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A comparative study of Chinese and foreign countries research on innovation ecosystems: Visual analysis based on CiteSpace

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Abstract
Purpose: This paper seeks to elucidate the current status of innovation ecosystem research in China and abroad, explore research hotspots and their dynamics, conduct a comparative analysis, and pinpoint issues and deficiencies. The ultimate goal is to provide a reference foundation for future research on innovation ecosystems.
Design/Methodology/Approach: Leveraging a literature review, this paper utilized CiteSpace version 6.1R3 for quantitative analysis and comparison of keyword sharing and hot word clustering. The data pool consisted of 833 papers from the CSSCI database and 511 papers from the Web of Science core collection. These datasets were employed to construct a knowledge map of collaborative innovation ecosystem research in China and abroad.
Findings: This study highlights the growing interest in innovation ecosystems research, noting a substantial discrepancy in cooperation levels between foreign and Chinese research institutions. The United States emerges as the leader in both quantity and influence in innovation ecosystems research. However, there is a notable lack of awareness and collaboration among Chinese scholars and institutions in this field. Urgent attention is needed to strengthen academic exchanges and cooperation.
Research limitations/implications: Data selection bias, limited comprehensiveness, and selection bias in studies can distort understanding of innovation ecosystems. Visualization tools, though intuitive, may not capture the complexity fully.
Practical implications: This research has practical implications for government policymakers, aiding in the formulation of innovation policies. It also opens doors for international collaboration and guides businesses in adjusting their innovation strategies globally. On a theoretical level, it contributes to the development of innovation ecosystem theory and introduces literature visualization methods using the CiteSpace tool.
Originality/value: Few scholars have explored the disparities between domestic and foreign innovation ecosystem research, lacking systematic comparative analyses. Notably, the reliance on subjective interpretation rather than scientifically measured tools is prevalent. This study

advocates for a more objective approach, employing quantitative research from a knowledge map perspective to accurately depict innovation ecosystem research trends and hotspots.

Key words：Innovation ecosystem,Knowledge mapping,CiteSpace

Introduction

Considering the rapid advancement of innovation networks, China's innovation paradigm has transitioned from innovation system 2.0 to innovation ecosystem 3.0, China's prospective global innovation leadership relies significantly on the evolution of competitive industrial innovation ecosystems(Pang,2022). As the innovation paradigm shifts from linear to nonlinear and from closed to synergistic, the study of innovation ecosystem research has gained prominence in both academia and practice (Xie et al., 2020).

Moore(1993) applied ecological theory to competitive strategy, introducing the term "enterprise ecosystem." He highlighted the co-evolution of firms within this ecosystem, emphasizing collaboration and competition for innovation, product development, and customer satisfaction. Adner(2006) further contends that innovation often results from collaborative networks and complementary partnerships, emphasizing the importance of working with others to create products that provide customer value.

Adner (2006) employs ecosystem theory to explore the intrinsic causes of rapid renewal of old and new technologies within the social context. Chen&Mei (2017) systematically delve into the origin, knowledge evolution, and theoretical framework of the innovation ecosystem theory using the scientometric method.ChenJian et al.(2016) categorize theoretical foundations related to innovation ecosystems, provide definitions, connections, and distinctions of relevant concepts, and outline the architecture and governance focus of four types of innovation ecosystems based on governance center characteristics.

Despite the abundance of Innovation Ecosystem studies, limitations persist. The existing research often relies on qualitative analyses conducted in a fragmented manner, lacking a comprehensive and systematic body of work(Xie et al., 2020). Additionally, scant attention has been given to differentiating domestic and foreign innovation ecosystem research, with subjective interpretations prevailing and limited use of scientometric tools for objective analysis (He & Chen, 2022).

This paper employs knowledge mapping in quantitative research to objectively delineate research trends and hotspots within the innovation ecosystem. Using bibliometric software Citespace, a comparative analysis of innovation ecosystems in China and abroad is conducted for the period 2006-2021, aiming to highlight differences and similarities. The study not only visually analyzes the gathered data but also, in conjunction with retrieved literature, examines the status, hotspots, and frontier development of the field. (He&Chen, 2022).This effort is crucial for advancing theoretical and practical aspects of innovation development, offering new insights and methodologies for China's innovation research and development practices. Through comparative analysis, this paper finds out the differences between domestic and foreign innovation ecology research and points out the direction for innovation ecology development.

Theoretical background

1.The Structure of Scientific Revolutions

The origin of CiteSpace software is rooted in the structure of scientific revolutions in bibliometrics (Kuhn, 1962). Scientific progress unfolds through a continuous process of revolutions, where new perspectives replace old ones, leading to the rise and fall of scientific paradigms. CiteSpace reflects this through clustering across different time periods.

2.Structural Holes

This theory stems from Granovetter's (1973) concept of the "strength of weak ties." Building on this, Burt (1992) introduced structural holes, positing that individuals in such positions gain competitive advantages and innovative capabilities through information filtering. In CiteSpace, structural holes and turning points are measured using node intermediary centrality (Brandes U, 2001). Burt (2003) suggests that one's position in a social network relates to the quality of their opinions, echoed in CiteSpace's focus on highly mediated centrality.

3.Information Foraging Theory

This theory likens information searching to the way humans and animals seek food, emphasizing energy minimization. Chen et al. (2015) integrate optimal information foraging theory and Hidden Markov Models to propose an integrated visual navigation strategy for maximizing benefits with minimal search costs.

