centre of the second cluster in ESG (blue cluster in Fig. 3B and cluster 2 in Table 9). Other productive journals in this clusters include “Environment, Development and Sustainably”, “Finance Research Letters”, and “Journal of Portfolio Management”.

#### 4. The conceptual structure of EF and ESG

Beyond the citation statistics analysis, we investigate conceptual structure of EF and ESG to understand the topic trends within each research area, based on main context or keywords analysis (Moss et al., 2007).

We recognize that there are studies which can be categorised in both EF and ESG areas. However, there will also be some different features of

each area. To visualize these distinctive and overlap features, we combine Venn diagram with word cloud analysis. Firstly, we draw Venn diagrams to shows word clouds for abstracts and keywords for both EF and ESG in top 200 frequency terms (see Fig. 4). The word size represents the mention frequency, which means the bigger the size, the higher the frequency of the word. The intersection part of EF and ESG in Fig. 4A presents the overlapped research topic mentioned in paper abstracts including social, environmental, governance, corporate, performance, sustainability, development, economics, etc. Specific abstract words in EF are included in *finance, emission, banking, funding, cost*; while in ESG included in *esg, responsibility, disclosure, stakeholder, boards*. The intersection part of EF and ESG in Fig. 4B presents the overlapped research topic mentioned in keywords including *climate, investments, technology, organizational, environment*. Specific abstract words in EF are included in *bond, carbon, debt, modelling, technological, globalization*; while in ESG included in *ethics, diversity, ecology, politics, shareholder, transparency*. Such difference word frequency in two areas also reflect distinctive research focus on which EF is more related in finance while ESG is in management. From the above, it can be shown that EF topics are more distinctively focus on financial terms, while ESG more incline with management.

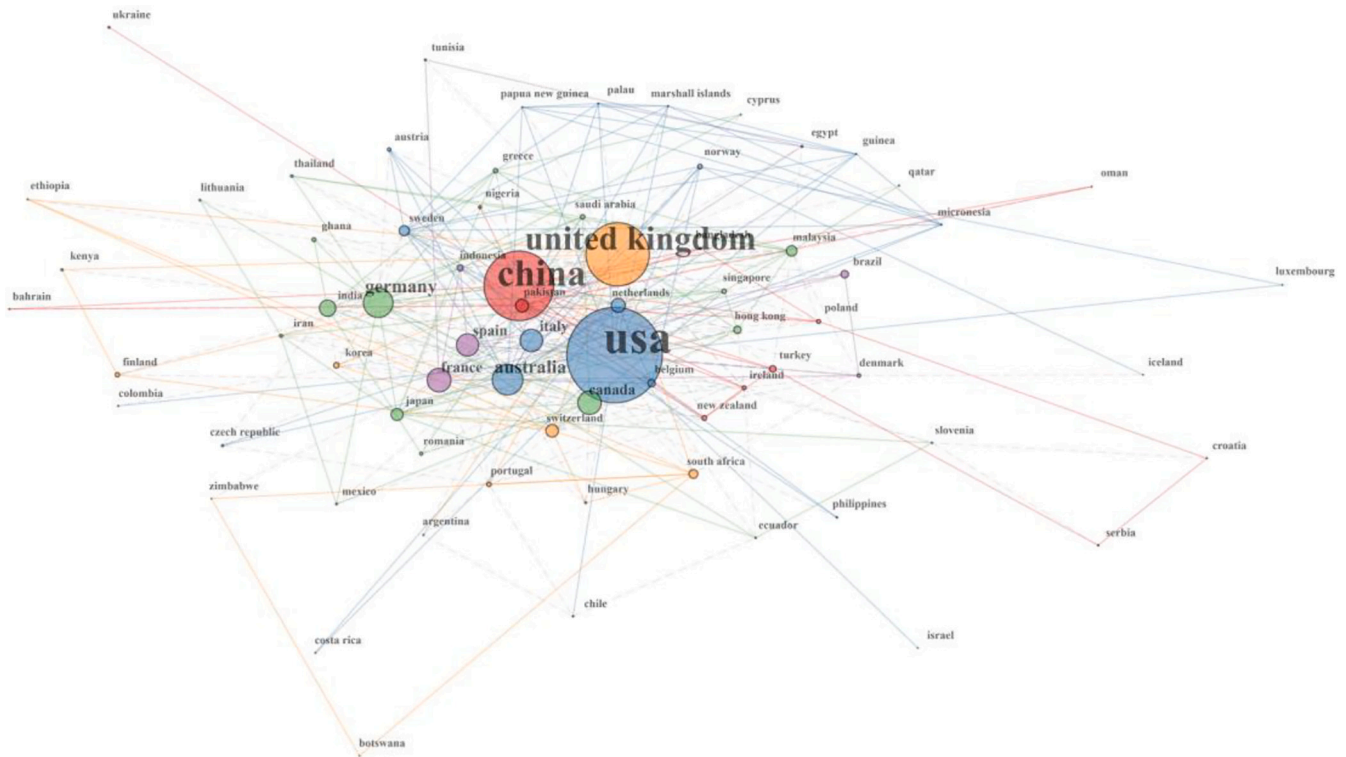
For visualizing the recent trend of topical development dynamic, we firstly calculate the median year for each keyword since 2010, and we choose the top 3 keywords in each year with minimum frequency of 3. Based on the term frequency of collected keywords, we draw on the evolutionary topic trend on the bar chart in Fig. 5. The length of the bar presents the first and last point of the mentioning the keyword. For example, *social responsibility* from EF started around 2005 but lost its popularity after 2013.<sup>6</sup> *Community forestry* from ESG started around 2008 but lost popularity after 2014. The dot in each line is the medium of the term frequency, and the size of the dot represent the level of the attention of this topic. The range term frequency in ESG ([100,200]) is quite bigger than in EF ([25, 100]), which echoes the larger research scale in ESG than in EF.

Certain research trends in EF and ESG can also be observed from Fig. 5. Before 2013, EF study more focused on economics perspectives including *environmental economics, regulation, and global warming*. Between 2013 and 2016, EF related topics were in management, especially in *corporate governance and environmental management*. After 2016, it emerged into finance topic such as *climate finance, green finance and investment, and sustainable finance*. However, before 2013, ESG research started in environmental dimension including *ethical investment, stakeholder, and globalization*. Between 2013 and 2016, it moved to social dimension especially in *social responsibility, corporate responsibility, regulation and ethics, institutional responsibility*. And after 2016, it shifted toward *governance dimension* and also started to combine all *environmental, social, and governance* factors together. This will be further discussed in Sections 4.1 and 4.2.

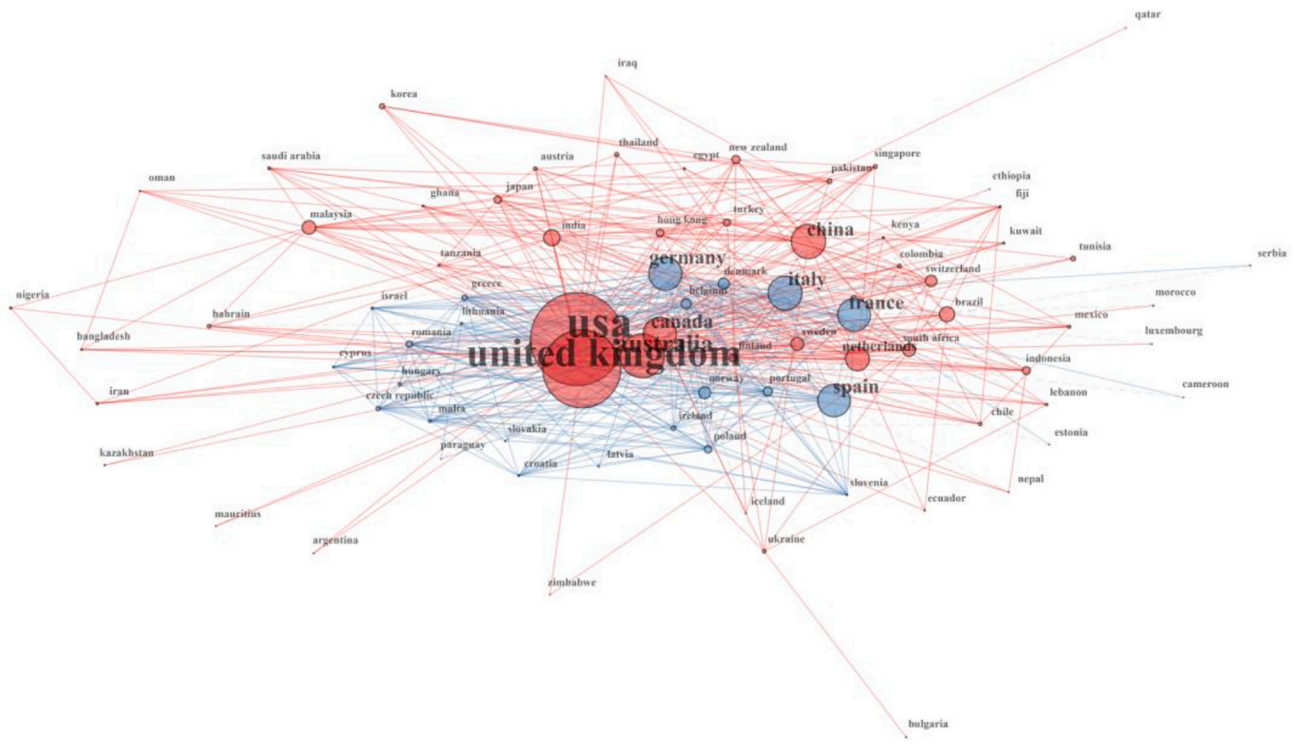
Secondly, we plot the frequency of overall top 10 keywords occurrence from 1990 to 2022 (see Fig. 6). The frequency of keywords in EF are volatile, such as *climate change, sustainability, financial performance, climate finance*, has grown much slowly before 2010 but jumped rapidly afterwards, which shows that this topic area has started to receive most attention in the recent years. The keyword growth trend in ESG is less volatile than in EF, however, topics such as *corporate social responsibility, sustainability, and governance* start to gain more attention after 2015.

