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Fintech research: systematic mapping, classification, and future directions

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Abstract

This systematic mapping study provides a comprehensive review of current Fintech publications, analyzing the current state, maturity level, and future directions of Fintech research. Reviewing 518 Fintech articles across four academic databases from 2008 to 2021, we find a significant increase in Fintech studies, especially in Quartile 1 and Quartile 2 journals. Fintech and banking, Fintech development, and Fintech adoption are the most popular research areas, and articles in these areas are increasing. We propose a classification scheme for Fintech studies across five dimensions. Our study provides a unique perspective on the subject, enabling researchers and practitioners to re-evaluate the direction and scope of future Fintech research.

Keywords: Fintech, Financial technology, Financial innovation, Systematic mapping study

Introduction

Fintech, which is an abbreviated form of financial technology, is a term that refers to the modern relationships between Internet-related technologies and business activities in the financial services industry (Suryono et al. 2020). Fintech has a wide range of meanings. In business, Fintech is broad enough to describe a complete supply chain. Fintech is defined as the provision of technology to financial service providers (Dorfleitner et al. 2017), as well as the provision of financial products or innovative financial services (Ratecka 2020) characterized by sophisticated technology (Knewtson and Rosenbaum 2020). Fintech can also refer to companies that provide innovative digital solutions for financial services (Laidroo et al. 2021). Moreover, Fintech is used to describe a series of new business models that have significant impacts on the financial market and supply of financial services (Li and Xu 2021). Fintech can even refer to an industry that applies technology to improve financial activities (Schueffel 2016). In the academic context, Fintech is a cross-disciplinary subject that combines finance, technology, and innovation management (Leong and Sung 2018). It is possible to define Fintech as initiatives (Nicoletti et al. 2017) that introduce new products and technologies (Goldstein et al. 2019) and reduce information asymmetry in the financial industry (Li and Xu 2021). Fintech can also be used as an inclusion mechanism that empowers financially underprivileged individuals to gain access to the traditional financial industry. As a business and an

academic term, Fintech has been applied in various contexts (Schueffel 2016). However, due to its nature, Fintech is Internet-based and financial-related in all contexts.

The diversity of Fintech development has resulted in its investigation across various disciplines. Thakor (2020) identified the following four areas of focus in Fintech and banking: (1) credit, deposits, and capital-raising services; (2) payments, clearing, and settlement services; (3) investment management services; and (4) insurance. They viewed Fintech as a disruptive innovation for traditional banks, especially for banks in the payment sector. Sangwan et al. (2019) undertook a thematic review of Fintech articles based on three themes—(1) industrial, (2) entrepreneurial, and (3) legal. They found that Fintech has had the most significant impact on the financial market in terms of capital and information asymmetry. Furthermore, Sangwan et al. (2019) stated that Fintech promises immense potential for further study by various stakeholders. In recent years, a few mapping studies have been performed in the Fintech field. Khan et al. (2022) analyzed 91 Fintech articles across five databases. They explored the barriers to and development of Fintech in the Gulf Cooperation Council regions and found that Fintech is a promising area for research due to its potential to provide various financial services worldwide. Ahmi et al. (2020) conducted a bibliometric analysis of Fintech research based on the Scopus database and identified basic research trends in Fintech. They suggested that although Fintech is a relatively new term, it highlights the significance of technology in the financial services industry. However, these mapping studies provided limited information on general Fintech research. Therefore, a comprehensive Fintech mapping study is required to systematically analyze the current research state and serve as a basis for future studies.

A lack of consensus among scholars and practitioners on the definition and theoretical foundations of Fintech has led to its multidimensional development across a range of meanings (Milian et al. 2019). Currently, the most common classification of Fintech research is in the business dimension. Suryono et al. (2020) classified Fintech research based on business models. They divided Fintech research into Fintech in general; payment, clearing, and settlement; risk management and investment; market aggregators; crowdfunding; peer-to-peer (P2P) lending; cryptocurrency; and blockchain. Takeda and Ito (2021) classified Fintech into the following four types according to company development and values derived from innovation: existing financial institutions, new entrants, new value-added, and improved efficiency. Additionally, they noted that among the articles reviewed, those addressing the new value-added by new entrants were the most numerous, whereas those examining improved efficiency by existing financial institutions were the least. Gomber et al. (2017) introduced the concept of the digital finance cube from the perspective of business administration and function. They divided Fintech into the dimensions of business functions (i.e., financing, investments, and payments), technology and technological concepts (i.e., blockchain, social networks, and near-field communication), and institutions (i.e., Fintech companies and traditional service providers). However, they viewed Fintech as an element of digital finance and did not identify frequency of studies in each dimension to present the current research state. Previous studies have demonstrated a lack of systematic dimensional differentiation in Fintech research.

Fintech, which primarily comprises startups that develop innovative services targeting specific finance-related functions, is still in its early stages of development. However, its growing prominence in the financial industry and the ongoing debates in the field have made it necessary to review and analyze Fintech research to consolidate existing knowledge and identify strategic areas for future innovation and development. Analyzing past and existing work is crucial for understanding anticipated trends in Fintech, as argued by Goldstein et al. (2019). Therefore, this study aims to bridge the gap by summarizing and analyzing current Fintech research to encompass the diverse research strands of Fintech and synthesize a comprehensive view of present and future Fintech studies. Using a comprehensive Fintech classification scheme, this study presents a systematic mapping review of Fintech studies to analyze the existing literature in both its current state and development trend and propose future research directions by answering the following research questions (RQs):

RQ1. What is the current state of Fintech research?
RQ2. What is the current maturity level of Fintech research?
RQ3. What types of Fintech does Fintech research involve?
RQ4. What are the potential future directions of Fintech studies?

The four RQs stem from the research motivation stated above. RQ1 and RQ2 aim to establish a fundamental understanding in the development of broad Fintech research. RQ3 aims to provide a systematic review of the existing types of Fintech and propose a classification scheme for Fintech studies. Finally, RQ4 aims to discuss the potential future directions of Fintech research based on the results of RQ1–RQ3.

Compared with previous studies, this systematic mapping presents a comprehensive view of Fintech research with detailed numerical data. Unlike similar mapping studies in the field, this study not only provides a simple research trend but also analyzes the situation in depth to assess the maturity level and future directions. It contributes to the literature by (a) describing the current state of Fintech studies by presenting statistical data on general trends, productive authors, and active countries in global Fintech studies; (b) identifying the maturity level of current Fintech studies by investigating the general index of research focus; (c) synthesizing the different types of Fintech into five dimensions to clarify the Fintech framework and enhance the understanding of this emerging research area; and (d) undertaking an in-depth analysis to explore future directions of Fintech studies. The study also ensures the quality of the results by considering the impact of the selected articles.

Methodology

Systematic mapping review

A systematic mapping review is a study that collects existing literature on a specific topic (Bates et al. 2007) and identifies the linkages between literatures (Cooper 2016) for further reviews (Grant and Booth 2009) and categorizes them according to predefined keywords to create a coded database of literature (Bates et al. 2007). Unlike systematic literature reviews, systematic maps are primarily concerned with structuring a research area (Petersen et al. 2015) and focus on the characteristics of articles (Cooper 2016).

The results of the systematic mapping serve a range of functions (Bates et al. 2007). In addition to providing an overview of a particular topic (Kitchenham et al. 2011), they provide the basis for an informed decision about whether to undertake an in-depth review and synthesis of all or a subset of the studies (Grant and Booth 2009). A systematic mapping review can also establish whether these studies will help answer the RQs and address pragmatic considerations about the resources available to complete the review (Grant and Booth 2009). This mapping study applies the process described in the Social Care Institute for Excellence (SCIE) Systematic mapping guidance (Clapton et al. 2009; Petersen et al. 2008).

Mapping process

Appendix 1 presents the visual workflow of the mapping process in this study. The research process consists of four stages—exploration and preliminary work, search strategy design, research execution, and coding and analysis. The research aims were first defined. Then, the existing scope of Fintech literature was identified, followed by capturing the broad and diverse research strands using a broad definition of Fintech. As the scope of this study aims to provide a thorough exploration of Fintech research, the RQs were developed from multiple dimensions. Therefore, general and broad search strings were chosen to gather sufficient articles across various disciplines. The search strings were refined and modified through iterative test searches until a satisfactory result was obtained.

A list of articles was collected from four databases based on the inclusion criteria outlined in Table 1. To eliminate duplicates, Endnote was initially used, followed by manual content checks. Next, a set of exclusion criteria was applied to filter out additional articles. The screening process and results of each phase are presented in Fig. 1. Finally, the selected articles were classified, aggregated, visualized, and mapped in a way that addresses the RQs (O'donovan et al. 2015). The process of constructing the scheme and extracting data underwent multiple iterations to achieve optimal results. To distinguish the authors of the selected articles from the current authors (Riccio et al. 2020), the authors of this study are referred to as "assessors".

Research questions

This study aims to determine the existing scope of Fintech literature and establish a foundation for future research in the field. To achieve this, the RQs were formulated to capture the diverse articles related to Fintech.