4.Map of Scientific Knowledge

Knowledge mapping, a recent addition to science metrology, integrates applied math, the science of information, and computer science. Based on science extraction, Chen (2003) emphasizes the visual reorganization of knowledge from extensive scientific research materials as the goal of mapping and assessing scientific knowledge.

Through these theories, CiteSpace, evolving within the context of scientometrics, data, and information visualization, serves as citation visualization and analysis software. As it visually presents the structure, laws, and distribution of scientific knowledge, the resulting visual graphs are termed "Mapping Knowledge Domains" (MKD).Continuously updated, CiteSpace not only facilitates citation space mining but also conducts co-occurrence analyses between various knowledge units,such as authors,institutions, national/regional collaborations, and so on.(Chen, 2006).This paper visualizes the data analysis tool CiteSpace, through the analysis of annual literature, core authors and important institutional cooperation networks, key co-occurrence analysis, we conducted a literature review and comparative study of China and foreign abroad innovation ecosystems. as in Figure 1.

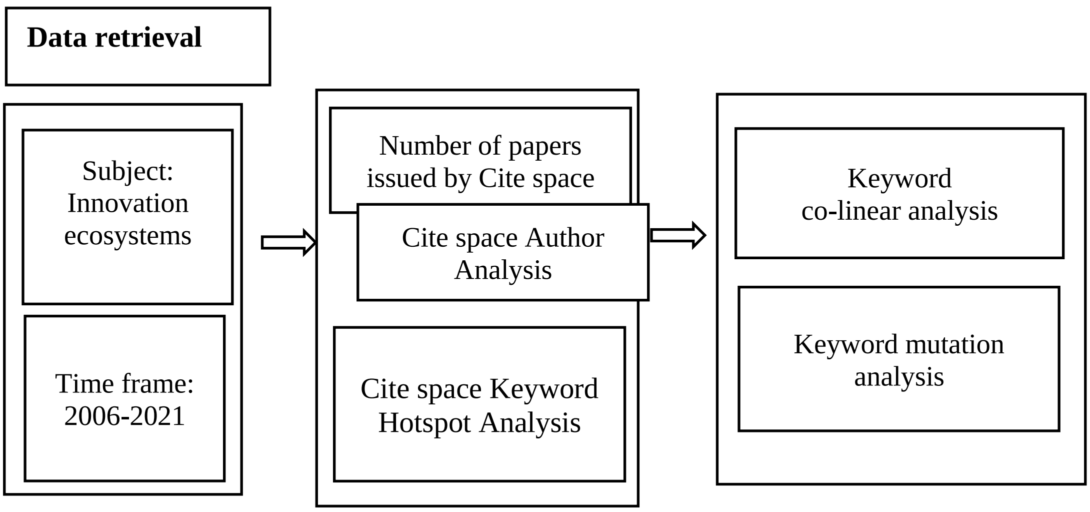

Figure 1: Research Framework

Methods

1.CiteSpace

Knowledge-domain visualization can be effectively achieved through the Java application CiteSpace (Fang et al., 2017). Unlike its predecessors, CiteSpace, as highlighted by Chen (2004), successfully tackles various challenges, including the improvement of network transitions and enhancing overall clarity.

Developed using the Java language, CiteSpace serves as an information visualization software capable of assessing a collection of literature within a specific field. This allows for the exploration of critical paths in the evolution of the subject area, enabling a comprehensive analysis of the discipline's development and frontiers through the creation of visual maps (Chen et al., 2015).

2.Network Types in CiteSpace

Among the node types, Author, Institute, and Country are used for Co-authorship analysis, and the difference between them is simply due to the different subject granularity in analyzing the cooperation (which can be understood as micro, meso, and macro cooperation, respectively) (Jie Li & Chaomei Chen, 2016). Among the various graphs generated using CiteSpace, the size of the nodes in the author's collaboration graph indicates the number of papers published by the author, institution, or country/region, and the connecting line between them reflects the strength of the collaboration. The size of the nodes in the network mapping of topics, keywords, and scientific categories of papers represents the frequency of their appearances, and the connecting lines between them indicate the strength of co-occurrence. The size of the nodes in the co-citation analysis mapping reflects the number of citations. The co-citation of literature reflects the number of citations of individual literature, the co-citation network of authors reflects the number of times authors have been cited, the size of nodes in the co-citation network of journals reflects the number of times journals have been cited, and the connecting line between them reflects the intensity of co-citation. In the literature coupling network, a node represents a paper, the size of the nodes is the same, and the connecting line between the nodes reflects the coupling strength (Chenchaomei, 2018).

3.Calculation of relationship strength in CiteSpace

Links parameter is mainly used to select the calculation of the association strength of the network nodes (in the process of processing can often be regarded as the process of normalization of the co-occurrence matrix) (Jie Li & Chaomei Chen, 2016), in this paper, the chosen method for calculating the strength of the connections in the network is Cosine, and the strength of the connection is calculated as follows:

Cosine algorithm:

$$\text{Cosine}\ (C_{ij}, S_i, S_j) = \frac{Cij}{\sqrt{SiSj}}$$

4.Co-Citation Analysis

Co-citation, as defined by Liu et al. (2017), refers to the frequent joint quoting of two older pieces of writing in later literature. This concept helps elucidate connections among different analytical elements such as references, journals, and cited writers. The conceptual scientific framework for co-citation patterns, as observed over time by Fang et al. (2019), indicates the mechanism of specialized development.

