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Bibliometric analysis of new quality productivity in biomechanics research based on CiteSpace

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Abstract: The new quality productive forces provide scientific guidance for countries to promote high-quality development and represent advanced productive forces in line with the new development concept. It is an inevitable requirement for adapting to the transformation of China's economic development stage and a strategic measure to cope with the increasingly fierce international competition. Existing research primarily focuses on the theoretical connotations, characteristics, formation logic, and industrial practices of new-quality productive forces, but lacks comparative analysis and literature reviews of domestic and international studies. Drawing inspiration from the principles of biomechanics, this study delves into the intricate mechanisms underlying the rise of these advanced productive forces, aiming to unravel their potential to empower sustainable economic development. Akin to the dynamic interplay of form, function, and adaptation observed in biological systems, the new-quality productive forces embody the harmonious integration of scientific guidance, technological innovation, and market-driven optimization. Just as the human body's musculoskeletal system leverages the principles of force transmission and load distribution to achieve efficient movement, these productive forces harness the synergistic power of knowledge, technology, and market forces to drive economic progress. This paper employs the CiteSpace knowledge map tool to analyze the publication volume, author collaboration networks, keyword clustering, timelines, and emergent words from relevant literature in the core databases of CNKI and Web of Science. Drawing inspiration from biomechanics, the study highlights the importance of balancing the top-down and bottom-up forces that govern the formation and transformation of new-quality productive forces. Much like the human body's ability to adapt to changing environmental conditions, the successful integration of these productive forces into the economic landscape requires a delicate interplay of strategic planning, technological innovation, and market-driven optimization. By aligning the insights from this research with the principles of biomechanics, the study offers a unique perspective on the sustainable development of the economy. Just as biological systems exhibit elegant and efficient mechanisms to harness energy and resources, the new-quality productive forces hold the potential to empower countries to navigate the increasingly fierce international competition and achieve long-term, high-quality economic growth.

Keywords: new quality productive forces; knowledge graph; quantitative analysis; CiteSpace; biomechanics

1. Introduction

Productivity, as a prominent hallmark of human social progress, stands as the pivotal force driving the development of modern society. New quality productive forces, centered on technological innovation, signify the direction of advanced productivity's development and have profoundly transformed production methods, industrial development, and economic structures [1]. In the face of profound changes unprecedented in the world in the past century, with the acceleration of technological

revolutions and industrial transformations, the emergence of digital economies and other emerging industries, continuous breakthroughs in cutting-edge technologies, and deep shifts in the global innovation and competitive landscape; simultaneously, the international environment has become complex and volatile, with escalating challenges necessitating reforms in the global governance system. In this context, despite making certain technological advancements, China still faces technological dependencies on foreign entities in some critical areas, posing "bottleneck" issues that not only limit the autonomy of industrial development but also bring potential supply chain risks and national security challenges. Therefore, accelerating the development of new quality productive forces, breaking through these key bottlenecks, and addressing technological shortcomings and industrial weaknesses have become strategic choices and inevitable paths for China to cope with international competition, seize the opportunities of the technological revolution, and achieve high-quality development [2].

The concept of new quality productive forces is not isolated; it is closely related to the long-term pursuit of productivity enhancement and sustainable development globally. In 1972, the United Nations Conference on the Human Environment in Stockholm proposed the idea that the environment and economy must develop in harmony. In 1987, the World Commission on Environment and Development published "Our Common Future," which first introduced the concept of sustainable development for human society. In 1994, the Asian Productivity Organization introduced the concept of Green Productivity and compiled the "Implementing GP Demonstration Projects" manual. The "Manila Declaration on Green Productivity" issued at the First World Congress on Green Productivity in 1996 marked the enhanced global environmental awareness and international recognition of green productivity development, thereby sparking a worldwide "green movement." Countries and regions responded enthusiastically, initiating green productivity plans and conducting relevant practices. Research on green productivity to this day still primarily focuses on economic development, environmental protection, and ecological benefits. Kuosmanen et al., in their measurement of green productivity for energy-intensive manufacturing enterprises in Finland from 2010 to 2019, found that technological progress and industrial restructuring were key factors driving the growth of green productivity [3].

Entering the 21st century, with the acceleration of the global technological revolution and industrial transformation, the connotation of New-Quality Productive Forces has continued to enrich and develop. Governments around the world have increased investments in technological innovation to promote the rapid development of new technologies, industries, and business models, aiming to secure a favorable position in global competition. For example, the European Union has implemented the "Green New Deal" since 2019, aiming to decouple economic growth from resource consumption. At the same time, in response to changing circumstances, it has introduced the "Green New Deal Industrial Plan" and flexibly adjusted funding subsidies to consolidate industrial competitiveness. Germany, through the high-tech startup fund under the "Industry 4.0" strategy, stimulates innovation, aiming to achieve fundamental changes in production methods through digitalization, networking, and intelligent technologies. The United States, on the other hand, is

committed to promoting the intelligent, networked, and green development of manufacturing by implementing the "National Strategic Plan for Advanced Manufacturing" and innovating cooperation models to guide investments in clean energy [4]. China, based on its actual situation, has creatively proposed the concept of "new quality productivity," enriching the connotation of green productivity. Its main strategic plans include leading industrial innovation with technological innovation, promoting the optimization and upgrading of industrial chains and supply chains, cultivating and expanding emerging and future industries, while strengthening the position of enterprises as the main body of technological innovation and expanding high-level opening up to the outside world.

In September 2023, Xi, J. P. General Secretary of China's CPC Central Committee and President of the People's Republic of China, pointed out during a visit to Heilongjiang that "it is necessary to integrate scientific and technological innovation resources, lead the development of strategic emerging industries and future industries, and accelerate the formation of new-quality productive forces." "Actively cultivate strategic emerging industries such as new energy, new materials, advanced manufacturing, and electronic information, as well as future industries, accelerate the formation of new quality productive forces, and enhance new drivers of development" [5]. The Central Economic Work Conference in December 2023 further emphasized that "we should promote industrial innovation through scientific and technological innovation, especially by leveraging disruptive and cutting-edge technologies to foster new industries, new models, and new drivers, and develop new-quality productive forces" [6]. The report of the 20th National Congress of the Communist Party of China stated that "high-quality development is the primary task in building a modern socialist country in all respects" and "we must adhere to the principles that science and technology are the primary productive forces, talent is the primary resource, and innovation is the primary driving force" [7]. In the government work report delivered by Premier Li, Q. in 2024, he pointed out that "we should vigorously promote the development of a modern industrial system and accelerate the development of new-quality productive forces," providing clear direction for China to vigorously develop new-quality productive force [8]. In response to the calls of the Party and the government, various departments and local governments at all levels in China have made positive and constructive responses on how to develop new-quality productive forces. In the current era, we need to consider three questions: ① Are there regional differences in the development of new quality productivity in China? ② Is there any difference in the path of practical activities in developing new quality productivity at home and abroad? ③ Is there any inspiration and reference for the development of new productivity in China from the practical activities of foreign countries?

By comprehensively and systematically combing domestic and foreign literature on the evolution and trend of new quality productivity research, and referring to advanced practical experience at home and abroad, this paper analyzes the future feasibility path of new quality productivity committed to China's high-quality economic development, which is of great significance.