Table 1 Inclusion criteria

Inclusion criteria	
IC1 – Key terms criterion	Key terms: "Fintech", "Financial Technology", "Fin Tech", "Fin-tech" are included in the title and keywords section
IC2 – Type of articles criterion	Papers only include published journal papers and conference papers
IC3 – Language criterion	English papers only
IC4 – Year range criterion	Paper published from 2000 to 2022

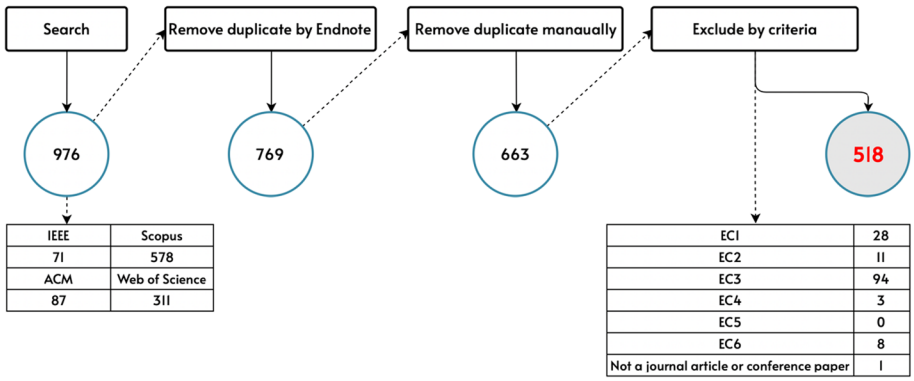


Fig. 1 Screening process

RQ1. What is the current state of Fintech research?

This RQ aims to provide an up-to-date snapshot of Fintech research to determine the current state of research in the field through a cross-sectional study of four key aspects—authorship, country, article type, and impact. By examining these factors, this question seeks a static view of Fintech research and identify trends and patterns that can inform future research in this rapidly evolving field. The impact of articles will be considered alongside other aspects in this analysis.

RQ2. What is the current maturity level of Fintech research?

The investigation of maturity level positions Fintech research in a dynamic state. Studying the maturity of Fintech research provides researchers with stronger intuitive insights into the development of the field. This question explores the current research focuses to identify concentrated research content and business activities in the industry.

RQ3. What types of Fintech does Fintech research involve?

The definitions of Fintech are often inconsistent and ambiguous (Schueffel 2016), which hinders a comprehensive understanding of innovative practices and developments in the industry. To address this issue, this RQ aims to broaden the scope of Fintech beyond its typical categorization by business models (Dorfleitner et al. 2017). By exploring diverse types of Fintech in the broadest sense, this question aims to provide a more comprehensive and nuanced understanding of the Fintech landscape.

RQ4. What are the potential future directions of Fintech studies?

To provide practical guidance for future research, this RQ aims to identify emerging areas in primary studies and the focus of scholars to obtain the potential research opportunities in Fintech.

Database selection

In this article, four well-known digital databases were employed for a comprehensive and quality coverage of the research area. The databases are the Association for Computing Machinery (ACM) Digital Library, Institute of Electrical and Electronics Engineers (IEEE) Xplore, Scopus, and Web of Science (WoS).

Both the ACM Digital Library and IEEE Xplore are science-related databases that mainly cover technical articles related to Fintech. The ACM Digital Library is employed for its extensive full-text articles and bibliographic literature that covers computing and information technology. IEEE Xplore provides a large number of indexed conference proceedings that allow the identification of emerging trends in research at an earlier stage (Chigarev 2021).

As a large database of abstracts and citations, Scopus offers a rich advanced search feature. It contains articles published in peer-reviewed journals by multiple publishers (Riccio et al. 2020). In addition, its multidisciplinary aspect allows researchers to easily search multiple disciplines (Burnham 2006). Although Norris and Oppenheim (2007) argued that Scopus is weak in the coverage of foreign journals and does not currently include social science articles published before 1996, this study is limited to articles written in English and published since 2000. As the largest data source in this study, Scopus was chosen to ensure that a wide variety of research domains are included (de Sousa Borges et al. 2014). WoS is a widely recognized proprietary database for peer-reviewed journal content (Mikki 2009). Therefore, WoS was used as a trustworthy source of quality studies, providing a depth of coverage.

Search string strategy

A systematic mapping study is generally considered less stringent (Kitchenham et al. 2011) as it usually focuses on the big picture and covers a large number of relevant articles in the field of study. This study employed a search string strategy of the research titles and keywords using the following keywords: "Fintech", "Financial Technology", "Fin Tech", and "Fin-tech". This strategy mainly returned articles with a higher-level and business-oriented focus rather than those with a technical or engineering focus. Additionally, articles that solely focus on blockchain and cryptocurrencies were excluded from this study. The search strings were created by combining the keywords and inclusion criteria, as presented in Table 1.

As each database's search facility is different, the primary search strings had to be transformed into the native syntax of each database (O'donovan et al. 2015). An example of a search query for the Scopus database is presented in Table 2.

Screening of research

The screening process for this mapping study is illustrated in Fig. 1, and the search was performed on December 14, 2021. A total of 976 Fintech-related articles were initially identified from the four selected databases, with 207 duplicates were removed using Endnote, primarily from Scopus and WoS. An additional 106 duplicates were removed manually, including pre-published papers, based on the exclusion criteria. This was done to ensure the clarity and practicality of the results.

Table 2 Sample search query

TITLE ("Fintech" OR "Financial Technology" OR "Fin Tech" OR "Fin-tec") AND KEY ("Fintech" OR "Financial Technology" OR "Fin Tech" OR "Fin tec") AND PUBYEAR > 1999 AND (LIMIT-TO [SRCTYPE, "j"] OR LIMIT-TO [SRCTYPE, "p"]) AND (LIMIT-TO [PUBSTAGE, "final"]) AND (LIMIT-TO [DOCTYPE, "ar"] OR LIMIT-TO [DOCTYPE, "cp"] OR LIMIT-TO [DOCTYPE, "re"]) AND (LIMIT-TO [LANGUAGE, "English"])

Table 3 Exclusion criteria

Exclusion criteria	
EC1 – Relevance criterion	Papers that do not focus on Fintech
EC2 – Availability criterion	Full text is not available, and the abstract does not provide enough information
EC3 – Impact criterion	Journal articles that are not ranked in SCImago and not in Scopus database or Web of Science Master Journal List Conference papers that are not ranked in SCImago, or not in Scopus database, Web of Science List, CORE conference list, ACM conference, or IEEE conference
EC4 – Recycling criterion	Articles that contain excessive recycled content by the same authors
EC5 – Plagiarism criterion	Articles that contain excessive copied content from other sources
EC6 – Year to date criterion	Articles published later than 31 December 2021

The 663 nonduplicated articles were processed using the exclusion criteria presented in Table 3. Only articles that directly focus on Fintech or are associated with Fintech practices or concepts are included, and studies that do not meet this criterion (28 articles) were excluded. To ensure a reliable understanding of the selected articles, this mapping study considers only those that are available in full text or have abstracts that provide sufficient information. The impact of each article has been considered, and for journal articles to be included, the journal must have a quartile rank (based on information from the SCImago database) or be listed in the WoS Master Journal List. Journals that are not assigned a quartile rank but are included in the Scopus database (usually new journals) are also included in this study. Regarding conference papers, they must be published in the Computing Research and Education Association of Australasia (CORE) conference list ("CORE Rankings Portal" 2016) or in either an ACM or IEEE conference proceeding. The impact criterion excluded 94 articles from this mapping study.

During the second round of screening, it was found that three articles had excessive recycled content under different titles by the same authors, and one article was a book that was misclassified by the databases. Therefore, the final number of articles included in this mapping study is 518.

Data abstraction and synthesis

To answer the RQs, the extracted data were synthesized through a data synthesis process (Li et al. 2015). In the data extraction step, the assessors thoroughly read, analyzed the relevant studies, and extracted all necessary information into a spreadsheet (Riccio et al. 2020). Afterward, the data were then grouped and synthesized for further frequency, network, and cooccurrence analyses.

The structures for answering each RQ were designed during the initial screening. For RQ1, the current state of Fintech studies is answered by classifying the statistical data of primary Fintech studies into four aspects—authors, countries, type of articles, and publication impact. Appendix 2 presents the detailed structure of data extraction. To answer RQ2, the maturity level of Fintech research was examined through an analysis of research focus and levels of activity.

In terms of RQ3, this study explored diverse types of Fintech beyond business models. Although the commonly used Fintech classification is based on business models and service types, this article refined the generalized "Fintech" by categorizing it into (1) Fintech

industry; (2) Fintech business; (3) Fintech platforms, systems, and apps; (4) Fintech services and Fintech as a tool; and (5) Fintech technology. The classification was developed based on observations made from the selected articles. Furthermore, a frequency analysis of each type of Fintech was conducted to provide a comprehensive understanding of the level of activity in each category.

To address RQ4, we conducted a comprehensive evaluation of the selected articles and examined the limitations and future directions identified by the authors. Through this process, we identified gaps in the current literature and provided insights for future studies. In addition, we offered our own perspectives on the research priorities in the field.

The datasets used and analyzed during the current study are available in the Mendeley repository (https://doi.org/10.17632/gd4hc7ym7r.3). Following the above systematic process, the results of this mapping study are presented below.

