Analysis on Research Hotspots and Evolutionary Context of Economic Development Based on CiteSpace

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ABSTRACT

This article focuses on 2,768 SCI and SSCI journal articles in the field of economic development from 1998 to 2020 in the core database of WOS (Web of Science). By combining scientific econometric methods and visual analysis, it systematically reviews the research evolution, research frontiers, and research hotspots in the field of WOS economic development, including publication volume statistics, institutional cooperation distribution, author cooperation characteristics, hot topic keywords, and evolution analysis of hot research topics. Research has shown that, firstly, research in the field of WOS economic development can be roughly divided into three stages of evolution: The first stage (1998-2007) focused on research content and themes such as international economic and trade, regional economic development, and sustainable global economic development; In the second stage (2007-2016), research content and themes included economic development and ecological protection, economic development and urban construction, economic development and information technology, etc.; The third stage (2017-2020) focused on the research content and themes of economic development transformation and upgrading, as well as digital economic development, closely following the global era background; secondly, a number of closely cooperated colleges and universities and research institutions have formed, and the Chinese Academy of Social Sciences occupied the core position in this field with the number of papers ranked first. The author cooperation is relatively close and has not yet formed a stable core author group; thirdly, keywords such as "economic development", "economic growth", "financial development", "energy consumption", and "co2 emission" occupied an important position in the co-occurrence network of WOS economic development research. The research theme "low-carbon economy" represented by keywords such as "social economic development" and "carbon emission" has become an emerging research hotspot.

Keywords: *Economic development, WOS, Knowledge graph, Research evolution, Keywords.*

1. INTRODUCTION

Development is a major issue facing all mankind, and economic development is a key issue that countries around the world focus on. The global outbreak of COVID-19 in 2019 has had a great impact on economies around the world. In order to mitigate the impact of occasional major crises on economic development, profound adjustments are urgently needed in the global value chain and world trade pattern. Since the reform and opening up, China's economic development has made remarkable achievements in the world. The 20th National Congress of the Communist Party of China proposed that the primary task of building a socialist modern country in an all-round way is high-quality development. In the face of the impact of the COVID-19 pandemic, although the national economy has been affected, it has consolidated the trend of stabilizing and improving through robustness measures. Economic development is a research hotspot that both Chinese and foreign government agencies and academia are concerned about. To this end, based on the current international situation, the researchers should conduct scientific quantitative analysis and visualization research on the economic development research journal literature included in the WOS core database, and should deeply explore

the hot topics and evolutionary trends of global economic development research. By systematically analyzing the literature characteristics of WOS economic development research, the researchers can identify cutting-edge hotspots represented by hot keywords and emerging words, outline the evolution of research hotspots in the field, and clarify the current status of global economic development research, which helps to deepen the research on economic globalization and provides valuable reference significance for the development of China's economic construction.

2. LITERATURE FEATURE ANALYSIS

To systematically analyze and grasp the research status and progress of the academic community in the field of WOS economic development, based on the Web of Science database, SSCI source journals and SCI source journals from 1998 to 2020 are selected as research samples. In advanced search, relevant literature is searched by title = "economic development" and "high quality economic development", resulting in 2,768 articles.

2.1 Number of Publications Statistics

The number of annual publications is an important indicator for measuring the research heat and development trend of academic issues related to economic development. From 1998 to 2020, the overall publication volume of international economic development research in the core journal database of WOS showed a stable upward trend (see "Figure 1").

