

A Bibliometric Review on the Digital Economy and Economic Growth Scholarship: Based on CiteSpace Software and WoS Database

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Abstract: In current academic and practical realms, there is a growing focus on exploring the correlation between the digital economy and economic development. Despite this heightened attention, a notable absence of systematic reviews analyzing this nexus exists. To address this gap, a comprehensive literature review, incorporating bibliometric and scientometric analyses, is imperative. Utilizing the Web of Science (WoS) database and CiteSpace (6.2.R4(64-bit)Advanced), we conduct an in-depth analysis of the digital economy and economic development research over the past two decades. The main results are as follows: Major contributors include universities and government departments, with notable input from Ukraine, Russia, and China. Collaborations are primarily country-based, and transnational groups are infrequent. Future research should explore digital technology's role in sustainable development, the catalyzing impact of digital innovation on emerging industries, the digital economy's influence on social inequality, and digital transformation.

Keywords: Scientometric analysis; digital economy and economic growth; citespace.

1. Introduction and Literature Review

In the age of rapid information technology and global digitization, the digital economy emerges as a key driver in global economic development (Chinoracky & Corejova, 2021; Savina, 2018).. Its swift expansion stimulates consumption, fuels investment, generates employment, and boost innovation and competitiveness, offering unprecedented growth opportunities for various regions (Abdurakhmanova et al., 2020; Goldfarb & Tucker, 2019a; Jiang & Wang, 2022; Wang Q., 2023). Despite its significance, a lack of direct evidence hampers understanding its role in shaping a modern economic system. To bridge this gap, conducting a systematic bibliometric analysis of existing literature can unravel the mechanisms and effects of the digital economy on economic development. Overcoming challenges like unclear definitions and lagging data, this approach provides a clearer understanding of the digital economy's actual impact, aiding policymakers and researchers in making informed decisions.

Reviewing the existing literature, scholars have extensively researched the impact of the digital economy on economic growth. The main focus has been on two aspects: positive impact and negative impact. Within the positive impact aspect, studies mainly fall into two categories. The first category emphasizes the technical attributes of the Internet, following the basic logic that technological progress promotes economic growth. These studies, often employing empirical methods, explore the contribution of advancements in Internet technology to economic growth (Choi & Hoon Yi, 2009; Czernich et al., 2011; Tchamyoun et al., 2019). Typical conclusions from such studies include that an improvement in certain indicators of Internet technology leads to a corresponding improvement in indicators reflecting economic growth. However, these conclusions vary, manifesting in two aspects: numerical disparities and directional inconsistencies (Sun et al., 2010; Zhang Y., & Li, 2008). The disparities in

numerical values and correlations reflect limitations imposed by data or research methods, and more importantly, a lack of in-depth mechanistic analysis in these studies regarding the relationship between Internet technology and economic growth. The second category explores the effects of applications of technologies like the Internet from the perspective of their impact. In comparison to the first category, these studies place more emphasis on exploring mechanisms. On a macro level, the starting point of such studies is often discussing the process and mechanism through which technological innovation influences the transformation and upgrading of industrial structures (Babkin et al., 2020; Eapen, 2012; Williams, 2021). On a micro level, these studies often focus on specific areas within the digital economy. In the production aspect, studies often start from the cost perspective, such as Zhang L. and Zhang P. pointing out the positive role of Internet technology in reducing marketing, management, and research and development costs (Zhang L., & Zhang, 2016). Yang X. analyzes the economic logic of the digital economy development from three levels: micro (enterprises), meso (industries), and macro (economic operation) (Yang X., 2017).

The second aspect involves scholars discussing the potential exacerbation of inequality brought about by the development of the digital economy. Critics express concerns about potential exacerbation of economic inequality, unequal access to technological benefits (LePoire, 2005), and the environmental impact of digital infrastructure (Tang, K. & Yang, 2023). Such as Yudina (2020) critically examines theoretical and methodological approaches in assessing digital inequality internationally, aiming to enhance indicators in Rossiyskaya Federatsiya.