Results and analysis

This section presents a synthesis of the data extracted from the primary studies. A total of 518 primary studies conducted from 2008 to 2021 were analyzed to answer the four RQs. The data analysis involved a qualitative content analysis, where the assessors identified and analyzed key themes, categories, and dimensions based on the data. The assessors used their own judgment and interpretation to group and categorize the data, considering the frequency and coverage of the selected articles both geographically and thematically (Meçe et al. 2020). By synthesizing and organizing the findings, a comprehensive and extensive understanding of Fintech was obtained, providing valuable insights and perspectives for future research.

RQ1 What is the current state of Fintech research?

The earliest article on Fintech identified in this study was in 2008, but there was a gap until 2016. From 2016 to 2017, there was a 73% increase in the number of articles (from 11 to 19). Since 2018, there has been a significant increase of 195%, with a total of 56 articles. In 2019, there was a stable rise of 5% (from 56 to 59 articles). The number of Fintech articles continued to surge, reaching a peak in 2021 with a total of 202 articles.

To ensure the quality of the articles included in the study, their impact was considered. During the initial screening, 94 articles from journals and conferences papers were excluded as they did not meet the impact criterion (EC3). The distribution of the included articles by year and impact criteria is presented in Table 4. Among the journal articles, 151 were published in Q1 journals, 122 in Q2, 85 in Q3, and 59 in Q4. Additionally, although 33 journal articles were not assigned a quartile ranking by SCImago, they were included in the study because they were indexed by WoS or Scopus.

The selected conference proceeding papers totaled 68, with 23 appearing in the CORE conference list, 13 in IEEE or ACM conferences, and 32 in the WoS list or Scopus list or assigned a quartile ranking in the SCImago database. While the largest increase in the number of articles occurred in 2021, most of the increase was observed in Q1 and Q2 articles.

Table 4 Number of articles by year and impact

Year	Total number	Number of Journal articles					Number of Conference papers		
		Q1	Q2	Q3	Q4	Others	CORE	IEEE & ACM	Others
2008	1	0	1	0	0	0	0	0	0
2016	11	3	1	2	2	0	2	1	0
2017	19	5	2	7	1	2	1	1	0
2018	56	15	9	10	10	4	1	3	4
2019	59	13	5	12	16	7	4	0	2
2020	170	39	37	36	17	12	10	4	15
2021	202	76	67	18	13	8	5	4	11
Total	518	151	122	85	59	33	23	13	32
		Total Journal papers 458					Total Conference papers 68		

Regarding authors

Out of the 518 selected articles, 1381 unique authors contributed to them. The top productivity level of authors was four Fintech articles each. Among these prolific authors, three of them published all their Fintech articles in Q1, WoS journals, or in more prestigious conferences, such as CORE, IEEE, and ACM. These authors can be considered the most productive in terms of publishing high impact Fintech research. In particular, the first author in Appendix 3 has published four high impact articles, which also achieved very high citation rates per year. The top productive authors with three or more articles are presented in Appendix 3.

Countries of publications

A total of 82 countries were involved in Fintech publications, with international collaborations accounting for 25.67% (135 out of 518). Table 5 presents the top ten countries ranked by the number of Fintech articles and the number of articles in high impact journals (Q1 and WoS). China leads with 102 articles, followed by the US with 60 articles and Indonesia with 46 articles.

Type of articles

The primary studies selected for this review were limited to published journal articles and conference papers. Of the 518 studies, 450 (86.87%) were journal articles and 68 (13.13%) were conference papers, as depicted in Fig. 2. Research articles were the most common type of journal article, comprising 68.22% (307 articles). Perspective, opinion, and commentary articles accounted for 16.67% (75 articles), while review articles accounted for 7.56% (34 articles).

Tables 6 and 7 present the most prominent journals and conferences for publishing Fintech research, respectively. Journals that have published more than five articles and conferences that have published more than three papers are included.

Table 8 presents a comparison of popular research areas in journal articles and conference papers. The analysis indicates that journal articles tend to focus on

Table 5 Top productive countries (number of articles in each year)

Country	2008	2016	2017	2018	2019	2020	2021	Total (ranking)	Number of high impacts articles[1] (ranking)	Percentage of higher impact articles (%)
China	0	3	5	5	6	25	58	102 (1st)	42 (1st)	41.18
USA	1	1	0	15	4	17	22	60 (2nd)	23 (3rd)	38.33
Indonesia	0	0	0	3	6	17	20	46 (3rd)	22 (4th)	47.83
UK	0	0	1	3	3	16	22	45 (4th)	30 (2nd)	66.67
India	0	0	0	2	8	11	8	29 (5th)	7 (6th)	24.14
Australia	0	0	2	3	2	9	10	26 (6th)	9 (5th)	34.62
Malaysia	0	1	0	3	4	7	7	22 (7th)	3(16th)	13.64
Germany	0	0	1	3	3	8	6	21 (8th)	7 (6th)	33.33
South Korea	0	2	3	4	3	2	2	16 (9th)	5 (9th)	31.25
Spain	0	0	0	1	3	4	6	14 (10th)	5 (9th)	35.71
Pakistan	0	0	0	0	2	2	10	14 (10th)	6 (8th)	42.86

[1] High impact articles refer to articles that are in both Q1 and WoS Master Journal Lists

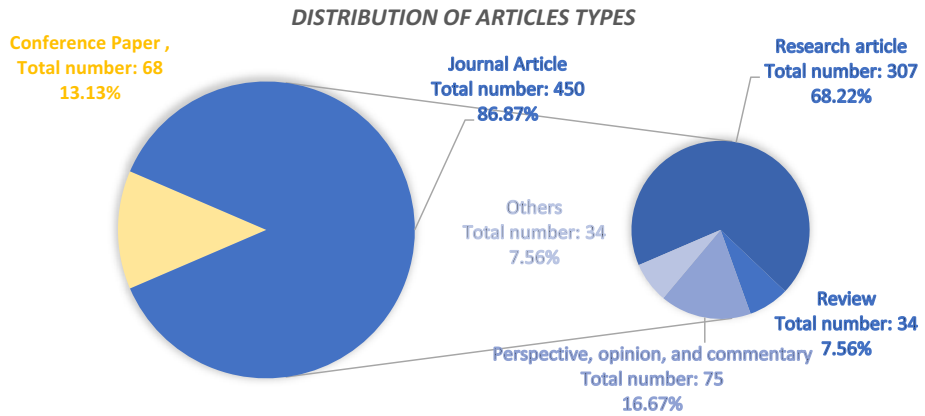


Fig. 2 Distribution of article types

Table 6 Top 12 popular journals

Publication frequency	Journal name	Quartile	WoS[1]
8	Financial Innovation	1	Y
7	IEEE Internet of Things Journal	1	Y
7	Journal of Open Innovation: Technology, Market, and Complexity	1–2	N
6	International Journal of Advanced Science and Technology	1	N
6	Journal of Asian Finance Economics and Business	2	Y
5	Small Business Economics	1	Y
5	Technological Forecasting and Social Change	1	Y
5	International Journal of Economics and Business Administration	2–3	N
5	Risks	2	Y
5	Investment Management and Financial Innovations	4	N
5	Journal of Payments Strategy and Systems	3–4	N
5	International Journal of Scientific and Technology Research	4	N

[1] WoS: Inclusion of journals in WoS Master Journal List (Y = Included; N = Not included)

Table 7 Top 6 popular conferences

Publication frequency	Conference name	CORE conference list	IEEE	ACM	Quartile	WoS[1]	Scopus[2]
5	Pervasive Health: Pervasive Computing Technologies for Healthcare	0	0	0	3	N	N
5	Journal of Physics: Conference Series	0	0	0	4	N	Y
4	CEUR Workshop Proceedings	0	0	0	0	N	Y
3	ACM International Conference Proceeding Series	0	0	1	0	N	Y
3	International Conference on Information Systems, ICIS 2020—Making Digital Inclusive: Blending the Local and the Global	1	0	0	0	N	N
3	Procedia Computer Science	0	0	0	0	N	Y

[1] WoS: Inclusion of conferences in WoS Master Journal List (Y = Included; N = Not included)

[2] Scopus: Inclusion of conferences in Scopus Database (Y = Included; N = Not included)

Table 8 Top research area of journal article and conference papers

Top 10 research areas in journal papers	Frequency	Top 10 research areas in conference papers	Frequency
Fintech and Banking	70	Fintech and Banking	11
Fintech Adoption by Customer	54	Fintech Development	9
Supervision & Regulation	36	Technology Analysis	7
Fintech Development	35	System Development	5
Industry Analysis	25	Fintech Security	4
Fintech and Financial Industry	24	Financial Transformation	3
Fintech Innovation	21	Fintech and Data	3
Fintech and Society	20	Fintech user Analysis	3
Fintech Ecosystem	18	Supervision & Regulation	3
Technology Analysis	18	Financial Inclusion	2

macro-level discussions of Fintech development, while conference papers are more oriented toward technology aspects.

Publication impact

Among the journal articles, 142 were published in Q1-ranked journals and listed in the WoS Master Journal List, which accounted for 31% of the total primary studies. Articles with more than 50 citations per year are summarized in Appendix 4. The number of citations per year was calculated based on citation data from Google Scholar, with all citation windows calculated from the first available year to 2022 rather than the official publication year.

