Review

Exploring the Knowledge Structure and Hotspot Evolution of Greenwashing: A Visual Analysis Based on Bibliometrics

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Abstract: As environmental protection changes from a purely social benefit to a social benefit mixed with an economic gain, the marketing strategy practice of corporate greenwashing is starting to become a popular research topic. However, the total number of existing review articles on greenwashing research is relatively small, and there are deficiencies in quantitative research and generalizability, scientificity and systematization. This paper attempts to bridge these gaps by combining systems theory with bibliometrics and using visualization techniques to analyze the evolution of knowledge structures and hotspots in greenwashing. Based on this, this paper takes the literature on greenwashing in the Web of Science core set database from 2004–2022 as a research sample and uses CiteSpace 5.8.R3 to conduct a descriptive statistical analysis and carve a visual map to reveal the evolution pattern of research in the field of greenwashing in a comprehensive and systematic way. The findings show that greenwashing research is prevalent in developed countries and continues to attract more scholars globally, focusing on the interpretation of greenwashing definitions and concepts, influencing factors, consequences and governance models. Finally, this paper introduces the system governance theory and improves organizational isomorphism theory to further generalize the existing research framework on greenwashing and provides an outlook on the future direction of greenwashing research from three perspectives: greening screening research, impact research and governance research.

Keywords: greenwashing; bibliometric analysis; systems governance; marketing ethics; corporate social responsibility; CiteSpace

1. Introduction

Looking back to 2021, the United States returning to the Paris Agreement and the volcanic ash blocking the sky in Fiji certainly show that it is urgent to solve the climate problem. As an important means of reducing climate extremes, the social consensus on energy efficiency and emissions reduction has led to more abundant research on this subject [1,2]. Among these, governments have carried out various green governance practices, using incentives and constraints to give society the motivation and pressure for environmental governance on the one hand [3–5] and advocacy tools to guide society towards a green and low-carbon culture on the other [6,7]. As one of the key players in energy conservation and emission reduction, enterprises have started to make many environmental promises to obtain government subsidies, avoid government pollution penalties and meet the growing consumer demand for green products. However, such promises are not backed up by facts and are intended only to deliberately mislead the government and consumers to create a false impression of them, thereby covering up their own polluting behavior. Numerous environmentalists, psychologists and ethicists

have termed this marketing strategy of responding to a formally pandering but essentially confronting environmentally responsible as "greenwashing" or "green sheen" [8].

In 2009, researchers in Terro Choice surveyed "big box" retailers in the US and Canada and found that over 98% of the 2219 products surveyed showed signs of greenwashing [9], suggesting that greenwashing had been identified by practitioners for over a decade. However, a search of the academic literature on "greenwashing" retrieved in WOS (Web of Science) shows that while the overall number has been increasing in recent years, it is still at a relatively low level and the gap between the number of articles on other popular topics is excessive. Therefore, strengthening the research on greenwashing is an inevitable and urgent academic topic. Meanwhile, the complexity of the greenwashing has led the existing research to be scattered and the scientific and systematic reviews to be scarce. Accordingly, we searched the WOS for literature review articles on the topic of "greenwashing" and the only ones most relevant are Yang et al. [10], Montero-Navarro et al. [11], Netto et al. [12], Martinez et al. [13], Vergara and Agudo [14], Pope and Wraas [15], Sdrolia and Zarotiadis [16], Pearson et al. [17], Popescu et al. [18], Geist [19], Goel et al. [20], Philp et al. [21] and DeFries et al. [22]. Through analyzing these articles, we found the following five main features: first, previous reviews have focused on greenwashing research in a specific area. For example, Yang et al. reviewed greenwashing in multinational enterprises in Asian emerging markets [10], while Montero-Navarro et al. focused on the agriculture, food industry and food retail sectors [11]. Second, previous reviews have focused on the conceptual evolution of greenwashing definition. For example, the perception behavior of greenwashing faced by consumers [13], corporate social responsibility cleaning [15], etc. Third, greenwashing is only a supplement to the literature review in other environmental areas. For example: green finance [14,18], green product [16], media for sustainable development [17], tobacco and deforestation [19], bioplastics [20,21] and voluntary certification of tropical agricultural commodities [22]. Fourth, previous reviews of greenwashing are scattered. For example, Martinez et al. and Pope and Wraas focused on the definition of greenwashing concept evolution [13,15], while Yang et al. paid attention to the causes, classification and consequences of greenwashing [10], and Netto et al. highlighted the form of greenwashing [12]. Fifth, the analytical methods of previous reviews are of insufficient depth. Apart from the traditional literature induction method, only one of the greenwashing review literatures used meta-analysis [12], one used fuzzy inference system [13], and one used bibliometric method [11]. As can be seen, the total amount of literature reviewed on greenwashing is relatively small, and the specific research on the concept of greenwashing is scarce. This is reflected in either narrowing down to a specific area or generalizing the concept of greenwashing, making it complementary to other studies, which have resulted in findings that are not universal and scientific. Simultaneously, the research framework of the greenwashing review is inadequate, as the concept, causes, classification and consequences of greenwashing are not included in the unified analysis framework. Apart from that, the research methodology is mainly subjective literature induction, although there are a few articles containing objective research methods such as bibliometric and meta-analysis, but the depth of analysis is not sufficient (e.g., the existing bibliometrics on greenwashing neglects the analysis of collaboration networks, the emerging trends and the further refining of research themes based on the delineation of research phases), which leaves the findings of the research lacking in systematicity and scientificity.

With this in mind, this paper focuses on the visualization of the concept and connotation of greenwashing, as well as on the research methods and findings, to show how this still relatively empty field has evolved over time. Based on system governance theory and organizational structure theory, this paper builds a complete analytical framework from "defining greenwashing (what is it)" to "tracing greenwashing (why does it exist)" to "assessing the consequences of greenwashing (why should it be controlled)" to "controlling the spread of greening (how to control it)" to predict future directions and trends of greenwashing research. In addition, traditional literature review articles tend to summarize, classify and synthesize a few articles from the existing literature, and then derive future

research hotspots in the field through the authors' own experiences [23–25]. Therefore, this approach often suffers from an incomplete literature sample, a neglect of links to other fields, unconvincing conclusions and the omission of secondary information such as authors and institutions, while scientometric analysis, on the other hand, circumvents these problems, as it is a visual, serialized knowledge map for discovering complex relationships within the field, including funding institutions, authors, research trends, etc. [26–28]. The CiteSpace used in this paper is one such analysis software, which combines co-citation analysis, collaboration networks and evolutionary trend detection to help researchers identify data relationships and intrinsic connections among research subjects. In scientific citation analysis, it can show trends and movements in a discipline or knowledge domain over time based on big data from the existing literature, forming the evolution of several research frontiers [29,30].

Against this backdrop, differing from previous literature review articles on greenwashing, this paper uses CiteSpace bibliometric software to draw co-citation networks, co-citation clusters, collaboration networks, keyword transition time-zone views and keyword emergence mapping from the literature of greenwashing research. This comprehensively and systematically reveals the evolutionary pattern of greenwashing research and provides empirical evidence for hotspot tracking and frontier exploration of subsequent research. Specifically, this paper needs to tackle the following four key questions.
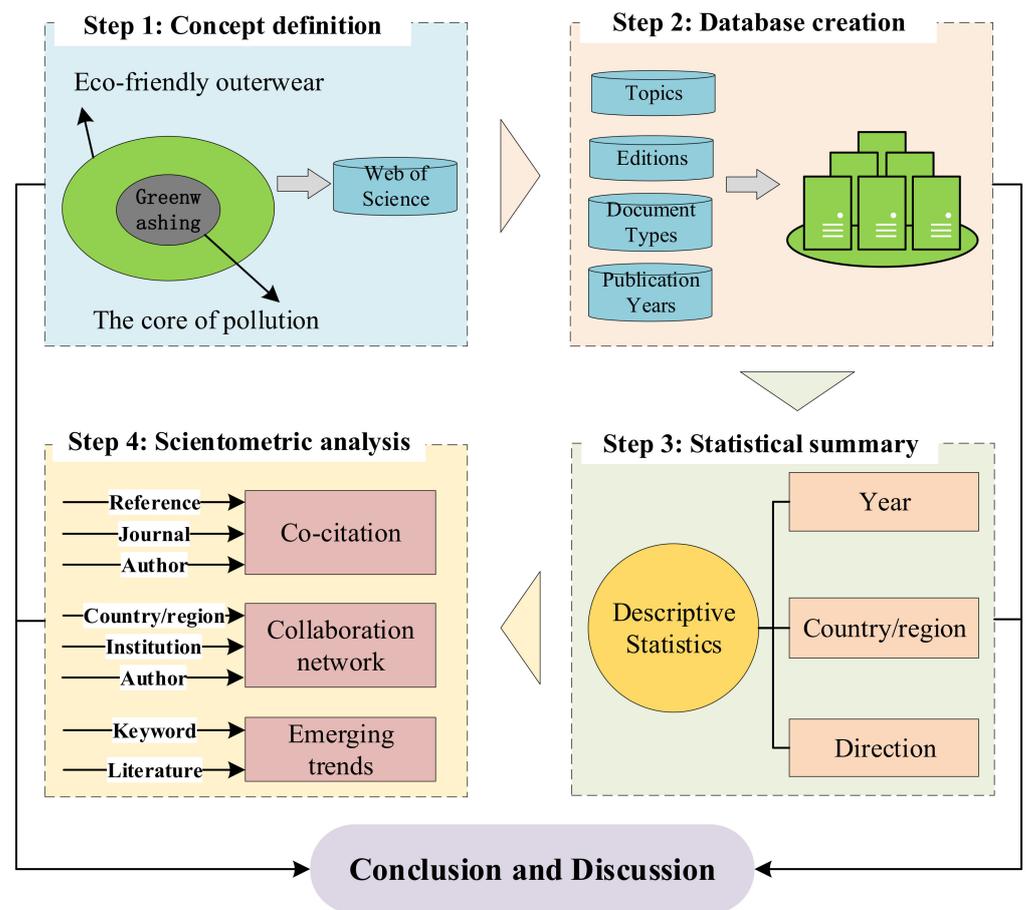
(1) What are the statistical characteristics and trends in the annual and regional distribution of publications, the classification of research directions in greenwashing?
(2) What is the influence of the references, journals and authors in greenwashing and what is the collaboration between the countries/regions, institutions and authors?
(3) What are the patterns in the evolution of hot topics and emerging trends in the greenwashing research?
(4) What is the analytical framework of the existing greenwashing studies and what directions exist for their improvement and enrichment in the future?

The rest of the paper is organized as follows. In Section 2, the research framework of this paper, the definition of greenwashing, the research data and the research tool are outlined. In Section 3, the descriptive statistics of the literature are presented. In Section 4, the co-citation analysis, collaboration network analysis and emerging trends analysis are conducted. In Section 5, the conclusion and discussion of this paper are shown, the framework of existing research is summarized, and the hot directions for greenwashing research in the future are proposed.

2. Methodology

2.1. Analysis Framework

To address the four key questions posed, a framework for visual data analysis of the literature was developed in this paper (shown in Figure 1), which subdivides the visualization research of the literature into four steps. In the first step, the existing concept of greenwashing is summarized and generalized, and then the raw data associated with it is exported in the literature database. In the second step, filtering rules are developed according to the research objectives of this paper, and then the raw data are screened to build the literature analysis database for this paper. In the third step, descriptive statistics are conducted on the constructed literature analysis database to summarize the statistical features and trends behind them. In the fourth step, a scientometric analysis is conducted to summarize the literature features, collaboration and the emerging research trends within the field. In the fifth step, the key findings from the four steps above are summarized and future research is discussed and foreseen.

