

Research Article

Intellectual Structure of Global Value Chain Research: Visualization and Bibliometric Analysis Based on VOSviewer

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Over the past few decades, numerous scholars have conducted research on global value chains, and the amount of literature in this field has grown rapidly to become “big data.” In order to deeply analyze and explore the current research status and development trends in the field of global value chains, this article conducted a systematic and quantitative study on the global value chain. Based on the Web of Science Core Collection SCIE and SSCI databases, this article searched 8273 articles published between 2001 and 2021 with the theme of “Global Value Chain” and used visualization and bibliometric analysis methods. The research field was analyzed using VOSviewer software. Research has shown that the number of papers published in the global value chain field has been continuously increasing over time and has entered a period of rapid development since 2016. The main disciplines are economics and management. A few researchers and research institutions have a strong influence, but the cooperation between scholars and institutions is relatively weak. The United States, the United Kingdom, and China dominate the research field. The complex impact of the natural environment and public health on the global value chain, and the impact of big data and artificial intelligence on the global value chain, has become a new direction for future research. Countries should actively promote the development of the digital economy and green economy, promote the effective allocation of global value chain resources by enterprises, and adhere to the development of good bilateral political relations to reduce the uncertainty of enterprise participation in the global value chain caused by political risks.

1. Introduction

Since the 1980s, with the gradual liberalization of international trade, the rapid development of information and communication technology, and the continuous deepening of international division of labor, the traditional development model of multinational companies has been gradually changed, and global value chains have gradually become the main form of international division of labor. The 2008 financial crisis resulted in global overcapacity, lack of motivation for the expansion of the global value chain, and stagnating. With the improvement of the technological level of enterprises and the level of artificial intelligence, seeking labor advantages around the world is no longer an important goal pursued by the manufacturing industry. Expansion of the value chain is hindered. With the outbreak and epidemic of COVID-19, international

trade production and transportation have been suspended, and the global value chain has been hit hard and has faced reshaping.

1.1. Literature Review. Many scholars have conducted research on the global value chain, and according to research methods, literature can be divided into two areas: econometrics and bibliometrics. The study of the value chain originated in the mid-1980s, and Porter pointed out in the book “Competitive Advantage” in 1985: “Every enterprise carries out various activities in the process of designing, producing, selling, dispatching, and assisting its products. Aggregate, all these activities can be represented by a value chain [1].” From the perspective of the value chain, Porter provided a microanalytical framework for industrial economic organization and enterprise strategic management.

He believes that in the era of globalization, the competitiveness of enterprises depends on whether they can operate these value chains and occupy high-value links in the chain. Led by Gereffi, scholars have studied the theoretical framework, dimension expansion, industrial upgrading, and governance types of value chains. In the early 1990s, Gereffi developed the first original framework for explaining the organization of international production networks, based on the economic power of large buyers and producers in driving these commodity chains. He also attempted to go beyond the A country-centered global economic analysis model that reveals macro- and micro-connections scattered across the globe, countries, and regions. To achieve this drive, Gereffi extended the three main dimensions of the commodity chain, namely, input-output structure, territoriality, and interfirm governance. Subsequently, scholars have conducted in-depth research on this dimension of interfirm governance, conceptualizing four types of GVC-related upgrading in industrial clusters [2]. Then, Gereffi et al. designed a theoretical work in economics and sociology, such as production fragmentation, coordination problems, and network analysis. He also constructed a type of supply chain through three supply chain variables, namely, transaction complexity, codeability, and capacity within the supply base, and types of value chain governance [3].

In 2000, the Rockefeller Foundation sponsored a large-scale global value chain conference, marking the beginning of the rapid development of global value chain research. In the field of econometrics, scholars have expanded their research perspectives from micro to macro. At the micro level, Akkermans et al. discussed how bounded rationality expressed by the differing beliefs and goals of supply chain partners enables functional independence and creates barriers to effective value chain management [4]. Lipparini, Lorenzoni, and Lipparini et al. argued that those who benefit most from knowledge transfer between partners are partners who share a common identity and language, acting as a safeguard against the potential threat of opportunism; allowing partners to learn from each other also reduces the risk of knowledge spillover [5]. Kano believes that the bounded rationality and reliability of decision-makers participating in enterprises affect the efficiency of global value chains. Therefore, the role of managers in leading firms is to control bounded rationality and reliability through mixed relational mechanisms, thereby increasing the likelihood that the global value chain (GVC) will be sustainable over time [6]. At the macro level, Griffith and Myers argued that cultural fit can improve performance and that GVC performance can be affected by influencing the ability of leading firms to effectively deploy relational strategies across the network [7]. Sturgeon et al. discussed the impact of the home country's cultural characteristics on the ability of leading American and Japanese firms to successfully engage in relational governance [8]. Barrientos et al. examined the dissemination impact of global and regional supermarkets in the "Global South" and found that the entry of large global retailers provides new opportunities for the most skilled local horticultural producers and workers. This condition is conducive to economic and social upgrading. However, continued economic downward pressure indicates that many less skilled suppliers are excluded from global and regional value

chains [9]. Laplume et al. analyzed the potential impact of 3D printing technology on the structure and geographic scope of global value chains [10].

In the field of bibliometrics, Jurowetzki et al. used bibliometric analysis to combine national innovation systems and global value chain literature to study policies related to global economic development [11]. Guan et al. considered measures related to length and location in vertical specialization literature from the perspectives of bibliometrics and economics, measuring the position of the industrial sector in the global value chain [12]. Luo et al. used bibliometric analysis to comprehensively analyze 1811 articles on low-carbon supply chains from 2003 to 2021, exploring the evolution trend and future research directions of low-carbon supply-chain-related literature [13]. They also studied the author distribution, geographical distribution, and cluster situation of literature in this field. Nabi et al. conducted a bibliometric analysis of 212 publications from 2001 to 2020 using VOS viewer, identifying the collaboration network between the main authors, suggesting that emerging country enterprises can enter the international market by reducing value chain activities, and providing direction for supplier downgrade strategies [14]. Wang and Gu used VOS viewer to analyze the main trends in global value-chain-related literature in 2022, showcasing the evolution of value chain theme development, the impact of value chain in different journals and literature, and the impact of keywords and countries on value chain literature publication. Finally, they predicted the trends and directions of future value chain research [15].

Through literature analysis, we found that research on global value chains includes qualitative analysis such as theoretical frameworks and empirical testing of micro basic assumptions. The research level has also expanded from micro to macro levels, analyzing not only the relationship between enterprises and the global value chain but also the impact of the global value chain on political, economic, and environmental systems. However, there are very few direct literature studies on global value chain literature using bibliometrics and visual analysis, and they remain in the descriptive statistical stage after literature visualization, lacking classification and summary, and lacking reference significance for future research. Most of the relevant literature is a combination of global value chains and other directions, rather than research on global value chains.

