

Evolution of Fintech Ensuring Sustainability in Financial Markets: A Bibliometric Analysis

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[Abstract] Financial technology, or Fintech, combines two major fields: finance and information technology. In today's era of automation, the financial markets and supply of financial services are significantly impacted by a mix of innovative business models, technology applications, and innovative products and services. The benefits of technology in the financial sector include increased operational effectiveness, cost reduction, disruption of the established industry structures, blurring of industry borders, facilitation of strategic disintermediation, creation of new entry points for entrepreneurship, and democratization of access to financial services. The paper provides a bibliometric review of FinTech in financial markets based on the 901 publications retrieved from the Scopus database between 1980 to 2022 (September). Initially, a wide range of keywords was used to search within "TITLE-ABS-KEY" with the help of Boolean operators in two parts: (1) financial technology and (2) financial markets, which resulted in 1,738 documents. Limiting the search to English as a language, journal as a source type, and article as a document type, documents were reduced to 901. The importance of technology in financial markets, especially the banking industry, is further illustrated through various tools, like Biblioshiny for graphs and tables, Microsoft Excel for frequency analysis, and the VOS viewer for data and network visualization. The empirical research of the study is divided into two parts: performance analysis and science mapping by using common bibliometric indicators like authorship, active institutions, citation analysis, geographic distribution, keywords analysis, co-citation analysis, bibliographic coupling, thematic analysis, and cluster analysis. The study will add to the existing literature by presenting a bird's eye survey on the evolution of FinTech in financial markets, the challenges faced by its stakeholders and how they have been overcome. The findings suggest that COVID-19 had played an essential role in facilitating the adoption of technology in the financial sector, ensuring the sustainability of all financial transactions even when everyone preferred to be behind closed doors.

[Keywords] bibliometric analysis, science mapping, performance analysis, financial markets, banking industry

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Introduction

Fintech is a multidisciplinary term that combines two well-developed disciplines, i.e., financial technology and financial markets. Payment gateways, digital wallets, mobile banking, online trading platforms, peer-to-peer lending, automated trading platforms, asset management, reg tech, insurtech, blockchain, the online stock market (Preda, 2006) and other products emerged as a result of the unintentional growth of information technology and its involvement in financial markets. All these products of fintech are well

accepted because of their advantages of quick processes, cost efficiency, elimination of physical movement, and related hassles (Lee & Shin, 2018).

The importance of fintech was further realized with the sudden breakdown of COVID-19, where the focus was to maintain regular functioning without coming into direct contact with human beings. In other words, fintech has played an essential role in ensuring the sustainable functioning of financial transactions during COVID-19 with the help of mobile applications and websites catering to all the needs of the individual; you name it, and you get it with the use of technology. For basic needs, we have an electronic interface. For food, we have Swiggy and Zomato; for making payments, we have e-wallets and internet banking; for pharmacy needs, we have MedLife and 1mg; for basic groceries, we have Grofers; and many more. This list doesn't end here; even doctors diagnosed their patients online via video calls, and the government initiated the Aarogya Setu app to keep records of COVID vaccinations. North et al. (n.d.) conducted a study examining mobile applications' effects on the healthcare sector. They highlighted the security risk associated with patient data. They concluded that Diasend is developing the safest healthcare app for patients without worrying about their data privacy. Obeidat et al. (2020) discussed the development and outspread of mobile banking, highlighting the paradigm shift from first-generation mobile telephony (analogue cellular phones) to fourth generation (wireless communications networks).

The emergence of the concept of fintech can be traced back to the 1980s, but the rate of acceptance has increased over time. Initially, people were skeptical about e-financial services because of cyber fraud and security issues, which experts have well addressed with sound-protected cyber walls to offer a smooth platform to their stakeholders. Covid-19 has also paced the transitional shift from traditional bank visits to online portals to ensure smooth and sustainable financial transactions. No player in the financial sector can undermine the importance of technology or part ways with it; instead, all are coming up with start-ups to revolutionize the way the financial sector operates in search of enhanced customer satisfaction, a more profitable business model, and innovative services, such as the concept of virtual property initiated by Kotak and the advent of robo-advising as opposed to traditional human advisors who got swayed by their emotions (Belanche et al., 2019; Rico Pérez et al., n.d.). Each player had to adopt innovative strategies incorporating information technology into their daily routine tasks to survive; otherwise, they would be kicked out of the market very soon. Obeidat et al. (2015) investigated business intelligence technology and how it converts enormous amounts of varied data gathered from malicious sources into helpful information, enabling more effective and efficient production. To transform financial services, the industry had to undergo various disruptions and innovations (Gomber et al., 2018).

Berger (2003) examined the introduction of financial technology in the banking sector and suggested that due to technological advancement, it became easy to consolidate the performance and functioning of all major players of the segment along with quality improvement and a large basket of new services offered, like internet banking, online transfer, online loan intimations and investments, etc. Buchak et al. (2018) posited that due to an increase in fintech lenders, the role of shadow banks in the mortgage industry doubled from 2007 to 2015. Further, this growth is not solely due to technological advancement but is equally supported by a loose regulatory framework for online lenders and shadow banks compared to traditional banks. Stakeholders initially supported fintech products due to their cost efficiency, but this has now shifted to convenience in dealings even with the same or marginally higher cost. Thako (2020) has done a review paper to summarize the connection between fintech and banking. Due to changes in the basic functioning of the financial sector, financial regulations need to be revamped to offer regulatory frameworks for monitoring online transactions, which were not required earlier. The global financial crisis also paved the

way for more stringent financial regulations (Arner et al., 2017) (Neu et al., 2006). Further, other authors have also studied the impact of fintech and regtech on financial regulations and the performance of the banking industry and other financial markets (Anagnostopoulos, 2018).

With the introduction of the internet in the 1980s, its impact on financial markets, the increasing role of artificial intelligence in financial services, and the increased demand for more financial regulations, this study is a need of the hour to map the evolution of fintech and highlight the emerging themes to help future researchers interested in fintech get a quick view on quantitative parameters. Thus, the present study intends to conduct a quantitative or bibliometric analysis of studies published in the Scopus database between 1980 and 2022. In light of the backdrop mentioned above, the remaining paper has been segregated into six Sections; Section II lists the objectives. The research methodology is expounded in Section III. Empirical analysis has been produced in Section IV, followed by a conclusion in Section V. Finally, limitations and scope for further research have been mentioned in Section VI and Section VII, respectively.

Objectives of the Study

The overall objective of the study is to conduct a bibliometric analysis to understand the evolution of financial technology in financial markets; specific objectives are as follows:

1. To identify leading nations publishing on fintech
2. To ascertain pioneer journals in the field of fintech
3. To recognize the most influential authors publishing in the domain of fintech
4. To find out the most cited articles or persuasive research papers on fintech
5. To discover the volume of publications on fintech every year; and
6. To detect keywords widely associated with fintech.

Research Methodology

In the initial literature review stage, it was observed that much research has already been done on the concept of “financial technology” and “financial markets” working together. Bibliometric analyses have also been done in the past on the related aspects of fintech, but to the best of the author’s knowledge, few similar studies exist (Bhatt et al., 2022). Further, addressing the gaps with its extensive dataset, this study aims to conduct a bibliometric analysis by following a “Triple A Framework,” i.e., “acquire, assemble, and analyze” all the data available in the concerned subject field.

Database

This study analyzes the bibliographic information of 901 documents from the Scopus database published between 1980 and 2022 (September). From the pool of available databases, Scopus is considered one of the largest and most widely used. Studies published in Scopus offer a sufficient sample size for generalizing the results. With the use of Boolean operators, a variety of keywords were initially employed (see Table 1) to search within “TITLE-ABS-KEY” in two parts: (1) financial technology and (2) financial markets, which produced 1,738 documents (Goyal & Kumar, 2021; Krishen et al., 2021). The number of papers decreased to 901 when the search was restricted to English, journals, and article types.