Step 1: Concept definition

Eco-friendly outerwear

Greenwashing

Web of Science

The core of pollution

Step 2: Database creation

Topics

Editions

Document Types

Publication Years

Step 4: Scientometric analysis

Reference
Journal
Author
Co-citation

Country/region
Institution
Author
Collaboration network

Keyword
Literature
Emerging trends

Step 3: Statistical summary

Descriptive Statistics

Year

Country/region

Direction

Conclusion and Discussion

Figure 1. Data analysis framework for the greenwashing research.

2.2. The Definition of Greenwashing

In 1986, the term "greenwashing" was first proposed by American environmentalist Jay Westerveld to describe the false environmental practices of hotels in their day-to-day operations. It is a new word created by fusing "green" and "bleaching". "Green" refers to pro-environmental, natural and healthy behavior. "Bleaching" means "washing away the substance with water" to refer specifically to the use of green to cover up the original color of something, so greenwashing is also the whitewashing of a false green, which is a false and deceptive behavior. The most influential definition of greenwashing in existing research was proposed by Terra Choice in 2007 in environmental marketing, where they argued that greenwashing is a practice of misleading consumers about corporate environmental practices or the environmental benefits of a product or service, and suggested the seven sins of greenwashing: the hidden trade-off, no proof, vagueness, irrelevance, lesser of two evils, fibbing and worshiping false labels [9]. Besides, greenwashing is defined in the Oxford Dictionary as the act of enterprises falsely and beautifully relating to environmental pollution to project a good image of environmental protection in front of their stakeholders. However, over time, forms of greenwashing have become diverse, such as selective disclosure of information, false advertising and misleading green labels for consumers [31]. Nowadays, greenwashing is becoming more subtle and the concepts it involves are gradually increasing (shown in Figure 2); it is no longer about damaging the environment or other false behaviors that make an enterprise "green". It is more often about exaggerating good performance and hiding poor performance, or "says more than it does", or perhaps even "deceptively manipulative" [32]. A word cloud is a visual representation of text data, a color graph composed of specific words. This paper selects the top 30 words

of the key word centrality of all greenwashing literature and then draws the word cloud map.

Figure 2. Word cloud map of greenwashing.

2.3. Source of Data

Web of Science (WOS) is a product of Clarivate (Thomson Reuters), including three major citation databases (SCI, SSCI and A&HCI) of authoritative and influential journals in various subject areas. It is one of the most crucial fundamental evaluation tools in bibliometrics and scientometrics because of its stringent selection criteria and citation indexing process. Consequently, to provide a global overview of the current state of greenwashing research, this paper uses the WOS core set database and develops the following search rules according to the purpose of the research: (1) topics = "greenwashing" or "greenwash" or "green wash" or "green-washing" or "green-wash" or "brownwashing" or "bluewashing" or "green sheen"; (2) editions = Science Citation Index Expanded (SCI-EXPANDED) or Social Sciences Citation Index (SSCI) or Arts and Humanities Citation Index (AHCI) or Emerging Sources Citation Index (ESCI) or Conference Proceedings Citation Index–Science (CPCI-S) or Conference Proceedings Citation Index–Social Science and Humanities (CPCI-SSH) or Book Citation Index–Science(BKCl-S) or Book Citation Index–Social sciences & Humanities (BKCI-SSH) or Current Chemical Reactions (CCR-EXPANDED) or Index Chemicus (IC); (3) document types = "Articles" or "Early Access" or "Review Articles" or "Proceedings Papers"; (4) publication years = "2004-01-01 to 2022-05-31". Besides, articles were not considered if they were incomplete. Based on the above search rules and manual checking to remove duplicates or articles not related to the research topic, a total of 594 articles were finally obtained for this paper.

2.4. Analytical Tool

CiteSpace is an information visualization research tool based on the JAVA language, which was developed by Professor Chaomei Chen of Drexel University in the US. It is currently the most widely used tool for knowledge mapping in academic research, visualizing research hotspots and research frontiers in a visual image, enabling researchers to quickly grasp the research status and research orientation [33–37]. In this paper, CiteSpace 5.8.R3, updated on 4 November 2021, was used to analyze the structural features and thematic variation of the literature on greenwashing to reveal the potential relationships and implicit information behind the literature. The relevant parameters are set as shown in Table 1.

Table 1. Original setting of CiteSpace.

Parameter Type	Parameter Setting	
Time slicing	Time interval	From January 2004 to May 2022
	Year per slice	1
Node types	Reference, author, journal, author, institution, country	
Term source	Title, abstract, author keywords (DE), keywords plus (ID)	
Links strength	Cosine	
Scope	Within slices	
Selection criteria	g-index = 25	
Pruning	Pathfinder, Pruning sliced networks, Pruning the merged network	

3. Statistical Summary

3.1. Publication Year

The annual distribution of the literature published on greenwashing from 2004–2022 (Figure 3) reveals some specific patterns. The statistics show that the global research literature on greenwashing is steadily increasing and can be broadly divided into three phases as follows. The first phase is the start-up phase, from 2004 to 2011, with around seven publications per year and the total output of 48 (8%). The second phase, from 2012 to 2016, is called the development phase. The number of publications is 34 annually, and total output is 136 (22.9%). The third phase is named rapid development. From 2016 to present, there has been a rapid increase in the publications on greenwashing with an annual average of 82 publications and growing, and the frequency of citations also moves positively.
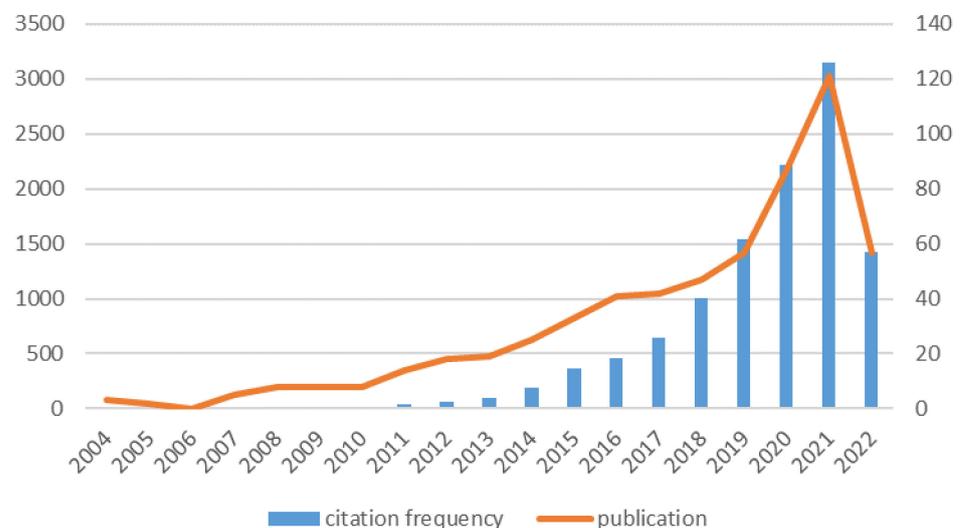
Figure 3. Distribution of publication year and citation frequency of greenwashing literature.

3.2. Country/Region

As the mapping of the distribution of greenwashing literature by country and region (Table 2) shows, the United States ranks first in terms of total publications, while China is in second place, followed by the United Kingdom and other western European countries. However, the gap between the US and the second is too large, almost twice that of China. Behind them are Canada, Germany, Australia and others. It is clear that the US has a unique advantage in this area. In contrast, African countries generally published less.

Table 2. Distribution of greenwashing literature by country and region of top 10.

Country/Region	Number	Percentage
USA	132	22.185
PEOPLE'S R CHINA	61	10.252
ENGLAND	59	9.916
CANADA	40	6.723
GERMANY	34	5.714
AUSTRALIA	31	5.210
ITALY	31	5.210
SPAIN	31	5.210
NETHERLANDS	28	4.706
FRANCE	22	3.697

3.3. Research Direction

In terms of research directions, in general, all the literature covers a total of 67 research directions of greenwashing, which includes almost all aspects of the economy and society. As shown in the classification of the top 10 research directions (Figure 4), the main directions involved are business economics (43.5%), environmental sciences ecology (34.3%) and science technology, other topics (17.3%). Scholars mostly choose to study business economics and environmental sciences ecology hoping to use these two most directly relevant directions as breakthroughs to summarize the different motives of greenwashing, analyzing the impact on the enterprises and the economy and society, as well as the promotion of the overall business environment. In addition to this, some minor directions of research also enrich the literature on greenwashing from other perspectives, such as government legal system, ecological environment, geographical area, etc.
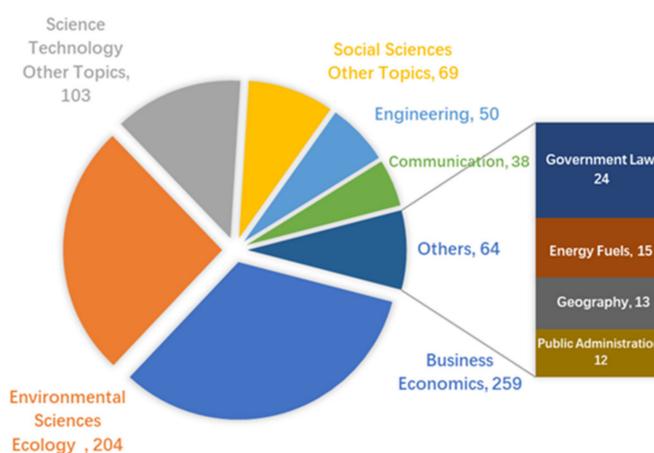
Figure 4. Classification of top 10 research directions.

4. Scientometric Analysis

This paper presents a visual representation of greenwashing research through scientometric analysis. In this section, the current status and future trends of greenwashing research will be analyzed and described in terms of co-citation analysis, collaboration network analysis and emerging trend analysis.

4.1. Co-Citation Analysis

As the level of citations can be considered an indication of the importance of an article, co-citation analysis is a common analytical tool used to analyze large volumes of literature and to reveal the knowledge mapping of a scientific discipline [38]. By performing reference co-citation analysis, journal co-citation analysis and author co-citation analysis, the structure of knowledge related to the field of research can be obtained [39].

4.1.1. Reference

Two references are defined as having a co-citation relationship if they are cited by n (n = 1, 2 . . .) references at the same time and the co-citation intensity between them is n. Co-citation intensity is usually used to measure the relevance of the content of two references. The co-cited literature is similar to the subject, so the co-citation intensity measures the relevance of the literature regarding content. The co-citation analysis of the reference is used to evaluate the references cited in 563 research studies in the field of "greenwashing", with a total of 684 nodes and 2132 lines generated for the mapping. In the network of reference co-citation, each node represents a reference, the links of the connected nodes represent co-citation relationships and the distance between nodes represents the relevance of the literature research discipline. In addition, the lines between different nodes represent the citation relationship between two references, and the different colors express corresponding time slices (each time slice represents one year). In addition to this, the lines between the different nodes represent the citation relationship between two references, and different colors represent the corresponding time slices (each time slice represents a year). The larger the node, the more cited the literature is, meaning that it has a greater impact, as shown in Figure 5.
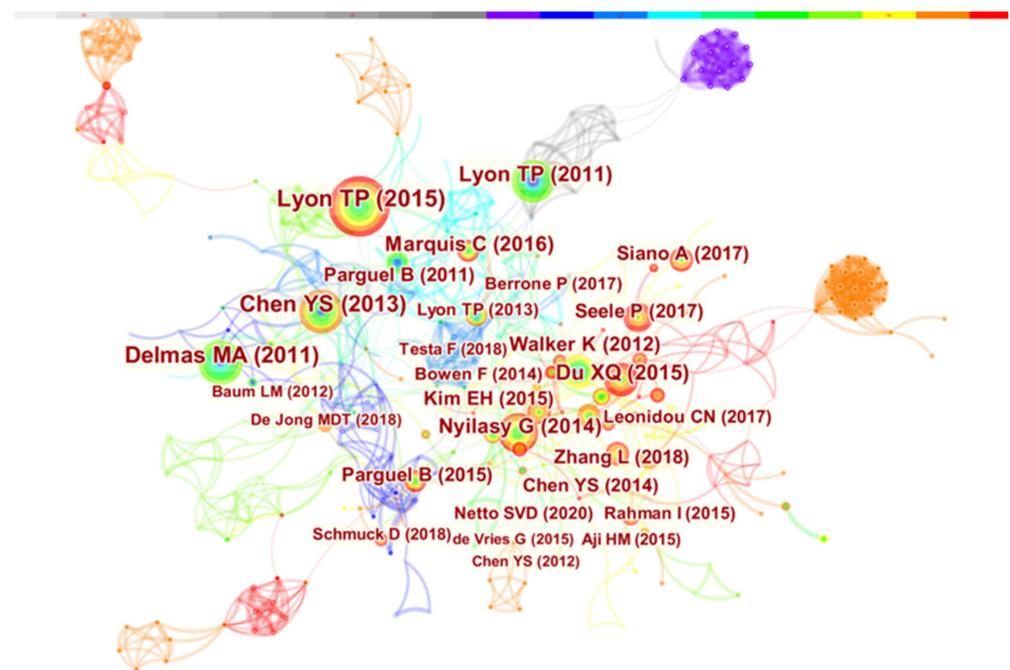
Figure 5. Network of references' co-citation.