5. Co-Occurrence Analysis of Keywords

The essence of the subject and literature lies in keywords. Keywords co-occurrence analytics helps identify popular subjects and evolving research areas over time (Yang et al., 2019). In this study, we use frequency and centrality sorting to analyze the key points and hotspots of the innovation ecosystem. Through keyword co-occurrence clustering, we deepen relationships and compute a closely-knit set of keywords, forming thematic clusters with multiple word groups (Shi Jingmin & Li Jian, 2019).

Through comparative analysis, this paper highlights distinctions between China and international innovation ecosystem research, providing insights into the direction for innovation ecosystem development.

6.Data sources

To ensure the credibility and persuasiveness of the collected data, we meticulously curated international literature from the "Web of Science Core Collection" (WOSCC) using the "Web of Science" database search interface. Focused on the subject term "innovation ecosystem," we obtained a total of 511 papers. Simultaneously, Chinese literature was sourced from the China Knowledge Network (CNKI) and CSSCI indexed journals, utilizing the same subject term and specifying document types as "paper" with "precise matching." This yielded a total of 833 papers. The subsequent refinement involved excluding duplicate publications, book reviews, conference abstracts, and any irrelevant papers, resulting in a comprehensive dataset.

Findings

1.Analysis of Trends in Domestic and International Literature on Innovation Ecosystem Research

In Figure2, the total publications in innovation ecosystem research have exhibited a consistent year-on-year growth. From 2006 to 2012, both China and other countries experienced the initial phase of innovation ecosystem development. Subsequently, from 2013 to 2120, scholars globally, particularly in China, entered a rapid expansion phase in innovation ecosystem research. The core literature has witnessed a notable surge, with Chinese publications increasing by 126 papers, surpassing the growth rate of foreign counterparts. This acceleration aligns with China's initiation of the innovation-driven development strategy and the robust implementation of policies such as "mass entrepreneurship and innovation for all" and the "plan to improve the innovation capacity of higher education institutions." Notably, cases like Huawei, Alibaba, and high-speed rail exemplify industries establishing innovation ecosystems with themselves as the core, as confirmed in the case of Huawei by Zhang Gui et al. (2018). This sparked a peak in domestic innovation research, with foreign publications surpassing those in China from 2019 to 2021.

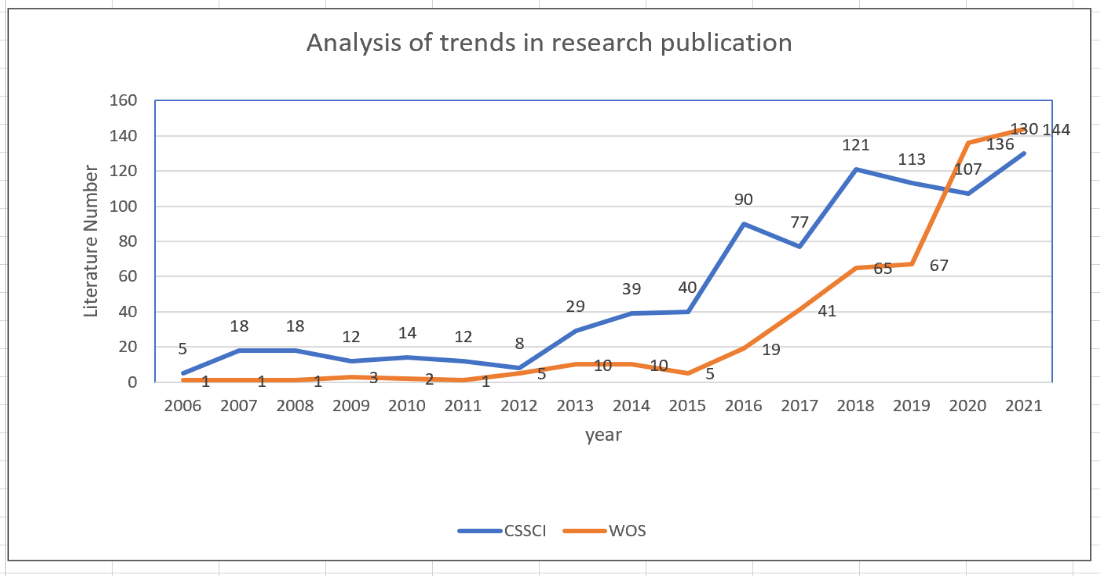

Figure 2 Annual distribution of innovation ecosystem literature in China and abroad

2.Comparative analysis of core author groups of innovation ecosystems at China and abroad

Author co-located knowledge networks in China's innovation ecosystem domains in Fig.3 illustrates that scholars with the highest node counts include Zhang Yunsheng, Zhang Gui, Liu Gang, and Liu Shulin, with Zhang Yunsheng leading the ranking. Notably, the figure indicates that certain prolific authors engage in limited collaboration, particularly evident in academic interactions among Zhang Yunsheng, Zhang Lifei, and Zeng Deming, while collaboration with other high-volume authors (such as Liu Gang, Liu Shulin, etc.) is limited. Conversely, some scholars, such as Song Juan, Ma Zongguo, Liu Jia, exhibit more individual nodes. This suggests a lack of communication and collaboration awareness among Chinese scholars in the innovation ecosystem research, emphasizing the urgent need to strengthen academic exchange and cooperation.

The Common Thread Knowledge Network mapping in Fig. 4 illustrates prominent foreign authors in the innovation ecosystem, with CARAYANNIS EG, WANG H, and WU J emerging as the most influential scholars. Comparing core author groups in domestic and foreign innovation ecosystems, foreign network density stands at 0.0064, surpassing China's 0.0029. This suggests a more tightly knit exchange among foreign authors, exemplified by higher centrality in the sub-network structures of ERWIN DH, JOHNSTON DT, DARROCH SAF, and seven others, as compared to Chinese authors' network structure.