Table 1*Search Terms used for Obtaining Dataset*

Search String	Search Terms
1. Financial Technology	FinTech OR fin-Tech OR “Financial Technology*.”
AND	
2. Financial Markets	“Financial Market*” OR “Capital Market” OR “Money Market” OR “Stock Market” OR “Stock exchange” OR Bank* OR “Banking Industry” OR “Banking sector”

Research Design

Bibliometric analysis is one of the common quantitative techniques used to gauge the recent trend in publications based on the bibliographic information of the literature. It is widely used to get a “bird’s eye view” opinion on any field. This paper has attempted to perform a bibliometric analysis on the “Evolution of Fintech” from 1980 through September 2022 on the studies available on the Scopus database entailing performance analysis, scientific analysis, and cluster analysis. More popularly, bibliometric analysis has been divided into analysis and science mapping (Donthu et al., 2021; Noyons et al., 1999). Analyzing the various research constituents (like countries, journals, authors, organizations, etc.) based on their number of citations and several publications helps analyze their performance in quantitative terms. In contrast, science mapping helps analyze the associations between the constituents using various analyses such as co-citation analysis, bibliographic coupling, co-occurrence analysis, etc.

Research Tools

Empirical analysis has been done with the help of the Biblioshiny package of R studio and Vos viewer software (version 1.6.16), two of the most widely used software packages, to gauge the basic trend using information available for the number of documents, number of citations, h index, and g index (Aria & Cuccurullo, 2017; Jan van Eck & Waltman, 2020).

Empirical Analysis

Empirical analysis has been conducted in three parts: (i) Descriptive Analysis, (ii) Performance Analysis and (iii) Science Mapping

Descriptive Analysis

Descriptive analysis entails descriptive statistic summary and annual scientific publications in the research area:

Descriptive Statistic Summary. A brief list of results for the bibliometric analysis conducted on a dataset of 901 studies published in the Scopus database between the period 1980 to 2022 is presented in Table 2.

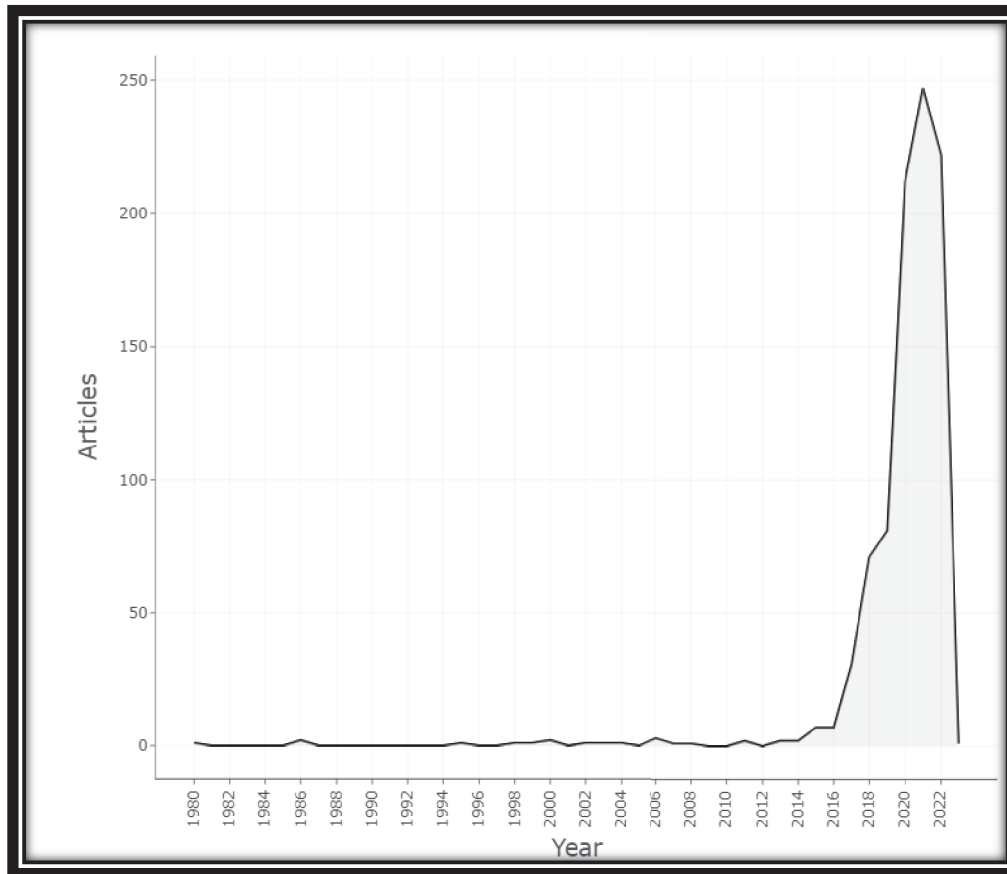
Table 2

Descriptive Statistic Summary

Description	Results
Main Information About the Data	
Timespan	1980:2022
Sources (Journals, Books, etc.)	496
Documents	901
Document Average Age	2.07
Average citations per doc	9.738
References	43406
Document Contents	
Keywords Plus (ID)	1719
Author's Keywords (DE)	2450
Authors	
Authors	2143
Authors of single-authored docs	193
Authors Collaboration	
Single-authored docs	212
Co-Authors per Doc	2.67
International co-authorships %	22.91

Looking carefully, Table 2 shows that 901 papers are distributed across 496 different sources with an average citation per document of 9.738. This is a good measure of impact; the higher the intermediate authority, the better. A total of 2143 authors have used 2450 different keywords to analyze the concept from different angles, which shows the attractiveness of FinTech as a research field. In contrast, there are only 193 authors with single-authored documents.

Annual Publication Analysis. Figure 1 shows the number of studies published from 1980 to 2022. The number of publications has increased significantly from 2017 to 2022, with the maximum number of documents published in 2021, the year following the COVID-19 pandemic.

Figure 1*Annual Publication Analysis*

Results show that from 1980-2015, the number of publications per year ranged between 1 and 7 documents, which shifted to 31 papers in 2017, followed by further increases to 71, 81, 212, 247, and 222 articles in subsequent years, respectively. The initial increase to 10 documents from 7 documents was in 2015, a year after the Modi government came into power. A drastic increase in 2020 can be attributed to COVID-19 and its role in digitalization.

Performance Analysis

This section analyzes the importance and output of various research constituents, such as journals, authors, countries, and articles to analyze their performance in FinTech.

Most Productive and Influential Countries

Productivity can be measured by the size of the circle and influenced by the number of connecting nodes or links and their strength. Figure 2 presents the results for the most productive and influential countries. It shows that studies in the dataset are diversified globally among 126 countries, out of which 39 meet the threshold of the minimum number of documents for Country 5 and the minimum number of citations for Country 50.

Figure 1

Most productive and Influential Countries

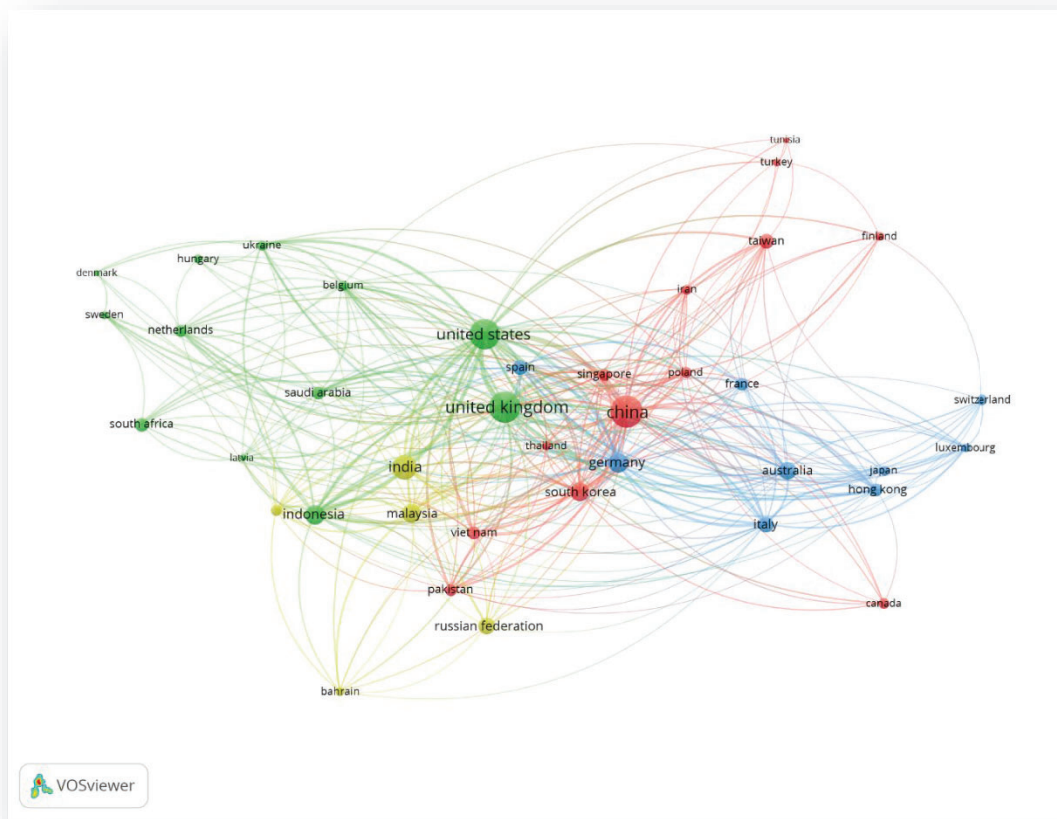


Figure 2 highlights three countries, namely the United States, the United Kingdom, and China, which have quite similar visual presentation and dominate the other counterparts. To get a more detailed view, Table 3 presents the top 10 countries based on number of publications on the left side, the number of citations in the middle, and the total link strength at the right side of the table.