2. Literature review

As Chinese scholars also publish papers in English journals, it is not appropriate to distinguish between domestic and international scholars as the research subjects to separate Chinese and English literature. Therefore, I will classify the literature based on whether it is in Chinese or English.

2.1. Chinese literature review

After the proposal of new quality productivity, academics and various departments have carried out various researches on new quality productivity and formed rich research results. At present, the research content of Chinese literature mainly centers on the following aspects:

Firstly, new quality productivity is a leap on the basis of the traditional productivity, Pu, Q. P. and Xiang, W. emphasized that the new quality productivity mainly consists of "high-quality" laborers, "new medium" labor materials and "new material quality". The new quality productivity mainly consists of "high-quality" workers, "new medium" labor materials and "new material" labor objects, which is the advanced stage of productivity development [9]. Wang and Cheng further pointed out that the core of the new quality of productivity lies in the qualitative leap achieved by the optimal combination of workers, labor materials and labor objects [10]. Zhou and Ye believe that the new quality of productivity is a new type of productivity that emerges through the realization of key and subversive technological breakthroughs led by scientific and technological innovation [11]. Li and Cui believe that the new quality productivity is rooted in the theoretical framework of the Marxist productivity, which represents a more advanced form of productivity that the constituent elements of the productivity are constantly rising in quality, and then show a more advanced form of productivity [12].

Secondly, the connotation and characteristics of the new quality productivity. Zhang and Tang pointed out that the "newness" of the new quality productivity is mainly reflected in the emerging factors of production and the innovative combination of these factors, while the "quality" is reflected in the high quality of the industrial base and the strength of the development momentum. The "newness" is mainly reflected in the emerging factors of production and the innovative combination of these factors, while the "quality" is reflected in the high quality of the industrial base and the strong development momentum [13]. Jiang and Qiao also emphasized that the "newness" of the new quality productivity lies in the new factors, new technologies, and new industries, and the "quality" is reflected in the high quality, multi-quality, and double-quality effect, while the "strength" is reflected in the high quality, multi-quality, and double-quality effect, and the "strength" is expressed in the new factors, new technologies, and new industries. Its "quality" is reflected in high quality, multi-quality and double-quality effect, and its "power" is manifested in the five major productivity of digital, collaboration, green, blue and openness [14]. Li believes that the new quality productivity presents the characteristics of disruptive innovation, new industrial chain, high development quality, etc., and also has the characteristics of the era of digitalization and greening [15]. Hu and Fang believe that the new quality productivity has the main characteristics of mainly mental workers, the technical

characteristics driven by subversive innovation, the structural characteristics of multi-factor penetration and integration, and the morphological characteristics of digitization and greening industry [16]. Yao and Zhang believe that the new quality productivity, need to have the characteristics of scientific and technological innovation driven, industrial high efficiency and low consumption and environmental sustainability, digital empowerment, modernization of national governance capacity [17].

Thirdly, the practical path and institutional guarantee for the development of new quality productivity. Ren and Wang believe that the digital new quality productivity, as a form of expression of the new quality productivity, provides a new productivity base element for the high-quality development of the economy [18]. Zhang et al. pointed out that the fundamental carrier to promote the development of the new quality productivity lies in the deep integration of the digital economy and the real economy, and the development of the new quality productivity is the road to realize the new industrialization. China needs to strengthen the institutional guarantee to create a favorable institutional environment for the development of new quality productivity [19]. Zheng and Xie pointed out that a new type of national system should be used to ensure that the key core technologies are attacked to form the real form of new quality productivity [20]. Jin also emphasized the development of new quality productivity not only to have the factor structure of science and technology innovation, but also to be equipped with the innovation bearing and allow trial and error institutional arrangements [21].

Since the research of domestic scholars mainly focuses on the two-year period of 2023–2024, the research generally belongs to the stage of clarifying the connotation of the terminology and initially constructing a theoretical framework to provide a foundation for subsequent research. The development of new quality productive forces is a long-term task, and with the advancement of in-depth practice, the future research on its practical path and the specific problems arising from practice needs to be further deepened.

2.2. English literature review

The research content of the English literature mainly focuses on technological progress, environmental protection, sustainable development and industry application, and the research focuses also mainly on how to promote the development of green productivity.

Firstly, technological progress and productivity. Scholars Acemoglu D and Restrepo P have deeply analyzed the impact of technological progress on NQP from the perspectives of technological growth and employment impact, providing a theoretical basis for policy formulation [22,23]. Liakos et al. synthesized the application of machine learning in agriculture, showing how new technologies can enhance the efficiency of agricultural production as one of the important areas for the application of new quality productivity [24]. Lowry et al. explored the opportunities and challenges of nanotechnology in the agricultural technology revolution, providing directions for new quality productivity innovations in the field of agricultural science and technology [25]. Lange et al. focused on the impact of digitization on energy

consumption, providing ideas for the application of new mass productivity in energy conservation and emission reduction [26].

Secondly, environmental policies and sustainable development. Albrizio et al. found that environmental policies have a positive impact on productivity growth of industries and firms, which provides guidance for the practice of new quality productivity in sustainable development [27]. Bünemann et al. focused on the relationship between soil quality and agricultural productivity and emphasized the importance of soil conservation in new quality productivity enhancement, which is closely related to sustainable development [28]. Raza et al. focused on the impacts of climate change on crop adaptation and coping strategies, providing a reflection on the role of NQP in addressing global climate change challenges [29]. Wang and Zhang investigated the mediating effect of environmental regulation through the digital economy to promote high-quality economic development in China, emphasizing the role of the combination of environmental policy and the digital economy in sustainable development [30].

Thirdly, industry application and practice. Song et al. explored the impact of fiscal decentralization on green total factor productivity, providing a theoretical basis for the practice of new quality productivity in the context of green development [31]. Wu et al. explored the impact of Internet development on green total factor productivity, providing a theoretical basis for the practice of new quality productivity in the context of the digital economy, showing how digital technology can promote the development of green productivity [32].

Synthesizing domestic and international literature research, the existing research literature on new quality productivity provides us with rich research perspectives and profound insights for understanding the theoretical connotation and formation logic of new quality productivity. However, the current research of scholars at home and abroad is still limited to small-scale cooperation and lacks international consensus; there is a lack of complete and systematic analysis and organization of the literature in Chinese and English, and the literature review is also limited to the analysis of the literature in Chinese, which lacks an international perspective; there is a lack of understanding of whether there are regional differences in the process of the development of new quality productive forces in China; whether there are differences in the paths of the development of new-quality productive forces in the domestic and overseas practices; and whether foreign practices are useful for the development of new-quality productive forces in China. Therefore, this paper adopts the CiteSpace knowledge mapping analysis tool to comprehensively and systematically analyze the current status and hotspots of domestic and foreign research in this field, aiming to reveal the research dynamics and development trends, compare the development methods of domestic and foreign new quality productivity, and explore the cooperative development mode of the new quality productivity field, so as to deepen the understanding and application of the new quality productivity.

