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FINANCIAL ECONOMICS | REVIEW ARTICLE

Decoding the trinity of Fintech, digitalization and financial services: An integrated bibliometric analysis and thematic literature review approach

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Abstract: Technology has reshaped how financial services are designed, delivered, and consumed over the past decade. The increased mobile and internet penetration and availability of cheap data combined with the advent of Fintech, digitalization, blockchain technology, machine learning, and artificial intelligence have fast-tracked the digital transformation of economies worldwide. Covid19-induced lockdowns accelerated the digitalization of financial services. This study identifies the main areas and current dynamics of Fintech, digitalization, and financial services and suggests future research directions. Using a bibliometric analysis followed by a thematic literature review, the study examines a sample of 583 journal articles from the Scopus database from 1984 to 2021. Based on the bibliometric analysis, we identified four dominant themes. These themes are further explored through a thematic literature review to gain further insights. We conclude by suggesting potential directions for future research in the field.

Subjects: Cognitive Artificial Intelligence; Sustainable Development; Banking; Credit & Credit Institutions; Investment & Securities; Insurance; Pensions; Risk Management; Management of Technology & Innovation; Entrepreneurial Finance

Keywords: artificial intelligence; blockchain; digital currency; digital transformation; financial inclusion; mobile money; mobile banking; cryptocurrency; P2P lending; crowdfunding

JEL Classification: G20; G28; O33

1. Introduction

How financial services are designed, created, and consumed has metamorphosed with the advent of technology. Fintech conveys the integration of technology with financial services. According to a comprehensive definition, Fintech is an innovative technology that improves and automates financial

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services that enable smooth management of firms, investors, and customers using specialized software and applications (Zhang-Zhang et al., 2020). The Fintech market initially developed in the US, followed by the UK (Haddad et al., 2019). However, the diffusion and adoption of Fintech were faster in Asia. According to a report on Global Fintech Adoption Index in 2019 by Ernst & Young (EY), Asia is the world leader in Fintech adoption, led by China and India. India enjoys the second-highest Fintech adoption rate of 87% compared to the global average of 64% (EY, 2021a). Likewise, in 2021, the Americas and the EMEA[1] regions saw 22% and 26% growth in Fintech startups, compared to 31% for the APAC[2] region (Statista, 2021). Fintech in the Asian region is more of a solution to the lack of banking infrastructure, which is not the case for the USA and European regions (Arner et al., 2020). A study (Rabbani et al., 2020) reports the quick adoption of Fintech by the Islamic finance industry.

An increase in smartphone penetration and internet users, investments in Fintech startups, and a mindset to leverage technology to create innovative product solutions remain the critical drivers for Fintech growth in emerging economies. Further, the Covid19 pandemic accelerated the speed and scale of Fintech growth and adoption in developing economies (Findexable, 2021). With the advent of new business organizations such as internet-only banks, regulators have shown willingness to strike a delicate balance between flexibility and security in financial activities (EY, 2021b). The future of the digital economy and financial inclusion depends on the advancements in Fintech business models, digital technology, and changing landscape of how financial services are designed, delivered, and consumed. Hence, as the new era of virtual financial services unfolds, there is a need to consolidate the knowledge in these closely interlinked domains. Such research can be a ready reckoner for scholars to understand the knowledge progression and present status. It offers future research directions in Fintech and the digitalization of financial services.

Table 1 lists important review papers on Fintech and financial services over the past three years. These studies contribute to the literature and offer future research directions in the following areas.

Table 1. Methodology of related research topics to see the gap

Topic	Methodology	Articles analyzed	Article
Fintech	BA	848	Li and Xu (2021)
Fintech (Trends & Directions)	BA	1556	Nasir et al. (2021)
Big Data in Finance	BA	1059	Awan et al. (2021)
Artificial Intelligence in banking	SLR	14	Ghandour (2021)
Artificial Intelligence and bank credit	LR	–	Sadok et al. (2022)
Blockchain security	SLR	75	Patricio and Ferreira (2021)
Fintech (Challenges & Trends)	SLR, Thematic Analysis, MA	81	Suryono et al. (2020)
P2P Lending (Problems & Potential Solutions)	SLR	81	Suryono et al. (2020)
Mobile banking	SLR	76	Souiden et al., 2021)
Digital banking and payment methods	LR, MA	46	Alkhowaiter (2020)
Mobile Commerce and Banking Services + Elderly people + Developing countries	SLR	11	Msweli and Mawela (2020)
Fintech	SLR	179	Milian et al. (2019)

Note: BA: Bibliometric analysis; SLR: Systematic Literature Review; MA: Meta analysis; LR: Literature Review

- Some studies are specific to technological applications like big data, artificial intelligence, and blockchain.
- Some studies are specific to Fintech products like P2P lending, mobile banking, and digital payments.
- Most studies on Fintech have either employed bibliometric methods or conducted a systematic literature review.