RQ2 What is the current maturity level of Fintech research?

The maturity level of Fintech research was evaluated based on the research focus and levels of activity. The research focus was analyzed in the following two ways: (1) by a matrix of research lenses and areas and (2) by conducting a keyword analysis of titles and abstracts using VOSviewer. Both approaches indicate that Fintech is a low maturity research sector that falls between technology triggers and the peak of inflated expectations (Steinert and Leifer 2010). The business lens reveals that Fintech research primarily focuses on startups and financing, indicating that the industry is still in a nascent stage with low maturity compared with other industries.

In the first approach, four research lenses (business, socioeconomical, technological, and political regulatory) were identified. The business lens examines the management and operations of firms as well as their development on a microeconomic scale. The socioeconomical lens focuses on macro-level social and economic development on a national, regional, or global scale. The technological lens covers the technological side of Fintech, including system development, Blockchain, and artificial intelligence (AI), etc. Finally, the political regulatory lens includes studies on national policy or regulations related to Fintech. It is possible for one study to fit into multiple lenses when it addresses multiple aspects.

The research areas were identified, summarized, categorized, and synthesized through three rounds of screening and are presented in Appendix 5. In the first screening, the assessors thoroughly read the articles and identified the detailed research focus of each

study. Then, the detailed research focus was abstracted and categorized into a general research area. In the second round, the assessors read the articles again to ensure they fit into the correct research area(s). The research areas were then synthesized into broader categories, including introduction and overview of Fintech; interaction between Fintech and industries; interaction between Fintech and institutions; interaction between Fintech and small and medium-sized enterprises (SMEs); management; innovation and development of Fintech; Fintech adoptions; Fintech ecosystems; Fintech user and service analysis; risks and issues of Fintech; sustainability; social-related areas; macroeconomy; credit systems; security; Fintech system development and maintenance; technologies in Fintech; regulation; and governance.

The third round of screening involved reading all the primary studies and assigning them to each research lens, while ensuring they are placed in the correct research category. To present the patterns in the table, the highest frequency in the research lens of each research area is highlighted in Appendix 5. In Appendix 6, a cooccurrence network analysis is presented to better understand the interdisciplinary relationships between different research areas and how they interact with each other. Additionally, in Appendix 7, a cooccurrence matrix on research lenses is presented to indicate research density and centrality, providing a clear picture of the prevalence and importance of different research lenses in the selected articles.

Figure 3 depicts the outcomes of the keyword analysis using VOSviewer—an online bibliometric network visualization tool. The node size denotes the frequency of appearance in the title and abstract fields of Fintech research, with larger nodes indicating higher frequency. The analysis highlights that banking, regulation, challenge, lending, use, and adoption are the most frequently occurring words in Fintech research. The proximity of two nodes indicates their relatedness, with closer nodes indicating a stronger relationship. The analysis identifies the following four clusters: the red cluster presents keywords in the business lens, the green cluster indicates keywords in the

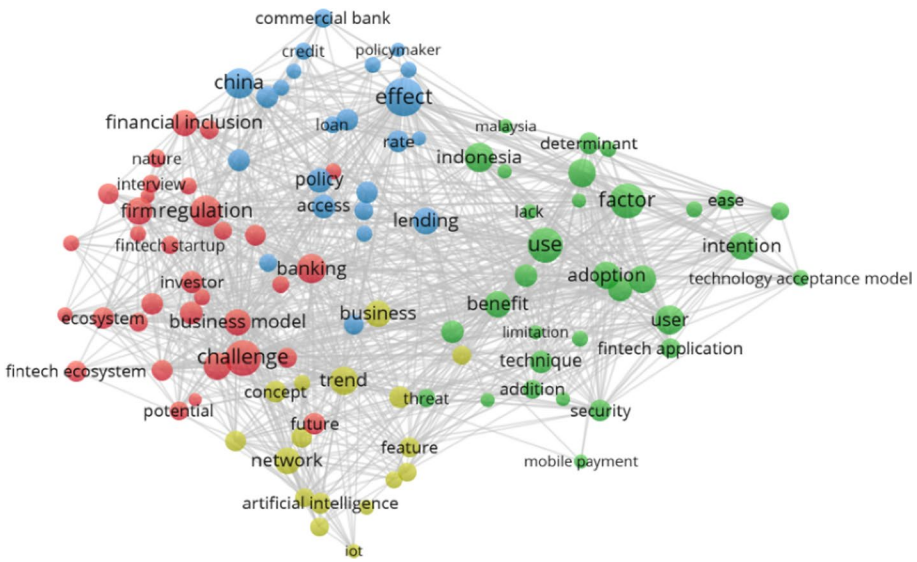


Fig. 3 Keywords analysis

socioeconomical lens, the yellow cluster highlights keywords in the technological lens, and the blue cluster presents keywords in the political regulatory lens. Some studies fit into multiple clusters as they discuss multiple aspects.

The keyword analysis revealed three key research areas with the highest frequency—Fintech and banking (represented by "banking" in Fig. 4), customer adoption of Fintech (represented by "adoption" in Fig. 5), and Fintech development (represented by "Fintech development" in Fig. 6).

In addition, keyword analysis provides insights into the relationships between different keywords. For example, in Fig. 4, the keyword "banking" is closely related to