3. Data sources and research methodology

3.1. Data sources

The research data for this paper were sourced from two core databases: China National Knowledge Internet (CNKI) and Web of Science. To ensure that the literature data used in this study comprehensively covers the current research status in this field, the search was conducted without any time restrictions, encompassing "all years" up to the data retrieval date of 18 September 2024.

For Chinese literature, a precise search was performed using the keyword "new quality productivity" as the theme. The literature type was limited to "academic journals," and the source categories were selected as "Peking University Core Journals" and "Chinese Social Sciences Citation Index (CSSCI)." Articles such as notes, comments, prefaces, and topic guides were excluded. After data de-duplication, a total of 1189 valid articles were retained.

For English literature, the search was conducted using the keyword "New quality productivity" as the theme. The literature sources were selected from core journals, with the version set to "Science Citation Index Expanded." The language was limited to "English," and the literature type was chosen as "journals." After screening and organizing the literature, irrelevant articles were excluded, resulting in a final set of 6106 valid articles.

In total, 7295 valid articles in both Chinese and English were collected and used as the data source for the knowledge map analysis in this paper.

3.2. Research methods

In this paper, we mainly use CiteSpace software to draw knowledge maps and conduct econometric analysis of the literature included in the core database of new quality productivity at home and abroad. CiteSpace is a scientific literature analysis tool jointly developed by Professor Chen, C. M. of Drexel University and the WISE Laboratory of Dalian University of Technology. It is mainly used to visualize and analyze scientific literature, helping researchers to sort out the development of the research field and discover research hotspots and trends. The software transforms complex literature data into intuitive knowledge maps by means of information visualization, with powerful bibliometric and visualization analysis capabilities, providing researchers with efficient research tools.

To analyze the literature included in the core databases of new quality productivity at home and abroad. As shown in **Figure 1**, the research steps of this paper are as follows: firstly, collect the data of journals on the topic of "new quality productivity" from China Knowledge and WOS databases during the period from 2014 to 2024 to ensure the representativeness and quality of the literature. Second, literature screening was conducted, focusing on the core journal literature in Chinese and English; CiteSpace was used to conduct econometric analysis of the publication time and authors and organizations to initially depict the research profile. Then, through the keyword frequency, centrality, clustering, emergent words and timeline analysis, we dig deeper into the research hotspots and evolutionary trends. Finally, all the analysis results are synthesized and discussed to clarify the research hotspots and development trends, forming a comprehensive and systematic research conclusion.
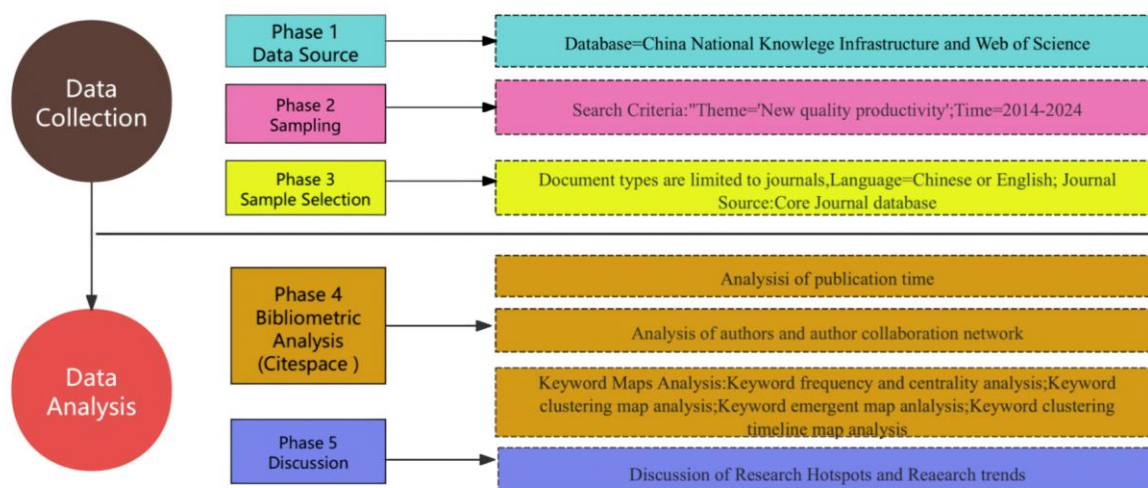
**Figure 1.** Research flowchart (drawn by the author).

4. Literature research results

By comparing the literature from China Knowledge Network and WOS, we present the results of analyzing the basic information, authors' partnership network and research hotspots, in order to compare the research focus and differences between the Chinese and English literature.

4.1. Basic situation of issued literature

According to the trend, we can see that the foreign literature first started in 1976, and when it really began to have a certain scale, it started from 2000, and generally showed a trend of increasing year by year. Starting after 2020, this research trend climbs year by year, and the heat remains high. Before 2023, there was very little literature on new quality productivity in China, and after General Secretary Xi, J. P. proposed new quality productivity during his research in Heilongjiang Province on 7 September 2023, the research trend has been increasing and the number of research papers has been growing rapidly. Therefore, the Chinese literature in this paper mainly focuses on the years 2023 and 2024, while the English literature has a wider distribution of time intervals. Details are shown in **Figure 2**.
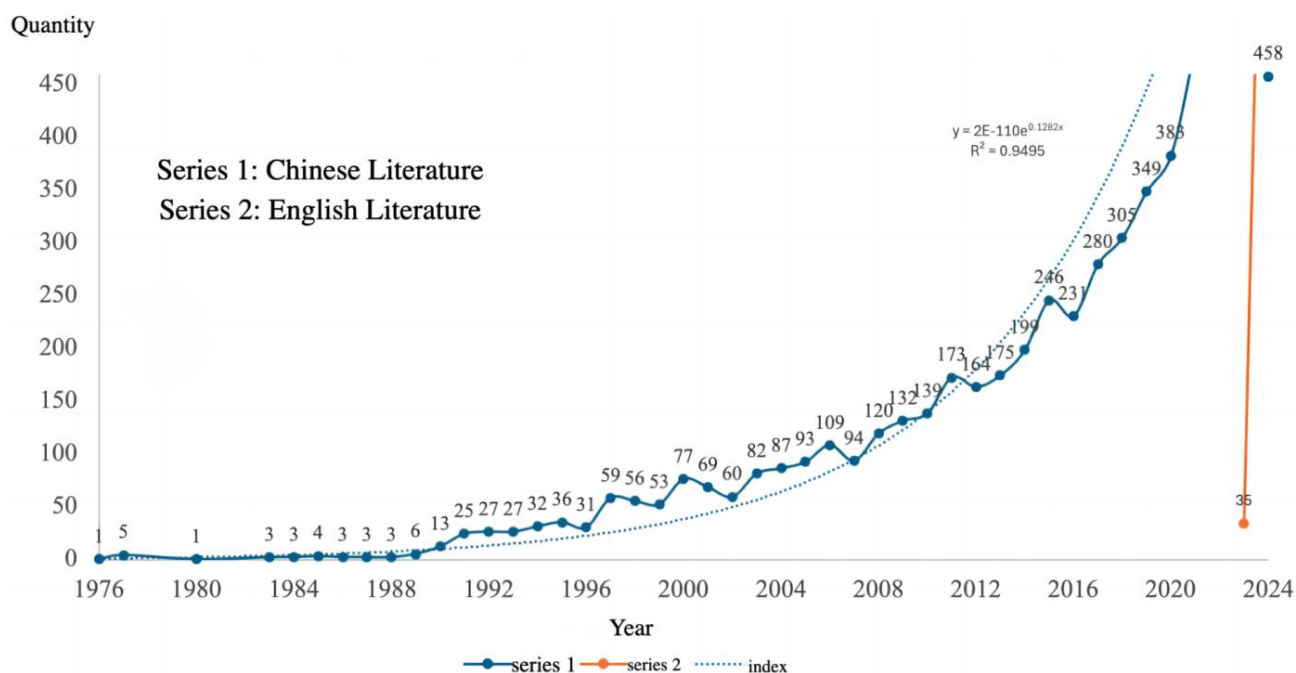
Figure 2. Comparison of the time of publication and the number of publications in English and Chinese literature on new quality productivity.

