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Talent agglomeration research within digital economy development: Trend analysis and research prospects

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Abstract

Talent is important for development and innovation across fields. Further, in this era of digital economy, primarily driven by modern information networks, how to attract talent and effectively leverage talent's agglomeration effect is a crucial research topic. Thus, this paper reviewed studies from the China Knowledge Network in the Chinese Social Sciences Citation Index and from the Web of Science Core Collection. By combining cluster analysis based on keyword co-occurrence with a review of highly relevant literature, this paper determines and compares mainstream directions in both domestic Chinese and international studies on talent agglomeration effects and digital economy talent research, thereby constructing a two-dimensional analytical framework. This paper recommends four research paths for the effects of talent agglomeration, namely, talent management, enterprise–industry development, industry–regional development, and industry–regional level of talent agglomeration. Meanwhile, considering the digital economy's key role in future national economic strategies, its human resources studies should be included in these same paths for studying talent aggregation effects. Introducing public sector strategic management theories into research on digital-economic talent aggregation could prove an extremely valuable subject matter in the future.

Keywords: Talent agglomeration effect; Digital economy talent; Mainstream research direction; Bibliometric analysis

1. Introduction

Talent has been a research subject throughout all societies' development; indeed, all nations' developmental trajectories underscore its significance. According to China's Outline of the National Medium- and Long-term Talent Development Plan, *talent* refers to individuals' possession of specialized knowledge and/or exceptional skills that enable them to engage in innovative labor; contribute to society; and become highly capable, quality-oriented human resources. The concept of the "talent agglomeration effect" pertains to a concentration of talents within specific regions or industries, driven by policy or economic factors, resulting in an outcome surpassing independent talents' cumulative impact on the social economy or in field-specific development. Furthermore, this agglomeration effect can be categorized into economic and non-economic effects.

With the advent of the third technological revolution and deepening globalization during the 1990s, production factors, such as talent, began to circulate freely around the world. How to attract and leverage talent agglomerations has since become an active topic of discussion among practitioners and researchers. Information technology's continuous advancement has brought forth new digital technologies such as 5G networks, big data analytics, cloud computing, the Internet of Things, blockchain, and artificial intelligence (AI). These have propelled the digital economy to a new round of technological revolution, crucial for driving sustainable economic growth and building new development engines. Thus, talent plays an indispensable role in shaping this landscape; talent's flow and concentration are deeply intertwined with the digital economy. Therefore, both present and future research will inevitably explore talent's relationship with this emerging field.

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Meanwhile, China has long cherished and cultivated talent, often alluding to "buying horse bones with gold." Over the years, indeed, the Chinese government has emphasized human resources development, making rejuvenation through science and education a national policy and valuing human resources as its foremost asset. As China comprehensively strengthens itself through talent, its various regions have introduced new talent policies to attract professionals, in turn making talent a prominent research topic in China's academic circles. In publication volume and growth, data from China Knowledge Network (CNKI) in the Chinese Social Sciences Citation Index (CSSCI) closely resembles data from the Web of Science Core Collection, indicating China's increasing global influence. Thus, comparative research among relevant domestic and international studies offers a valuable entry to investigation.

Therefore, this paper comparatively analyzes the talent agglomeration effect and studies on digital economy talent in China and abroad over the past two decades. It describes statistical characteristics, tracks the field's prevailing research direction, focuses on research paths and paradigms, and analyzes the question "what do people know?" about talent flow and agglomeration in relation to the digital economy. The objective is to attract more scholars to explore the digital economy's talent agglomeration effects and to provide valuable results for current social and economic development.

2. Material and methods

2.1. Data source

For this paper, CSSCI data from CNKI and data from the Web of Science Core Collection are the literature sources; to ensure the literature data's continuity and integrity, the literature review spans January 2000 to October 2023. In the CNKI literature search, 557 articles were obtained with the keyword "talent gathering" and 381 articles with the keywords "digital economy" and "talent." In the Web of Science search, "talent aggregation," "talent gathering," and "talent clustering" produced 524 articles, after exclusion by hand of non-academic literature; next, "digital economy" and "talent" produced 75 articles. These articles were considered a quantitative sample of talent agglomeration effects and of digital economy talent in China and abroad. Simultaneously, combined with correlation rankings, these articles refined the literature review for study.

2.2. Research method

As a bibliometric analysis method, the Knowledge Graph integrates co-occurrence analysis technology, applied mathematics, information visualization technology, and graphics. Furthermore, it offers an intuitive representation of the overall situation, structure, hotspots, and evolutionary trends of specific research topics in graphic form. In this field, CiteSpace software is widely used for document metrology and visual analysis. Based on CiteSpace's functional characteristics, high-frequency and high-core keywords often serve as inflection points in keyword co-occurrence networks. To some extent, they can represent specific disciplines' research topics and can identify several main research fields through cluster analysis of closely related research directions.

Therefore, this paper leveraged CiteSpace software's advantages to analyze talent agglomeration effects and explore talent research's main directions and development in the digital economy. By examining representative literature, relevant research characteristics, and mainstream paradigms, we eventually drew conclusions regarding the effects of talent agglomeration on the digital economy.

In this study, CiteSpace was utilized with years per slice set at 1. The minimum spanning tree algorithm was selected for pruning to generate a clustering graph based on keyword co-occurrence.