Therefore, to comprehensively understand the relationship between the digital economy and economic development, it is necessary to conduct a bibliometric overview and scientometric analysis of existing relevant literature. This

aims to clarify: (1) What are the current main research themes, directions and hotspots concerning the digital economy and economic growth? (2) What is the basic profile of the major research groups currently engaged in the study of the digital economy and economic growth? (3) What are the potential future research directions in the field of the digital economy and economic growth?

Through the use of metrics and visualization tools like Citespace, the research intends to reveal trends, identify gaps, and propose an agenda for future studies. This approach allows for a nuanced understanding of the multifaceted relationship between the digital economy and economic growth, considering various criticisms that underscore the need for thoughtful examination and policy considerations in this evolving landscape.

2. Methodology

Bibliometrics enables the quantitative and objective analysis of database information, often involving co-term and co-citation analyses (Luo et al., 2022). This paper utilizes bibliometrics to investigate digital economy and economic growth through co-authorship, co-term, and co-citation analyses.

Web of Science (WoS), among the most extensively utilized bibliographic databases globally, offers entry to an extensive repository of scholarly research literature across diverse fields (Mongeon & Paul-Hus, 2016). It encompasses the indexing of numerous scholarly journals, conference proceedings, books, and various academic sources, thereby streamlining the literature review process (Singh et al., 2021). CiteSpace, created by Chen Chaomei, is an information visualization and analysis tool coded in Java. It is employed for exploring co-citation networks through extensive bibliometric datasets (Chen et al., 2012). Several scholars employed CiteSpace to conduct literature reviews across diverse domains, including economy. For example, Peng et al. (2023) utilize the citespace to analysis the research on the impact of the digital economy on enterprise innovation behavior, and find the current research hotspots and future research directions. The pairing of Web of Science (WoS) and CiteSpace was extensively employed in various influential review articles. Such as (Su et al., 2019).

“Digital economy” and “economy development or economic growth” are the terms used to find the articles. In order to guarantee the excellent quality of the data source, the type of reference is set to “articles and reviews”. Initially, retrieved December 10, 2023, 697 papers were chosen. However, the reliability of bibliometric analyses hinges on precise metadata, including author names, publication titles, abstracts, publication year, and citation details. In case of any absence, incompleteness, or formatting errors in these essential metadata within the Web of Science (WoS) data export, the bibliometric software may encounter challenges in accurate data processing. To ensure the integrity of the analysis, 121 papers with incomplete data were manually screened and excluded, resulting in a final set of 576 documents for bibliometric analysis.

3. Results

3.1. Overview of Selected Publications

This section primarily analyzes the average annual publication of papers in this field and identifies the journals that publish the most relevant papers. Understanding the current status of research on the relationship between the digital economy and economic development is made possible by this analysis.

Knowing the annual number of articles published and cited is necessary for predicting research trends (Kousha & Thelwall, 2023; Liu, 2013). The annual publication count reflects the growth of knowledge in a specific field, and at the same time, it can indicate the development status and research trends of that field (Su & Luo, 2023). The distribution of publications on digital economy and economic growth is illustrated in Figure 2, with the horizontal axis representing the years, the left vertical axis indicating the number of publications, and the right vertical axis denoting the citation counts. In conclusion, both the number of published articles and the citation count show an upward trend year by year. Particularly, after the pandemic in 2021, the number of published articles and overall citation count have shown an explosive upward trend, indicating a growing academic interest in the relationship between the digital economy and economic development.

Using search results from the Web of Science, Figure 2 shows that the period from 2001 to 2017 marked the nascent stage of research on the nexus between the digital economy and economic development. A total of 18 articles were identified in the Web of Science (WoS) database during this phase, signifying the growing scholarly interest in understanding the impact of the digital economy on economic development. Selected scholars commenced their investigations into the intricate dynamics that characterize the relationship between the digital economy and overall economic progress.