4.2. Analysis of authors' collaborative networks

In the Chinese literature, Xu, Z. had the most collaborations with other scholars, co-authoring a total of 24 papers. Zhou, W. had 15 papers, and Ren, B. P. had 10 papers, all starting in 2023. In 2024, collaborations among multiple scholars increased, with Zhang, X. H. co-authoring 9 papers and Jiang, Y. M. co-authoring 8 papers. This indicates that research on new quality productivity in China is developing rapidly and that collaboration among scholars is gradually strengthening. See **Table 1** for details.

Table 1. Top 10 authors with publications in CNKI and WOS.

WOS				CNKI			
Rank	Author	Quantity	Year	Rank	Author	Quantity	Year
1	Berg, J.	16	2017	1	Xu, Z.	24	2023
2	Capsa, D.	16	2017	2	Zhou, W.	15	2023
3	Kobelt, G.	16	2017	3	Ren, B. P.	10	2023
4	Spinelli, R.	14	2015	4	Zhang, X. H.	9	2024
5	Shivay, Y. S.	6	2015	5	Jiang, Y. M.	8	2024
6	Magagnotti, N.	6	2015	6	Zhang, J. Y.	8	2023
7	Siddique, K. H. M.	6	2023	7	Zhou, S. D.	6	2024
8	Gannedahl, M.	6	2017	8	Lu, M. F.	6	2024
9	Dhar, S.	5	2015	9	Yao, S. J.	5	2024
10	Eriksson, J.	5	2017	10	Chen, J.	5	2024

4.2.1. Network diagram of author collaboration in Chinese literature

As shown in **Figure 3**, from the collaboration network diagram of Chinese literature authors, it can be seen that Xu, Z. has collaborated with multiple scholars

such as Zheng, L. H. and Zhang, J. Y., while most other scholars have primarily collaborated in pairs, with fewer instances of collaboration among multiple individuals. There is still room for further strengthening cooperation among Chinese scholars in the future.
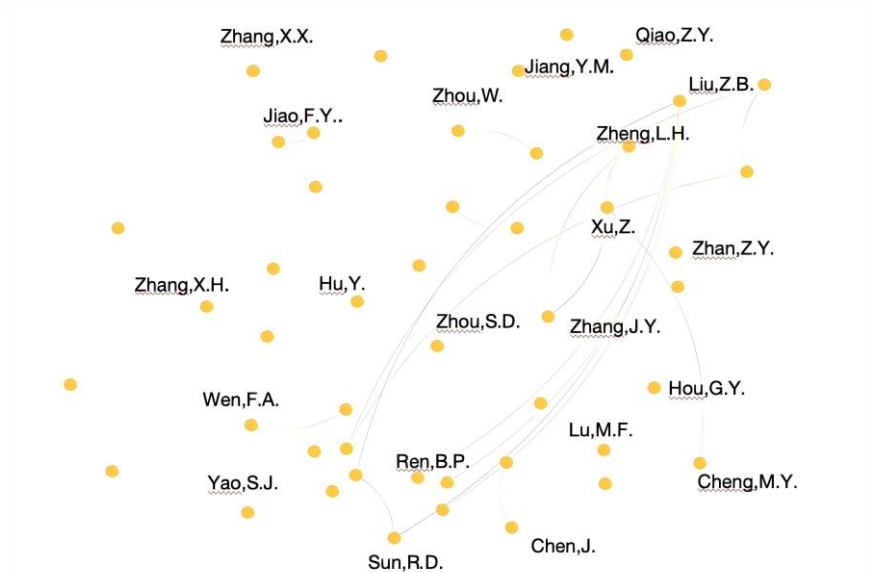
Figure 3. Collaboration network diagram of Chinese literature authors.

4.2.2. Network diagram of author collaboration in English literature

From the collaboration network diagram, it is evident that scholars such as Magagnotti, Natascia and Otté, Kerstin demonstrate a high level of cooperation and have formed a closely connected collaborative circle, indicating their deep academic exchanges and joint research efforts. Additionally, the frequent collaboration between Spinelli, Raffaele and Capsa, Daniela also stands out, reflecting their tight cooperation within the same research field. Details are shown in **Figure 4**.
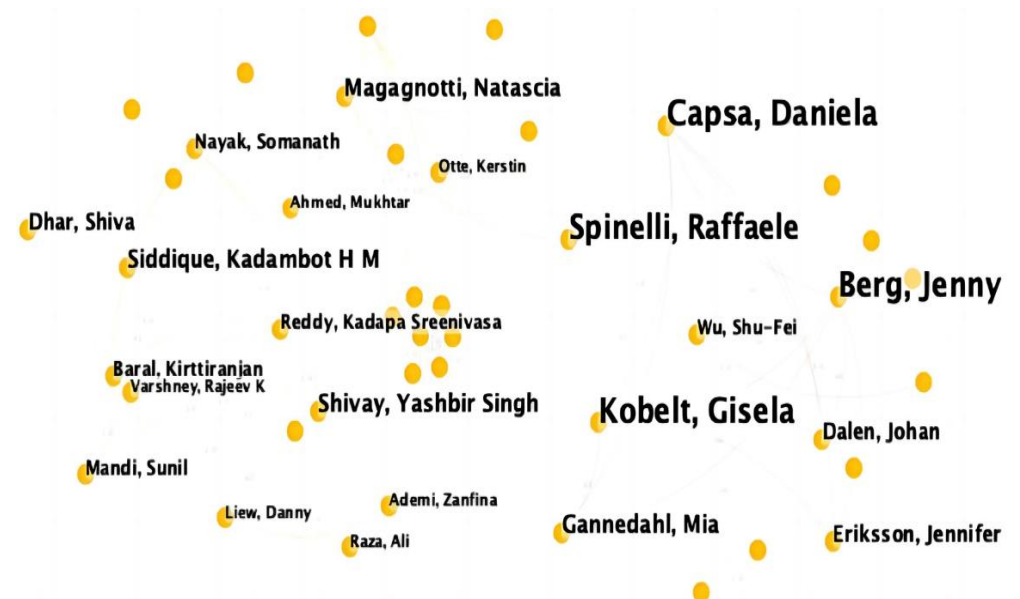
Figure 4. Collaboration network diagram of English literature authors.