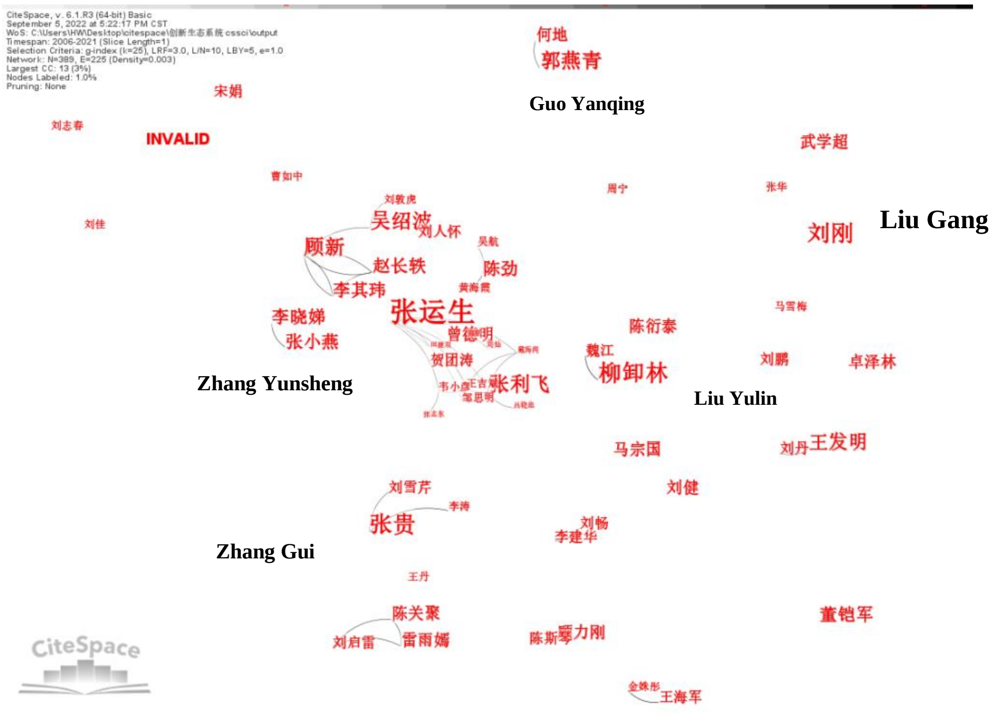

Figure 3. Mapping of author co-located knowledge networks in China's innovation ecosystem domains

3.Comparative analysis of domestic and foreign innovation ecosystem high-yield organizations

Run Cite Space, configuring the node type as institution, and maintaining identical setup parameters to authors, yielded a knowledge network mapping of Chinese innovation ecosystem institutions. The resulting map comprises 308 nodes, 134 connecting lines, and exhibits a density of 0.0028 (refer to Fig.5). Notably, leading contributors in this field include the School of Economics and Management at Tsinghua University and the School of Business Administration at Hunan University.

In comparing highly productive institutions in innovation ecosystems between China and abroad, foreign network density (0.0069) surpasses domestic network density (0.0028). Figure 6 shows significant differences in collaboration between foreign and Chinese research institutions. Stanford University leads a sub-network with the strongest international collaboration. Notably, Tsinghua University, the University of São Paulo and the University of Cambridge demonstrate strong academic capabilities on a global scale. The United States dominates innovation ecosystem research, with Stanford, George Washington University and Northwestern University ranking in the top ten for centrality. As shown in Figure 6, major alliances are centered on collaborations between North America and Asia, between Europe and Asia, and between North America and Europe, while strong alliances have yet to be formed within Asia. China's collaboration with the world's top universities is particularly strong in high-tech industries and innovation ecosystems.