Table 3.

Most Productive and Influential Countries (TD: Total Documents; TC: Total Citations; TLS: Total Link Strength)

Rank	Country	TD	TC	TLS	Rank	Country	TD	TC	TLS	Rank	Country	TD	TC	TLS
1	China	122	1369	222	1	United States	108	2003	266	1	United States	108	2003	266
2	United Kingdom	111	1530	214	2	United Kingdom	111	1530	214	2	China	122	1369	222
3	United States	108	2003	266	3	China	122	1369	222	3	United Kingdom	111	1530	214
4	India	67	414	57	4	Germany	45	1099	177	4	Germany	45	1099	177
5	Indonesia	46	140	93	5	South Korea	42	747	100	5	South Korea	42	747	100
6	Germany	45	1099	177	6	Australia	36	568	78	6	Indonesia	46	140	93
7	South Korea	42	747	100	7	Hong Kong	20	444	54	7	Spain	25	361	82
8	Malaysia	41	213	81	8	India	67	414	57	8	Malaysia	41	213	81
9	Australia	36	568	78	9	Singapore	16	410	74	9	Australia	36	568	78
10	Russian Federation	34	101	19	10	Spain	25	361	82	10	Italy	29	156	78

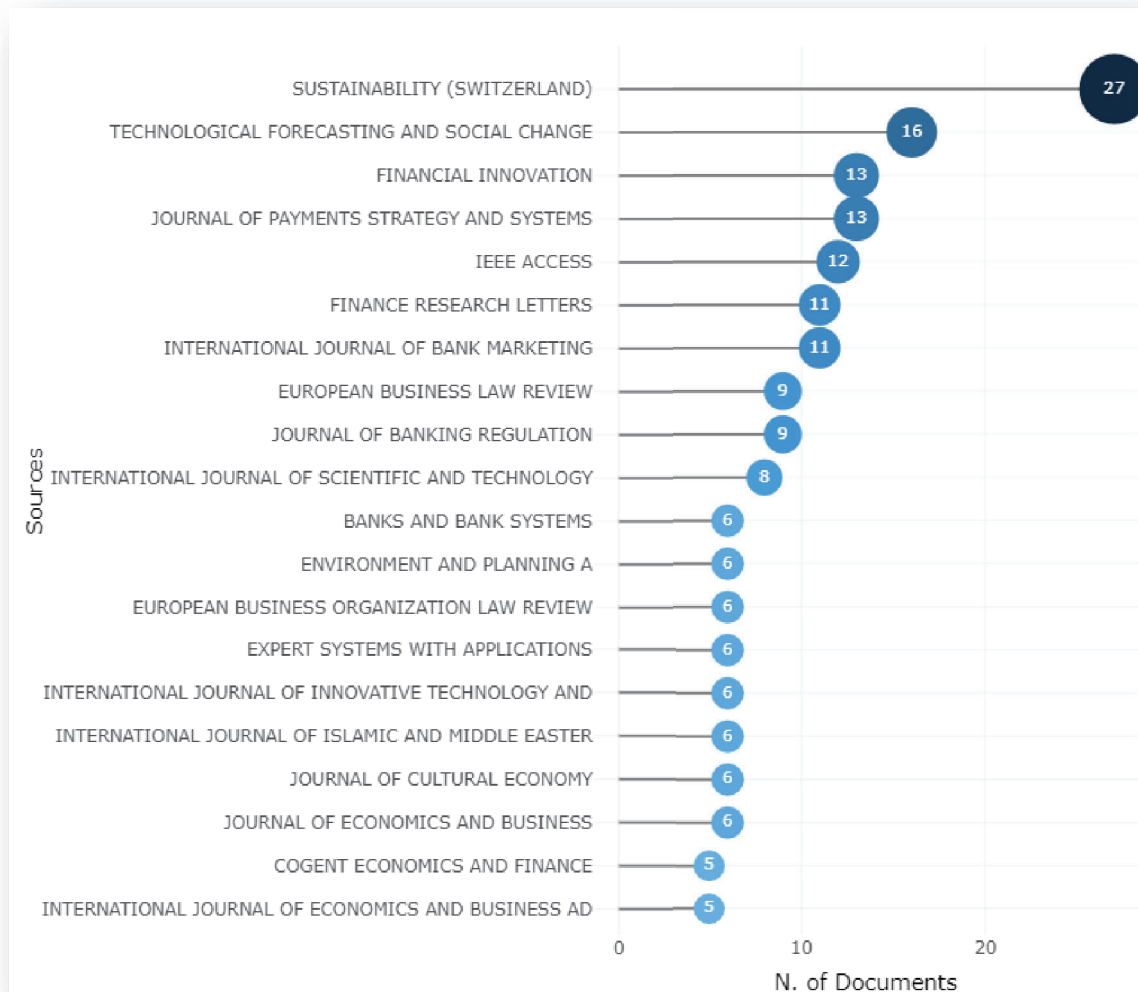
The findings of Table 3 support Figure 2 and emphasize the importance of China, the United Kingdom, and the United States in the field of fintech, as the top three positions are shared among the three, with a slight variation in ranks with respect to different parameters, such as total documents, total citations, and total link strength. China is in first place with 122 documents, whereas the United States won the game in terms of citations and total link strength. Total link strength is a commonly used parameter in the Vos viewer to analyze the influence of one research element (in this case, country) on the others; it measures the association or connectedness of the selected country with the other countries publishing in the same domain. On the other hand, India ranks fourth in terms of the number of documents and seventh in terms of the number of citations but falls out of the top ten in terms of total link strength as a selected criteria.

Most Productive and Influential Journals

Figure 3 lists the most productive journals measured on the basis of the number of publications in the selected time period of the study, i.e., 1980 to 2022. Almost 20 percent (187 out of 901) of total publications are contributed by these top 20 journals, highlighting their importance in the fields of financial technology and financial markets.

Figure 2

Top 20 Productive Journals



The top position is secured by the *Sustainability* journal, with 27 publications, followed by the journal named *Technological Forecasting and Social Change*. The next position is shared by the *Financial Innovation Journal* and the *Journal of Payments Strategy and Systems*. The fact that *Sustainability* journal is the journal with the most publications can be attributed to its semi-monthly publication frequency.

Table 4

Most Productive and Influential Journal (TC: Total citations; NP: Number of Publications; PY start: Publishing Years)

Journal Name	h-index	g-index	m-index	TC	NP	PY start
Business Horizons	2	2	0.333	450	2	2017
Technological Forecasting and Social Change	9	16	3	445	16	2020
Journal Of Management Information Systems	2	2	0.4	363	2	2018
Financial Innovation	7	13	0.875	293	13	2015
Journal Of Economics and Business	3	6	0.6	286	6	2018
Journal Of Money, Credit and Banking	1	2	0.05	260	2	2003
Journal Of Financial Economics	2	3	0.4	218	3	2018
Sustainability (Switzerland)	9	13	1.5	202	27	2017
IEEE Access	8	12	2	184	12	2019
Journal Of Financial Intermediation	2	3	0.667	155	3	2020

Table 4 lists the top ten journals in terms of total citations, as well as their publications and year of publication. The *Sustainability* journal, the one on top with the most publications, slips to the eighth position based on total citations, which shows that this journal, even though it scores highly on productivity, is not the most impactful journal. On the other hand, articles published in the *Business Horizon* journal are having maximum impact, measured by total citations of 450, with only 2 documents. The position of “Technological Forecasting and Social Change” remains the same (second position), irrespective of ranking criteria. *The Journal of Money, Credit, and Banking* has the earliest articles with seminal papers on fintech that can be traced back to understand the concept when it first emerged. Additional information on the h index, g index, and m index given in Table 4 further assesses the quality of journals.