According to "Figure 1", it can be seen that the publication volume of journals related to economic development in the WOS core database shows a trend of "slow fluctuation rise - severe fluctuation rise". Among them, the period from 1998 to 2016 was a period of slow fluctuation and increase, with an average annual publication volume of over 71 articles. From 1998 to 2010, the publication volume increased in an orderly manner, and decreased slightly in 2011. However, from 2012 to 2016, the publication volume basically reached the level of 100 articles per year; The period from 2017 to 2020 was a period of sharp fluctuations and upward trend, with an average annual publication volume rapidly increasing to over 330 articles. In 2017, the publication volume increased significantly, but slightly decreased in 2018. From 2019 to 2020, it maintained a relatively high increase and reached a peak of 413 articles per year. "Figure 1" shows that economic development research has received explosive attention in the academic community since 2017. Based on the current growth trend of the number of publications in the field, it can be inferred that the number of publications in the field of economic development research will still maintain a high level in the future.
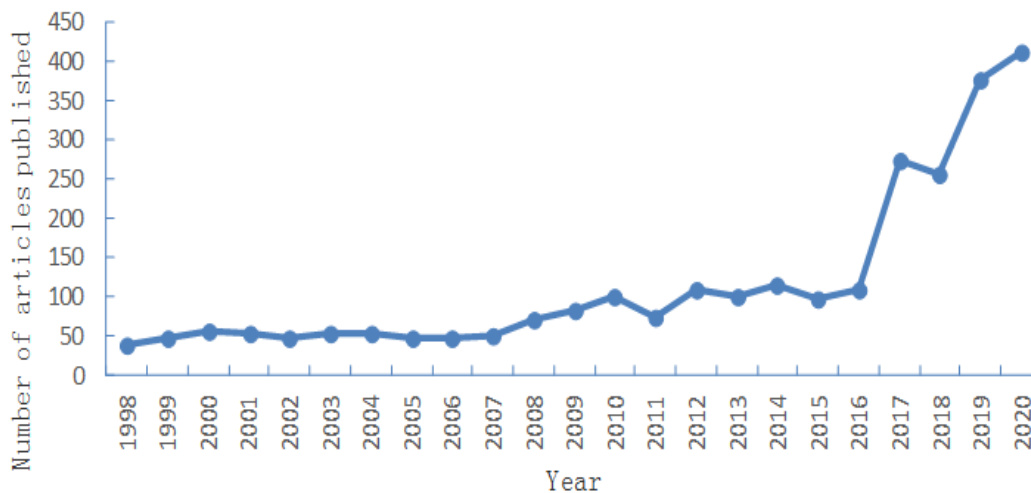

Figure 1 Number of core library publications in the field of WOS economic development research.

2.2 Institutional Cooperation Distribution

By using CiteSpace visualization analysis software, the top ten institutions in terms of

publication volume can be obtained (see "Table 1") and the network graph of institutional cooperation (see "Figure 2").

It can be seen from "Table 1" that the number of papers issued by the Chinese Academy of Social

Sciences in the field of economic development research in WOS is second to none, with a total of 41 papers issued from 1998 to 2020. Secondly, University of Science and Technology Beijing ranks second with 26 articles published.

Table 1. Top 10 institutions with the highest number of publications from 1998 to 2020

Serial number	Unit name	Number of articles published	Serial number	Unit name	Number of articles published
1	Chinese Acad Sci	41	6	Australian Natl Univ	13
2	Beijing Inst Technol	26	7	Univ Illinois	13
3	Univ Chinese Acad Sci	18	8	Michigan State Univ	12
4	Russian Acad Sci	16	9	Univ Malaya	12
5	Univ Manchester	14	10	Harvard Univ	12

In "Figure 2", there is a positive correlation between the size of institutional fonts and their publication volume. The thickness of the connecting lines reflects the tightness of cooperation between different institutions, while the thicker the connecting lines, the closer the cooperation. According to "Figure 2", the organization with the largest number of papers in the field of economic development research in the WOS core database and a core representative position is the Chinese Academy of Social Sciences. At the same time, the University of Science and Technology Beijing, the University of the Chinese Academy of Social Sciences, the Russian Academy of Sciences, the University of Manchester, the

Australian National University and other representative institutions have become sub core institutions. In addition, a number of closely cooperated universities and research institutions have formed in this field, such as the Chinese Academy of Social Sciences - University of Science and Technology Beijing - University of Chinese Academy of Social Sciences, Renmin University of China - Russian Academy of Sciences, Harvard University - University of Manchester, Michigan State University - Brunel University London, Australian National University - Monash University, among which the Chinese Academy of Social Sciences is the center of the largest institutional cooperation group.
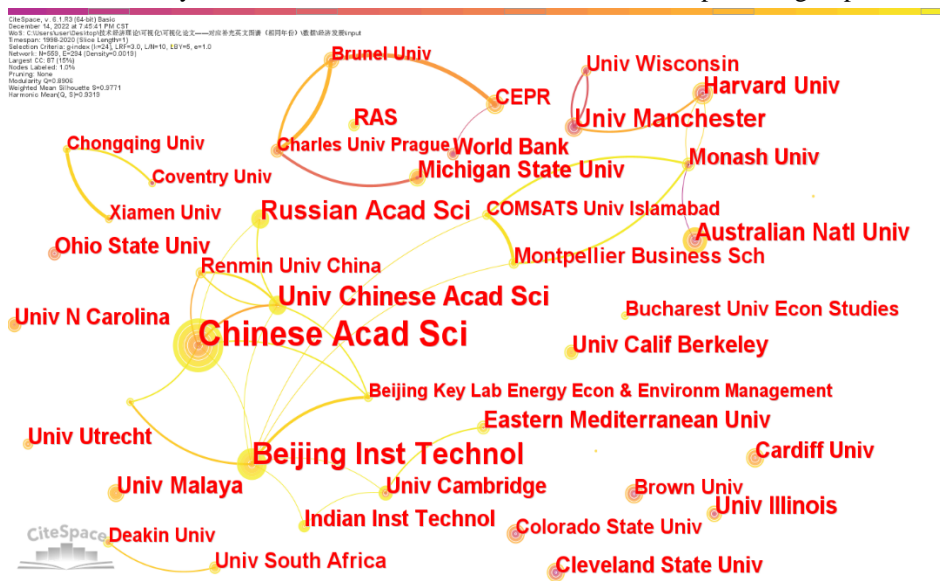