1.2. Research Questions. This article provides a detailed explanation of the global value chain, and the research questions are as follows: What is the scale and source journal of global value chain research? What are the key and cutting-edge aspects of global value chain research? What is the distribution of global value chain research in terms of countries, institutions, and authors? What is the cocitation status of literature on global value chain research?

1.3. Research Purpose. This article analyzes the research hotspots and trends in the field of global value chains, in order to provide certain guidance for future academic

research and policy formulation. In the post pandemic era, the global value chain is facing reshaping. On the one hand, in the new situation, new research hotspots and trends have emerged in the field of global value chains. This article will analyze the research situation in this field in the past 20 years, explore new research perspectives in this field, and provide guidance for scholars' future research. On the other hand, it provides reference for the effective allocation of global value chain resources and the upgrading of industrial structures in various countries.

1.4. Research Significance. This study analyzes the research hotspots and trends in the global value chain field and divides the existing research content into four major parts, which can provide certain guidance for future academic research and policy formulation. This paper finds that with the increasing global attention to environmental issues and the prevalence of the COVID-19 epidemic, the direction of environment and public health has become a new research direction in the field of global value chain. This article also found that digital trade in the context of the digital economy is increasingly affecting the international trade pattern, and global value chains are facing restructuring. Countries should use the digital economy as a new engine to drive economic development, breaking through the low-end lock-in dilemma in the division of labor in the global value chain. The direction of the digital economy and global value chain has also become a new research direction in the field of global value chains. This article also provides policy recommendations for countries to formulate international trade rules, promote the effective allocation of global value chain resources by enterprises, and promote economic growth.

2. Data Sources and Research Methods

2.1. Data Sources. Web of Science is the world's largest and most interdisciplinary comprehensive database platform, containing a large amount of data on natural sciences and humanities and social sciences worldwide from 1900 to the present. It is rich in information and updates quickly, providing relevant information for scholars around the world to conduct scientific research. The most important thing is to retrieve the history of research literature in a certain field of the lake and track its latest progress by searching the database. Therefore, this article chooses the Web of Science database as the literature source for the global value chain.

This article selects the Web of Science core collection as the data source. In order to obtain a comprehensive literature record and make each year's literature record statistically meaningful, the search time is set to "2001–2021," the dataset is limited to "SCIE" and "SSCI," the language is limited to "English," and the literature type is limited to "Article." The retrieval formula was determined to be $(TS=((\text{"global"}) \text{ AND } (\text{"value chain"}) \text{ OR } (\text{"value chains"})))$, resulting in a total of 8273 records.

2.2. Discharge Standards. Inclusion criteria were as follows: English literature related to the global value chain. Exclusion criteria were as follows: literature with duplicate or incomplete data, conference papers, news, and newspapers.

2.3. Analysis Methods. Bibliometrics is a discipline that studies the distribution structure, quantitative relationships, and changing patterns of literature information using mathematical, statistical, and other econometric methods, focusing on the literature system and bibliometric characteristics. Scientific metrology is the study of the quantitative contribution patterns of the overall development of science and technology and related components using quantitative methods. It is a research field that uses quantitative methods to handle the inputs (such as researchers and research funds), outputs (such as the number of papers and citations), and processes (such as information dissemination and the formation of communication networks) of scientific activities. There is a certain overlap between the two, as one of the main forms of scientific activity output is scientific literature. Therefore, quantitative research on such literature is both scientific metrology research and bibliometric research.

Knowledge graph is a research method that combines the theories and methods of applied mathematics, information visualization technology, and other disciplines with the cooccurrence analysis methods of scientific metrology and bibliometrics and uses a series of graphics to display the process and structural relationship of knowledge development in a certain discipline. Knowledge mapping is used more and more widely as a method of data visualization. Dai and Xu, based on the Web of Science core collection database, used bibliometrics methods and CiteSpace software to conduct a visual analysis of literature in the field of global value chain from 2011 to 2021 [16]. CiteSpace software distinguishes keyword clustering and literature cocitation by clustering blocks to highlight the frontiers of word segmentation and automatically generates titles in clustering blocks, and some information may be omitted. The VOSviewer used in this article is developed using Java programming language and has many analytical functions, such as keyword cooccurrence network analysis, collaborative network analysis, and literature cocitation analysis. It can draw various knowledge graphs, and researchers can use it to analyze research hotspots and trends in the discipline to reveal the knowledge structure of the discipline. This article not only extends the sample period to 2001–2021 but also uses VOSviewer software to distinguish keyword clustering and cocitation of cutting-edge literature by different colors, so it can extract and summarize complete viewpoints on its own.

2.4. Research Limitations. Bibliometrics relies on the quantity and quality of literature as indicators to measure the impact of research, rather than just relying solely on the number of publications to measure the results and level of research. For example, in the analysis of keywords, research authors, research institutions, and research countries, we not only used the number of publications but also used the ratio

of citation to publication to reflect the quality of the literature. However, we have to admit that this may still be influenced by self-citation factors. Meanwhile, all studies are based on the selection of specific keywords and database limitations. Therefore, in order to improve the credibility of the paper and ensure the representativeness of the research topic, we expanded the analysis scope from the Web of Science database to the Scopus database in Chapter 3 of the research content analysis and compared the analysis results under different databases to verify the reliability of the research as much as possible.

3. Research Content

3.1. The Scale Analysis of Global Value Chain Literature. In Figure 1, the historical development of GVC research can be divided into three stages, namely, exploration, preliminary development, and rapid development.

3.1.1. Exploratory Phase (2001–2007). 533 papers were published during this phase. An article entitled “Governance in Global Value Chains” states that governance is at the heart of the global value chain approach, and this article explains its definition and importance for development research and policy. The concept is used to refer to the relationships and institutional mechanisms between firms through which nonmarket coordination of activities in the chain occurs. This coordination is achieved by setting and enforcing the product and process parameters to be satisfied by the actors in the chain. In global value chains, in supply chains typically operated by producers in developing countries, buyers play an important role in setting and enforcing these parameters [17].

3.1.2. Initial Development Stage (2008–2015). 2084 papers were published in this stage. Since 2008, many scholars and institutions have gradually deepened their understanding of exploring the nature of global value chains. They gradually formed the following definition: we define global value chains as a governance arrangement; that is, multiple governance models within a single structure are used to govern different, geographically dispersed, and segmented parts of the value chain. In other words, GVCs are the nexus of interconnected functions and operations whereby goods and services are produced, distributed, and consumed on a global scale [18, 19].

3.1.3. Rapid Development Stage (2016–2021). In this stage, research results emerge rapidly, with 5,656 papers published, averaging more than 900 papers per year. Especially since 2019, the number of documents has increased dramatically. With the advancement of the Internet and computer technology, the global value chain based on big data has received attention. At the same time, studies on sustainability, carbon emissions, and the environment continue to emerge, gradually forming a cross-disciplinary and cross-industry integration.