2.3. Literature feature analysis

To offer a preliminary understanding of relevant research publications' overall growth, this section reports statistical analysis of the number of documents. From our search results, we calculated the number of annual publications on talent agglomeration effects and on digital economy talent-related research domestically in China and internationally from 2000 to 2023 (Figs 1 and 2).

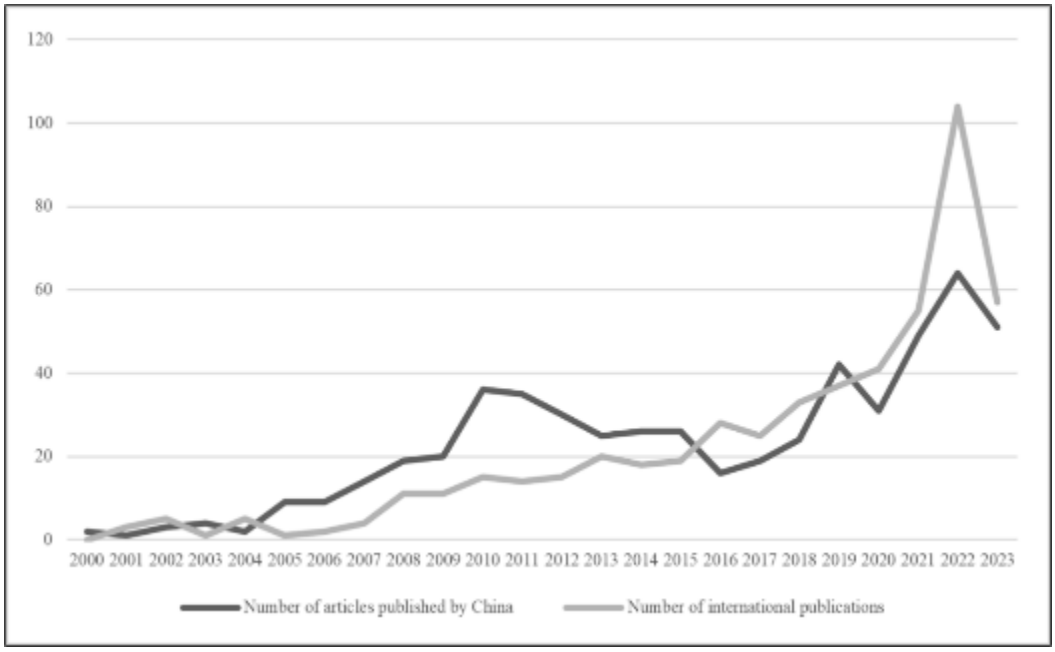

Figure 1 Annual Research Publications on Talent Agglomeration Effects, 2000–2023

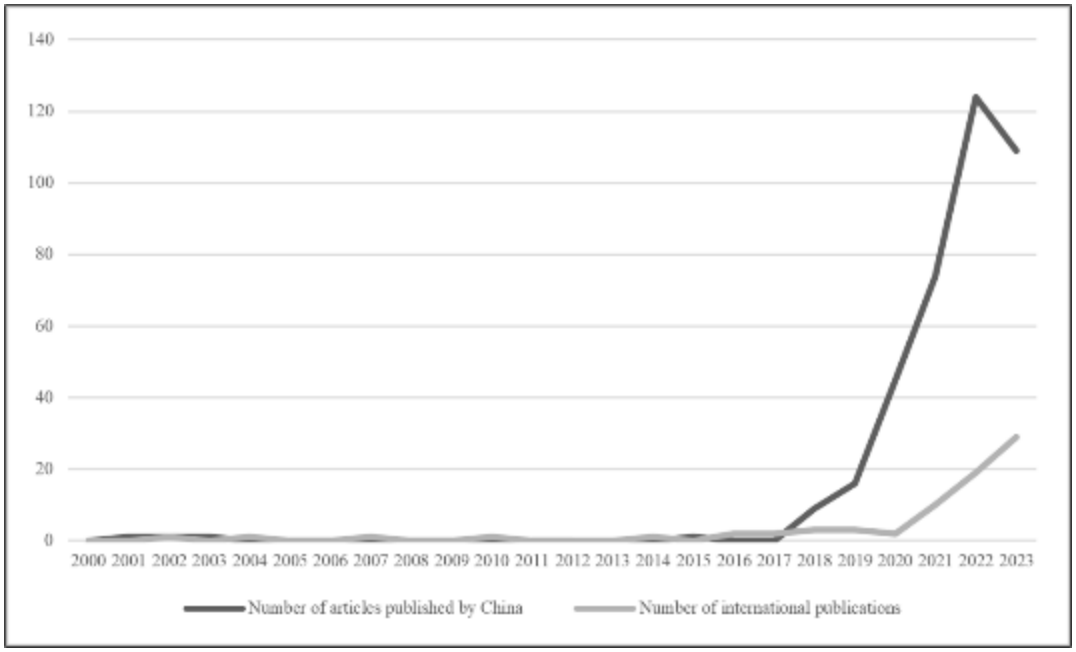

Figure 2 Annual Publications of Digital Economy Talent-related Research, 2000–2023

As Fig 1 shows, the number of studies on the talent agglomeration effect within and outside China has grown rapidly since the beginning of the 21st century. Around 2010, the domestic academic community produced an apex of research on the talent agglomeration effect, indicating that China's domestic research activities were closely related to its National Medium- and Long-term Talent Development Plan (2010–2020) and that the continuous strengthening of "Talent Power Strategic" initiatives is closely linked. The number of foreign literature publications indicates that in the past two years, the field entered a new research apex.