Figure 2 Organizational cooperation network in the field of WOS economic development research.

2.3 Author Collaboration Characteristics

The cooperation relationship and degree between authors directly reflect the academic sharing situation in the field of economic development research, and the diffusion of academic achievements by high-impact author cooperation groups is easier [1]. By using CiteSpace visualization analysis software, the author collaboration network in this field from 1998 to 2020 can be obtained (see "Figure 3"). In "Figure 3", the larger the node, the higher the influence of the author in the field, and the connection represents the cooperative relationship between authors. The tightness of author cooperation is positively correlated with the thickness of the connection. According to "Figure 3", it can be seen that the collaboration among authors in this field is not close, and the distribution of authors is relatively scattered. There are also some academic collaborative teams, such as Muazu Ibrahim - Paul Alagide, Simon Jenniches - Ernst Worrell, Gulsara A. Junusbekova Svetlana O. Mukhametzhan, Krishna Reddy Chittedi - Chandrashekar Raghutla, and other academic groups that collaborate with three or more authors, including Mak Arvin Rudra Prakash Pradhan - Bennett Sara E and a multi scholar collaborative team centered around Muhammad Shahbaz.
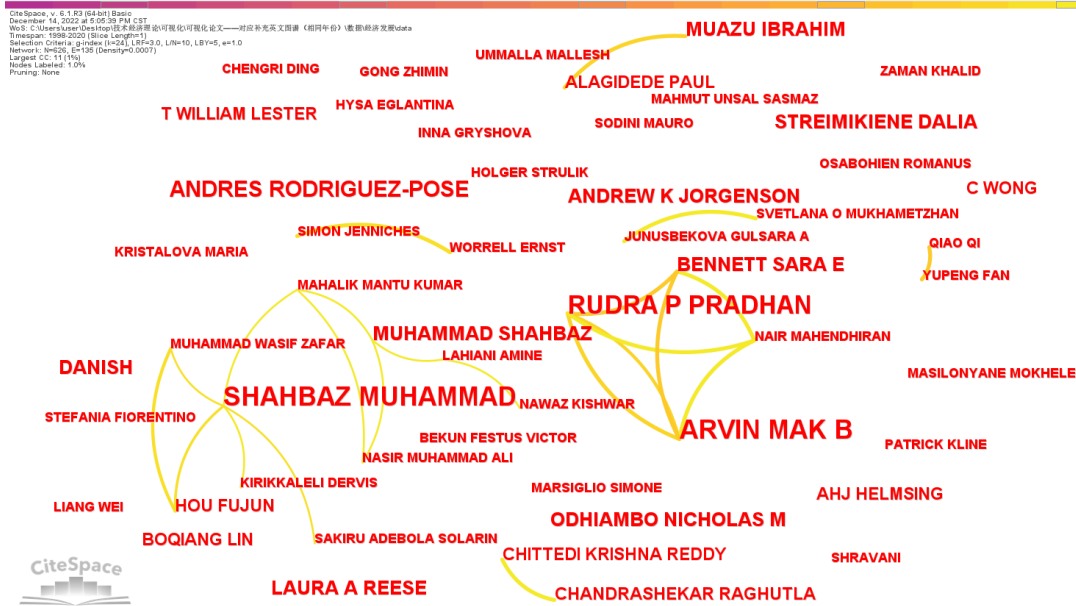

Figure 3 Author cooperation network in the field of WOS economic development research.

In combination with "Figure 3", the researchers use the formula [2] defined by Price, a famous scientific metrology expert, to screen the core authors in this research field, namely

$$m = 0.749\sqrt{n_{max}} \qquad (1)$$

In equation (1), m represents the lower limit of the number of publications by the core author; n_{max} is the total number of publications by the most prolific scholars in this field.