Most Productive and Influential Authors

Out of 2143 authors, Figure 4 shows the top 20 authors from diverse backgrounds (such as finance, information technology, supply chain management, etc.) who have contributed the most papers to the evolution of fintech. The list is dominated by Baber H, Li X, and Okoli TT, with each contributing six papers to the literature on fintech. Following the top three, the second position is shared by four authors with the same number of publications (5 papers each), namely, Liu Y, Tewari DD, Wang J, and Wang L.

Figure 3

Most Productive Authors

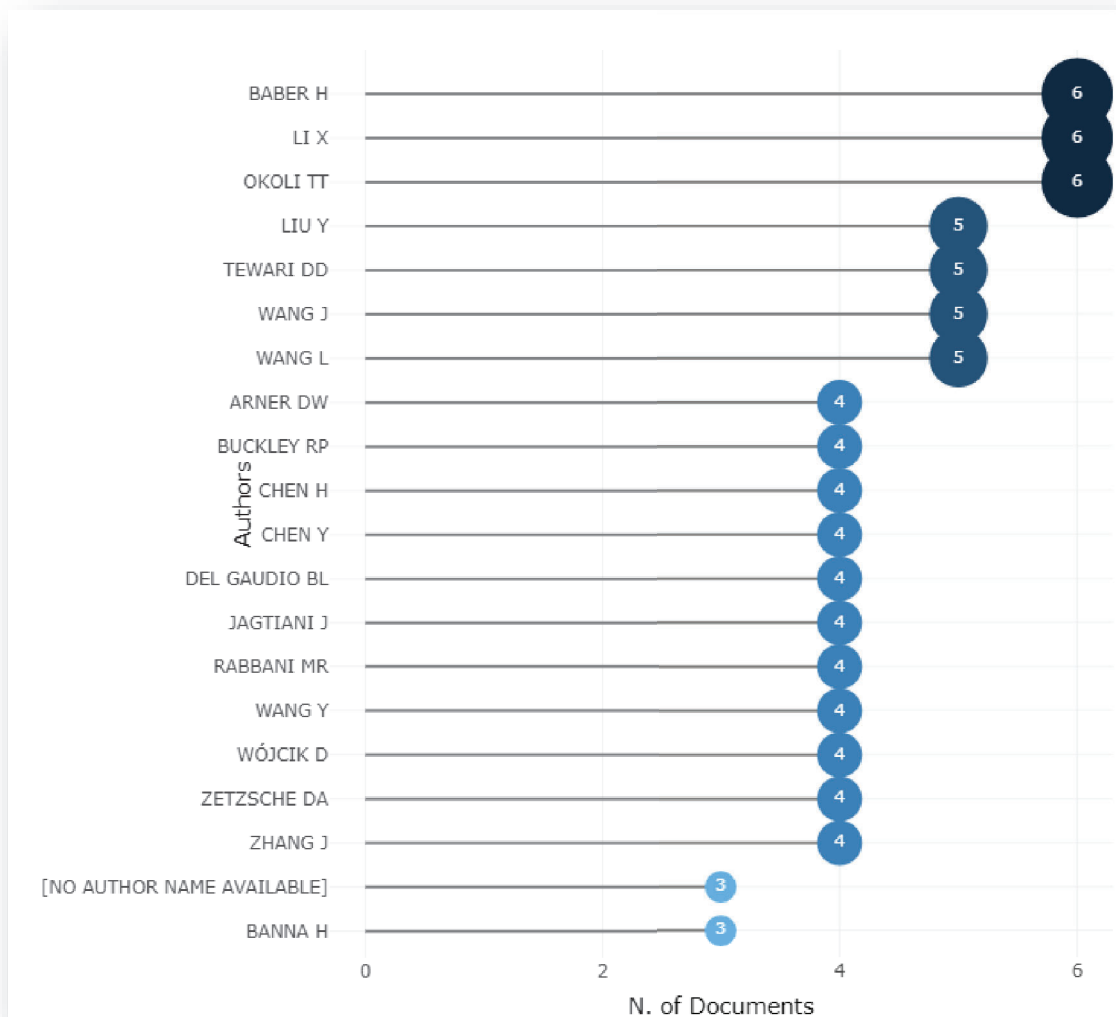


Figure 4 shows that in top 20, most authors belong to one of dominating countries that is either the US, the UK, or China. Table 5 shows the list of most influential authors calculated on the basis of total number of citations received from year of publication till date.

Table 5

Most Influential Authors

Rank	Author Name	Author's Affiliation	h-index	g-index	m-index	TC	NP	PY start
1.	Lee I	“School of Computer Sciences, Western Illinois University, Macomb, IL 61455-1390, U.S.A”	1	1	0.2	360	1	2018
2.	Shin Yj	“Hankyong National University, Anseong 17579, South Korea”	1	1	0.2	360	1	2018
3.	Gomber P	“Chair of e-Finance, Department of Information Systems, Faculty of Economics and Business Administration, at Goethe University of Frankfurt, Germany”	1	1	0.2	357	1	2018
4.	Kauffman Rj	“Professor of information systems, School of Information Systems, Singapore Management University (SMU)”	1	1	0.2	357	1	2018
5.	Parker C	“Assistant professor of supply chain management in the Department of Supply Chain and Information Systems in the Smeal College of Business of Pennsylvania State University”	1	1	0.2	357	1	2018
6.	Weber Bw	“Dean of the Lerner College of Business and Economics at the University of Delaware, where he is a professor of business administration and an affiliated faculty member of the Institute for Financial Services Analytics”	1	1	0.2	357	1	2018
7.	Berger An	“Senior Economist at the Board of Governors of the Federal Reserve System and a Senior Fellow at the Wharton Financial Institutions Centre”	1	1	0.05	260	1	2003
8.	Arner Dw	“Kerry Holdings Professor in Law, University of Hong Kong”	4	4	0.667	236	4	2017
9.	Buckley Rp	“CIFR King & Wood Mallesons Chair of International Financial Law, Scientia Professor, and Member, Centre for Law, Markets & Regulation, UNSW Australia”	4	4	0.667	236	4	2017
10.	Buchak G	“University of Chicago, United	1	1	0.2	216	1	2018

		States”						
11.	Matvos G	“McCombs School of Business, University of Texas at Austin, United States”	1	1	0.2	216	1	2018
12.	Piskorski T	“Columbia Graduate School of Business, United States”	1	1	0.2	216	1	2018
13.	Seru A	“Stanford GSB and the Hoover Institution, United States”	1	1	0.2	216	1	2018
14.	Jagtiani J	“Federal Reserve Bank of Philadelphia, United States; Federal Reserve Bank of Chicago, United States”	3	4	0.6	149	4	2018
15.	Thakor Av	“ECGI, Belgium and Olin Business School, Washington University in St. Louis, United States”	1	1	0.333	148	1	2020
16.	Zhang H	NA	2	3	0.667	139	3	2020
17.	Barberis J	“Senior Research Fellow, Asian Institute of International Financial Law, Faculty of Law, University of Hong Kong, and Founder, FinTech HK”	1	1	0.167	137	1	2017
18.	Lemieux C	“Federal Reserve Bank of Chicago, United States”	2	2	0.4	136	2	2018
19.	Anagnostopoulos I	“Kingston Business School, Department of Accounting, Finance and Informatics, Kingston Hill CampusKT2 7LB, United Kingdom”	2	2	0.4	135	2	2018
20.	Preda A	“Department of Sociology, University of Edinburgh, Adam Ferguson Building, George Square, Edinburgh EH8 9LL, United Kingdom”	1	1	0.059	131	1	2006

Analyzing the details of the authors, their affiliation, and their rank presented in Table 5 further confirms the findings of the most influential country. The list is dominated by authors affiliated with the US, the UK, and China, with the US in first position, highlighting the fact that the US is the most influential country measured by the sum total of citations received by its authors and the total link strength. Findings from US studies are widely accepted and implemented worldwide. The contributions of the most influential authors are as follows: Lee and Shin, securing top positions with 360 citations, have collectively contributed only one paper titled “Fintech: Ecosystem, Business Models, Investment Decisions, and Challenges” (Lee & Shin, 2018), followed by Gomber, Kauffman, Parker, and Weber, who are sharing third, fourth, fifth, and sixth positions, respectively, with a total of 357 citations and have collectively contributed a paper titled “On the Fintech Revolution: Interpreting the Forces of Innovation, Disruption, and Transformation in Financial Services” (Gomber et al., 2018). An interesting fact to note is that authors with recent publications in 2018 have secured the most positions, surpassing those who published in their initial years.