As can be seen from the network diagram of cooperation relationship between authors of domestic and foreign literature, the current research of domestic and foreign scholars in general has shown a small-scale cooperation mode, less cooperation between research teams, and not many connecting lines, which shows that the research on the new quality productivity needs to be further deepened, no matter whether it is the exchange between domestic and foreign scholars, or between scholars within each country.

4.3. Analysis of research hot spots

In bibliometrics, research hotspots in subject areas are generally represented by high-frequency keywords. The higher the frequency of a keyword, the more attention the research content it represents receives. The research direction with higher attention generally predicts the future development trend of the field, which helps research scholars to grasp the development dynamics of the field as a whole.

4.3.1. Analysis of research hot spots in Chinese literature

By analyzing the Chinese literature data, we can grasp the research dynamics of domestic scholars in the field of new qualitative productivity, and make statistics on the top 10 keywords of new qualitative productivity. Between 2023 and 2024, among the top 10 popular research topics in China, "science and technology innovation" takes a distant lead with a frequency of 165 and a centrality of 0.77, and occupies a central position. The center of the world's top 10 hot research topics in China between 2023 and 2024. "Digital Economy" follows with a frequency of 57 and centrality of 0.19. In 2024, 'Data Elements' rises with a frequency of 45 and centrality of 0.22, indicating its importance. Meanwhile, "vocational education" becomes the focus with 35 occurrences and a centrality of 0.17. In addition, "future industry", "artificial intelligence", "digital technology" and 'common wealth' also appear frequently. This also reflects the main research focus and direction of domestic scholars on the new quality of productivity. Wang [33] pointed out that strategic emerging industries and future industries are the core carrier and the main position for the formation of new quality of productivity. Shi and Xu [34] believe that the development of new quality productivity can further improve the level of science and technology, promote the transformation and upgrading of industries, and ultimately realize the high-quality development of the economy. Shen, K. R. et al. believe that the new quality productivity is a specific form of advanced productivity in the new era, and that the sustained innovation of digital technology has accelerated the change of the mode of production, which then empowers the high-quality development. Du and Li [35] believe that breakthrough technological innovation has an important role in promoting the formation of new quality productivity. In the era of digital economy, the development of new-generation information technology, such as the Internet, big data, cloud computing, artificial intelligence and other new-generation information technology, further empowers industrial transformation and upgrading. Therefore, in the new stage of development, the new quality productivity also shows the characteristics of the era, such as digitalization, intelligence, networking and data. Details are shown in **Table 2**.

Table 2. Top 10 keywords in Chinese literature.

Rank	High frequency words	Quantity	Centrality	Year
1	Technological Innovation	165	0.77	2023
2	Digital Economy	57	0.19	2023
3	Data Elements	45	0.22	2024
4	Vocational Education	35	0.17	2024
5	Future Industries	26	0.09	2023
6	Artificial Intelligence	24	0.07	2024
7	Digital Technology	23	0.07	2023
8	Common Prosperity	21	0.09	2023
9	Technological Innovation	21	0.07	2024
10	Productivity	20	0.03	2023

4.3.2. Analysis of research hot spots in English literature

The keywords of the English literature were counted and the top 10 keywords were analyzed to understand the research hot spots of the academia on the new quality productivity, as shown in **Table 3**.

Table 3. Top 10 keywords in English literature.

Serial Number	Keyword	Frequency	Centrality	Years
1	productivity	563	0.04	2014
2	quality	548	0.03	2014
3	growth	348	0.03	2014
4	impact	269	0.04	2014
5	performance	244	0.02	2014
6	management	235	0.05	2014
7	yield	176	0.03	2014
8	climate change	168	0.05	2014
9	quality of life	144	0.03	2014
10	model	142	0.02	2014

Table 3 shows that the keyword clustering map of the English literature is centered on "productivity", with a frequency of 563, highlighting its global importance. The high frequency of "impact" and "performance" suggests that research not only focuses on productivity improvement, but also on its socio-economic effects and optimization. High-quality development, green productivity and China-style modernization have become key issues. First, high-quality development has attracted attention because of its strong link to economic prosperity, improved livelihoods and national strength. Countries are pursuing development with the aim of improving living standards and enhancing international competitiveness. Second, in the face of the serious challenge of climate change, green productivity has emerged, emphasizing sustainable development and balancing economic growth with environmental protection. Finally, Chinese-style modernization faces environmental pressures amidst rapid growth, so green productivity research focuses on China to explore a win-win

path for both the economy and the environment. The Chinese government's efforts in green development and low-carbon transition have achieved remarkable results, providing researchers with valuable practical experience and models.

4.4. Keyword clustering analysis

Through clustering of keywords, research hotspots and cluster labels of new-quality productivity can be identified, and each cluster can be analyzed to understand various research perspectives on new-quality productivity in academia. Based on the S-values and Q-values obtained from the clustering of both Chinese and English literature, the clustering is valid. The key information and trends reflected in these clusters are as follows:

4.4.1. Keyword clustering analysis of Chinese literature

According to **Figure 5,** we can observe the research framework for promoting the comprehensive socio-economic development of China's new forms of productivity. The digital economy (#1), as a current research hotspot, focuses on the widespread application and profound impact of digital technologies in the economic sphere. The issue of talent (#0) is also gaining significant attention, encompassing key aspects such as talent cultivation, recruitment, and management. Research on regional disparities (#4) aims to explore the imbalanced economic and technological development across different regions. Data elements (#6), as a new type of production factor, are increasingly recognized for their value and significance. Research on practical pathways (#5) emphasizes the conversion of theory into practice to facilitate steady progress in various endeavors. Industry-education integration (#7) highlights the deep integration of education and industry to cultivate talents that better meet market demands. Research on future industries (#2) keeps pace with the times, exploring emerging industry trends and vast prospects. Artificial intelligence (#3), as a cutting-edge technology, is profoundly transforming various aspects of social life through its applications. Agricultural power (#8) is dedicated to enhancing agricultural productivity through technological innovation and promoting the modernization of agriculture.
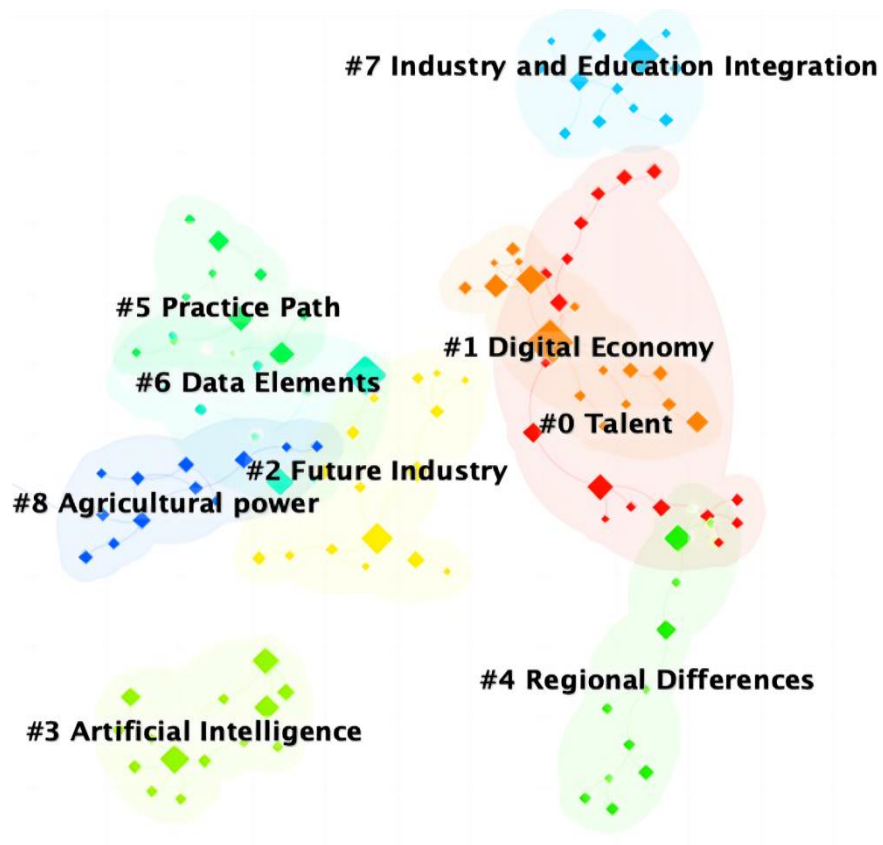
Figure 5. Clustering map of keywords in Chinese literature.