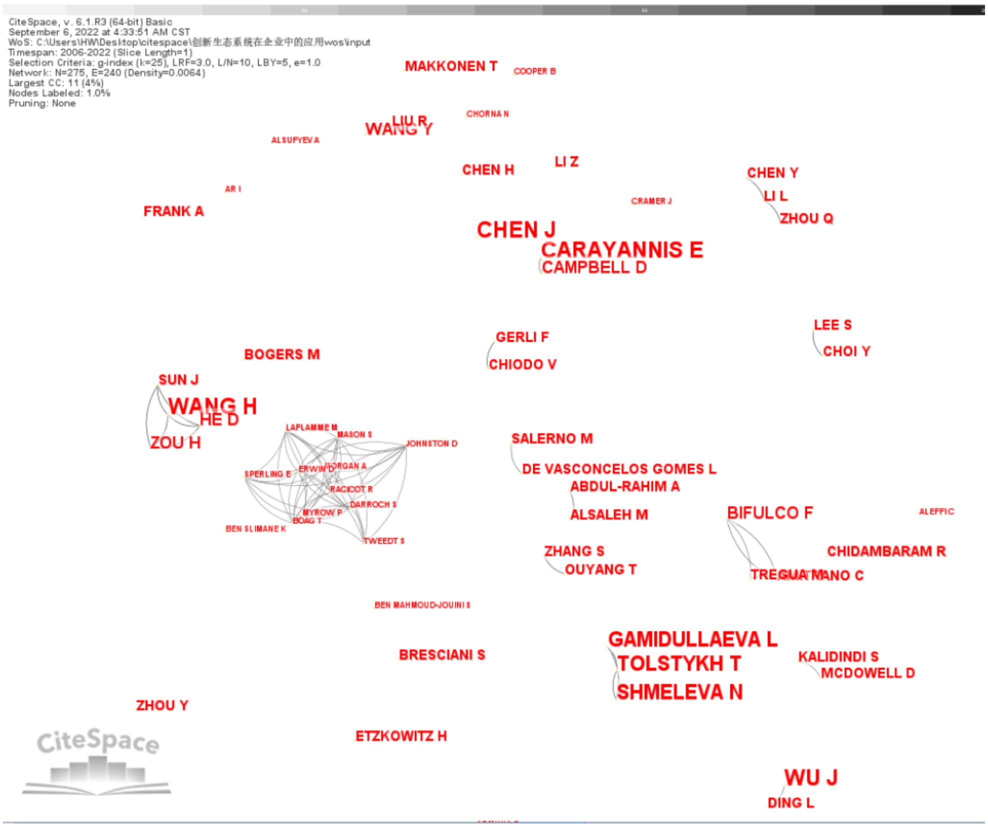

Figure 4. Mapping of common thread knowledge networks of authors in foreign innovation ecosystem domains

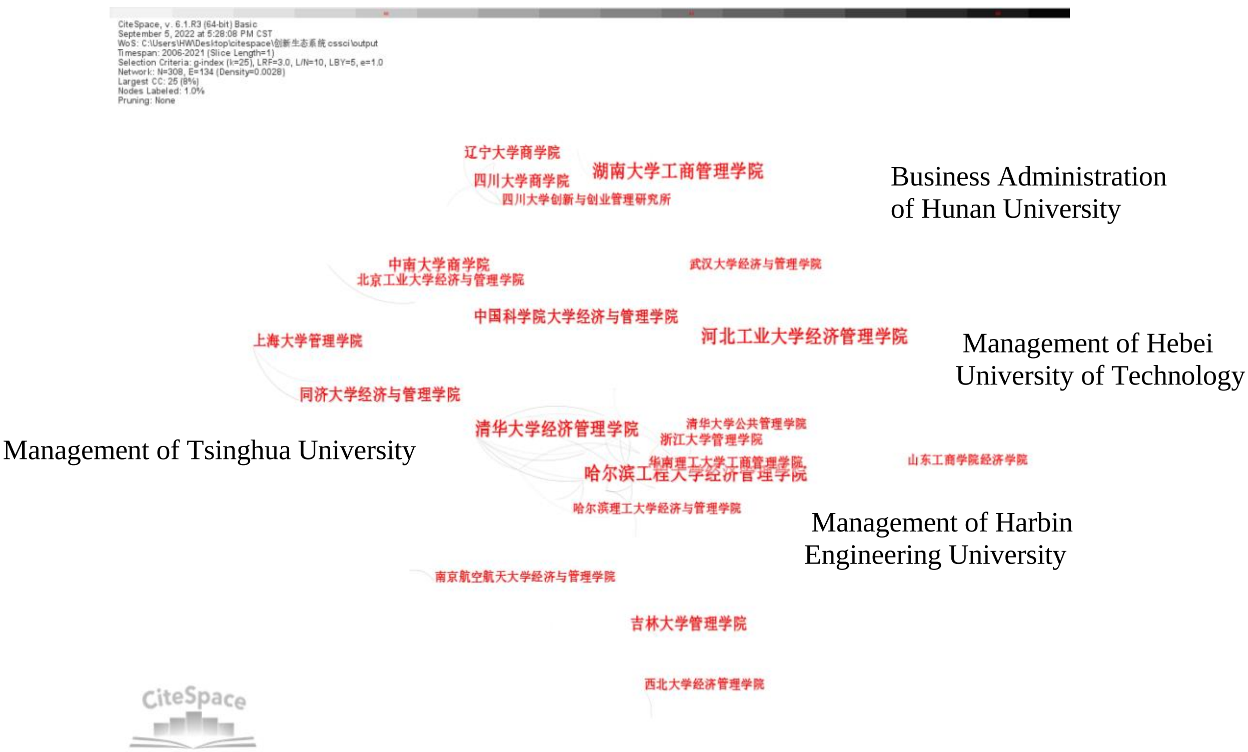

Figure 5. Mapping of institutional co-located knowledge networks in China's innovation ecosystem domains

The preceding analysis indicates that the formation and growth of high-tech enterprises are significantly influenced by conversations and partnerships within the innovation ecosystem. High-tech firms like Huawei and Alibaba are frequently founded because of innovative conversations. Research indicates that these companies' success is largely dependent on the active exchange of ideas and cooperation within the innovation ecosystem. Through significant R&D expenditures and collaborations with academic institutions, these businesses further foster innovation. This mutually beneficial partnership helps the companies both directly through innovation talks and indirectly by ongoing investments in innovation and strategic alliances that support the growth of the entire ecosystem.

A portion of the success of businesses like Alibaba and Huawei can be ascribed to their proactive involvement in innovation research and conversations. They receive technical and strategic help from these conversations, which enables them to take the lead in the industry.

Enhancing communication between institutions is also hampered by impediments such as cultural differences, intellectual property issues, and resource inequality, which impede innovative collaboration .Scholars have argued that differences in academic expectations and research methodologies can lead to misunderstandings and misalignment of goals, which impede effective collaboration (Chen, Tjosvold, & Su, 2005); the reluctance of organizations to share information due to intellectual property rights (IPR) issues triggers mutual mistrust (Wang et al., 2019); and inequalities in resources, funding, professionals, and technologies make it and technology make it difficult for organizations to cooperate on an equal and mutually beneficial basis (Wang et al., 2019), all of which are reasons that impede innovation collaboration .

