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Analysis of Research Hotspots, Current Status and Trends in Total Factor Productivity: A Bibliometric Analysis Based on WOS and CiteSpace

Ting Fang

Anhui University of Finance and Economics, Bengbu 233030, China.

Abstract

This paper uses bibliometric methods to systematically review the current status, research hotspots, and development trends of total factor productivity in order to provide a reference for future research. Based on the relevant literature on total factor productivity in the Web of Science Core Collection database from 2008 to 2023, CiteSpace software was used to analyze the annual frequency, journals, institutions, co-occurring keywords, co-citation, and research frontiers of the literature on total factor productivity. The results show that the research hotspots of total factor productivity are performance, economic growth, and other related areas. The number of publications and citations of the literature on total factor productivity have increased annually. From the perspective of institutions, universities are the main contributors to the literature. The centrality of keywords such as investment and panel data is high, indicating that these research topics are important in total factor productivity. As attention to total factor productivity gradually increases, research perspectives are becoming more diversified, and economic growth will be a future research focus. The research results can provide theoretical references for the further development of total factor productivity.

Keywords

Total Factor Productivity; Knowledge Graph; Bibliometrics; Visualization; Cite Space.

1. Introduction

Currently, the world economy is transitioning from the high-speed growth stage of the industrialization process to the middle-speed growth stage of post-industrialization. The driving force of economic growth has also shifted from investment-driven to innovation-driven, and enhancing total factor productivity (TFP) has become a hot topic. TFP is an important indicator of the comprehensive productivity of an economy and measures whether its production factors and resource endowments are being fully utilized. Technological progress is the main driving force behind the improvement of TFP for enterprises (Solow, 1957[18]; Romer, 1990[17]). Research on TFP and its decomposition can help identify the sources of economic growth and explore the influencing factors at a deeper level, in order to find effective ways to achieve economic quality improvement, efficiency enhancement, and stable growth. Currently, research on TFP is quite extensive, with most of the research conducted at the macro level. In recent years, the focus has shifted from the macro level to the micro-enterprise level, and the OP method (Olley and Pakes, 1996[15]) and the LP method (Levinsohn and Petrin, 2003[9]) are two commonly used semi-parametric estimation methods for calculating TFP at the micro-enterprise level. TFP plays an important role for enterprises, indicating whether their resources are being fully utilized. Solow (1957)[18] proposed using the "Solow residual," which cannot be explained by input growth of production factors in production, to measure technological progress. Romer (1990)[17] pointed out that enterprises can improve their TFP through deliberate research and development investment, and external market demand can greatly drive the growth of productivity. Lee et al. (2022) [8]investigated the mechanism of the impact of environmental regulations (ER) and innovation capability (ICY) on green total factor productivity (GTFP) and provided strong empirical evidence from panel data of 30 provinces in China from 2006 to 2017. The results show that both ICY and ER can effectively promote GTFP, but compared to ER, ICY has a heterogeneous impact on GTFP. Amri et al. (2019)[2] studied the relationship between carbon dioxide (CO2) emissions, TFP measured as income, and information and communication technology (ICT) in Tunisia from 1975 to 2014. The results show that the long-term TFP value is higher than the short-term coefficient, thus rejecting the environmental Kuznets curve (EKC) hypothesis. Pan et al. (2022)[16] used set regression to examine the innovation-driven effect of the digital economy on China's total factor productivity (TFP). The data used in this study included provincial TFP calculated by the double method and the digital economy index proposed by principal component analysis. The results showed a positive non-linear relationship between the digital economy index and provincial TFP, indicating that the digital economy, as an innovation driver, promotes the widespread and sustained development of TFP. However, the acceleration of digital integration in eastern China has led to high-quality TFP growth, while it is relatively poor in the central and western regions, revealing regional disparities.

While existing literature has examined green innovation from different perspectives, research from the perspective of bibliometrics is relatively scarce. Therefore, this study uses quantitative methods and technologies such as bibliometrics and knowledge mapping to systematically review domestic and foreign research progress based on published literature, draw visual knowledge maps of relevant literature, and intuitively reveal the research progress and development trends of TFP. This provides a reference for future TFP research.

Bibliometrics is a branch of library and information science that describes, evaluates, and predicts the current situation and development trends of science and technology using mathematical and applied statistical methods based on the publication quantity of literature. To effectively understand the research trend of TFP in recent years, this study analyzed the research progress of TFP based on literature published from 2008 to 2023 in the Web of Science core database (WOS). By drawing relevant knowledge maps of literature, the abstract literature data is visually represented. The study analyzed the annual frequency, publication journals, publishing institutions, co-occurrence of subject words, citation of literature, and research frontiers of relevant literature using bibliometric and applied statistical methods. Finally, the study used Cite Space software to draw a visual knowledge map of TFP. By systematically reviewing the research status and development trends of TFP, this study provides a reference for further TFP research.

