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Article

Three decades of green finance : the state of the art and way forward

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Kontakt/Contact

ZBW – Leibniz-Informationszentrum Wirtschaft/Leibniz Information Centre for Economics
Düsternbrooker Weg 120
24105 Kiel (Germany)
E-Mail: [rights\[at\]zbw.eu](mailto:rights[at]zbw.eu)
<https://www.zbw.eu/>

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Three Decades of Green Finance: The State of the Art and Way Forward

Md. Sazib Miyan^{1,2*}, Calvin W. H. Cheong¹, Arshian Sharif¹, Sahar Afshan¹

¹Sunway Business School, Sunway University, Malaysia, ²Department of Finance and Banking, Begum Rokeya University, Rangpur, Bangladesh. *Email: sazibmiyan@brur.ac.bd

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ABSTRACT

Green finance (GF) constitutes a multifaceted research domain, yet extant reviews often provide fragmented insights from subsets rather than a holistic examination of the entire green finance corpus. To bridge this gap, this study endeavors to conduct an extensive review to offer a comprehensive overview of green finance's performance and intellectual landscape. Leveraging a dataset of 2685 articles from the Scopus database spanning 1991-2023, this study aims to unveil influential articles, top contributing journals, authors, institutions, and countries in green finance research. Additionally, it elucidates seven principal thematic clusters in GF research, encompassing responsible investment, carbon and climate financing, green banking and economy, green finance and innovation, sustainability, environmental finance, and sustainable finance. Furthermore, this study outlines six prospective avenues for future GF research, including the integration of behavioral finance principles, the utilization of modern technologies, and the formulation of policy frameworks to enhance sustainability and curb greenwashing practices aimed at advancing sustainable practices and addressing emerging challenges.

Keywords: Green Finance, Sustainability, Sustainable Finance, Green Investment, Bibliometric Analysis

JEL Classifications: Q5, Q2, O2, N5

1. INTRODUCTION

The relentless expansion of the global economy, boasting an annual growth rate of 3-4%, encounters a pivotal moment due to its inequitable resource distribution and adverse ecological impact (Sachs et al., 2019). Ongoing patterns in fossil fuel consumption pose alarming prospects, with forecasts suggesting a potential temperature rise of 4-6°C, heralding severe repercussions for environmental quality, agricultural productivity, public health, natural resources, and biodiversity (Sachs and Du Toit, 2015). Despite significant international initiatives such as the Paris Agreement and Sustainable Development Goals (SDGs), aimed at adapting climate change and mitigating global warming, the translation of these ambitions into concrete actions remains notably inadequate. Growing concern on environmental issues, including climate change, global warming, pollution, natural resource depletion, and biodiversity loss, with global consequences such

as rising sea levels, natural disasters, extreme weather events, ecosystem degradation, and species extinction urging immediate action to be taken to ensure a sustainable future (IPCC, 2014; 2022).

The integration of environmental sustainability into financial decision-making has emerged as a critical area of research and practice in recent years. With the growing recognition of climate change and environmental degradation as significant global challenges, the concept of “green finance” has gained traction as a means to mobilize capital towards environmentally sustainable projects and initiatives. Green finance exhibits an umbrella nature encompassing sustainable finance, environmental finance, carbon finance, and climate finance (Akomea-Frimpong et al., 2022; Barua, 2020). In this context, understanding the landscape of green finance research becomes paramount for both scholars and practitioners. Given the expansive scope of green finance and its pivotal role in

advancing the sustainability agenda, numerous studies have been conducted to deepen comprehension and implementation within this domain. Recent reviews of green and sustainable finance by Naeem et al. (2022), Kumar et al. (2022), Debrah et al. (2023), Mohanty et al. (2023), and Kashi and Shah (2023) explored 1413, 936, 995, 1748, and 723 articles respectively. Akomea-Frimpong et al. (2022), Bhatnagar and Sharma (2022), Cunha et al. (2021), Yu et al. (2021), and Zhang et al. (2019) likewise examined far fewer articles – 76, 666, 166, 888, and 381 articles respectively, possibly due to sample period differences as they only considered periods only as far back as 2021. The field of GF, however, is ever evolving and has grown exponentially in recent years. Even a recent review article by Gafoor et al. (2024) was able to examine only 481 articles meaning that, till today no review article on GF has been able to consider the full corpus.

Moreover, prior studies have tended to concentrate on specific aspects of green finance, such as climate finance (Carè and Weber, 2023), carbon finance (Zhou and Li, 2019), ESG (Li et al., 2021; Rau and Yu, 2024), impact investing (Migliavacca et al., 2022), socially responsible investing (Koenigsmarck and Geissdoerfer, 2021), ethical investments (Lemonakis et al., 2020), and sustainability of environmental finance (Al-Zoubi, 2024). The field, however, is far wider, as we now demonstrate through the present review comprising nearly double the number of prior reviews with 2685 articles to address these gaps and provide a comprehensive overview of the domain. We employed bibliometric analysis using two common but powerful software: RStudio (Biblioshiny R) and Vosviewer; to analyze the extensive dataset, facilitating performance analysis, and to visualize the intellectual landscape of the green finance research domain through science mapping. Bibliometric analysis provides a systematic and quantitative approach to examining scholarly literature in a particular field (Donthu et al., 2021). By analyzing publication trends, citation patterns, and thematic developments, bibliometric studies offer valuable insights into the evolution of research themes, the influence of key authors and institutions, and emerging areas of interest. In the realm of green finance, bibliometric analysis can help identify the most influential publications, uncover research gaps, and guide future directions for inquiry.

In this study, we present a comprehensive bibliometric review of the green finance research field. We draw on data from leading academic databases (Scopus) to analyze publication trends, citation patterns, and thematic developments over three decades (1991-2023). Our objective is to provide a systematic overview of the scholarly literature on green finance, identify key research themes and clusters, and assess the trajectory of research in this rapidly evolving field. By synthesizing and analyzing a large body of literature, we aim to contribute to a deeper understanding of green finance and inform future research agendas and policy discussions. In this regard, to be more specific we formulated five research questions (RQ) based on the research objective.

- RQ1: How has the publication trend in green finance research evolved over time?
 RQ2: What are the most influential articles and leading journals contributing to the field of green finance research?
 RQ3: Who are the top authors, institutions, and countries

contributing significantly to green finance research?

RQ4: What are the predominant themes and topics explored in the realm of green finance research?

RQ5: What future research directions can be identified for further exploration and advancement of green finance research?

The findings gleaned from this review contribute to the literature in various ways. First, it explores publication trends over time, shedding light on the evolving landscape of green finance research (RQ1), providing researchers, new and old, with a critical overview of the domain. Second, it identifies the most influential articles and top contributing journals, providing insights into the core literature and scholarly discourse in the field (RQ2). Third, by examining the top contributing authors, institutions, and countries, it highlights the key players driving research efforts in green finance (RQ3). Furthermore, this review delves into the major themes and topics prevalent in green finance research, offering a comprehensive overview of the current state of the field (RQ4). Lastly, it discusses future research directions, providing valuable guidance for researchers and practitioners seeking to advance knowledge and address emerging challenges in green finance (RQ5). We anticipate that these collaborative endeavors will aid both current and prospective researchers, policymakers, practitioners, and relevant stakeholders in enhancing their comprehension and making informed decisions.

The rest of this paper is as follows: Section 2 outlines the data collection methodology. Section 3 presents the results from the bibliometric analysis along with network visualizations while Section 4 discusses potential future research directions, and section 5 focuses theoretical and practical implications. Finally, section 6 acknowledging study limitations after concluding by synthesizing key findings and their broader implications for green finance research.

2. METHODOLOGY

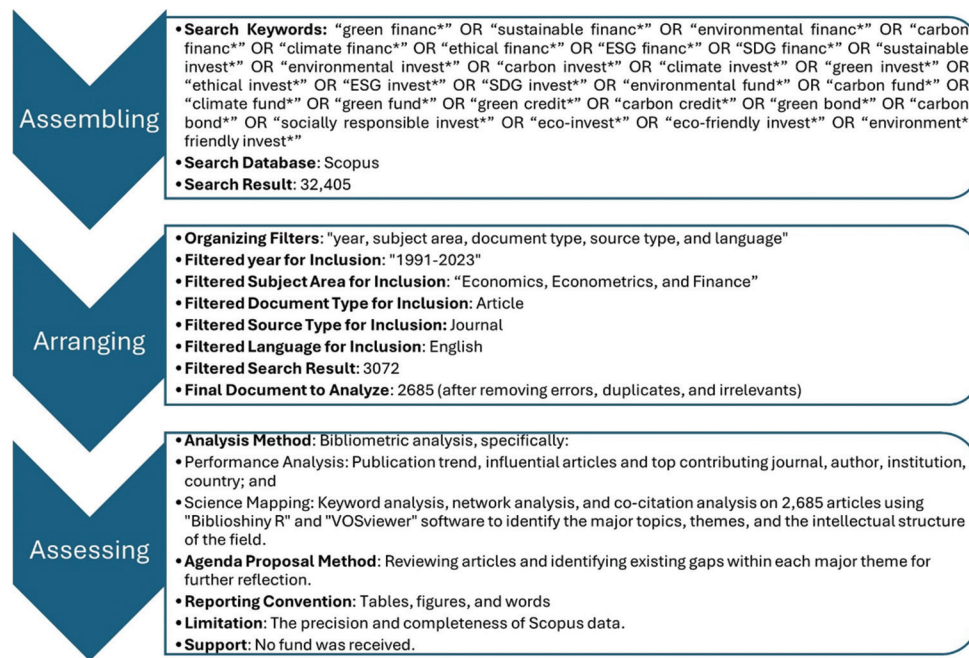
This study engages in the compilation of bibliometric data concerning green finance (GF) research for review. To accomplish this task, we employ the Scientific Procedures and Rationales for Systematic Literature Reviews (SPAR-4-SLR) protocol, delineated into three core stages: assembling, arranging, and assessing (Paul et al., 2021). The procedural overview is shown in Figure 1 for clarity and coherence.