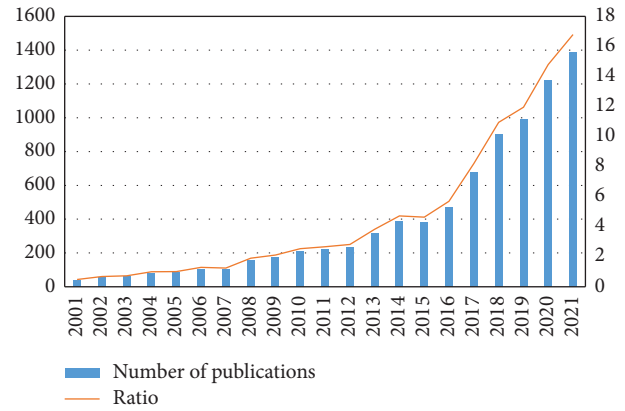


FIGURE 1: The scale analysis of GVC literature.

3.2. The Source Journal and Disciplinary Analysis of Global Value Chain Literature. Academic journals are an important carrier of academic achievements. By analyzing the source journals of literature in the global value chain field, we can discover the distribution of literature in journals, which also plays an important guiding role for scholars in selecting and submitting articles. We have compiled the journals with the most papers in the global value chain field and listed the top ten journals with the most papers in this field in Table 1. The top three journals in the rankings are Sustainability, Journal of cleaner Production, and Support chain management an International JOURNAL, with a total of 188, 156, and 90 published papers in the global value chain field, respectively.

Table 2 shows the JCR main subject distribution of the journals listed in Table 1. The top five journals are Management, Green and sustainable science & technology, Environmental studies, Business, and Economics. The research of global value chain is still the main topic of economic management discipline.

3.3. The Research Hotspot Analysis of Global Value Chain Literature. The keywords of the literature are the core viewpoints of the paper and the refined expression of the research topic, which can highlight the core content of the full text. Therefore, the analysis of the keywords is helpful to explore the research hotspots in this research field. Keyword cooccurrence analysis is universal in bibliometric analysis, and it mainly studies the link strength between cooccurring keywords in various studies. Its function is to analyze the internal relationship of an academic field and reveal the research frontier in the field. The larger node and font size indicate higher keyword frequency and higher similarity of keywords with the same color; the thicker connection indicates a closer connection between the two keywords. Figure 2 shows that through the keyword cooccurrence network analysis, the main research topics can be divided into four clusters, and the keywords in the same cluster have a great similarity. In Table 3, we have listed the frequency and connection strength of some keywords. It can be seen that the most frequently appearing keyword is the global value chain, with a frequency of up to 1316 times and a connection strength ranking first at 5118.

TABLE 1: Distribution of top ten source journals of GVC literature.

Rank	Journals	Total publications	JCR category
1	Sustainability	188	Green & sustainable science & technology Environmental studies Green & sustainable science & technology Environmental sciences
2	Journal of cleaner production	156	Engineering, environmental Environmental sciences Green & sustainable science & technology
3	Supply chain management an international journal	90	Business Management
4	Plos one	61	Multidisciplinary sciences
5	World development	60	Development studies Economics
6	International journal of operations production management	57	Management
7	World economy	56	International relations Economics Business, finance
8	International journal of physical distribution logistics management	54	Management
9	Geoforum	53	Geography
10	International journal of logistics management	48	Management

TABLE 2: Distribution of top ten disciplines of GVC literature.

Rank	Categories	Total
1	Management	4
2	Green & sustainable science & technology	3
3	Environmental studies	2
4	Business	2
5	Economics	2

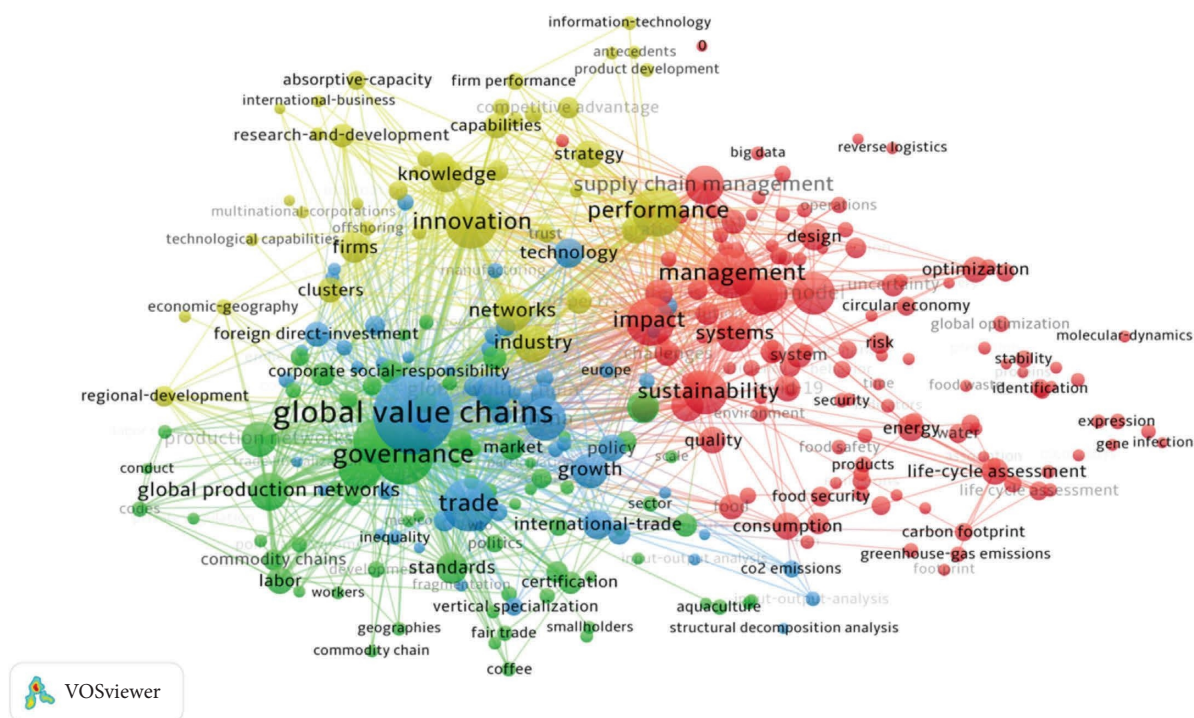


FIGURE 2: Keyword cooccurrence map of GVC literature (Web of Science).

TABLE 3: Keyword quantity analysis of GVC literature.

Keyword	Occurrences	Total link strength
Global value chains	1316	5118
Governance	743	3776
Trade	596	2323
Innovation	556	2735
Performance	534	2473
Management	505	2113
Impact	492	2176
Globalization	423	2033
Sustainability	409	1700
Value chains	398	1823

According to the results of the keyword cooccurrence map, we analyze the four clusters formed separately, and the keywords in the same cluster have great similarity. Four aspects of economics, labor economics, value chain composition, and international economics are elaborated.