2. Data Source and Research Methodology

2.1. Data Source

According to Bradford's Law, core journals concentrate the core literature in research areas. The data used in this study was sourced from the Web of Science Core Collection (WOS) database, launched by the Institute for Scientific Information (ISI). The search formula for literature data was TS = Total Factor Productivity, with literature types set to Article and Review, and a time span from 2008 to 2023 (as shown in Table 1). After using the bibliographic information analysis tool SATI to remove duplicates, 4773 valid articles were obtained.

Table 1：Literature Retrieval Identification

Identification	Name	WOS Retrieval Instructions
Se	Search Query	Ts= Total Factor Productivity
Ts	Time Span	2008-2023
Dt	Document Type	Article、Review
Ds	Data Source	Web of science Core Collection Database

2.2. Research Method

With the development of information technology, the information sources are becoming larger and larger, and big data analysis software is being applied to various disciplines to understand the research direction, research authors, institutions, and other relevant information in the field. Bibliographic analysis is a tool for studying published literature based on statistical and quantitative analysis methods, which can make information visualized. In this paper, we comprehensively used Cite Space visualization software to conduct bibliometric analysis and draw bibliographic knowledge maps.

Cite Space software is developed based on the Java programming language and has powerful knowledge map drawing functions. Cite Space is a multidimensional, time-varying, and dynamic visualization software that combines methods such as social network analysis and association rule analysis. It can analyze the development dynamics of research fields and explore the evolution trends and research hotspots of its topics through knowledge map analysis. The quantitative analysis process of total factor productivity is shown in Figure 1.

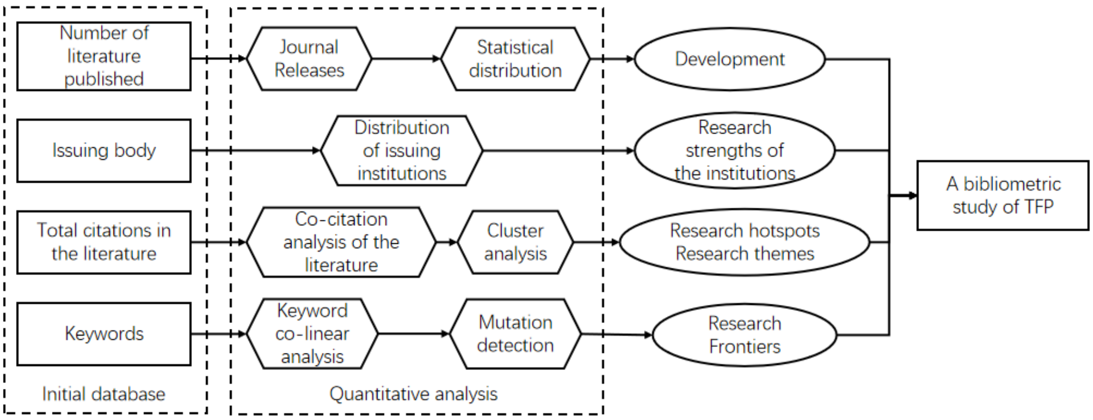

Figure 1：Quantitative analysis process for green bonds

Based on bibliometrics and applied statistical methods, the 4,773 retrieved papers were used as a total factor productivity database. The literature database was imported into Cite Space software for analysis of the development trajectory, institutional distribution, keyword co-occurrence, cited literature, and research frontier analysis. The visualized bibliometric analysis was conducted on the evolutionary trajectory, frontier hotspots, and potential issues of total factor productivity research. The selection of relevant evaluation indicators is explained below.

Development trajectory: The number of publications represents to some extent the academic attention and importance given to the research field. By using the citation analysis report function in the Web of Science database, the number of publications and citation frequency can be obtained. Through temporal distribution analysis of these data, the development trajectory of the total factor productivity research field can be inferred.

Institutional research strength: Using the literature retrieved from the Web of Science database, institutional analysis can be conducted in Cite Space software. By drawing the co-occurrence knowledge map of publishing institutions, the number of published papers and other parameters of research institutions in the total factor productivity field can be obtained to analyze their cooperation relationships.

Research hotspots and topics: The high-frequency keywords are a highly condensed representation of the research content of the literature. By analyzing the co-occurrence of high-frequency keywords, indicators of research hotspots can be calculated. The centrality can reflect the importance and connectivity of the topic keyword nodes in a particular research field, and can be used to test whether high-frequency keywords are in a central position, reflecting the status of the nodes in the overall network.

Research frontier: The concept of "research frontier" is used to reveal the dynamic evolution of research fields, defining a group of emerging concepts within a specific field as "research frontiers." Using Cite Space's word frequency detection technology, high-frequency keywords with a high rate of change can be screened, and the frontier areas and development trends can be determined based on the trend of the word frequency change.