Fig. 7 represents the keyword co-occurrence networks. In EF, the central keyword co-occurrence nodes including, *sustainable development, financial performance, and climate change*. “Sustainable development” topic connects with environmental management, decision making, pollution control (cluster in red, Fig. 7A). “Financial performance” topic relates with financial system, green finance, financial development (cluster in blue, Fig. 7A). “Climate change” topic links with carbon

<sup>6</sup> Social responsibility is different from corporate social responsibility.



(A) EF country collaboration



(B) ESG country collaboration

Fig. 1. Co-authorship Patterns across countries-EF &ESG.

Note: For limiting the amount of visual clutter, we focus on authors who have published 5 or more papers. This figure illustrates the co-authorship pattern across countries.

**Table 8**  
Country members of co-authorship clusters.

Country	EF Cluster	Country	EF Cluster	Country	ESG Cluster	Country	ESG Cluster	Country	ESG Cluster
China	1	Canada	3	US	1	Lebanon	1	Slovakia	2
Pakistan	1	Malaysia	3	United Kingdom	1	Bangladesh	1	Estonia	2
Turkey	1	Japan	3	China	1	Saudi Arabia	1	Croatia	2
Ukraine	1	Hong Kong	3	Australia	1	Kenya	1	Cyprus	2
Nigeria	1	Greece	3	Canada	1	Argentina	1	Malta	2
Poland	1	Ghana	3	Brazil	1	Morocco	1	Cameroon	2
New Zealand	1	Romania	3	Netherlands	1	Fiji	1	Paraguay	2
Ireland	1	Iran	3	Malaysia	1	Kazakhstan	1	Slovenia	2
Serbia	1	Saudi Arabia	3	India	1	Mauritius	1		
Bangladesh	1	Singapore	3	Sweden	1	Tanzania	1		
Bahrain	1	Thailand	3	South Africa	1	Bulgaria	1		
Croatia	1	Lithuania	3	Switzerland	1	Luxembourg	1		
Oman	1	Mexico	3	Indonesia	1	Kuwait	1		
USA	2	Ecuador	3	New Zealand	1	Ecuador	1		
Australia	2	Qatar	3	Japan	1	Oman	1		
Italy	2	Cyprus	3	Ukraine	1	Iraq	1		
Netherlands	2	Slovenia	3	Finland	1	Nepal	1		
Sweden	2	Spain	4	Korea	1	Iceland	1		
Belgium	2	France	4	Turkey	1	Italy	2		
Norway	2	Brazil	4	Hong Kong	1	Spain	2		
Austria	2	Indonesia	4	Pakistan	1	Germany	2		
Costa Rica	2	Denmark	4	Colombia	1	France	2		
Czech Republic	2	Egypt	4	Tunisia	1	Portugal	2		
Chile	2	Tunisia	4	Nigeria	1	Norway	2		
Colombia	2	United Kingdom	5	Qatar	1	Romania	2		
Israel	2	South Africa	5	Zimbabwe	1	Poland	2		
Micronesia	2	Switzerland	5	Ethiopia	1	Belgium	2		
Philippines	2	Portugal	5	Thailand	1	Greece	2		
Iceland	2	Finland	5	Iran	1	Denmark	2		
Luxembourg	2	Korea	5	Bahrain	1	Czech Republic	2		
Palau	2	Hungary	5	Mexico	1	Ireland	2		
Guinea	2	Kenya	5	Singapore	1	Hungary	2		
Marshall Islands	2	Argentina	5	Chile	1	Lithuania	2		
Papua New Guinea	2	Ethiopia	5	Egypt	1	Israel	2		
Germany	3	Botswana	5	Austria	1	Serbia	2		
India	3	Zimbabwe	5	Ghana	1	Latvia	2		

Note: The above table presents the country clusters in the research sample.

emissions, renewable energy, emission control (cluster in green, Fig. 7A). In ESG, the central keyword co-occurrence nodes including, *governance approach* and *sustainable development*. “Governance approach” topics relates to corporate social responsibility, climate change, stakeholders, investment (cluster in red, Fig. 7B). “Sustainable development” topic connects with economic and social effects, environmental protection, public policy, emission control (cluster in blue, Fig. 7B). These findings are also consistent with the analysis of word clouds (Fig. 4).

From the results of topic trend and keyword occurrence analysis, we can see periodical development to both research area. In the following two subsections, we will solely review key literature in the different periods.

#### 4.1. Environmental finance

##### 4.1.1. Economics dimension: global policy and regulation (<2012)

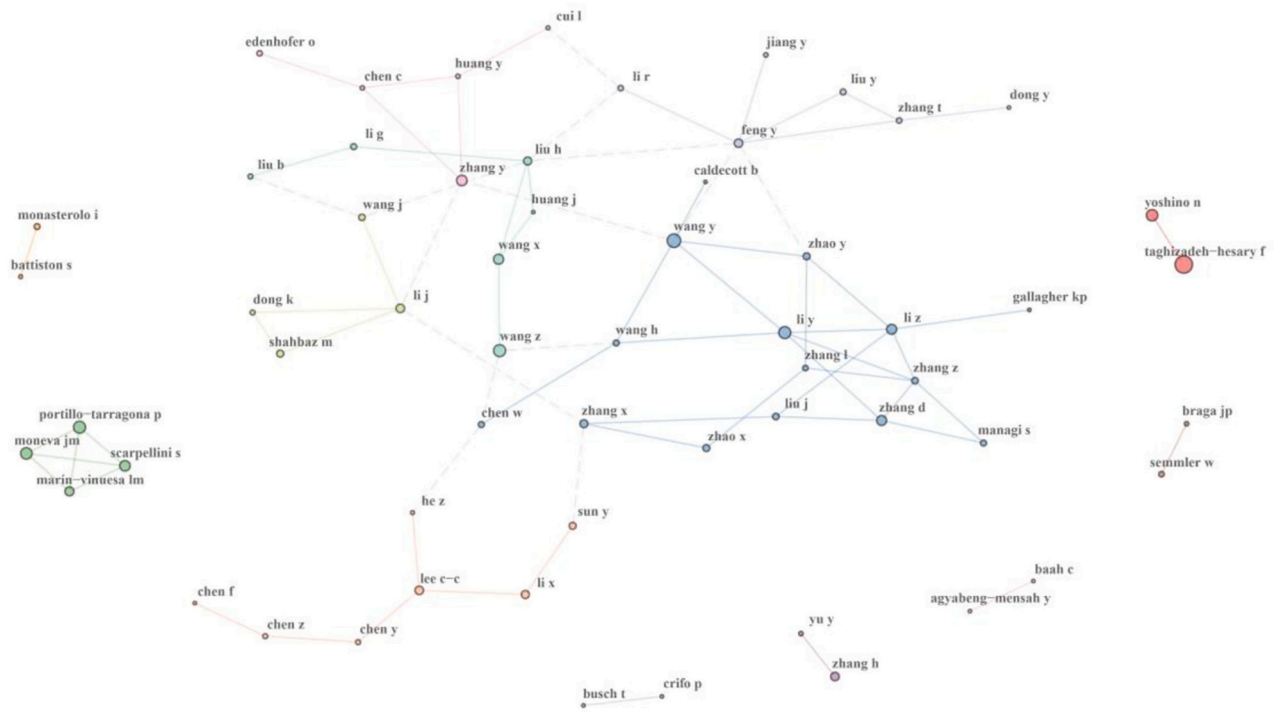
Before 2012, environmental finance study more focused on the discussions of environmental economics, regulation, and global warming. For example, Klassen (1996) proposes a theoretical model to prove a strong environmental management could improve future financial performance. But Rassier & Earnhart (2010) provide empirical evidence that more stringent US Clean Water Act regulation undermines expected future financial performance. Laurent-Lucchetti & Leach (2011) develop a theoretical model to indicate unequal distributional implications of climate policies on generational welfare. López-Gamero, Jose, & Enrique (2010) evaluate the relationship between managerial perception and the different styles of environmental regulations.

