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A bibliometric analysis by using VOSviewer for FinTech research

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Abstract The field of Financial Technology, or "FinTech," emerged in 2008 and has since garnered notable attention from academics due to advancements in technology. This research analyzes 1,855 scholarly articles published between 2014 and 2023, with a focus on FinTech. We utilized the Scopus database to gather these articles and conducted a bibliometric analysis using VOSviewer software. Our analysis delves into publication patterns, global distribution, author affiliations, prolific authors, and keyword correlations within the research body. We identify significant interrelationships between FinTech and three prominent domains: Finance, Blockchain, and Artificial Intelligence. These fields have significantly influenced the development of FinTech discourse over the last decade. Our study presents significant findings on the current research status in FinTech, providing guidance and motivation for future research in this rapidly-evolving sector. Ultimately, our objective is to clarify the intricate relationship between FinTech and its related domains, offering insight for future research endeavors.

Keyword: FinTech (Financial Technology), VOSviewer, Bibliometric Analysis.

1 Introduction

FinTech is the abbreviation of Financial Technology; this term first appeared in 2008. Bill Gates, an American financial technology company entrepreneur, proposed it. He mentioned the word "Financial Technology" in a speech at the time and abbreviated it to "FinTech." This term has quickly been widely used by all walks of life, especially in the financial technology industry, and has become one of the most commonly used words [1]. FinTech refers to “technological innovation methods to improve and automate financial services” [2]. Jarvis & Han [3] referred to Thakor [4] and Chen et al. [5] to define the three stages of development from FinTech 1.0 to FinTech 3.0. The various stages of FinTech and their definitions are shown in Figure 1 below.

The benefits of FinTech can help financial institutions better meet customer needs and improve market competitiveness, including: (1) Improving efficiency: FinTech can help financial institutions process transactions faster, thereby improving efficiency. (2) Reduce costs: FinTech can help financial institutions reduce costs, for example, by automating processes and reducing labor costs. (3) Improve convenience: FinTech can provide customers with more convenient services, such as online banking, mobile payment, and etc. (4) Promote

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innovation: FinTech can promote financial innovation, such as through blockchain technology, artificial intelligence, etc. [6].

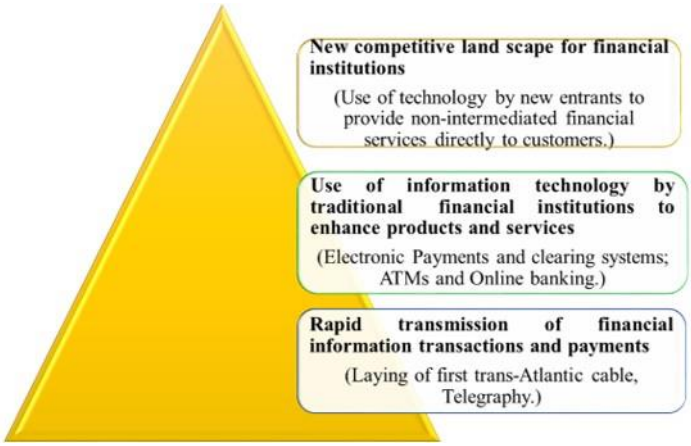

Fig. 1 Three Phases of FinTech Revolution [3]

In addition, the risks and disadvantages of FinTech can be divided into the following points [7, 8, 9]: (1) Consumer risks: FinTech's harm to consumers can be roughly divided into privacy loss, data security damage, fraud and Risk of scams, unfair and discriminatory use of data and data analysis, etc. (2) Financial stability risks: The impact of FinTech on financial stability mainly comes from: The decline in the risk management capabilities of financial institutions, B. The increased instability of financial markets, and C. The increased challenges of financial supervision. (3) Legal and regulatory risks: The development of FinTech also brings legal and regulatory challenges, such as how to protect consumer rights, how to ensure data security, how to prevent money laundering, etc.