New quality productivity is deeply integrated with cutting-edge technologies such as digital technology, data technology, and artificial intelligence, driving the digital transformation of China's industrial system. As the core of high-quality development, technological innovation aids in the green and low-carbon transformation of industries by breaking through frontier technologies and improving the innovation system. Traditional industrial bases like Northeast China urgently need to promote full value chain collaborative transformation through digital upgrades in the process of new industrialization, pushing China's economy towards a more sustainable and high-quality direction.

4.4.2. Keyword clustering analysis of foreign literature

As shown in **Figure 6**, Quality of Life (#1) focuses on improving people's living standards and happiness, covering various aspects such as health, housing, education, and employment. Through improving environmental conditions, technological innovation, and social policies, it aims to enhance overall life quality. Molecular Technology (#2) involves research and application of molecular-level technologies in fields such as biomolecules, drug development, and gene editing, aiming to solve health problems, promote medical advancements, and develop new materials. Machine Learning (#3) centers on the design of machine learning algorithms, model training, data analysis, and pattern recognition applications. It leverages computer algorithms to achieve intelligent data processing and decision-making, widely applied in finance, healthcare, transportation, and other sectors. Climate Change (#4) studies the causes of climate change, its impact on ecosystems, the establishment of climate

models, and mitigation strategies, which are of great significance for understanding and slowing down climate change. Environmental Regulations (#5) pertain to environmental protection and regulation formulation, including environmental policy evaluation, pollution control, and sustainable development strategies, aiming to protect the natural environment and ecosystems through legal and policy means. Technological Innovation (#6) focuses on new technology development, technology application, innovation management, and other aspects, driving technological progress and economic development across fields such as information technology, biotechnology, and new energy. Diversity (#7) explores issues such as cultural diversity, gender equality, racial equality, and social inclusivity, aiming to promote social fairness and harmonious development. Sustainability (#8) emphasizes the balance between resource utilization, environmental protection, economic development, and social progress, striving for a long-term sustainable development model that encompasses ecological, economic, and social dimensions.
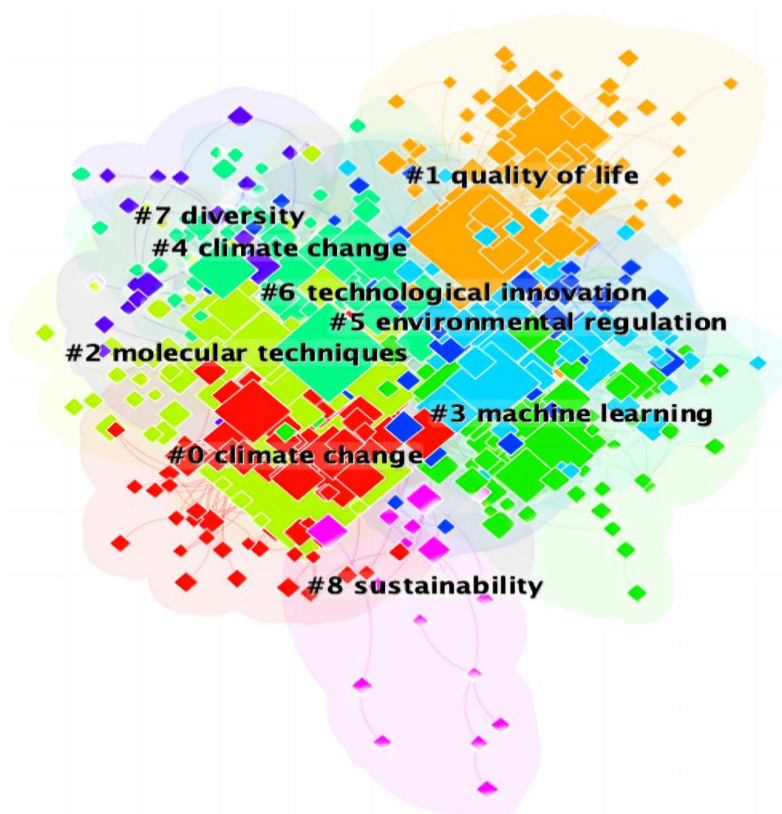
Figure 6. Keyword clustering mapping of foreign language literature.

Foreign literature still mainly focuses on the study of green productivity and environmental protection, sustainable and healthy development. Although both green productivity and new quality productivity pursue sustainable development, they have their own focus. Green productivity focuses on reducing negative environmental impacts and promoting the recycling of resources, while new quality productivity emphasizes improving production efficiency, scientific and technological innovation and industrial upgrading to achieve high-quality economic development. It is evident that China has enriched the meaning of green productivity by proposing new quality productivity.

5. Research frontiers and trend analysis

The evolution analysis of research fields primarily involves the use of time-series graphs to obtain the distribution of research hot spots and themes in different years within a discipline, further analyzing to derive the evolutionary trends in the field of new-quality productivity research.