3. Results and Analysis

3.1. Analysis of Temporal Distribution of Literature Quantity

According to the citation analysis report in the Web of Science database, the total number of publications related to total factor productivity (TFP) is 4,773, with an average of 318 publications per year. The specific distribution is shown in Figure 2.

As shown in Figure 2, the publication quantity of TFP-related literature has been on the rise from 2008 to 2023, indicating that research on TFP is continuously increasing, and the research system is steadily advancing. The TFP research can be divided into two stages: steady growth and rapid growth. Steady growth (2008-2020): during this stage, the number of publications showed fluctuating growth with a low volume at the beginning, and then continued to grow with small inter-annual differences. Rapid growth (2020-2023): during this stage, the increase in the number of publications was significantly higher than that of the first stage, and the stage breakpoint was in 2020. The number of published articles reached its peak in 2022, with 801 articles, indicating that research on TFP has been highly valued by experts and scholars. The citation frequency of literature on TFP has shown a significant growth trend from 2008 to 2023. The above analysis shows that research on TFP is still widely valued and has good research prospects.

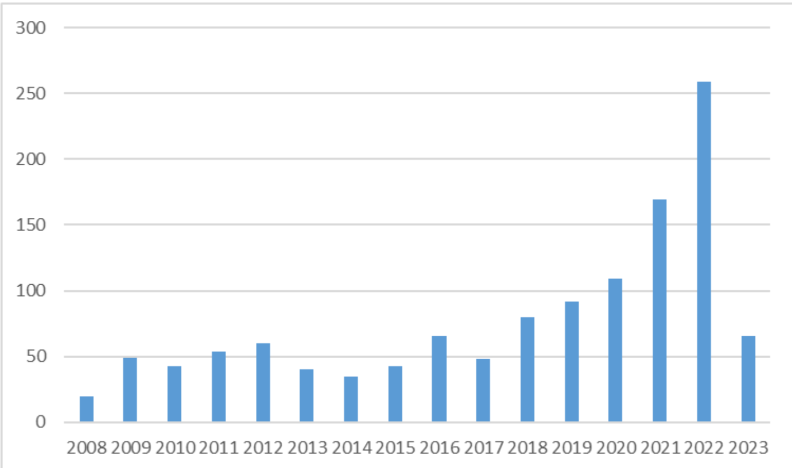

Figure 2: Bar chart of publication distribution.

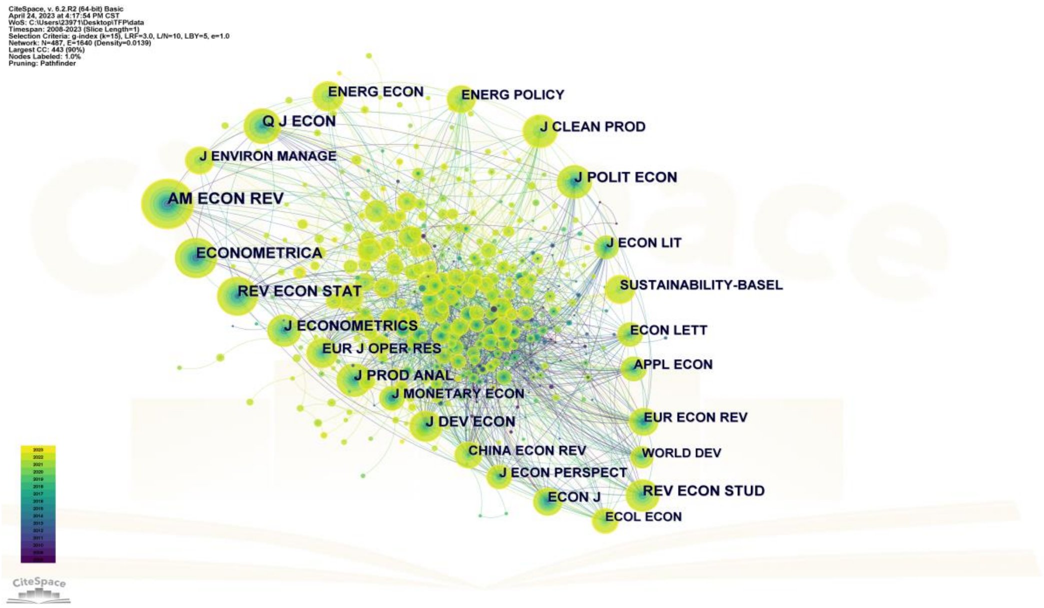

Figure 3: Knowledge Map of Journals by Citations

Using Cite Space to extract journal source data, the highest ranked journal is "American Economic Review" with 705 citations, followed by "Econometrica" with 490 citations, and "Review of Economics and Statistics" with 457 citations. The journals mainly cover areas such as economics, statistics, and econometrics.