FinTech has substantially entered human life and brought many unprecedented conveniences, attracting researchers to invest in FinTech-related research. How to continue this FinTech research fire, in addition to accompanying the development of science and technology, also requires quantitative literature to provide essential reference materials for subsequent researchers. This is the motivation of this study. Finally, the purpose of this study is to find answers to the following three questions from the research process:

(1) Question 1: In the past ten years, in the research on financial technology topics, which countries and organizations have advantages in the quantity and quality of published papers?
(2) Question 2: What are the relevant studies on financial technology research topics?
(3) Question 3: What are financial technology research's potential areas and future directions?

2 Materials and Methods

2.1 Vosviewer

VOSviewer is a set of software used for bibliometric analysis. It can convert much literature data into visual graphics to help users better understand and analyze the relationship between documents. These graphs include co-occurrence graphs, reference graphs, coupling graphs, etc. VOSviewer can also group and research documents to help users better understand the

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similarities and differences between documents [10, 11, 12, 13]. VOSviewer can also group and analyze documents to help users better understand the similarities and differences between documents. In addition, VOSviewer can also convert literature data into various formats, including CSV, Excel, XML, etc., to facilitate users to analyze further and process literature data [14].

In addition to VOSviewer, there are some similar bibliometric analysis tools, such as: (1) CiteSpace: CiteSpace is a software for bibliometric analysis. It can convert many bibliometric data into visual graphics to help users better understand and analyze relationships between documents. CiteSpace is mainly used to discover and explore cutting-edge issues and trends in the academic field. (2) BibExcel: BibExcel is a software used for bibliometric analysis. It can convert much literature data into visual graphics to help users better understand and analyze the relationship between documents. BibExcel is mainly used for co-occurrence analysis and cluster analysis. (3) SciMAT: SciMAT is software for science and technology management and science policy research. It can convert a large amount of scientific literature into visual graphics to help users better understand and analyze problems and problems in the scientific field. Trends [15, 16, 17, 18].

2.2 PDSA

The PDSA (Plan, Do, Study, Act) cycle is a management practice to improve processes. Its full name is Plan, Do, Study, Act. This cycle focuses on small tests and shorter time frames to implement plans to help drive process improvements. PDSA is a continuous improvement model with four iterative steps of constant improvement and continuous learning. PDSA was initially proposed by Walter A. Shewhart in the 1920s and became widely used in Dr. Deming's organizational development and leadership methods [19].

In some cases, PDSA improves immediately; in other cases, the plan is modified, and the process is repeated several times before achieving the desired results. The cycle has proven popular among those who use it because it is simple, does not require a lot of time or resources, and is flexible. PDSA is a scientific method that all walks of life have used. Donnelly & Kirk [20] applied the PDSA model (Figure 2) to solve problems and improve practice in medical education. In addition to highlighting the advantages of the PDSA model, the study includes promoting teamwork, improving data-driven decision-making, increasing opportunities for innovation and learning, and reducing waste and costs. The study also pointed out some challenges of the PDSA model, such as the need for time and resources, effective communication and feedback, appropriate measurement and evaluation tools, and ongoing commitment and support.

There are many studies related to the application of PDSA. Applying PDSA to teaching experience allows students to simulate and experience problems on the spot to solve problems, improve hospital service processes, and reduce patient waiting times. There are also studies using the PDSA framework to analyze the establishment of the Taiwan Mask Machine Alliance to complete its mission. The four-stage development process [21]. This study applied the four stages of PDSA to conduct quantitative literature analysis. It formulated four locations corresponding to essential activities requiring five steps, as shown in Figure 3 below.