2.1. Assembling

We identified search keywords by examining the keywords associated with green finance used in the most pertinent and relevant studies in the field. Additionally, consultation with four experts was conducted to validate the appropriateness of these keywords in representing green finance. This process resulted in a compilation of 29 keywords that can be structured into the following search string:

“green financ*” OR “sustainable financ*” OR “environmental financ*” OR “carbon financ*” OR “climate financ*” OR “ethical financ*” OR “ESG financ*” OR “SDG financ*” OR “sustainable invest*” OR “environmental invest*” OR “carbon invest*” OR

Figure 1: Flow chart of systematic review procedure applying the SPAR-4-SLR protocol



Source: Authors’ own work

“climate invest*” OR “green invest*” OR “ethical invest*” OR “ESG invest*” OR “SDG invest*” OR “environmental fund*” OR “carbon fund*” OR “climate fund*” OR “green fund*” OR “green credit*” OR “carbon credit*” OR “green bond*” OR “carbon bond*” OR “socially responsible invest*” OR “eco-invest*” OR “eco-friendly invest*” OR “environment* friendly invest*”

Upon finalizing the search keywords, we commenced an article retrieval process utilizing the designated search string within the “article title, abstract, and keywords” section on Scopus. Scopus, renowned as a premier repository of scholarly articles, was chosen over Web of Science for its superior article repository size (Kumar et al., 2022; Naeem et al., 2022; Paul et al., 2021). Conducted on January 18, 2024, the search yielded a total of 32,405 documents.

2.2. Arranging

In order to systematically organize the compilation of 32,405 articles, this study utilized Scopus’ category (code) function. The search outcomes underwent meticulous review, considering various criteria including year, subject area, document type, source type, and language. Filters were applied to narrow down the results to the time frame “1991-2023,” focusing on the subject area of “Economics, Econometrics, and Finance,” document type “article,” source type “journal,” and language “English.” The decision to exclude publications before 1991 was due to limited availability on the subject, while 2023 was chosen as it represented the latest full year. The subject area was specifically chosen to align with the domain of green finance. Exclusions were made for non-articles, such as editorials and notes, to ensure the peer-reviewed nature of the corpus. Additionally, non-journal sources like books, book chapters, and conference proceedings were omitted to maintain rigorous peer review standards. Non-English articles were also excluded due to language proficiency limitations. This meticulous filtering process resulted in a refined

corpus consisting of 3072 articles.

Subsequently, we embarked on the process of downloading and meticulously scrutinizing each article following the procedure of Harari et al. (2020), eliminating an additional 387 articles in which the search keywords appeared rarely. Put differently, these articles did not predominantly address facets of green finance, thus meriting their exclusion. This culminated in a final corpus of 2685 articles earmarked for examination.

2.3. Assessing

To evaluate the extensive corpus of 2,685 articles focused on green finance, this study employs a bibliometric analysis approach using two most popular software “Biblioshiny R” package (Aria and Cuccurullo, 2017) and “VOSviewer” (Van Eck and Waltman, 2010). Bibliometric analysis using Biblioshiny R and VOSviewer offers researchers a comprehensive view of scholarly literature, highlighting trends, key contributors, and thematic patterns. It aids in identifying emerging topics, assessing performance, and guiding evidence-based decisions. By systematically mapping the literature, these tools help identify research gaps and foster collaboration among scholars (Donthu et al., 2021). Additionally, they ensure quality control by analyzing citation patterns and keeping researchers abreast of the latest developments (Naeem et al., 2022). This study contributes to the field by proposing a future research agenda based on identified gaps and themes. The subsequent sections detail the findings of the review, complemented by visual aids (table, and Figure) for clarity.

3. RESULTS AND FINDINGS

3.1. Samples’ Features

Table 1 encompasses research publications from 1991 to 2023, drawn from 512 journals with a total of 2685 articles – an

impressive annual growth rate of 21.25%. The average age of documents is 4.30 years, reflecting the recency of research contributions. Each document receives an average of 23.95 citations suggesting substantial academic impact. With 117,041 references cited across all documents and 5909 distinct author-provided keywords, the research covers a wide range of topics. With 5372 unique authors, including 400 single-authored and 5041 multiple-authored documents with an average of 2.84 co-authors per document, collaboration is prevalent. Furthermore, 30.50% of co-authorships are international, highlighting the global reach and diversity of perspectives in the research landscape.

3.2. Yearly Publication Trend

Figure 2 illustrates a substantial increase in the number of articles published over the years, with a clear upward trajectory. In the early 1990s, the number of articles remained relatively low, with <5% of the total number of articles published annually. However, from the year 2000 onwards, there's a notable surge in publication rates. By 2014, the number of articles published per year increased to about 7% of the total, marking a significant jump. The growth trend continues, with an increasing percentage of publications each year. Notably, from 2014 to 2023, the percentage of publications annually remains consistently high, with particularly remarkable growth observed from 2015 onwards. The year 2023 stands out with the highest percentage, representing a substantial portion of the total articles published over the entire period. This trend suggests a significant acceleration in research output, potentially driven by various factors such as increased funding, technological advancements, and evolving research priorities.

3.3. Most Influential Authors

The authors who have demonstrated a significant scholarly output

stand out as the principal contributors within the domain under investigation. This scrutiny provides profound insights into the aggregate contributions of these authors, encompassing various metrics including the quantity of authored papers, collaborative endeavors, and the reception of citations. The evaluation hinges upon the cumulative sum of articles authored by each individual scholar, offering a comprehensive understanding of their scholarly impact and influence within the field. Figure 3 displays the 20 most influential authors based on their article counts. “Wang Y” leads with 31 articles, followed by “Taghizadeh-Hesary F” with 28, and “Li Y” with 27. Other notable authors include “Lee C-C”, “Zhang J”, and “Wang X”, each with substantial contributions. These authors play a significant role in shaping academic discourse and advancing knowledge within this green finance research field.

Additionally, Figure 4 illustrates the most prolific authors in the field of GF research over the years, based on their publication output. “Li Z” emerges as the primary contributor to this research field, beginning in 2012 and maintaining activity through 2023. Meanwhile, “Zhang J” and “Liu X” have made substantial contributions to this domain, commencing in 2016 and 2017, respectively. The majority of authors who followed suit in contributing to this field were drawn in from 2019 onwards, focusing on various facets of green finance. However, despite “Li Z’s” early start in 2012, “Wang Y” demonstrated remarkable productivity in publications, beginning from 2019 onwards.

3.4. Most Influential Documents

The documents deemed most influential are those that have garnered the highest number of citations. These influential documents serve to elucidate how specific themes within the study are subsequently explored and developed. Table 2 showcases the top 25 documents that have attained significant influence within the field.

Table 2 presents a diverse array of influential articles spanning topics such as socially responsible investments (SRI), corporate social responsibility (CSR), and green finance. These articles delve into various dimensions of sustainable finance, ranging from the assessment of social ratings’ effectiveness in measuring CSR to the impact of green investments on corporate behavior and financial performance. Notable studies investigate the relationship between SRI and portfolio performance, the influence of pro-environmental preferences on bond prices, and the role of green finance in enhancing total factor productivity. Additionally, there’s a focus on the drivers of environmental innovation, consumer motivations towards purchasing organic food, and the impact of firm size on corporate sustainability ratings. These articles collectively contribute to advancing knowledge in sustainable finance and offer valuable insights for policymakers, investors, and corporate stakeholders alike.

3.5. Most Influential Sources

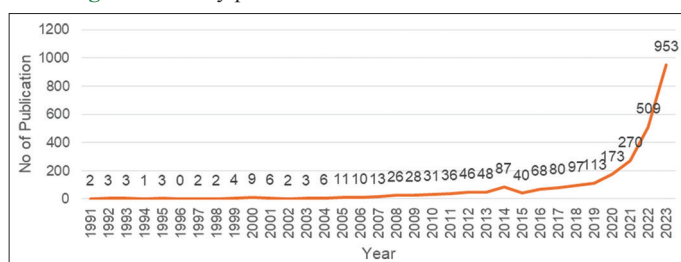
The sources in a research stream are pivotal, with Figure 5 and Table 3 listing the top 20 based on publication count. A scholarly journal’s quality is often judged by metrics like the h-index or citations. A journals or article’s significant relevancy can be proved by the citations it receives.