During the period spanning 2018 to 2020, the field entered a phase characterized by steady development. A total of 156 articles were documented in the Web of Science (WoS) database, with an average annual publication about 50 articles. These contributions garnered a cumulative citation count of 454, with an approximate annual citation of 155. Scholars initiated a more nuanced exploration of the impact of the digital economy on economic development during this timeframe, with particular emphasis on the influences exerted on the labor market and industries. F

From 2022 to the present, as of December 10, 2023, a total of 523 scholarly articles pertaining to this timeframe have been cataloged in the Web of Science (WoS) database. The cumulative citation count for these publications has reached 4900, reflecting a substantive level of scholarly engagement and recognition within the academic community. This phase represents a period of rapid development. Since 2021, research on the digital economy's impact on economic development has predominantly focused on aspects such as digital transformation, e-commerce and electronic payments, digital financial services, human capital and skill development, innovation and competitiveness, as well as digital inequality and societal implications.

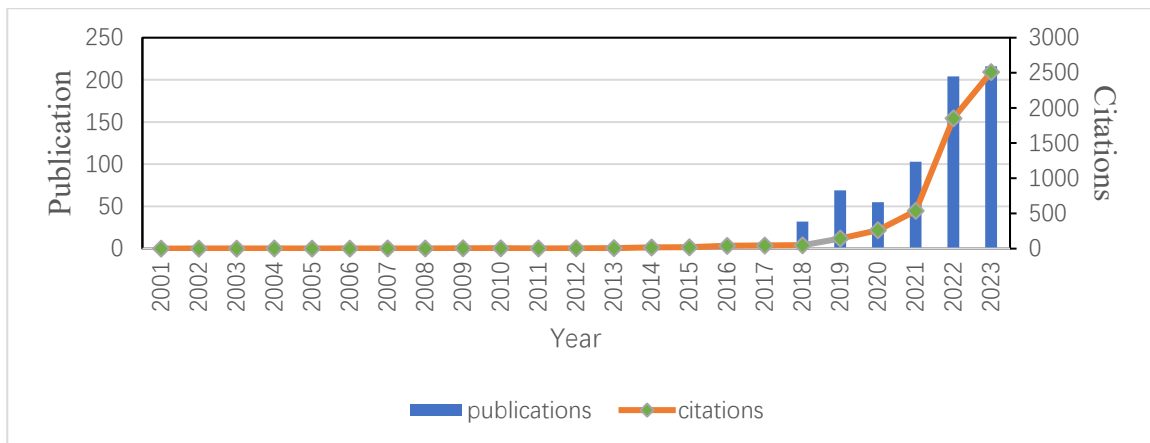


Figure 2. Number of cited times and publications per year over time in digital economy and economic growth research.

3.2. Co-Authorship Analysis

Co-authorship analysis is a methodology employed to investigate academic collaborative relationships within the scientific domain (Glänzel & Schubert, 2004). Primarily centered on scrutinizing collaborative ties among authors in scholarly publications, this form of analysis serves to unveil collaboration patterns within academia, identify associations among research themes, and offer valuable insights for the advancement of research communities.

3.2.1. Country Analysis

Co-country analysis is a useful tool for measuring the spatial distribution of articles (Pan, L. et al., 2023). Figure 3 shows the network with the threshold set to 2 and a network of 69 nodes and 118 links. It contains the countries that make the main contributions in the field. Every node in the network represents a country. The larger the node, the greater the number of relevant publications for that country. From Figure 4, it can be observed that China has the highest publication volume, followed by Russia, Ukraine, the United States, and

the United Kingdom. The purple circle around the node reflects the strength of the centrality, which indicates the significance of a network node. In terms of centrality, China exhibits the highest centrality, followed by the United States, Russia, the United Kingdom, and Poland.

It is noteworthy that China ranks first in both centrality and frequency, indicating its significant role in the research domain, and widespread attention to studies related to digital economy and economic growth in China. This aligns with the rapid growth of China's digital economy in recent years. Countries with a substantial number of published articles, such as the United States, Russia, the United Kingdom, Ukraine, and Poland, are key contributors to this research field. Furthermore, the overall network exhibits a relatively dispersed pattern, indicating limited collaboration among different countries. The emergence of digital economy as an academic focal point occurred relatively recently, and collaborative research is still in the exploratory phase, with the research framework yet to mature.