3.3.1. Cluster 1 (Red): Aspects of Macroeconomics Level.

The development of GVCs is affected by a number of macro factors, including intellectual property and foreign direct investment protection regimes [20], trade and tariff regimes, government policies, economic development levels [18], and technological levels. States play a major role in the organization and evolution of global value chains [21]. With the increasing global attention to environmental issues and the outbreak and prevalence of COVID-19, environmental and public health directions have become new research perspectives. The key themes are summarized in the following section.

Institutional direction (cooccurrence keywords include institutions, policies, and management): Institutional factors are a major determinant of the governance attributes of GVCs, and host countries can attract investment from lead firms through policies that promote local supplier linkages but are also skeptical of such investments due to insufficient intellectual property protection and underdeveloped legal systems [22]. However, the impact of the host country's institutional environment on GVCs is heterogeneous, and while we assume that leading firms are attracted to favorable local institutions, it also depends on the specific activities offshore, motivations for internationalization, and the strategies and capabilities at the leading firm level [23, 24]. Institutions strongly impact the ability of GVCs to engage in and profit from innovation, and the lack of local institutions prevents domestic firms from transforming research and development into innovative products and services [25], effectively hindering the supplier catch-up and upgrade. Multinational originates from a developed institutional environment and thus demonstrates technological leadership, a challenge that peripheral players of GVCs can address by engaging in international cooperation and integrating more broadly into international networks to offset local weaknesses [26]. The impact of institutions is dynamic, as trade and liberalization in emerging markets progress, as well as the strategy of suppliers, with internal research and development as the dominant strategy for upgrading

[27, 28]. In addition, more technologically advanced suppliers will become the core of the regional network [28]. Green innovation in manufacturing can create economic and social benefits but with risks. It needs to be scientifically and systematically managed based on the perspective of global value chains to promote and protect the value of green innovation [29].

Economic direction (cooccurrence keywords include circular economy, cost, and efficiency): Economic factors can greatly affect the configuration of GVCs and determine the transfer of production in GVCs so suppliers seek higher efficiency and better production capacity [30]. In the global automotive industry, an inverted U-shaped relationship is found between international diversification and performance in manufacturing. The advantages of diversified manufacturing are ultimately offset by increasing organizational complexity and management inefficiencies. Furthermore, location decisions not only aim to reduce costs but are also related to the company's strategic priorities [31]. The simultaneous realization of cost efficiency and production capacity results in a lower cost-to-capacity ratio, which is beneficial to the sustainable development of suppliers. *n* interdisciplinary research agenda with a focus on the Global South is proposed to provide a stronger evidence base to demonstrate how the circular economy can contribute to sustainable global value chain goals for sustainable societies and address degradation and pollution in the Global South [32].

Technology direction (cooccurrence keywords include big data, blockchain, and technology): In the process of intelligent development of the value chain, technology has played a major impact on its life cycle [33]. Thus far, in the 21st century, the development of ICT and the digital economy has enabled "big data" to become the focus of development analysis of dynamic changes, strategic decision-making, and forecasting in urban management [34]. By using the differential panel model with big data in Chinese enterprises, Chinese enterprises' participation in the global value chain can promote their green technology progress and provide a reference for the strategy of solving the dilemma of Chinese enterprises limited by the low-end global value chain [35]. Blockchain technology also has potential implications for all aspects of GVC management, including boundaries, structures, and relationships [36]. 3D printing technology has potential impacts on global value chain structure and geographic scope [10]. While digital connectivity can leverage complementarities between geographically dispersed processes [22], it may limit the participation of suppliers located in less technologically developed regions [37].

Public health direction (cooccurrence keywords include new coronavirus, disease, diagnosis, and health): Amid the COVID-19 pandemic, the shortage of N95 respirators in the U.S. is less a market failure than a policy failure, and the global value chain framework highlights strategic options that could lead to more resilient supply chains and diversified procurement models [38]. The impact of the COVID-19 pandemic on corporate strategies, especially the configuration of corporate global value chains after the

pandemic, is under control. The advantages and disadvantages of alternative location strategies and different governance arrangements for GVC activities are compared [39]. The growing global population also increasingly demands different types of food, especially animal proteins. Research on novel proteins requires not only the development of new value chains but also the impediment of negative environmental impacts and some health concerns [40].

Environmental protection direction (cooccurrence keywords include sustainability, carbon emissions, energy, and environment): Internationally, many scholars have studied the goals of global value chain construction, emphasizing green and environmental protection, and realizing the vision of sustainable economic, social, and environmental development. Sustainability plays an important role in the global economic operation and regulatory structure, and the way that leading companies in the global value chain achieve sustainability has also changed. In the context of achieving environmental sustainability, leading companies in the value chain have captured value [41]. By decomposing the global photovoltaic industry value chain and identifying the main factors affecting the transfer and diffusion of photovoltaic technology, the development history of my country's photovoltaic industry shows that innovation in clean energy technology can be achieved through innovation and knowledge exchange in the global photovoltaic value chain [42]. By combining value-added trade and implied emissions from trade in a consistent manner, the potential environmental costs in GVCs can be estimated from different perspectives, such as production, consumption, and trade [43].

3.3.2. Cluster 2 (Yellow): Aspects of Value Chain Composition. Geographical orientation (cooccurrence keywords include location and cluster): Location decisions determine the most favorable geographic configuration of GVCs, where activities should be located and how they should be allocated to maximize the value created and captured by GVCs. Colocation of manufacturing and sales also allows leading firms to be more responsive to customer needs and offsets the cost of globally dispersed activities by reducing investment in transportation and logistics [31]. An industrial cluster refers to a group of interconnected enterprises, financial institutions, suppliers, and service providers with concentrated geographical locations in a certain industrial environment and is a common feature of industrialization development. The continuous stabilization of the global value chain brought about by economic globalization and trade liberalization has also prompted local industrial clusters to be passively or actively embedded in the global economic system. The literature on industrial clusters emphasizes the role of interfirm cooperation and local institutions in facilitating upgrade, and clusters are inserted in different ways into global value chains. These approaches have implications for enabling or disabling local upgrading efforts, with particular attention to the status of developing country firms [2]. Companies and suppliers seek strategic assets, thereby largely explaining the geographic structure of

GVCs, with multinational corporations positioning value chain activities in globally specialized units to take advantage of the international division of labor [44].

Leading enterprise direction (cooccurrence keyword package firm and leading firm): The smooth and effective functioning of GVCs depends to a large extent on the ability of the lead company to build, coordinate, and lead the network. The way GVCs are organized differs not only by the size and productivity of leading firms but also by other heterogeneous firm-level characteristics. GVC researchers should not make assumptions about the uniqueness of large leading firms as a group, looking out for other potential sources of heterogeneity [45]. Through a case study of GVCs of Chinese power companies, we find that power relations in GVCs appear to be more balanced when emerging market countries are in the lead [46, 47].