##### 4.1.2. Management dimension: corporate social responsibility (2013–2016)

From 2013 to 2016, EF research is closely related with corporate social responsibility topics. Cheng et al. (2014) provide evidence that superior performance on CSR strategies could lower company's capital constraints and lead to better access to finance. Chava (2014) finds that firms with environmental concerns have higher cost of capital. Casey & Grenier (2015) provide an empirical examination of the CSR assurance market in the United States. They find that highly regulated companies are more likely to obtain CSR assurance, but highly leveraged firms are less likely to obtain CSR assurance. Lee et al. (2016) also show significant positive relationships between environmental responsibility and corporate financial performance of Korean firms in early 2010s.

##### 4.1.3. Finance dimension: climate change, green finance, financial performance (2016>–)

From 2016 up to now, EF related literature has moved to finance dimension such as climate change, green finance, and financial performance. For instance, Geddes and Schmidt (2020) provide empirical analysis of the role of finance in re-directing the development of new technological practices. Cojoianu et al. (2020) exam how different type of environmental policies affect the financing of green (low carbon), brown (fossil fuel) and gray (unrelated to natural resources) industries. Ren et al. (2020) find the role of green finance in carbon mitigation. Huij, Laurs, Stork, & Zwinkels (2021) propose, carbon beta, as a market-based proxy to measure for climate risk. Bressan & Romagnoli (2021) exam the climate and weather derivatives as instruments to hedge climate risk as well as their implication for financial stability. Braga et al. (2021) provide empirical evidence that governments and multilateral organizations can de-risk green investments by supporting



(A) EF author collaboration



(B) ESG author collaboration

Fig. 2. Co-authorship Patterns across authors.

Note: This figure above shows the co-authorship patterns across individual authors, with the threshold set again at the minimum of 4 publications.



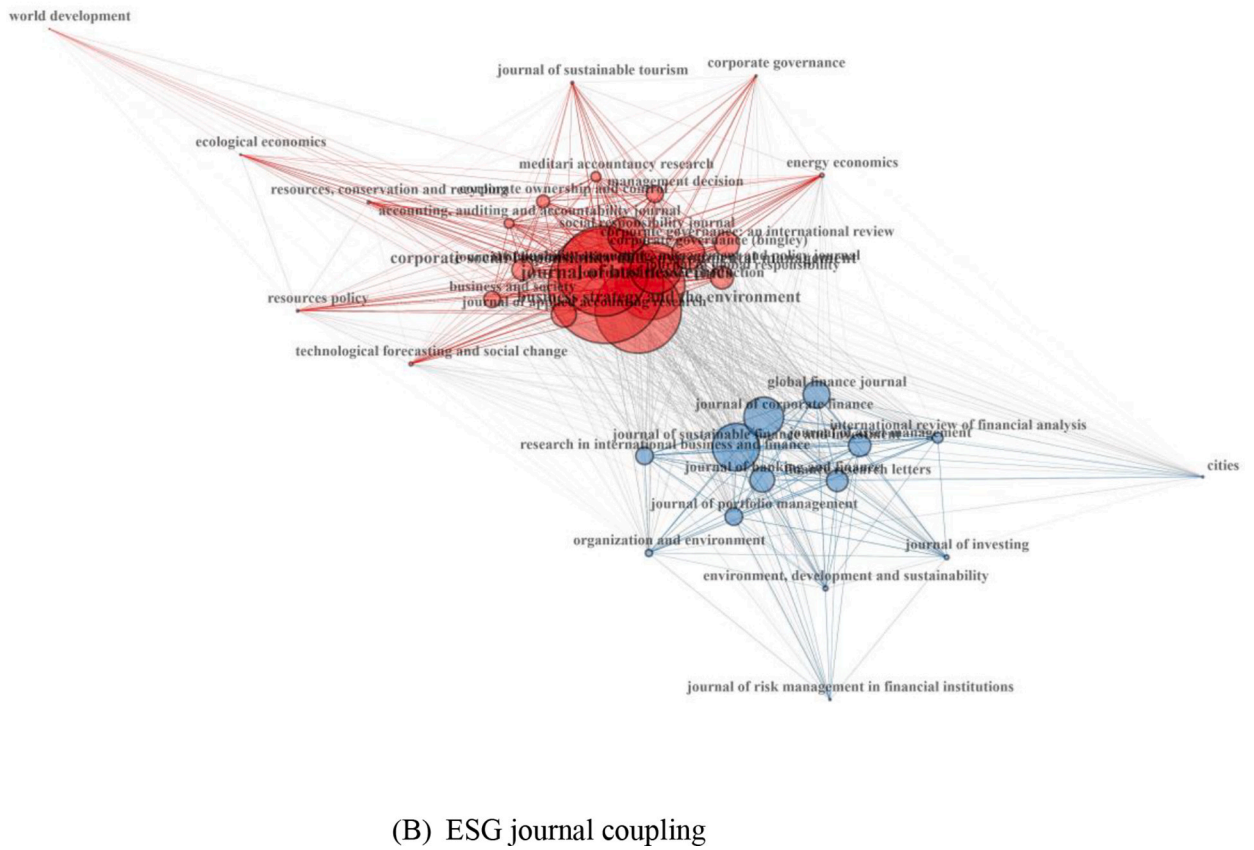
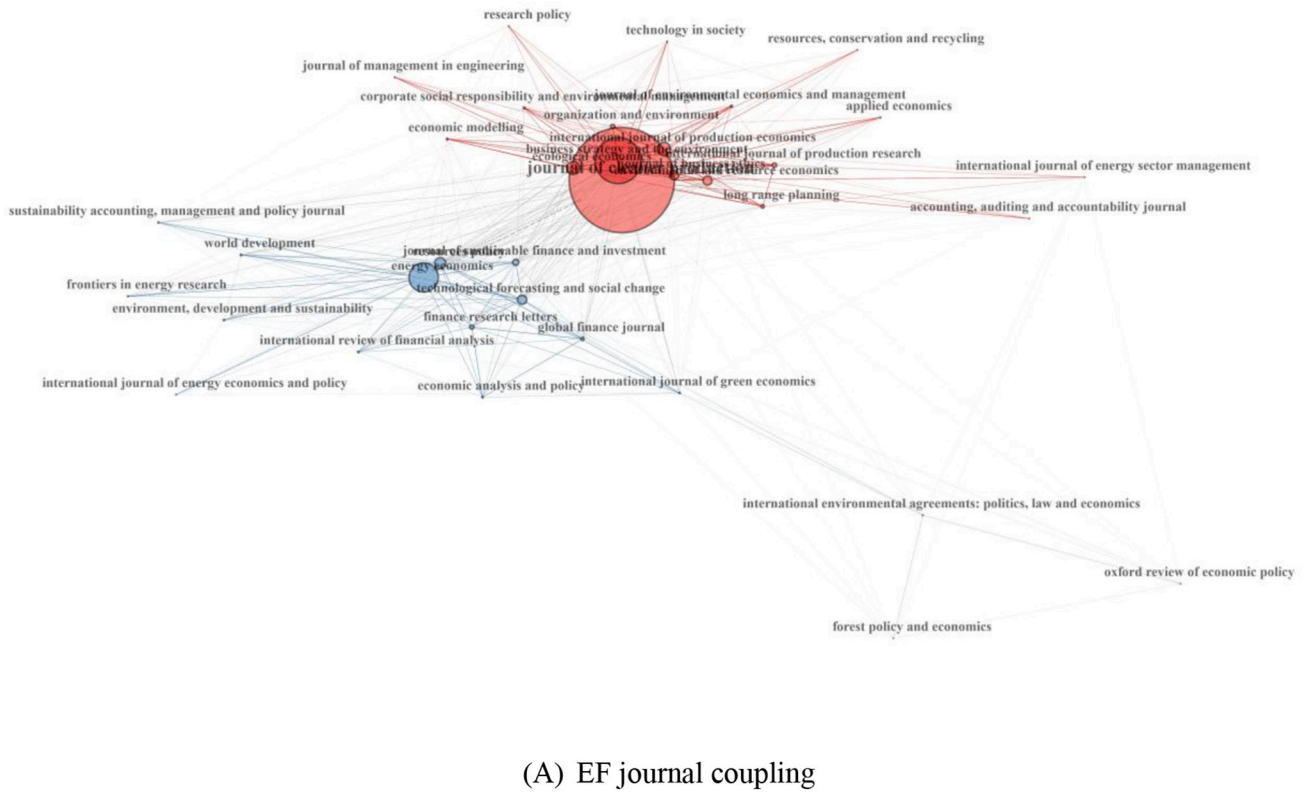


Fig. 3. Journal coupling.  
 Note: This figure above shows the journal citation cluster patterns. We impose a 6-article citation.