To quantify the influence of different literature, Table 3 represents the information of the top 10 most highly cited references in greenwashing in terms of total citation frequency from 2004–2022. Among them, there are four references issued in the *Journal of Business Ethics*, indicating that the *Journal of Business Ethics*, a high-level international academic journal in the field of business and ethics, includes more literature relevant to greenwashing and its governance. In all of the high-frequency co-citation literature, Lyon TP is the author with the highest frequency of co-citation literature.

Table 3. Highly cited literature in the field of greenwashing.

Citation	Author	Journal	Published Year	Average Citations per Year
65	Lyon TP	*Organization & Environment*	2015	9.3
53	Chen YS	*Journal of Business Ethics*	2013	5.3
51	Delmas MA	*California Management Review*	2011	4.6
44	Lyon TP	*Journal of Economics & Management Strategy*	2011	4
40	Du XQ	*Journal of Business Ethics*	2015	5.7
37	Nyilasy G	*Journal of Business Ethics*	2014	4.6
34	Maquis C	*Organization Science*	2016	5.7
30	Walker K	*Journal of Business Ethics*	2012	3
28	Seele P	*Business Strategy and the Environment*	2017	5.6
26	Kim EH	*Organization Science*	2015	3.7

As shown in Table 3, through analyzing the tightness of network connections and the associated impact, Lyon TP's article "The means and end of greenwash", published in 2015 in *Organization & Environment*, has the highest co-citation frequency (citation = 65) of all the high-frequency co-citation literature, implying that its research direction on the relationship between corporate CSR performance and greenwashing has provided guidance to many subsequent papers, with a high degree of similarity in the themes of the literature and a strong guiding role. After the literature of Lyon TP [31], articles with high frequency of co-citation are Chen YS [40] and Delmas MA [41]. Through reading the literature, we can learn that as the research progresses, the direction of greenwashing research gradually transitions from the level of corporate behavior to the level of consumer influence on the enterprise.

As can be seen through Figure 6, the research for greenwashing can be divided into three stages from the perspective of time dimension. The first stage is from 2004 to 2010. In the theory horizon, greenwashing attracted the attention of scholars two decades ago. Although the amount of literature regarding greenwashing had increased from 2004, the topic was still not a hot issue among academics before 2011. It is evident that corporate environmental behavior has not caused heated debate. During this period, the co-citation frequency of the literature is still low, which reflects low relevance and similarity between the different literature and the diversification of the research themes. Among them, the literature published by Chen YS [40] and Delmas Ma [41] in 2010 was the most frequently cited literature, which respectively explored the relationship between consumers' green trust and corporate greenwashing behavior and how the enterprises mislead consumers about their environmental behavior through greenwashing. The second stage is from 2011 to 2017, during which all the literature had a high frequency of co-citation. The relevance of research themes in greenwashing has increased, indicating that as people become more environmentally conscious and enterprises become more aware of CSR, research on greenwashing has attracted more attention from scholars, and the topic has concentrated on the relationship between CSR and greenwashing choices. In the top 10 literature with high frequency of co-citation, seven pieces of literature belong to this period, and the most representative ones are Lyon TP [31] and Chen YS [40]. The third stage is from 2018 until now. After the second phase, represented by the high-frequency co-cited literature of Zhang L [42], the research perspective on greenwashing has been enriched from corporate environmental behavior to consumers to government regulation, showing a trend toward deep tandem multidisciplinary studies in the field of greenwashing research. As Figure 6 shows, there is a general trend toward co-citation literature, which is first increasing and then decreasing. Specifically, the frequency of co-citations fluctuates upward in the first stage, reaches its highest overall level in the second stage, and then decreases in the third stage. The reasons for this are that the third stage contains fewer years, which corresponds to a limited number of documents, and because the years are newer they are not included in CiteSpace's visual analysis of document co-citations, making the overall co-citation frequency of the literature in this stage low. On the other hand, with

the number of articles published on greenwashing increasing, the frequency of co-citations has decreased, which to some extent reflects the increasing fragmentation of the topic in greenwashing research, especially the low correlation between research in recent years. With the update of research methods and techniques, the existing research has become more scenario-based or empirical, resulting in greater uniqueness. This ultimately leads to a lower probability of co-citation of the literature.
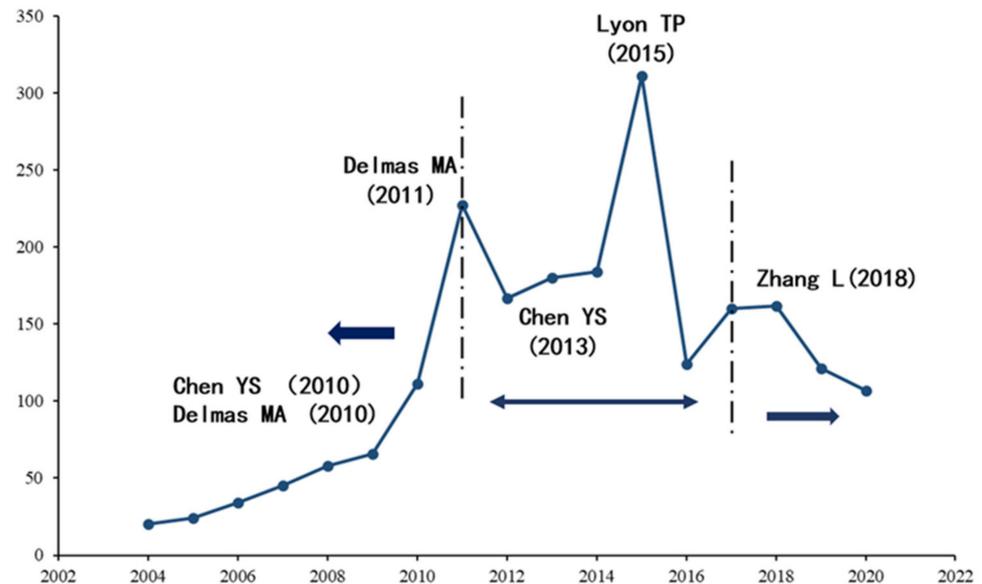
Figure 6. Trend of the number of references with a total citation frequency greater than 1 from 2004 to now.

4.1.2. Journal

When analyzing journals related to the topic of greenwashing, this paper will look at both the number of articles published and the co-citation frequency of the journal to analyze how hot the topic of greenwashing is in a particular journal and how influential a particular journal is in the field of greenwashing research.

From the perspective of total articles in the top 10 list of published journals (Table 4), the top five are *Sustainability* (6.22%), *Journal of Business Ethics* (4.37%), *Business Strategy and the Environment* (3.53%), *Journal of Cleaner Production* (3.53%), and *Corporate Social Responsibility and Environmental Management* (2.02%), while the number of publications in other journals is below 10, accounting for a relatively small percentage. As can be seen from the data, there are journals with a large overall volume of publications, and thus the number of pieces of literature on greenwashing is also higher, such as *Sustainability*, etc. It is clear that greenwashing is still a worthy and hot topic to explore in these journals.

Table 4. Distribution of top 10 highly cited journals.

Periodicals	Record Count
Sustainability	37
Journal of Business Ethics	26
Business Strategy and the Environment	21
Journal of Cleaner Production	21
Corporate Social Responsibility and Environmental Management	12
Environmental Communication a Journal of Nature and Culture	6
Business and Society Review	5
Energies	5
Environment Development and Sustainability	5
International Journal of Hospitality Management	5

Co-citation analysis of journals helps us to learn more about the mainstream journals in our field of study and their influence. In co-citation analysis, betweenness centrality (BC) is a measure of the extent to which a node assumes a "bridging" role in a graph or network by calculating the fraction of the shortest path between all node pairs and summing the pair dependency scores of all the pairs [43,44]. Therefore, BC is often used in co-citation analysis to evaluate the importance of a journal and to highlight the category (or author, journal, institution, etc.) with a purple circle.

Based on a summary of 18 years' worth of journals (2004–2022) serving greenwashing research, Figure 7 shows the co-citation network at journal level. Since the literature of greenwashing spans several scientific disciplines, journals in various fields published literature regarding this topic, showing a trend of tandem and succession of research disciplines. The network of journals' co-citation shows that there are 32 kinds of journals with co-citation frequency of 50 or more, with a large degree of relevance to research on the topic of greenwashing and a diversity of journal types. In addition, the higher the BC, the higher the number of times they act as "intermediaries" and the stronger their mediating power. As the top journal in the field of environmental economics, the *Journal of Environmental Economics and Management* publishes theoretical and empirical papers addressing economic questions; its topics of interest include the environmental behavior of enterprises and agencies, non-profit organizations, households, individuals, etc. With the growing interest of academics in the topic of greenwashing, the balance between corporate environmental behavior and economic efficiency has attracted the attention of scholars and the relevance of the topic is high. The journal, as the top journal in the field of economics, contains more classical literature on topics related to greenwashing and has a high co-citation frequency, while *Sustainable Cities and Society* is a leading international journal that aims to encourage interdisciplinary and multidisciplinary research in the field of green, low-carbon behavior.

Figure 7. Network of journals' co-citation.

When the cited literature was analyzed for journal co-citations, a total of 605 nodes and 2149 links were obtained. The relative size of the node represents the frequency of co-citation in each journal within the dataset. This paper analyzes the importance and influence of different journals on greenwashing from the perspective of co-citation frequency and finds that the five journals with the highest frequency in the co-citation network, i.e., the broadest influence, are the *Journal of Business Ethics* (citation = 307), *Journal*

of Cleaner Production (198), *Business Strategy and the Environment* (156), *California Management Review* (143) and *Academy of Management Review* (142).

4.1.3. Author

The development and improvement of a discipline, including greenwashing, mainly relies on the cooperation of researchers in related disciplines [45,46], and the co-citation analysis of authors can demonstrate the influence and importance of different scholars in their related research fields. Similar to the co-citation analysis of journals, the node size of the analysis mapping represents the co-citations frequency for each scholar, while the links represent the collaborative relationships between scholars.