We apply bibliometric analysis and thematic literature review on Fintech and digitalization in financial services. A hybrid approach using bibliometric analysis followed by a thematic literature review enables us to have a holistic view of the topic and generate thematic future research directions.

This study contributes to the body of literature on Fintech and digital financial services in more than one way. First, we apply a unique two-stage sequential approach by first identifying major research themes using bibliometric analysis followed by a thematic literature review. Such an approach helps cover the breadth and the depth of the field. Second, the study synthesizes knowledge structure by thoroughly analyzing the field's conceptual and intellectual structures. Third, the study identifies and presents a thematic literature review of four major themes and a descriptive review of the 53 most relevant papers; it serves as a reference for scholars working in this field. Fourth, the study provides future research directions for Fintech and digital financial services, especially in the changing landscape and pace of digitalization of financial services.

This paper aims to understand the knowledge progression and its present status, draw a thematic map, and identify future research directions. We achieve this by looking at the extant literature through an integrated lens of bibliometric analysis and thematic literature review. Accordingly, the following research questions are identified for this study.

RQ1. Which are the most influential documents, authors, sources, institutions, and countries in Fintech (digital) and financial services research?

RQ2. What are the conceptual structure and thematic evolution of the Fintech (digital) and financial services research?

RQ3. What is the existing intellectual structure of Fintech (digital) and financial services research?

RQ4. Which Fintech (digital) and financial services research areas need further research?

The rest of the paper proceeds as follows. Section 2 explains the research methodology, followed by section 3 discusses the bibliometric analysis and findings. Section 4 presents a thematic literature review, and section 5 offers discussion, future research directions, and a conclusion.

2. Research methodology

The study analyses the linkages between Fintech, digitalization, and financial services rather than a review of a specific field (e.g., blockchain (Cai, 2018); financial literacy (Goyal & Kumar, 2021; Ingale & Paluri, 2020); open innovation (Schueffel & Vadana, 2015).

The study applies a unique two-stage sequential approach to understanding knowledge progression and eliciting trends through knowledge structure synthesis. The bibliometric analysis provides insights into the field's intellectual structure and thematic evolution. The thematic literature review provides insights into the progression of knowledge within each theme and helps identify future research directions. Within the bibliometric analysis, the study includes performance analysis and science mapping. Performance analysis reveals essential characteristics of the field of research in terms of sources, authors, and documents; The science mapping, done

through the synthesis of the knowledge structure, helps understand the thematic evolution and the current status of research. It also gives insights into future research directions.

The first and the most significant step in any bibliometric study is identifying relevant documents consistent with the study's objective. To this end, the study used the 1984 to 2021 period in the search strategy and document selection process. While the number of documents from the early years is scanty, and the last decade has seen significant advancement in the field, the logic of using the more extended period is to avoid missing out on any seminal study.

The study uses ("Fintech" OR "Financial Technology" OR "Financial Technologies" OR "Finance Technologies" OR "Blockchain" OR "Cryptocurrency" OR "Crowdfunding" OR "P2P lending" OR "digital" OR "digital transformation") AND "Financial Services" as keywords for the search in author keywords, abstract, and title to find the articles related to financial services connected with either Fintech or digital technology. We restrict the search to only English articles published in journals. Initially, we found 587 articles with four duplicates. After removing duplicates, the data has 583 documents for bibliometric analysis. Further, we used 53 most cited and influential articles comprising 38 most cited articles from A-A* category ABDC listed journals and 15 curated articles based on abstract and full-text analysis.

Figure 1 depicts the search strategy used for document selection and data analysis techniques used in this study. The study uses the Scopus database. Scopus, along with Web of Science (WoS), is a widely used abstract and citation database, and these are the two widely used indexing databases for bibliometric studies (Zhu & Liu, 2020). Scopus has a broader coverage of publications than Web of Science (Echchakoui, 2020). Zhu and Liu (Zhu & Liu, 2020) advocate using either to complement each other.