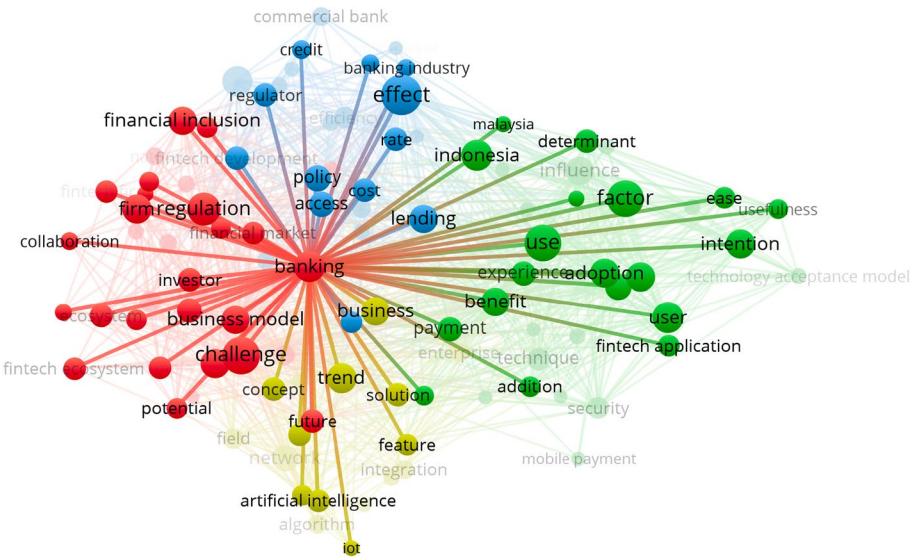


Fig. 4 Linkage of banking

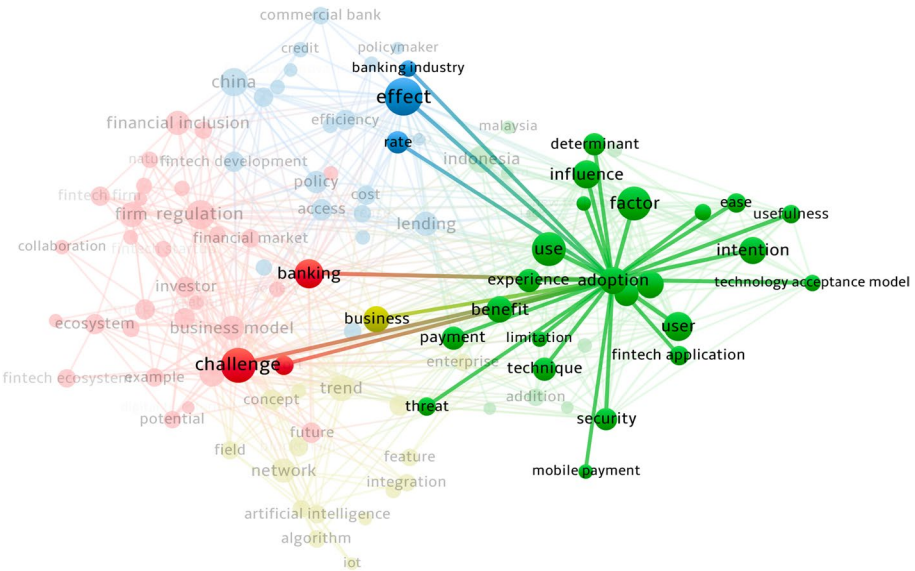


Fig. 5 Linkage of adoption

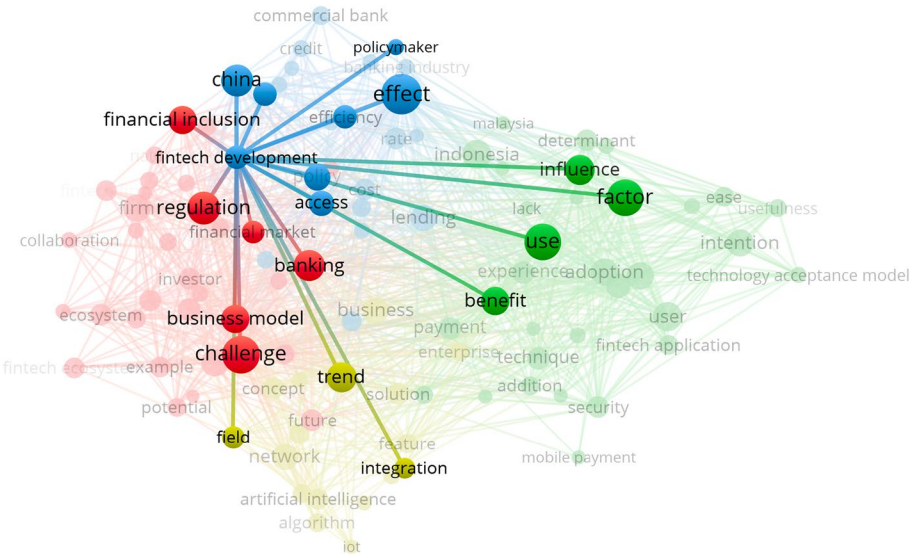


Fig. 6 Linkage of Fintech development

"business", "financial markets", "access", and "sustainable development". This observation can be supported by the work of Kou et al. (2021), which suggests that banks invest in Fintech to achieve a competitive advantage in the financial market. Figure 5 depicts that the keyword "adoption" is closely related to "trust", "Fintech service", "benefit", "ease (of use)", and "intention (of use)". In Fig. 6, the keywords "regulation", "regulator", "financial inclusion", "access", and "challenge" are closely related to "Fintech development". This suggests that Fintech development is heavily influenced by challenges related to regulatory policies and financial inclusions.

RQ3 What types of Fintech does Fintech research involve?

The difficulty of defining the exact boundaries of Fintech is evident in the vague definitions that have been presented in the literature (Lai and Samers 2021). Although Fintech is often categorized based on its distinctive business models (Dorfleitner et al. 2017), it encompasses a wide range of financial technology-related aspects. The objective of RQ3 was to create a clear and robust classification system for all types of Fintech for understanding the latest innovations and emerging developments in this rapidly evolving field to provide a foundation for future research.

To classify the diverse types of Fintech mentioned in the selected articles, the assessors read, abstracted, and coded them. They were organized into five distinct dimensions, as presented in Appendix 8. The classification presented in this study adopts an industry structure framework, encompassing not only the various segments within the Fintech industry but also the regulators and supervisors overseeing it. Within this framework, the dimension of "Regulation and supervisions" oversight and compliance is explored, with topics such as regulatory sandboxes, regulatory challenges, and legislative issues frequently discussed. In addition, the category of "Fintech in general" captures broader conceptual discussions surrounding the industry, including its

definition and overview, as well as its associated risks and general issues. This multi-dimensional classification allows for a comprehensive and nuanced understanding of the Fintech landscape and its components.

The classification scheme also identified the frequency of Fintech types discussed in the primary studies. As a single study may cover multiple types of Fintech, the numbers may overlap across categories. The number of the units and sub-units are not in an inclusion relationship but only the frequency with which each unit appeared in the selected articles. The five main Fintech categories are described below.

Fintech industry

In this study, the Fintech industry is categorized as a macro dimension (113 articles) that includes various Fintech firms and encompasses the entire supply chain of Fintech services for commercial and retail customers. Although some scholars argue that Fintech is not yet recognized as an independent industry (Wójcik 2020) but rather a branch of the general financial industry (Pollari 2016), to identify the logical flow of diverse types of Fintech, in this study, it is considered an industry rather than a segment of the financial industry.

Fintech firms

A total of 58 articles were identified that discussed Fintech firms in general. The Fintech industry comprises Fintech firms that offer both business-to-business (B2B) and business-to-consumer (B2C) services, covering technology, financial services, and other aspects of Fintech. For instance, companies that provide technology to financial service providers (Dorfleitner et al. 2017) were classified as Fintech firms. Similarly, companies offering nonbanking financial services, such as online insurance services and mobile money services, were also considered Fintech firms. The four main topics related to Fintech firms are (1) Fintech startups, (2) investment in Fintech businesses (Fintech investments), (3) financing solutions or problems of Fintech businesses (Fintech financing), and (4) the management of Fintech firms (Fintech management).

Fintech systems, Fintech platforms, and Fintech apps

Fintech firms are responsible for the development and ownership of Fintech systems, platforms, and apps. These technological tools enable firms to offer Fintech services and tools to their clients.

This mapping study applied the definition of Fintech platforms proposed by Dhar and Stein (2018) that Fintech platforms are complete or incomplete platforms that facilitate exchange between interdependent groups, usually consumers and producers, through a combination of channel access, functionality embedded in an information technology system, and associated key business processes. Examples of Fintech platforms are Amazon and PayPal.

In contrast, Fintech systems refer to the technology systems that provide financial services to various companies, such as online accounting systems and other software-as-a-service financial solutions. Additionally, Fintech systems encompass systems that enable

Fintech services. Fintech apps are mobile applications provided by Fintech firms that allow users to access their financial services.

Fintech as tools and Fintech services

"Fintech as tools" and "Fintech services" are supported by various Fintech technologies. In this study, "Fintech as tools" refers to B2B Fintech tools used by traditional financial institutions and other industry service or product providers. These institutions adopt Fintech tools to serve their customers or streamline their business operations. Some examples of Fintech tools are online banking, chatbots, and robo-advisors.

"Fintech services" are directly offered to end users and include investment services, lending, payments, and insurance. Fintech services were the most discussed in the selected research. Within the dimension of Fintech services, P2P lending and payment, transfer, and settlement were the two most frequently discussed subunits in the selected studies.

Fintech technology

Fintech technology encompasses the various technologies utilized in Fintech services, such as the Internet of things (IoT), AI, machine learning (ML), and deep learning. As the building blocks of Fintech, these technologies support other sectors in the industry. Among the technologies discussed in the sample articles, blockchain was the most frequently mentioned, followed by AI, ML, and big data. Although they are less discussed, IoT, deep learning, and cloud computing are also important technologies that should not be overlooked in Fintech research.

RQ4 What are the potential future directions of Fintech studies?

Trending topics

The insights gained from past articles on Fintech can help us identify future research directions. Fintech development, Fintech and banking, and Fintech adoption are currently the most popular research topics in Fintech and are expected to remain so in the future. By examining the future research directions outlined in the selected articles, we identify potential areas of research in each topic.

In the area of Fintech and banking, future research is likely to focus on the integration of banking and Fintech systems. Regarding Fintech adoption, research will continue to explore end users' continued use of Fintech services, as well as the perceived benefits and risks of such services for customers. In the field of Fintech development, there is a need for further investigation into sustainable development, including consumer protection, cross-industry cooperation, and financial regulation.

In addition, technology adoption in Fintech has the highest growth rate in articles. Based on the proposed Fintech classification scheme in this study, Fintech technologies are the fundamental units that support Fintech services. Future research in this area will continue to explore how the use of technology influences the service scope and innovation ability of Fintech services and ultimately shapes the future of the Fintech industry.

Fintech and sustainable development

The topics discussed above prompt us to reflect on the future of Fintech and its potential impact on sustainable development. The rapid advancements and innovations in Fintech can serve as a driving force for sustainable development, while the pressing need for sustainable development can provide a compelling impetus for further Fintech innovation and progress. The interplay between these two forces is complex and multifaceted and requires careful consideration by researchers, policymakers, and industry leaders.

Fintech has the potential to significantly contribute to sustainable development, and this is a promising field that warrants further investigation. Past research suggests that Fintech can promote sustainable development in many ways. First, the innovative nature of Fintech arises from the financial industry's pursuit of sustainability with the technology being applied to financial services to reshape existing propositions (Petrushenko et al. 2018) and support digital financial transformation (Arner et al. 2019), enabling Fintech to offer a broader range of services to customers and promote financial inclusion. Second, Fintech serves as a catalyst for technology-driven sustainable development. As a technology-driven industry, Fintech integrates technology into financial services, enabling it to act as a technology enabler (Beder 1994) and foster sustainable development. Third, Fintech has the potential to promote sustainable development in various industries due to its role as an intermediary and final goods provider. As a platform industry (Shin and Choi 2019), Fintech can integrate with almost all industries, enabling sustainable development and promoting overall economic performance. Given its potential, it is crucial to continue exploring Fintech's role in sustainable development to identify ways in which Fintech can promote sustainable development.

Exploring innovation is essential for the future of sustainable development in the Fintech industry. Sustainable development in Fintech aims to improve existing technologies for long-term development, ensuring that current needs are met without compromising the ability of future generations to meet their needs (Rogers et al. 2012). To achieve sustainable innovation, the application of technology in Fintech needs to be deepened and broadened. Fintech technology serves as the foundation of the industry structure and expanding its application will enrich service categories. Additionally, deepening the industry's foresight by developing interpretative financial datasets for analyzing and predicting anomalous financial situations can aid in sustainable innovation (T. Li et al. 2021).