**Table 9**  
Journal coupling.

J-EF	Cluster	J-ESg	Cluster
J Cleaner Prod	1	J Cleaner Prod	1
Bus Strategy Environ	1	Bus Strategy Environ	1
Ecol Econ	1	Ecol Econ	1
Environ Resource Econ	1	J Bus Ethics	1
J Environ Econ Manage	1	Corp Soc Resp and Envir Manage	1
Resources, Conservation and Recycling	1	World Development Sustainability Accounting, Manage and Policy J	1
J Bus Ethics	1	Resources Policy	1
Int J Prod Research	1	Social Responsibility J	1
Long Range Planning	1	Corp Gov	1
Int J Energy Sector Manage	1	Accounting, Auditing and Accountability J	1
Organization And Envir	1	J Applied Accounting Research	1
Applied Econ	1	J Bus Research	1
Econ Modelling	1	Resources, Conservation and Recycling	1
Accounting, Auditing and Accountability J	1	Business And Society	1
Corp Soc Resp and Envir Manage	1	Meditari Accountancy Research	1
J Manage in Engineering Research Policy	1	Corp Gov: An Int Review	1
Technology In Society	1	Management Decision	1
Energy Economics	2	Corp Ownership and Control	1
J Sustainable Finance and Investment	2	Journal Of Global Responsibility Technological Forecasting And Social Change	1
Resources Policy	2	Corp Gov (Bingley)	1
Technological Forecasting and Social Change	2	J Sustainable Tourism	1
World Development	2	Energy Econ	1
Int Environ Agreements: Politics, Law and Econ	2	J Sustainable Finance and Investment	2
Envir, Development and Sustainability	2	Envir, Development and Sustainability	2
Forest Policy and Econ	2	Finance Research Letters	2
Finance Research Letters	2	J Portfolio Manage	2
Frontiers In Energy Research	2	Cities	2
Global Finance J	2	J Asset Manage	2
Int J Energy Econ and Policy	2	J Corp Finance	2
Sustainability Accounting, Manage and Policy J	2	J Investing	2
Int J Green Economics	2	Global Finance J	2
Int Review Financial Analysis	2	Research In Intl Bus and Finance	2
Econ Analysis And Policy	2	Organization And Environment	2
Oxford Review Economic Policy	2	Int Review Financial Analysis	2
		J Banking And Finance	2
		J Risk Manage in Financial Institutions	2

Note: The above table presents the journal clusters in the research sample.

the issuance of green bonds. LeitAo, F, & Santibanez Gonzalez, 2021 prove that green bonds are underlined in determining the behaviour of the European Union carbon markets with greater persistent effect than conventional bonds and energy commodities.

## 4.2. ESG

### 4.2.1. Environmental dimension: ethics and globalization (<2012)

Before 2012, ESG research are more focused on ethical investment, stakeholder, and globalization. For example, Halter, de Arruda, & Halter (2009) assess the consistency of transnational companies in their home and host countries, concerning ethics values and social responsibility. Eccles & Viviers (2011) reflect the ethical investment practice mentioned in the academic literature from 1975 to 2009. They show

that ethical investment is significantly more frequently used in journals dealing with ethics, business ethics and philosophy than in finance, economic and investment journals in the sample period. In terms of stakeholder interests, Coleman (2011) provides empirical evidence that firms' sales margin will be hurt by unethical treatment of stakeholder. Fransén (2012) exams the effect of various policy attempts on global environmental issues. They argue that legitimation politicking is a divergence between the surface appearance of the governance of programmes and the programmes' actual institutional design.

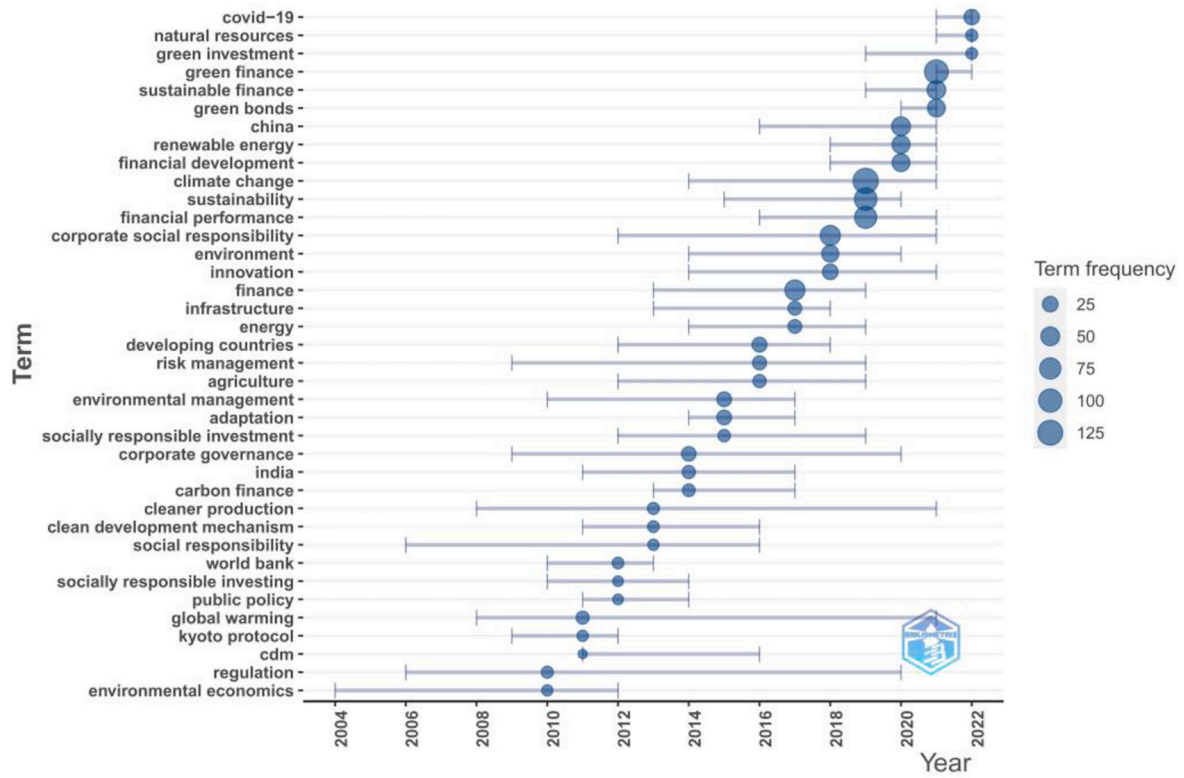
### 4.2.2. Social dimension: institutional responsibility (2013–2016)

From 2013 to 2016, ESG research especially increases attention in examining industry corporate strategy as well as the significant economic and social consequences. For example, Singal (2013) examines the link between sustainability and economic performance for the hospitality industry. Martínez-Ferrero & Frías-Aceituno, 2015 clarify the relationship between companies' sustainable behaviour and their financial performance from 25 countries. Stellner, Klein, & Zwergel (2015) exam the link between corporate credit risk ratings and their non-financial performance results. Shaikat, Qiu, & Trojanowski (2016) develop a theoretical model to explicit the link between CSR related board attributes to financial performance. And Sethi et al. (2016) analyse the link for 48 of the world's largest corporations in the extractive industry.