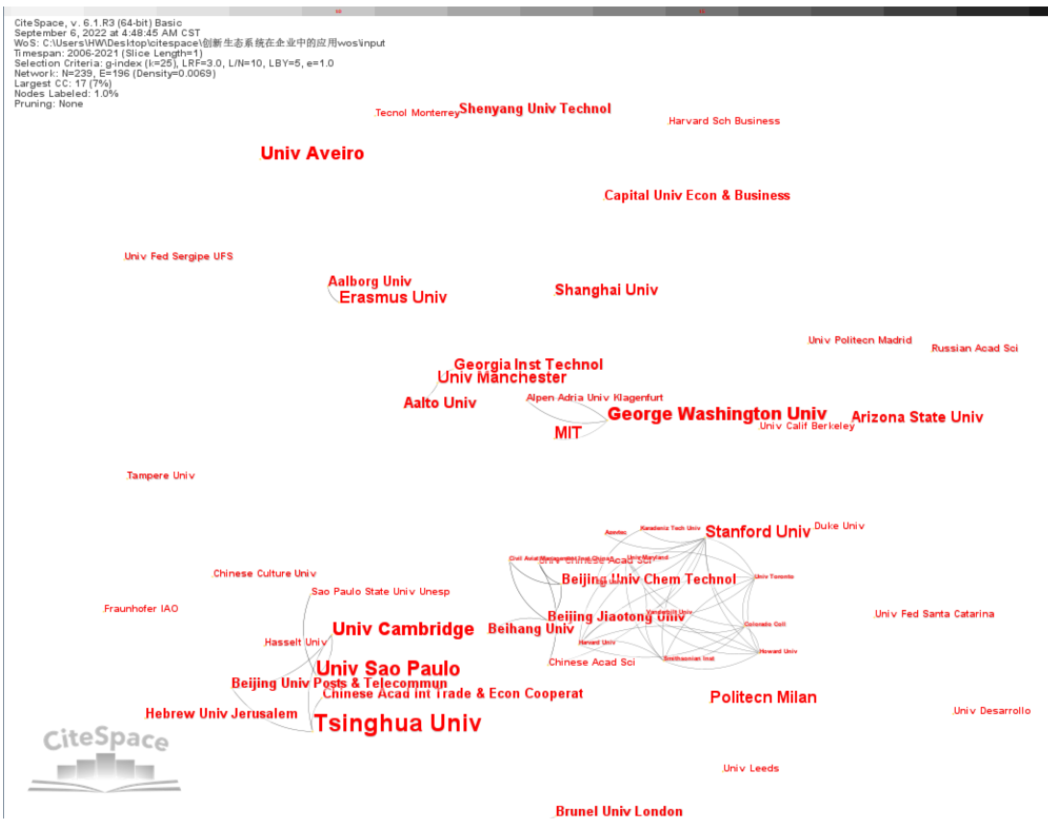

Figure 6. Mapping of common thread knowledge networks of institutions in foreign innovation ecosystem areas

4.Comparative analysis of domestic and foreign innovation ecosystem research characterization areas

This paper conducts a comprehensive analysis of innovation ecosystem research in China and abroad, utilizing keyword clustering. The results reveal distinct hot topics in each region. In China, the focus is on Ecosystem, Technological innovation, Innovation chain, Industrial chain, and Industrial innovation. Conversely, foreign research emphasizes Social innovation ecosystem, Case study, Knowledge economy, Higher education, and Innovation systems. China's research primarily centers on innovation ecosystem theory, evolution models, open innovation, symbiotic evolution, technological innovation, and business models. Notably, technological innovation remains a key focus, particularly in emerging industries, university discipline construction, and industrial clusters. Foreign scholars, having delved into innovation ecosystem research earlier, concentrate on foundational theoretical aspects at the micro level. Their attention extends to areas like the "digital innovation ecosystem" and constructing innovation ecosystems centered on pharmaceutical R&D and biopharma.

Table 1 Clustering table of domestic keyword covariance networks

Cluster	Size	Top Term (log-likelihood ratio p-level)
0	40	Ecosystem (Ecosystem); Technological innovation (Technological innovation); Innovation chain (Innovation chain); Industrial chain (Industrial chain); Industrial innovation (Industrial innovation)
1	27	Industrial clusters; Collaborative innovation; Institutional environment; Innovation networks; Innovation clusters Innovation clusters)
2	25	Technological innovation (Technological innovation); Ecological niche (Ecological niche); Case study (Case study); Ecology (Ecology); Evolution (Evolution)
3	22	Innovation driven); Innovation ecology (Innovation ecology); Innovation systems (Innovation systems); Interactivity (Interactivity); Subject interaction (Subject interaction)
4	21	Innovation and entrepreneurship (创新和 entrepreneurship); Value co-creation (價值共创ation); Business models (商务模式); Universities (高校); Literature measurement (文献计量)
5	19	Knowledge innovation (Knowledge innovation); Knowledge management (Knowledge management); Information ecology (Information ecology); Knowledge innovation mechanisms (Knowledge innovation mechanisms); Libraries (Libraries)
6	19	Innovation; Theory Evolution; Innovation Paradigm; Systematic Review; Innovation and Entrepreneurship
7	15	Platform (Platform); Technology standard (Technology standard); Economic evolution (Economic evolution); Cyberspace (Cyberspace); Resource allocation method (Resource allocation method)
8	8	Beijing-Tianjin-Hebei (京津冀) ; Innovation main body (创新主体) ; Innovation path (创新路径) ; Talent allocation (人才配置) ; Corporate environment (企业环境)
9	7	Core firms (核心企业) ; Innovation performance (创新业绩); Innovation challenges (创新挑战); Corporate technology innovation ecosystem (企業技术创新生态系统) ; Knowledge advantage (Knowledge advantage)
15	4	Stability; Industrial technology; Balance; Coupling strategies; Innovation ecosystem
16	4	Simulation; Symbiotic evolution; Value evolution; Knowledge flow; Symbiosis model)
26	3	spatio-temporal characteristics; symbiotic platforms; topsis ecological niche assessment projection model; symbiotic networks; symbiosis; and the use of the symbiosis model. (symbiotic networks; symbiosis