The Fintech industry relies heavily on information and communication technology to create innovative and disruptive business models in financial services (Leong and Sung 2018). The urgency for Fintech innovation has increased in the post-COVID-19 era, particularly in improving financial service processes. Finally, Fintech innovation will drive research into the application of Fintech in different user scenarios. While most Fintech services are currently used as a tool to complete a business loop, expanding the scope of Fintech usage across various user scenarios is essential for sustainable development. Therefore, sustainable innovation is critical to the future of the Fintech industry. By expanding the application of technology,

promoting financial innovation, and researching Fintech applications in different user scenarios, the Fintech industry can achieve sustainable development.

Discussion and conclusion

This systematic mapping study provides an extensive overview of Fintech research, including its current status, maturity level, and types of Fintech. Through a systematic review of 518 Fintech articles from 2008 to 2021 across four databases, the study reveals that Fintech is an emerging research field, and the number of Fintech articles is rapidly increasing, especially in 2021. The study also found that China, the US, and the UK are leading in both the total number of articles and high impact articles. The maturity level of Fintech research is still in its early stage, and Fintech services are the most popular research area. The study proposes future research directions, such as exploring the integration of Fintech and banking systems; assessing the continued use and perceived benefits and risks of Fintech services for end users; and investigating sustainable development of consumer protection, cross-industry cooperation, and financial regulation.

Maturity level

The maturity level of Fintech studies is investigated through the research areas and lenses. The results reveal that Fintech and banking, Fintech development, and Fintech adoption are the most popular research areas, and the number of articles is increasing. Fintech is a business-related industry that combines financial and technology in both word and content. More than half of the Fintech articles fall under the purview of the business lens. However, the number of studies in the socioeconomic and political regulatory lenses is increasing, reflecting growing social and regulatory concerns, especially in financial inclusion. Regulatory sandbox in the Fintech industry is another topic that has recently attracted attention. In terms of the maturity of research, Fintech is still in its initial stage of development, positioned in the middle of technology triggers and the peak of inflated expectations (Steinert and Leifer 2010). Most Fintech products or business models are in their first generation from mass customisation to personalisation. Compared with other industries, the research area of Fintech in the business lens is concentrated on startups and Fintech financing, indicating that Fintech is at a low maturity level.

Types of Fintech

The classification of Fintech can be challenging due to the large volume of articles and broad coverage. The assessors proposed a vertical classification scheme based on the most commonly appearing dimensions in current studies. In the scheme, Fintech is categorized into the following five dimensions: (1) Fintech industry; (2) Fintech firms; (3) Fintech systems, platforms, and apps; (4) Fintech as tools and Fintech services; and (5) Fintech technologies. The results reveal that while Fintech research is evenly distributed across each level, Fintech services and the Fintech industry are popular

research topics currently. However, Fintech services remain a top priority for future development as the value of Fintech to its users lies in improving their experience. The structure and future development of the Fintech industry will evolve depending on the future growth and innovation of Fintech services. Regardless of the level, Fintech should always aim to be a financial solution and innovation initiator that integrates financial services, enhances customer experience, adapts to regulatory change (Pollari and Raisbeck 2017), and fosters cooperation between different industries driven by technology.

Future research directions

Future directions for Fintech research involve exploring the integration of Fintech and banking systems, continued use, and perceived benefits and risks of Fintech services for end users, as well as sustainable development of consumer protection, cross-industry cooperation, and financial regulation. One critical area of exploration is the impact of Fintech on sustainable development and the sustainable development of the Fintech industry itself. Fintech has the potential to contribute to sustainable development through its innovative nature, technology-driven industry, and role as an intermediary and provider of final goods. Therefore, sustainable innovation is a crucial direction for the Fintech industry, requiring the expansion and deepening of Fintech technology applications, financial innovation, and the exploration of Fintech applications in various user scenarios. Specifically, the Fintech industry has the potential to play a vital role in achieving sustainable development through its innovation and technology-driven approach.

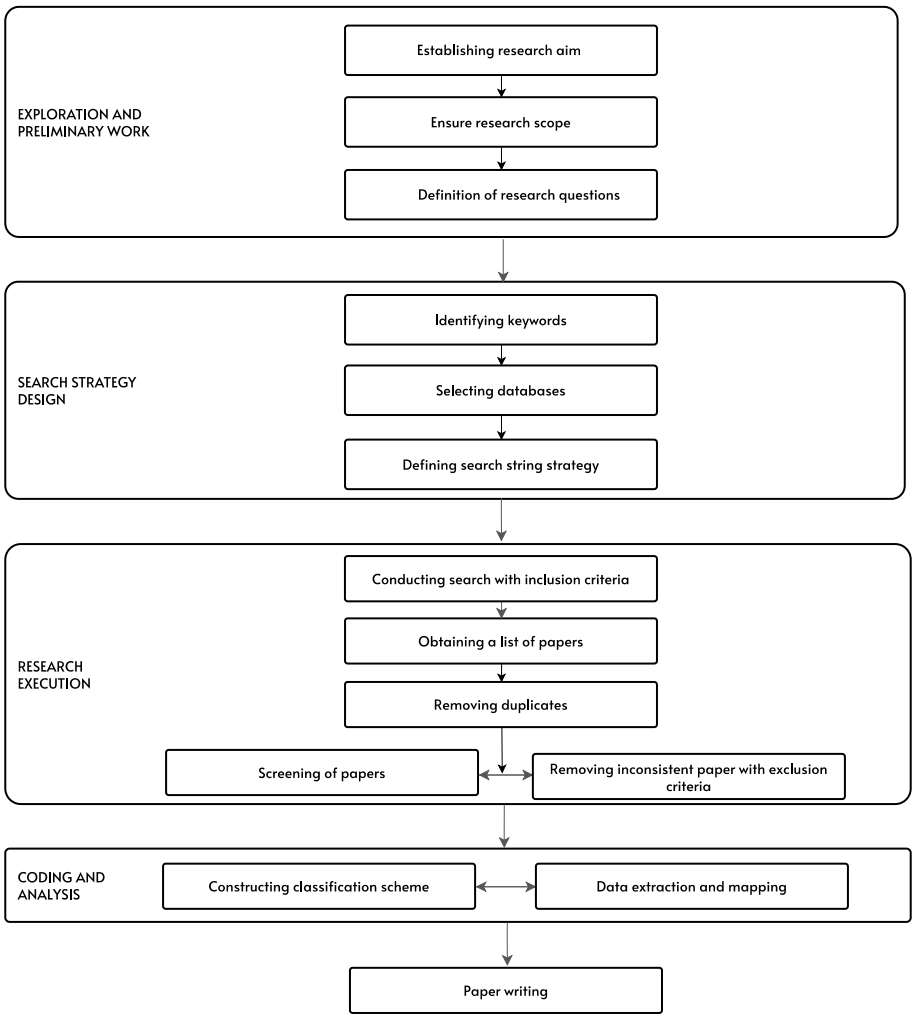
Contributions

This mapping study contributes to the Fintech literature in several ways. First, unlike most existing reviews that assess Fintech research based on a single definition, this study integrates diverse types of Fintech and provides a comprehensive analysis with numerous data and figures. Second, this study not only presents the most recent research state but also examines the maturity of Fintech research, enabling both researchers and practitioners to evaluate the direction and scope of future research. Furthermore, the study provides a comprehensive classification that considers all types of Fintech identified in selected studies and proposes a vertical classification scheme for the Fintech category. The results provide valuable research information for scholars and practitioners and support the identification of future research areas and a unique perspective on the subject.

Limitations

This study has certain limitations as it only includes highly Fintech-focused articles. Articles that are related to Fintech but do not directly focus on it, such as those that only concentrate on blockchain or cryptocurrencies, are not covered. Therefore, future studies may explore each research subject individually and in greater detail.

Appendix 1: research process



The graph shows the research process followed by this mapping. Applied the process from the SCIE Systematic mapping guidance (Clapton et al. 2009; Petersen et al. 2008)

Appendix 2: data synthesise structure of RQ1

Statistical data	Total number and trend	1. The first publication year
		2. Increasing rate from beginning year to current year
		3. Article number of each year and responding increasing rate
RQ1-1	Regarding authors	1. Total number of authors
		2. Top productive authors
		3. Top productive authors in high impact journals
		4. Top cited articles
RQ1-2	Regarding countries	1. Total number of publication countries and international collaboration
		2. Top 10 productive countries
		3. Top 10 productive countries in high impact journal and ratio to the total publications
RQ1-3	Regarding the type of articles	1. Total number of journal articles
		2. Number of conferences papers
		3. Type of articles (and proportion)
		4. Top frequency journals for publication
		5. Top frequency conferences for publication
		6. Comparison of journal and conference by research focus
RQ1-4	Regarding the publication impact	1. Early indicators: Number and proportions of papers in each journal quartile Number and proportions of papers in high impact journals (Journals in Q1 and WoS) Trend of article number by years in each quartile
		2. Late indicators: Top citation papers and the comparison of their impact factor Top authors in citation number

Appendix 3: top productive authors

Public frequency	Name of author	Research area of the paper	Sequence of author	Year	Journal/ Conference name	Quartile	WoS[1]	Citations per year[2]
Top productive authors								
4	Armin Schwienbacher	Fintech and bank	4	2021	Small Business Economics	1	Y	65.00
		Fintech overview	3	2021	Journal of Corporate Finance	1	Y	32.00
		FinTech entrepreneurship	2	2021	Small Business Economics	1	Y	24.75
		Fintech development/ Supervision & Regulation	2	2018	Corporate Governance-an International Review	1	Y	13.00
	Daniel Gozman	Fintech ecosystem/ Financial inclusion	3	2021	European Journal of Information Systems	1	Y	0.00