According to equation (1), the researchers select the number of articles published by Muhammad Shahbaz, the author with the highest number of publications in this field, as the reference value, which is $n_{max}=12$. After calculation, $m=2.59$ indicates that the core author is one who has published more than 3 articles. According to the screening criteria, the core authors of research in this field are shown in "Table 2".

Table 2. Core author group in WOS economic development research field

Publication frequency	Core author
7 or more articles	Muhammad Shahbaz (12 articles), Mak Arvin (8 articles), Rudra Prakash Pradhan (7 articles)
5 articles	Andrés Rodríguez-Pose
4 articles	Danish, Muazu Ibrahim, Dalia Streimikiene, Andrew Jorgenson
3 articles	Mantu Kumar Mahalik, Mahendhiran Nair, Liang WEI, Ting GAN

The Price Law [2] proposes that the core author's publication volume should account for 50% or more of the total publication volume in the research field. According to statistical calculations in "Table 2", the core author groups in this field only account for 2% of the total publication volume of the WOS core journal library, which is far less than the standard of 50%. Therefore, there is an urgent need for cooperation in the field of economic development research to accelerate the formation of a stable core author group.

3. ANALYSIS OF RESEARCH HOTSPOTS IN THE FIELD OF WOS ECONOMIC DEVELOPMENT

Based on a grasp of the field's bibliometric characteristics, CiteSpace is used to explore the development of hotspots in the field.

3.1 Analysis of Hot Keywords

Hot research topics in the field are discussed in terms of keyword co-occurrence analysis and keyword mutation analysis. And the keyword timeline analysis further reveals the evolution of the research field.

3.1.1 Keywords Co-occurrence Analysis

Keywords are important tools that reflect the research object and field of the article, and the research hotspots in the field can be identified by sorting and mining high-frequency keywords in the literature in this field.[3] By conducting keyword co-occurrence analysis on core journal literature in the field of WOS economic development from 1998 to 2020, a keyword co-occurrence knowledge graph (see "Figure 4"), keyword frequency, and centrality ranking table (see "Table 3") are obtained.

The connection between keywords indicates that two keywords co-occur in the same literature, and the thickness of the connection is proportional to the frequency of co-occurrence. The circular nodes and font size are directly proportional to the frequency of keywords [3]. The centrality of keywords reflects the importance of this node in the knowledge graph of keyword co-occurrence. 0.1 is usually used as the standard for measuring centrality. If the centrality value of the keyword is greater than or equal to 0.1, it indicates that the keyword has high centrality and significant influence in the co-occurrence knowledge graph. Although the frequency of keyword occurrences is not necessarily related to the size of centrality, keywords with high frequency and centrality values play a more important role in the knowledge graph of keyword co-occurrence.

According to "Figure 4", firstly, based on the circular nodes and font size, the keyword "growth" is the most frequent, central, and closely related core keyword in the co-occurrence network graph. Secondly, words such as "economic development", "economic growth", "financial development", "energy consumption", "co2 emission", "model", "China", "impact", "policy" also have high frequency and high mindedness, highlighting the core themes of economic development research from 1998 to 2020.
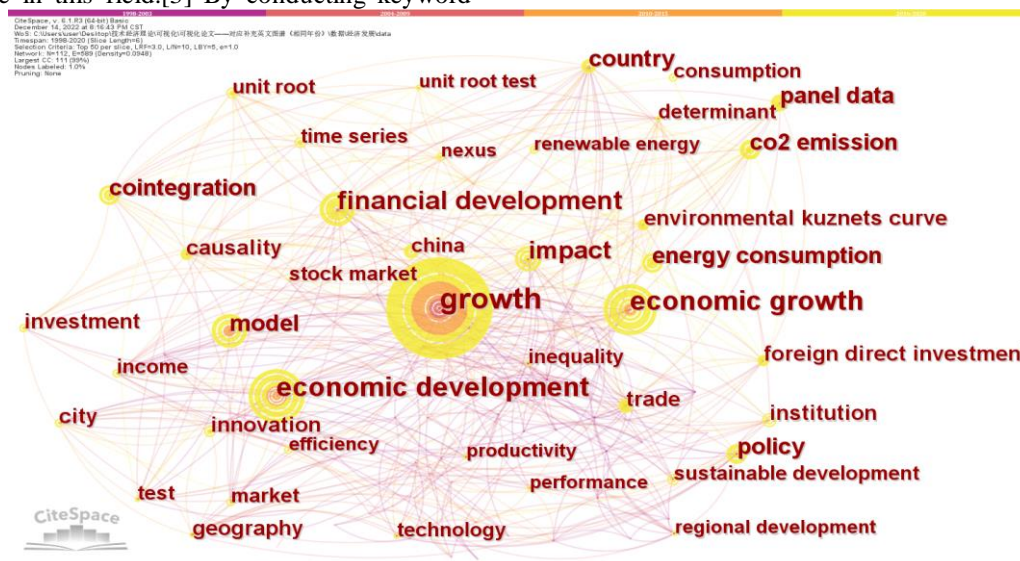

Figure 4 Keyword co-occurrence graph in the field of WOS economic development research.

