Research Theme Progress, Knowledge Structure and Research Frontiers in Global Innovation Network (GIN) from 2016 to 2021 Using Citespace Based Bibliometric Analysis

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Abstract The research literature related to Global Innovation Network (GIN) is analyzed to explore its development history, research hotspots and frontiers in the field of GIN, to provide references for future research. By using the bibliometric analysis tool Citespace, the Web of Science core database was used to conduct a computer visualization analysis of the evolution of the theme progress, knowledge structure and research frontiers of GIN research from 2016 to 2021. The results found that: 1) The research on GINs belongs to the interdisciplinary research scope. 2) The hotspots of the research theme process show an increase year by year and continue to explode, with terms such as global innovation networks and regional studies having prominent influence, while SMEs and foreign direct investment have been hot topics of research in the last three years. 3) The knowledge structure of GINs, i.e., the cited literature research, has obvious spatial structure characteristics in global networks, regional innovation and local-global linkages levels. Based on which four subfields of new development paths, competitive advantage, global value chain and cluster research are active research frontiers in GIN research.

Keywords: Global innovation network; Bibliometric analysis; Research themes progress; Knowledge structure; Research frontiers

1 Introduction

In the context of the new technological revolution, economic globalization, knowledge globalization, and accelerated integration of information technology and industry, Global Production Networks (GPNs) have gradually evolved into Global Innovation Networks (GINs). GIN has been widely used in practice, and because of its diverse forms, different bases and scattered fields, a sound system has not been formed in the academic community, and the definition and perception of its concept are not uniform. The term global innovation network first appeared in the overview of the UNCTAD Investment Report "Internationalization of R&D and Development" but was not clearly defined and explained[1]. Ernst 's earliest study on innovation offshoring in 2006 elaborated that GINs are networks that cross firm, industry and national boundaries spawned by the progressive opening of corporate innovation systems and network interconnections[2]. According to Ma and Wu [3], GIN is a value network innovation model in which

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firms search for available knowledge resources globally, focus on resource access, and have a high degree of openness. The above-mentioned scholars all point out that global innovation networks are open technology-related networks built by firms on a global scale. Haakonsson and Kirkegaard [4] argues that GINs should be global networks of interconnected and integrated functions and operations of technology innovating firms and non-firms, they also point out that GIN research draws on the global value chain research framework to focus on how leading firms evolve as coordinators of spatially decentralized production activities.

GINs focus on various formal and informal relationships among industries, sectors, and firms in complex networked production structures and relates them to firms in linear value chains, focusing on knowledge and technological innovation in networks. The research covers wind power industry [5-7], ICT industry [8], water recycling system industry [9], photovoltaic industry [10], aviation cluster [11], automotive cluster [12], precision agriculture [13], nanotechnology [14], internationalization of SMEs [15, 16], network governance [17], ecological governance [18], climate governance [19, 20], and other multi-industry, multi-object, and multi-disciplinary comprehensive research.

Bibliometrics is a quantitative analysis method that uses mathematical and statistical methods, computer technology and other methods to describe, evaluate and predict the current status and trends of scientific research, taking various external characteristics of scientific and technical literature as the object of study. Currently, software for bibliometrics analysis includes CiteSpace and VOSviewer, etc..CiteSpace is a tool that focuses on finding key points and turning points in the development of domain knowledge to analyze trends and patterns in scientific literature progressive knowledge domain visualization [21, 22].

In order to have a comprehensive and systematic understanding of the research progress and potential research framework of GINs, this paper aims to conduct a scientometric and visualization study of GIN-related literature with the help of CiteSpace bibliometric analysis tool, and to sort out and summarize the GIN research by topic and field, so as to provide reference and reference for researchers to determine the research direction and research focus of GINs.