Public frequency	Name of author	Research area of the paper	Sequence of author	Year	Journal/ Conference name	Quartile	WoS[1]	Citations per year[2]
		Fintech ecosystem	3	2020	International Journal of Information Management	1	Y	5.00
		Fintech innovation	1	2018	Journal of Management Information Systems	1	Y	32.25
		Fintech and bank/Fintech development	2	2019	40th International Conference on Information Systems, ICIS 2019	Core Conference List		1.67
	Stan Karanasios	Financial inclusion	2	2020	International Conference on Information Systems, ICIS 2020—Making Digital Inclusive: Blending the Local and the Global	Core Conference List		0.00
		Fintech development	3	2019	Proceedings of the 23rd Pacific Asia Conference on Information Systems: Secure ICT Platform for the 4th Industrial Revolution, PACIS 2019	Core Conference List		1.33
		Fintech and bank	3	2017	Proceedings of the 28th Australasian Conference on Information Systems, ACIS 2017	Core Conference List		4.60
		Fintech ecosystem/ Financial inclusion	2	2021	European Journal of Information Systems	1	Y	0.00
	Mustafa Raza Rabbani	Fintech algorithms/ Fintech impact on SMES	3	2020	International Journal of Economics and Business Administration	2	N	37.00
		Current research	1	2020	International Journal of Economics and Business Administration	2	N	38.50

Public frequency	Name of author	Research area of the paper	Sequence of author	Year	Journal/ Conference name	Quartile	WoS[1]	Citations per year[2]
		Fintech and bank	2	2020	Journal of Economic Cooperation and Development	3	N	21.50
		Fintech and bank	1	2020	International Journal of Scientific and Technology Research	4	N	4.50
	Nofie Iman	Fintech service analysis	1	2018	Electronic Commerce Research and Applications	1	Y	29.25
		Industry analysis	1	2020	Cogent Business & Management	2	Y	10.50
		Fintech and bank	1	2019	Banks and Bank Systems	3	N	6.67
		Industry analysis	1	2018	Investment Management and Financial Innovations	4	N	8.75
	Hasnan Baber	Financial inclusion	1	2020	Qualitative Research in Financial Markets	3	Y	8.50
		Fintech and bank	1	2020	Vision-the Journal of Business Perspective	3	Y	6.00
		Fintech and bank	1	2020	International Journal of Business and Systems Research	3	N	0.00
		Fintech service analysis	1	2019	International Journal of Electronic Finance	4	N	0.00
3	Wójcik, D	Fintech definition	1	2021	Progress in Human Geography	1	Y	8.00
		Future of Fintech	1	2021	Progress in Human Geography	1	Y	11.00
		Current research situation on Fintech	1	2021	Progress in Human Geography	1	Y	7.00
	Priyadharshini Muthukannan	Fintech and financial Industry/ Fintech ecosystem	1	2021	International Journal of Information Management	1	Y	2.00
		Fintech ecosystem	1	2020	International Journal of Information Management	1	Y	5.00

Public frequency	Name of author	Research area of the paper	Sequence of author	Year	Journal/ Conference name	Quartile	WoS[1]	Citations per year[2]
		Fintech and bank/Fintech development	1	2019	40th International Conference on Information Systems, ICIS 2019	Core Conference List		1.67
	Barney Tan	Fintech ecosystem	2	2017	International Journal of Information Management	1	N	44.00
		Fintech ecosystem	2	2020	International Journal of Information Management	1	Y	5.00
		Fintech and financial Industry/ Fintech ecosystem	2	2021	International Journal of Information Management	1	Y	2.00
	Julapa Jagtiani	Technology analysis	1	2019	Financial Management	1	Y	52.33
		Fintech and bank	1	2018	Journal of Economics and Business	2	Y	50.25
		Fintech risks	1	2018	Journal of Economics and Business	2	Y	15.25
	Liangrong Song	Risk of Fintech	2	2021	Sustainability	2	Y	0.00
		Fintech and bank/Fintech risks	2	2021	Applied Economics	2	Y	4.00
		Fintech and bank/Fintech risks	2	2021	International Journal of Finance & Economics	2	Y	1.00
	M. Kabir Hassan	Fintech and bank	1	2020	Journal of Economic Cooperation and Development	3	N	21.50
		Fintech and bank/Financial inclusion	2	2021	Journal of International Financial Markets Institutions & Money	1	Y	2.00
		Fintech and bank	3	2021	International Journal of Islamic and Middle Eastern Finance and Management	2	Y	0.00
	Tochukwu Timothy Okoli	Fintech and bank	1	2020	Cogent Economics & Finance	2	Y	0.00
		Fintech adoption by customer	1	2021	Asian Economic and Financial Review	3	N	1.50

Public frequency	Name of author	Research area of the paper	Sequence of author	Year	Journal/ Conference name	Quartile	WoS[1]	Citations per year[2]
		Fintech adoption by customer	1	2021	Asian Academy of Management Journal of Accounting and Finance	3	Y	0.00
	Adam Konto Kyari	Fintech and bank/Fintech investment	1	2021	International Journal of Technological Learning, Innovation and Development	3	N	0.00
		Fintech adoption by customer	2	2020	African Journal of Science Technology Innovation & Development	3	Y	2.00
		Fintech and bank	1	2020	International Journal of Innovation, Creativity and Change	0	N	9.50
	Rand Al-Dmour	Fintech and bank/Fintech innovation	3	2020	Interdisciplinary Journal of Information, Knowledge, and Management	2	N	8.50
		Fintech innovation	1	2021	International Journal of Knowledge and Learning	3	Y	0.00
		Fintech innovation/Fintech and bank	2	2021	International Journal of Information Systems in the Service Sector	3	Y	0.00
	Arvind Ashta	Fintech innovation	1	2018	FIIB Business Review	3	Y	3.50
		Technology analysis	1	2021	Strategic Change-Briefings in Entrepreneurial Finance	2	Y	7.00
		Technology adoption	2	2021	Strategic Change-Briefings in Entrepreneurial Finance	2	Y	3.00

The table presents a list of the most productive authors who have published three or more fintech papers among all the primary studies

[1] WoS: Inclusion of Journals or Conferences in WoS Master Journal List (Y = Included; N = Not included)

[2] Citations per year are calculated based on the first online-available year

Appendix 4: articles cited more than 50 times per year

Article name	Journal name	First available year	Citation rate/year	Impact	
				Quartile	WoS[1]
Fintech: Ecosystem, business models, investment decisions, and challenges	Business Horizons	2017	144.20	1	Y
Fintech, regulatory arbitrage, and the rise of shadow banks	Journal of Financial Economics	2017	142.60	1	Y
Fintech and banking: What do we know?	Journal of Financial Intermediation	2020	132.00	1	Y
On the Fintech Revolution: Interpreting the Forces of Innovation, Disruption, and Transformation in Financial Services	Journal of Management Information Systems	2017	116.20	1	Y
Digital Finance and FinTech: current research and future research directions	Journal of Business Economics	2017	115.20	1	N
A survey on FinTech	Journal of Network and Computer Applications	2018	82.00	1	Y
The digital revolution in financial inclusion: international development in the fintech era	New Political Economy	2017	73.40	1	Y
Consumer-lending discrimination in the FinTech Era	Journal of Financial Economics	2019	71.67	1	Y
The emergence of the global fintech market: economic and technological determinants	Small Business Economics	2016	66.83	1	Y
The future of Fintech	Financial Management	2017	60.00	1	Y
Fintech	Business and Information Systems Engineering	2017	54.40	1	Y
Do Fintech lenders penetrate areas that are underserved by traditional banks?	Journal of Economics and Business	2018	50.25	2	Y

[1] WoS: Inclusion of Journals in WoS Master Journal List (Y = Included; N = Not included).