Table 3. Top 20 keywords for frequency and centrality

Ranking	Frequency			Ranking	Centrality		
	Frequency	Centrality	Keywords		Centrality	Frequency	Keywords
1	668	0.03	growth	1	0.1	171	co2 emission
2	417	0.02	economic growth	2	0.08	290	financial development
3	405	0	economic development	3	0.06	47	liberalization
4	290	0.08	financial development	4	0.05	30	globalization
5	181	0.01	impact	5	0.05	16	business
6	171	0.1	co2 emission	6	0.05	16	competitiveness
7	171	0.01	model	7	0.05	14	benefit
8	162	0	policy	8	0.04	137	energy consumption
9	156	0.02	cointegration	9	0.04	124	trade
10	152	0.01	panel data	10	0.04	105	innovation
11	145	0.02	country	11	0.04	92	environmental kuznets curve
12	137	0.04	energy consumption	12	0.04	83	income
13	124	0.04	trade	13	0.04	42	democracy
14	111	0.02	institution	14	0.04	11	choice
15	105	0.04	innovation	15	0.03	668	growth
16	103	0.01	investment	16	0.03	73	inequality
17	100	0.01	city	17	0.03	64	regional development
18	99	0.01	causality	18	0.03	45	industry
19	99	0.02	foreign direct investment	19	0.03	38	firm
20	92	0.01	China	20	0.03	36	government

3.1.2 Keyword Mutation Distribution

Mutant words are based on keywords and refer to keywords that have increased in frequency during a certain time span. They can be used to detect potential research problems in the academic field, test emerging development trends in the discipline, and reflect cutting-edge hot issues. Based on "Figure 4", the distribution table of keyword mutations in the top 20 domestic and international economic development research fields from 1998 to 2020 is obtained (see "Table 4"). In "Table 3", Year represents the time when the keyword first appeared, and Strength represents the intensity of the mutation. The intensity is directly proportional to the frequency of the keyword appearing within a certain period of time. Begin represents the time when the keyword became a research hotspot, End represents the time when the keyword ended becoming a research hotspot, and the red line represents the duration of the keyword's emergence.

According to "Table 3", from 1998 to 2003, endogenous growth, policy, united states, local economic development, location, and long run growth became the main emerging words in the field of WOS economic development research, with regional heterogeneity development and policy differences becoming the focus of current research. From 2004 to 2016, economic development, geography, space, law, etc. became the main emerging words in the field of WOS economic development research. Research hotspots will deepen or change over time. Currently, global economic development is closely related to environmental protection and social development. In this context, China has proposed high-quality development goals and a dual carbon plan. Therefore, in the period from 2017 to 2020, social economic development, carbon emission, and other research hotspots have become prominent words and research hotspots.

Table 4. Mutation distribution of the top 20 keywords in the field of WOS economic development research from 1998 to 2020

Keywords	Year	Strength	Begin	End	1998 - 2020
Model	1999	7.65	1999	2015	
policy	1998	7.56	1998	2009	
endogenous growth	1998	6.99	1998	2015	
state	2001	6.8	2001	2015	
city	1998	6.74	1998	2015	
united states	1998	6.34	1998	2009	
convergence	1999	5.99	1999	2015	
cluster	2001	5.88	2001	2015	
firm	1999	5.67	1999	2015	
increasing return	1998	5.59	1998	2015	
long run growth	1999	5.13	1999	2015	
local economic development	1998	5.07	1998	2009	
location	1998	4.98	1998	2009	
intermediation	2001	4.91	2001	2015	
space	2005	6.01	2005	2015	
economic development	1998	5.77	2004	2009	
geography	1999	5.46	2004	2020	
law	2003	5.34	2004	2015	
socio-economic development	2017	5.54	2017	2020	
carbon emission	2017	4.72	2017	2020	

3.2 Analysis of Hot Research Topics

CiteSpace provides users with four algorithms to extract cluster labels, namely LSI (implicit semantic index), TF * IDF weighted algorithm (the default automatic algorithm of the system), LLR (log likelihood ratio test), and MI (mutual information algorithm). Through comprehensive comparison, it can be seen that the LLR algorithm has good applicability and accuracy in the practical application of extracting cluster labels, that is, the extracted cluster labels are more in line with the actual situation and have less repetition [5]. Therefore, the LLR algorithm is used to cluster high-frequency keywords and obtain a keyword clustering graph for the WOS economic development research field (see "Figure 5").