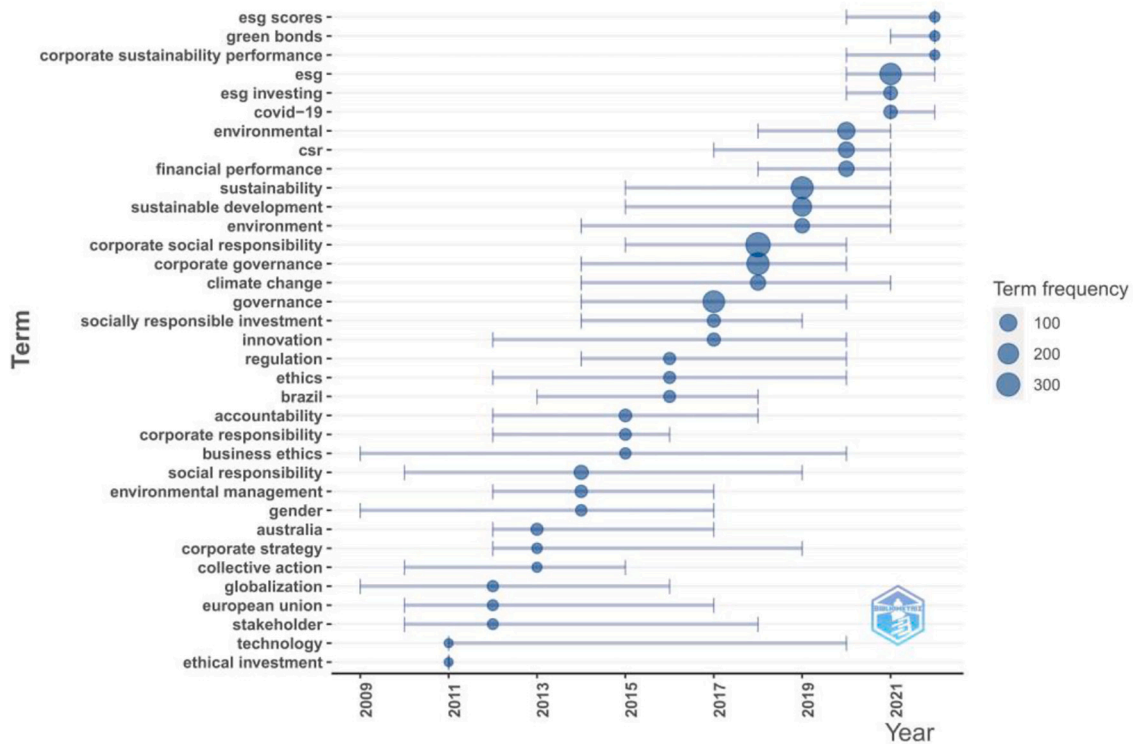
### 4.2.3. Governance & ESG dimension (>2017)

After 2016, ESG related literature shifted from to governance dimension and starting to combine all ESG factors. For instance, Li et al. (2017) find a positive association between ESG disclosure level and firm value. Kim et al. (2019) study the role of institutional investors influences corporate ESG policies. Engle et al. (2020) model climate risk exposures by using firms' ESG scores and hedge climate change risk in a mimicking portfolio approach. Ni & Sun (2018) evaluate different governance mechanisms against the level of environmental dynamism and stakeholder pressure. Nguyen, Nguyen, & Ha (2020) provide empirical evidence that environmental financial accounting practices improve financial performance. Bolognesi & Nahrath, 2020a new theoretical explanation that transversal transaction costs (TTCs) as a critical source of governance failures. Phelps et al. (2021) provide empirical evidence that experts preferred solutions are distinct from resource users' governance measures. Another significant trend of study is in sustainable asset pricing topic embedding ESG factors. Pedersen et al. (2020) compute the empirical ESG-efficient frontier and show the costs and benefits of responsible investing. Avramov et al. (2021) apply an equilibrium model accounting for ESG demand and supply dynamics. They find that in equilibrium, ESG preference shocks associate with positive risk premium. Berk and van Binsbergen (2021) find no evidence that the ESG divestiture strategies could increase the cost of capital of firms, so they suggest socially conscious investors should increase their impact in term of control to change corporate policy. Goldstein et al., 2022develop a rational expectations equality model in which an improvement in the ESG information quality can raise green investors' cost of capital. Ardia et al. (2022) show that green firms outperform brown firms when concerns about climate change increase unexpectedly. Faccini et al. (2021) exam whether climate risk factors are reflected in US stock prices. They find out only climate-policy factor is priced but not natural disaster, global warming, etc. Pástor et al. (2021) exam the outperformance of green assets in recent years reflects unexpectedly strong increases in environmental concerns, not high expected returns. Han et al. (2022) document that the anomalous return of sin stocks is larger in low-liquidity periods than in high-liquidity periods since arbitrage capital is limited in low-liquidity states. Based on recent political fights between ESG believers and deniers, Edmans (2022) responses that ESG is extremely important but nothing special, since it is no better or worse than other intangible assets to drive long-term value and create positive externalities for wider society. Instead, reasonable





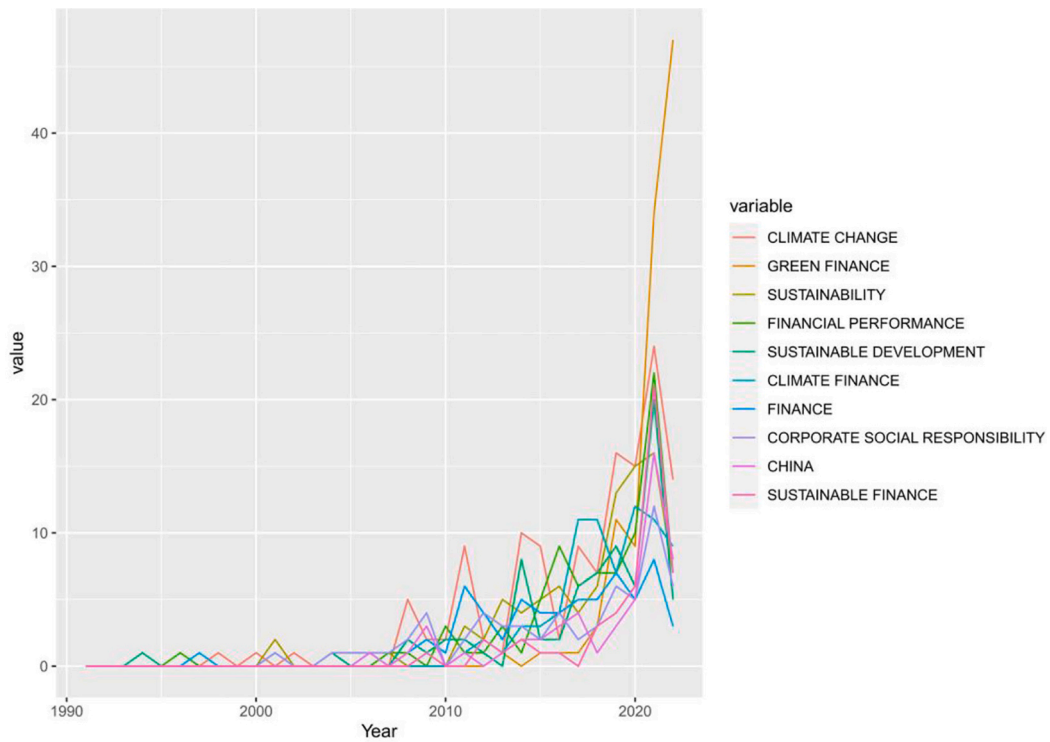
(A) EF trend topics



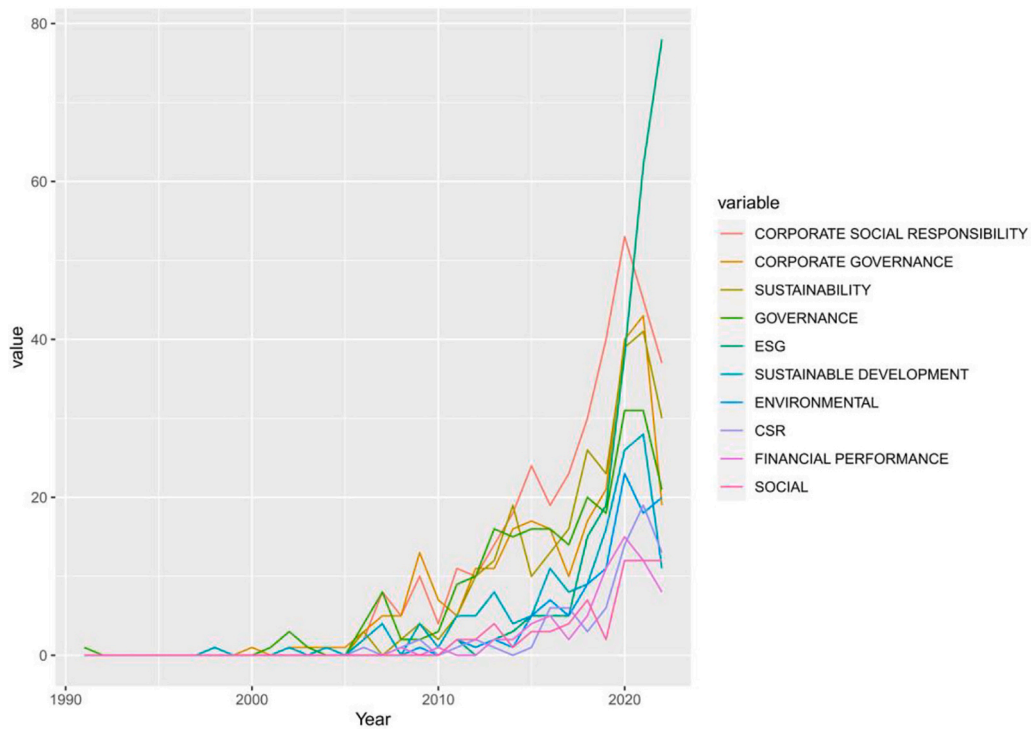
(B) ESG trend topics

Fig. 5. Evolution of topics-EF & ESG.