Figure 3. Co-country network map

3.2.2. Authors Analysis

The purpose of co-author analysis is to identify significant authors and their collaborative relationships (Uddin et al., 2012). By identifying the core authors' groups and collaborative relationships, the development trends in the field can be reflected. Figure 5 illustrates the co-authorship network of major authors. Node size represents the number of publications by each author, and the connections between

nodes indicate collaboration among different authors, with the thickness of the lines representing the degree of collaboration. In the analysis of the author's collaboration network, a total of 210 nodes and 116 links were formed. The entire graph appears relatively dispersed, indicating that scholars in the research of digital economy and economic growth conduct more independent studies, with weak collaboration relationships among them. The formation of a core team in the research of digital economy and economic growth is still

in progress.

From Figure 4, it can be observed that there are several complex research teams in the field of digital economy and economic development, centered around authors such as Watanabe Chihiro, Wu Haitao, Neittaanmaki Pekka, and others. Many of these teams are from China, including Wu Haitao, Tou Yuji, Ma Qiang, etc., and there are also teams from other countries, such as Watanabe Chihiro, Pimonenko Tetyana, etc. However, overall, there are only a few clear collaboration networks among researchers, and many researchers are relatively dispersed. The reasons for this are

attributed to the late emergence of digital economy research, the immature knowledge system among scholars, research questions being scattered, insufficient research continuity, and a lack of concentration in research content. Among these authors, three are from China, reflecting a strong interest among researchers in the study of digital economy and economic growth. In addition, other authors who are not showed in this table, are also important in advancing the field of digital economy and economy development since their combined publication volume accounts for approximately 95% of the total.



Figure 4. Co-author network map

3.3. Co-Term Analysis

3.3.1. Keyword Co-occurrence Analysis

Adjusting the threshold to 12, we obtain Figure 5, a co-occurrence network of keywords. The graph comprises 364 nodes and 817 lines, with a network density of 0.0124. Larger nodes and fonts indicate higher keyword frequencies, while thicker lines represent stronger connections between keywords. In terms of keyword frequency, “digital economy” has the highest occurrence, followed by growth, economic growth, and impact. Subsequent keywords include innovation,

technology, and digital transformation. Scholars show significant interest in the innovative aspects of technology, the integration of digital transformation with industry for economic growth, and the various impacts brought about by the development of the digital economy. The top five keywords in centrality rankings are digital divide, intensity, innovation, economic growth, and information technology, Digital Economy. These keywords form the foundation of research on the digital economy and economic growth, representing the focal points of investigation in this field.