3.2. Institution Analysis

In order to further understand the research status and actual contributions of publishing institutions in the field of total factor productivity, the number of articles published by each research institution was analyzed. Based on 4773 articles as the basic information, Cite Space software was used to set the network nodes as "Institution", the threshold was set to "Top15", and the network was pruned using the Minimum Spanning Tree (MST) algorithm. The advantage of MST is that it is computationally efficient and can quickly calculate results. The time span was set from 2008 to 2023, and to improve the speed and accuracy of the software, the time was divided into 12 periods for analysis. The distribution of institutions by the number of publications was obtained and shown in Figure 4.

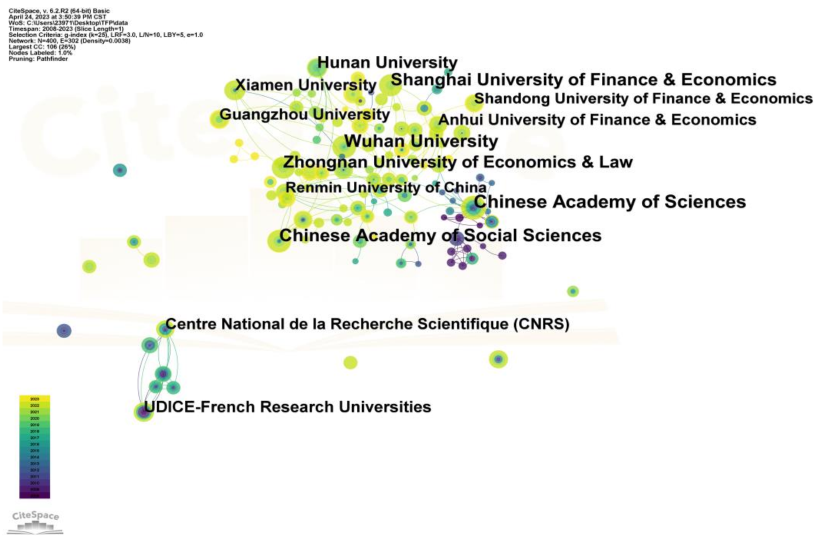

Figure 4: Institution distribution knowledge map

Figure 5: Knowledge map of countries publishing in the field of green bonds

From the graph, it can be seen that total factor productivity research involves 400 institutions in the Web of Science Core Collection database, and the publishing institutions are mainly concentrated in universities, with Chinese Academy of Sciences playing a pivotal role in this field. In terms of geographical distribution, publishing institutions are mainly located in China, followed by the United States. In terms of network collaboration, there are certain cooperative relationships between various research institutions.

3.3. Keyword co-occurrence analysis

Keyword co-occurrence analysis using Cite Space software captures snapshots of certain regions based on time series, which can infer the research direction, trend changes, and research characteristics of the research area. The basic information of 4773 documents were transferred into Cite Space for keyword analysis, and the subject term co-occurrence mapping was obtained after running and merging synonyms, as shown in Figure 6.

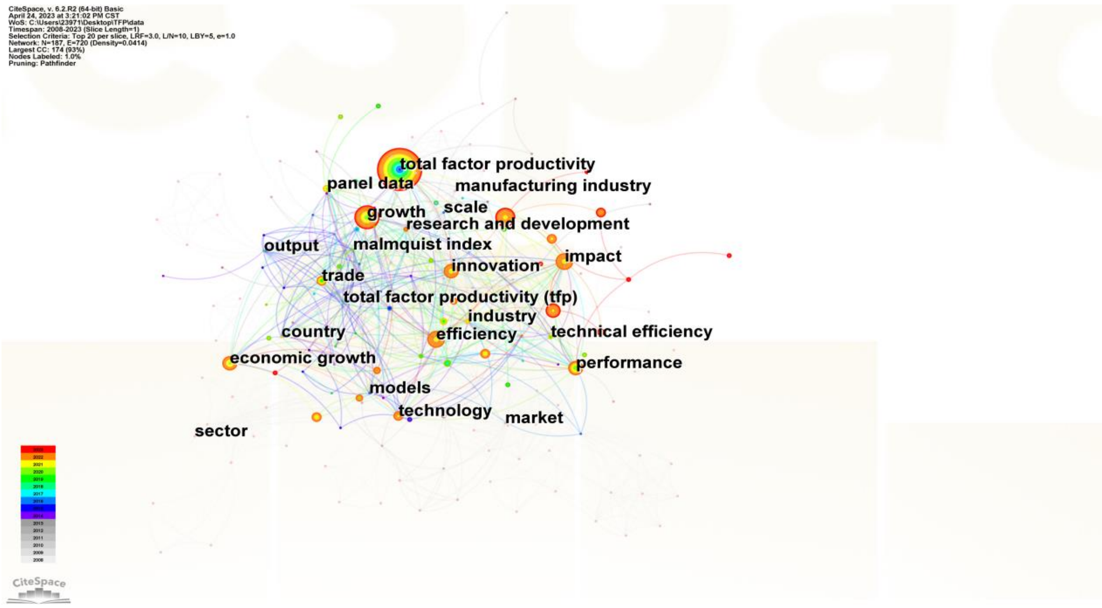

Figure 6: Keyword Co-occurrence Knowledge Map

The co-occurrence map density was calculated based on the literature data analysis using Cite Space software. From Figure 6, it can be seen that the density of the map is 0.0414, indicating that the keyword co-occurrence map is relatively sparse and the research direction tends to be dispersed. There are 187 nodes and 720 connections in the graph, and the top 20 keywords with high frequency were selected. Their relevant information was obtained using Cite Space software and is shown in Table 2.