Note: This figure above draws the range and median year for each keyword up to 2020.



(A) EF keywords frequency occurrence



(B) ESG keywords frequency occurrence

Fig. 6. Occurrence frequency of keywords-EF & ESG.

Note: This figure above draws the frequency of keywords occurrence from 1990 to 2020.



**Table 10**  
Top Journal Publications.

EF-J Title	<2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Account									1		
J Account Research					1						
American Eco Review	1										
Econometrica	1										
J Political Economy	1										
J Finance	2	1									
J Financial Ecos	1				1					1	
Review Financial Studies									1		
MIS Quarterly: Manage Information Systems		1									
Research Policy	4								2	1	
J Marketing		1									
J the Academy Marketing Science	1										
J Operations Manage	3							1			
Manage Science	4		1								
Public Administration Review	1										
Strategic Manage J	2		1		1	1					
ESG-J Title	<2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Account										1	
J Account and Ecos									1		
Review Financial Studies									1	2	
J Int Business Studies										1	
Research Policy	1		1					1	1		
J Operations Manage									1	1	
Manage Science								1	1		
Organization Science			1	1						1	
Public Administration Review	1						1				
Strategic Manage J	2		1			1		2			

Note: The above table presents the international leading journal publications in the research sample.

green firms. [Flammer \(2021\)](#) show investors tend to increase in long-term ownership on corporate green bonds. [Avramov et al. \(2022\)](#) suggest ESG uncertainty is an important barrier to sustainable investing.

**5. Open research questions and future research agenda**

Our bibliometric analysis does not only present the past and present development of study in EF and ESG, but also help to identify research gaps and new research topics. Based on the results discussed in previous sections, we highlight a few directions for future research in these two areas.

*5.1. For EF: climate finance and green finance*

The growing topics in EF focus on applying climate integrated financial innovation to improve financial stability and environmental regulation frameworks. However, limited studies have explored financial products embedded with other natural risks such as land loss, water pollution, and fatal pandemics. Therefore, we suggest research agenda in EF at least in three directions. Firstly, researchers are encouraged to explore the use of various financial innovations to attract more investments to provide environmental benefits. Secondly, there is an immediate need to proactively measure risks of environmental financialization, for example whether traditional financial asset pricing models could be useful to capture the volatility of green finance products. Thirdly, an important issue for further researcher to discuss how to establish efficient regulation framework to tackle regional or global ecological issues, or how to tailor environmental protection schemes in either developing or developed countries.

*5.2. For ESG: ESG disclosure and ESG investing*

The majority of ESG research look in the role of ESG scores on corporate performance and impact of ESG investment on sustainability. Based on the two aspects, we firstly suggest that in the literature of ESG disclosure, it would be very important to explore the cost-benefit

analysis of the real impact of ESG disclosure for academics as well as policy makers, given the limited and ambiguous evidence published in accounting journals.<sup>8</sup> Secondly, in terms of ESG investing, several questions needed to be answered, such as, to what extent ESG investing influence a structure change in the way investors allocate resources, how well ESG investing can truly achieve sustainability goals in the asset management industry, whether ESG investing really be beneficial for asset managers and their clients.

**6. Conclusions**

The objective of this research is to present the conceptual and intellectual structure of EF and ESG study in economics and finance. To draw a chronological picture of the past, present, and future research in two research fields, we use a bibliometric analysis method to conduct top author, cited papers, journal analysis, co-authorship analysis, country collaboration analysis, co-citation analysis of both authors and articles, keyword cluster analysis, keyword co-occurrence analysis, topical trends over timeline analysis, and top journal publications analysis on the relevant literature in the Scopus database from 1990 to 2021.

In EF related studies, Taghizadeh-Hesary F. contributes most numbers of publications and Zhang D. is the top single contributed author. Sixteen percent of these articles are published in three journals: “Journal of Cleaner Production”, “Energy Economics”, and “Journal of Sustainable Finance and Investment”. Secondly, the co-authorship analysis finds out that the largest clusters of co-authorship are centred in the US, then the UK and China. Five high concentrated author collaboration groups and two journal clusters have been established. Thirdly, the topic trend analysis describes that climate change, green finance, and sustainability are the hottest topics.

In ESG related research, Li Y. contributes most numbers of publications and Buallay A. is the top single contributed author. Fifteen percent

<sup>8</sup> For example, [Drempetic et al. \(2020\)](#), [Whelan et al. \(2021\)](#), and [Krueger et al. \(2021\)](#).

of articles are published in three journals: “Journal of Cleaner Production”, “Marine Policy”, and “Ecological Economics”. Secondly, the co-authorship analysis finds out that the largest clusters of co-authorship are centred in the US and Italy. The four high concentrated author groups and two journal clusters have been established, although the collaboration network has been quite scattered. Thirdly, the topic trend analysis describes that apart from ESG key words, financial performance and sustainability are also the hottest topics in the ESG study.

Between 1990 and 2022, there are 38 EF papers and 25 ESG papers published in the top journals. Most of them are published in organization and management journals, only 6 EF papers and 4 ESG papers are published in Economics and Finance journals.

The bibliometric analysis does not only visualize the history of research trend and current interested topics, but also help us to identify future research. We summarize three main research directions in EF study, including global effort to establish environmental regulation framework for ecological challenges, developing financial innovation in green sectors, and managing risks associated with environmental financialization. Several questions are needed to be addressed in future research of ESG investing, for example, to what extent ESG investing influence a structure change in the way investors allocate resources; how well ESG investing can truly achieve sustainability goals in the asset management industry, whether ESG investing really be beneficial for asset managers and their clients. The future research programme in the literature of ESG disclosure needs to explore the cost-benefit analysis of the real impact of ESG disclosure.

## Data availability

Data will be made available on request.