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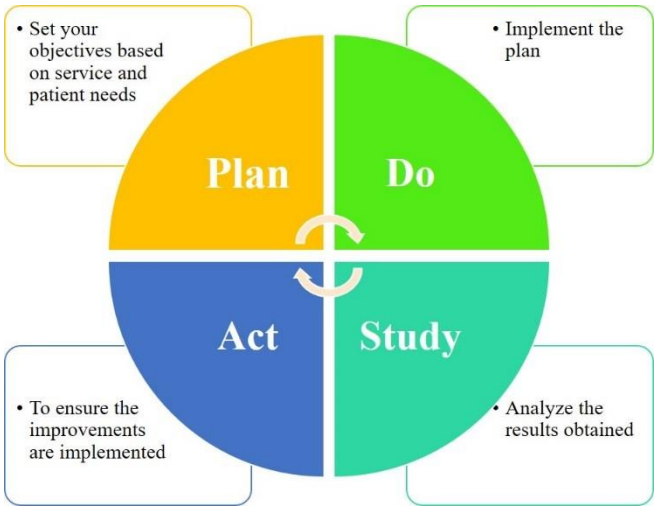

Fig. 2 The PDSA cycle

Phase	Events
Plan	■ Step 1: Define the research topic, research period and research scope.
Do	■ Step 2: Select research tools. ■ Step 3: Collect research-related literature; include key papers.
Study	■ Step 4: Achieve learning objectives through research and analysis of data.
Act	■ Step 5: Revise the content of the paper, write down research conclusions and research suggestions.

Fig. 3 The bibliometric flow chart of this research

3 Results and Discussion

This research was conducted in August 2023, and the relevant documents included in the Scopus database were searched using the keyword "FinTech" in the Scopus database until now (August 30, 2023). Among the 3,120 articles in the initial search results (document type), the most analytically valuable should be a journal paper, so this study only lists the two types of documents as Article and Review—journal literature. In addition, among the languages in which articles are published, this study selected journal documents with FinTech as keywords and published in English (excluding Spanish, Chinese, Russian...). Finally, 1,855 articles were selected, and their (1) Citation Information, (2) Bibliographical Information, (3) Abstract and keywords, (4) Funding Details, and (5) Other Information and other related literature

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information were output to CSV archives, and used VOSviewer version 1.6.18 to conduct the quantitative literature analysis of this study.

3.1 Top 5 cited references

This study used VOSviewer to analyze the five most cited documents in the FinTech field. These five documents were concentrated in 2017 and 2018 and are summarized in Table 1 below. In addition, this study found that the difference in the degree of influence of these five documents (Figure 4) is a little small. This section also summarizes the key points of these five documents.

Table 1 Top 5 cited references list

Item No.	Top 5 Cited References	Citations
1	Fintech Ecosystem, Business Models, Investment Decisions, and Challenges [22]	537
2	Impact of Digital Finance on Financial Inclusion and Stability [23]	467
3	Blockchain [24]	467
4	Fintech, regulatory arbitrage, and the rise of shadow banks [25]	371
5	The financial crisis: Lessons for the future [6]	310

1. Fintech Ecosystem, Business Models, Investment Decisions, and Challenges

The article first introduces the historical background of FinTech and discusses the ecosystem of the FinTech industry. Next, the authors discuss various FinTech business models and investment types. The article also explains methods for making FinTech investment decisions using real options. Finally, the authors discuss the technical and management challenges faced by FinTech start-ups and traditional financial institutions.

2. Impact of Digital Finance on Financial Inclusion and Stability

This paper mainly explores the impact of digital finance on financial inclusion and stability. The authors first introduce the definition and development of digital finance and discuss the impact of digital finance on financial inclusion and stability. The article also explains how digital finance can improve financial inclusion and strength, as well as the challenges digital finance faces.

3. Blockchain

This paper mainly discusses the applications and challenges of blockchain technology. The article first introduces the basic concepts and development of blockchain technology and discusses the application scenarios of blockchain technology. Next, the authors discuss blockchain technology's challenges, including security, scalability, and reliability. This article also explains how blockchain technology can improve existing business models and financial services, as well as the impact of blockchain technology on future financial markets.