Scholars use two indicators, Q value and S value, to comprehensively evaluate the quality of clustering results. The Q value refers to the degree of modularity, and its size is directly proportional to the significance of clustering. The S value and average contour value are directly proportional to the rationality of clustering. In general, if the Q and S values are both greater than 0.7, it indicates that the clustering effect is not only significant and reasonable, but also that the internal clustering situation of the module is good [6]. Through clustering analysis of literature in the field of economic development research in the core journal library of WOS, the clustering module value Modular Q was obtained to be 0.8192, indicating that the clustering results are reliable. The average contour value Mean S of the clustering is 0.9353, indicating that the clustering results are reasonable.

According to "Figure 5", the hot keywords in the field of WOS economic development research are divided into 6 clusters, mainly including "# 0 economic development", "# 1 economic growth", "# 2 development policy", "# 3 financial development", "# 4 energy consumption", "# 5 city", and "# 6 local development". Moreover, the smaller the sequence number of the cluster, the more keywords it contains. From "Figure 5", it can be

seen that the main content of research in the field of WOS economic development can be divided into the following four aspects: The first is the research on economic development at the macro level. The clusters included are: # 0 economic development, # 1 economic growth, # 2 development policy; The second is the research on economic development at the regional level. The clusters included are: # 5 city, # 6 local development; The third is the research on economic development at the ecological level. The clusters included are: # 4 energy consumption; The forth is the research on economic development of key industries. The cluster included is: # 3 financial development.
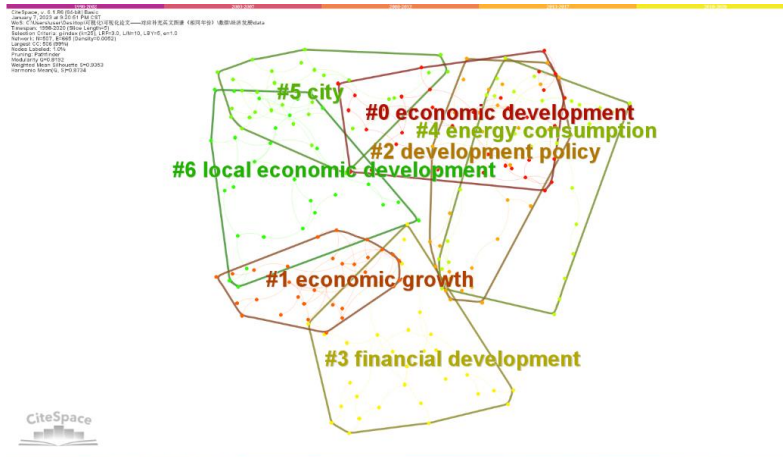

Figure 5 Keyword clustering knowledge graph of research hotspots in the field of WOS economic development from 1998 to 2020.