2 Research Design

2.1 Methodology

Mapping knowledge domains, as a new method and field of bibliometrics, has emerged and gained great development since it was first proposed in 2003. It takes knowledge domair as the object, and has the dual nature and characteristics of "map" and "spectrum": it is both a visual knowledge graph and a sequential knowledge spectrum, which shows the complex relationship between knowledge units.

With the improvement of bibliometric methods, related research tools have emerged. CiteSpace is an information visualization software developed in Java, which is mainly based the co-citation analysis and path finder algorithm to measure the literature (collection) of a specific field, to explore the key paths and knowledge inflection points of the evolution of the discipline, and through a series of visual scientific knowledge mapping to form the analysis of the potential dynamic mechanism of the discipline evolution and the detection of the discipline development frontier[21].

We apply CiteSpace 5.8 R1 to conduct a bibliometric visual analysis of GINs. We applied noun term co-occurrence analysis, co-citation cluster analysis, and term burst and citation burst detection to 982 English-language papers published in the Web of Science core database during the six years since the emergence of relevant research concepts in the field of global innovation networks research, and then explored the evolution of the theme progress, knowledge structure and frontier trends in the research practices of the international academic community in the field of GINs.

2.2 Data sources

The data were obtained from the Web of Science core collection with the advanced search formula TS=(global innovation network) OR TS=(global network of innovation) and Articles (Document Types), the search time was not limited.

The result revealed articles published before 2016 were screened to exclude those that did not match the research topic, and the valid data collection was confirmed to be from 2016 to August 2021, with a total of 1,224 articles shown in the search results. Manual screening and elimination of irrelevant and duplicate literature, such as paper excerpts from journals and computer networks, resulted in a total of 982 valid literature related to GINs.

3 Results

3.1 Overview

3.1.1 Trend analysis of thematic publication.

Figure 1 was obtained by compiling and plotting the volume and changes of international scholars' publications on global innovation networks in each year from January 2016 to August 2021.From an overall perspective, the total number of publications in English literature in the field of global innovation networks research shows a trend of increasing year by year. The number of thematic publications in 2020 is twice as much as that at the beginning of the study, and the research on global innovation networks is getting more and more attention from international scholars, but due to its novel concept, the total research results are not much and no systematic research has been formed yet.

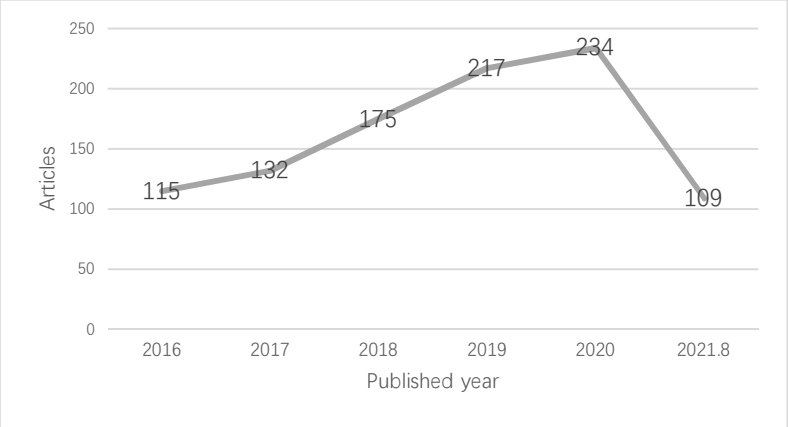

Fig. 1. The number of GIN articles published by year from 2016 to 2021.8

3.1.2 Disciplinary category profile.

Table 1 shows the distribution of disciplinary categories with frequencies greater than 10 in the disciplines to which the 982 literature studies belonged during the 6-year period. Described by the disciplinary scope, the distribution of GIN research disciplines involves business, management, economics, environment, geography, computer, engineering, agronomy, etc.. The existence of a large number of cross-disciplinary and interdisciplinary applications, with the most extensive research at the intersection of business and economics.