4. Fintech, regulatory arbitrage, and the rise of shadow banks

This paper mainly discusses the development and regulatory issues of FinTech. The authors first introduce the historical background of FinTech and discuss the development trends of the FinTech industry. Next, the authors discuss the regulatory challenges faced by the FinTech industry, including insufficient supervision, inconsistent supervision, and regulatory costs. The article also explains how the FinTech industry exploits regulatory loopholes and how to improve the existing regulatory framework.

5. The financial crisis: Lessons for the future

This paper mainly discusses the causes, impacts, and lessons of the 2008 global financial crisis. The article first introduces the background and motivations of the financial crisis and

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discusses the effects of the financial crisis on the global economy. Next, the authors discuss issues revealed by the financial crisis, including aspects of risk management, regulation, and moral hazard. The article also explains how lessons can be learned from the financial crisis and how the existing financial system can be improved.

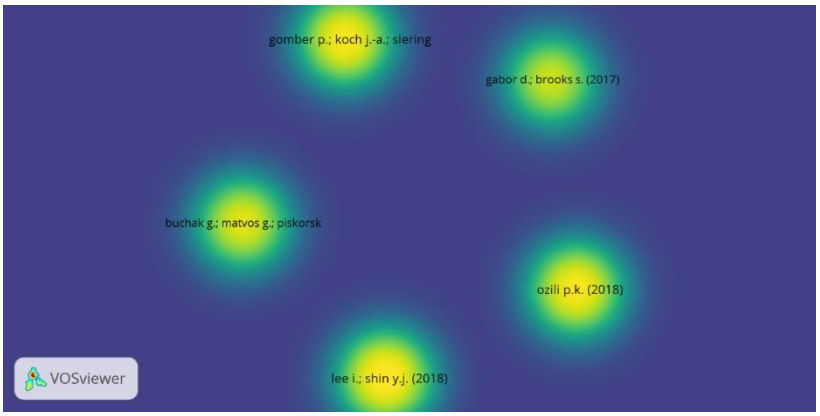

Fig. 4 A representation of the strengths and weaknesses of the five most cited documents

3.2 Research Categories

Before 2014, the critical term FinTech received very little attention from researchers. As a result, only one paper was included in the Scopus database starting in 2014. However, since 2017, FinTech research has received substantial attention, with more than three times the number of papers published internationally in 2018. From Figure 5, 476 articles have been published internationally in 2022, but the statistics of this study are as of August 2023 it has reached 463. The number issued in 2023 this year is almost the same as last year's high. The number of papers published in FinTech in 2023 is believed to reach a new high in history. This also means that the popularity of FinTech will continue unabated. FinTech must be closely related to industrial development or human life.