4. EVOLUTION OF WOS ECONOMIC DEVELOPMENT RESEARCH FIELD

To reveal the evolution of the WOS economic development research field in different periods, based on keyword clustering knowledge graph, CiteSpace visualization analysis software is used to obtain a keyword timeline evolution knowledge graph (see "Figure 6"). According to "Figure 6", the research process in the field of WOS economic development from 1998 to 2020 can be roughly divided into three stages: the first stage is to increase the speed of economic development from 1998 to 2007, the second stage is to maintain stable economic development from 2008 to 2016, and the third stage is to transform the existing economic development mode from 2017 to 2020.
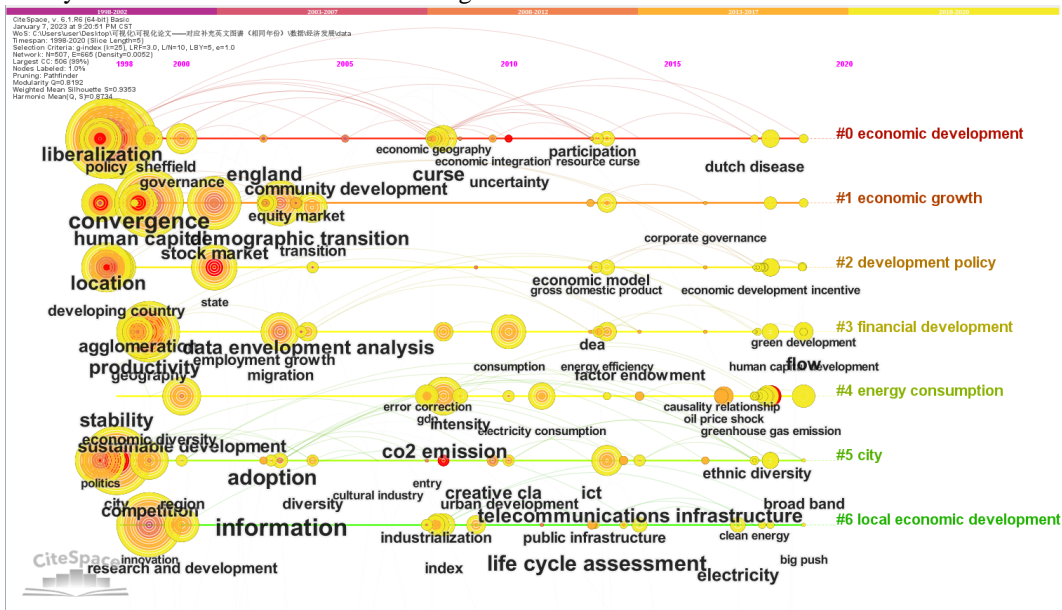

Figure 6 Research context of WOS economic development field from 1998 to 2020.

The main keywords in this field from 1998 to 2007 are summarized as follows: liberalization, policy, government, human capital, economic geography, economic integration, convergence, equity market, demographic transition, location, developing country, agglomeration, DEA, employment growth, productivity, stability, economic diversity, sustainable development, politics, competition, region, adoption, cultural industry, diversity, innovation, research and development. By sorting out the keywords in the literature at this stage, it can be seen that the research focus on economic development during this time span is on improving speed. Focus are paid on the following three aspects: research on the relationship between differences in national policies and the economic development of domestic and trading countries, research on the relationship between regional development imbalance and the process and quality of global economic integration, and research on the relationship between diversification of economic forms and sustainable development of the global economy. According to the relevant literature, Danny Bahar [7] pointed out that differences in national immigration policies will affect the economic development of the country to varying degrees, and the correct use of expatriate capital can positively promote regional economic development; Zhou Zhonglin et al. [8] pointed out that although the two climaxes of regional economic collectivization after the war objectively promoted the process of global economic integration, the intensification of international economic market competition led to imbalanced regional economic development; Xu Zhongmin et al. [9] pointed out that the consumption of nonrenewable energy exceeds the environmental load, and developing economic diversity to alleviate energy consumption is the only way for sustainable economic development.

From 2008 to 2016, the main keywords in this field are summarized as follows: participation, resource curse, corporate governance, economic model, gross domestic product, consumption, energy efficiency, factor endowment, error correction, intensity, electricity consumption, co2 emission, creative cla, urban development, ICT, industrialization, index, life cycle assessment, and public infrastructure. By sorting out the keywords in the literature at this stage, it can be seen that the research focus on economic development during this time span is on maintaining stability. Focus is paid on the following three aspects: research on the relationship between economic development,

resource consumption, and environmental protection, research on the relationship between economic development and urban construction, and research on the relationship between economic development and information technology. According to relevant literature, Dziku ć Maciej et al. [10] proposed that focusing on the technological ecological benefits of energy utilization and seeking new green energy can balance environmental protection and economic development quality; Yuan Xueliang et al. [11] proposed that strict environmental policies, reasonable industrial structure, and improved energy efficiency can alleviate the impact of economic development on the environment; Yue Wenze et al. [12] conducted a case study on the impact of urban planning on economic development and environmental change in Shanghai's rapid expansion; Arapoglou Vassilis et al. [13] used London as an example to study the correlation between urban economic development and urban space and regional culture; Seifallah Sassi et al. [14] found that information and communication technology can significantly promote regional economic development by taking countries in Central and Northeast Africa as an example; Hazuki Ishida [15] found, using Japan as an example, that investment in information and communication technology can moderately reduce energy consumption but cannot increase regional gross domestic product.