The centrality measure proposed by Freeman[23] can be used to represent key points of potential paradigm change, and we find that the three disciplinary categories of environmental sciences, engineering, and telecommunications have the highest centrality and are the core disciplines associated with the distribution of research disciplines and the shift in research disciplines across the GIN.

Table 1. Distribution of disciplinary categories of GIN research

Count	Centrality	Year	Disciplinary Category
414	0.05	2016	BUSINESS & ECONOMICS
224	0.1	2016	MANAGEMENT
223	0.39	2016	ENVIRONMENTAL SCIENCES & ECOLOGY
170	0.38	2016	ENVIRONMENTAL STUDIES
169	0	2016	BUSINESS
140	0	2016	ECONOMICS
130	0.9	2016	ENVIRONMENTAL SCIENCES
123	0.23	2016	SCIENCE & TECHNOLOGY - OTHER TOPICS
110	0.03	2016	GEOGRAPHY

102	0.62	2016	ENGINEERING
97	0.24	2016	GREEN & SUSTAINABLE SCIENCE & TECHNOLOGY
93	0.37	2016	PUBLIC ADMINISTRATION
80	0.25	2016	REGIONAL & URBAN PLANNING
49	0.1	2016	COMPUTER SCIENCE
43	0	2016	DEVELOPMENT STUDIES
36	0	2016	INFORMATION SCIENCE & LIBRARY SCIENCE
35	0.2	2016	URBAN STUDIES
34	0	2016	ENGINEERING, INDUSTRIAL
31	0.51	2016	ENGINEERING, ENVIRONMENTAL
27	0.22	2016	OPERATIONS RESEARCH & MANAGEMENT SCIENCE
25	0.21	2016	MULTIDISCIPLINARY SCIENCES
23	0.19	2016	SOCIAL SCIENCES - OTHER TOPICS
22	0.43	2016	COMPUTER SCIENCE, INFORMATION SYSTEMS
21	0.31	2016	ENGINEERING, ELECTRICAL & ELECTRONIC
21	0.19	2016	SOCIOLOGY
20	0.03	2016	GOVERNMENT & LAW
20	0	2016	COMPUTER SCIENCE, INTERDISCIPLINARY APPLICATIONS
19	0.61	2016	TELECOMMUNICATIONS
19	0.05	2016	POLITICAL SCIENCE
19	0.03	2016	INTERNATIONAL RELATIONS
16	0.26	2016	PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH
13	0.31	2016	MATHEMATICS
12	0.23	2017	ENGINEERING, MANUFACTURING
11	0	2016	COMMUNICATION
10	0.19	2017	ENERGY & FUELS

3.2 Research theme progress

Co-term analysis can identify the most popular words in journals over a certain period of time, and the temporal changes in such popular words can capture potential changes in the structure of topics within a research area. Noun Phrase co-word analysis was performed to extract terms after natural language processing process for Title (TI), Keywords (DE), Supplementary Keywords (ID) and Abstract (AB). The data were imported into Citespace, set Time slicing as 2016-2021; Node Type as Terms; Selection criteria as Top 50; Network clipping methods as Minimum panning tree, Pruning sliced networks and Pruning the merged network. After manually sifting

through the extracted noun terms and merging the English singular and plural, synonyms, etc., a noun term visualization network with 395 nodes and 1520 edges was obtained.