The author co-citation network for greenwashing is shown in Figure 8, which contains 694 nodes and 1980 co-citation links. It is important to note that only the first author of the reference will be considered in the analysis, and references from the same author will be combined. By setting the frequency threshold at 30, the 10 scholars who are the most frequently co-cited authors were identified through analyzing the network: namely Lyon TP (frequency = 142, 2010); Delmas MA (122, 2011); Chen YS (89, 2014); Parguel B (81, 2014); Laufer WS (72, 2011); Ramus CA (55, 2011); Walker K (54, 2015); Marquis C (51, 2015); Terrachoice (45, 2012); and Bansal P (45, 2013). In terms of the year, essentially all of the highly cited authors conducted their research during the second phase of greenwashing research, indicating that they were relatively early in their research and that their publications have served as a guide to future scholars of greenwashing. Therefore, when the researcher conducts a follow-up study on greenwashing, on the one hand, he or she can get to know renowned expert scholars in the field of greenwashing. On the other hand, it is therefore possible to search the literature of the scholars, which was published in the second phase of the greenwashing research, if one wants to gain in-depth knowledge about greenwashing.


Figure 8. Network of authors' co-citation.

4.2. Collaboration Network Analysis

The society and knowledge network formed by the collaboration of different research subjects to produce research results is called a research collaboration network. By analyzing research collaboration networks, we can obtain information on the development and dissemination trends of a particular research field across different countries/regions, institutions and authors, on the basis of which we can learn the distribution of relevant

scholarly knowledge to draw more comprehensive research conclusions [46,47]. This section analyzes the collaboration networks of countries/regions, institutions and authors in the field of greenwashing from macro, meso- and micro-perspectives, respectively, through which we can explore the knowledge genealogy system and the evolutionary process of the literature in the field of greenwashing.

4.2.1. Country/Region

Figure 9 shows the country collaboration network mapping (nodes numbers = 82, number of connected lines = 118). The relative contribution of different countries or regions in this research field can be measured by the size of the betweenness centrality (expressed as the thickness of the purple aperture around the periphery of the node) and the amount of the literature (expressed as the size of the node) in the mapping. When the number of publications from a country is greater than five, the relative contribution of that country to the research field can be considered high [39]. According to the mapping, this paper found that there are 32 countries with no less than five publications, and the top five countries in terms of the number of publications are the United States (number of articles issued = 132, betweenness centrality = 0.56), China (61, 0), England (59, 0.72), Canada (40, 0.03) and Germany (34, 0.03). However, the contributions of Germany, Canada and China to the overall collaboration network building do not match the number of their research results. The top five countries in terms of BC are England (59, 0.72), the US (132, 0.56), Italy (31,0.35), Australia (31, 0.35) and Spain (13, 0.26), all of which are significant nodes in linking other countries in the collaboration network.
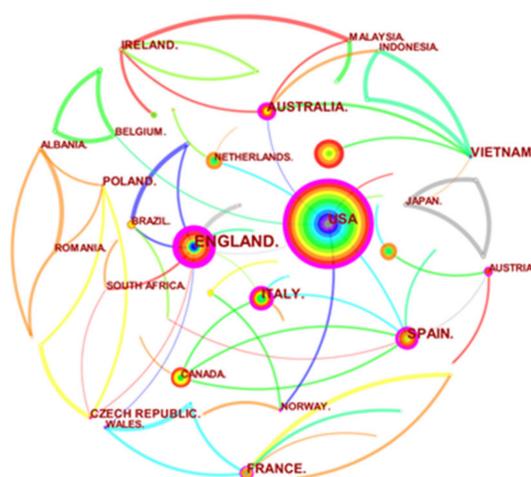
Figure 9. Country/region collaboration network.

The US has published 132 papers, far more than any other country, and it is also the first country to start the research on greenwashing (starting in 2004, the same year the UK also carried out research on greenwashing). The frequency of the greenwashing is usually closely related to a number of factors, including consumer environmental awareness, corporate social responsibility, market competition pressure, government regulation and the effectiveness of social monitoring [41,48]. As consumers in the UK and US become more environmentally conscious and the pressure to compete in the marketplace increases, more and more enterprises in these countries are beginning to engage in greenwashing [41], and the more widespread the greenwashing, the richer the output of research results in terms of definition, traceability and governance in this field will be. For example, based on the theory of institutional and organizational isomorphism, many current studies on the governance

mechanisms of greenwashing focus on the mechanisms of coercive isomorphism, mimetic isomorphism and normative isomorphism, and gradually explore new models to further enhance the effectiveness of greenwashing governance.

The earliest research links with other countries were established by countries in Europe, West Asia and Oceania, including England and Turkey (starting in 2009) and Spain and Austria (2010). Among these countries, England has the highest BC and plays the most important role as a bridge in the collaboration network. Subsequently, North American countries joined the collaboration network, for example the US (2014). In the Southeast Asian region, the nodes are scantier and their complexity of network structure is far less than that of European countries. However, Southeast Asia still has closer links than South America and Africa. Many countries in South America and Africa are in their infancy in the field of greenwashing and most of the research is more isolated, making it difficult to establish close collaborations. Economic backwardness makes it difficult for consumers in these regions to quickly develop environmental awareness, and insufficient demand for green products also discourages enterprises in economically backward regions from engaging in greenwashing activities, resulting in a relative lack of research in the field of greenwashing [49].

4.2.2. Institution

To make the characteristics of meso- and micro-collaboration networks more obvious, these mappings are adapted in this paper, as shown in Figure 10. Since the individual references cannot form effective connections and appear in the figure only as a dotted pattern, contributing very little to the collaboration network, this part of the mapping is completely hidden in this paper. The visual effect of the dual-subject collaboration pattern is thin, reflecting a low collaboration, but it is an essential stage in the process of further expanding the collaboration network. The collaboration structure of the ternary subject has been further expanded on the basis of the dual-subject collaboration, and this collaboration relationship has taken the shape of a collaboration network. Although the multi-subject collaboration network still lacks a central node, it is relatively mature compared with the above forms of collaboration, and with the gradual addition of new collaboration subjects, this type of collaboration network has a greater possibility of gradually developing into a large collaboration network with a system.

These small collaboration networks have the characteristics of being multiple and scattered, and traditional mapping methods usually have the problem of being cluttered when dealing with such a network, and it is difficult to visualize the specific information contained in the mapping of different types of collaboration networks, such as the number, time, proportion, etc. However, in this paper, the mappings involved in such problems are modulated in a stepped arrangement while ensuring that the relevant data are complete and valid, and are presented according to the closeness of collaboration and the growth stage of the collaboration network, to achieve an intuitive visual effect.

Figure 10 shows the institutional collaboration network mapping(306, 137).The research institutions with the most publications are the League of European Research Universities (number = 22), University of London (10), University of Michigan (8), University of Michigan System (8) and University System of Georgia (8); all five research institutions are located in Europe and America. Although their number of publications is relatively high, they do not play a bridging role in the formation of institutional collaboration networks.
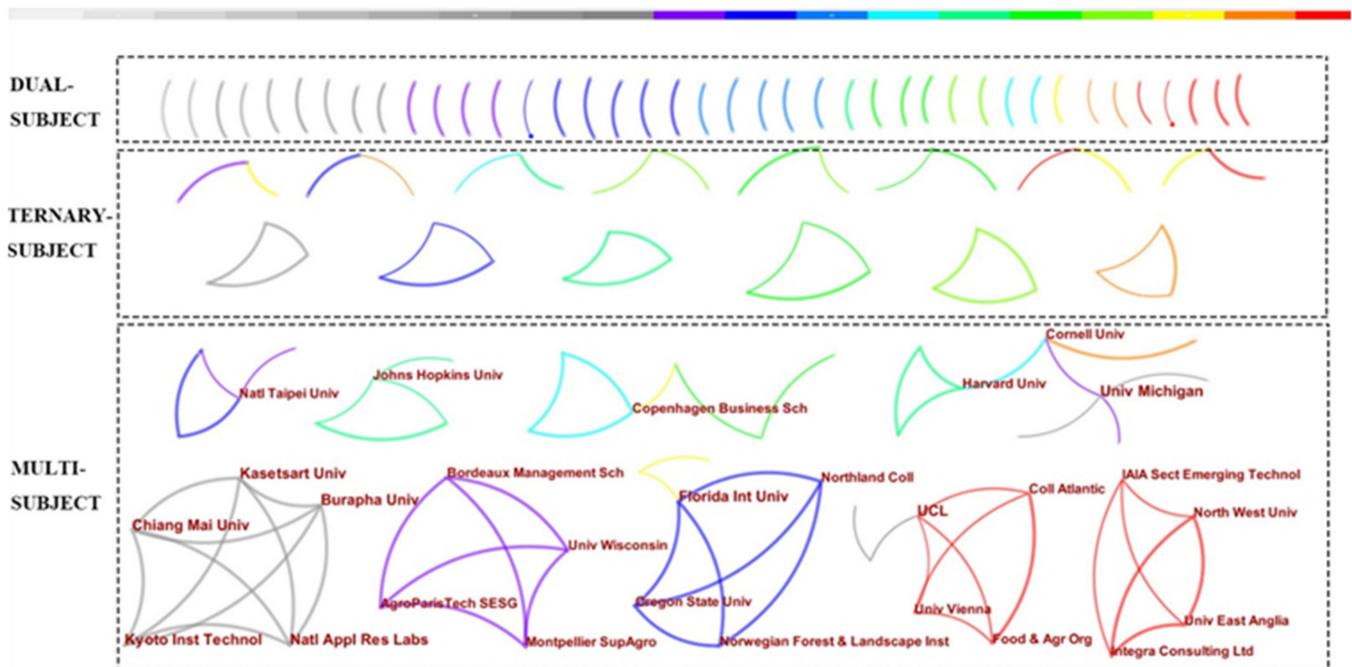
Figure 10. Institutional collaboration network.

Overall, the network of institutional collaboration shown is relatively loose. Most of the networks are small and independent. Meanwhile, the collaboration is mainly led and participated in by European and American countries, and their respective research is relatively independent, with a late and slow development of established collaboration networks. For example, Figure 10 shows that the first collaboration links were established in 2004 and the first collaboration networks were only initially formed in 2011. Therefore, there is a lack of important research institutions that can play the role of a bridge to link the existing achievements.

4.2.3. Author

Figure 11 shows the author collaboration network mapping(343,190). The top five scholars in terms of number of publications are Boiral O (number = 6) from Laval University, Canada, Testa F (6) from Sant' Anna School of Advanced Studies, Italy, Font X (5) from the University of Surrey, UK, Lyon TP (5) from the University of Michigan, US, and Siano A (5) from the University of Michigan, US, who have relatively high attainment in this field of research. Apart from Lyon TP, who started his research in 2011, the other scholars only started their research after 2016, and the relatively late start of their research may be one of the reasons for the low number of results produced by these scholars. Interestingly, the three scholars who first published the paper in 2004, Charles A. Francis of the University of Nebraska in the US, Simon Lightfoot of Liverpool John Moores University in the UK and Jon Burchell of Brunel University in the UK, and Reynolds of the University of Sheffield, did not pursue this field in depth, but published only one article related to greenwashing and then moved on to other fields of exploration.
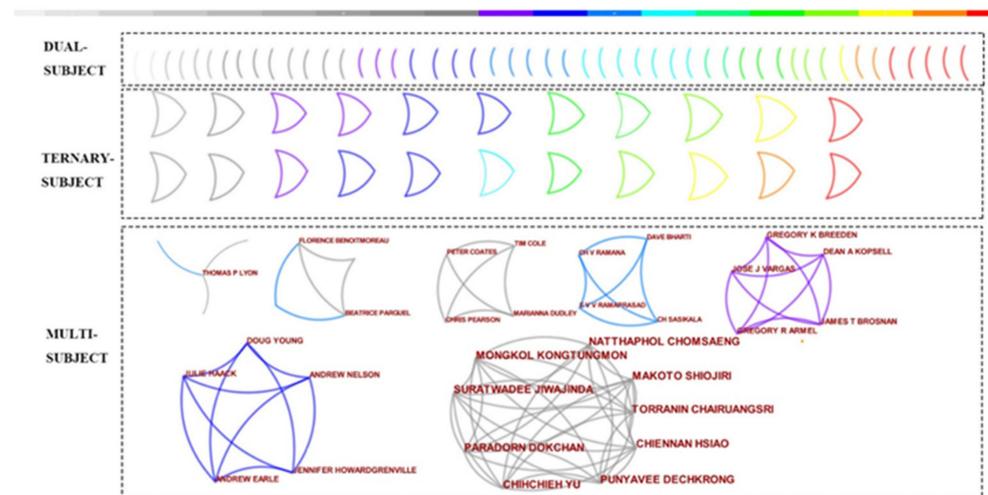
Figure 11. Author collaboration network.