Table 1: Sample characteristics of the GF research field

Timespan	1991:2023
Sources (Journals)	512
Documents (Article)	2685
Annual growth rate %	21.25
Document average age	4.30
Average citations per doc	23.95
References	117041
Author’s keywords (DE)	5909
Authors	5372
Authors of single-authored docs	400
Authors of multiple-authored docs	4972
Co-authors per doc	2.84
International co-authorships %	30.50

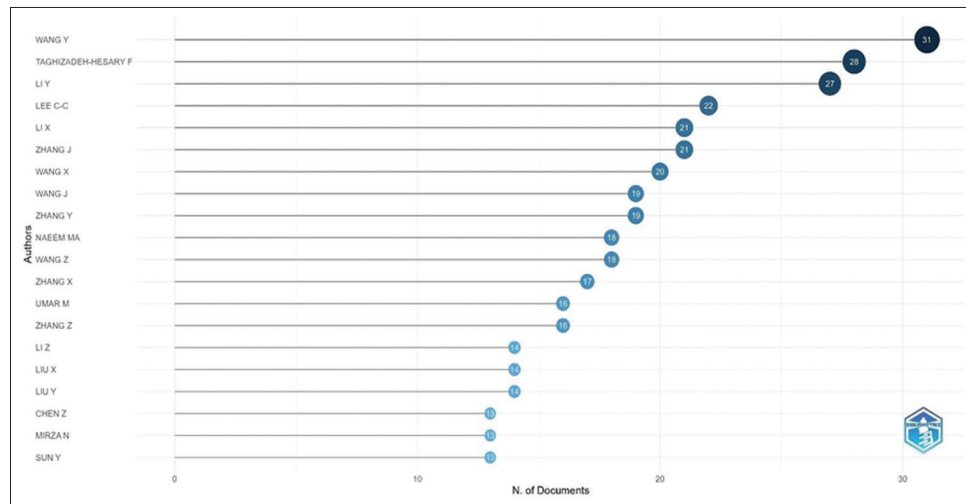
Source: Authors’ own work

Figure 2: Yearly publication trend of the GF research field



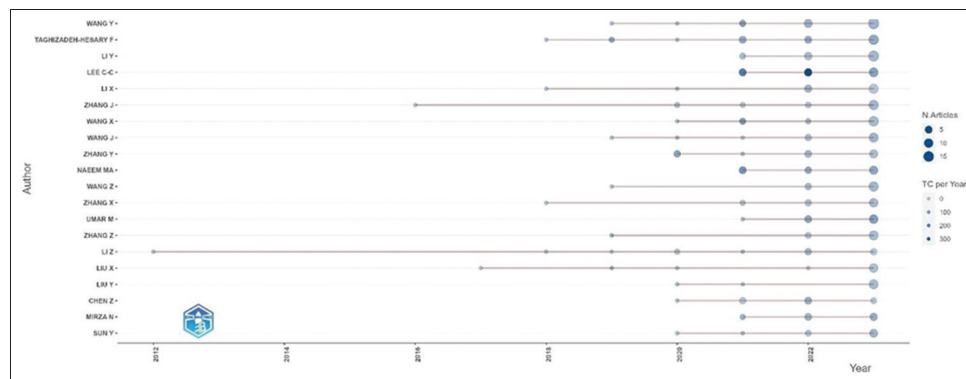
Source: Authors’ own work

Figure 3: Top 20 most influential authors by number of publications



Source: Authors' own work

Figure 4: Most productive authors' publication over time



Source: Authors' own work

The h-index of a particular source (journal) represents its highest number of papers receiving h or more citations each. In contrast, the g-index is the highest number (x) of publications with at least x^2 citations. The m-index is similar to the h-index but indicates the h-index per year since publication inception (Egghe, 2008). Table 3 offers a comparative analysis of the academic impact and citation performance of various journals within the field of sustainable finance, economics, and environmental studies. Journals like the *Journal of Business Ethics*, *Energy Economics*, and *Resources Policy* stand out with high h-index values of 47, 38, and 31 respectively, indicating a substantial number of highly cited articles. *Energy Economics* exhibits the highest m-index of 2.923, suggesting a strong citation impact per article on average. In contrast, journals like the *Journal of Banking and Finance* and *World Development* have relatively lower h-index values of 16 and 15, indicating a comparatively lower number of highly cited articles. Additionally, newer journals such as *Finance Research Letters*, and *Economic Research-Ekonomika Istrazivanja* demonstrate promising performance with h-index values of 27 and 19, respectively, despite being established more recently. These metrics offer insights into the relative influence and productivity of journals within the field. Additionally, journals relevancy can also be shown based on number of publications, presented in Figure 5.

Subsequent to the presentation of Table 3, Figure 6 depicts the bibliographic coupling of sources. Bibliographic coupling serves as a comprehensive method for assessing similarity among sources, wherein two documents are considered coupled if they cite the same third document (Donthu et al., 2021; Zupic and Čater, 2015). VOSviewer proves instrumental in generating bibliographic maps, facilitating the identification of commonalities among documents referencing identical works (Van Eck and Waltman, 2010). The inclusion criteria for sources in the map entail a minimum requirement of five documents from a source and a minimum of 20 citations. Adhering to these criteria, only 99 items meet the threshold out of the total 512 sources, forming four distinct clusters. Cluster 1 (red) comprises 31 sources, Cluster 2 (green) encompasses 27 sources, Cluster 3 (blue) comprises 24 sources, and Cluster 4 (yellow) encompasses 17 sources. Notably, prominent sources such as the *Journal of Business Ethics*, *Resources Policy*, *Journal of Sustainable Finance*, *Energy Economics*, and *Finance Research Letters* exhibit strong coupling within the map.

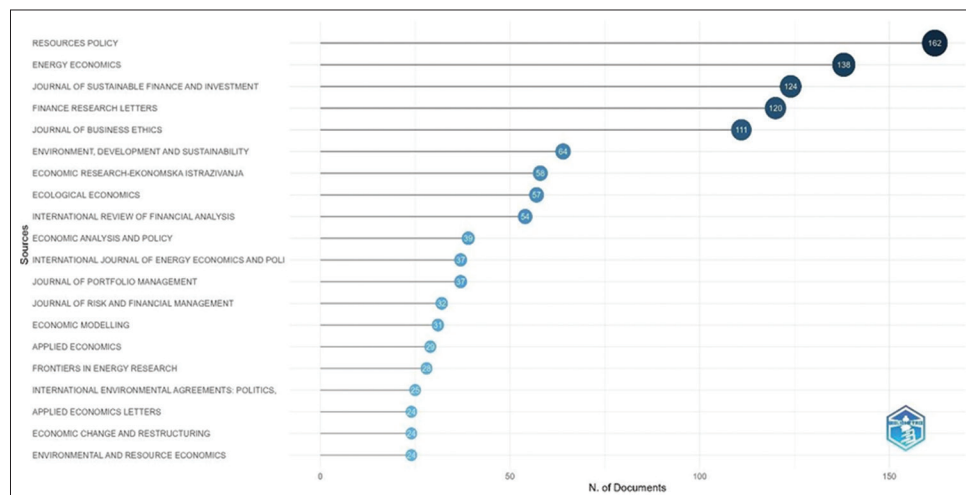
Figure 7 reflects the evolution of sources, underscoring a notable surge in research activity within the realm of green finance, particularly in the late 1990s. The impetus for this surge can be traced back to 1999 when the *Journal of Business Ethics* first shed light on the subject, initiating a trajectory of substantial growth.

Table 2: Most influential documents in the green finance research

Author (s)	Title	Journal	Year	TC	C/Y
Renneboog L.; Ter Horst J.; Zhang C.	Socially responsible investments: Institutional aspects, performance, and investor behavior	Journal of Banking and Finance	2008	890	52.35
Chatterji A.K.; Levine D.I.; Toffel M.W.	How well do social ratings actually measure corporate social responsibility?	Journal of Economics and Management Strategy	2009	688	43.00
Heinkel R.; Kraus A.; Zechner J.	The effect of green investment on corporate behavior	Journal of Financial and Quantitative Analysis	2001	530	22.08
Derwall J.; Guenster N.; Bauer R.; Koedijk K.	The eco-efficiency premium puzzle	Financial Analysts Journal	2005	518	25.90
Statman M.	Socially Responsible Mutual Funds	Financial Analysts Journal	2000	461	18.44
Renneboog L.; Ter Horst J.; Zhang C.	The price of ethics and stakeholder governance: The performance of socially responsible mutual funds	Journal of Corporate Finance	2008	425	25.00
Kempf A.; Osthoff P.	The effect of socially responsible investing on portfolio performance	European Financial Management	2007	422	23.44
Zerbib O.D.	The effect of pro- environmental preferences on bond prices: Evidence from green bonds	Journal of Banking and Finance	2019	416	69.33
Lee C.-C.; Lee C.-C.	How does green finance affect green total factor productivity? Evidence from China	Energy Economics	2022	413	137.67
Amir A.-Z.; Serafeim G.	Why and how investors use ESG information: Evidence from a global survey	Financial Analysts Journal	2018	413	59.00
Galema R.; Plantinga A.; Scholtens B.	The stocks at stake: Return and risk in socially responsible investment	Journal of Banking and Finance	2008	404	23.76
Flammer C.	Corporate green bonds	Journal of Financial Economics	2021	392	98.00
Taghizadeh-Hesary F.; Yoshino N.	The way to induce private participation in green finance and investment	Finance Research Letters	2019	386	64.33
Borghesi R.; Houston J.F.; Naranjo A.	Corporate socially responsible investments: CEO altruism, reputation, and shareholder interests	Journal of Corporate Finance	2014	369	33.55
Riedl A.; Smeets P.	Why Do Investors Hold Socially Responsible Mutual Funds?	Journal of Finance	2017	355	44.38
Tang D.Y.; Zhang Y.	Do shareholders benefit from green bonds?	Journal of Corporate Finance	2020	329	65.80
Campiglio E.	Beyond carbon pricing: The role of banking and monetary policy in financing the transition to a low-carbon economy	Ecological Economics	2016	329	36.56
Yalabik B.; Fairchild R.J.	Customer, regulatory, and competitive pressure as drivers of environmental innovation	International Journal of Production Economics	2011	326	23.29
Smith S.; Paladino A.	Eating clean and green? Investigating consumer motivations towards the purchase of organic food	Australasian Marketing Journal	2010	317	21.13
Pedersen L.H.; Fitzgibbons S.; Pomorski L.	Responsible investing: The ESG-efficient frontier	Journal of Financial Economics	2021	316	79.00