Table 2 Clustering table of foreign keyword covariance networks

Cluster	Top Term (log-likelihood ratio p-level)
0	social innovation ecosystem (11.01, 0.001); case study (7.74, 0.01); knowledge economy (7.33, 0.01); higher education (7.33, 0.01); innovation systems (4.97, 0.05); case study (7.74, 0.01); knowledge economy (7.33, 0.01)
1	open innovation ecosystem (12.79, 0.001); global competitiveness (8.76, 0.005); evolutionary game (8.76, 0.005); technological innovation (5.55, 0.05); product innovation (5.18, 0.05); and innovation (5.18, 0.05). 0.05); product innovation (5.18, 0.05)
2	pharmaceutical r&d (9.61, 0.005); innovation policy (8.08, 0.005); knowledge integration (4.8, 0.05); diy laboratory (4.8, 0.05); network (4.8, 0.05); diy laboratory (4.8, 0.05); network structure (4.8, 0.05)
3	smart city (22.93, 1.0E-4); smart cities (10.94, 0.001); internet of things (9.97, 0.005); industry 4.0 (7.25, 0.01); genetic algorithm (5.46, 0.05)
4	business ecosystem (13.42, 0.001); coopetition (11.07, 0.001); digital innovation (7.37, 0.01); new ventures (7.37, 0.01); bibliometric analysis (7.37, 0.01)
5	open innovation (10.04, 0.005); innovation ecosystem (8.98, 0.005); information technology (6.5, 0.05); standardization (6.5, 0.05); system (6.5, 0.05); standardization (6.5, 0.05); system dynamics (6.5, 0.05)
6	innovation management (10.44, 0.005); innovation networks (8.37, 0.005); biopharma (5.21, 0.05); public policy (5.21, 0.05); regional community (5.21, 0.05); regional community (5.21, 0.05)
7	microstructure (16.34, 1.0E-4); combinatorial (8.14, 0.005); ecosystem engineers (8.14, 0.005); kernel (8.14, 0.005); organizational ecology (8.14, 0.005)
8	Open innovation (14.67, 0.001); academic firm (5.68, 0.05); technology licensing (5.68, 0.05); value chain disaggregation (4.64, 0.05); role (4.64, 0.05) 0.05)
9	grassroots innovations (14.86, 0.001); portfolio of choices (7.41, 0.01); accelerators performance measurement (7.41, 0.01); human capital (7.41, 0.01); procter (7.41, 0.01); and 0.01); procter (7.41, 0.01)

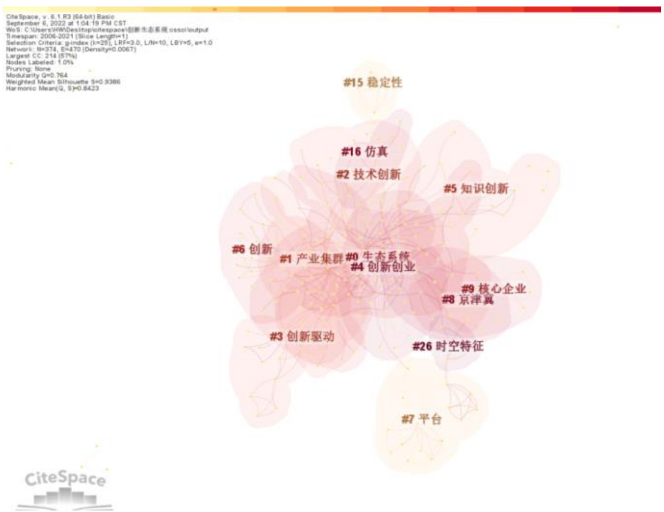

Fig. 7 Co-occurrence mapping of keywords of CSSCI-recorded innovation ecosystem studies
Note: #0 Ecosystem;#1 Industry Clusters;#2 Technology Innovation;#3 Innovation -Driven;#4 Innovation and Entrepreneurship;#5 KnowledgeInnovation;#6Innovation;#7platform;#8Beijing-Tianjin-Hebei;#26Spatio-temporal characteristics