The author collaboration network mapping is dominated by small collaboration networks of two to three people, and in the three largest collaboration networks, established in 2011, 2013 and 2014, respectively, the largest network includes nine partners. These collaboration networks are highly fragmented, with low levels of synergy and high levels of independence, and BC is zero for all authors. It is difficult to form important nodes connecting different networks in the author collaboration mapping. The local collaboration links between different authors are relatively strong, but the whole presents a fragmented and broken collaboration state, although this may also indicate that each co-group has a specific expertise and that there is no need for close communication between the groups.

Generally, due to the similarity of research fields and ease of communication, it is easier for researchers with colleagues or faculty–student relationships within the same institution or department to initiate and establish long-lasting and stable collaboration relationships, and therefore it is more common for research members of collaboration networks to have similar close relationships [50]. However, the author collaboration relationships in the field of greenwashing are different from the common situation. As this research field involves a variety of disciplines such as psychology, ecology, finance, law, journalism and communication, forestry, sociology, management, etc. [21,51–54], scholars with interdisciplinary backgrounds are more likely to achieve certain scientific results in research related to greenwashing, which is why more scholars with various professional backgrounds from different institutions are working together to form collaboration networks. However, this also means that greenwashing research is likely to have a high degree of fragmentation, which can be assisted by a systematic analysis with the help of ideas such as system theory, information theory and synergy theory.

By observing the collaboration network mapping from different perspectives, this paper found a loose collaboration among the subjects at the author level in the micro-perspective and at the institution level in the meso-perspective, and most of these collaborations are individual independent research studies, dual-subject linear collaborations, ternary-subject triangular collaborations and multi-subject collaborations. The implicit collaboration relationships that cannot be presented in the meso- and micro-mapping are manifested at the macro level, thus we can observe the high degree of collaboration at the national level at the macro perspective. There are obvious central nodes and systematic collaboration networks in the mapping, and the research results of various regions can form organic connections. In addition, from the perspective of the temporal development of the collaboration network, combined with system theory ideas, it can be found that the state of collaboration at the institutional level is in the process of gradually evolving from a low-level cycle to a high-level cycle, while changing from disorderly dispersion

to an orderly whole, and is gradually strengthening the state of interdependence of the collaboration subjects.

The number of research results in the field of greenwashing is considerable, but with the switch and depth of perspective, this paper found that its research collaboration state is still in the primary stage, the collaboration of meso- and micro-subjects are limited to the local circles, and the overall collaboration relationship shows the characteristics of multiple and scattered. The reason for this, on the one hand, is that the research in the field of greenwashing is strongly influenced by the economic development and business environment, consumer awareness and other factors, resulting in the research on greenwashing in less-developed areas being more isolated, which is manifested by the current status of a few research results, scarce researchers and a low degree of collaboration. On the other hand, although greenwashing research has been developing for several years, few authors have conducted long-term explorations in this field, and most scholars have published only two to three articles before moving on to other fields of research, which subsequently makes it more difficult to form stable and close collaborations.

4.3. Emerging Trends Analysis

Keywords are terms that have a significant meaning in expressing the main idea of the work and are chosen from the title, abstract and body of the document. They are words that are used in computer systems to cite the content features of a paper and are easily converged in information systems for readers to search. In contrast, several keywords are usually given at the same time in a paper, and there is generally some kind of association between them. For this degree of association, most existing research measures it by the frequency of keyword co-occurrences. Typically, if the word pair appears more often in the same literature, it means that the two topics are more closely related. Therefore, by counting the frequency of occurrence of subject words in the same document, a co-word network can be formed by the association of these word pairs, thus accurately reflecting the research themes and research hotspots of the co-word network.

Based on this, this paper used CiteSpace to construct a co-occurrence network mapping of the sample literature (as shown in Figure 12). In addition, in the knowledge mapping generated by CiteSpace, the centrality of a node refers to the number of all the shortest paths that pass through that node in the network and is a measure of the importance of the node's connectivity role in the overall network. In general, the higher the centrality of a node, the more it appears on the shortest path in the overall network, and the greater its influence and importance. To analyze the current research status in the field of greenwashing, this paper extracted the top 20 high-frequency keywords among them according to the centrality magnitude (as in Table 5).

By analyzing the co-occurrence network of keywords and the top 20 high-frequency keywords in the field of greenwashing, this paper found that, first, the keyword "corporate social responsibility" is in the top five of high-frequency keywords in terms of both citation frequency and centrality, and it is highly consistent with the research theme. Greenwashing is a phenomenon that is carried out by enterprises, which are profit-oriented and neglectful of environmental protection, and is essentially a neglect of their own environmental responsibilities. Second, greenwashing research has expanded from the evolution of concepts (e.g., "consumer", "information", "consumption", "performance", etc.) to other themes in the environmental field, including "brand" (e.g., Wang et al. inspected the effect of a brand's greenwashing on consumers' willingness to purchase other brands of green products [55]), "climate change" (e.g., Huckestein analyzed the underlying reasons for defining reforestation to compensate for greenhouse gas emissions as greenwashing [56]), "green marketing" (e.g., Huang et al. studied how green incumbents in emerging markets competed with greenwashing entrants through pricing methods [57]), etc. Finally, the basic framework of greenwashing research has emerged, showing a parallel trend of theory and practice, with theoretical research focusing on "attitude", "information", "reputation" and other motives of greenwashing, and with practical research focusing on environmental

propaganda and green consumption, including "corporate environmental performance", "climate change", "brand", "consumer", "consumption", etc.
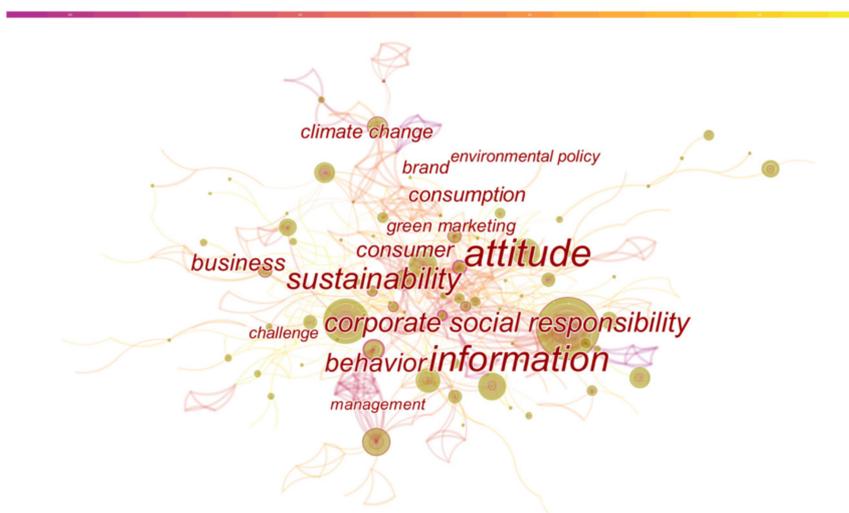

Figure 12. Keyword co-occurrence mapping.

Table 5. High-frequency keywords for greenwashing research in top 20 centrality rankings.

Number	Keywords	Frequency Cited	Centrality Magnitude
1	attitude	20	0.27
2	information	22	0.25
3	sustainability	32	0.21
4	corporate social responsibility	117	0.19
5	behavior	23	0.18
6	consumer	26	0.16
7	business	19	0.16
8	consumption	19	0.15
9	climate change	27	0.14
10	green marketing	23	0.13
11	brand	4	0.13
12	challenge	13	0.12
13	environmental policy	5	0.12
14	management	51	0.11
15	perception	18	0.09
16	perspective	12	0.09
17	adoption	9	0.09
18	preference	9	0.09
19	corporate sustainability	8	0.09
20	reputation	6	0.09

To better present the changes of research themes and hotspots, this paper performed clustering based on keyword co-occurrence network mapping. Since keywords are related to each other within groups but different from other groups, this paper chose the log-likelihood ratio (LLR) algorithm with both intra-class similarity and low inter-class similarity to generate clusters, and to exclude invalid co-citations among the literature or self-citations of team members, and finally obtains a keyword clustering network mapping covering the top 15 clusters. However, this analysis only yielded static conclusions that cannot capture the dynamic changes. Based on this, this paper drew the keyword transition time-zone mapping on the basis of keyword co-occurrence and clustering mapping (shown in Figure 13), which takes the year of keyword occurrence as the marker point and the frequency of occurrence as the cumulative amount, and can better capture the thematic