Fig 2 shows that research activities related to digital economy talents began to appear only after 2017, which have shown explosive growth since 2020, especially in research by Chinese scholars. Comparison of governmental strategic

behaviors inside and outside China shows that the digital economy's rise and national development orientation greatly impact talent studies and related research activities.

During the review period, Chinese scholars published, respectively, 205 and 45 studies on talent agglomeration effects and digital economy talents. Thus, after long-term, sufficient research on talent in other countries, China remains in an intense research development stage closely related to the background of the times and its national strategies. Additionally, changes in the number of publications indicate Chinese scholars' continuous and rapidly growing influence.

3. Results

3.1. Research status of the talent agglomeration effect

Having used the "Keyword" option of slicing in CiteSpace, this section combines changes in the number of publications on the talent agglomeration effect during the past two decades, in order to analyze keywords' co-occurrence and clustering in domestic Chinese and international literature. Along with the map and targeted reading, this section summarizes mainstream research directions.

3.1.1. Co-occurrence keyword clustering analysis

In systematically analyzing the existing research situation, we first determined main research directions, frontier hotspots, and development trends through keyword co-occurrence cluster analysis.

Analysis of Chinese research literature

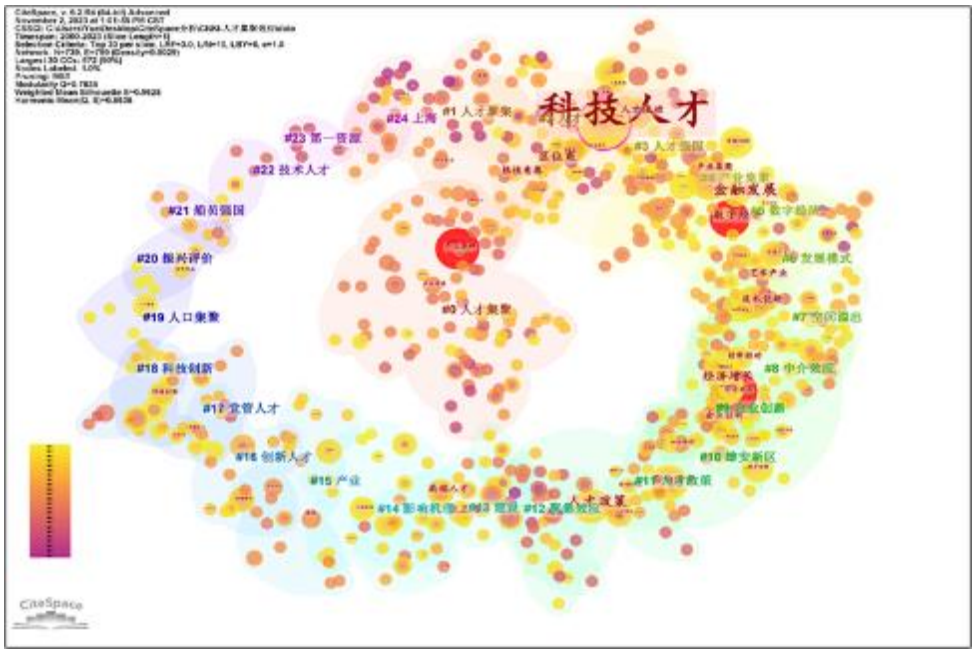

Figure 3 Co-occurrence Cluster Map of Keywords in the Literature on Talent Agglomeration Effect in China from 2000 to 2023

After importing the 557 Chinese studies into CiteSpace and selecting "Top N per Slice" as the top 30 highly cited or high-frequency nodes in each time zone and displaying keyword co-occurrence nodes by centrality, we obtained 739 nodes and 246 lines. After excluding such insignificant nodes as "talent agglomeration (人才集聚)" and "talent gathering (人才聚集)," we continued with keyword clustering analysis to deeply sort mainstream research directions. The parameters in Fig 3's top left corner, that is, the cluster module value Q and the average silhouette value S have both reached over 0.7, and this score indicates that this clustering structure is significant with ideal results. Keywords with higher centrality are displayed in larger fonts, representing the field's mainstream and classic research directions. We infer that since 2000, related studies revolve mainly around 25 themes, such as "talent empowerment (人才强国)," "industry agglomeration (产业集聚)," "digital economy (数字经济)," "development model (发展模式)," "spatial

spillover (空间溢出)," "mediation effect (中介效应)," "corporate innovation (企业创新)," "talent policy (人才政策)," and "impact mechanism (影响机理)." This includes various aspects like research direction, paradigm, and framework; for instance, "location entropy" has high centrality, suggesting it is a commonly used research method. This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

Analysis of international research literature

Due to CiteSpace's previously mentioned parameter settings, the number of co-occurrence nodes for international studies' keywords exceeds 1000, leading to poor analysis results. The reason is possibly that international literature includes various widely scattered research topics and keywords. Therefore, to examine how keywords are used together in international literature, we obtained 522 nodes and 603 connections by choosing "Top N per Slice" as the top 10 highly cited or high-frequency nodes for each CiteSpace time zone and by showing keyword co-occurrence nodes by centrality. Fig 4 shows that continuing with cluster analysis yielded visual results. In the figure's upper left corner, the Q value and average silhouette value S of the clustering module are 0.7976 and 0.9587 respectively, indicating the clustering structure's significance and ideal results. Moreover, Fig 4 shows that foreign-related research revolves primarily around 25 topics such as, "innovation," "talent development," "prioritized aggregation operations," "urban development," "aggregation analysis," "industry service flexibility," and "regional development." Most of these topics are from studies on talent aggregation performance and talent management, with some focusing on the interactive relationship between talent aggregation and urban economic development. However, certain cluster labels are not relevant to talent agglomeration effects; hence, themes from this quantitative method still require refinement.