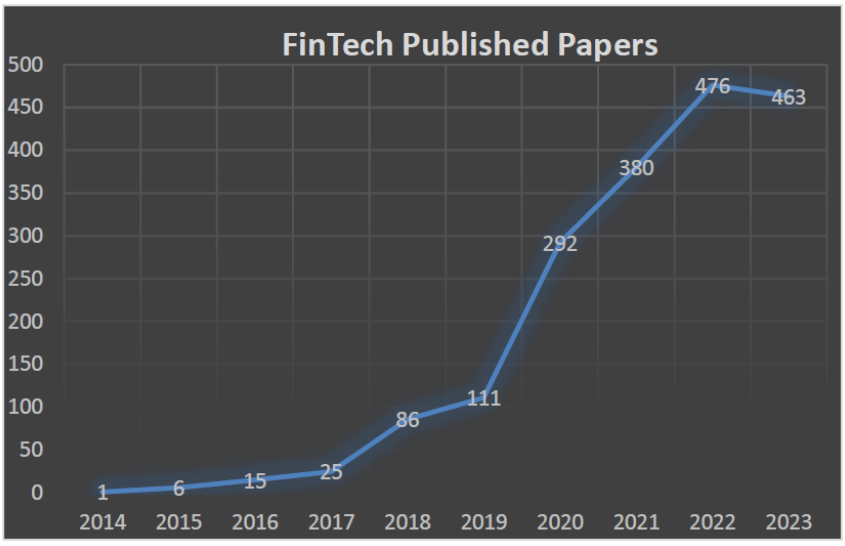

Fig. 5 FinTech research papers published in the past ten years

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1. Journal Distribution

VOSviewer statistical results: among 773 journals in the field of FinTech, the first journal that publishes the most papers is the "Sustainability" journal; this is a journal that is included in both SSCI (Social Sciences Citation Index) and SCI (Science Citation Index) This journal is also accessible for readers, but authors have to pay APC (Article Processing Charge) for OA (Open Access) journals. Before a submission to an OA journal is accepted and published, the publisher often requires the author to pay the APC as soon as possible. However, there are still many journals where authors are exempt from paying APC. Researchers should obtain relevant information before submitting their manuscripts. This study summarizes the top 20 journals that publish the most papers in the FinTech field in Table 2 below for readers' reference.

Table 2 Top 20 most productive journals

Item No.	Source	Documents	%
1	Sustainability (Switzerland)	58	7.5%
2	Finance Research Letters	43	5.6%
3	IEEE Access	36	4.7%
4	Financial Innovation	31	4.0%
5	Technological Forecasting and Social Change	28	3.6%
6	Journal of Risk and Financial Management	21	2.7%
7	Electronic Commerce Research and Applications	17	2.2%
8	International Review of Financial Analysis	16	2.1%
9	International Journal of Bank Marketing	14	1.8%
9	Journal of Open Innovation: Technology, Market, and Complexity	14	1.8%
11	European Business Law Review	13	1.7%
11	Risks	13	1.7%
13	Mathematics	12	1.6%
13	Electronic Commerce Research	11	1.4%
15	Electronic Markets	11	1.4%
15	European Business Organization Law Review	11	1.4%
15	IEEE Internet of Things Journal	11	1.4%
15	Industrial Management and Data Systems	11	1.4%
15	Journal of Business Research	11	1.4%
15	Journal of Economics and Business	11	1.4%
15	Journal of Payments Strategy and Systems	11	1.4%
15	Research in International Business and Finance	11	1.4%

2. Country and Institution Distribution

According to statistical calculations by the VOSviewer, 126 countries have published FinTech-related journal papers in the past ten years. If we look at the top ten countries in terms of the number of published articles, a country must accumulate at least 60 papers to be among the top ten in terms of the number of published papers. According to statistical data, the first place is China, which accounts for 21.5% of the number of published articles; it is nearly double that of the second place, the United States. The relevant information is shown in Table 3 below. In addition, the visual diagram of the network correlation of the countries where the papers are published is shown in Figure 6, which will clearly show the degree of correlation of the countries where the articles are published.

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Table 3 Top 20 publication countries/economy (n=126)

Item No.	Country	Documents	%
1	China	398	21.5%
2	United States	231	12.5%
3	United Kingdom	201	10.8%
4	India	145	7.8%
5	Malaysia	116	6.3%
6	Indonesia	101	5.4%
7	South Korea	91	4.9%
8	Australia	89	4.8%
9	Italy	82	4.4%
10	Germany	69	3.7%