Most Influential Articles

Table 6 shows the most influential articles based on the total number of citations. Top position is secured by the paper of the first and second most influential authors titled “Fintech: Ecosystem, Business Models, Investment Decisions, and Challenges,” which is a conceptual paper that aims at highlighting fintech models and challenges faced by financial markets due to the interference of information technology.

Table 6*Most Influential Articles*

Paper	Title of paper	DOI	Total Citations	TC per Year
Lee I, 2018, Bus Horiz	“Fintech: Ecosystem, business models, investment decisions, and challenges”	10.1016/j.bushor.2017.09.003	360	72.00
Gomber P, 2018, J Manage Inf Syst	“On the Fintech Revolution: Interpreting the Forces of Innovation, Disruption, and Transformation in Financial Services”	10.1080/07421222.2018.1440766	357	71.40
Berger An, 2003, J Money Credit Bank	“The Economic Effects of Technological Progress: Evidence from Banking Industry”	10.1353/mcb.2003.0009	260	13.00
Buchak G, 2018, J Financ Econ	“Fintech, regulatory arbitrage, and the rise of shadow banks”	10.1016/j.jfineco.2018.03.011	216	43.20
Thakor Av, 2020, J Financ Intermediation	“Fintech and banking: What do we know?”	10.1016/j.jfi.2019.100833	148	49.33
Arner Dw, 2017, Northwest J Intl Law Bus	“FinTech, RegTech, and the Reconceptualization of Financial Regulation”	NA	137	22.83
Preda A, 2006, Soc Stud Sci	“Socio-Technical Agency in Financial Markets: The Case of the Stock Ticker”	10.1177/0306312706059543	131	7.71
Anagnostopoulos I, 2018, J Econ Bus	“Fintech and Regtech: Impact on	10.1016/j.jeconbus.2018.07.003	129	25.80

	Regulators and Banks”			
Neu D, 2006, Account Organ Soc	“Informing technologies and the World Bank”	10.1016/j.aos.2005.07.002	121	7.12
Belanche D, 2019, Ind Manage Data Sys	“Artificial Intelligence in FinTech: understanding robo-advisors adoption among customers”	10.1108/IMDS-08-2018-0368	115	28.75

The list of influential articles includes a mix of conceptual and theoretical papers addressing all aspects of fintech, from fundamental to advanced. These papers collectively talk about how financial markets started accepting the interference of information technologies for the enjoyment of benefits, such as cost efficiency, quick impact, no need to physically move from one place to another, etc.

Science Mapping

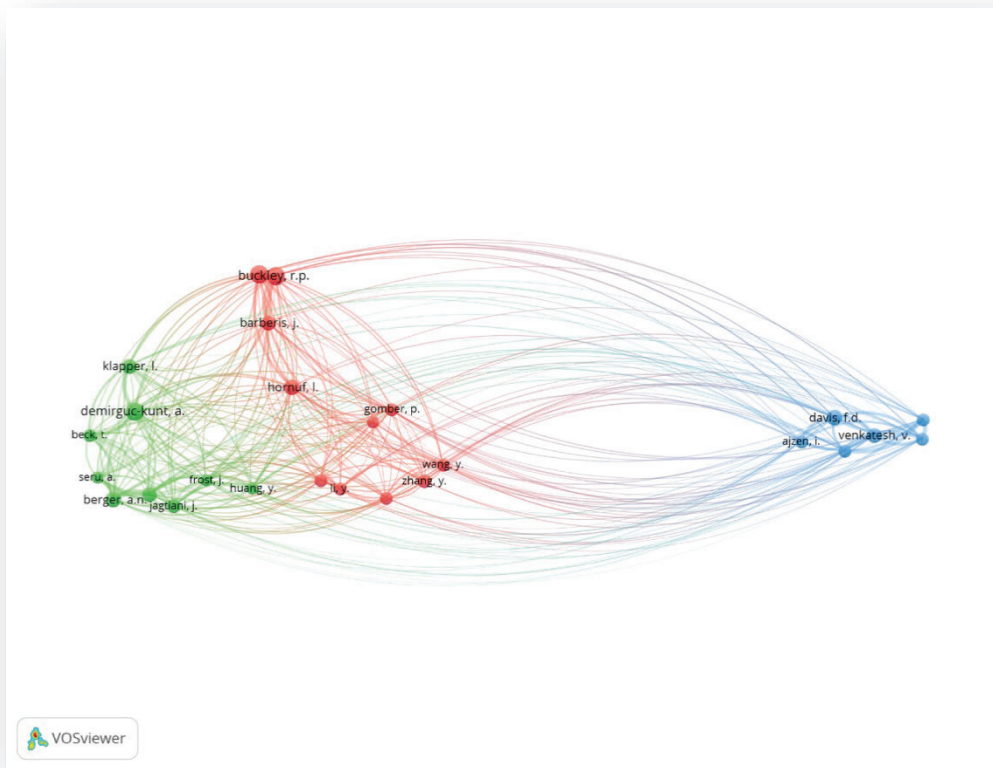
The dictionary meaning of the word “science” is to conduct a systematic study of a construct, whereas “mapping” means to associate one element with the other elements of the dataset. In research, science mapping is done with respect to different constituents to gauge the association between them. For the purpose of this study, it is done with the help of co-citation analysis, bibliographic coupling, and co-occurrence analysis.

Co-citation Analysis of Authors

Figure 5 shows a network visualization of co-citation analysis of authors publishing financial technology. Items are created, viewed, and explored on maps using VOSviewer. Items are the objects of interest, such as the authors in this instance. There is a link between every pair of objects. A link is a connection or relationship between two things, such as the co-citations between the authors in this instance. The strength of each link is indicated by a positive numerical value. The stronger the relationship, the higher this value. The sum of the times two authors has been quoted together is an indicator of a link's strength in this analysis (Jan van Eck & Waltman, 2020).

Figure 4

Co-citation of Authors



Setting threshold of 70 as the minimum number of citations of an author, only 26 meet the criteria and are divided in three clusters red, green and blue which are further analyzed with the help of Table 7. The weight or the circle size is described based on the number of citations, and each author is connected to all other authors with 25 links (the total number of links is always one less than the total number of items presented in the graph).