Knowledge innovation direction (cooccurrence keywords include knowledge, innovation, and ability): Research on industrial clusters using a social network approach shows that, in knowledge-intensive industries, a network structure supported by horizontal linkages of local firms tends to improve innovation performance, while vertical linkages between local firms and multinational can promote labor-intensive cluster innovation [48]. Escalating within established GVCs and developing new ones under local control are difficult, requiring the mobilization of entrepreneurial capacities and the development of complex management skills. Successful upgrades depend not only on suppliers' access to knowledge but also on their ability to absorb knowledge and turn it into innovation, ultimately improving the supplier's position in the global value chain [19].

3.3.3. Cluster 3 (Green): Aspects of Labor Economics. Individual orientation (cooccurrence keywords include labor force and worker): Eriksson et al. believed that the individual-level cognitive and management skills of managers that lead enterprises, such as cultural awareness, global thinking, and analytical skills, can help enterprises to successfully realize cross-border transactions in global value chains [49]. Sinkovics et al. explored the relationship between information complexity, information codification, and supplier capabilities to knowledge connectivity in global value chains, arguing that the risk perception ability of leading enterprise managers can moderate the relationship [50]. Control of global value chains rests with technology leaders, also known as core figures [47].

3.3.4. Cluster 4 (Blue): Aspects of International Economics. Direction of foreign investment (cooccurring keywords include foreign direct investment, international trade, and economic growth): Foreign direct investment enables multinational companies to build a global network under their control, offering a wide range of products with differentiated and low-cost features. Research on Taiwanese electronics firms shows that FDI typically starts close to home, where resources can be drawn from domestic networks, and then, it moves further field as dominant firms develop regional subnetworks to support their further

expansion [51]. A strong relationship exists between GVC participation and a country's network location, with forward participation being associated with more agglomeration but less trade linkages and backward participation with less agglomeration but more trade linkages [52]. Emerging markets should increase high-value-added domestic value chains, reduce foreign-led global value chains, and increase the participation of global value chains in economic growth [53].

Equity and efficiency direction (cooccurrence keywords include developing countries and inequality): In developing countries, the domestic institutional environment, such as the support of national policies and business associations, is more important than the influence of lead companies in shaping network dynamics [26]. Fair value distribution increases partner reliability and enhances the sustainability of global value chains over time [6]. Notably, a fair distribution of value undermines the potential efficiency gains achieved through the externalization of activities, but such sacrifices in efficiency losses may be necessary to ensure the survival of the global factory [54].

3.3.5. The Trend Analysis of Research Hotspots. Figure 3 shows trends in the emergence of keywords in global value chains in recent years. These trends should be studied to explore cutting-edge research. The color change of nodes from blue to yellow in Figure 3 represents the trend of keywords from 2015 to 2021, including: "supply chain, commodity chain, geography, industrial cluster, governance, Internet, global production network, system, vertical division of labor, global value chains, economic growth, sustainability, carbon emissions, and big data." Keywords related to "environmental protection direction" include "sustainability, carbon emissions, environment, and energy." The keywords related to "technical direction" are "big data, blockchain, and technology."

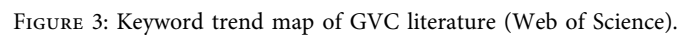
In 2011, global value chain research mainly focused on geography, industrial clusters, and other aspects. An industrial cluster refers to a group of interconnected enterprises, financial institutions, suppliers, and service providers with centralized geographical locations in a certain industrial environment. Groups are a common feature of industrial development. The continuous stabilization of the global value chain brought about by economic globalization and trade liberalization has also prompted local industrial clusters to be passively or actively embedded in the global economic system. Against such a background, industrial clusters must compete for a place in the global market while facing local competition. Therefore, measuring the role of industrial clusters in the global value chain and exploring the impact mechanism of the global value chain on the development of industrial clusters have become the research hotspots of scholars.

In 2015, scholars began to study vertical specialization in global value chains. The division of labor in the global value chain refers to the division of labor and production links that countries or regions are responsible for when participating in the global value chain. At present, the mode of

international division of labor has begun to change from horizontal division of labor to vertical division of labor; that is, the enterprises of various countries participating in the international division of labor and cooperation have changed from producing final products to relying on their own factor endowments and only complete a certain link in the final product formation. Developing countries have the opportunity to create and capture higher added value by participating in global value chains. This potential has spawned research on continuous vertical specialization, and development policy and research should delve more deeply into the barriers to vertical division of labor and the development of value-added chains [55]. China participates in the manufacturing and processing links in the global value chain with cheap labor costs and will be locked in the low end of the industry in the long run. Therefore, studying the division of labor model is extremely important for my country to better participate in the division of labor in the global value chain.

In 2018, the research on global value chain and economic growth achieved certain results. GVCs can facilitate developing countries to enter the international market and integrate into the global economic system. They no longer need to develop a complete industry; they can only focus on one link in the industrial chain. Moreover, joining GVCs can create jobs and promote the growth of gross domestic product and national income. GVC-related trade stimulates economic growth. The impact of GVC participation on economic growth is diverse. Policies that promote GVC participation and strengthen domestic fundamentals should be the goal of countries to further benefit from trade [56].

In 2020, CO₂ emission and COVID-19 have become new topics of research. Carbon emissions generally refer to greenhouse gas emissions, which cause the greenhouse effect to increase global temperatures. On August 9, 2021, the IPCC released a report stating that due to global warming, extreme weather conditions, such as heat waves, heavy rains, and droughts, have become more frequent, clearly blaming greenhouse gas emissions for rising temperatures and pointing out that the solution to slow and reverse global warming is to reduce greenhouse gas emissions to zero. With the increasing attention to the environment, the research on the value chain and the environment become a new hotspot. Multiregional structural decomposition analysis technology is used to quantify the global value chain determinants of China's carbon dioxide emission intensity from the perspectives of production and consumption and to analyze whether global value chain participation decouples China's development from carbon dioxide emissions. The study shows that global value chains are still major barriers to environmental sustainability in China [57]. COVID-19 has brought global production to a standstill, shrinking international trade. Downstream countries and industries are more affected by China's production disruption than upstream countries and industries. The United States, South Korea, and Japan are the most affected, as well as the electronics, textile, machinery, manufacturing, and wholesale trade industries. China's position in the global value chain is very important [58].