TC: Total citations, C/Y: Average citations per year

Source: Authors' own work

Figure 5: Top 20 most influential source based on number of publications


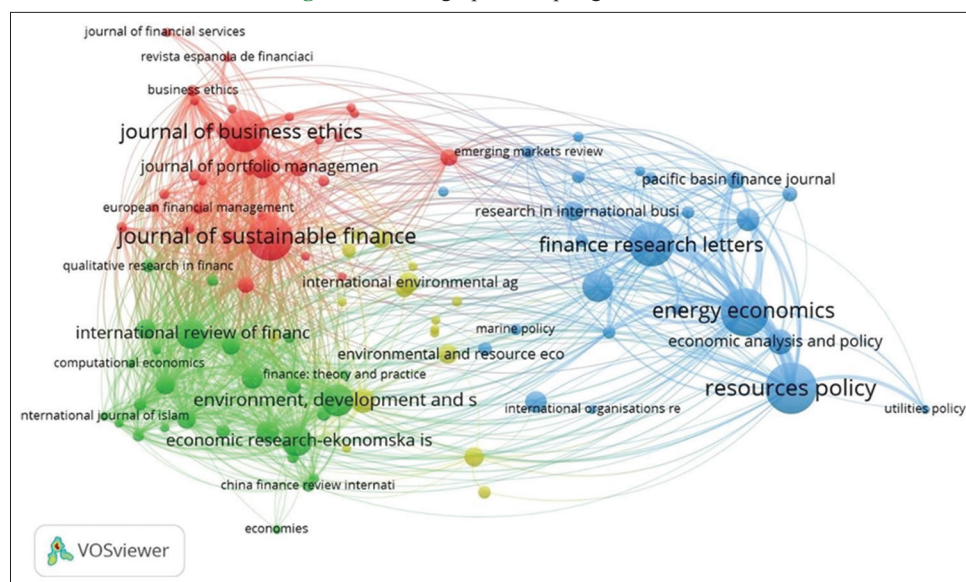
Source: Authors' own work

Table 3: Most influential sources of GF research field

Journals	h_index	g_index	m_index	TC	NP	PY_start
Journal of Business Ethics	47	83	1.424	7085	111	1992
Energy Economics	38	70	2.923	5245	138	2012
Resources Policy	31	49	1.292	2916	162	2001
Ecological Economics	28	52	0.875	2730	57	1993
Finance Research Letters	27	56	2.7	3399	120	2015
Journal of Sustainable Finance and Investment	21	40	1.5	2084	124	2011
Economic Analysis and Policy	19	32	6.333	1031	39	2022
International Review of Financial Analysis	18	33	1.636	1189	54	2014
Journal of Banking and Finance	16	19	0.8	2659	19	2005
Economic Research-Ekonomska Istrazivanja	15	24	1.364	685	58	2014
World Development	15	19	0.484	730	19	1994
Economic Modelling	14	29	0.636	844	31	2003
Environmental and Resource Economics	14	24	0.636	710	24	2003
International Environmental Agreements: Politics, Law and Economics	14	21	0.7	460	25	2005
Forest Policy and Economics	12	20	0.571	432	20	2004
Research in International Business and Finance	12	22	1.091	523	23	2014
Environment, Development and Sustainability	11	17	0.478	371	64	2002
Global Finance Journal	11	21	0.917	685	21	2013
Emerging Markets Finance and Trade	10	19	1.429	383	22	2018
Journal of Portfolio Management	10	27	0.4	793	37	2000

TC: Total citation, NP: Number of publication, PY: Publication year

Source: Authors' own work

Figure 6: Bibliographic coupling of sources

Source: Authors' own work

The burgeoning interest in achieving sustainable development has catalyzed a surge in research output, evidenced by the consistent increase in research articles published by the Journal of Sustainable Finance and Investment. Concurrently, *Energy Economics*, *Finance Research Letters*, and *Resources Policy* have demonstrated sustained growth trends, indicative of their enduring relevance in the field. Notably, *Resources Policy* has emerged as the most prolific source, occupying the foremost position in terms of the number of publications by the year 2023.

3.6. Most Relevant Affiliations

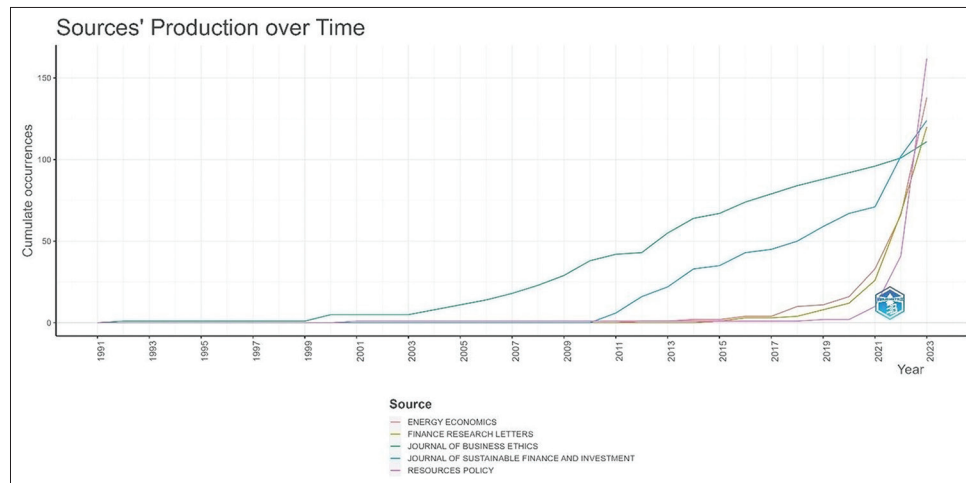
Figure 8 presents a breakdown of the top affiliations contributing to research in the field. Southwest University of Finance and Economics leads with 62 articles, followed closely by Qingdao University with

54 articles and Central South University with 46 articles. These institutions demonstrate a significant presence in academic research, highlighting their contributions to the advancement of knowledge within the field. Other notable affiliations include Zhongnan University of Economics and Law, Tianjin University of Commerce, and University of International Business and Economics, each contributing over 40 articles. The list reflects a diverse range of institutions from the universe especially from China, showcasing the global collaboration and diversity prevalent in research endeavors within the field of finance and economics.

3.7. Most Significant Countries

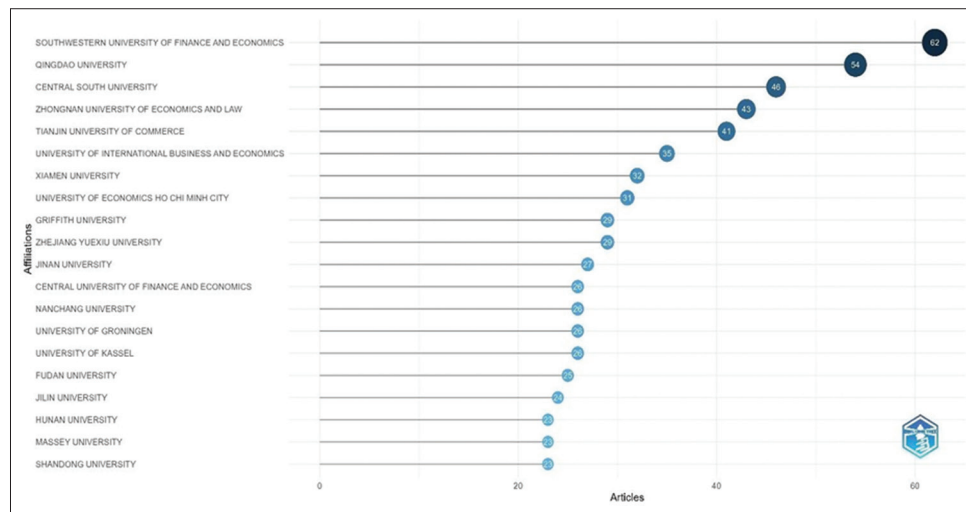
Figure 9 illustrates the distribution of corresponding author countries in article publications. China leads with 628 articles,

Figure 7: Annual research output from the top 5 sources



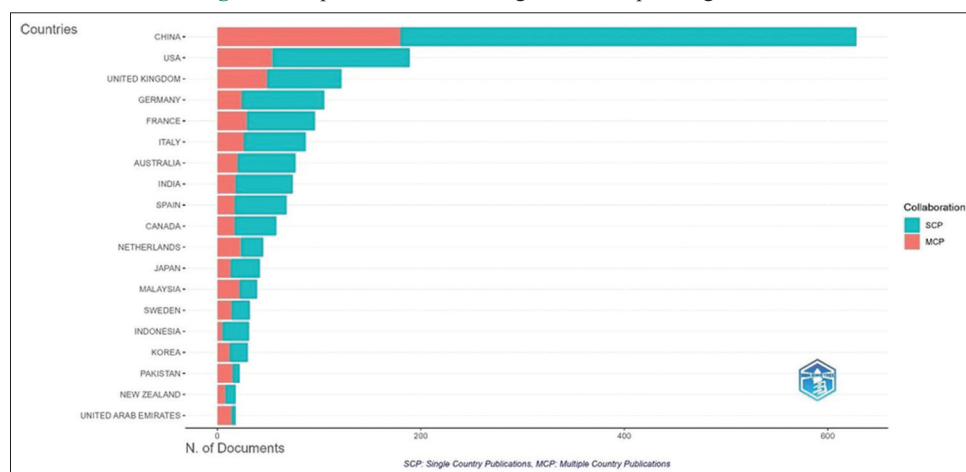
Source: Authors' own work

Figure 8: Top 20 most influential affiliations in green finance



Source: Authors' own work

Figure 9: Top 20 countries of origin of corresponding authors



Source: Authors' own work

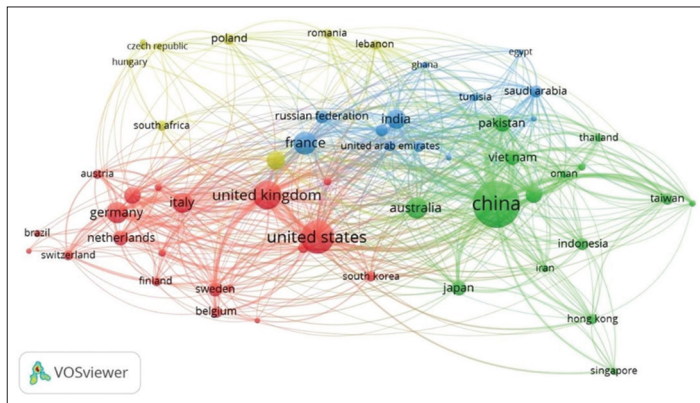
followed by the USA with 189 and the United Kingdom with 122. While single-country publications dominate across most

nations, China, the USA, and the UK stand out for their significant research output and active engagement in global collaborations.