Table 7

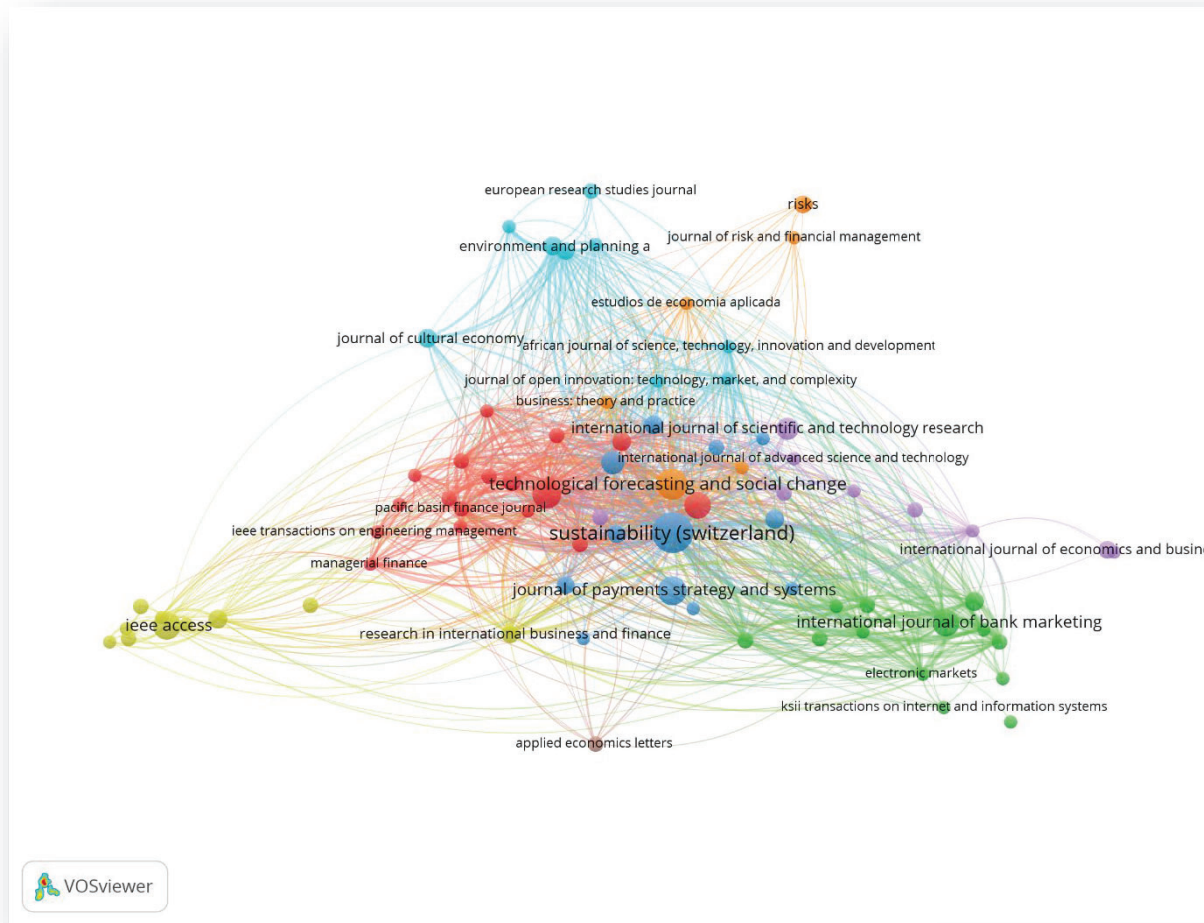
Mapping the Co-citation Clusters of Authors

Cluster	Authors	Citations	Total Link Strength
1. Red	Arner DW	168	1402
	Barberis J	116	759
	Buckley RP	176	1454
	Gomber P	92	651
	Hornuf I	128	852
	Kauffman RJ	77	491
	Li X	89	439
	Li Y	90	429
	Wang J	92	459
	Wang Y	90	501
	Zhang Y	105	399
2. Green	Beck T	86	600
	Berger AN	120	802
	Demirguc-kunt A	177	1057
	Frost J	80	578
	Huang Y	71	665
	Jagtiani J	96	669
	Klapper I	112	719
	Seru A	78	500
	Thakor AV	107	838
3. Blue	Ajzen I	85	777
	Davis FD	130	1096
	Hair JF	92	998
	Ringle CM	86	1052
	Sarstedt M	88	1079
	Venkatesh V	109	988

Table 7 shows the elements in each cluster along with the number of citations and total link strength of each item (author). Buckley RP has the most citations and link strength in the first cluster shown in red, supporting its largest circle in network visualization. Similarly, Demirguc-kunt A has the most citations in cluster 2 (green), with 177 and a total link strength of 1057. Davis FD dominates the blue cluster, with 130 citations and 1096 link strengths. Some of the authors have not only co-cited but have also co-authored the studies based on financial technologies, such as the one published by Gomber and Kauffman along with two more titled “On the Fintech Revolution: Interpreting the Forces of Innovation, Disruption, and Transformation in Financial Services,” one of the most influential articles. It is interesting to note here that some of the most influential authors are missing from the network visualization of the co-citation analysis of authors, revealing the fact that some of the most influential authors have not cited well with others even though individually they have significant citations.

Bibliographic Coupling of Sources

Figure 6 shows the results for bibliographic coupling of sources. Out of 496 sources, 82 meet the threshold if the minimum number of documents of a source and the minimum number of citations of a source are taken as 3. Out of 82, only 79 are connected with each other, and 8 clusters are formed as shown in the Figure 6.

Figure 5*Bibliographic Coupling of Sources*

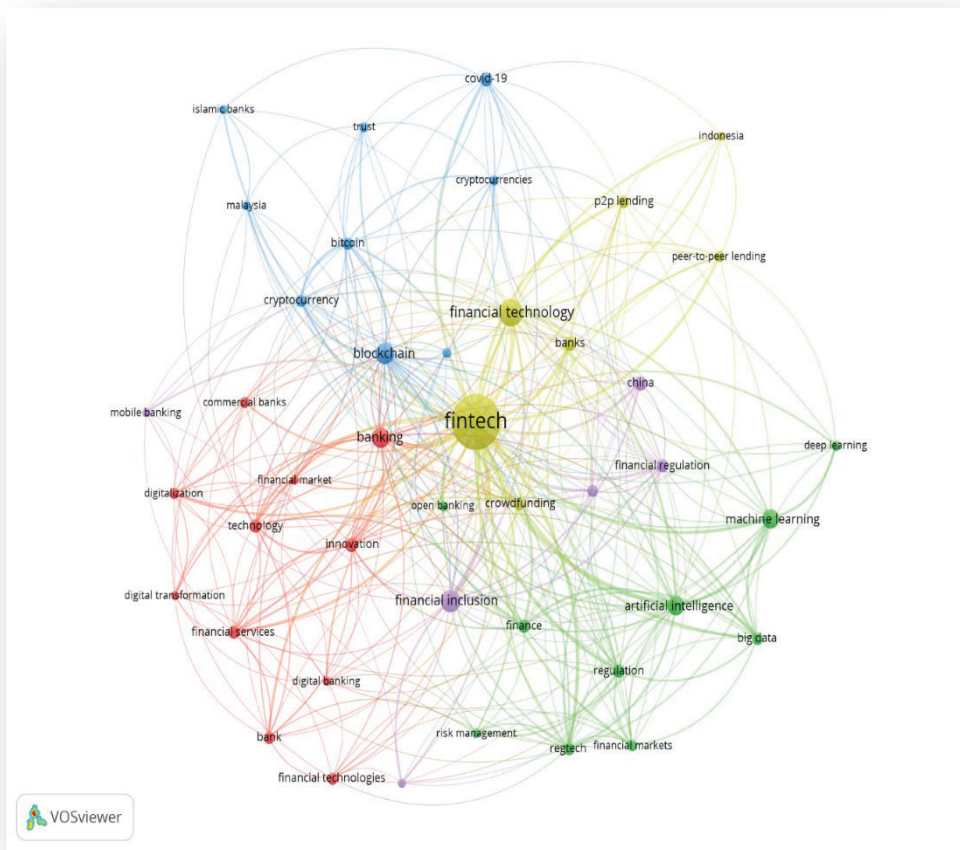
Bibliographic coupling means the strength of a link that indicates the number of cited references two publications have in common. Three journals that are excluded because of zero link strength with other sources from the network are as follows: “Enterprise Development and Microfinance,” “European Business Law Review,” and “European Competition Journal.”

Author’s Keyword Co-Occurrence Analysis

Figure 7 depicts 43 authors' keywords that meet the minimum keyword occurrence threshold of 10. The selected 43 keywords are divided into five clusters, each of which is represented by a different color. Cluster 1, depicted in yellow, with fintech and financial technology as the most widely used keywords with maximum strength, is highlighted as the largest circle, and the underlying reason can be traced back to their presence in the search string.