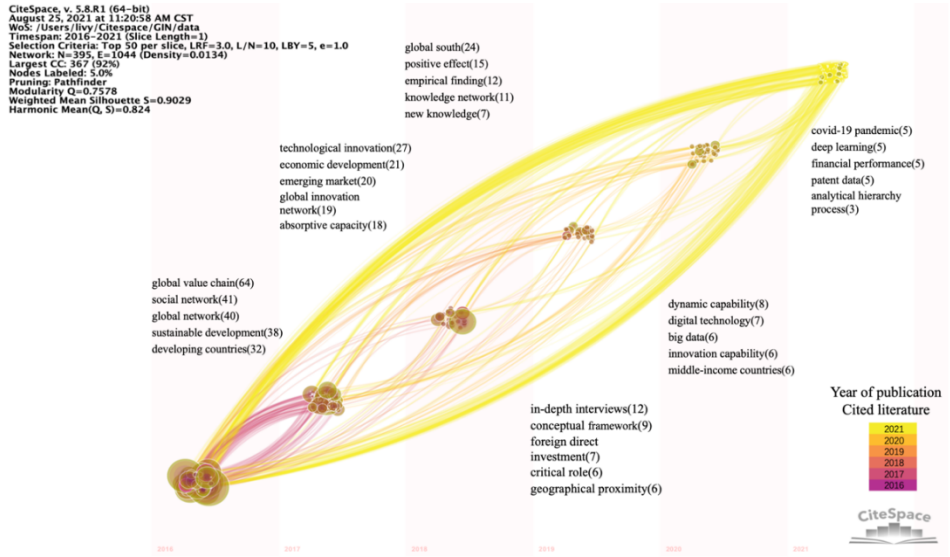

Fig. 2. Time zone map of the nomenclature co-occurrence network

The term co-occurrence network time zone diagram can be used to analyze the temporal evolution of the topics extracted from the terms. The time zone diagram collects the nodes in the same time zone, and Figure 2 shows the top five high-frequency noun terms that emerged in the past six years, with the time period in which the subject term first appeared, and the number of occurrences in the total time period in parentheses.

3.2.1 Evolutionary process of the GIN study population.

The country-level study is refined from developing countries and developed countries in 2016 to middle-income countries in 2020. The regional level study is derived from emerging economies, regional study, and European union in 2016 to European regions in 2017, and further expanded to global south, global north, and global community in 2018. In 2019, the study of the South Africa region is added, and in 2020, the focus is refocused on developing economies and Latin America. It shows a trend of refocusing after gradually expanding the horizon.

3.2.2 GIN research methodology development process.

In 2016, scholars applied network / social network analysis, empirical analysis, and bibliometric analysis to the study of GINs. In 2019, the use of regression analysis for related research begins. 2020, new comparative analysis research emerges, and 2021 are further enriched with analytical hierarchy process, comprehensive analysis and main path analysis methods.

Table 2. Top 18 Terms with the Strongest Citation Bursts

Terms	Year	Strength	Begin	End	2016 - 2021
regional study	2016	3.35	**2016**	2017	
global health	2016	3.35	**2017**	2018	
economic geography	2016	2.66	**2017**	2019	
local level	2016	2.38	**2017**	2018	
global innovation network	2016	4.68	**2018**	2019	
emerging market	2016	2.97	**2018**	2019	
knowledge network	2016	2.91	**2018**	2019	
new knowledge	2016	2.74	**2018**	2019	
positive effect	2016	2.39	**2018**	2019	
firm level	2016	2.34	**2018**	2019	
innovation policy	2016	2.13	**2018**	2019	
economic development	2016	1.96	**2018**	2019	
medium-sized enterprises	2016	3.45	**2019**	2021	
foreign direct investment	2016	2.41	**2019**	2021	
critical role	2016	2.07	**2019**	2021	
knowledge sharing	2016	2.07	**2019**	2021	
medium enterprises	2016	2.07	**2019**	2021	
social innovation	2016	2.06	**2019**	2021	

Table 2 shows the results of the GIN terminology emergence detection from 2016 to the present, and a total of 18 emergent hot terms were detected, reflecting the research hotspots and frontier persistence in the GIN field in different periods.

Among them, the strength of "global innovation network", "regional research", "global health" and "medium-sized enterprises" is higher than that of the other terms, indicating their prominent impact in the field. "Regional studies" is the only detected research hotspot in 2016 and has a very high strength, indicating that research in the field of GINs initially focused on regional studies, but with a low level of persistence. "Global health", "economic geography" and "local level" started to explode in 2017, with "economic geography " has been the longest lasting. "Global Innovation Networks," "emerging markets," and "knowledge networks" all continue to explode in 2018-2019, with the "Global innovation networks" is the most significant. Among the emergent terms that have continued to explode in the past three years, "medium-sized enterprises" and "foreign direct investment" are the hot frontiers of academic attention.