Notably, some countries like Indonesia and Pakistan exhibit a higher proportion of multi-country collaborations relative to their overall research output, indicating a propensity for international collaboration. This underscores the evolving landscape of research dissemination and cooperative efforts in advancing scientific knowledge globally.

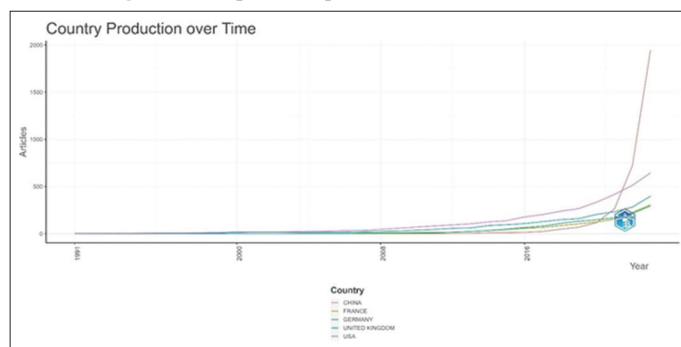
On the other hand, in the Figure 10, generated using VOSviewer, serves to elucidate collaborative linkages among authors' countries within the GF research field. This map is constructed

Figure 10: Authorship linkages, by country



Source: Authors' own work

Figure 11: Top 5 most productive countries, annual



Source: Authors' own work

with a minimum requirement of 10 documents and 10 citations per country. Adhering to this threshold inclusion criteria, only 56 countries meet the conditions out of a total of 96, yielding four distinct clusters of linkages. Cluster 1 (red) comprises 20 countries, cluster 2 (green) comprises 15, cluster 3 (blue) comprises 12, and cluster 4 (yellow) comprises 9 countries. Notably, prominent nations such as China, the United States, the United Kingdom, Germany, and France emerge as dominant forces and collaborative within the green finance research domain, as evidenced by their substantial representation in the collaborative map.

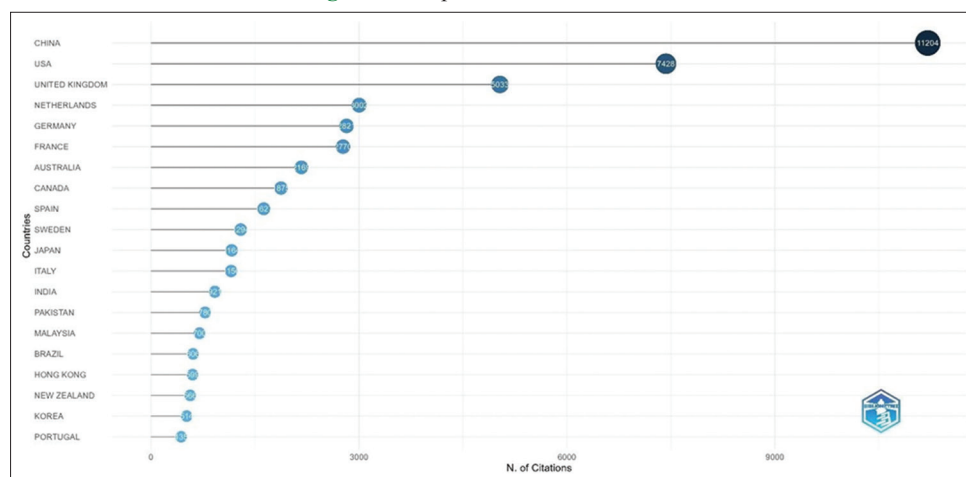
Figure 11 illustrates the scientific production output of five countries over the period spanning 1991-2023. China emerges as the most prolific contributor with a total frequency of 1947 scientific productions, followed by the USA with 645, the UK with 398, France with 307, and Germany with 294. An intriguing observation among the five countries is that, while their average publication outputs were comparable in the year 2008, a notable shift occurred after 2020. China experienced a dramatic and exponential surge in publication output, catapulting to the forefront and claiming the top position. Conversely, the United States, which had previously held the leading position in publication output, transitioned to second place. This shift underscores China's significant strides in scientific production, establishing itself as the primary contributor and surpassing other nations by a considerable margin.

Figure 12 delineates the total number of citations accrued by various countries in the GF research field. China leads with a total cited count of 11,204, followed by the USA with 7428, and the United Kingdom with 5033. Notably, the Netherlands, Germany, and France also exhibit substantial citation counts, with 3002, 2821, and 2770 respectively. Other countries such as Australia, Canada, and Spain also demonstrate noteworthy citation counts, indicative of their significant contributions to the global scholarly discourse.

3.8. Top 20 Most Frequent and Relevant Words

In the realm of green finance research, an analysis of the top 20 most frequent words reveals prevalent themes and topics within the

Figure 12: Top 20 most cited countries



Source: Authors' own work

literature (Figure 13). Among these, “green finance” emerges as the most frequently occurring term, appearing 306 times, followed closely by “green bonds” with 210 occurrences. Noteworthy terms such as “ESG” (Environmental, Social, and Governance), “sustainable finance,” and “climate change” reflect the growing emphasis on environmental sustainability and responsible investment practices. Additionally, terms such as “sustainability,” “socially responsible investment,” and “corporate social responsibility” underscore the interconnectedness between financial activities and broader societal and environmental concerns. Notably, the prominence of terms like “climate finance,” “sustainable development,” and “renewable energy” highlights the focus on addressing climate-related challenges and promoting sustainable economic development. Moreover, emerging topics such as “COVID-19” and “green innovation” underscore the evolving dynamics and emerging trends within the field. This analysis provides valuable insights into the prevalent discourse and key areas of focus within green finance research.

By analyzing the top 100 most commonly used keywords in the realm of green finance through the Biblioshiny R package, we can visualize the significance of keywords in relation to one another via a wordcloud depicted in Figure 14. This visualization underscores the central position occupied by the term “green finance,” indicative of its pervasive usage within the research domain. Subsequently, “green bonds” emerges as the second most prevalent term, while keywords such as “ESG,” “sustainable finance,” “climate change,” “sustainability,” “socially responsible investment,” “climate finance,” and “China” prominently signify their significance and frequency within the green finance research milieu.

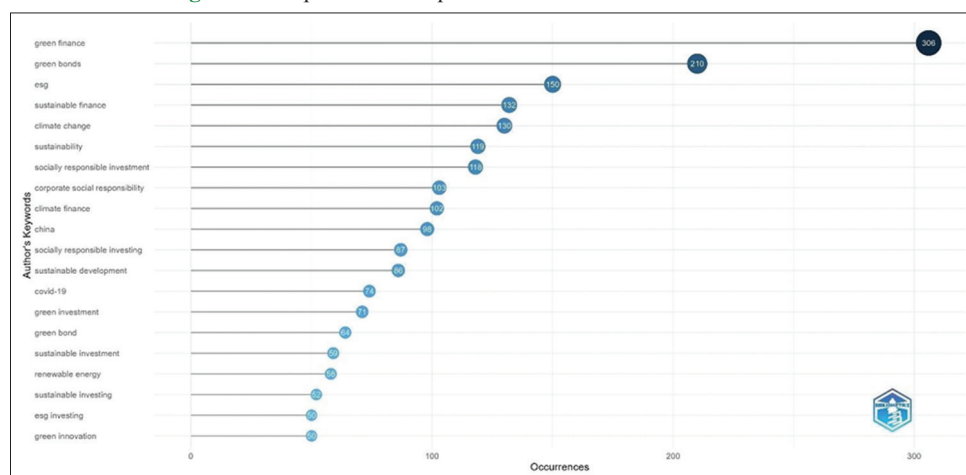
For a comprehensive keyword analysis, we employed the top 50 authors’ keywords, visualizing them in a “TreeMap” format using the Biblioshiny R package. Figure 15 presents the proportional distribution of keywords relative to the total number of authors’ keywords. Notably, “green finance” commands the most substantial share at 10%, followed by “green bonds” at 7%, and “ESG” at 4%, respectively. This visualization offers nuanced insights into the prevalence and significance of specific keywords within the dataset, providing valuable context for understanding the underlying research themes and trends.

Figure 16 illustrates that “green finance” stands as the predominant term employed by researchers in the green finance domain throughout the period spanning 1991-2023. Initially, the field emphasized ethics and ethical investment. Subsequently, attention shifted towards notions of responsibility, particularly concerning corporate social responsibility (CSR), socially responsible investment (SRI), and Environmental, Social, Governance (ESG) investing. As the field progressed, researchers increasingly delved into topics such as the green climate fund, carbon finance, and climate finance, with a noticeable uptick observed around 2020 in the exploration of sustainable finance, green bonds, green investment, and green finance. This sequential evolution reflects the dynamic nature of research focus within the green finance domain over time.