Figure 6

Author's Keyword Co-occurrence Analysis



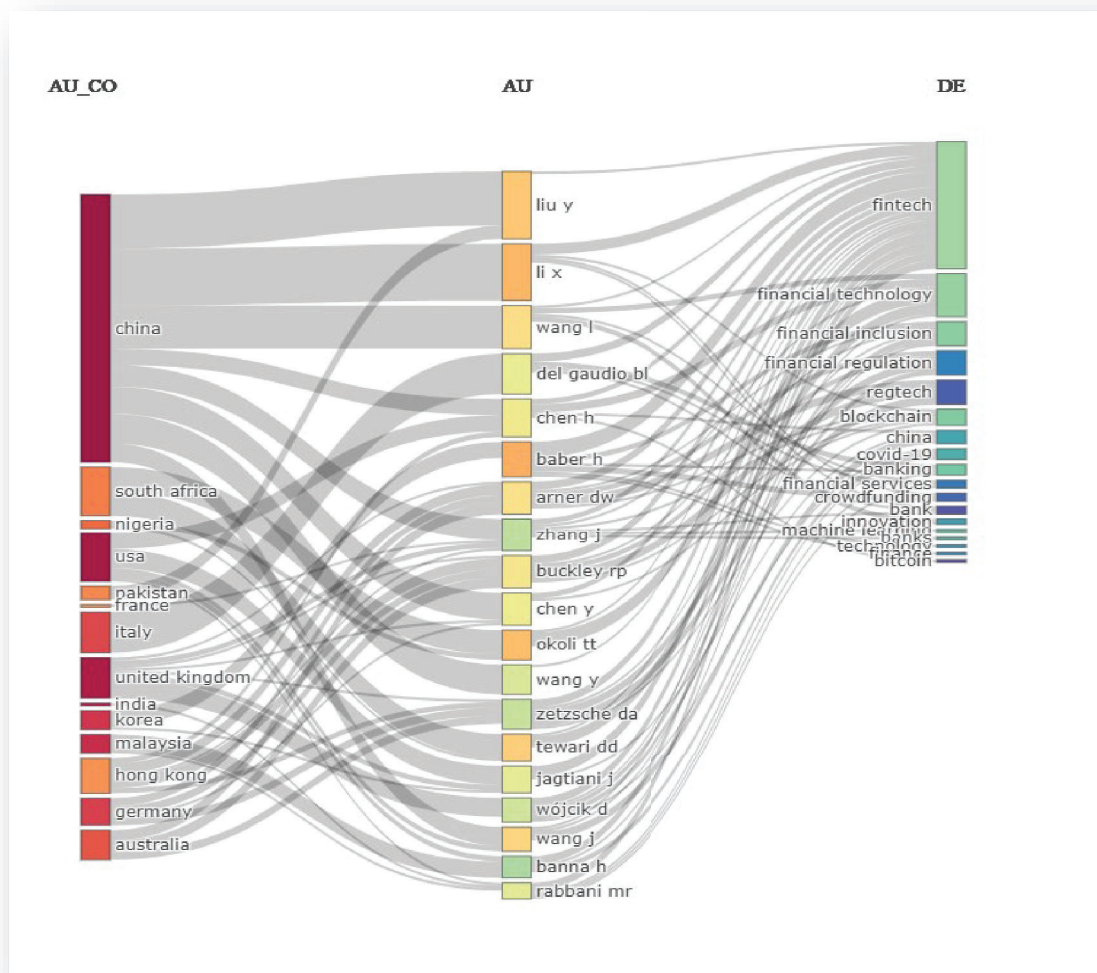
The clusters are formed with some similarities, such as the red cluster containing the most banking terminologies, whereas the green cluster focuses on IT terminologies, such as big data, artificial intelligence, and so on. A blue cluster shows the latest products of FinTech, like blockchain, cryptocurrency, bitcoin, etc. Finally, the purple cluster emphasizes issues, such as financial inclusion, regulation, and stability.

Three Field Plot

Figure 8 depicts a three-field plot that illustrates the interconnectedness of countries, authors, and keywords as measured on the left, middle, and right sides of the plot, respectively. The acronym used in the plot, i.e., AU_CO, which stands for country, AU for authors, and DE for keywords.

Figure 7

Three Factor Plot with Country, Authors and Keywords



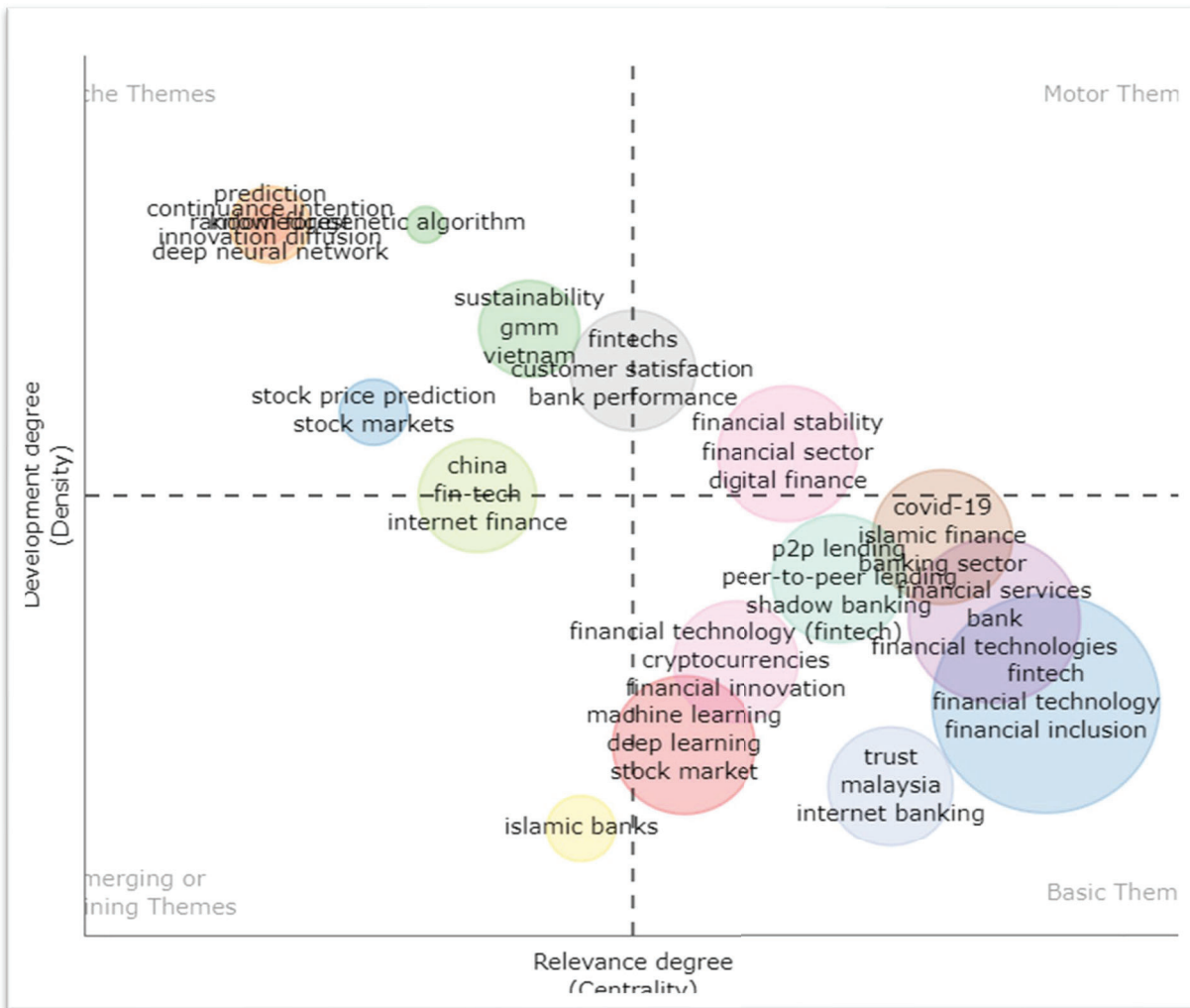
Results show that the studies are distributed across different countries and authors, with most authors affiliated with China. When closely looking at the authors' keywords, it shows China as a selected keyword by some of the authors. FinTech and Financial technology are the most widely used keywords for which connect can be seen with almost all the authors, whereas, other keywords, like financial inclusion, regulation, regtech, bitcoin etc., have connection with few authors.

Thematic Map

Figure 9 shows the thematic map based on the author's keywords used in the selected dataset. The map is divided into four quadrants, namely: niche themes, motor themes, basic themes, and emerging or declining themes. Each quadrant represents a unique combination with a different degree of centrality and density. The X-axis represents centrality, while the Y-axis represents density; closer to the origin represents a low degree value, while farther from the origin represents a high degree value.

Figure 8

Thematic Map based on Author's Keywords



Density denotes the development of the theme, whereas centrality denotes the connectedness of the theme with the other themes (Paule-Vianez et al., 2020). Motor themes score high on both parameters, reflecting well-developed concepts, whereas emerging or declining themes are the ones that score least on both parameters and are the least developed. Basic themes are high on centrality but low on density, which means they are interconnected but not well explored. On the contrary, niche themes have a high density but a low centrality, indicating that they are developed but not closely related to or associated with the other themes. The green bubble on the top left side of the graph (niche themes) highlights the term “sustainability,” which provides a scope to future researchers to further explore the association between fintech and sustainable functioning of financial markets.