## References

- Ardia, D., Bluteau, K., Boudt, K., & Inghelbrecht, K. (2022). *Climate change concerns and the performance of green versus brown stocks*. Tech. rep. National Bank of Belgium.
- Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11, 959–975. <https://doi.org/10.1016/j.joi.2017.08.007>
- Avramov, D., Cheng, S., Lioui, A., & Tarelli, A. (2022). Sustainable investing with ESG rating uncertainty. *Journal of Financial Economics*, 145, 642–664. <https://doi.org/10.1016/j.jfineco.2021.09.009>
- Avramov, D., Lioui, A., Liu, Y., & Tarelli, A. (2021). *Dynamic ESG equilibrium*. SSRN Journal: Tech. rep.
- Berk, J. B., & van Binsbergen, J. H. (2021). *The impact of impact investing*. Tech. rep., Stanford University Graduate School of Business. <https://doi.org/10.2139/ssrn.3909166>.
- Bolognesi, T., & Nahrath, S. (2020). Environmental governance dynamics: Some micro foundations of macro failures. *Ecological Economics*, 170, Article 106555. <https://doi.org/10.1016/j.ecolecon.2019.106555>
- Bolton, P., & Kacperczyk, M. T. (2022). Global pricing of carbon-transition risk. *The Journal of Finance*, 78, 3677–3754.
- Bressan, G., & Romagnoli, S. (2021). Climate risks and weather derivatives: A copula-based pricing model. *Journal of Financial Stability*, 54, 100877.
- Broadus, R. N. (1987). Toward a definition of “bibliometrics”. *Scientometrics*, 12, 373–379.
- Callahan, C. W., & Mankin, J. S. (2022). Globally unequal effect of extreme heat on economic growth. *Science Advances*, 8.
- Card, D., & DellaVigna, S. (2013). Nine facts about top journals in economics. *Journal of Economic Literature*, 51, 144–161. <https://doi.org/10.1257/jel.51.1.144>, 3.
- Carmona, R., & Hinze, J. (2011). Risk-neutral models for emission allowance prices and option valuation. *Management Science*, 57, 1453–1468. Retrieved from <http://www.jstor.org/stable/25835791>.
- Casey, R. J., & Grenier, J. H. (2015). Understanding and Contributing to the Enigma of Corporate Social Responsibility (CSR) Assurance in the United States. *Auditing: A Journal of Practice and Theory*, 34, 97–130.
- Chava, S. (2014). Environmental externalities and cost of capital. *Management Science*, 60, 2223–2247. Retrieved from <http://www.jstor.org/stable/24550583>.
- Chen, C., & Paul, R. J. (2001). Visualizing a knowledge domain’s intellectual structure. *Computer*, 34, 65–71. <https://doi.org/10.1109/2.910895>
- Cheng, B., Ioannou, I., & Serafeim, G. (2014). Corporate social responsibility and access to finance. *Strategic Management Journal*, 35, 1–23. <https://doi.org/10.1002/smj.2131>
- Cojoianu, T. F., Clark, G. L., Hoepner, A. G., Veneri, P., & Wójcik, D. (2020). Entrepreneurs for a low carbon world: How environmental knowledge and policy shape the creation and financing of green start-ups. *Research Policy*, 49, Article 103988. <https://doi.org/10.1016/j.respol.2020.103988>
- Coleman, Les. (2011). Losses from Failure of Stakeholder Sensitive Processes: Financial Consequences for Large US Companies from Breakdowns in Product, Environmental, and Accounting Standards. *Journal of Business Ethics*, 98, 247–258.
- Corbet, S., Dowling, M., Gao, X., Huang, S., Lucey, B., & Vigne, S. A. (2019). An analysis of the intellectual structure of research on the financial economics of precious metals. *Resources Policy*, 63, Article 101416. <https://doi.org/10.1016/j.resourpol.2019.101416>
- Drempetic, S., Klein, C., & Zwergel, B. (2020). The influence of firm size on the ESG score: Corporate sustainability ratings under review. *Journal of Business Ethics*, 167, 333–360.
- Eccles, N. S., & Viviers, S. (2011). The Origins and Meanings of Names Describing Investment Practices that Integrate a Consideration of ESG Issues in the Academic Literature. *Journal of Business Ethics*, 104(3), 389–402.
- Edmans, A. (2022). *The end of ESG*. Tech. rep. European Corporate Governance Institute.
- Engle, R. F., Giglio, S., Kelly, B., Lee, H., & Stroebel, J. (2020). Hedging climate change news. *The Review of Financial Studies*, 33, 1184–1216. <https://doi.org/10.1093/rfs/hhz072>, 2.
- Faccini, R., Matin, R., & Skiadopoulos, G. (2021). Dissecting climate risks: Are they reflected in stock prices? *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3795964>, 1.
- Fahimnia, B., Sarkis, J., & Davarzani, H. (2015). Green supply chain management: A review and bibliometric analysis. *International Journal of Production Economics*, 162, 101–114. <https://doi.org/10.1016/j.ijpe.2015.01.003>
- Fan, R., Xiong, X., Li, Y., & Gao, Y. (2023). Do green bonds affect stock returns and corporate environmental performance? Evidence from China. *Economics Letters*, 232, 111322.
- Feng, F., Han, L., Li, Y., & Jin, J. (2023). *Climate change exposure and bankruptcy risk*. Working paper.
- Flammer, C. (2021). Corporate green bonds. *Journal of Financial Economics*, 142, 499–516. <https://doi.org/10.1016/j.jfineco.2021.01.010>
- Flammer, C., Hong, B., & Minor, D. (2019). Corporate governance and the rise of integrating corporate social responsibility criteria in executive compensation: Effectiveness and implications for firm outcomes. *Strategic Management Journal*, 40, 1097–1122. <https://doi.org/10.1002/smj.3018>
- Fransen, L. (2012). In *Multi-Stakeholder Governance and Voluntary Programme Interactions: Legitimation Politics in the Institutional Design of Corporate Social Responsibility*. *Socio-Economic Review*. doi:10.
- Friede, G., Busch, T., & Bassen, A. (2015). ESG and financial performance: Aggregated evidence from more than 2000 empirical studies. *Journal of Sustainable Finance & Investment*, 5, 210–233.
- Fu, L., Boehe, D., & Orlitzky, M. (2020). Are R&D-intensive firms also corporate social responsibility specialists? A multicountry study. *Research Policy*, 49, Article 104082. <https://doi.org/10.1016/j.respol.2020.104082>
- Geddes, A., & Schmidt, T. S. (2020). Integrating finance into the multi-level perspective: Technology niche-finance regime interactions and financial policy interventions. *Research Policy*, 49, Article 103985. <https://doi.org/10.1016/j.respol.2020.103985>
- Germain, R., Claycomb, C., & Dröge, C. (2008). Supply chain variability, organizational structure, and performance: The moderating effect of demand unpredictability. *Journal of Operations Management*, 26, 557–570. <https://doi.org/10.1016/j.jom.2007.10.002>
- Goldstein, I., Kopytov, A., Shen, L., & Xiang, H. (2022). *On ESG investing: Heterogeneous preferences, information, and asset prices*. Tech. rep., NBER: National Bureau of Economic Research.
- Gualandris, J., Longoni, A., Luzzini, D., & Pagell, M. (2021). The association between supply chain structure and transparency: A large-scale empirical study. *Journal of Operations Management*, 67, 803–827. <https://doi.org/10.1002/joom.1150>
- Guo, L., Han, X., & Li, Y. (2023). The smog that hovers: Air pollution and asset prices. *Finance Research Letters*, 53, Article 103633. <https://doi.org/10.1016/j.frl.2023.103633>
- Halter, M. V., de Arruda, M. C. C., & Halter, R. B. (2009). Transparency to Reduce Corruption?: Dropping Hints for Private Organizations in Brazil. *Journal of Business Ethics*, 84, 373–385.
- Han, X., Li, Y., & Onishchenko, O. (2022). Shunned stocks and market states. *The European Journal of Finance*, 28, 705–717. <https://doi.org/10.1080/1351847X.2021.2015699>
- Harzing, A. W., & Alakangas, S. (2016). Scopus and the web of science: A longitudinal and cross-disciplinary comparison. *Scientometrics*, 787–804.
- Hong, H., Karolyi, G. A., & Scheinkman, J. A. (2020). Climate finance. *The Review of Financial Studies*, 33, 1011–1023. <https://doi.org/10.1093/rfs/hhz146>, 2.
- Hsu, P.-H., Li, K., Tsou, C.-Y., & Tsou, C.-Y. (2022). The pollution premium. *Journal of Finance*. <https://doi.org/10.2139/ssrn.3909166>. Forthcoming.
- Huij, J., Laurs, D., Stork, P. A., & Zwinkel, R. C. J. (2021). *Carbon beta: a market-based measure of climate risk*. SSRN working paper.
- Jacobs, B. W., Singhal, V. R., & Subramanian, R. (2010). An empirical investigation of environmental performance and the market value of the firm. *Journal of Operations Management*, 28, 430–441. <https://doi.org/10.1016/j.jom.2010.01.001>
- Kim, I., Wan, H., Wang, B., & Yang, T. (2019). Institutional investors and corporate environmental, social, and governance policies: Evidence from toxics release data. *Management Science*, 65. <https://doi.org/10.1287/mnsc.2018.3055>, 2.
- Klassen, R. D., & McLaughlin, C. P. (1996). The impact of environmental management on firm performance. *Management Science*, 42, 1199–1214. Retrieved from <http://www.jstor.org/stable/2634452>.
- K’olbel, J., Busch, T., & Jancso, L. (2017). How media coverage of corporate social irresponsibility increases financial risk. *Strategic Management Journal*, 38. <https://doi.org/10.1002/smj.2647>, 2.