5.1. Timeline charts

5.1.1. Keyword timeline map of Chinese literature

In order to further grasp the research dynamics of Chinese scholars in the field of new quality productivity, Chinese literature keywords were utilized to draw a time-series mapping of the literature keywords in the relevant research fields, as shown in **Figure 7**.
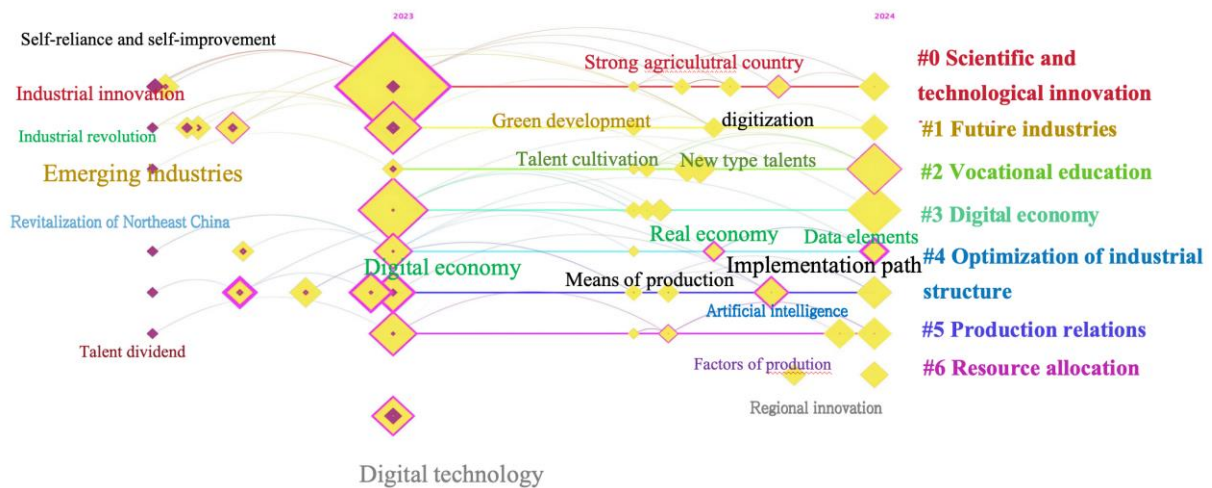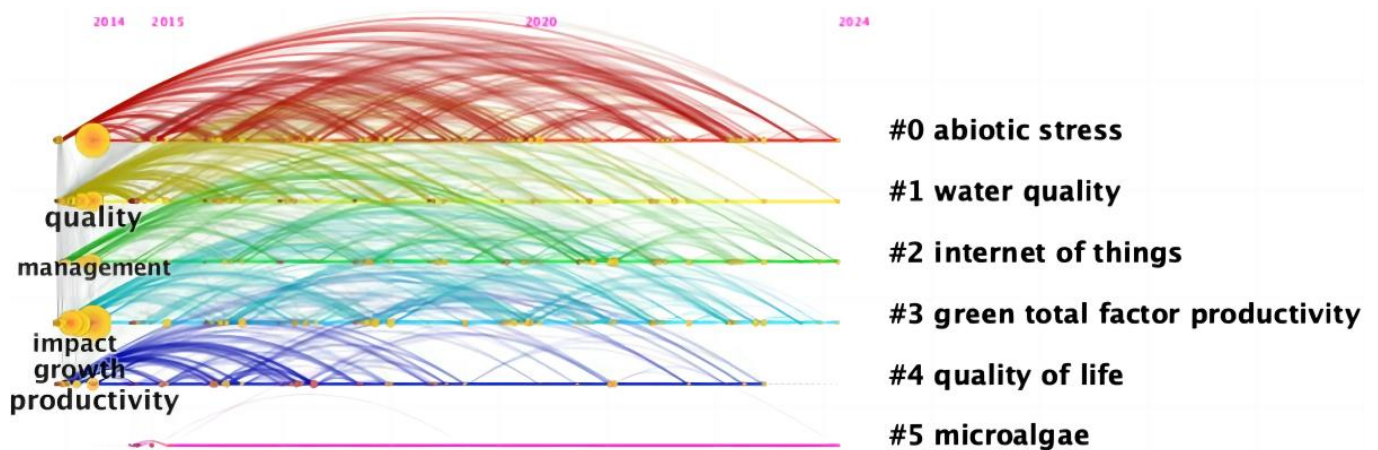

Figure 7. Keyword sequence diagram of Chinese literature.

China's research primarily concentrates on the period from 2023 to 2024. In the initial stage, research focused on innovative factors and production factors, exploring their potential impact on economic growth. Subsequently, technological innovation and the digital economy gradually emerged as significant forces driving changes in production relations and economic growth. In recent years, artificial intelligence, technology finance, and vocational education have become new hot spots in research, demonstrating great potential in promoting industrial upgrading, optimizing resource allocation, and enhancing labor quality. These studies not only reveal the internal logic of economic development but also provide a solid theoretical foundation and practical guidance for the formulation and implementation of future policies.

5.1.2. Keyword timeline map of English literature

In order to grasp the evolutionary trend of international scholars in the field of new quality productivity, the English literature data is used to draw the time-series map of keywords in related research fields, as shown in **Figure 8**.

Figure 8. Keyword sequence diagram of English literature.

Based on this timeline chart, we can observe the development trends of five key areas from 2014 to 2024: "abiotic stress," "water quality," "internet of things," "green total factor productivity (impact on growth)," and "quality of life and productivity." The research focus demonstrates clear phased changes over the timeline from 2014 to 2024.

From 2014 to 2015, research primarily focused on strategies to cope with abiotic stress, aiming to understand the impact of non-biological factors on ecosystems and explore mitigation measures. At the same time, water quality management began to receive attention, with research concentrating on the causes of water quality deterioration and initial treatment solutions. Additionally, the technology of the internet of things initially entered the research horizon, laying the foundation for subsequent intelligent management.

From 2016 to 2020: As research deepened, green total factor productivity emerged as a focal point, emphasizing environmental protection and sustainable development alongside economic growth. Concurrently, studies related to quality of life gradually increased, reflecting a concern for human well-being and social development. During this period, the internet of things technology saw widespread application, with research exploring its impact on the socio-economy.

From 2021 to 2024: Research focus shifts to biotechnology applications such as microalgae, with possible breakthroughs in biofuels and biotechnology. In addition, ongoing quality management and productivity impact studies remain central, but with an increased focus on integrated development and sustainability impact assessments.

In summary, the focus of research has evolved from basic ecological stress and water quality management to a focus on green productivity, quality of life, IoT technology applications, and ultimately on biotechnology applications such as microalgae. This evolution reflects a shift in scientific research from basic resource management and environmental protection to sustainable development and high-technology areas.

5.2. Keyword emergence analysis

The term "emergent words" refers to keywords whose frequency of use increases dramatically in a specific period of time or research area, and they are often indicative

of emerging concepts or cutting-edge research hotspots. In this study, we applied the emergent word detection method to screen out the 10 emergent words with the highest intensity, and accordingly analyzed the changing trends of new quality productivity research topics in Chinese and English literature.

5.2.1. Analysis of keyword emergence in Chinese literature

Table 4 shows that research on new quality productivity in China mainly began in 2023, demonstrating a concentrated outbreak trend. Among the keywords, "future industries" topped the list with a citation strength of 2.25, becoming the most popular topic during this period. Following closely behind was "self-reliance and self-improvement" with a citation strength of 1.29. Additionally, keywords such as "science and technology," "digital technology," and "emerging industries" were also highly focused, with citation strengths not lower than 0.64. These keywords primarily centered on emerging technologies and industrial development, reflecting the current frontier trends and future directions of scientific research. Scholars such as Zhang et al. [36] systematically elaborated on the connotations, theoretical innovations, and value implications of new quality productivity in 2023, marking the official rise of academic research on new quality productivity in China.