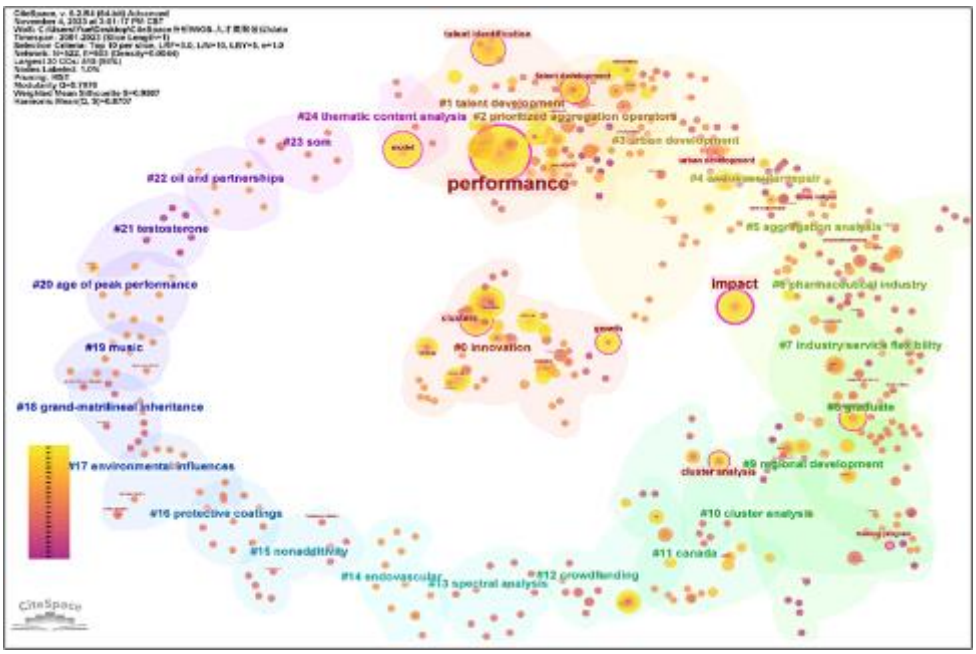

Figure 4 Co-occurrence Cluster Map of Keywords in Literature on International Talent Agglomeration Effect from 2000 to 2023

3.1.2. Analysis of mainstream research directions

To refine the research direction further and based on the clustering results above, we must study the review's highly relevant literature. After comparison and summary, we can focus on this field's main research directions: (1) interactive research with economic and social development, (2) interactions with industrial structure research, (3) research on factors influencing talent aggregation, (4) research on evaluation of the talent agglomeration effect, and (5) micro-level talent mobility and management research.

Interactive research with economic and social development

Various factors influence talent agglomeration's economic and non-economic effects. Thus, a popular research direction is its mutual influence with technological progress and economic growth, taking the level of talent agglomeration as an explanatory, intermediary, or dependent variable. This is especially true in technology talent aggregation. In the United States, for example, David S. Bieri (2010) [1] evaluated major metropolitan areas' economic growth drivers and their

relationship with high-tech industries and talent agglomerations. Regression analysis confirmed significant complementarity among talent, technology, tolerant culture, and regional urgent growth power. Conducting empirical analysis through a vector aggressive (VAR) model, Rui Xueqin et al. (2014) [2] found that technological innovation capability improved the scale of tech-talent agglomeration but not vice versa, verifying a bidirectional causal relationship between tech-talent agglomeration effect and regional innovation ability. Based on the assumptions of non-linearity, conjugate driving, and spatial spillover effects, Shi Mengyu and Shen Kunrong (2021) [3] used regression analysis to verify a nonlinear inverted U-shaped relationship between talent and industrial agglomeration in Chinese regional economic growth. This conformed to Williamson's hypothesis. Focusing on recent "talent wars" among Chinese cities and using the differences-in-differences model for empirical testing, Shi Xiaoli (2022) [4] examined how local talent policies affected city innovation performance where, due to brain drain or "siphon effect," first-tier cities have suppressed improvement of innovative capabilities of surrounding regions.

Interactions with industrial structure research

Connotations of the interaction are rich between the talent agglomeration effect and industrial structure, including aspects such as industry agglomeration, upgrading and optimization of industrial structure, and impact on single industries. However, this field's research is primarily concentrated in China. For example, Sun Jian and You Wen (2008) [5] constructed a regression equation with talent and industry agglomeration as the independent and dependent variables, respectively. Analytic results based on data from China's regional software industry revealed that total talent agglomeration in the software industry highly correlated with and mutually promoted industry agglomeration. Cao Weilin et al. (2015) [6] used location entropy to measure Chinese talents' degree of agglomeration in first, second, and third industries. They respectively conducted unit root, cointegration, and Granger causality tests. They believe a stable cointegration relationship exists between talent agglomerations and all industries. The primary industry's agglomeration brings about talent agglomeration, which in turn promotes the secondary industry's agglomeration. However, neither is significant in reverse. Only the tertiary industry's aggregation has a mutual causal relationship with talent aggregation.