3.9. Thematic Map of the Green Finance Research

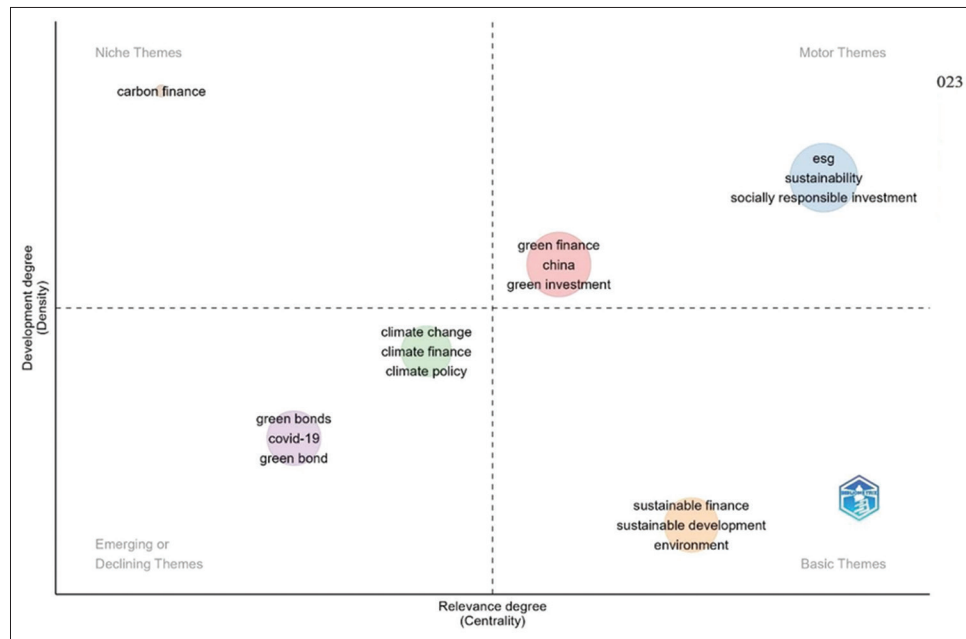
Figure 17 provides insight into six prominent themes encapsulating the green finance research landscape. The upper right quadrant signifies the pivotal “motor theme,” characterized by the prevalence of research on “green finance” and “ESG.” Notably, “green finance” emerges as the most prominent and developed theme, as evidenced by its heightened density and centrality within the thematic map criteria. Conversely, the lower left quadrant, denoting emerging or declining themes, encompasses “climate finance” and “green bonds.” Of these, “climate finance” exhibits notable emergence, situated centrally compared to “green bonds” within the thematic map. This emerging positioning underscores its increasing significance as a focal point of inquiry and highlights its potential to shape the discourse and direction of GF research in addressing climate-related challenges. Meanwhile, the lower right quadrant, representing the basic theme, features solely “sustainable finance.” Lastly, the upper left quadrant, housing niche themes, is occupied solely by “carbon finance.” Such placement highlights the unique focus and specialized attention devoted to “carbon finance” within the green finance research domain. This could imply that “carbon finance” addresses specific and nuanced aspects related to carbon emissions, carbon trading, or carbon offsetting, distinct from the broader themes of sustainability, climate finance, or green bonds observed in other quadrants. This segmentation offers a comprehensive understanding of thematic distribution and prominence within the green finance research domain.

Figure 13: Top 20 most frequent and relevant words in GF research



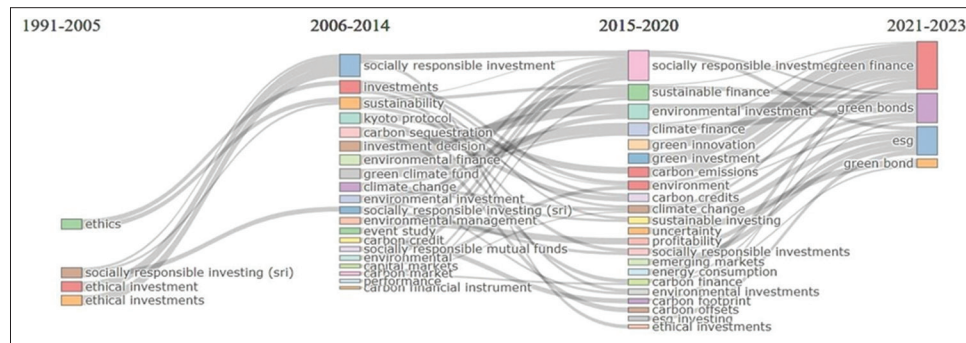
Source: Authors’ own work

Figure 17: Thematic mapping of GF research using authors keywords



Source: Authors' own work

Figure 18: Thematical evolution of green finance, 1991-2023



Source: Authors' own work

a heightened emphasis on this particular facet within the GF research landscape.

Following the procedure of Kumar et al. (2022); Naeem et al. (2022), we generated Figure 19, which delineates the keyword co-occurrence network to find the thematic clusters of GF research, wherein we established a criterion of 15 as the minimum number of occurrences of keywords. Guided by this threshold, a total of 84 keywords met the specified conditions, forming 7 distinct clusters within the network. Cluster 1 (red) encompasses 21 keywords, while cluster 2 (green) comprises 15 keywords. Similarly, cluster 3 (dark blue) encompasses 12 keywords, cluster 4 (yellow) comprises 13 keywords, and cluster 5 (purple) incorporates 11 words. Additionally, cluster 6 (light blue) comprises 6 keywords, whereas cluster 7 (orange) contains 4 keywords. These clusters serve as visual indicators of the evolutionary trajectory and transformative trends within the realm of GF research, providing valuable insights into the thematic progression and thematic convergence within the field over time.

Cluster 1: Responsible Investment – the most prominent cluster (red) comprise of 21 keywords. The cluster encompasses

keywords related to responsible investment and sustainable finance, including corporate social responsibility, environmental finance, ESG, ethical investing, impact investing, and socially responsible investment. It demonstrates significant linkages among these terms, with high total link strength, suggesting a cohesive thematic connection. These keywords exhibit frequent occurrences, indicating their prominence and relevance in the discourse surrounding responsible investment and sustainable finance within the field.

Cluster 2: Carbon and Climate finance – this cluster comprises of 15 keywords. This cluster revolves around keywords related to climate finance and environmental policy, featuring terms such as carbon credits, carbon finance, climate change, climate finance, and green bonds. These keywords exhibit significant linkages, with high total link strength, indicating a cohesive thematic connection within the realm of climate finance and environmental policy. Additionally, terms like clean energy, developing countries, and the Paris Agreement further underscore the cluster's focus on addressing climate-related challenges and advancing environmental sustainability.

as pivotal figures within this cluster, fostering robust network connections. Moreover, authors within this cluster predominantly delve into themes surrounding socially responsible investment, a prominent area within the green finance research domain. Their investigations and studies primarily center on institutional aspects, investment performance, and investor behavior, elucidating critical dimensions of this field.

Cluster 2, denoted by the color green, epitomizes the second-highest level of linkages and citations among authors. Figures such as “Wang Y.”, “Zhang J.”, and “Wang H.” emerge as central nodes within this cluster, boasting significant link strength within the network. Their scholarly endeavors predominantly revolve around examining the spillover effects of carbon-related policies and markets, as well as devising strategies to mitigate the impact of carbon emissions on the development of the green economy.

Cluster 3, indicated by the color blue, centers around authors deeply engrossed in research pertaining to green bonds and sustainable finance. Notably, the most interconnected and influential authors within this cluster include “Naeem M. A.”, “Reboredo J. C.”, and “Shin Y.”, who exhibit strong network connections. However, this cluster appears less densely connected compared to others, suggesting a more segregated arrangement among the authors.

Cluster 4, identified by the color yellow, highlights the collaborative efforts of authors exploring green finance instruments and strategies to bridge the green finance gap. Notably, Taghizadeh-Hesary F. emerges as a prominent and prolific contributor within this cluster, demonstrating significant activity and influence. Additionally, “Mohsin M.” and “Mirza N.” are recognized as notable contributors to the collective body of work within this thematic cluster.

Cluster 5, designated by the color purple, exhibits fewer connections and network strength compared to other clusters. The predominant theme within this cluster revolves around climate transition risk and policy. Notably, “Monasterolo I.” emerges as the most significant contributor and a highly connected author within this thematic cluster, indicating a focused contribution to research exploring climate transition risks and associated policy implications. It is apparent that this cluster is in a nascent stage of development, characterized by a limited number of interconnections both within the cluster and with external nodes. Consequently, research pertaining to climate change and transitional risk is still in its infancy, albeit addressing a crucial aspect of sustainable development.

4. FUTURE RESEARCH DIRECTIONS

Green finance remains pertinent for business schools, financial institutions, markets, and regulatory bodies. Notably, both developed and developing nations are increasingly emphasizing the achievement of the SDGs through initiatives like carbon, climate, and green financing. Furthermore, financial markets persistently pursue innovative sustainable finance instruments to tactically address economic needs while substantially progressing sustainability and sustainable development objectives. This

pursuit notably corresponds with the alignment of SDGs and the mitigation of carbon emissions as mandated by the Paris Agreement. Likewise, modern investors demonstrate heightened interest in ESG criteria and socially responsible investment funds, prompting fund managers to diligently screen and pursue impactful investment opportunities. Table 4 provides a summary of the future research agendas and research questions motivated by our findings on the last 5 years (2019-2023) of green finance research.

5. THEORETICAL AND PRACTICAL IMPLICATIONS

This bibliometric analysis of green finance over three decades reveals key seven thematic clusters that underscore the evolution and interconnectedness of responsible investment, climate finance, sustainable development, and innovation. The findings highlight the prominence of keywords such as green finance, ESG, green bonds, and sustainable investments, indicating their central role in the discourse. However, examining the thematic clusters, emerging trends, and future research directions in green finance research unveils diverse implications for sustainable development. These findings guide the development of effectual policies and schemes, and the formulation of environmental regulation aimed at fostering sustainable green growth for all.