3.3 Knowledge structure and research frontiers

Knowledge structure is considered to be the citation trajectory of a research frontier in a field of study[12]. From a bibliometric perspective, the citations of the cited literature form the research frontier, and the cited literature of the cited literature forms the knowledge structure[24].

Price de Solla [25] notes that scientists seem to have a tendency to cite the most recent publications and suggests that the "research frontier" is essentially a dynamic change in the field of research.

In literature co-citation analysis, the titles of the cited literature (research frontiers) are clustered by correlation methods to extract vocabulary, and the cited literature (knowledge structures) are observed as nodes in the graph. Therefore, co-citation clustering can not only sort out the time-independent basic knowledge, but also give a dynamic presentation of the research frontiers in the global innovation network field by time mapping.

On the basis of section 3.2, the CiteSpace map parameters were adjusted as followed. The node type changed to Reference, the node link extraction was adjusted to g-index (k=38), and no cropping algorithm was adopted to ensure the integrity of citations; the map was clustered according to the title similarity, and 13 major clusters were obtained by LLR algorithm. The network density was 0.0137, the Q value was 0.7666 (>0.3), and the clustering structure was significant and reasonable, with clear boundaries between research topics and significant domain differentiation; the Mean Silhouette value was 0.8917 (>0.4), with great similarity and good homogeneity among clusters.

The burst citations in the field of GINs and their corresponding hot fronts are shown in Table 3. The timeline visualization graph in Citespace depicts the cluster distribution along a horizontal timeline, with nodes representing citations (basic knowledge), the larger the node radius, the more citations. A citation burst (nodes in red or with red tree wheels) implies a spike in citations to a piece of literature in a given time period and is often considered a landmark piece of literature in the development history of a research topic.

The most landmark literature in the progress of research comes from Lorenzen and Mudambi [26] 's paper on cluster connectivity theory, followed by MacKinnon MacKinnon [27]'s critical evaluation of research on global production networks (GPNs). Other high intensity citations include Morrison Morrison, Rabellotti and Zirulia [28], who introduces global pipelines to extend Cowan and Jonard [29]’s model of network structure and knowledge diffusion.

The citation that continued to explode for three years and continues to this year is the global innovation systems (GIS) research and analysis framework of a four-level (one-level global actor; two-level national innovation system; three-level regional technology cluster knowledge subsystem; and four-level new market segment) configuration model proposed by Binz and Truffer [30] in 2017.

Table 3. Top 10 References with the Strongest Citation Bursts

References	Year	Strength	Begin	End	2016 - 2021
MacKinnon D, 2012	2012	3.55	**2016**	2017	▬▬▁▁▁▁
Parrilli MD, 2013	2013	2.25	**2016**	2018	▬▬▬▁▁▁
Cooke P, 2013	2013	2.15	**2016**	2017	▬▬▁▁▁▁
Yin R K, 2017	2017	2.03	**2017**	2017	▁▬▁▁▁▁
Lorenzen M, 2013	2013	4.6	**2017**	2018	▁▬▬▁▁▁
Morrison A, 2013	2013	3	**2017**	2018	▁▬▬▁▁▁

Ponte S, 2014	2014	2.94	**2018**	2019
Boschma R, 2017	2017	2.44	**2018**	2019
Binz C, 2016	2016	2.2	**2018**	2019
Binz C, 2017	2017	1.98	**2019**	2021

The citation publication times within clusters are shown from left to right by time at the top of the view (Figure 3), with the connecting line between nodes representing the first co-citation of two nodal documents; the darker the color of the line, the earlier the cited document was published, and the lighter the later it was published, and the active sustainability of the research frontier subfields represented by each cluster varies.