Research on factors influencing talent aggregation

Studies on the factors influencing talent aggregation generally regard its effect as a variable explained by the impact of various factors—the environment, policy, and the economy—to identify policy directions for attracting, retaining, and cultivating talent. In studying talent policies, Zhang Yang (2021) [7] employed the continuous double difference method to verify that pilot policies for innovative Chinese cities positively affect individual cities' level of technology talent aggregation. Furthermore, it presented time heterogeneity in which pilot policies influenced tech-talent gathering through the socioeconomic environment, human capital level, and industrial structure level. Noonan et al. (2021) [8] investigated the influence of market size, concentration of similar talents, geographical environment, and infrastructure convenience on entrepreneurs' choices for relocating their business areas. Finally, Ai Xiaoqing et al. (2022) [9] applied spatial econometric models to explore the effects of regional environments, regional heterogeneity, and its spatial effects on science and technology talent agglomeration. The results revealed that improvements in regional innovation environments can promote technical personnel clustering, with a siphon effect evident in eastern regions.

Research on evaluation of the talent agglomeration effect

Research on evaluation of talent agglomeration effects primarily refers to studies on the construction of an agglomeration index system and evaluation of agglomeration degree or effect. Majority of the literature in this area has important reference value for understanding and judging regional imbalances in talent distribution and their differences. Such research is concentrated primarily in China. Representative studies include the following. Niu Chonghuai et al. (2006) [10] summarized eight characteristics of talent agglomeration effects based on analysis of spatiality, clustering, and scale, using hierarchical analysis to rank them by importance. Zhang Tongquan and Wang Lejie (2009) [11] constructed a four-part evaluation index system for manufacturing's base-talent agglomeration effects from four aspects—economic effects, scale effects, innovation effects, and growth potential—and concluded that regional disparities are inevitably influenced by such factors as location elements, institutional elements, historical factors, and foreign direct investment. Based on value chain theory, Liu Zhongyan et al. (2021) [12] built an evaluation index system for the regional talent aggregation level, including three dimensions—generation, configuration, and efficiency degrees—and created a comprehensive evaluation model for assessment of regional talent aggregation coordination.

Micro-level talent mobility and management research

Primarily concentrated in Western countries, this research path began early and followed business's traditional human resource management. It mainly focuses on talent management within companies or regional industries. In studies since

2000, Fallick et al. (2006) [13] explored job-hopping phenomena in Silicon Valley. They found that education level and gender positively influenced turnover rate in the computer industry, which showed regional heterogeneity compared to areas outside California. Based on strategic human resource management and organizational development principles, Kontoghiorghes Constantine(2016) [14] constructed a model for attracting and retaining talent by analyzing the influence of organizational culture and employee attitudes. The study revealed that transformative and technology-driven cultures were closely related to talent retention. According to Hsieh et al. (2019) [15] clear organizational strategies helped concentrate resources toward achieving goals; hence, they introduced concepts including knowledge management, capability management, e-learning, education and training through exploratory case analysis to develop a comprehensive tool for implementing corporate talent strategy.

In conclusion, the study of talent agglomeration effects can be summarized into two major directions: research on the effect itself and studies on the effect's interaction with other external variables. The former mainly occurred before 2010; thereafter, research gradually extended to quantitative paradigms such as regression analysis for investigating variable interactions. Additionally, based on analysis of the literature's features and specific literature review situations, domestic and international research were found basically consistent. However, approximately 40% of international research papers were contributed by Chinese scholars. Chinese scholars clearly preferred macro-level studies, perhaps because of China's extensive macro-talent planning and strong drive toward higher-level planning. However, other countries' researchers tended to focus on relatively micro-subjects like universities, enterprises, industries, or local governments.

3.2. Current status of research on digital economy talent

The aforementioned literature analysis demonstrates that, at least in terms of talent-related research, the digital economy has become a research hotspot only during the past three or four years. Simultaneously, combined with results of literature retrieval and combing, the proportion of highly relevant literature in international publications are extremely limited—not enough to support CiteSpace software analysis. Therefore, we begin our analysis with only keywords' co-occurrence in Chinese publications.

3.2.1. Co-occurrence keyword clustering analysis

For this section, we adjusted the threshold "Top N per Slice" of CiteSpace back to the top 30 high-citation or high-frequency nodes in each time zone. Displaying keywords' co-occurrence nodes by centrality, we obtained 280 nodes and 300 lines. Continuing with cluster analysis, Fig 5 depicts the results.