Following (Donthu, Kumar, Pattnaik, et al. (2020, 2020)), we do performance analysis, followed by network analysis to understand the knowledge structure of the field using the Biblioshiny

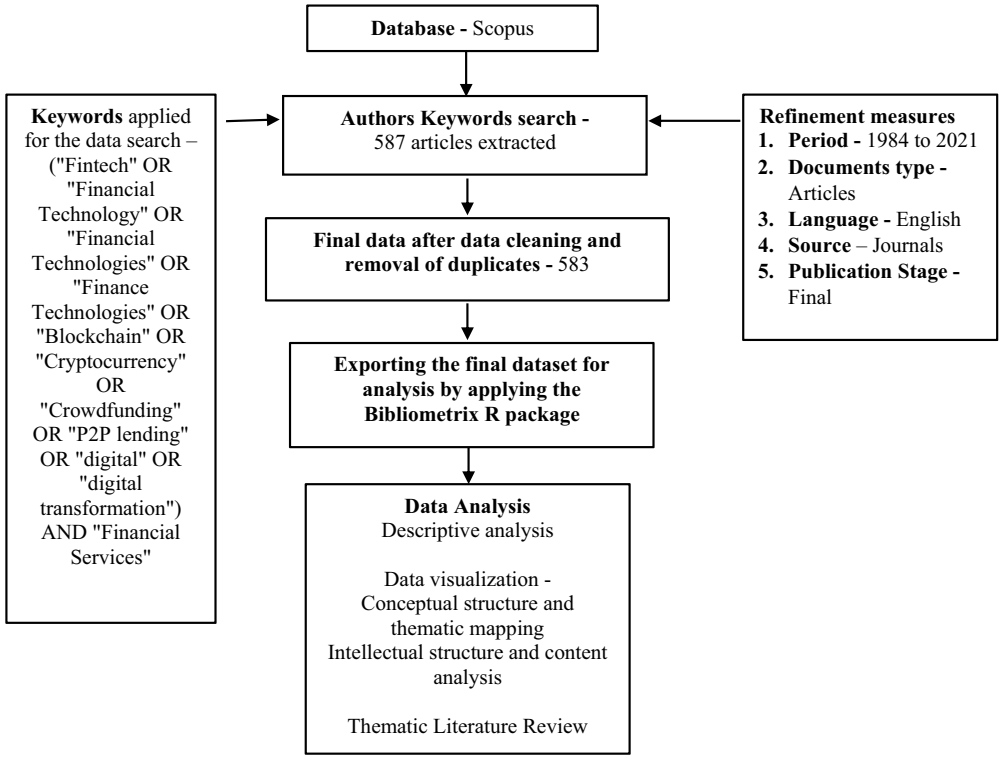

Figure 1. Flowchart of search strategy, document selection for Bibliometric analysis.

version 3.1.4. Biblioshiny incorporates various techniques as it is the most recently developed software tool.

We screened data to use articles published in journals only. Due to the review process, they are more reliable documents and represent "certified knowledge" (Danvila-del-Valle & of B, 2019). Therefore, the database excluded proceedings papers, news, and other document types. We searched the database citation records from scholarly journals across our research areas by searching for keywords in the title, abstract, and topic fields.

3. Bibliometric analysis and findings

3.1. Descriptive analysis

To answer RQ1 (Which are the most influential documents, authors, sources, institutions, and countries in Fintech (digital) and financial services research?), we present descriptive analysis on trends in scientific production, most relevant documents, journals, authors, institutions, and countries, in Fintech and financial services.

3.1.1. Dataset

Table 2 summarizes the final database used for the analysis after cleaning and filtration for relevance. 583 documents were published between 1984 and 2021 in 385 journals by 1480 authors. However, on average, 2.93 years from publication reveals that most articles were published recently. Over 90% of articles are multi-author documents. A collaboration index of 2.94 shows that the research on Fintech and financial services has high author collaboration.