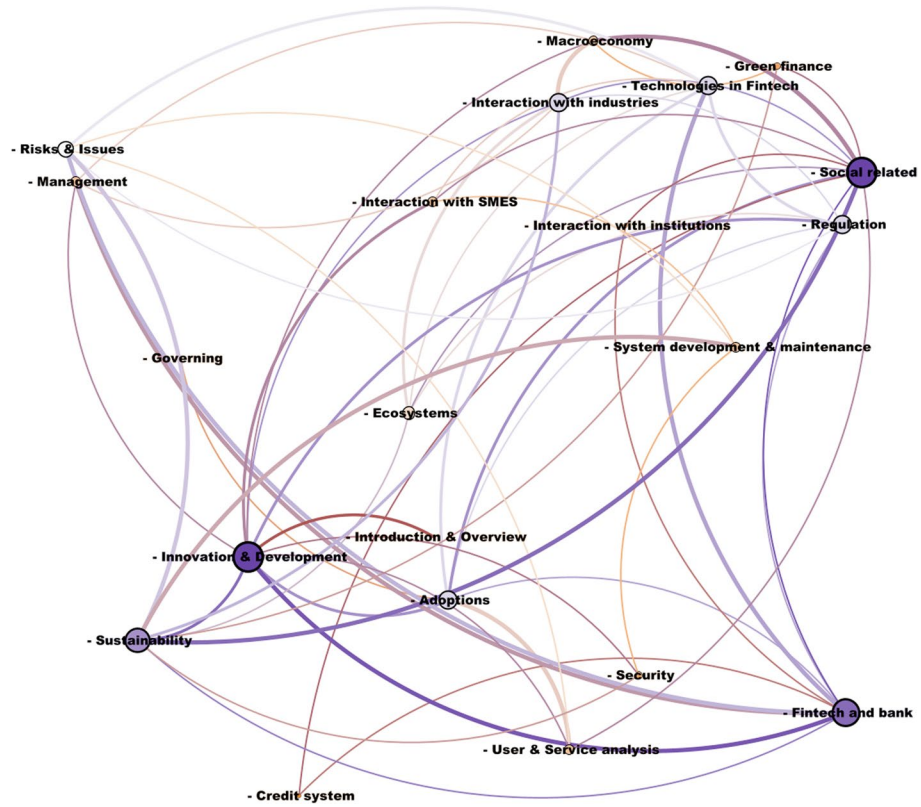
Appendix 5: combination of research area and research lenses

Category	Research area	Business lens	Socioeconomical lens	Technological lens	Political-regulatory lens
Introduction & overview	Definition of Fintech	4	0	0	0
	Current research	7	1	4	1
	Industry analysis	25	1	2	0
	Fintech overview	2	1	1	1
Interaction with industries	Fintech impact on other industries	5	2	0	0
	Fintech and financial industry	22	2	0	2
	Fintech and banking	77	2	6	4
	Financial transformation	5	2	0	0
Interaction with institutions	Fintech and FI competitions	5	1	0	0
	Fintech impact on companies	4	0	0	0
Interaction with SMES	Fintech lending on SMES	6	1	0	0
	Fintech impact on SMES	2	0	1	0
Management	Fintech operation & management	5	0	1	0
	Fintech investment	6	0	1	0
	Fintech entrepreneurship	12	0	0	0
Innovation & development	Fintech innovation	22	2	2	1
	Fintech development	39	3	2	3
	Future of Fintech	3	1	0	0
	Fintech challenges	1	0	0	0
Adoptions	Fintech adoption by customer	52	7	4	1
	Fintech adoption by SMSEs	5	0	0	1
	Fintech adoption by other industries	1	1	0	0
Ecosystems	Fintech ecosystem	11	3	6	1
User & service analysis	Fintech user analysis	7	0	0	0
	Fintech service analysis	12	1	1	2
Risks & issues	Fintech risks	10	3	1	4
	Fintech issues	4	4	1	4
Sustainability	Sustainable development	1	16	1	0
	Fintech impact on sustainability	1	3	0	0
	Sustainable development of Fintech industry	2	4	0	0
	Fintech and environment	0	3	0	0

Social related	Fintech and society	3	20	0	0
	Financial inclusion	5	17	0	1
Macroeconomy	Fintech and economy	2	11	0	0
	Fintech and national finance	1	5	0	2
	Regional development	0	1	0	0
	Fintech and global finance	1	1	0	0
Credit system	Credit system	2	2	1	0
Security	Technology and security	1	1	4	0
	Fintech security	1	1	0	5
System development & maintenance	Fintech algorithms	1	0	5	0
	System development	3	2	5	1
Technologies in Fintech	Technology adoption	0	0	10	1
	Technology analysis	7	2	21	0
	Fintech and data	4	0	7	1
	Fintech implementation	0	0	1	0
	Fintech networks	0	0	1	0
Regulation	Supervision & Regulation	5	1	0	39
	Regulatory sandbox	0	0	1	5
	Regulatory Challenges				6
	Legislation	0	0	0	2
Governing	Fintech governing	1	0	0	4
	Fintech and government	0	0	0	1

This table shows the number of papers in each research area and lens. The business lens examines Fintech on a microeconomic scale, while the socioeconomical lens focuses on macro aspects. The technological lens looks at the technology side, while the political regulatory lens examines national policies and regulations. Studies may fit into multiple lenses.

Appendix 6: co-occurrence network analysis on research areas



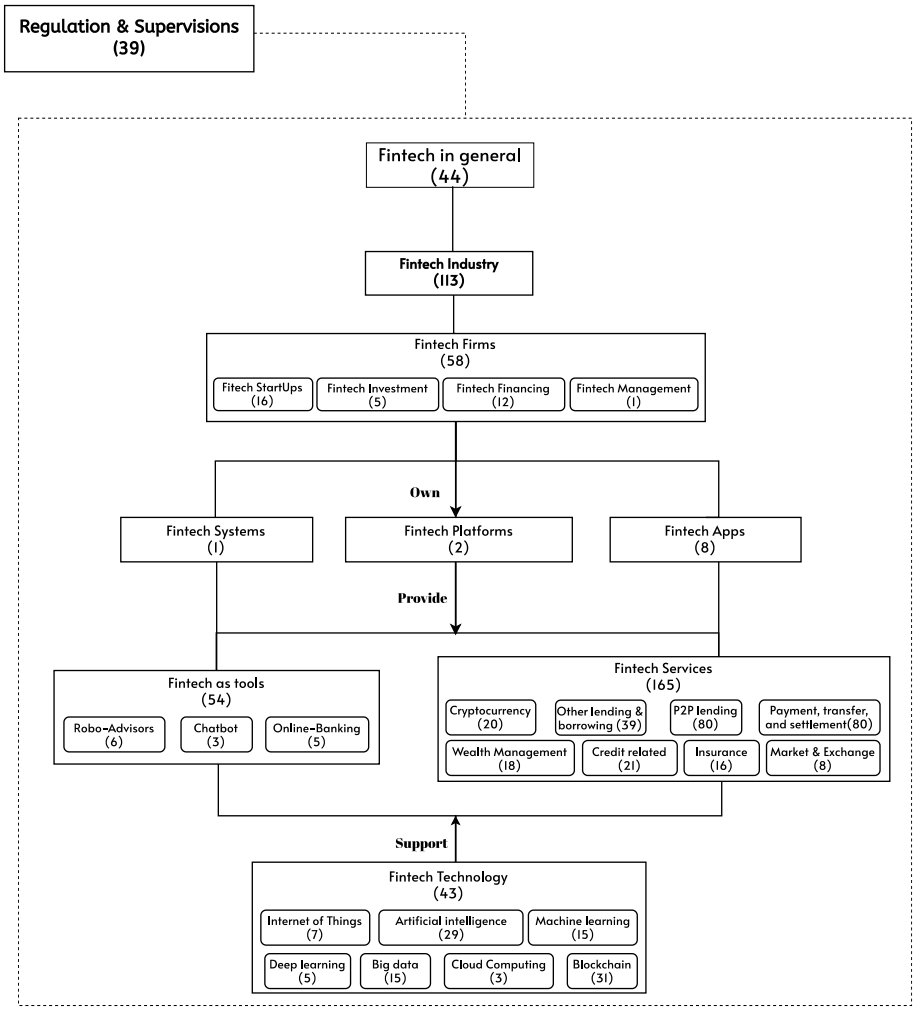
This network analysis depicts the cooccurrence of each research area, with node size representing the frequency of discussions. Larger nodes indicate higher frequency of discussion. The thickness of lines reflects the strength of cooccurrence relationships between research areas. The analysis highlights that Fintech and bank, innovation and development, sustainability, and social-related areas are the most frequently discussed topics in the selected articles. Fintech and bank are closely linked to innovation and development, risk and issues, and Fintech technologies, suggesting an interconnectivity between these areas.

Appendix 7: cooccurrence matrix on research lens

Research lens	Business lens	Socioeconomical lens	Technological lens	Political-regulatory lens
Business lens	263	26	33	14
Social-economical lens	26	66	2	4
Technological lens	33	2	51	5
Political-regulatory lens	14	4	5	60

This matrix presents the cooccurrence of each research lens. Most studies only focus on one research lens, indicated by the highest value in the matrix. The linkage between different research lenses can also be viewed, a larger value indicates a closer relationship between the two lenses. Notably, the business lens is intricately linked with other lenses, particularly the technological lens. In contrast, the socioeconomical lens is relatively distant from the technological lens.

Appendix 8: classification scheme of Fintech



The Fintech classification scheme presented in this table was created by the authors based on all the Fintech types that appeared in the primary studies. The Fintech types are laid out in the form of an industry structure, and the numbers in the table represent the frequency of each Fintech type discussed in the primary studies.

Abbreviations

ACM	Association for computing machinery
AI	Artificial intelligence
B2B	Business-to-business
CORE	Computing research and education association of Australasia
Fintech	Financial technology
IEEE	Institute of electrical and electronics engineers
IOT	Internet of Things
ML	Machine learning
P2P	Peer-to-peer
Q1, Q2, Q3, Q4	Quartile 1, Quartile 2, Quartile 3, and Quartile 4 journals
RQ	Research question
SCIE	Social care institute for excellence
SMEs	Small and medium-sized enterprises
WoS	Web of science

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Declarations

Competing interests
All authors do not have any financial and/or non-financial competing interests to declare.

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