5.1. Theoretical Implications

The findings from this bibliometric analysis have several theoretical implications:

- **Interdisciplinary Integration:** The strong linkages among keywords across different clusters suggest that green finance research is inherently interdisciplinary, integrating concepts from finance, environmental science, and social responsibility. This underscores the need for theoretical frameworks that can accommodate the complex interplay between these domains.
- **Evolution of Concepts:** The temporal evolution of research themes, as illustrated by the co-occurrence network, indicates a dynamic shift in focus areas. Early research emphasized corporate social responsibility, which has progressively expanded to include climate finance, green economy, and sustainability (Alqudah et al., 2024). This evolution suggests that theoretical models need to be adaptive to capture emerging trends and shifting priorities.
- **Role of Innovation:** The emphasis on innovation within green finance highlights its critical role in driving environmental sustainability. Theoretical frameworks should incorporate the mechanisms through which financial innovation can enhance the effectiveness of green finance in achieving sustainability goals.

5.2. Practical Implications

The practical implications of these findings are significant for policymakers, financial institutions, and businesses:

- **Policy Development:** Policymakers can leverage the insights from this analysis to develop comprehensive policies that support responsible investment, climate finance, and sustainable development. The strong thematic connections identified can inform policy frameworks that promote ethical financial practices and environmental sustainability.

Table 4: Future research agendas and research questions

Future agendas	Research questions	Relevant references
Integrating behavioral finance principles into the realm of green finance	<ul style="list-style-type: none"> • How do investor biases affect green finance decisions? • The role of psychology in shaping green financial preferences. • Cognitive biases' impact on green finance risk perception. • Institutional investors' use of behavioral finance in green investments. 	Gao et al. (2023); Kumar et al. (2022); Prajapati et al. (2021); Quang et al. (2022); Sedláčková et al. (2020); Tang and Yang (2024)
Harnessing the capabilities of modern technologies for green finance	<ul style="list-style-type: none"> • How can companies utilize cutting-edge technologies like artificial intelligence, blockchain, big data analytics, cloud computing, and machine learning to innovate, streamline, and enhance their green financing operations and instruments in agile, smart, and inventive manners? 	Gupta et al. (2020); Hua et al. (2023); Kashif et al. (2023); Macchiavello and Siri (2022); Mirza et al. (2023); Tiwari et al. (2023)
Inventing innovative new green finance instruments	<ul style="list-style-type: none"> • Can crowdfunding and peer-to-peer lending mobilize retail investors for renewable energy and sustainable projects? • How can innovative insurance products protect against climate risks and promote adaptation? • Can Fintech, like DLT and smart contracts, streamline green finance processes while ensuring compliance and data integrity? 	Shaydurova et al. (2018); Taghizadeh-Hesary and Yoshino (2019; 2020); Yoshino et al. (2019)
Improving the yields of green financing	<ul style="list-style-type: none"> • How can public-private partnerships mobilize capital for green projects? • How can we boost returns on green financing while staying eco-friendly? • Do market conditions sway green bond pricing compared to regular bonds? 	Auer (2021); Gutiérrez Ponce et al. (2023); Khalid et al. (2023); Mirza et al. (2023); Yang and Liu (2023)
Formulating and harmonizing policies and frameworks for green finance	<ul style="list-style-type: none"> • What challenges arise in aligning policies across different jurisdictions? • What policy frameworks encourage adoption of green finance? • How do regulatory variations affect green finance adoption? • Can international standards harmonize green finance policies globally? 	Cisco and Gatto (2021); Gurvich and Creamer (2022); Keshminder et al., 2022; Liyanage (2021); Martini (2021); Smoleńska and van't Klooster (2022); Zetsche et al. (2022)
Stopping greenwashing and ensuring sustainability of green finance	<ul style="list-style-type: none"> • How can regulatory bodies effectively enforce measures against greenwashing? • What strategies can financial institutions implement to prevent greenwashing? • How can transparency and accountability be improved in green finance practices? 	Baldi and Pandimiglio (2022); Hu et al. (2023); Kleffel and Muck (2023); Sensharma et al. (2022); Shi et al. (2023); Xu et al. (2022); Zhang (2023)

Source: Authors' own work

- **Investment Strategies:** Financial institutions can utilize the findings to design investment strategies that align with sustainable finance principles. The prominence of keywords such as ESG, green bonds, and sustainable investments provides a roadmap for structuring investment portfolios that prioritize environmental and social outcomes.
- **Corporate Governance:** Businesses can integrate the insights into their corporate governance practices, emphasizing the importance of ESG criteria, risk management, and responsible corporate behavior. This can enhance their reputation, attract socially conscious investors, and contribute to long-term financial stability.

6. CONCLUSION

This bibliometric review sheds light on the expansive landscape of green finance (GF) research, offering a comprehensive overview of its performance and intellectual structure. Through an exhaustive analysis of 2685 articles spanning from 1991 to 2023 sourced from the Scopus database, this study has uncovered significant insights into influential articles, top contributing entities, and thematic clusters within the GF domain. The identification of seven major research themes, including responsible investment, carbon and climate financing, and green banking and economy,

green finance and innovation, sustainability, environmental finance, and sustainable finance. Moreover, by proposing six future research directions, such as integrating behavioral finance principles and harnessing modern technologies, this study seeks to guide and inspire further scholarly inquiry in GF. Additionally, the theoretical implications emphasize the need for interdisciplinary integration, adaptive theoretical models, and the critical role of innovation in driving sustainability. Practically, the insights can guide policymakers in developing comprehensive policies, financial institutions in structuring sustainable investment strategies, and businesses in enhancing corporate governance practices which underscores the importance of green finance in promoting long-term economic and environmental resilience. Ultimately, this review not only consolidates existing knowledge but also paves the way for future research endeavors aimed at advancing sustainable finance practices and addressing emerging challenges in the field.

In conducting this bibliometric review paper focused on green finance research within the field of Economics, Econometrics, and Finance, certain limitations have been identified. Firstly, it's important to note that only Scopus data was utilized for data collection, thus excluding potentially relevant studies indexed in other databases such as Web of Science (WoS). This may have introduced a degree of bias into the findings, as some relevant

research may have been overlooked. Additionally, the timeframe considered for analysis spans from 1991 to 2023, which may have excluded recent developments in the field that could be pertinent to understanding current trends and future directions. Furthermore, biases may have arisen during the clustering process and determination of future research themes, as these methods are subject to interpretation and subjective decision-making. Finally, although bibliometric analysis helps to deal with big data, side-by-side we also advocate to use meta-analysis and systematic review for identifying essential relationships and variables, such as linear or nonlinear connections, and dependent or independent factors more rigorously (Kumar et al., 2022; Naeem et al., 2022).