- Köbel, J. F., Busch, T., & Jancso, L. M. (2017). How media coverage of corporate social irresponsibility increases financial risk. *Strategic Management Journal*, 38, 2266–2284. <https://doi.org/10.1002/smj.2647>
- Krueger, P., Sautner, Z., Tang, D. Y., & Zhong, R. (2021). *The effects of mandatory ESG disclosure around the world*. Tech. rep. European Corporate Governance Institute.
- Kurtz, L., Cooper, L. L., & Shimada, A. (2012). *Sustainable investing across emerging markets*. Tech. rep. San Francisco, CA, USA: Nelspon Capital.
- Larcker, D. F., & Watts, E. M. (2020). Where's the greenium? *Journal of Accounting and Economics*, 69, Article 101312. <https://doi.org/10.1016/j.jacceco.2020.101312>
- Laurent-Lucchetti, J., & Leach, A. (2011). Generational Welfare Under a Climate-Change Policy with Induced Innovation. *Scandinavian Journal of Economics*, 113.
- Lee, K.-H., Cin, B. C., & Lee, E. Y. (2016). Environmental responsibility and firm performance: The application of an environmental, social and governance model. *Business Strategy and the Environment*, 25, 40–53. <https://doi.org/10.1002/bse.1855>
- Lefebvre, L. A., Mason, R., & Lefebvre, É. (1997). The influence prism in SMEs: The power of CEOs' perceptions on technology policy and its organizational impacts. *Management Science*, 43, 856–878. Retrieved from <http://www.jstor.org/stable/2634627>.
- Leitao, J. C., F. J., & Santibanez Gonzalez, E. (2021). Green Bonds, Sustainable Development and Environmental Policy in the European Union Carbon Market. *Business Strategy and the Environment*, 30, 2077–2090.
- Li, Y., Gong, M., Zhang, X., & Koh, L. (2017). The impact of environmental, social, and governance disclosure on firm value: The role of CEO power. *The British Accounting Review*, 50. <https://doi.org/10.1016/j.bar.2017.09.007>, 9.
- Li, Y., Liao, M., & Liu, Y. (2023). How does green credit policy affect polluting firms' dividend policy? The China experience. *International Review of Financial Analysis*, 88, Article 102631. <https://doi.org/10.1016/j.irfa.2023.102631>
- Lin, C., Li, J., Jiang, W., Gao, X., He, Y., & Yang, L. (2023). Risk and economic cost of hospitalization due to atrial fibrillation caused by air pollution: A multi-city time series analysis. *Environmental Sciences Europe*, 35.
- Linnenluecke, M., Smith, T., & Mcknight, B. (2016). Environmental finance: A research agenda for interdisciplinary finance research. *Economic Modelling*, 59. <https://doi.org/10.1016/j.econmod.2016.07.010>, 7.
- López-Gamero, M. D., Jose, M. A., & Enrique, C. C. (2010). The Relationship between Managers' Environmental Perceptions, Environmental Management and Firm Performance in Spanish Hotels: A Whole Framework. *International Journal of Tourism Research*, 13, 141–163.
- Ortiz-de-Mandojana, N., & Bansal, P. (2016). The long-term benefits of organizational resilience through sustainable business practices. *Strategic Management Journal*, 37, 1615–1631. <https://doi.org/10.1002/smj.2410>
- Malthus, T. (1878). *An Essay on the Principle of Population*. St. Paul's Church-Yard. London.
- Marsh, G. P. (1864). *Man and Nature*. Baird Corr. New York: Smithsonian Institution.
- Martínez-Ferrero, J., & Frías-Aceituno, J. V. (2015). *Relationship Between Sustainable Development and Financial Performance: International Empirical Research*. *Business Strategy and the Environment*, 24(1) pp. 20–39). Wiley Blackwell.
- Michels, C., & Schmoch, U. (2012). The growth of science and database coverage. *Scientometrics*, 831–846.
- Mill, J. S. (1849). *Principles of political economy with some of their applications to social philosophy* (Second edition) (Second edition., In two volumes. London: John W. Parker, West Strand.
- Moss, H. E., Tyler, L. K., & Taylor, K. I. (2007). Conceptual structure. In *The Oxford handbook of psycholinguistics* (pp. 217–234).
- Mussio, I., Chilton, S., Duxbury, D., & Nielsen, J. S. (2023). A risk–risk trade-off assessment of climate-induced mortality risk changes. *Risk Analysis*. <https://doi.org/10.1111/risa.14185>
- Nguyen, H.A., Nguyen, L.S. & Ha, H.H. | McMillan, D. (Reviewing editor) (2020) Environmental accounting practices and cost of capital of enterprises in Vietnam, *Cogent Economics & Finance*, 8:1.
- Ni, W., & Sun, H. (2018). A contingent perspective on the synergistic effect of governance mechanisms on sustainable supply chain. *Supply Chain Management*, 23(3), 153–170.
- Pástor, L., Stambaugh, R. F., & Taylor, L. A. (2021). Sustainable investing in equilibrium. *Journal of Financial Economics*, 142, 550–571. <https://doi.org/10.1016/j.jfineco.2020.12.011>
- Pedersen, L., Fitzgibbons, S., & Pomorski, L. (2020). Responsible investing: The ESG-efficient frontier. *Journal of Financial Economics*. <https://doi.org/10.1016/j.jfineco.2020.11.001>, 11.
- Phelps, J., Zabala, A., Daeli, W., & Carmenta, R. (2021). Experts and resource users split over solutions to peatland fires. *World Development*, 146, Article 105594. <https://doi.org/10.1016/j.worlddev.2021.105594>
- Pritchard, A. (1969). Statistical bibliography or bibliometrics. *Journal of Documentation*, 25, 348–349.
- Ramos-Rodríguez, A.-R., & Ruiz-Navarro, J. (2004). Changes in the intellectual structure of strategic management research: A bibliometric study of the “strategic management journal”, 1980–2000. *Strategic Management Journal*, 25, 981–1004.
- Ren, X., Shao, Q., & Zhong, R. (2020). Nexus between green finance, non-fossil energy use, and carbon intensity: Empirical evidence from China based on a vector error correction model. *Journal of Cleaner Production*, 277, Article 122844. <https://doi.org/10.1016/j.jclepro.2020.122844>
- Renneboog, L., Horst, J. T., & Zhang, C. (2008). Socially responsible investments: Institutional aspects, performance, and investor behavior. *Journal of Banking & Finance*, 32, 1723–1742. <https://doi.org/10.1016/j.jbankfin.2007.12.039>
- Richard, O. C., Murthi, B. P., & Ismail, K. (2007). The impact of racial diversity on intermediate and long-term performance: The moderating role of environmental context. *Strategic Management Journal*, 28, 1213–1233. Retrieved from <http://www.jstor.org/stable/20141983>.
- Rockström, J., Steffen, W., Noone, K., Persson, Å., F. Stuart Chapin, I. I., Lambin, E. F., ... Foley, J. (2009). A safe operating space for humanity. *Nature*, 46, 472–475, 1.
- Sato, M., Gostlow, G., Higham, C., Setzer, J., & Venmans, F. (2023). *Impacts of climate litigation on firm value*. Tech. rep. Centre for Climate Change Economics and Policy, London: London School of Economics and Political Science.
- Sautner, Z., van Lent, L., Vilkov, G., & Zhang, R. (2023). Pricing climate change exposure. *Management Science*, 00(0).
- Sethi, S. P., Martell, T. F., & Demir, M. (2016). Building corporate reputation through corporate social responsibility (CSR) reports: The case of extractive industries. *Corporate Reputation Review*, 19, 219–243, 10.
- Shaukat, A., Qiu, Y., & Trojanowski, G. (2016). Board Attributes, Corporate Social Responsibility Strategy, and Corporate Environmental and Social Performance. *Journal of Business Ethics*, 135(3), 569–585.
- Singal, M. (2013). The link between firm financial performance and investment in sustainability initiatives. *Cornell Hospitality Quarterly*, 55, 19–30. <https://doi.org/10.1177/1938965513505700>, 1.
- Stellner, C., Klein, C., & Zwergel, B. (2015). Corporate social responsibility and Eurozone corporate bonds: The moderating role of country sustainability. *Journal of Banking & Finance*, 59(2015), 538–549.
- Stern, N. (2007). *The economics of climate change – The Stern review*. Cambridge, UK: Cambridge University Press.
- Terjesen, S., Sealy, R., & Singh, V. (2009). Women directors on corporate boards: A review and research agenda. *Corporate Governance: An International Review*, 17, 320–337. <https://doi.org/10.1111/j.1467-8683.2009.00742.x>
- Waltman, L. (2016). A review of the literature on citation impact indicators. *Journal of Informetrics*, 10, 365–391. <https://doi.org/10.1016/j.joi.2016.02.007>
- Whelan, T., Atz, U., Holt, T. V., & Clark, C. (2021). *ESG and financial performance: Uncovering the relationship by aggregating evidence from 1000 plus studies published between 2015–2020*. Tech. rep. NYU Stern Center for Sustainable Business.
- Young, O. R., & Steffen, W. (2009). In C. Folke, G. P. Kofinas, & F. S. Chapin (Eds.), *The earth system: Sustaining planetary life-support systems*. New, York, NY: Springer New York. [https://doi.org/10.1007/978-0-387-73033-2\\_14](https://doi.org/10.1007/978-0-387-73033-2_14).
- Zemigala, M. (2015). Bibliometric analysis of corporate social responsibility-different countries' perspective. *Human Resources Management & Ergonomics*, IX, 123–138.
- Zhang, J., Yu, Q., Zheng, F., Long, C., Lu, Z., & Duan, Z. (2015). Comparing keywords plus of WOS and author keywords: A case study of patient adherence research. *Journal of the Association for Information Science and Technology*, 67. <https://doi.org/10.1002/asi.23437>, 2.
- Zhao, H., Zhang, F., & Kwon, J. (2018). Corporate social responsibility research in international business journals: An author co-citation analysis. *International Business Review*, 27, 389–400. <https://doi.org/10.1016/j.ibusrev.2017.09.006>
- Zhao, J., Elmore, A. J., Lee, J. S., Numata, I., Zhang, X., & Cochrane, M. A. (2023). Replanting and yield increase strategies for alleviating the potential decline in palm oil production in Indonesia. *Agricultural Systems*, 210, Article 103714. <https://doi.org/10.1016/j.agsy.2023.103714>