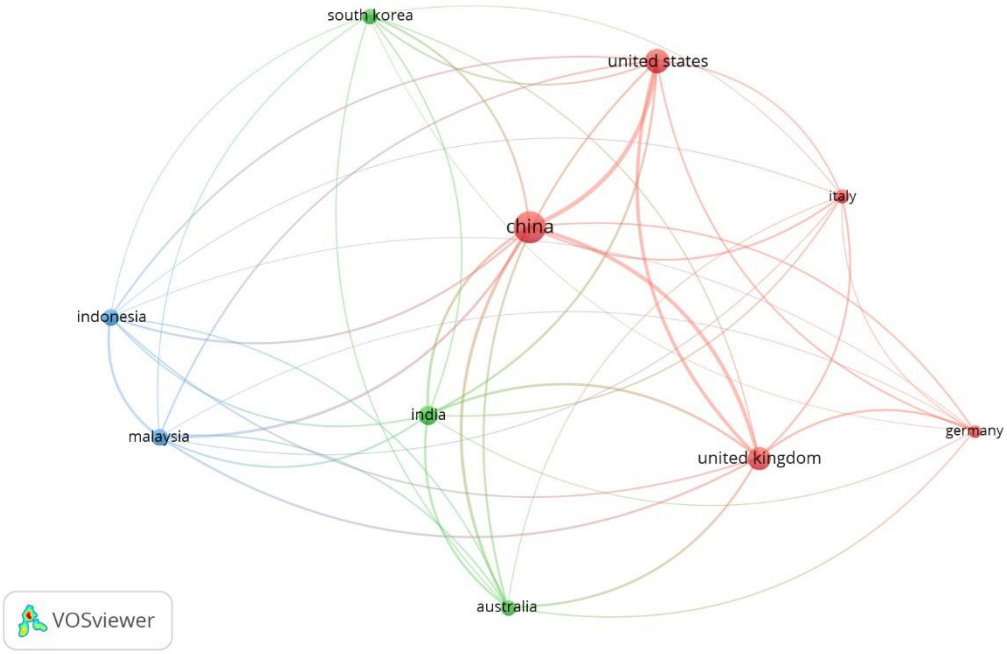

Fig. 6 The bibliographic coupling network visualization of countries

3. Author Distribution

According to the statistical analysis results of the research tool, a total of 1,781 authors published papers in the past ten years, led by Ozili P.K., who posted six articles. Secondly, regarding the total number of citations of published documents, Ozili P.K. still ranks first. It is worth mentioning that the number of publications of the second author, Langley P. & Leyshon A., and the third author, Iman N., are higher than those of other authors who have published more papers. The result can be seen more clearly in Table 4 below. In addition, from the perspective of the author's affiliations, the number of papers published by the top six is similar. We can see this from the statistical summary of the affiliations of the top six authors in Table 5.

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Table 4 Prominent authors by documents and citations

Item No.	Author	Documents	Citations
1	Ozili P.K.	6	590
1	Baber H.	6	78
3	Alaassar A.; Mention A.-L.; Aas T.H.	4	64
3	Iman N.	4	141
5	Langley P.; Leyshon A.	4	178
5	Bernards N.	3	41
5	Hodula M.	3	35
5	Tan G.k.s.	3	11
5	Wonglimpiyarat J.	3	51

Table 5 Top 6 publication organizations

Item No.	Organization	Documents	Citations
1	Faculty of Business, Management and Economics, University of Latvia, Riga, Lv-1586, Latvia	5	51
2	Excelia Business School, La Rochelle, France	4	34
3	Faculty of Business, Philadelphia University, Amman, Jordan	4	18
4	Faculty of Law, Mcgill University, Montreal, Canada	4	36
5	Institute of Digital Finance, Peking University, China	4	46
6	School of Economics and Management, Beijing Jiaotong University, Beijing, 100044, China	4	7

Table 6 Top 20 research keywords of FinTech publications

Item No.	Keyword	Occurrences	Total Link Strength
1	FinTech	1585	1606
2	Blockchain	230	432
3	Finance	138	292
4	Financial Inclusion	119	182
5	Commerce	110	303
6	Financial Technology	106	201
7	Innovation	100	212
8	Banking	98	185
9	China	97	156
10	Artificial Intelligence	91	207
11	Machine Learning	90	215
12	Financial Services	89	192
13	Financial Markets	82	260
14	Investments	69	191
15	Covid-19	66	93
15	Crowdfunding	66	130
17	Cryptocurrency	62	149
18	Bitcoin	58	137
19	Big data	57	132
20	Forecasting	47	155

4. Keywords Co-Occurrence Analysis

In the field of FinTech, the top three keywords most related to FinTech are (1) Blockchain, (2) Finance, and (3) Financial Inclusion. Table 6 below is a statistical summary of the top 20 keywords associated with FinTech. Among the statistical information, there is a column that explains the strength of the connection between the keyword and FinTech. From the statistical

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data, FinTech, Blockchain, and Commerce and Investments should be among the top three. It can also be seen more clearly from Figure 7 that these three sub-fields have formed an iron triangle.