3.1.2. Three field plot

Three field plot (Figure 2) shows the relationship between three fields using Sankey Plots, where the size of the portion represents the node's value (Riehmann et al., 2005). Authors (left), keywords (middle), and sources (right) were the three fields. Wang, Arner and Buckley are important authors. Fintech, financial services and inclusion, digital financial services, blockchain, and artificial

Table 2. Summary of dataset

Description	Results
Timespan	1984:2021
Sources (Journals)	385
Documents (Articles)	583
Average years from publication	2.93
Average citations per document	16.68
Average citations per year per doc	3.838
References	29506
Keywords Plus (ID)	1446
Author's Keywords (DE)	1774
Authors	1480
Author Appearances	1632
Authors of single-authored documents	115
Authors of multi-authored documents	1365
Single-authored documents	119
Documents per Author	0.394
Authors per Document	2.54
Co-Authors per Documents	2.8
Collaboration Index	2.94

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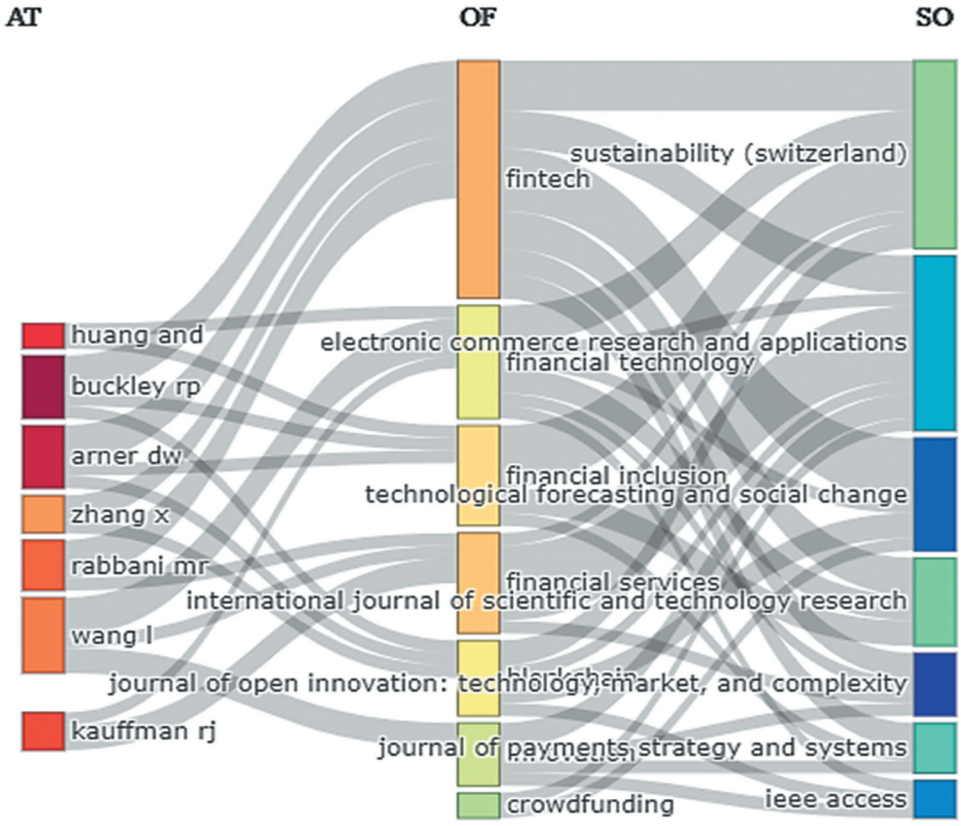

Figure 2. Three field plot: Authors (left), Keywords (middle) and Sources (right).

intelligence emerged as the primary keywords. Electronic commerce, research and applications, Technology forecasting and social change, Journal of scientific technology and research and Sustainability (Switzerland) remained the preferred journals were the most prominent Fintech and financial services authors published their work.

3.1.3. Annual scientific production

Figure 3 shows the growth in annual scientific production in Fintech and financial services. It is visible that Fintech and digitalization influence how financial services are designed, delivered, and consumed. Increased mobile penetration, internet access, and availability of cheap data