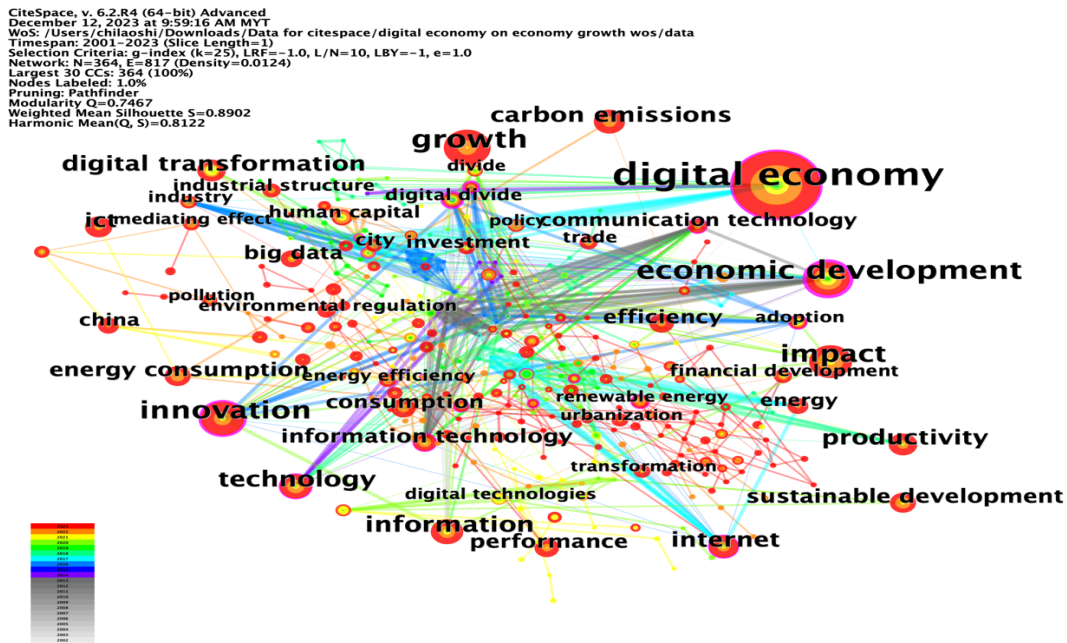


Figure 5. Keyword co-occurrence network map

3.3.2. Keyword Cluster Analysis

The keyword clustering by Citespace gives Figure 6, with 361 nodes and 806 links, which indicate current research hotspots. As shown in Figure 6, the clustering of the research keywords of digital economy and economic growth obtains the network modularity evaluation index Modularity $Q=0.7365$ ($Q > 0.3$, indicating better clustering), and the

average value of network homogeneity Mean Silhouette=0.9037 (the average value is greater than 0.7, indicating higher homogeneity), which indicates that the clustering of this mapping network is reasonable. The network consists of 23 clusters. The largest 14 clusters are summarized as figure 6.

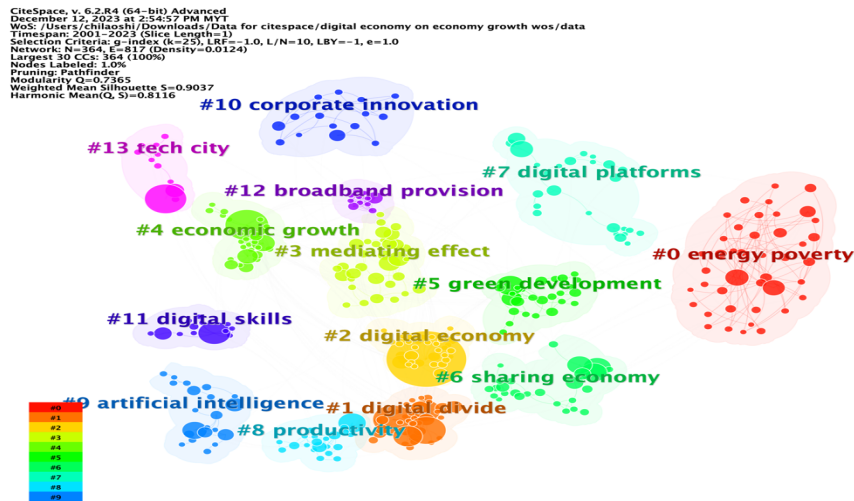


Figure 6. Keywords clusters map

CiteSpace software can objectively analyze the direction of research topics, but it may overlook certain crucial content, and therefore cannot be solely relied upon as the basis for research topics. Therefore, through manual curation, combined with Table 1 and the co-occurrence graph of keywords, keyword centrality and frequency, and real-world considerations, the content of the 576 articles was categorized. This analysis revealed four primary research areas in the study of the digital economy and economic growth: theoretical research on the digital economy, research on the influence of the digital economy on income distribution, research on the sustainable development of the digital economy, and research on digital transformation.

The theoretical research on the digital economy primarily encompasses an understanding of the digital economy's essence and an analysis of the mechanisms behind economic growth. The investigation into the essence also involves research on measuring the digital economy. Scholars propose that at the micro-level, emerging technologies such as the Internet, mobile communication, big data, and cloud computing can create an economic environment that combines economies of scale, scope, and long-tail effects. This environment better matches supply and demand, forming a more sophisticated pricing mechanism, thereby enhancing the equilibrium level of the economy. On the macro-level, the digital economy can promote economic growth through three pathways: new input factors, enhanced efficiency in resource allocation, and improved total factor productivity (Jing & Sun, 2019). The digital economy also exhibits a self-reinforcing growth pattern similar to the one proposed by Smith. Theoretical research plays a guiding role in practical development, and the insights from these scholars have significant reference value for the development of research on the economic growth of the digital economy.