Table 2: Top 20 keywords ranked by centrality

Rank	Frequency	Betweenness Centrality	First Appearance Year	Keyword
1	66	0.15	2009	investment
2	80	0.13	2009	panel data
3	637	0.12	2008	total factor productivity
4	344	0.12	2008	growth
5	131	0.12	2008	performance
6	33	0.1	2011	convergence
7	63	0.09	2009	data envelopment analysis
8	31	0.09	2011	technical change
9	182	0.07	2009	economic growth
10	72	0.07	2009	technology
11	44	0.07	2009	policy
12	24	0.07	2009	dynamics
13	14	0.07	2008	agricultural productivity
14	74	0.06	2009	technical efficiency
15	66	0.06	2010	industry
16	57	0.06	2009	country
17	32	0.06	2009	total factor productivity
18	30	0.06	2011	determinants
19	29	0.06	2009	models
20	15	0.06	2012	model

From the co-occurrence map and Table 2, it can be seen that, in addition to the search keywords, nodes such as Growth, research and development, Performance, efficiency, and innovation are relatively large, indicating that these keywords have a high frequency of occurrence and represent the research hotspots of total factor productivity. The centrality of keywords such as Investment, panel data, total factor productivity, Growth, Performance, and convergence is relatively high, indicating that these research topics are important in the study of total factor productivity and act as "bridges" for research hotspots.

3.4. Co-citation Analysis

Co-cited literature refers to the literature that shares the same research content and references in scientific maps. Co-cited literature contains a large amount of scientific knowledge. Co-cited

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literature can effectively explore the knowledge structure of the research field of total factor productivity. The number of citations of literature is an important indicator to measure academic influence and can trace the evolution of research in the discipline through literature. The more co-cited literature there is, the greater the correlation between the literature. Co-citation analysis is a related analysis of co-cited literature. In Cite Space, the network nodes are set as references to obtain a co-citation network diagram, as shown in Figure 7.

In the knowledge graph of citations, the larger the node, the more times it has been cited. The colors in the top layer of the graph represent the corresponding year in which the literature was displayed in the implemented knowledge graph. By analyzing the key nodes of the graph, it can be seen that there are two larger nodes, indicating that these two articles have been cited more frequently and have a greater impact on the research field of total factor productivity. The first authors of these two articles are Lin and Chen (2018)[11] and Liu et al.(2019)[14], respectively. The most frequently cited article is the one published by Lin and Chen in 2018 in the Journal of Cleaner Production, which discusses whether distortions in factor markets inhibit China's green development by measuring green total factor productivity (GTFP). The results show that distortions in factor markets have a significant negative impact on China's GTFP growth, exports, and foreign direct investment spillover effects. In addition, it was found that distortions in factor markets are a threshold for the spillover effects of exports and foreign direct investment, which leads to low levels of exports and foreign direct investment, further suppressing GTFP growth. By discussing the impact pathway of factor distortions, the article provides a new perspective on the impact mechanism of exports and foreign direct investment on GTFP growth, and also expands the empirical framework of research direction. Based on the citation network graph of the literature, cluster analysis was conducted on the literature, and the clustering results are shown in Figure 8.