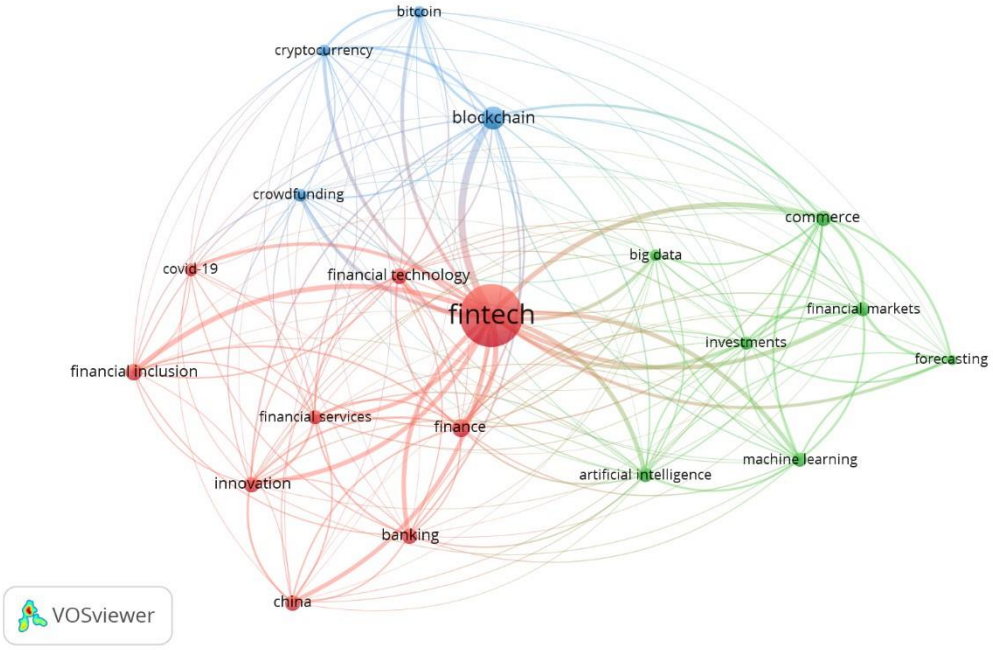

Fig. 7 Network visualization of keyword co-occurrence analysis

4 Conclusion

This study uses VOSviewer software to conduct quantitative literature analysis on journal articles with "FinTech" as the keyword/topic. The analysis results are sufficient to answer the three questions set in the first chapter. The following is a review of the three questions and the responses to this study:

(1) Question 1: In the past ten years, in the research on financial technology topics, which countries and organizations have advantages in the quantity and quality of published papers?

■ Answer 1: As analyzed in 3.2, China is in the leading position regarding the total number of papers published. However, regarding the total number of citations, Chinese authors and their affiliated institutions need to lead in terms of the total number of sources. Instead, American and European authors have higher citation rates.

(2) Question 2: What are the relevant studies on financial technology research topics?

■ Answer 2: FinTech research fields can be divided into three significant sub-fields, namely: (A) finance-related, (B) blockchain, and (C) investment.

(3) Question 3: What are financial technology research's potential areas and future directions?

■ Answer 3: From the correlation diagram in Figure 7 of this study, it can be seen that blockchain is still a field that continues to attract research enthusiasm; in recent years, due to the improvement of artificial intelligence technology and tools, the number of

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research publications in this related sub-field should gradually increase. In addition, in terms of commercial application investment, this is also a subfield that continues to receive attention. The most important thing about financial technology is to integrate into people's lives and create business development.

- We look forward to more financial technology-related research to make people's lives more convenient and able to be more fulfilling.

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