transition and evolution of greenwashing, while combining with the keyword citation burst mapping to dissect the internal research hotspots at each evolutionary stage. The analysis reveals that, first, the first three major clusters are all core themes of greenwashing, indicating that the clusters are consistent with the reality of greenwashing, among which Cluster 0 "attribution theory" is a retrospective study of greenwashing, which is often caused by the symbolic practice of enterprises to pursue profit maximization while neglecting environmental responsibility [52,58,59]. Cluster 1 "green marketing" is the means by which greenwashing is perpetrated, where enterprises package greenwashing through inaccurate green marketing to make it acceptable to consumers at the point of purchase [60–62]. Cluster 2 "climate change" is the consequence of greenwashing, and as climate change is a growing concern in more and more countries, the issue of how to reduce the probability of extreme weather events has become a popular one. As a result, greenwash is gaining increasing attention from environmentalists [63,64]. Second, before 2010, there was less literature on the research of greenwashing, and although there were numerous definitions for it, the related research was not yet standardized and was in a nascent state. Between 2010 and 2016, a large amount of literature related to the definition of greenwashing and retrospective research emerged, focusing on corporate social responsibility and based on classical theory (e.g., "attribution theory" [65], "institutional theory" [66], "organizational information disclosure theory" [67], etc.), the definition of greenwashing has gradually been standardized. At the same time, the research model of collecting empirical evidence to prove research hypothesis is beginning to emerge in the field of greenwashing [15,68], indicating that the research is beginning to transit from a nascent stage to a development stage in this field. In 2017–2019, the research on the consequences of greenwashing is incorporated into a unified analytical framework, e.g., "corporate environmental performance" [69], "pollution" [70], "firm value" [71], "innovation" [54], "green economy" [72] and "tax avoidance" [73], which further enriched and improved the form and content of research in this field. In addition, its research methods in the field of greenwashing have gradually expanded from empirical methods to multiple research methods such as "partial least square" [58], "evolutionary game" [54] and "case study" [32], which from the side indicates that the research has started to mature gradually in the field of greenwashing. From 2020 to the present, as environmental issues are being taken seriously by more and more countries, research on their governance mechanisms has gradually intensified, with "green finance" in Cluster 5 "sustainable finance" [14], "environmental regulation" in Cluster 10 "environmental impact" [74–76], "law energy sector" in Cluster 14 "environmental certification" [77] and other governance tools beginning to emerge. At the same time, the accelerating pace of global economic integration has led to a deepening of cooperation among countries in the field of environmental governance, and the research paradigm is gradually spreading globally across national boundaries, resulting in a richer literature in the fields of "global compact" [78], "civil society" [79] and "developing country" [57]. Third, according to the first 15 clusters obtained in this paper, which are closely focused on greenwashing research and have formed many modules, by analyzing the most relevant citation literature affected by clusters in each cluster, they can be divided into four major modules, which include deductive research on the definition of greenwashing and its manifestations (#0, #1 and #3), traceability research on greenwashing (#8, #11 and #12), consequences research on greenwashing (# 2, #4, #6, #10 and #13) and governance research on greenwashing (#5, #7, #9 and #14).
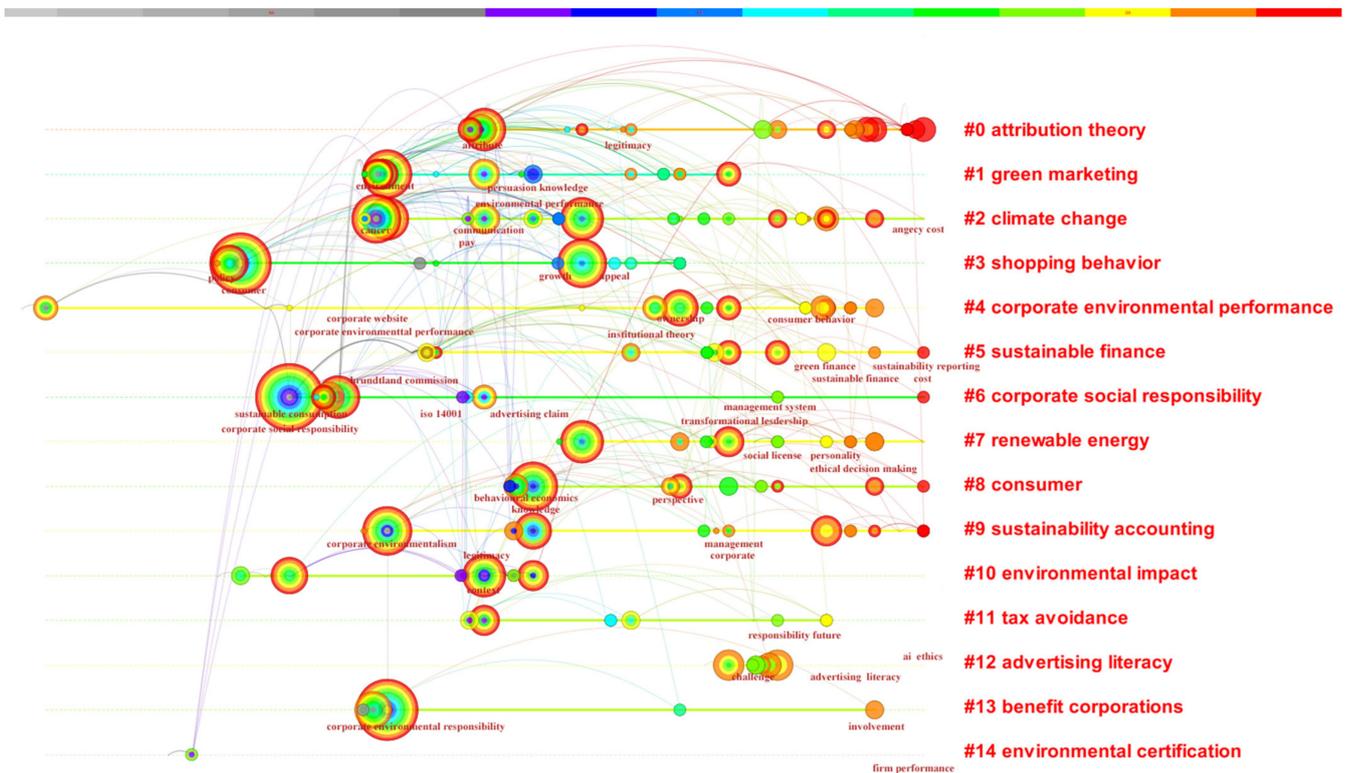
Figure 13. Keyword transition time-zone mapping.

In addition, from the citation burst mapping of keywords (Table 6), the research themes of interest in greenwashing are constantly changing. In the early part of the research interval, greenwashing research is relatively scattered and no citation burst of keywords is formed. Since 2009, research on "corporate social responsibility" has started to emerge, which shows that greenwashing is essentially a poor business strategy because of the weakness of corporate social responsibility. After this, the research of greenwashing began to gradually move from the micro to macro level, when the phenomenon of greenwashing began to migrate to its consequences on politics, economics and society, and these research studies have continued for many years, basically integrating the disciplines of management, economics, political science, law and psychology. However, looking around at the research trends in recent years, there is a tendency for the field of greenwashing to return to the micro level again. Unlike the previous ones, recent studies have focused more on the innovation of perspectives and the improvement of theories, and the research findings are more universal, weakening the cultural context of the research area, making the existing greenwashing research more comprehensive and three-dimensional.

Table 6. Top 15 citation burst mapping of keywords.

Authors	Title	Journal	Strength	Begin	End	Burst Period	Keyword	Citations
Delmas, Magali A	The Drivers of Greenwashing	*California Management Review*	3.45	2009	2015		corporate social responsibility	540
Lyon, Thomas P	The Means and End of Greenwash	*Organization and Environment*	3.24	2013	2015		consumer	212
Chen, Yu-Shan	Greenwash and Green Trust: The Mediation Effects of Green Consumer Confusion and Green Perceived Risk	*Journal of Business Ethics*	2.94	2013	2014		green marketing	284
Sirieix, Lucie	Consumers' perceptions of individual and combined sustainable food labels: a UK pilot investigation	*International Journal of Consumer Studies*	2.49	2013	2016		product	131
Wu, Meng-Wen	Corporate social responsibility in the banking industry: Motives and financial performance	*Journal of Banking and Finance*	2.03	2013	2018		reputation	271
Nyilasy, Gergely	Perceived Greenwashing: The Interactive Effects of Green Advertising and Corporate Environmental Performance on Consumer Reactions	*Journal of Business Ethics*	4.05	2014	2016		social responsibility	194
Nyilasy, Gergely	Perceived Greenwashing: The Interactive Effects of Green Advertising and Corporate Environmental Performance on Consumer Reactions	*Journal of Business Ethics*	3.14	2014	2015		ethics	194
Zhang, Lu	The influence of greenwashing perception on green purchasing intentions: The mediating role of green word-of-mouth and moderating role of green concern	*Journal of Cleaner Production*	2.51	2016	2018		behavior	92
Schuetze, Thorsten	Urban Sustainability Versus Green-Washing-Fallacy and Reality of Urban Regeneration in Downtown Seoul	*Sustainability*	2.23	2016	2017		politics	29

Table 6. *Cont.*

Authors	Title	Journal	Strength	Begin	End	Burst Period	Keyword	Citations
Zhang, Lu	The influence of greenwashing perception on green purchasing intentions: The mediating role of green word-of-mouth and moderating role of green concern	*Journal of Cleaner Production*	2.93	2017	2019		risk	92
Testa, Francesco	Does it pay to be a greenwasher or a brownwasher?	*Business Strategy and the Environment*	1.97	2017	2018		environmental communication	38
Chen, Han	Greenwashing in hotels: A structural model of trust and behavioral intentions	*Journal of Cleaner Production*	2.28	2019	2022		word of mouth	46
Testa, Francesco	The circular economy and consumer behaviour: The mediating role of information seeking in buying circular packaging	*Business Strategy and the Environment*	2.68	2020	2022		circular economy	29
Yu, Ellen Pei-yi	Greenwashing in environmental, social and governance disclosures	*Research in International Business and Finance*	2.3	2020	2022		responsibility	40
Fernandes, Juliana	When consumers learn to spot deception in advertising: testing a literacy intervention to combat greenwashing	*International Journal of Advertising*	2.01	2020	2022		green advertising	6

5. Conclusions and Discussion

With more and more enterprises learning and imitating "greenwashing", it has shown more obvious signs of proliferation, and its adverse effects have spread to all fields of people's production life. Therefore, a systematic literature review is urgently needed to analyze this marketing strategy based on existing research. Based on this, this paper used CiteSpace 5.8. R3 software to visualize the core set of the literature from the WOS database in the field of greenwashing, analyze their internal characteristics and summarize the change patterns of the hot topic, with a view to defining, tracing, evaluating and governing greenwashing in a more reasonable, scientific, effective and precise manner, which can help to promote green and high-quality development.

5.1. Summary

The descriptive statistics show that the number of publications in the field of greenwashing has increased year by year since 2011, and the growth rate accelerates year by year. In terms of research direction, most of the literature in this field comes from the business economics and environmental science direction, accounting for 77.8%. In terms of publishing regions and research institutions, developed countries dominate, with the US and the League of European Research Universities in Europe topping the list of regions and research institutions, making US scholars dominant in the global discourse. Meanwhile, the UK is far ahead of the US in terms of collaborative centrality, ranking first and strengthening the links between scholars from different countries, making it an important research link. In terms of published journals, *Sustainability*, the *Journal of Business Ethics and Business Strategy* and the *Environment* rank as the top three, accounting for 14.12%. Among them, one of most highly cited pieces of literature (540 citations) was published in 2011 by Delmas and Burbano in *California Management Review*, entitled "The Drivers of Greenwashing", which provides a comprehensive study of corporate motivation for greenwashing from multiple perspectives (e.g., institutional, market, organizational and individual) and lays the theoretical foundation for many subsequent studies on greenwashing.

The co-citation analysis mapping presents a gradual increase in the number of publications with a strong influence on greenwashing research and a relationship between succession and innovation (e.g., Lyon TP [31], Chen YS [40] and Delmas MA [41]. Simultaneously, *Sustainability* and the *Journal of Business Ethics* are the journals with the highest record count. Besides, influential scholars in the field of greenwashing, whose research began earlier, are refining the theoretical framework of greenwashing research while attracting more scholars to the field. For the mapping of collaboration networks, it shows that there is strong collaboration between developed countries such as Europe and the US, but a lack of collaboration between developing countries such as in Southeast Asia, South America and Africa. Collaboration among research institutions is loosely distributed, with small collaboration networks in the majority. Additionally, there is an overall fragmented collaboration among many scholars, and the same researchers have insufficient depth of research. Throughout the development of greenwashing research, the content has focused on the fields of its definition and conceptual interpretation, impact factors, consequences and governance models. At the same time, the research method has gradually shifted from normative research to empirical research and then to a combination of research methods. In addition, the research paradigm is gradually spreading across national boundaries and globally, with more emphasis on the universality of the research while weakening the research context, thus further enriching and improving the research framework of "defining greenwashing (what is it)" to "tracing greenwashing (why does it exist)" to "assessing the consequences of greenwashing (why should it be controlled)" to "controlling the spread of greenwashing (how to control it)".