Based on the Scopus database, we further analyzed the trend changes of research hotspots, as shown in Figure 5, where the color changes of nodes from blue to yellow represent the trend of keyword appearance from 2001 to 2021. We can clearly see the latest two types of research directions. The keywords in the bottom right corner of Figure 5 are mostly green, including sustainable

3.4. The Research Author Distribution of Global Value Chain Literature. The coauthorship map of the published authors can reflect the cooperative relationship between the published authors in this field. Table 4 provides the information of the ten authors, who have published the most papers in this field. Gereffi has the highest number of papers (29 papers), followed by Ponte (27 papers) and then by Lund-Thomsen (21 papers). In Figure 6, each node represents an author, the size of the node represents the number of his published articles, the color of the node represents the group the author belongs to based on the default clustering method, and the thickness of the line represents the strength of the partnership between authors. From the perspective of the author group as a whole, GVC research is in a state of

TABLE 4: The research author analysis of GVC literature.

Author	Total production	Total citation	Total citation/total production
Gereffi, Gary	29	2164	75
Ponte, Stefano	27	1393	52
Lund-Thomsen, Peter	21	729	35
Nadvi, Khalid	17	868	51
Mudambi, Ram	17	1477	87
Di Maria, Eleonora	16	308	19
Bush, Simon R	15	329	22
De Marchi, Valentina	15	302	20
Maertens, Miet	15	468	31
Xing, Lizhi	14	60	4

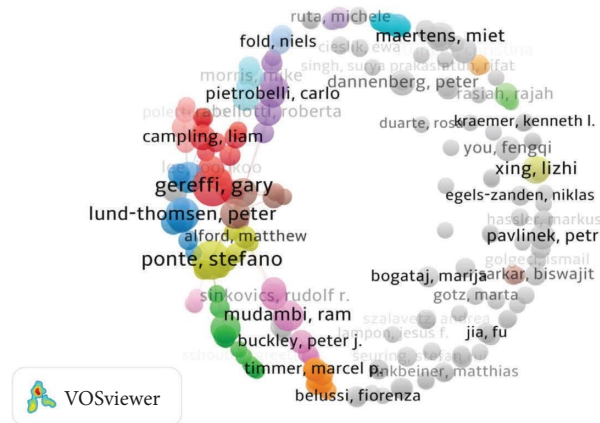


FIGURE 6: The research author map of GVC literature.

TABLE 5: The research institution analysis of GVC literature.

Organization	Country	Total production	Total citation	Total citation/total production
University of Manchester	England	122	5540	45
Copenhagen Business School	Denmark	91	2750	30
Chinese Academy of Science	China	86	1699	20
Wageningen University	Netherlands	76	2423	32
Duke University	USA	66	6183	94
University of Sussex	England	66	6652	101
University of Cambridge	England	59	1421	24
University of Sao Paulo	Brazil	58	938	16
National University of Singapore	Singapore	57	2382	42
University of Oxford	England	55	1667	30

red, are not closely related and are relatively independent, and need to strengthen cooperation. The University of Chinese Academy of Sciences ranked third with 86 publications, indicating that Chinese scholars are more interested in the field of global value chains. The ratio of the number of citations to the number of publications reflects the quality of the literature to a certain extent. According to the TC/TP value, the University of Sussex ranks first with 101, and Duke University ranks second with 94, indicating that the quality of its literature is relatively high. However, the TC/TP value of China is at a low level of 20, indicating that the quality of Chinese scholars' papers still has a lot of room for improvement.

3.6. The Research Country Distribution of Global Value Chain Literature. Table 6 shows the top 10 countries by the number of published papers. The top three countries by the number of published papers are USA, England, and China, with 1,748, 1,124, and 1,019 papers, respectively. In this research field, countries with relatively high levels of economic development, such as the United States, the United Kingdom, China, Germany, and Italy, are currently dominant.

In Figure 8, each node represents a country, and its size represents the number of GVC-related documents it generates. The color of the nodes represents the group to which the organization based on the default clustering method

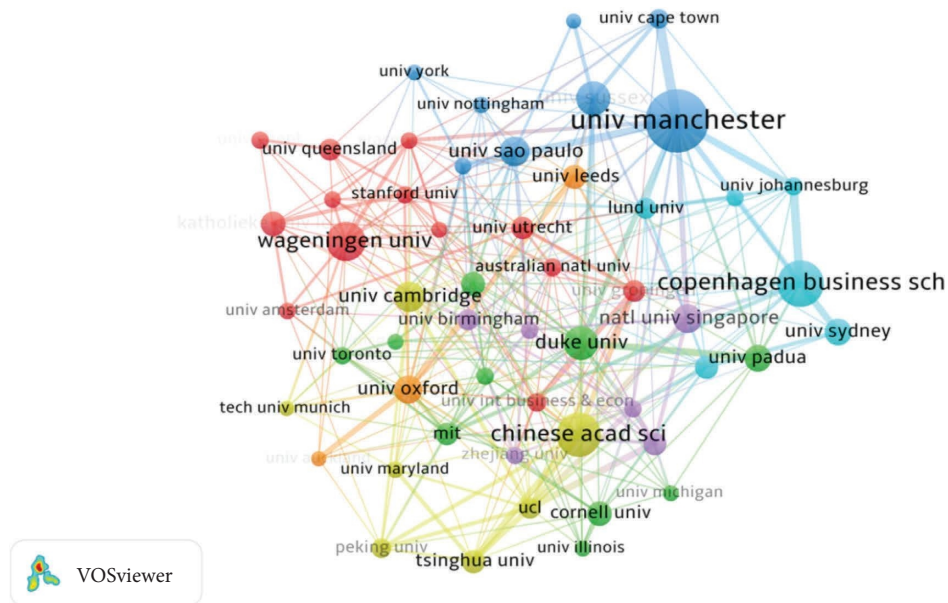


FIGURE 7: The research institution map of GVC literature.

TABLE 6: The research country analysis of GVC literature.

Country	Total production	Total citation	Total citation/total production
USA	1748	59120	34
England	1124	34847	31
China	1019	15630	15
Germany	724	15743	22
Italy	508	11447	23
France	452	8983	20
Australia	437	8511	19
Netherlands	420	11761	28
Spain	410	7461	18
India	385	5177	13