For example, cluster #0 New Path Development lasted the longest at 9 years, followed by cluster #2 Peripheral Technology and cluster #5 Global Value Chain at 8 years, with cluster #0 New Path Development and cluster #5 Global Value Chain remaining active until 2020, the most recent year of references cited by the cited literature in this study. The cluster #2 and cluster #9 continuing to be active until 2019, and cluster #15 International Patent Performance, on the other hand, is active for only three years (2012 to 2014), and there is a pathway link between this area of research and Clusters #0 and #1, with the researcher's perspective shifting to the active cluster area.

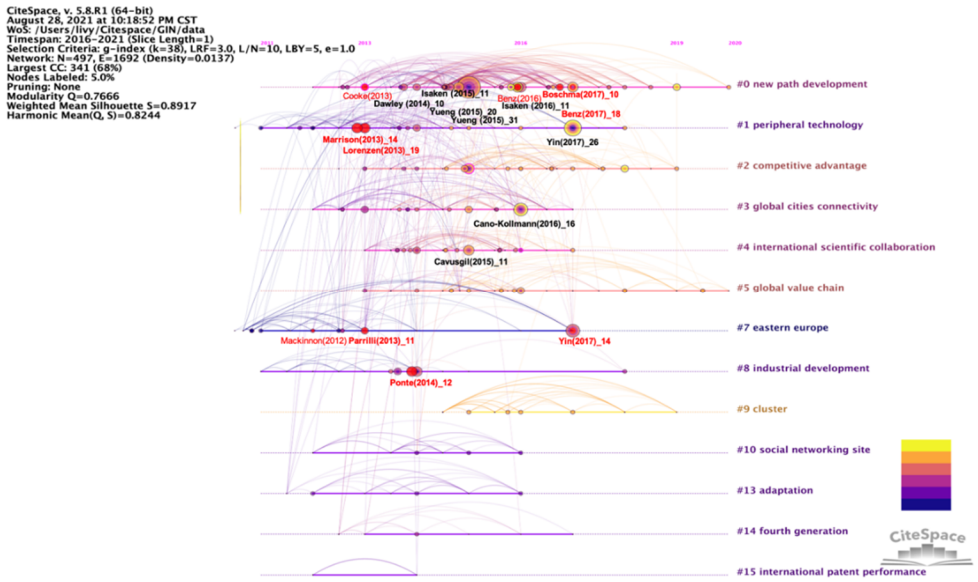

Fig. 3. Co-citation timeline visualization[1]

[1] Citations cited more than 10 times are marked in bold type, and citations bursts are marked in red type.

3.3.1 Cluster #0 New Path Development.

The largest cluster in the co-citation network and the research frontier with the largest and active knowledge structure in GIN research. There are 62 references between 2012 and 2020, which have an average citation year of 2015 and a silhouette of 0.847, with a high level of horizontal homogeneity.

The timeline visualization (Fig.3) reveals the evolution of the knowledge structure of the new development path sub-domains, which, combined with Table 4, can be summarized as: technology and knowledge, global networks, path dependence and regional diversification.

The evolution started with studies related to knowledge structure, knowledge transfer and industrial zones[31], then the study of Global Production Networks (GPN) versus Global Innovation Networks (GIN) in the ICT industry[32] became the first citation explosion in the field, kicking off the high-impact studies that followed. Yeung further proposed a dynamic global production network theory[33] in 2015, which is the most highly cited literature in the subfield. The four-level Global Innovation System (GIS) proposed by Binz [9] was followed by another citation explosion, and the literature continues to be active in the most recent studies, as analyzed by the duration of the citation explosion in the study profile.