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REFERENCES

- Akomea-Frimpong, I., Adeabah, D., Ofosu, D., Tenakwah, E.J. (2022), A review of studies on green finance of banks, research gaps and future directions. *Journal of Sustainable Finance and Investment*, 12(4), 1241-1264.
- Alqudah, H., Al Qudah, M.Z., Abu Huson, Y., Lutfi, A., Alrawad, M., Almaiah, M.A. (2024), A decade of green economic literature: An analysis-based bibliometric. *International Journal of Energy Economics and Policy*, 14(3), 497-511.
- Al-Zoubi, W.K. (2024), How sustainable is environmental economics?: A review of research trends and implications. *International Journal of Energy Economics and Policy*, 14(2), 319-334.
- Aria, M., Cuccurullo, C. (2017), bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11(4), 959-975.
- Auer, B.R. (2021), Implementation and profitability of sustainable investment strategies: An errors-in-variables perspective. *Business Ethics, the Environment and Responsibility*, 30(4), 619-638.
- Baldi, F., Pandimiglio, A. (2022), The role of ESG scoring and greenwashing risk in explaining the yields of green bonds: A conceptual framework and an econometric analysis. *Global Finance Journal*, 52, 100711.
- Barua, S. (2020), Financing sustainable development goals: A review of challenges and mitigation strategies. *Business Strategy and Development*, 3(3), 277-293.
- Bhatnagar, S., Sharma, D. (2022), Evolution of green finance and its enablers: A bibliometric analysis. *Renewable and Sustainable Energy Reviews*, 162, 112405.
- Carè, R., Weber, O. (2023), How much finance is in climate finance? A bibliometric review, critiques, and future research directions. *Research in International Business and Finance*, 2023, 101886.
- Cisco, G., Gatto, A. (2021), Climate justice in an intergenerational sustainability framework: A stochastic OLG model. *Economies*, 9(2), 47.
- Cunha, F.A.F.S., Meira, E., Orsato, R.J. (2021), Sustainable finance and investment: Review and research agenda. *Business Strategy and the Environment*, 30(8), 3821-3838.
- Debrah, C., Darko, A., Chan, A.P.C. (2023), A bibliometric-qualitative literature review of green finance gap and future research directions. *Climate and Development*, 15(5), 432-455.
- 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.
- Egghe, L. (2008), Mathematical theory of the h-and g-index in case of fractional counting of authorship. *Journal of the American Society for Information Science and Technology*, 59(10), 1608-1616.
- Gafoor, C.A., Perumbalath, S., Daimari, P., Naheem, K. (2024), Trends and patterns in green finance research: A bibliometric study. *Innovation and Green Development*, 3(2), 100119.
- Gao, Y., Li, Y., Wang, Y. (2023), The dynamic interaction between investor attention and green security market: An empirical study based on Baidu index. *China Finance Review International*, 13(1), 79-101.
- Gupta, S., Kumar, V., Karam, E. (2020), New-age technologies-driven social innovation: What, how, where, and why? *Industrial Marketing Management*, 89, 499-516.
- Gurvich, A., Creamer, G.G. (2022), Carbon risk factor framework. *The Journal of Portfolio Management*, 48(10), 148-164.
- Gutiérrez Ponce, H., Chamizo González, J., Al-Mohareb, M. (2023), Sustainable finance in cybersecurity investment for future profitability under uncertainty. *Journal of Sustainable Finance and Investment*, 13(1), 614-633.
- Harari, M.B., Parola, H.R., Hartwell, C.J., Riegelman, A. (2020), Literature searches in systematic reviews and meta-analyses: A review, evaluation, and recommendations. *Journal of Vocational Behavior*, 118, 103377.
- Hu, S., Wang, A., Du, K. (2023), Environmental tax reform and greenwashing: Evidence from Chinese listed companies. *Energy Economics*, 124, 106873.
- Hua, J., Lin, J., Wang, K., Liu, G. (2023), Government interventions in new technology adoption to improve product greenness. *International Journal of Production Economics*, 262, 108924.
- IPCC. (2014), *Climate Change 2014: Mitigation of Climate Change*. Vol. 3. Cambridge: Cambridge University Press.
- IPCC. (2022), *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Geneva, Switzerland: IPCC.
- Kashi, A., Shah, M.E. (2023), Bibliometric review on sustainable finance. *Sustainability*, 15(9), 7119.
- Kashif, M., Pinglu, C., Ullah, S., Zaman, M. (2023), Evaluating the influence of financial technology (FinTech) on sustainable finance: A comprehensive global analysis. *Financial Markets and Portfolio Management*, 38, 1-33.
- Keshminder, J., Abdullah, M.S., Mardi, M. (2022), Green sukuk-Malaysia surviving the bumpy road: performance, challenges and reconciled issuance framework. *Qualitative Research in Financial Markets*, 14(1), 76-94.
- Khalid, F., Naveed, K., Nawaz, R., Sun, X., Wu, Y., Ye, C. (2023), Does corporate green investment enhance profitability? An institutional perspective. *Economic Research-Ekonomska Istraživanja*, 36(1), 1-24.
- Kleffel, P., Muck, M. (2023), Aggregate confusion or inner conflict? An experimental analysis of investors' reaction to greenwashing. *Finance Research Letters*, 53, 103421.
- Koenigsmarck, M., Geissdoerfer, M. (2021), Mapping socially responsible investing: A bibliometric and citation network analysis. *Journal of Cleaner Production*, 296, 126376.
- Kumar, S., Sharma, D., Rao, S., Lim, W.M., Mangla, S.K. (2022), Past, present, and future of sustainable finance: Insights from big data analytics through machine learning of scholarly research. *Annals of Operations Research*, 308, 1-44.
- Lemonakis, C., Kouskoukis, M.N., Garefalakis, A., Zopounidis, C., Eskantar, M. (2020), A bibliometric analysis of ethical investments (EI) research: Alternative investments. In: *Recent Advances and Applications in Alternative Investments*. United States: IGI Global. p286-305.
- Li, T.T., Wang, K., Sueyoshi, T., Wang, D.D. (2021), ESG: Research

- progress and future prospects. *Sustainability*, 13(21), 11663.
- Liyanage, S.I.H. (2021), Insights from EU policy framework in aligning sustainable finance for sustainable development in Africa and Asia. *International Journal of Energy Economics and Policy*, 11(1), 459-470.
- Macchiavello, E., Siri, M. (2022), Sustainable finance and fintech: Can technology contribute to achieving environmental goals? A preliminary assessment of “green fintech” and “sustainable digital finance”. *European Company and Financial Law Review*, 19(1), 128-174.
- Martini, A. (2021), Socially responsible investing: from the ethical origins to the sustainable development framework of the European Union. *Environment, Development and Sustainability*, 23(11), 16874-16890.
- Migliavacca, M., Patel, R., Paltrinieri, A., Goodell, J.W. (2022), Mapping impact investing: A bibliometric analysis. *Journal of International Financial Markets, Institutions and Money*, 81, 101679.
- Mirza, N., Umar, M., Afzal, A., Firdousi, S.F. (2023), The role of fintech in promoting green finance, and profitability: Evidence from the banking sector in the euro zone. *Economic Analysis and Policy*, 78, 33-40.
- Mohanty, S., Nanda, S.S., Soubhari, T., Biswal, S., Patnaik, S. (2023), Emerging research trends in green finance: A bibliometric overview. *Journal of Risk and Financial Management*, 16(2), 108.
- Naeem, M.A., Karim, S., Rabbani, M.R., Bashir, A., Kumar, S. (2022), Current state and future directions of green and sustainable finance: A bibliometric analysis. *Qualitative Research in Financial Markets*, 15(4), 608-629.
- Paul, J., Lim, W.M., O’Cass, A., Hao, A.W., Bresciani, S. (2021), Scientific procedures and rationales for systematic literature reviews (SPAR-4-SLR). *International Journal of Consumer Studies*, 45(4), 1-16.
- Prajapati, D., Paul, D., Malik, S., Mishra, D.K. (2021), Understanding the preference of individual retail investors on green bond in India: An empirical study. *Investment Management and Financial Innovations*, 18(1), 177-189.
- Quang, P.T., Rasoulinezhad, E., Linh, N.N., Thao, D.P. (2022), Investigating the determining factors of sustainable FDI in Vietnam, *China Finance Review International*, 12(2), 334-350.
- Rau, P.R., Yu, T. (2023), A survey on ESG: Investors, institutions and firms. *China Finance Review International*, 14, 3-33.
- Sachs, J.D., Du Toit, H.J. (2015), Earth calling the financial sector. Earth. Project Syndicate. Available from: <https://www.project-syndicate.org/commentary/sustainability-finance-leaders-by-jeffrey-d-sachs-and-hendrik-j-du-toit-2015-02> [Last accessed 2024 Mar 14].
- Sachs, J.D., Woo, W.T., Yoshino, N., Taghizadeh-Hesary, F. (2019), Importance of green finance for achieving sustainable development goals and energy security. In: *Handbook of Green Finance*. Berlin: Springer. p3-12.
- Sedliačiková, M., Aláč, P., Moresová, M. (2020), How behavioral aspects influence the Sustainable Financial decisions of shareholders: An empirical study and proposal for a relevant decision-making Concept. *Sustainability*, 12(12), 4813.
- Sensharma, S., Sinha, M., Sharma, D. (2022), Do Indian firms engage in greenwashing? Evidence from Indian firms. *Australasian Accounting, Business and Finance Journal*, 16(5), 67-88.
- Shaydurova, A., Panova, S., Fedosova, R., Zlotnikova, G. (2018), Investment attractiveness of “green” financial instruments. *Journal of Reviews on Global Economics*, 7(Special Issue), 710-715.
- Shi, X., Ma, J., Jiang, A., Wei, S., Yue, L. (2023), Green bonds: Green investments or greenwashing? *International Review of Financial Analysis*, 90, 102850.
- Smoleńska, A., van’t Klooster, J. (2022), A risky bet: Climate change and the EU’s microprudential framework for banks. *Journal of Financial Regulation*, 8(1), 51-74.
- Taghizadeh-Hesary, F., Yoshino, N. (2019), The way to induce private participation in green finance and investment. *Finance Research Letters*, 31, 98-103.
- Taghizadeh-Hesary, F., Yoshino, N. (2020), Sustainable solutions for green financing and investment in renewable energy projects. *Energies*, 13(4), 788.
- Tang, T., Yang, L. (2024), Shaping corporate ESG performance: Role of social trust in China’s capital market. *China Finance Review International*, 14(1), 34-75.
- Tiwari, A.K., Abakah, E.J.A., Shao, X., Le, T.L., Gyamfi, M.N. (2023), Financial technology stocks, green financial assets, and energy markets: A quantile causality and dependence analysis. *Energy Economics*, 118, 106498.
- Van Eck, N., Waltman, L. (2010), Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523-538.
- Xu, G., Lu, N., Tong, Y. (2022), Greenwashing and credit spread: Evidence from the Chinese green bond market. *Finance Research Letters*, 48, 102927.
- Yang, J., Liu, X. (2023), The role of sustainable development goals, financial knowledge and investment strategies on the organizational profitability: Moderating impact of government support. *Economic Research-Ekonomska Istraživanja*, 36(1), 1570-1591.
- Yoshino, N., Taghizadeh-Hesary, F., Nakahigashi, M. (2019), Modelling the social funding and spill-over tax for addressing the green energy financing gap. *Economic Modelling*, 77, 34-41.
- Yu, X., Mao, Y., Huang, D., Sun, Z., Li, T. (2021), Mapping global research on green finance from 1989 to 2020: A bibliometric study. *Advances in Civil Engineering*, 2021, 1-13.
- Zetzsche, D.A., Bodellini, M., Consiglio, R. (2022), The EU sustainable finance framework in light of international standards. *Journal of International Economic Law*, 25(4), 659-679.
- Zhang, D. (2023), Can environmental monitoring power transition curb corporate greenwashing behavior? *Journal of Economic Behavior and Organization*, 212, 199-218.
- Zhang, D., Zhang, Z., Managi, S. (2019), A bibliometric analysis on green finance: Current status, development, and future directions. *Finance Research Letters*, 29, 425-430.
- Zhou, K., Li, Y. (2019), Carbon finance and carbon market in China: Progress and challenges. *Journal of Cleaner Production*, 214, 536-549.
- Zupic, I., & Čater, T. (2015), Bibliometric methods in management and organization. *Organizational Research Methods*, 18(3), 429-472.