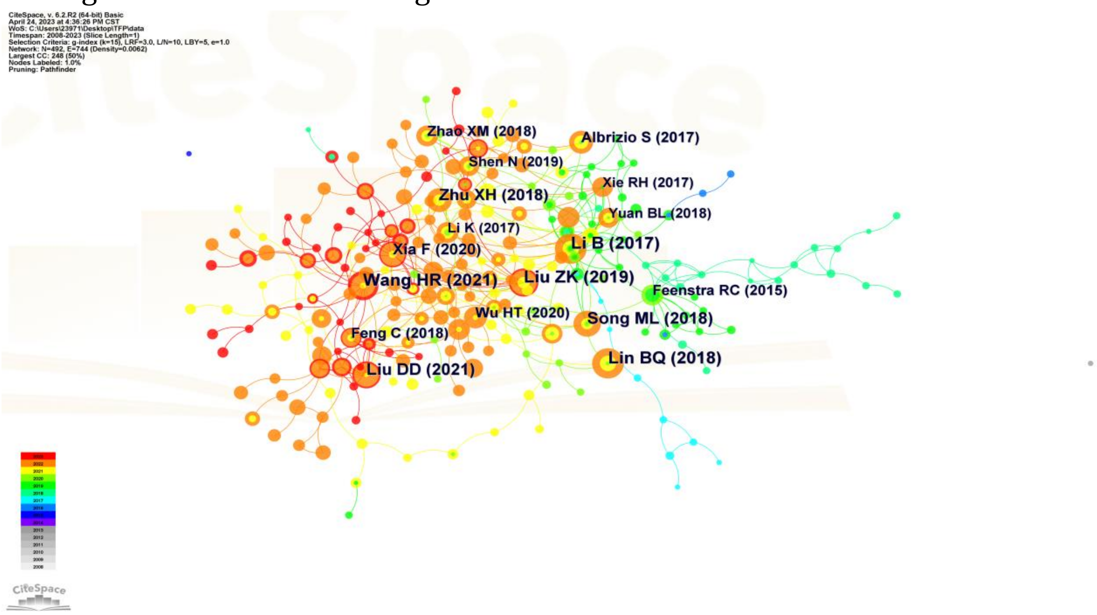

Figure 7: Knowledge graph of literature co-citations.

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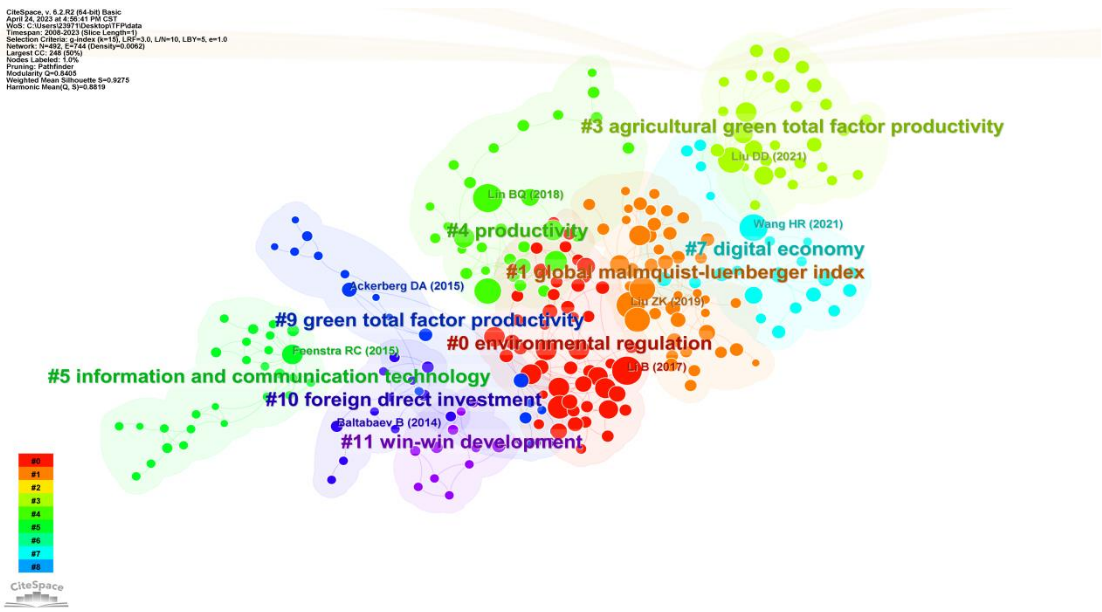

Figure 8: A knowledge map of the research topics of co-cited references.

As shown in Figure 8, there are 492 network nodes and 744 connections. The clustering results were evaluated using the modularity (Q value) and the average silhouette value (S value). Generally, the Q value is in the range of [0,1), and a Q value greater than 0.3 indicates a significant community structure. From Figure 8, Q=0.8405>0.3, indicating that the community structure identified by the clustering result is significant. Further analysis reveals that the clustering identified 9 groups (#0, #1, #3, #4, #5, #7, #9, #10, #11). Therefore, based on the cited literature, total factor productivity can be classified into 9 research categories: Environmental Regulation, Green Total Factor Productivity, Agricultural Green Total Factor Productivity, Free Trade Zone, Regional Economic Development, Digital Economy, Econometric Analysis, Technological Factor, and China's Industry. Green Total Factor Productivity, Agricultural Green Total Factor Productivity, and Regional Economic Development are likely the main research directions in this field, while Environmental Regulation, Free Trade Zone, Technological Factor, and China's Industry may be the main research branches. Digital Economy and Econometric Analysis may be related to the relevant disciplines involved in calculating this indicator.

Table3： Summary of the largest 5 clusters.