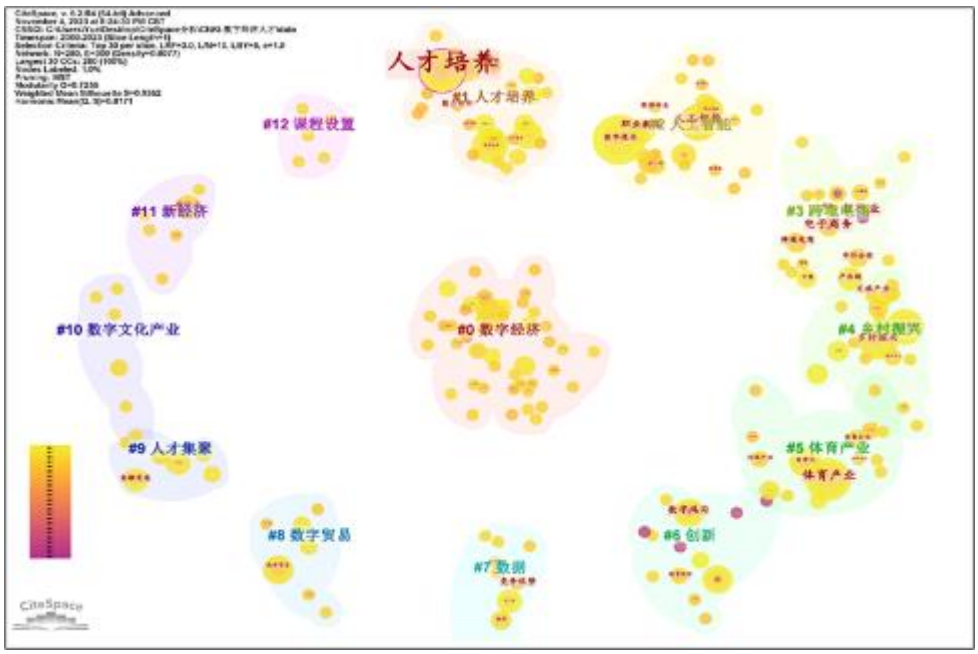

Figure 5 Co-occurrence Cluster Map of Keywords in Digital Economy Talent Research Literature in China from 2000 to 2023

The cluster module value Q and average silhouette value S in Fig 5's top left corner depict a significant, ideal structure. Keywords with higher centrality included "talent training (人才培养)," "artificial intelligence (人工智能)," "digital technology (数字技术)," "digital divide (数字鸿沟)," "vocational education (职业教育)," "e-commerce (电子商务)," "digital trade (数字贸易)," "competitive advantage (竞争优势)," "rural revitalization (乡村振兴)," "new economy (新经济)," "industrial chain (产业链)," and "data security (数据安全)." These terms should focus primarily on areas such as talent cultivation, popularization and development of digital technology, and digitization of industries. However, there are relatively few nodes, possibly due to this area's shorter research duration or each research direction's lack of sufficient refinement.

Overall, the Chinese digital economy's talent-related research involves 13 themes, such as talent training, AI, cross-border e-commerce, rural revitalization, sports industry, and innovation. However, for a reasonable grasp of mainstream research directions, it also requires cluster themes' selection and adjustment based on specific literature reviews.

3.2.2. Analysis of mainstream research directions

Based on the previous section's analysis of keyword co-occurrence clustering, combined with the study of literature related to digital economy talent both within and outside China, the field's main research directions can be divided into three paths: digital economy talent cultivation, demand for digital economy talent, and interactive studies with digital economic development.

Research on the cultivation of digital economy talent

This research area is primarily concentrated in China, suggesting that the country emphasizes its digital economy. Currently, however, China has mainly adopted a qualitative research paradigm. In summarizing the current status of China's innovative talent cultivation models, Wu Huabin and others (2019) [16] have proposed that considering the digital economy, a government-led "endogenous + exogenous" cultivation model and an enterprise-implemented "1 + 1 + N" innovative talent cultivation model should be implemented. Under the current circumstances, Ding Lieyun (2022) [17] combined the digital economy's impact on vertical industries, trends toward intelligent business formats, and analysis of demand for compound and innovative engineering talents. He further sees an urgent need to promote interdisciplinary integration to form a networked knowledge structure and has proposed new mechanisms for cultivating compound engineering talents. Combining the analysis of demand for composite digital technology talents and digitized governance-type talents, along with summarizing the current stage-wise issues, Wang Sini (2023) [18] proposed youth digital-talent-training modes that combine strategic guidance and policy support coordination, knowledge supply and industry–education integration, and corporate leadership and a demand-oriented approach.

Research on the demand for digital economy talent

In fact, research on digital economy talent is closely related to talent cultivation in general. Where there is demand, there is a driving force of supply. Both are currently receiving increased scholarly attention, and internationally, the field has produced numerous studies. Xia Luhui and He Dongxin (2020) [19] constructed a digital economy industry classification framework, including a digital industrialization layer as well as an industry and governance digitization layer. Through the T-I framework, they further analyzed employees' situations in China's digital economy industry, believing that the talent supply is generally insufficient. Wehrle et al. (2020) [20] analyzed how rapidly developing digital technologies affect the future roles of supply chain management personnel and conducted a Delphi survey among experts from business, academia, and politics. Subsequently, they used fuzzy C-means clustering analysis to find that current supply chain management and digital technology were strongly integrating, thus requiring new managerial capabilities. According to Jackson et al. (2021) [21] digital transformation is rapidly changing today's competitive landscape and talent war within organizations; human resources departments must reassess core leadership structures while studying four-step models on how organizations can incorporate innovative construction into succession planning.