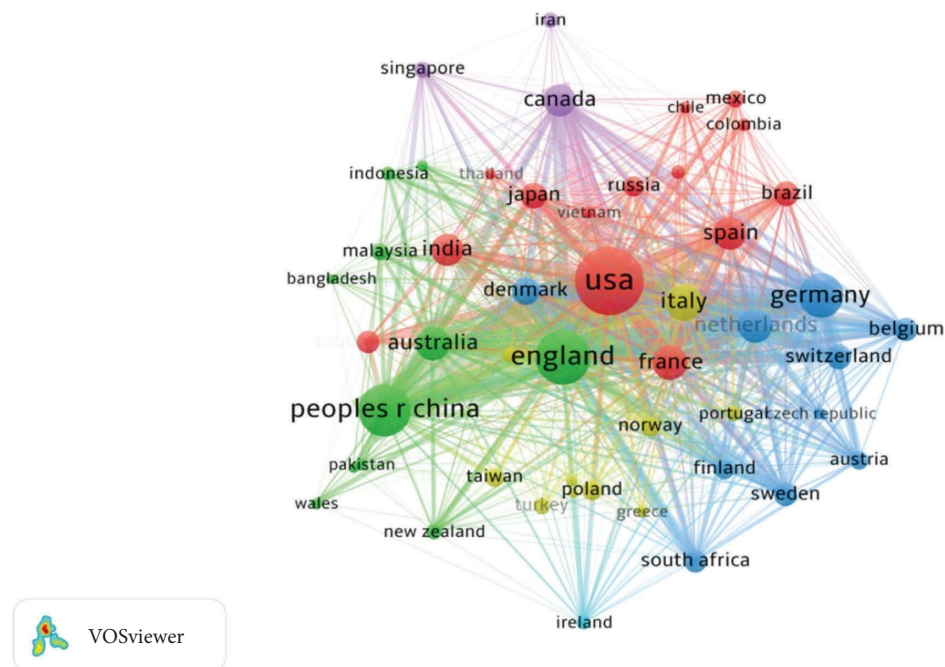


FIGURE 8: The research country map of GVC literature.

belongs, and the connections in the network diagram represent cooperation between countries. The wider connection indicates a stronger degree of cooperation. The group of countries headed by the top three countries with the highest number of publications is displayed in red and green. The United States has a low degree of connection with the United Kingdom and China, and the nodes with Japan, Spain, France, and India are red. The connecting lines are also thicker, indicating that they are more closely related. The lines connecting the UK and China are thicker, and the nodes are green, indicating that the two are closely connected. Countries with strong ties are ranked higher, indicating that progress and development in new areas require exchanges between different countries to cooperate for development. China ranks third with 1,019 publications, indicating that Chinese scholars are more interested in the field of global value chains. However, according to the TC/TP value, the USA ranks first with 34, and England ranks second with 31, indicating that the quality of its literature is high, whereas the TC/TP value of my country is at a low level of 15, indicating that Chinese scholars have much room for improvement in the quality of the papers.

In the United States, in 2008, Sturgeon, Sturgeon et al. applied global value chain analysis to the latest development status of the global automotive industry, taking North America as an example, using the three main elements of global value chain enterprises, governance, power, and institutions to highlight some defining characteristics of the automotive industry [8]. The U.S. outsources product production to foreign companies and earns significant revenue from intellectual property and services embedded in physical products sold to consumers around the world, yet traditional trade statistics are compiled based on the value of goods declared to customs across borders; intellectual property and service-related added value embedded in goods are not recorded as exports. Current trade statistics vastly underestimate U.S. exports, and if the added value of Apple's intellectual property and services embedded in all Apple products sold to foreign consumers were included in U.S. exports, then the total U.S. exports would have grown and the trade deficit will decrease [59].

In England, on January 31, 2020, the United Kingdom officially left the European Union after 47 years of membership, a historic turning point that will accelerate the shift in the economic trajectory. The impact of "Brexit" on UK trade is not only a change in the surface figures but also leads to the adjustment of the UK's global value chain structure. From the perspective of development trends, the UK's global value chain cooperation focus shows signs of gradually shifting to Asian countries in line with the development trend of globalization. From 2000 to 2018, the UK's total trade with Asian countries increased by 185%, whereas trade with European countries only increased by 125%.

In China, Chinese companies enter the field of photovoltaic manufacturing through technology acquisition and then gradually establish global competitiveness through vertical integration strategies and the photovoltaic value chain [42]. The U.S. antidumping policy toward China has accelerated and shortened the length of production based on

backward linkages and ultimately improved the position of "Made in China" in the global value chain. Therefore, China should continue to adhere to opening up and strengthening linkages with the world economy to gain new development prospects [60]. In the context of the digital economy, the global value chain is facing restructuring. How China can use the digital economy as a new engine to drive economic development and break through the low-end-lock dilemma in the division of labor in the global value chain is a key research direction in the future.

3.7. The Cocitation Analysis of Global Value Chain Literature. Reference cocitation analysis mainly studies key documents and research hotspots in the field, and document cocitation clustering reflects the hot topics and research directions of common concern among clustered documents. When two documents appear in the references of the third document at the same time, the cocitation of documents occurs. Mining the cocitation relationship of documents through big data is called literature cocitation analysis. Based on a large number of cited references, the analysis can efficiently and rapidly understand the core literature in the research field and can also analyze the correlation between the studies.

Cocitation analysis was performed on the literature using VOSviewer, and the results were obtained as shown in Table 7 and Figure 9. As shown in Table 7, the top three cited papers are "The Governance of Global Value Chains," "The Organization of Buyer-driven Global Commodity Chains: How US Retailers Shape Overseas Production Networks," "Global Production Networks and the Analysis of Economic Development"; the citations are 1103, 611, and 510 times, respectively. As shown in Figure 9, through literature cocitation analysis, research in the field of global value chains has formed three literature clusters around key nodes. Global value chain research networks are highly centralized and have a high degree of network overlap. A strong degree of correlation exists between node documents, and they have strong explanatory power. The key node documents with high citations are located at the junction of knowledge groups, which play a linking role between the groups and provide theoretical support and direction guidance for follow-up research.

The red cluster is located in the center of the network and is closely related to the surrounding area. It is the theoretical basis of the entire global value chain research field. The main theme of this clustering is the theoretical framework. Gereffi et al. built a theoretical framework to explain governance patterns in GVCs, the complexity of transactions, the ability to encode transactions, and the ability to supply bases play an important role in determining how GVCs are governed and changed; grades, captive, relational, modular, and market are the five types of GVC governance [3]. Based on the cross-border activities and development results of early enterprises, a global production network framework is proposed to analyze the asymmetric relationship between economic integration and economic and social development [61].

TABLE 7: The cocitation analysis of GVC literature.

Cluster	Cited reference	Total citation	Title	Author
Red	Gereffi G, 2005, rev int polit econ, v12, p78	1103	The governance of global value chains	Gereffi G
	Gereffi G, 1994, commodity chains glo	437	The organization of buyer-driven global commodity chains: How US retailers shape overseas production networks	Gereffi G
	Henderson J, 2002, rev int polit econ, v9, p436	370	Global production networks and the analysis of economic development	Henderson, J
Green	Humphrey J, 2002, reg stud, v36, p1017	611	How does insertion in global value chains affect upgrading in industrial clusters?	Humphrey, J
	Gereffi G, 1999, j int econ, v48, p37	510	International trade and industrial upgrading in the apparel commodity chain	Gereffi G
	Giuliani E, 2005, world dev, v33, p549	261	Upgrading in global value chains: Lessons from Latin American clusters	Giuliani, E
Blue	Hummels D, 2001, j int econ, v54	288	The nature and growth of vertical specialization in world trade	Hummels, D
	Koopman R, 2014, am econ rev, v104, p459	287	Tracing value-added and double counting in gross exports	Koopman, Robert
	Johnson RC, 2012, j int econ, v86, p224	268	Accounting for intermediates: Production sharing and trade in value-added	Johnson, Robert C