5.2. Future Directions

From the research results, the complexity of greenwashing behavior leads to a modularity of its research content. Through the study of changes and mutations in keywords,

it is found that the existing research on greenwashing has initially achieved a multidisciplinary integration, and the research subjects are also showing an intertwined macro and micro situation, with a gradual diversification of cultural contexts and research regions. Therefore, this paper introduced the idea of system governance and connects the existing research modules and found that they are initially interlinked and successive, i.e., this paper believes that the existing research on greenwashing has initially formed from an analytical framework from "defining greenwashing (what is it)" to "tracing greenwashing (why does it exist)" to "assessing the consequences of greenwashing (why should it be controlled)" to "controlling the spread of greenwashing (how to control it)" (Figure 14). However, looking at the existing studies, there are still many shortcomings in the existing literature as to whether the definition is reasonable, whether the traceability is scientific, whether the assessment is effective and whether the control is precise.
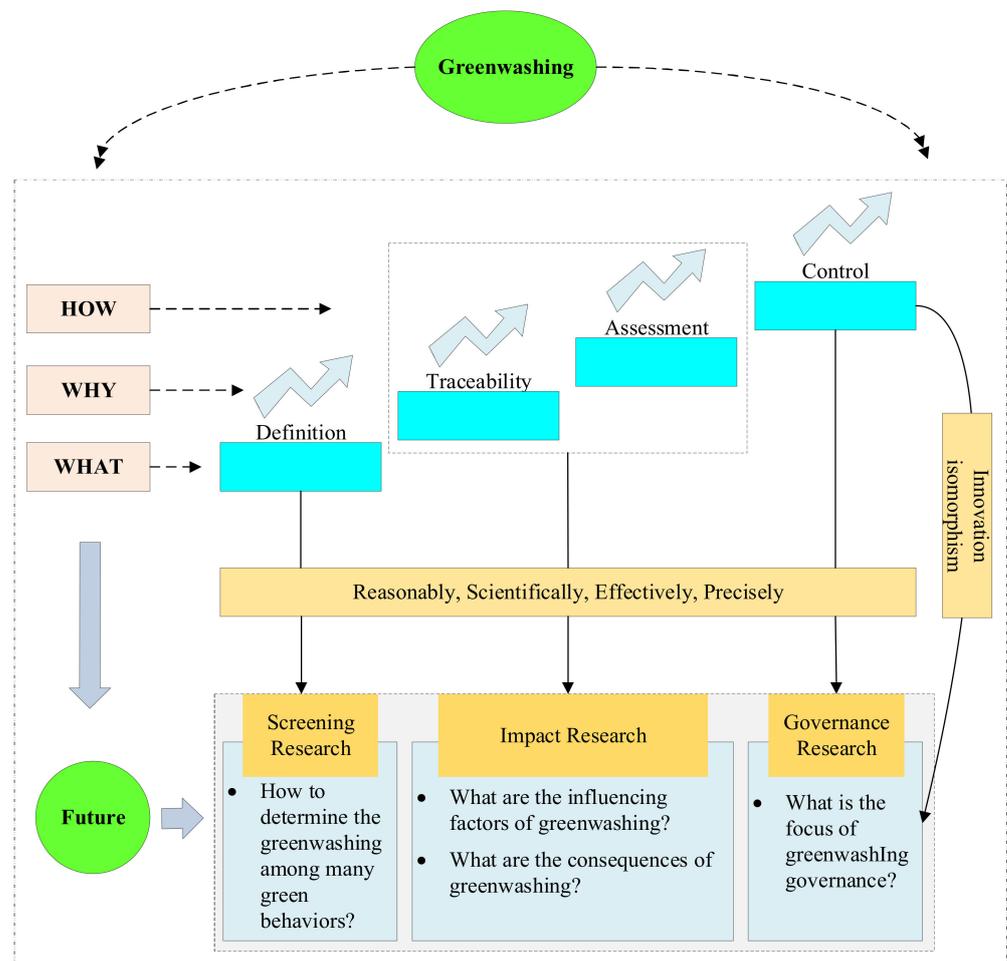
Figure 14. Analytical framework of the greenwashing study.

Simultaneously, enterprises, as a special kind of social organization, are often extraordinarily concerned by a host of social subjects, such as the government, for their bad behavior. Therefore, many scholars believe that the destination of greenwashing research should be the governance of the behavior to regulate the business behavior of enterprises [80–82]. Based on this, the results of the study show that existing research on governance mechanisms tends toward the intersection of formal and informal systems, but with both passive acceptance and active imitation when considering the corporate motivations. Therefore, this paper introduced the theory of institutional and organizational isomorphism, benchmarked existing research and found that coercive isomorphism, mimetic isomorphism and normative isomorphism are all reflected in governance mechanisms and make enterprises

abandon greenwashing through isomorphic behavior. However, as a new type of marketing strategy practice, the governance mechanism of greenwashing requires not only acceptance and imitation, but also transcendence and innovation based on both, which unfortunately has not been explored in depth in the existing literature.

Therefore, based on the analytical framework of greenwashing, this paper aimed to be reasonable, scientific, effective and precise, and proposed the improvement and enrichment directions existing in this field from three perspectives: screening research, impact research and governance research of greenwashing. In addition, this paper added the field of "innovative isomorphism" to the future directions of governance research, taking into account the uniqueness of greenwashing.

5.2.1. Perspectives from Screening Research

The screening research of greenwashing is mainly to solve the problem of how to detect greenwashing from many green behaviors, which depends on whether the definition of greenwashing is reasonable on the one hand, and whether screening mechanism is reasonable according to the definition on the other hand.

For the definition of greenwashing, while existing studies have provided clear and generally accepted definitions based on various classical theories [65–67,78,83,84], whether the deduction of this definition and its use in different scenarios is justified needs to be further explored in future studies (e.g., evolution of greenwashing gas, greenwashing innovation, greenwashing M&A, etc. from greenwashing behavior, and definition of greenwashing behavior in specific scenarios in the construction industry, government agencies, households, etc.). Meanwhile, this scenario is still deeply rooted in the environmental protection field; therefore, how to connect greenwashing with the hot topics of environmental protection will also become an emerging direction for future research (e.g., the goal of carbon neutrality pioneered by developed countries, and greenwashing is undoubtedly an obstacle to the achievement of this goal, so key carbon concepts such as low-carbon economy, carbon pricing, and carbon trading market should be in the consideration of enriching the definition of greenwashing). In addition, there are relatively few literature reviews on the greenwashing system and even fewer literature reviews on the definition of greenwashing, so there is a need to strengthen the sharing and discussion of literature reviews, especially on the definition of greenwashing, in future research. In addition, on the research tools of the review, besides CiteSpace, which is used in this paper, Gephi, COOC, VOSviewer and Bibexcel are also used in other fields of bibliometrics; therefore, the combination and innovation of research tools may also become a potential growth point of greenwashing research.

For the greenwashing screening mechanism, existing studies directly determine the type of greenwashing based on qualitative research based on the definition of greenwashing or the results of questionnaires [42,85] and indirectly construct a greenwashing index by collecting disclosure data to judge greenwashing [86]. However, the former lacks the support of large-scale empirical evidence, and the latter's generalizability of model construction and the lack of relevant papers published make the reasonableness of its screening mechanism questionable. Therefore, how to combine qualitative and quantitative research to construct a reasonable screening mechanism becomes one of the hot directions of greenwashing research in the future.

5.2.2. Perspectives from Impact Research

The impact research of greenwashing is designed to address what factors may lead to greenwashing and what consequences greenwashing can have.

For influencing factors, existing studies are more systematic—for example, "The drivers of greenwashing", published by Delmas and Burbano [41]. However, with the increase in environmental protection in countries around the world and changes in the external environment of enterprises, the existing influencing factors should be gradually expanded in the future—for example, the internal factors with the characteristics of the

times (e.g., the religious culture of the enterprise's location and the development of the digital economy), as well as the impact of external events (e.g., the impact of the new crown epidemic and the increase in energy prices that are due to the conflict between Russia and Ukraine). In addition, internal factors are mainly focused on the macro level of the enterprise and less attention has been paid to individual enterprise characteristics (e.g., Roulet and Touboul point out the impact of a business leader's focus on family on greenwashing [51]). Therefore, the personal characteristics of corporate executives and heads of marketing departments, their personal experiences, their sensitivity to institutional pressures and their values are all likely to be of interest for future research.

For consequences, existing studies focus on the negative impacts of greenwashing. Concretely, they can be divided into direct and indirect impacts, where the direct impact is the pollution of the environment and the indirect impact is on indicators related to the development of the business [87–89] and the potential benefits for other stakeholders [59]. However, the implementation of a greenwashing strategy by enterprises depends on the short-term benefits it brings to the enterprise (e.g., increased commitment to sustainability and improved external assessment ratings), which are not supported by existing studies with empirical evidence and do not have a clear temporal boundary between short-term benefits and long-term losses. At the same time, the phenomenon of greenwashing is occurring in many environmental areas, and its negative consequences are increasing (e.g., natural economy, environmental culture, biodiversity, etc.), but the existing consequence studies do not provide a comprehensive overview. Apart from this, the research methods of consequence studies are mainly empirical, with fewer mathematical derivations and field experiments. Therefore, future research can enrich the consequences while combining multiple research methods to improve the science.

In addition, the study of the path of greenwashing becomes a bridge between the influencing factors and the consequences, and the existing literature mainly places it in the mediating path of the direct effects of other relevant factors (e.g., the customer's perception of greenwashing plays a mediating moderating role in the path of the influence of the enterprise's environmental behavior on the willingness to purchase green products [55]), but the number of articles on this topic is currently limited. Thus, greenwashing is influenced by a variety of factors, and its influence path is highly extensible in future research.

5.2.3. Perspectives from Governance Research

The governance research of greenwashing mainly aims to solve how to manage greenwashing, which relies on the summary and analysis of a greenwashing governance mechanism, and the exploration of a governance model is also crucial.

For the governance mechanism, as a social behavior, greenwashing mainly relies on institutional norms. Therefore, based on the theory of institutional and organizational isomorphism, existing research focuses on three mechanisms: coercive isomorphism (e.g., policies and regulations, government supervision, state audits, etc.), mimetic isomorphism (e.g., imitating superior enterprises, imitating advanced industrial chains, etc.) and normative isomorphism (e.g., greenwashing lists, CSR reports, ESG investment, corporate ethics, etc.). This shows that many scholars mainly take greenwashing as a starting point to reduce the negative impact of greenwashing from multiple perspectives [42,90], but do not sufficiently consider research heterogeneity and research perspectives (e.g., the motivation of enterprises to engage in greenwashing under media pressure, the influence of enterprise green innovation culture on greenwashing, the heterogeneity of greenwashing governance in the energy industry etc.). In spite of the need for external pressure, there is also a need for "innovative assimilation" based on active imitation. Specifically, on the one hand, there is a need to introduce and improve appropriate governance tools from other fields of study, and on the other hand, there is also a need to innovate in the light of the characteristics of greening behavior (e.g., building a corporate green information disclosure platform based on big data and cloud computing, including typical cases of greenwashing in environmental protection courses to raise social awareness of environmental protection,

establishing special committees on social responsibility in the boards of directors of enterprises and financial institutions, and including the results of greenwashing assessments in corporate social responsibility reports and even financial reports, etc.). Therefore, on the basis of existing research, further research on the traceability of greenwashing is needed, with a focus on its influencing factors and "innovative assimilation" to explore the precise governance mechanism of greenwashing.

For governance models, the factors affecting greenwashing are multifaceted, and existing studies have mainly focused on indirect factors such as governance environmental information disclosure, environmental performance and corporate social responsibility [60,91–94], with few constructing governance models directly based on the motivation of greenwashing, making the greenwashing governance model lacking in precision. At the same time, when it comes to direct factors, the focus is on individual internal micro-governance factors and there is a lack of consideration of the linkages between internal and external factors, resulting in a governance model that is limited to corporate autonomy and neglects the importance of collaborative governance inside and outside the enterprise. Therefore, future research needs to further clarify the many elements of external governance, grasp their internal correlation, and use new technologies to break down the barriers of cooperation, so as to achieve the transformation from "common" governance to "collaborative" governance (e.g., collaborative inter-regional governance combined with financial technology, big data and blockchain, building an information sharing platform for collaborative governance of greenwashing for multiple subjects and designing a collaborative governance framework based on qualitative models such as SFIC, quantitative models such as evolutionary games and computer technology such as system simulation), with a view to exploring a new model of greenwashing governance. Greenwashing governance is a systemic project, which requires reasonable definition, scientific traceability and effective assessment to achieve the best governance effect; therefore, the enrichment and development of greenwashing screening and impact research are also improving the precision of greenwashing governance in disguise.