Interactions with the development of the digital economy

Socioeconomic development holds high hopes for the digital economy, so many researchers have explored the mutual influences of talent agglomeration and digital economic development to discover development's influencing trends and factors. Although most literature on talent in the digital economy falls within this field, it comes primarily from Chinese researchers, including the following. In the Beijing–Tianjin–Hebei region, Liang Lin et al. (2022) [22] evaluated human resource systems' resilience by constructing a talent ecological zone entropy flow model, along with a four-dimensional indicator system covering diversity, mobility, buffering capacity, and evolution—combined with concepts of coupling

coordination degree. Using a spatial weight matrix for empirical analysis, Yu Bo and Pan Aimin (2022) [23] found that a digital economy mainly promoted regional high-quality development by improving the efficiency of production, marketing, government services, and the resource environment and that the promotion effect on high-quality development in non-core areas was stronger. Furthermore, uneven talent mobility had an inverse regulatory effect on positive correlation between the digital economy and regional high-quality growth in non-core regions. However, opposite effects were observed in core regions. Huang Xin (2023) [24] used four models—fixed effects, threshold effects, regulatory effect, and spatial econometric—in empirical studies showing nonlinear relationships between green technology innovation and the digital economy. The digital economy also exhibited regional heterogeneity effects, while digital talent aggregation negatively regulated promotion of green tech innovation by the digital economy, which intensified at the spatial level.

Our international review of relevant literature shows that research into digital economy talent has not yet entered into a comprehensive study of such talent's agglomeration effect but still focuses on supply and demand analysis. Studies on training digital economy talents occupy a large portion, which would be even larger if we included studies about that talent's demand. However, due to comprehensive research on talent agglomeration effects in China currently and influenced by recent trends toward quantitative studies of variable interactions, interactive research on digital economic development has become an important direction.

4. Discussion

From the features of the literature analysis to discussion of current research status, we see that limited studies on talent agglomeration effects were published before 2003. Indeed, actual studies on digital economy talents did not appear until about 2019. Therefore, only research from these two decades has analytical value. Furthermore, the research situation in China and abroad is consistent; hence, this article does not sort out and visualize this literature data on a timeline. For showing the current state of research on talent agglomeration effects and digital economy talents based on understanding changes in publication numbers and using keyword co-occurrence cluster analysis, reading existing studies and writing narrative reviews is sufficient. Finally, this paper offers a brief review and outlook on existing studies from the perspective of digital economic development.

4.1. Review of research status

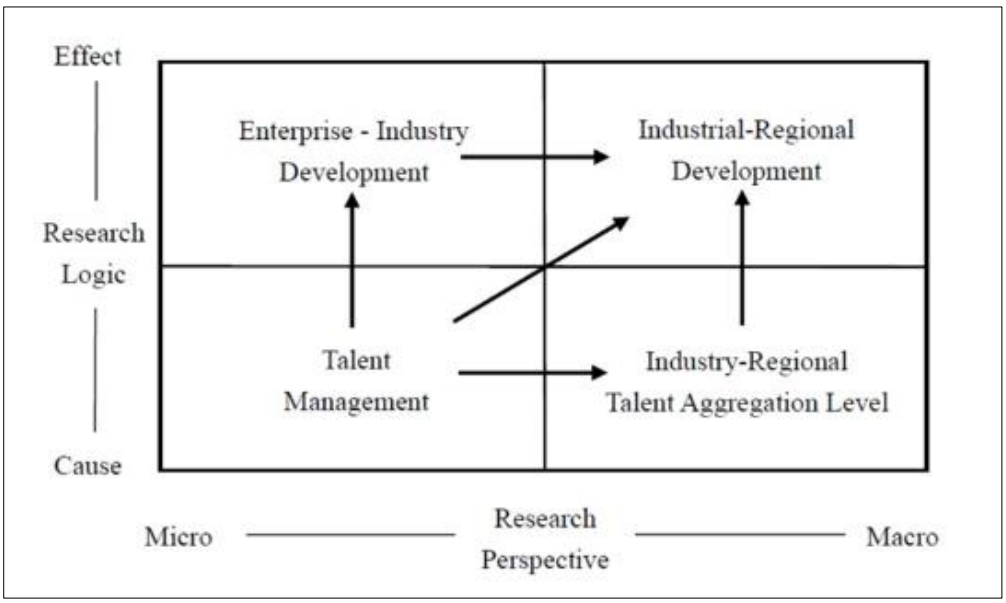

Figure 6 Framework for the Analysis of Talent Aggregation Effect Research Development Paths

From this study's three analytical sections, we can obtain comprehensive understanding of the current state of China's talent agglomeration research. Conversely, the reviewed mainstream directions in digital economy talent research showed that related studies are conducted under the talent agglomeration effect's theoretical framework, and they follow a consistent research paradigm. Therefore, digital economy talent research could be considered a branch within talent agglomeration effect studies if classified by talent types [25][26][27]. Moreover, this would allow us to integrate mainstream research directions from a higher dimension and construct an analytical framework.