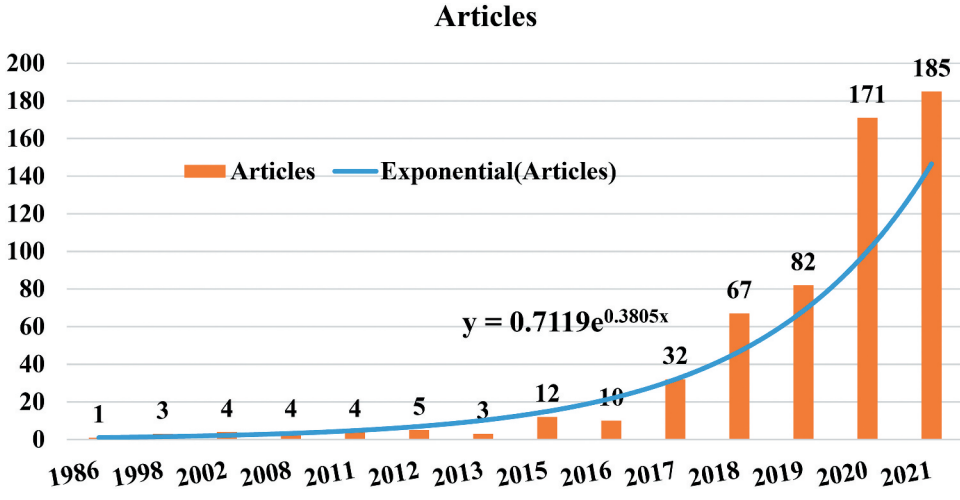

Figure 3. Annual Scientific Production and Publication growth in the field of Fintech and Financial services

Figure 4. Word cloud of the most frequent authors' keywords in the field of fintech (digital) and financial services

accelerated the digitalization of financial services. Covid19 induced restrictions, and lockdowns further accelerated it. The rapid digitalization of financial services and economies has drawn a significant surge in research interest, resulting in a continuous increase in annual publications since 2016. as presented in Figure 3.

3.1.4. Sources

583 articles on Fintech (digital) and financial services appeared in 385 journals. Many journals from different domains cover the research domain, reflecting the research field's diverse nature in that area (Low & Siegel, 2020). International Journal of Web and Grid Services, Electronic Commerce Research and Applications, and Journal of Management Information Systems are the most relevant journals based on total citations (Table 3). Sustainability (Switzerland) has the maximum number of publications (18) with 153 total citations, followed by Electronic Commerce Research and Applications, Technological Forecasting and Social Change, and IEE Access are journals with eight publications each. Interestingly, the source with the most citations—the International Journal of Web and Grid Services, has its top position owing to just one article (Zheng et al., 2018) with 1109 citations. This significant publication lands all five authors in the top five author positions by citations, and the country China comes out as the top most-cited country.

It clearly shows that the journal with the maximum number of articles published is not necessarily the journal with maximum influence in research. That may be because the articles in these journals are more recently published and are yet to move up the ladder of total citations. Among the top-20 most cited sources in Table 3, all except Electronic Commerce Research and Applications have started publishing on our area of interest from 2015 or later. Two among the top 20 most-cited journals have a finance focus, and two have economics; the rest all have a technology or sustainability focus or focus on more than one area.

3.1.5. Authors, affiliations, and countries

1480 authors from 851 affiliations and 92 countries have published articles related to Fintech (digital) and financial services from 1984 to 2021. The most relevant authors in the research field were identified based on the total number of publications and citations. While the total number of articles shows the authors' productivity, the total citations show the authors' influence on the

Table 3. Most relevant sources by total citations

Sources	TC
International Journal of Web and Grid Services	1109
Electronic Commerce Research and Applications	742
Journal of Management Information Systems	378
IEEE Transactions on Systems, Man, and Cybernetics: Systems	292
Business Horizons	272
Applied Economics	268
Journal of Business Economics	246
Technological Forecasting and Social Change	217
Journal of Corporate Accounting and Finance	199
Borsa Istanbul Review	188
International Journal of Electronic Commerce	164
Sustainability (Switzerland)	153
Journal of Strategic Information Systems	143
Journal of Network and Computer Applications	142
Geoforum	131
Journal of Financial Regulation and Compliance	130
Technology in Society	128
Information and Organization	127
Cryptography	120
Sustainable Cities and Society	118

study field. Buckley R, Kaufmann R, Arner D, and Rabbani are the most productive authors (left panel of Table 4). As discussed earlier, Wang H, Chen X, Zheng Z, Dai H, and Xie S are the top-5 most-cited authors and co-authors of the most-cited article (Zheng et al., 2018) (middle panel of Table 4). Makerere University Business School—Uganda, Southwestern University of Finance and Economics—China, and the University of Hong Kong—China are the most relevant affiliations with the maximum number of publications (right panel of Table 4).