Path dependency theory complements the traditional notion of regional path-dependent industrial development, with high-impact citations from Dawley [5], who study of new path creation in the UK's emerging offshore wind industry and Isaksen [34] who study of path extension in peripheral regions. The research of Beijing's on-site water recycling system industry as an object of research by Binz, Truffer and Coenen [9] on path creation achieved Citation explosion.

Boschma, Coenen, Frenken and Truffer [35], whose theory of regional diversification is one of the landmark literatures. Zhu, He and Zhou [36] pointed out that regional diversification is a process of path dependence. The latest citation studies are interrelated based on the rich deepening of the four knowledge structures of knowledge and technology, global networks, path dependence and regional diversification [36-39].

Table 4. High Impact Citations in Cluster #0

Freq	Burst	Degree	Centrality	Sigma	Author	Year
31		33	0.08	1	Yeung HWC	2015
20		22	0.03	1	Yeung	2015
18	1.98	25	0.03	1.06	Binz C	2017
11		18	0	1	Isaksen A	2015
10	2.44	40	0.02	1.05	Boschma R	2017
10		31	0.04	1	Isaksen A	2016
10		33	0.02	1	Dawley S	2014
9	2.2	34	0.01	1.03	Binz C	2016
9		11	0.03	1	Huenteler J	2016
8	2.15	28	0.12	1.28	Cooke P	2013

In the case of analyzing cluster members, i.e., cited literature on the perception of the basics, analyzing information from the cited literature will provide information on the dynamics of the research frontier. Table 5 lists the main cited literature with citation coverage of members above 15%. The two articles with the highest literature coverage are Hassink, Isaksen and Trippl [40] and Tödtling and Trippl [41] on the theory of new regional industrial path development and regional innovation policy for new development paths, respectively, followed by MacKinnon 's geopolitical economy approach to path creation[42] and MacKinnon's multivariate portfolio study of the above knowledge structures[39]. Fuenfschilling and Binz [43], whose study continues to expand the research base to include the institutional structure of technology, path creation and catch-up perspectives.

Table 5. Main Citation Literature in Cluster #0

Coverage	Bibliography
17	Hassink, Robert (2019.0) Towards a comprehensive understanding of new regional industrial path development. REGIONAL STUDIES, V53, P10 DOI 10.1080/00343404.2019.1566704
17	Toedtling, Franz (2018.0) Regional innovation policies for new path development - beyond neo-liberal and traditional systemic views. EUROPEAN PLANNING STUDIES, V26, P17 DOI 10.1080/09654313.2018.1457140
16	MacKinnon, Danny (2019.0) Rethinking path creation: a geographical political economy approach. ECONOMIC GEOGRAPHY, V95, P23 DOI 10.1080/00130095.2018.1498294
15	MacKinnon, Danny (2019.0) Path creation, global production networks and regional development: a comparative international analysis of the offshore wind sector. PROGRESS IN PLANNING, V130, P32 DOI 10.1016/j.progress.2018.01.001
15	Fuenfschilling, Lea (2018.0) Global socio-technical regimes. RESEARCH POLICY, V47, P15 DOI 10.1016/j.respol.2018.02.003
15	Binz, Christian (2018.0) Unrelated diversification in latecomer contexts: emergence of the chinese solar photovoltaics industry. ENVIRONMENTAL INNOVATION AND SOCIETAL TRANSITIONS, V28, P21 DOI 10.1016/j.eist.2018.03.005

3.3.2 Cluster #2 Competitive Advantages.

With 38 references cited and a silhouette of 0.883, higher than cluster #0 indicating better homogeneity or more specialization, and with an average cited literature publication year of 2016, it belongs to one of the latest frontiers of global innovation network research. The cluster has three citations with 5% or more coverage, all published in 2020, Mordue and Karmally [44] focuses on the competitive advantage of semi-peripheral automotive industry producing countries in between the core-periphery[41], Bathelt and Li [45] on how MNCs can extend their local knowledge networks globally through cross-border knowledge pipelines to enhance their competitive advantage.