Table 4. Knowledge graph of Chinese literature burst words.

Keywords	Year	Strength	Begin	End	2023–2024
Future industry	2023	2.25	2023	2024	▬
Self-improvement	2023	1.29	2023	2024	▬
Science and technology	2023	1	2023	2024	▬
Digital technology	2023	0.96	2023	2024	▬
Emerging industry	2023	0.75	2023	2024	▬
Intelligent Age	2023	0.64	2023	2024	▬
Development Strategy	2023	0.64	2023	2024	▬
Collaboration	2023	0.64	2023	2024	▬
Tax incentives	2023	0.64	2023	2024	▬
Tax reform	2023	0.64	2023	2024	▬

Note: The horizontal line represents the time interval from 2023 to 2024.

5.2.2 Analysis of keyword emergence in English literature

Table 5 indicates that in 2014, scholars' research areas were primarily focused on "quality of life" and "cost efficiency." From 2015 to 2020, the research domains shifted to "agricultural production efficiency," "diseases," and "water resource utilization." From 2022 to 2024, the research hotspots concentrated on "Internet of Things," "pollution," "machine learning," and "deep learning," demonstrating a yearly increase in the popularity of emerging research fields.

Internationally, the field of green productivity research exhibits trends of multidisciplinary integration, green production, and intelligent technology. Green Total Factor Productivity (GTFP) and machine learning technologies have emerged as

hot topics. GTFP, emphasizing environmental friendliness and sustainable development, has become a crucial indicator for measuring the relationship between economic growth and the environment. Since 2018, China has actively addressed climate change and promoted the construction of a green and low-carbon economic structure. Furthermore, machine learning technologies, supported by data-driven approaches, facilitate resource management, environmental monitoring, and other areas, thereby contributing to the development of green productivity and pushing the economy towards a more environmentally friendly and efficient direction. The trend towards intelligent technology is evident.

Table 5. Knowledge graph of English literature burst words.

Keywords	Year	Strength	Begin	End	2023–2024
Quality of life	2023	2.25	2023	2024	▬▬▬
Multiple sclerosis	2023	1.29	2023	2024	▬▬▬
Burden of illness	2023	1	2023	2024	▬▬▬
Double blind	2023	0.96	2023	2024	▬▬▬
Green total factor productivity	2023	0.75	2023	2024	▬▬▬
Water use efficiency	2023	0.64	2023	2024	▬▬▬
Primary productivity	2023	0.64	2023	2024	▬▬▬
New Zealand	2023	0.64	2023	2024	▬▬▬
Disease	2023	0.64	2023	2024	▬▬▬
Digital economy	2023	0.64	2023	2024	▬▬▬

Note: The horizontal line represents the time interval from 2023 to 2024.

It can be seen that although China's research on new quality productivity started late, it has developed very rapidly and the research is very hot. Currently, China's development strategy is closely related to scientific and technological progress, digital transformation, intelligent manufacturing, etc., through the realization of effective innovation to promote industrial transformation and upgrading, so as to achieve the goal of high-quality development.

6. Discussion

6.1. Research limitations

Due to the abundance of Chinese and English core journal papers on the topic of "new quality productivity," considering the timeliness of the research, I primarily read papers with higher citation counts and significant weight in keyword clustering. It was not feasible to cover all the papers, and thus the literature review formed on this basis may have slight biases. However, overall, it will not affect the accuracy and systematicness of summarizing the current research dynamics and trends in the field. Meanwhile, there are numerous software options for drawing knowledge maps. Although CiteSpace is a relatively representative software, it is not as good as

VOSviewer in text visualization and expressiveness, which may also affect the graphical presentation to a certain extent.

6.2. Research prospects

In future research endeavors, I will comprehensively read all relevant key literature to provide a more comprehensive, systematic, and specific focus on the study of new quality productivity. I will utilize diverse software tools to enhance the creation of various charts, achieving information visualization in a clearer and more accurate manner.

7. Conclusion

This article employs a bibliometric approach to conduct a statistical analysis of 7295 core journal articles on "new-quality productive forces" from CNKI and WOS. It focuses on analyzing keywords, collaboration networks, research hotspots, timelines, and burst words in the field of new-quality productive forces both domestically and internationally. Through an in-depth study of these domestic and international literature sources, the following conclusions are drawn:

(1) Digital economy and emerging industries have emerged as research hotspots in the field of new-quality productive forces. With the development of next-generation information technology, the digital economy, as a foundation, is deeply integrated with emerging and future industries, forming new industries and driving significant changes in disruptive innovative technologies. Through application in the industrial production process, these technologies permeate production factors and are converted into actual productive capacities, leading to profound transformations and tremendous growth in productive forces, thereby forming new-quality productive forces. Countries around the world are exploring development paths for new-quality productive forces that suit their national conditions. Western countries, building on green productive forces, focus on environmental protection and ecological benefits, differing somewhat from China's research emphasis. However, the overall goal is to promote sustainable economic development, providing direction for the progress of human society. China needs to fully consider its national conditions and clarify future development strategic priorities based on the actual stage of economic development, in order to facilitate sustained, rapid, and healthy economic growth.

(2) Interdisciplinary collaboration and the integration of multidisciplinary research have taken initial shape. New-quality productive forces are closely related to disciplines such as digital science, artificial intelligence, and machine learning, with the latest technologies from various disciplines mutually inspiring and promoting each other. The emergence of interdisciplinary fields like information technology and new material technology signifies that new-quality productive forces are driving the deep integration of the industrial economy, and revolutionary leaps are occurring in productive forces and their elements. The fourth industrial revolution is on the horizon, and interdisciplinary collaboration in the field of new-quality productive forces is about to become normalized. Currently, as China promotes industrial restructuring and technological innovation through the development of new-quality productive forces to facilitate economic growth, it is also important to properly handle the relationships

between government and market, research institutions and enterprises, old and new production relations, as well as autonomous innovation and open cooperation.

(3) Chinese scholars should emphasize both breadth and depth in the field of new quality productivity research. In terms of breadth, China's research institutions have conducted more research in the last two years, with foreign scholars focusing more on technological progress, sustainable development and industrial applications, while Chinese scholars are mainly concerned with the interpretation of the connotation of new quality productivity, the construction of theoretical frameworks and the construction of evaluation systems. The themes and directions of scholars' attention are so different that it is difficult to form organic integration and connection. Chinese scholars also need to fully take into account the differences in the level of economic development of various regions in China, and carry out empirical research on the practical activities of various regions, in order to summarize the reasonable path of the development of new-quality productivity in China, and provide a realistic basis for the development of new-quality productivity. In terms of depth, there have been a number of English papers published by Chinese scholars, as well as collaborative research with foreign scholars, but overall, there has been no deep cooperation on a larger scale, presenting a decentralized research pattern of multidisciplinary and multi-faceted. At the same time, foreign scholars have paid insufficient attention to and studied the development of China's new quality productivity, focusing more on the exploration of the practical activities of their own industries. Therefore, Chinese scholars need to strengthen in-depth cooperation with scholars from different countries, increase research efforts, and improve the center position and world influence.

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