3.3.3. Keyword Emerging and Evolution Analysis

An emerging keyword is a key term whose keywords

suddenly increase or whose frequency of use increases significantly over a period of time (Jun et al., 2018). The phenomenon of emerging keywords serves as an indicative tool, showcasing pivotal research domains at the forefront of phases in the development of the digital economy and economic studies. As shown in the figure 7, a total of 7 emerging keywords are obtained in the area of digital economy and economic development research, which are: information and communication technologies, un captured GDP, economic development, digital transformation, digital technologies, artificial intelligence and divide. The “information and communication technologies” (ICT) impact period, spanning from 2013 to 2020, represents the earliest focal point of scholarly attention in the investigation of the digital economy and economic development. It stands out as the field with the longest sustained duration of academic interest. This is attributed to the rise of the mobile internet around 2010, facilitated by the widespread adoption of smartphones and mobile devices, which propelled the rapid expansion of the digital economy on mobile platforms (Roessler, P., 2018). Regardless of the digital industry's explosive growth, industrialized nations' productivity appears to be declining, which begs the question of whether there could be a productivity paradox in the digital economy. The limits of GDP figures in gauging the progress of the digital economy have gained significant attention (Watanabe et al., 2018).

The term “un-captured GDP” exhibited the highest prominence from 2018 to 2020, signifying its status as a focal point of research during that period. In 2019, the COVID-19 pandemic significantly impacted global economic development (Asare Vitenu-Sackey & Barfi, 2021). Scholars have extensively explored economic development dynamics from various perspectives, with digital economy emerging as a focal point of research. Therefore, in 2019, terms such as “digital transformation”, “digital technologies” and “artificial

technology” emerged as highlighted keywords associated with “economic development” and “digital economy”. Within the trajectory of digital economic development, another notable characteristic of the global landscape is the increasing complexity, with growing prevalent asymmetries in economic, social, cultural, and political dimensions (Murthy et al., 2021).

Consequently, research related to the term “divide” has emerged as highlighted keywords during the period from 2019 to 2021. Primary areas of investigation encompass diverse definitions of the digital divide, the myriad mechanisms contributing to its emergence (Reddick et al., 2020), and the impacts of the digital divide (Shah et al., 2022).



Figure 7. Emerging keywords in the research on the digital economy and economic growth

3.4. Co-cited References Analysis

Table 1 lists the top 9 co-cited references by frequency and centrality. Zhao et al. (2022), which has the highest total number of citations, is mainly concerned with the measurement of the digital economy and the relationship between the digital economy and the high-quality

development of the economy. The second most frequently cited document mainly argues that the digital economy reduces the cost from five aspects: search, reproduction, transportation, tracking, and verification. All these articles have played a fundamental role in the understanding and appreciation of the digital economy.

Table 1. Top 9 co-cited references by frequency and centrality list

No.	Frequency	Reference	Centrality	Reference
1	46	(Zhao et al., 2022)	0.18	(Jorgenson et al., 2008)
2	45	(Goldfarb & Tucker, 2019b)	0.14	(Basu & Fernald, 2007)
3	42	(Pan, W. et al., 2022)	0.13	(Brynjolfsson & Hitt, 1996)
4	41	(Ren et al., 2021)	0.12	(Crandall R, 2007)
5	38	(Li, Y. et al., 2021)	0.12	(Ahmad N, 2016)
6	35	(Lange et al., 2020)	0.11	(Röller & Waverman, 2001)
7	34	(Ma & Zhu, 2022)	0.1	(Czernich et al., 2011)
8	33	(Li, Z. & Wang, 2022)	0.09	(Negroponte N, 1995)
9	33	(Nunn & Qian, 2014)	0.09	(Antonelli, 2003)

4. Conclusions and Discussion

This article employs the scientometric analysis tool CiteSpace to visualize and analyze 576 references on digital economy and economic growth. The main conclusions are as follows:

Regarding the publication volume, journals, and citation frequency over time in the research on digital economy and economic growth, the study indicates the significant practical significance of this field. The research in this area began in WoS in 2001, and relevant studies were relatively weak before 2017. During 2018-2020, there was a fluctuating increase, and after 2021, the number of studies sharply increased, entering a phase of rapid development. Scholars' attention to this field has also been increasing, showing an overall trend of rising research interest. However, the research in this field has not yet formed a mature system, with only 216 articles in 2023. Compared with the rapid development of the digital economy, the output of related research is still relatively low. There is a need for further research to strengthen the theoretical guidance of practical development.