The main keywords in this field from 2017 to 2020 are summarized as follows: Dutch disease, economic development incentive, green development, human capital development, causality relationship, oil price shock, greenhouse gas emission, ethnic diversity, broad band, information, telecommunications infrastructure, clean energy, big rush. By sorting out the keywords in the literature at this stage, it can be seen that the research focus on economic development during this time span is on the level of transformation and development. Focus is paid on the following two aspects: conducting research on economic development transformation and upgrading based on the reality of global warming, and conducting digital research on economic development based on emerging network technologies. According to relevant literature review, Peng Benhong et al. [16] found that one of the key goals of sustainable development is to strengthen the coupling relationship between economic development and environmental protection. Specifically, efforts can be made to increase scientific and technological

innovation, adhere to the strategy of building a strong talent country, and reduce the negative impact of economic development on environmental protection. At the same time, efforts can be made to accelerate the transformation of economic development methods to enhance the positive impact of economic development on environmental protection; Chen Lingming et al. [17] used 31 provinces in China as an example to study and found that environmental regulation can have an impact on the quality of economic development through industrial structure transformation and upgrading. Adjusting environmental regulation policies appropriately can promote industrial structure upgrading and promote high-quality regional economic development; Oladipo Olalekan David et al. [18] found that the penetration of information and communication technology has a positive impact on economic development, taking the African region as an example; Godwin Myovella et al. [19] compared the economies of countries in sub Saharan Africa with those of the Organization for Economic Cooperation and Development, and analyzed the differences in the impact of digital technology on the economic development of developed, developing, and least developed countries. The results showed that digitization had a positive contribution to the economic growth of both groups of countries.

Overall, the evolution and convergence of research hotspots in the field of WOS economic development are smooth and focused. Environmental issues have emerged as research hotspots in the later stages of increasing economic development speed, while maintaining stable economic development has been a key issue throughout the research. From the stage of transforming the existing economic development mode, constantly updated technology and continuously harsh ecology have given rise to research on the coordinated development of ecology and economy from different perspectives.

5. CONCLUSION

Taking 2768 literature related to Chinese and international economic development research collected from SSCI and SCI source journals in the WOS core database as the research object, CiteSpace visualization software is used for bibliometric and visual analysis, with a focus on analyzing the literature characteristics, research hotspots, and evolution process of the economic development research field in the WOS core

database. The following research conclusions are drawn:

First, from the evolution of the number of literature publications, the overall development trend of the WOS economic development research field is good, and the characteristics of the publication volume stage are significant, showing a trend of "slow fluctuation rising - severe fluctuation rising". From 1998 to 2016, it was a period of slow fluctuation and upward trend, with an average annual publication volume of over 71 articles; From 2017 to 2020, it was a period of intense fluctuations and an increase in annual publication volume, reaching over 330 articles.

Second, from the analysis of the cooperation between research scholars and research institutions published in the literature, it can be found that the cooperation network of research scholars presents the characteristics of "small aggregation and large dispersion", with Muhammad Shahbaz being the most published scholar. The cooperation network of research institutions shows that a core cooperation group led by the Chinese Academy of Social Sciences has been formed in this field, and the Chinese Academy of Social Sciences has become a representative research institution with outstanding contributions in this field with 41 papers. However, a stable core author group has not yet formed in this field, and there is still a need for in-depth cooperation and exchange between different research institutions in China and foreign countries.

Third, according to the keyword co-occurrence network graph and keyword mutation distribution table, keywords such as "economic development", "economic growth", "financial development", "energy consumption", and "co2 emission" occupy an important position in the co-occurrence network of WOS economic development research field. The research theme "low-carbon economy" represented by keywords such as "social economic development" and "carbon emission" has become an emerging research hotspot. According to the keyword clustering graph, the main research content in the field of WOS economic development is concentrated in four aspects: national level economic development research, regional level economic development research, ecological level economic development research, and key industry economic development research.

Forth, according to the knowledge graph of keyword timeline evolution, the research process in the field of WOS economic development from 1998 to 2020 can be roughly divided into three stages:

the first stage is to increase the speed of economic development from 1998 to 2007, the second stage is to maintain stable economic development from 2008 to 2016, and the third stage is to transform the existing economic development mode from 2017 to 2020. The first stage focuses on the following three aspects: research on the relationship between differences in national policies and the economic development of domestic and trading countries, research on the relationship between regional development imbalance and the process and quality of global economic integration, and research on the relationship between diversification of economic forms and sustainable development of the global economy. The second stage focuses on the following three aspects: research on the relationship between economic development, resource consumption, and environmental protection, research on the relationship between economic development and urban construction, and research on the relationship between economic development and information technology. The third stage focuses on the following two aspects: conducting research on economic development transformation and upgrading based on the reality of global warming, and conducting digital research on economic development based on emerging network technologies.

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