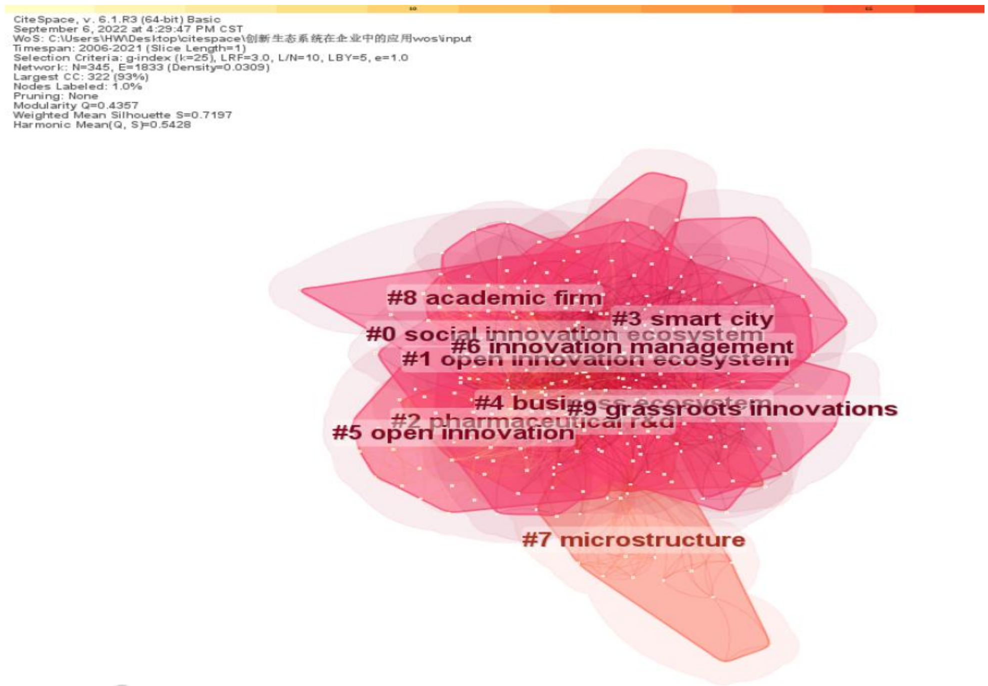

Fig.8 Co-occurrence map of keywords for innovation ecosystem research included in the core ction

China's major innovation ecosystem research areas include ecosystems, industrial clusters and technological innovation, with Tsinghua University, Hunan University, Harbin Engineering University and Hebei University of Technology as the main research universities, which are committed to constructing and optimizing innovation ecosystem models, researching the formation mechanism of industrial clusters, and researching technological innovation. The main innovation ecosystem research areas abroad focus on social innovation ecosystems, pharmaceutical R&D and open innovation ecosystems, etc. Stanford University, George Washington University and Northwestern University have made important contributions in these areas, playing a key role in the implementation of social innovation, the promotion of pharmaceutical R&D and the establishment of open innovation ecosystems, respectively. The research of these universities has provided important theoretical support and practical experience for the development of global innovation ecosystems.

5.Discussion and Conclusion

Firstly, examining the current landscape of innovation ecosystem literature both in China and internationally, there has been a notable surge in publication volume since 2013. This upward trend underscores the increasing attention garnered by innovation ecosystem research.
Secondly, there is a significant disparity in the level of collaboration between foreign and Chinese research institutions when considering the issuing organizations. Notably, the United States stands out as the leading country in both research quantity and influence on innovation ecosystems. Encouraging international academic exchanges can enhance the collaboration among research institutions worldwide . Enhancing communication between institutions is also hampered by impediments such as cultural differences, intellectual property issues, and resource inequality, which impede innovative collaboration .

Thirdly, delving into core authors, it's evident that Chinese scholars lack awareness of effective communication and cooperation in innovation ecosystem research. Urgent steps are needed to fortify academic exchanges and cooperation among Chinese scholars. A comparison of core authors in the field reveals more cohesive communication among foreign authors, emphasizing the necessity for enhanced interaction among Chinese authors.

Fourthly, major alliances are centered on collaborations between North America and Asia, between Europe and Asia, and between North America and Europe, while strong alliances have yet to be formed within Asia.

with a focus on research hotspots and trends, China's innovation ecosystem research should accentuate the exploration of micro-level innovation ecosystems. Additionally, emphasis on constructing "digital innovation ecosystems" and those centered around pharmaceutical R&D and biopharma can further enrich the research landscape.

Fifthly, from a theoretical standpoint, while existing research on innovation ecosystems predominantly revolves around concepts, characteristics, and case descriptions, there's a pressing need to delve into mature concepts. Exploring the principles, mechanisms, and organizational functioning of innovation ecosystems from a theoretical logical perspective will provide a deeper understanding of the phenomena at play.

Theoretical Implications

1.Development of Ecosystem Theory: The comparative analysis may provide new perspectives and directions for the development of innovation ecosystem theory.

2.Literature Visualization Methods: The use of the CiteSpace tool in the study might contribute to the application of literature visualization methods in innovation ecosystem research.

Practical and Social Implications

1.Policy Formulation and Implementation: The research may serve as a reference for government policymakers in formulating and adjusting innovation policies to foster the development of innovation ecosystems.

2.International Collaboration Opportunities: By identifying gaps and opportunities between Chinese and foreign innovation ecosystems, the study can lay the foundation for international collaboration.

3.Corporate Strategic Planning: Businesses can adjust their innovation strategies based on the research results to adapt to the diverse innovation environments in different countries.

Limitations and Suggestions for Future Research

Data Selection Bias: If the data chosen in the study is not comprehensive or exhibits selection bias, it may lead to an inaccurate understanding of the true state of innovation ecosystems.

Methodological Limitations: While literature visualization tools provide intuitive analysis results, they may not fully explore the complexity of innovation ecosystems.

Timeliness: The rapid development in the innovation field might limit the timeliness of the research, requiring periodic updates of conclusions in the future.

In summary, this study provides valuable insights into understanding Chinese and foreign innovation ecosystems, but caution is advised in interpreting and applying the research results due to its limitations.

Suggestions for Future Research : Subsequent investigations ought to concentrate on transnational cooperation, the amalgamation of cutting-edge technologies (like blockchain and artificial intelligence), and environmentally conscious innovation methodologies. These paths will contribute to the development of more robust and flexible worldwide innovation ecosystems.

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