The Co-Authorship Analysis of research on digital economy and economic growth shows the involvement of numerous countries and scholars. Overall, there is a diversified research landscape, but there is still a lack of

leading figures and influential institutions. The research pattern appears fragmented, with low correlation between different authors, institutions, and countries. Academic cooperation needs to be strengthened. In the future, it is necessary to establish a long-term research mechanism, form a mature research system, emphasize cooperation between institutions and scholars, create a diverse and stable research community, and promote a virtuous cycle in this field of study.

The Keyword Analysis of research on digital economy and economic growth indicates that ICT, digital economy measurement, digital transformation, artificial intelligence, digital divide, and digital economy's impact on sustainable development are all research hotspots. The main research topics include “energy poverty”, “digital divide”, “digital economy”, “sharing economy” and “digital skills” among 14 major themes. At the same time, the keyword co-occurrence map and keyword clustering map also reflect that the research in this field is relatively dispersed and has not yet formed a mature research system. It also indicates that the research topics in this field are relatively single, necessitating interdisciplinary collaborative research. The current main research directions in this field are theoretical research on the digital economy, the impact of the digital economy on income distribution, research on the sustainable development of the digital economy, and research on digital transformation.

However, there are still areas that require further thought and deepening. Firstly, there is a need to strengthen collaboration among different countries, institutions, and scholars. Collaborative exchanges contribute to the enhancement of academic capabilities, leading to the production of more high-quality outcomes. Secondly, interdisciplinary research can be pursued. With the development of the digital economy, the connections between disciplines have become tighter, involving various fields such as law, management, and political science. Emphasizing interdisciplinary research is crucial in this context. Additionally, the study's constraints merit acknowledgment. Primarily, the reliance on a singular search source imposes limitations on the data scope. The inclusion of alternative sources, such as Scopus and CNKI, might yield supplementary insights. Moreover, variations in parameter settings, influenced by software constraints, could produce divergent analysis outcomes. Subsequent investigations may benefit from employing systematic literature review methodologies to delve into specific construction types or the application of distinct assessment methods.