In addition, with the gradual increase in integrated global environmental governance, global governance, social contract and other key words for cooperation among regions are gradually emerging in the field of greenwashing governance [57,78,79]. Therefore, how to base on the global issues (e.g., green finance, energy policy, climate change, etc.) will become one of the hot directions for future research on greenwashing governance.

Besides, statistical analysis, co-citation analysis and collaboration network analysis revealed the following opportunities for existing research greenwashing scholars in terms of publication and collaboration of papers.

First, according to the research results, it is found that scholars and institutions in developed countries have a unique advantage in terms of both the number of publications and the frequency of co-citations, but it also shows from the side that it is an opportunity that cannot be missed for developing countries in Africa, Asia and South America. For example, for US institutions and scholars, they prefer to use their own data, cases and background to conduct greenwashing research to take advantage of the local advantage, so there are huge gaps in greenwashing research in developing countries such as Africa, and how developing countries can use their own data to supplement the existing greenwashing research will become a new research hotspot. At the same time, with the deepening of theoretical and practical research in developed countries, there will also be an increased incentive for enterprises to use multinational corporations to move greenwashing practices from developed to developing countries to reduce the cost of greenwashing, which will also attract more attention from more scholars working on global governance. In addition, there are great differences between developing and developed countries in terms of economy, politics and culture, which also provide the possibility to enrich the study of greenwashing heterogeneity and explore the global governance model.

Second, in the process of future research on greenwashing research sharing, relevant scholars need to improve the marginal contribution of their own research and analyze the

existing research direction and existing research results comprehensively. For example, follow the publication trends of greenwashing research in recent years in influential journals such as *Sustainability*; pay attention to "The means and end of greenwashing" [31], "The Drivers of greenwashing" [41] and other classic literature; focus on "Greenwash and Green Trust: The Mediation Effects of Green Consumer Confusion and Green Perceived Risk" [40], "The influence of greenwashing perception on green purchasing intentions: The mediating role of green word-of-mouth and moderating role of green concern" [42] and other representative literature at different stages of greenwashing development, which can help scholars to identify specific directions of greenwashing research, so as to improve research inheritance, science and practicality. At the same time, the subject of greenwashing research is mainly concentrated in the field of environmental science and business economics, but because of the complexity of greenwashing itself, it has caught the awareness of scholars in the fields of management, economics, political science, law, psychology, etc. Therefore, in future research, in addition to combining the findings of this paper, it is necessary for scholars to seek collaboration with scholars and institutions in countries such as the UK and the US who have advantages in centrality and publication to improve the credibility of their own research. They also need to actively seek collaboration with scholars in multidisciplinary fields and continue research in the field to form a stable collaborative network and improve the science of their own research.

5.3. Managerial Implications

The term "greenwashing" was first used in 1986, and after nearly 40 years of development, the concept has gradually expanded from the practical to the theoretical field, becoming an integral part of environmental protection research and attracting the attention of many scholars. On this basis, this paper used Citespace bibliometric software to analyze the literature in the field of greenwashing in four sections: descriptive statistics, co-citations, collaboration networks and emerging trends. The research process and results of this paper can be summarized as the following contributions to the development of research in the field from both theoretical and practical perspectives.

5.3.1. Theoretical Implications

First, bibliometrics and information visualization techniques are deepened in the study of the greenwashing literature. As an important branch of science, bibliometrics takes scientific literature as its research object and uses a combination of statistical analysis, social network analysis and mathematical modeling. By statistically summarizing the research literature in a specific field, the overall development status of this field can be discovered and the current situation can be assessed [95]. Information visualization technology is designed to help researchers understand information quickly, visualize the information behind complex data and take advantage of the fact that the human eye can see and interact with the images, making the information behind the data visible to the researcher at a glance [96]. Throughout the existing literature reviews in the field of greenwashing, most of them are based on the traditional literature induction method, and the application of bibliometrics and information visualization technology is rare. On these above, this paper combined the two to conduct a literature review in the field of greenwashing. On the one hand, it can make the conclusions of the review studies more accurate, objective and scientific. On the other hand, it can help scholars in the field quickly understand the current level of greenwashing research, analyze the problems and grasp possible future research problems and development directions. In addition, business ethics is an interdisciplinary discipline that is characterized by the unity of subjectivity and objectivity, ideals and reality [97], and requires large-scale discussion and debate, leading to a large body of literature on the same topic in the field, which is cross-disciplinary, cross-cultural and cross-methodological in character, and views that may not yet be uniform, making it difficult to draw comprehensive and objective conclusions through the traditional method of literature induction. Therefore, this paper provided a literature review using bibliometric theory and

information visualization technology in the field of greenwashing and also provided an analytical framework and empirical evidence for literature reviews on other topics in the field of business ethics. Besides, this paper is different from previous studies. In addition to the literature from the SCI, SSCI and A&HCI Citation Index in WOS, the literature was also from Conference Proceedings Citation Index (CPCI-S and CPCI-SSH), Book Citation Index (BKCl-S and BKCI-SSH) and Emerging Sources Citation Index (ESCI) to enhance the completeness and scientific validity of the literature review.

Second, systemic ideas are extended to the field of greenwashing literature research. Systems theory has evolved from SCI (systems, control and information theory) around the 1940s to DSC (dissipative structure theory, synergy theory and mutation theory) since the 1970s, reflecting the core view of systems theory, which emphasizes the interdependence, mutual influence and constraints between the whole and the part, the part and the part, and the system itself and the external environment [98,99]. Greenwashing is a deliberate manipulation that leads to various motivations. In fact, when an enterprise intends to greenwash, it has a variety of means to achieve the purpose of manipulation, including selective disclosure, dazzling publicity, image packaging, etc., which in turn leads to complex studies on the impact of greenwashing. The precise governance of greenwashing needs to be based on scientific screening and effective assessment of its consequences, while the number of subjects involved in greenwashing is gradually increasing as the research progresses, resulting in a multi-component approach to the governance of greenwashing. However, the existing studies have not paid much attention to this issue, which has led to the research on greenwashing to be too fragmented and difficult to form a system. Based on this, this paper drew on the ideas of system theory, information theory and synergy theory to quantify the evolutionary trend of the existing literature and built a systematic analysis framework of "reasonable definition of greenwashing–scientific traceability of greenwashing–effective assessment of greenwashing–precise governance of greenwashing", which makes the various aspects of greenwashing research interdependent and mutually constrained, and accordingly captures the hot spots and predicts the future research trends in this research field. Additionally, the study of sustainable development involves multidisciplinary cross-fertilization and complementarity and is an ideal model for living in harmony with nature, leading to the complexity and variability of many topics in the field, which in turn may lead to a systematization of the relevant research in the field. Therefore, the analytical framework built on systems ideas in this paper can be further transferred to other concepts in the field of sustainable development, providing an analytical paradigm for its literature review.

Finally, the theory of organizational isomorphism is enriched and extended to the field of greenwashing governance. A key question that needs to be answered by institutional theory is "why do social organizations tend to evolve in a similar way" [100], defined by scholars of institutional theory as the phenomenon of organizational isomorphism, where organizations adapt to their institutional environment to survive, and thus incorporate the prevailing practices and norms of institutional forces in today's society as their own code of action. Dimaggio and Powell first explored institutional isomorphism around the organizational domain and categorized it into coercive isomorphism, mimetic isomorphism and normative isomorphism. Among them, coercive isomorphism is driven by external forces, where organizations may be pressured by external authorities such as laws and regulations to meet certain expectations. Mimetic isomorphism is driven by imitation, where an organization is faced with uncertainty about its external environment and internal goals and will reduce that uncertainty by imitating other advanced or successful organizations. Normative isomorphism is driven by specialization, where organizations are guided by common norms and standards consisting of professional vocabulary, job descriptions, etc., and are made to think and act in similar ways [101,102]. However, as a new sustainable development issue, greenwashing is developing and morphing rapidly, showing a development stance from imitation to proliferation, while greenwashing is being learned by an increasing number of enterprises adaptively, leading to the risk of lagging

and failing in its governance responses [103]. Therefore, beyond the passive pressure (coercive isomorphism), passive guidance (normative isomorphism) and active imitation (mimetic isomorphism) of enterprises, there is a need for active improvement and innovation. Based on this, this paper argues that in the study of the governance mechanism of greenwashing, a new form of isomorphism, "innovative isomorphism", can be added to the three forms of isomorphism proposed by the original organizational isomorphism theory to help enterprises improve and innovate their governance mechanism on the basis of active imitation and thus improve the efficiency of governance. In addition, the findings of this paper reveal that there is heterogeneity in the form of greenwashing in terms of industry, region and time, and that "innovative homogeneity" can reduce the inappropriateness of greenwashing governance responses through simple imitation of advanced or successful organizations, thus effectively alleviating the governance dilemma brought about by the heterogeneity of greenwashing. This will ultimately provide theoretical support for the construction of a series of universal governance models based on a global perspective.

5.3.2. Practical Implications

First, although greenwashing research has been carried out for many years in both theoretical and practical circles, the visualization in this paper reveals that the research institutions and scholars are concentrated in developed countries, mainly in the US and the UK, with relatively few publications from developing countries. Therefore, a systematic review of the literature on greenwashing can help scholars interested in this field to understand the full view of the field and thus promote the globalization of greenwashing research. In addition, the mapping of co-citation and collaboration networks can also help scholars in this field to identify more opportunities for collaboration and hot topics, as well as provide a reference for practitioners (e.g., governments, international agencies, environmental accountants, etc.) to find more governance subjects to collaborate in the governance of greenwashing, thus promoting the improvement of greenwashing research.

Second, the generalization of concepts has become a common feature of many behaviors. From the findings of this paper, the deduction and transition of the concept of greenwashing have recently begun to emerge, but the scientific validity of these generalized concepts is the applicability of their screening, and governance mechanisms deserve further consideration. Therefore, the systemic analysis framework of greenwashing proposed in this paper can help scholars to comprehensively grasp the relevant research on greenwashing and furthermore have a reasonable evaluation of the generalized concepts and ensure the rationality of the research paradigm shift. In addition, the existing research on the impact factors and consequences of greenwashing is relatively abundant but disorganized. Consequently, this paper provided an outlook on future research in terms of greenwashing impact factors, consequences and impact path, seeking to expand the scope of research on greenwashing and to standardize and extend the research chain on the impact of greenwashing.

Finally, this paper argues that the terminal of the greenwashing research is the governance, which coincides with the purpose of the current global environmental research. Accurate and efficient governance of greenwashing depends on the screening in environmental behavior and the verification of the negative consequences of greenwashing by various governance subjects. Therefore, this review can help governance subjects to systematically grasp the overall view of greenwashing research, strengthen global cooperation and combat greenwashing more scientifically and effectively. Specifically, at the macro level, this review helps governments to identify the motives for greenwashing and to develop scientific screening mechanisms, thus providing a reference for the formulation of scientific and effective environmental regulations. At the micro level, on the one hand, it will alert enterprises to abandon their greenwashing strategies, and on the other hand, it will attract more subjects to participate in greenwashing governance, to form a good culture of honest and trustworthy low-carbon consumption in the whole society.

5.4. Limitations

In common with many studies, this paper still suffers from the following shortcomings. First, the sample was selected from the WOS core collection database, and only articles in the English language were retained in the search rules. This means that literature not included in the core collection of the WOS database and not in English was not included in the analysis; therefore, the subsequent study will further improve the search strategy and expand the scope of the literature sample as much as possible. Second, the literature study in this paper was mainly based on keywords and references for emerging trends analysis and direction prediction, resulting in important components of the article such as titles, abstracts and texts not being included in the analysis. Therefore, subsequent research will further incorporate machine learning algorithms while expanding the scope of manual screening analysis to comprehensive analyze the remaining important components.

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