As previously mentioned, the study direction for the effects of talent agglomeration can be further summarized into two parts, namely, (1) focus on the effects themselves, including influencing factors and evaluation aspects and (2) extension from these effects to study interactions with other variables such as economic development, technological innovation, and industrial structure. Regression analyses from numerous studies essentially verify these interactive relationships. Henceforth, by combining relevant domestic and international developmental trajectories, along with early literature on human resource management, this paper establishes "cause–effect" logic and "macro–micro" perspectives, respectively, thus parsing four paths for future development, namely, "talent management," "enterprise–industry development," "industry–regional development," and "industry–regional talent aggregation level." Based upon these paths, future studies are proposed.

Based on Fig 6, we can further predict the field's research development paths.

Prior to 2010, international scholars followed a traditional talent research development path that concentrated on factors influencing talent introduction and planning at micro-levels (e.g., in enterprises). This stage represents the theoretical origin and practical basis for studying talent agglomeration effects [28][29][30][31][32].

Research on enterprise–industry development is based on measuring talent agglomeration's role and impact. This research path explores technical innovation performance, talent cultivation, and demand at micro- and meso-levels within enterprises or industries. Such studies generally emerged early but have accrued relatively fewer literature references [33][34][35][36].

Talent aggregation's regional level expands its perspective to industry–regional meso- and macro-levels but remains focused on factors influencing talent aggregation effect. This study type was mainstream both domestically and internationally around 2010 [37][38][39][40][41].

Industry–regional development is currently the most mainstream. After completely understanding the characteristics and influencing factors of effects from aggregating talents, this study type conducts empirical research into various interactive relationships between variables[42][43][44], for example, how talents are gathered by industrial structures or economic developments [45][46][47].

However, by combining analysis of these four research development paths and reading specific literature, we see that majority of the current studies adopt a quantitative research paradigm, primarily using various yearbook data and methods such as regression analysis and principal component analysis. Thus, mainstream research is relatively single, lacking exploration of cases and sorting of theoretical systems. In other words, rather than theory-driven, most current talent agglomeration effect studies are phenomenon-driven [48][49][50]. They have introduced concepts such as ecological chains and value chains through grafting so far, and greater consensus exists on definitions and assumptions than on theoretical frameworks [51][52][53]. Whether room still exists for optimizing the match between current theories and research methods is an entry point for expanding the research development paths.

4.2. Future research outlook

From talent management research to industry–regional development, the study of talent agglomeration effects remains in a continuous enrichment stage. For China, as a traditional and populous country, how to become a nation of great talents has always been a question. In this historical context and environment, China's research on talent agglomeration stands at the global forefront in terms of quantity and quality. However, behind the macroscopic view of talent agglomeration lie policies and strategies. Talent strategy is considered secondary and should be subordinate to national strategy. Without high-level coordinated mechanisms for talent development or the state's comprehensive, systematic planning of talent strategy, market regulation alone will fall short of optimally effective outcomes for talent agglomeration, thus failing to advance economic growth or social progress [54][55]. Therefore, this article suggests three directions for future studies on the effects of talent agglomeration:

4.2.1. Systematic and comprehensive research from a strategic perspective

The full realization of talent aggregation and its effects is closely related to the current state of socioeconomic development; it requires ever-increasing synergy with superior strategies. In the current global economic growth (which is gradually becoming fatigued), in particular, social contradictions frequently occur, competition between countries intensifies, and innovative breakthroughs become an important national issue. Therefore, future research should pay increased attention to public sector strategic management by constantly approaching major national strategic deployments and cutting-edge technological innovations. Furthermore, guided by creating public value, we

should systematically and comprehensively gather talent and conduct related research activities. By following a direction that combines quantitative and qualitative methods, we should strengthen innovation in research paradigms.

4.2.2. Rooted in the practice of talent gathering in China, we conduct systematic theoretical research on multiple levels

Multiple environments, levels, and entities influence the complex activity of talent gathering. Central and local governments play a leading role, but different levels of government have varied strategic visions and capabilities. Therefore, different circumstances require different strategies, emphases, and policies—besides requiring varied research from diversified perspectives. Starting from theory, combined with current rich phenomenological problems and practical activities, we determine those theories appropriate for talent aggregation and conduct innovative, theoretical, and systematic research in multiple dimensions.

4.2.3. Solidify a theoretical foundation and conduct in-depth interdisciplinary cross-integration research

The theory of the talent agglomeration effect has a wide range of applications in various aspects, such as society, economics, and politics. Furthermore, every industry has specific talent categories. However, current systematic and interdisciplinary technological innovations and applications are becoming increasingly mainstream; therefore, no field can develop independently without considering external factors. Thus, to use related theories scientifically in learning more about talent agglomeration issues, future research should actively combine different fields. By conducting interdisciplinary academic exchanges and dialogues while fully processing existing theoretical foundations, we can promote theoretical integration and innovation as well as construct a theoretical system of the talent agglomeration effect in the Chinese context.

5. Conclusion

Finally, the digital economy, occupying a significant position in China's current development strategy, is profoundly changing our society's modes of production, lifestyle, and governance. Moreover, it provides a powerful impetus for the social economy's sustainable and healthy development by offering us rich prospects in new global situations, competitive challenges, and once-in-a-century opportunities. Academic research on the digital economy is surging. Therefore, we can use the digital economy strategy as a keynote to integrate these three paths. We begin with government strategy, driven by public sector strategic management theory, combined with practical experience of socialism with Chinese characteristics. Furthermore, determining relevant policy data and studying the talent agglomeration effect in the digital economy could constitute a specific research direction with great practical significance and theoretical value.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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