References

- [1] Abdurakhmanova, G., Shayusupova, N., Irmatova, A., & Rustamov, D. (2020). The role of the digital economy in the development of the human capital market. *International Journal of Psychosocial Rehabilitation*, 24(7), 8043–8051. <https://doi.org/10.37200/IJPR/V24I7/PR270779>
- [2] Antonelli, C. (2003). The digital divide: understanding the economics of new information and communication technology in the global economy. *Information Economics and Policy*, 15(2), 173–199. [https://doi.org/10.1016/S0167-6245\(02\)00093-8](https://doi.org/10.1016/S0167-6245(02)00093-8)
- [3] Babkin, A., Tashenova, L., Smirnova, O., & Burkaltseva, D. (2020). Analyzing the trends in the digital economy and the factors of industrial clustering. *ACM International Conference Proceeding Series*, 1–10. <https://doi.org/10.1145/3444465.3444516>
- [4] Basu, S., & Fernald, J. (2007). Information and communications technology as a general-purpose technology: Evidence from US industry data. *German Economic Review*, 8(2), 146–173. <https://doi.org/10.1111/j.1468-0475.2007.00402.x>
- [5] Chinoracky, R., & Corejova, T. (2021). How to evaluate the digital economy scale and potential? *Entrepreneurship and Sustainability Issues*, 8(4), 536–552. [https://doi.org/10.9770/jesi.2021.8.4\(32\)](https://doi.org/10.9770/jesi.2021.8.4(32))
- [6] Choi, C., & Hoon Yi, M. (2009). The effect of the Internet on economic growth: Evidence from cross-country panel data. *Economics Letters*, 105(1), 39–41. <https://doi.org/10.1016/j.econlet.2009.03.028>
- [7] Czernich, N., Falck, O., Kretschmer, T., & Woessmann, L. (2011). Broadband Infrastructure and Economic Growth. *The Economic Journal*, 121(552), 505–532. <https://doi.org/10.1111/J.1468-0297.2011.02420.X>
- [8] Eapen, A. (2012). Social structure and technology spillovers from foreign to domestic firms. *Journal of International Business Studies* 2012 43:3, 43(3), 244–263. <https://doi.org/10.1057/JIBS.2012.2>
- [9] Goldfarb, A., & Tucker, C. (2019a). Digital economics. *Journal of Economic Literature*, 57(1), 3–43. <https://doi.org/10.1257/jel.20171452>
- [10] Jing, W., & Sun, B. (2019). Digital economy promotes high-quality economic development: a theoretical analysis framework. *Economist*, 2, 66–73. <https://doi.org/10.16158/j.cnki.51-1312/f.2019.02.008>
- [11] Kousha, K., & Thelwall, M. (2023). Factors associating with or predicting more cited or higher quality journal articles: An Annual Review of Information Science and Technology (ARIST) paper. *Journal of the Association for Information Science and Technology*. <https://doi.org/10.1002/ASI.24810>
- [12] Lange, S., Pohl, J., & Santarius, T. (2020). Digitalization and energy consumption. Does ICT reduce energy demand? *Ecological Economics*, 176, 106760. <https://doi.org/10.1016/J.ECOLECON.2020.106760>
- [13] Mongeon, P., & Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: a comparative analysis. *Scientometrics*, 106(1), 213–228. <https://doi.org/10.1007/S11192-015-1765-5/FIGURES/6>
- [14] Röller, L. H., & Waverman, L. (2001). Telecommunications Infrastructure and Economic Development: A Simultaneous Approach. *American Economic Review*, 91(4), 909–923. <https://doi.org/10.1257/AER.91.4.909>
- [15] Savina, T. N. (2018). Digital economy as a new paradigm of development: Challenges, opportunities, and prospects. *Finance and Credit*, 24(3), 579–590. <https://doi.org/10.24891/FC.24.3.579>
- [16] Sun, Z., Zhang, B., Wang, Y., & Niu, J. (2010). A study of the relationship between Internet resources and the economic development of China's provincial areas. *Geography and Geo-Information Science*, 26(3), 44–48.
- [17] Uddin, S., Hossain, L., Abbasi, A., & Rasmussen, K. (2012). Trend and efficiency analysis of co-authorship network. *Scientometrics*, 90(2), 687–699. <https://doi.org/10.1007/S11192-011-0511-X>
- [18] Wang, G., Cheng, K., Luo, Y., & Salman, M. (2022). Heterogeneous environmental regulations and green economic efficiency in China: the mediating role of industrial structure. *Environmental Science and Pollution Research*, 29(42), 63423–63443. <https://doi.org/10.1007/S11356-022-20112-5/TABLES/8>
- [19] Wang, Q. (2023). Digital economy, new urbanization and upgrading of industrial structure. *Journal of Industrial Technological Economics*, 3, 73–81.
- [20] Watanabe, C., Naveed, K., Tou, Y., & Neittaanmäki, P. (2018). Measuring GDP in the digital economy: Increasing dependence on uncaptured GDP. *Technological Forecasting and Social Change*, 137(October 2017), 226–240. <https://doi.org/10.1016/j.techfore.2018.07.053>
- [21] Williams, L. D. (2021). Concepts of Digital Economy and Industry 4.0 in Intelligent and information systems. *International Journal of Intelligent Networks*, 2, 122–129. <https://doi.org/10.1016/J.IJIN.2021.09.002>
- [22] Zhao, T., Zhang, Z., & Liang, S. (2022). Digital Economy, Entrepreneurship, and High-Quality Economic Development: Empirical Evidence from Urban China. *Frontiers of Economics in China*, 17(3), 393–426. <https://doi.org/10.3868/s060-015-022-0015-6>
- [23] Yang, X. (2017). Digital economy: economic logic of in-depth transition of traditional economy. *Journal of Shenzhen University (Humanities & Social Sciences)*, 34(4), 101–104.