Cluster ID	Size	Silhouette	Label (LLR)	Representative publication
#0	53	0.863	Environmental Regulation	Fang, Y (2022), Li B(2017), Albrizio S(2017), Zhao XM(2018)
#1	44	0.89	Green Total Factor Productivity	Fang, Y (2022), Liu ZK(2019), Zhu XH(2018), Xia F(2020)
#3	32	0.97	Agricultural Green Total Factor Productivity	Tang, M (2023), Liu DD(2021), Fang L(2021), Chen YF(2021)
#4	30	0.928	Free Trade Zone	Liu, L (2022), Lin BQ(2018), Song ML(2018), Wu HT(2020)
#5	27	0.991	Regional Economic Development	Beugelsdijk, S (2018), Feenstra RC(2015), Ladu MG(2014), Jing W(2014)

Cluster #0: Environmental Regulation. In a representative study, Fang et al. (2022)[5] first used the Super-Efficiency-Based Slack-Based Measure (SBM) model to measure the Green Total Factor Productivity (GTFP) of 30 provinces in China from 2011 to 2020 and analyzed the impact of artificial intelligence on GTFP under the environmental decentralization system. Then, using the Spatial Durbin Model (SDM) and Threshold Regression Model, they empirically studied the spatial evolution characteristics and restrictive effects of artificial intelligence on GTFP. The results showed that the correlation between artificial intelligence and GTFP follows a U-shaped curve, and environmental decentralization serves as a positive regulator linking artificial intelligence to GTFP. The Moran's I index showed the spatial correlation of GTFP. Under the constraint of technological innovation and regional absorption capacity as threshold variables, the impact of artificial intelligence on GTFP follows a U-shaped curve, providing useful reference for China to accelerate the formation of a digital-driven green economic development model. Li and Wu (2017)[10] used the Metafrontier Malmquist Luenberger index and Spatial Durbin Model to study the effects of local and private environmental regulation and their spatial spillover effects on green total factor productivity in 273 Chinese cities from 2003 to 2013. The results showed that the effect of local environmental regulation on green total factor productivity is significantly positive in cities with high political attributes (A1 and A2 areas), but negative in cities with low political attributes (B2 and B3 areas). Furthermore, environmental regulation inhibits firms' original technological innovation, indicating that the government should reduce market intervention, improve firms' market flexibility, and promote original technological innovation. Therefore, the government and citizens should make targeted pollution reduction policies to improve the green total factor productivity. Albrizio et al. (2017)[1] studied the impact of changes in the stringency of environmental policies on productivity growth at the industry and firm levels in an OECD country. The results showed that in countries with the most advanced technology, the tightening of environmental policies was associated with a short-term increase in productivity growth at the industry level. This impact decreases as the distance from the global productivity frontier increases and eventually becomes insignificant.

Cluster #1: Green Total Factor Productivity. In a representative literature, Liu and Xin (2019)[14] focused on the key provinces along the "Belt and Road" in China, using the GML index based on the directional distance function of SBM to evaluate the provincial-level green total factor productivity (GIP) and quantitatively analyze the net effect of the "Belt and Road" on provincial GTFP. The results showed that the development of provincial GTFP was good, and technological progress was the main driving force. There were significant differences in the development of the G11 and 1' regions along the Silk Road Economic Belt and the Maritime Silk Road, and the BRI played a significant role in promoting the provincial and regional GTFP. Zhu et al. (2018)[22] used global data envelopment analysis (DEA) to analyze the green total factor productivity of China's mining and quarrying industry from 1991 to 2014 from aspects of technology, scale, and management. The results showed that during the sample period, the green total factor productivity of China's mining and quarrying industry increased by 71.7%. Technological progress was the most important contributor, while the decline in scale efficiency and management efficiency were two inhibiting factors. Fortunately, in recent years, the management efficiency has gradually improved and become a new driving force for the growth of green total factor productivity.

Cluster #3: Agricultural Green Total Factor Productivity. In representative literature, Tang et al. (2023)[20] explored the relationship between Agricultural Green Total Factor Productivity (AGTFP), environmental governance, and green low-carbon policies using panel data from 30 provinces in China from 2005 to 2019, using a systematic generalized method of moments model. The results showed that environmental governance not only directly affects AGTFP but also indirectly affects it by influencing green technological innovation. Secondly, it can strengthen the promotion of green low-carbon policies on AGTFP, and there are regional differences in the causal relationship between them. Liu et al. (2021)[12] used panel data on Chinese provincial agriculture and the Super-SBM model to calculate China's agricultural green total factor productivity based on carbon emissions. The results showed that China's agricultural carbon emissions showed a "U" shaped trend, but the overall growth rate gradually decreased. Fang et al. (2021)[4] used SBM-GML (Global-Malmquist-Luenberger) index model to calculate agricultural green total factor productivity based on provincial panel data from 2002 to 2015 in China, and systematically examined the impact of crop insurance on agricultural green total factor productivity and its mechanism. The study found that crop insurance has a significant positive impact on agricultural green total factor productivity. In addition, the results showed that the promoting effect of crop insurance on agricultural green total factor productivity increases with the expansion of the operating scale, and the promoting effect of economic crops is stronger than that of food crops.