Conclusion

The purpose of this research is to perform a comprehensive bibliometric analysis of the dataset exported from the Scopus database published in 1980–2022, with an emphasis on the following keywords and their

synonyms: financial technology and financial markets. The two main categories for the study's empirical analysis are performance analysis and science mapping.

Findings suggest that the United States, the United Kingdom, and China are the three prominent countries that have contributed the most papers in the field of fintech and financial markets; the rank order slightly changes with respect to citations and documents, but the top three players remain the same. Further, the maximum number of authors on the list of influential authors belong to one of three countries to further emphasize their role. The top six most influential authors based on citations have contributed two papers in recent years that have changed the direction of research in fintech, namely “Fintech: Ecosystem, Business Models, Investment Decisions, and Challenges” and “On the Fintech Revolution: Interpreting the Forces of Innovation, Disruption, and Transformation in Financial Services.” The variation in the results for the top journal as per number of publications and citations is highly influenced by the frequency of each journal’s issues, making *Sustainability* the most productive journal, which suggests that citation is the most relevant measure for performance. Further, with the help of thematic analysis, this study suggests themes where fintech proponents need to pay attention for future development, such as sustainability, Islamic banking, customer satisfaction, deep neural networks, internet finance, continuation intentions, robo-advising, etc. Especially after Covid-19 scenario, the relevance and significance of fintech has increased tremendously, as also reflected by increase in number of publications during the pandemic and onwards. Hence, the study becomes all the more relevant in better understanding the soaring role of fintech ensuring sustainability in day-to-day life.

Limitations

Some flaws are inherent in the Biblioshiny and Vos viewer software, such as when generating the graph for most productive authors, “no author name available” appears in place of author at the 19th position. On similar lines, a csv file extracted from the Scopus database by default shows the name of the *Sustainability* journal as “Sustainability Switzerland.” Initially, when the csv file was downloaded, it was checked manually to remove any inadvertently entered information. At this stage, it was observed that although the dataset included 901 studies, the csv file showed 908 studies, which was then altered to remove any extra rows and duplications for better analysis. Another limitation is that the software, by default, accepts bibliographic details of the first author. In this study, Lee and Shin are the first and second most influential authors based on the number of citations with their paper titled “Fintech: Ecosystem, Business Models, Investment Decisions, and Challenges,” which is also the most influential article, but a point to note here is that Lee is affiliated with a US institute, whereas Shin is affiliated with a South Korean institute. This will add a number to the US publication, making it the most influential country with the highest citations and total link strength.

Scope for Future Research

Various software programs are available today to perform bibliometric analyses, including Gephi, Biblioshiny, Vos viewer, Pajek, Sci2, Citespace, Publish or Perish, and others; however, for ease of use and free availability, this study only used Biblioshiny and Vos viewer, leaving a research gap for future researchers to produce similar work using other software and databases, such as Web of Science, PubMed, and others. With the help of qualitative analysis, such as content, thematic, or sentiment analysis, future researchers can delve deeper into the facts highlighted in this study and provide a conceptual background for identified trends.

References

- Anagnostopoulos, I. (2018). Fintech and regtech: Impact on regulators and banks. *Journal of Economics and Business*, 100, 7-25. <https://doi.org/10.1016/j.jeconbus.2018.07.003>
- Aria, M., & Cuccurullo, C. (2017). Bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*, 11(4), 959-975. <https://doi.org/10.1016/j.joi.2017.08.007>
- Arner, D. W., Barberis, J., Buckley, R. P., Arner, D., & Barberis, J. (2017). FinTech, RegTech, and the reconceptualization of financial regulation. *Northwestern Journal of International Law & Business*, 37(3). <http://scholarlycommons.law.northwestern.edu/njilb/vol37/iss3/2>
- Bajwa, I. A., Ur Rehman, S., Iqbal, A., Anwar, Z., Ashiq, M., & Khan, M. A. (2022). Past, present and future of FinTech research: A bibliometric analysis. *SAGE Open*, 12(4). <https://doi.org/10.1177/21582440221131242>
- Belanche, D., Casaló, L. v., & Flavián, C. (2019). Artificial Intelligence in FinTech: Understanding robo-advisors adoption among customers. *Industrial Management and Data Systems*, 119(7), 1411-1430. <https://doi.org/10.1108/IMDS-08-2018-0368>
- Berger, A. N. (2003). The economic effects of technological progress: Evidence from the banking industry. *Journal of Money, Credit and Banking*, 35(2), 141-176.
- Bhatt, A., Joshipura, M., & Joshipura, N. (2022). Decoding the trinity of Fintech, digitalization and financial services: An integrated bibliometric analysis and thematic literature review approach. *Cogent Economics and Finance*, 10(1). Cogent OA. <https://doi.org/10.1080/23322039.2022.2114160>
- Buchak, G., Matvos, G., Piskorski, T., & Seru, A. (2018). Fintech, regulatory arbitrage, and the rise of shadow banks. *Journal of Financial Economics*, 130(3), 453-483. <https://doi.org/10.1016/j.jfineco.2018.03.011>
- Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285-296. <https://doi.org/10.1016/j.jbusres.2021.04.070>
- Gomber, P., Kauffman, R. J., Parker, C., & Weber, B. W. (2018). On the Fintech Revolution: Interpreting the Forces of Innovation, Disruption, and Transformation in Financial Services. *Journal of Management Information Systems*, 35(1), 220-265. <https://doi.org/10.1080/07421222.2018.1440766>
- Goyal, K., & Kumar, S. (2021). Financial literacy: A systematic review and bibliometric analysis. *International Journal of Consumer Studies*, 45(1), 80-105. Blackwell Publishing Ltd. <https://doi.org/10.1111/ijcs.12605>
- Jan van Eck, N., & Waltman, L. (2020). VOSviewer Manual for VOSviewer version 1.6.16. Centre for Science and Technology Studies (CWTA), Leiden University. https://www.vosviewer.com/documentation/Manual_VOSviewer_1.6.16.pdf
- Krishen, A. S., Dwivedi, Y. K., Bindu, N., & Kumar, K. S. (2021). A broad overview of interactive digital marketing: A bibliometric network analysis. *Journal of Business Research*, 131, 183-195. Elsevier Inc. <https://doi.org/10.1016/j.jbusres.2021.03.061>
- Lee, I., & Shin, Y. J. (2018). Fintech: Ecosystem, business models, investment decisions, and challenges. *Business Horizons*, 61(1), 35-46. <https://doi.org/10.1016/j.bushor.2017.09.003>
- Neu, D., Ocampo Gomez, E., Graham, C., & Heincke, M. (2006). "Informing" technologies and the World Bank. *Accounting, Organizations and Society*, 31(7), 635-662.

- <https://doi.org/10.1016/j.aos.2005.07.002>
- North, M. M., Richardson, R., North, S. M., Okhio, C., Garofalo, D., Golias, Y., Koch, G., Lopez, A., Mambobo, D., Patel, K., & Watson, D. (n.d.). Mobile applications utilization in the healthcare sector. *International Management Review*, 18(1).
- Noyons, E. C. M., Moed, H. F., & van Raan, A. F. J. (1999). Integrating research performance analysis and science mapping. *Budapest Scientometrics*, 46(3).
- Obeidat, M., North, M., Richardson, R., Rattanak, V., & North, S. (2015). Business intelligence technology, applications, and trends. *International Management Review*, 11(2).
- Obeidat, M., Puckett, W., Jackson, L., & Abusalem, H. (2020). Mobile technology innovation. *International Management Review*, 16(1).
- Paule-Vianez, J., Gómez-Martínez, R., & Prado-Román, C. (2020). A bibliometric analysis of behavioural finance with mapping analysis tools. *European Research on Management and Business Economics*, 26(2), 71-77. <https://doi.org/10.1016/j.iedeen.2020.01.001>
- Preda, A. (2006). Socio-technical agency in financial markets: The case of the stock ticker. *Social Studies of Science*, 36(5), 753-782. <https://doi.org/10.1177/0306312706059543>
- Rico Pérez, H., Arenas-Parra, M., & Quiroga-García, R. (2022). Scientific development of Robo-advisor: A bibliometric analysis. *Review of Economics and Finance*, 20, 776-786. <https://refpress.org/ref-vol20-a87/>
- Thakor, A. v. (2020). Fintech and banking: What do we know? *Journal of Financial Intermediation*, 41. <https://doi.org/10.1016/j.jfi.2019.100833>