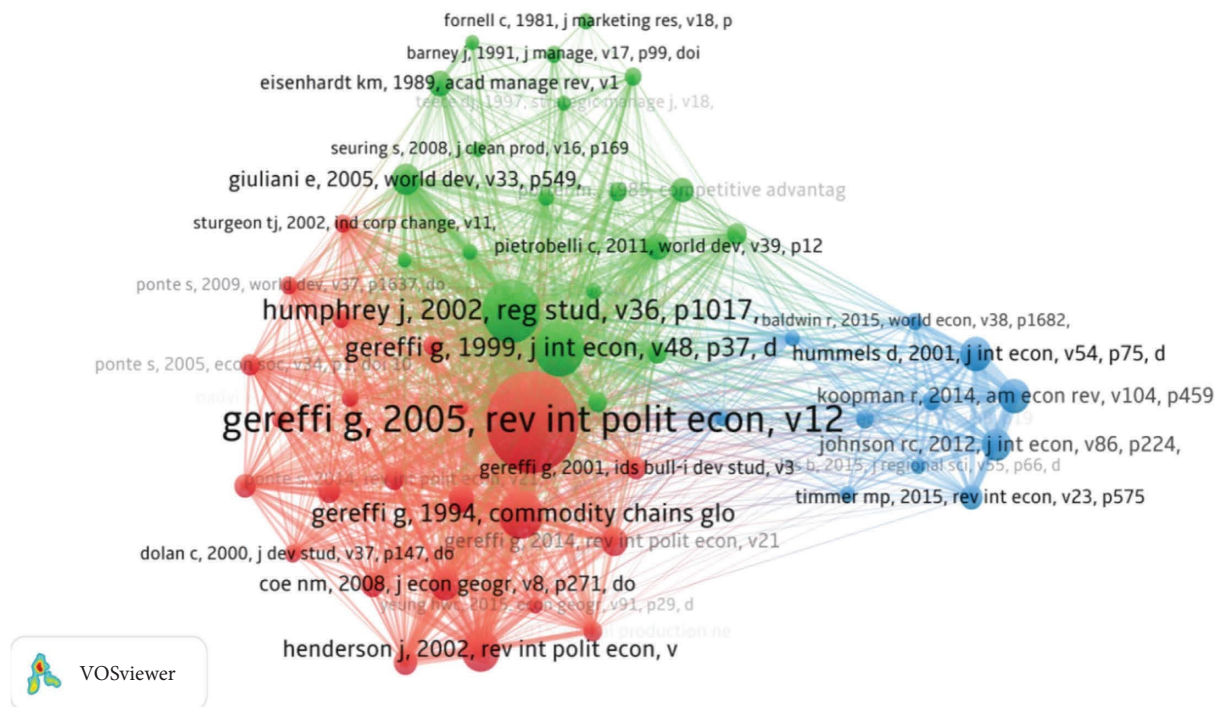


FIGURE 9: The cocitation map of GVC literature.

The green cluster is at the center of the network and is closely related to its surroundings. It is also the theoretical basis of the entire global value chain research field. The main themes of this cluster are industrial clusters and industrial upgrading. Most industrial cluster literature emphasizes the role of business-government cooperation in promoting development and upgrading. The value chain literature focuses on consumers worldwide and their role in value chain upgrading. Clusters are combined with global value chains in different ways. It also has a certain impact on the value chain [2]. From the perspective of the global commodity chain, the national trade network and the conditions for promoting the upgrading of the garment industry are analyzed [62]. By analyzing the relationship among clusters, GVCs, upgrading, and sectoral innovation patterns in Latin America, we find that sectoral characteristics have a significant impact on the upgrading patterns of clusters in GVCs [63].

The blue cluster is at the edge of the network, showing a certain degree of independence, and it is not strongly related to other studies. To become a frontier branch of value chain research is an extension of the group's theory and its application in practice. The main research themes of this cluster are vertical specialization and a new method of statistical trade data, the value-added method. Using input-output tables for the OECD and four emerging countries, we find that growth in vertical specialization accounts for one-third of export growth in these countries. This condition illustrates that the nature of international trade is changing; the trade chain tends to be vertical when production processes tend to span many countries [64]. Koopman et al. proposed an accounting framework that divides a country's gross exports into various value-added components by

source and additional double-counting clauses, bridging the gap between gross-value and value-added trade data [65]. By combining input-output and bilateral trade data to calculate the value-added bilateral trade, we find that the ratio of value added to total exports in manufacturing is lower than in services, and bilateral production linkages are responsible for the change in this ratio [66].

4. Conclusion and Recommendation

4.1. Conclusion. This article uses bibliometric analysis to analyze the research hotspots and trends in the field of global value chains, which has reference significance for countries to better participate in the global value chain in the post pandemic era. Research has shown that the number of papers published in the global value chain field has been continuously increasing over time and has entered a period of rapid development since 2016; the main disciplines are economics and management; a few researchers and research institutions have strong influence, but the cooperation between scholars and institutions is relatively weak; the United States, the United Kingdom, and China dominate the research field; the research directions with high attention include governance, innovation, globalization, and sustainability; new research directions include CO₂ emission, COVID-19, economic growth, and big data.

4.2. Recommendation. This article analyzes the research hotspots and trends in the field of global value chains, which can provide certain guidance for future academic research. On the one hand, with the increasing global attention to environmental issues and the prevalence of the COVID-19

epidemic, the direction of the environment and public health has become a new research perspective. In the future, scholars can further study the complex impact of the natural environment and public health on the global value chain, especially the impact of carbon emissions on the global value chain and the change of the value chain in the post epidemic era.

On the other hand, the global value chain in the context of the digital economy is facing restructuring, and digital trade is increasingly affecting the international trade pattern. How countries can use the digital economy as a new engine to drive economic development and break through the low-end lock-in dilemma in the global value chain division of labor is a key research direction in the future. Scholars can analyze the impact of big data and artificial intelligence on the global value chain and explore the interaction between digital trade and traditional trade and its impact on the status and division of labor of economies in the global value chain.

The conclusion of this article also has important reference value for policy makers. At present, with the prevalence of unilateralism and trade protectionism, the global economy is facing the challenge of antiglobalization. In addition to the impact of COVID-19, the global economic recovery is facing great challenges, and the global value chain may be reshaped. Green development and digital economy are the focus of future research in the value chain field and are also important driving forces for achieving modernization. China can actively promote the development of the digital economy and green economy, guide the upgrading of industrial structure, and promote the effective allocation of global value chain resources by enterprises while the rules are not yet finalized. At the same time, we adhere to the development of good bilateral political relations with countries around the world, reduce the uncertainty of corporate participation in the global value chain division of labor caused by political risks, and provide strong support for enterprises to go global.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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