Cluster #4: Free Trade Zone. In representative literature, Liu et al. (2022)[13] used the difference-in-difference method (DID) and a mediation effect model to examine the impact and mechanism of the National Ecological Industrial Demonstration Park (NEDP) on green total factor productivity (GTFP). The results showed that the construction of NEDP significantly improved urban GTFP, and the conclusion remained valid after robustness tests. This study provides reference for China to further improve the quality of NEDP construction and promote green development. Liu and Chen (2018)[11] discussed whether factor market distortions have hindered China's green development by measuring green total factor productivity (GTFP). The results showed that factor market distortions have a significant negative impact on China's GTFP growth, export, and FDI spillover effects. Song et al. (2018)[19] constructed a panel quantile regression model by calculating the intensity of environmental regulation and the degree of fiscal decentralization to analyze the impact of fiscal decentralization and

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environmental regulation on GTFP. The results showed that fiscal decentralization can stimulate the growth of GTFP, but this effect decreases with the increase of the quantile value.

Cluster#5: Regional Economic Development. In representative literature, Beugelsdijk et al. (2018)[3] use the technique of development accounting to decompose the output differences per worker in 257 EU regions into a part due to local production factor availability and a part due to total factor productivity (TFP). The results show that TFP differences are significant even within countries and are closely related to economic geography and historical development paths. This suggests that the spread of technology and efficient production methods between regions is limited. Feenstra et al. (2015)[6] describe the theory and practice of comparing real GDP across different countries and time periods. First, they provide a measure of productive capacity, called output-based real GDP, in addition to using the composition of real GDP in expenditures to compare standards of living. Second, growth rates are benchmarked using cross-country price data spanning multiple years, making them less sensitive to new benchmark data. Third, data on capital stock and productivity are (re)introduced. Ladu and Meleddu (2014)[7] study the long-term relationship between TFP and energy consumption at the regional level in Italy from 1996 to 2008. The results show a bi-directional causal relationship among regions in Italy, meaning that regions characterized by higher TFP invest more in research rather than energy-intensive activities, improving the efficient use of scarce resources and favoring sustainable growth.

3.5. Analysis of Research Frontiers

Through keyword burst analysis, 20 keywords with burst strength were detected, as shown in Figure 9. Keywords with high burst strength indicate emerging hot topics in the research field. Further analysis shows that the keyword with the highest burst strength is "Green Total Factor Productivity" with a burst strength of 13.38, followed by "Growth Accounting" with a burst strength of 7.9, indicating a high correlation between total factor productivity research and growth accounting from 2008 to 2023. The burst times of "Green Total Factor Productivity," "Environmental Regulation," "Financial Development," and "Energy" are all between 2021 and 2023, which may become future research hotspots for total factor productivity. Overall, the research perspective on total factor productivity has been very diverse between 2008 and 2023.

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Figure 9: High-frequency emerging keywords

Note: The red line segment corresponds to the duration of the emerging period of the keyword; the blue line segment represents the other periods during the research period where there was no emergence.

4. Conclusion

Since 2008, the academic community has gradually increased its focus on the study of total factor productivity, which is currently receiving considerable attention and generating many new research hotspots. Journals in the field mainly focus on economics, statistics, econometrics, and other related fields, demonstrating a multi-disciplinary cross-over characteristic. It is expected that the research interest in total factor productivity will continue to grow in the future. The research institutions of the first authors of the literature are mainly concentrated in universities, with the Chinese Academy of Sciences having the highest number of publications, and the various publishing institutions are closely connected, indicating that research teams are relatively centralized. In the future, research institutions can try cross-national exchanges to form more innovative research results.

The high frequency of theme words such as "Performance" and "Economic Growth" represent the research hotspots of total factor productivity. The high centrality of theme words such as "Investment" and "Panel Data" indicates that these research topics are of great importance in the study of total factor productivity. Through the analysis of key word bursts, it is known that in recent years, the research perspective of total factor productivity has been very diverse, and economic growth will be the focus of future research.

Productivity is a very important indicator for measuring the quality of economic development. Strengthening productivity research has an important reference role in timely adjusting industrial structure, rational allocation of resources, and preventing economic growth bubbles. After many years of exploration and research by numerous scholars, the theory and measurement research of total factor productivity have tended to become mature and stable, but there are still shortcomings in the research level of the research objects. There are more studies on the macro level of total factor productivity, involving countries, regions, provinces, cities, and diverse application fields, but there are fewer empirical studies on the micro level, such as the total factor productivity of enterprise clusters and representative leading enterprises, which are limited by data and other factors and have not been thoroughly explored in the academic community. At the same time, in-depth and meticulous research on the operating trends and fluctuations of total factor productivity itself still has blank areas.

Finally, this article still has some research deficiencies. Considering the display effect of the graph, this article only uses high-frequency keywords to draw social network diagrams and does not show the research results of medium- and low-frequency keywords. The above prospects and deficiencies are also the directions and emphasis of future research.

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