3.3.3 Cluster #5 Global Value Chain.

There are 32 references within the cluster with a silhouette of 0.835, one of the latest clusters in terms of average citation year. The citation literature within the cluster is cited less frequently than within the cluster, mainly focusing on global value chain governance and upgrading[17, 46], with a citation coverage of more than 5% of the cited literature revealing the diversity of themes in the frontier areas of global value chain sub-research: innovation and upgrading of emerging market firms[47], firm's response to global value chain positioning strategies[16], GVC resilience[48], etc.

3.3.4 Cluster #9 Cluster.

The number of members within the cluster is 14, silhouette with a great value of 1, because the dominant study has only one scholastic citation, namely the study of innovation promotion of airlines in European aviation industry clusters using qualitative comparative analysis[11]. The knowledge structure focuses on airline industry and cluster studies[49-51], firm innovation[50, 52] and institutional advantage[52, 53], where Breschi's study[54] on urban collaborative networks is associated with cluster #2 competitive advantage through Ye's paper[55] discussing the impact of local versus non-local industries on university performance.

In the light of the above analysis, we summarizes the research frontiers and basic knowledge with respect to the systematically extracted cited literature cluster names and cited literature subject terms as follows. a) Research on new development paths, competitive advantages, global value chains and clusters among the research frontiers are the emerging frontiers of attention in the GIN. b) The knowledge structure of GINs mainly consists of three levels in terms of spatial distribution, the global network level (global production networks, global innovation networks, global innovation systems, etc.), the regional innovation network level (regional diversification, cluster innovation, systems, etc.) and local-global networks (firms, global pipelines, locational choices, etc.). The literature that plays a key contribution to the research process mainly studies global production networks, global innovation systems, clusters and global pipelines, among other studies.

4 Conclusion

4.1 Discussion

This paper presents a scientometric study and visual analysis of the global innovation network and its related literature in the Web of Science core database. Firstly, a statistical descriptive analysis of the research data is conducted, including literature year graph, disciplinary category distribution and key literature presentation. The results show that the research intensity of GINs is increasing year by year, and the research disciplines show a interdisciplinary research scope, mainly focused on business and economics, while environmental sciences, engineering and communication are the core disciplines that take up interdisciplinary research.

Secondly, the evolution of research themes is sorted out, covering the hot topics, theme progress, research method innovation and dynamics of keyword emergence each year. The analysis of the evolution of nomenclature subject terms reveals a spiral development trend of concentration to expansion to focus of research scope in time and space. Based on the analysis of social networks, industrial and regional economic research methods are continuously incorporated. The main focus is on global innovation networks, regional studies and other prominent influential subject terms, and SMEs and foreign direct investment are the hot research topics in the past three years.

Finally, we identify the research frontier areas and their related knowledge structures based on clustering, and sort out the lineage between them, including the introduction of high-impact citations and highly cited literature in the research frontier areas. The co-citation analysis reveals that the knowledge structure of GINs, i.e., the cited literature research, has obvious spatial structural features, mainly at the global network level, regional innovation level and local-global

linkage level, based on which the four subfields of new development path, competitive advantage, global value chain and cluster research are the active frontiers in GIN research.

4.2 Suggestion

By analyzing and sorting out the status of GIN research, the following suggestions are made. Firstly, the existing related research involves hot social topics such as digital technology, big data, Covid-19, etc., and attention should be paid to the social timeliness of the theme evolution.

Secondly, strengthening the methods of interdisciplinary scope to complement the study of GINs, which are mostly business and economic studies. With the enrichment of interdisciplinary fields, methods such as psychology, sociology, and computer science should be considered for inclusion in the framework of GIN analysis.

Finally, path research, competitive advantage, global value chains and clusters are the hot frontiers in the field, especially the path research field, which is the largest subfield, still has room for in-depth research. The rich development of GVC research framework as an integral part of GIN analysis framework will also promote the development of global innovation networks.

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