China, USA, United Kingdom (UK), India, and South Korea have the highest published articles. On the other hand, China, the USA, UK, Germany, and South Korea are the most-cited countries. New Zealand, China, Sweden, Brazil, and Germany are the most relevant countries in the average articles cited (Table 5).

3.1.6. Documents citation analysis

Citation analysis is an appropriate way to assess the impact of a document (Ding & Cronin, 2010). It helps assess the impact and influence of the document in the research domain. Global citations show the number of times a document is cited by other documents in the network of documents and beyond and measure the overall impact. In contrast, the number of local citations shows the number of times the document is cited within the network of documents in the specific field. As shown in Table 6, Zheng et al. (2018), Gomber et al. (2018), and Wang et al. (2019) are the most relevant documents with the highest number of global citations, whereas Gomber et al. (2017, 2018) and Ozili (2018) are the most local cited documents. Zheng et al. (2018) comprehensively survey blockchain's technological and application aspects. Gomber et al. (2017) provides future research directions in the field of Fintech; Gomber et al. (2018) investigates the forces driving the Fintech revolution. Wang et al. (2019) shed light on architecture, applications, and future trends of blockchain-enabled smart contracts. Ozili (2018) discusses the impact of digital finance on financial inclusion and stability.

Table 4. Most relevant authors and affiliations

Most relevant Authors by the documents published		Most relevant Authors by Total Citations (TC)		Most relevant affiliations by number of publications	
Authors	**Articles**	**Author**	**TC**	**Affiliations**	**Articles**
Buckley Rp	5	Wang H	1133	Makerere University Business School	7
Kauffman Rj	4	Chen X	1122	Southwestern University of Finance and Economics	7
Arner Dw	4	Zheng Z	1118	University of Hong Kong	6
Rabbani Mr	4	Dai Hn	1109	Kazan Federal University	5
Wang L	3	Xie S	1109	Nanyang Technological University	5
Huang Y	3	Kauffman Rj	712	Peking University	5
Zhang X	3	Gomber P	546	Singapore Management University	5
Wang H	2	Parker C	302	Soongsil University	5
Karjaluoto H	3	Weber Bw	302	Sumy State University	5
Shaikh Aa	3	Han X	292	University of Bahrain	5
Gleasure R	3	Ni X	292	University of California	5
Iman N	2	Ouyang L	292	University of Delhi	5
Loubere N	3	Wang Fy	292	Ajou University	4
Zetzsche Da	3	Wang S	292	Kingdom University	4
Iheanachor N	3	Yuan Y	292	Kyiv National Economic University	4
Li W	2	Au Ya	271	London School of Economics	4
Rupeika-Apoga R	2	Emekter R	265	Masaryk University	4
Xing L	2	Jirasakuldech B	265	Pan-Atlantic University	4
Liu Z	3	Lu M	265	Universitas Airlangga	4
Li L	2	Tu Y	265	Universitas Indonesia	4

Table 5. Most relevant countries by total articles, total citations, and average citations per article

Country	TA	Country	TC	AC
China	135	China	1922	44.70
USA	132	USA	1359	33.98
United Kingdom	100	United Kingdom	707	24.38
India	86	Germany	571	35.69
South Korea	58	South Korea	340	10.97
Indonesia	53	New Zealand	228	114.00
Germany	52	Sweden	220	44.00
Australia	34	Singapore	178	19.78
Spain	28	Finland	142	28.40
Ukraine	27	Pakistan	138	19.71
Malaysia	26	Brazil	108	36.00
Italy	22	Ireland	100	16.67
Netherlands	20	Denmark	92	30.67
South Africa	19	India	81	4.50
Pakistan	18	France	80	13.33
Finland	17	Australia	70	7.00
France	17	Canada	66	22.00
Nigeria	15	Thailand	66	22.00
Singapore	14	South Africa	62	6.89
Jordan	13	Nigeria	54	10.80

Notes: TA—Total articles; TC—Total citations; AC—Average citations per article

3.2. Conceptual structure

To answer RQ2 (What are the conceptual structure and thematic evolution of the research involving Fintech (digital) and financial services research?), we analyzed the conceptual structure of the field using the most frequent keywords, keywords co-occurrence, and study of thematic evaluation about research in Fintech (digital) and financial services.

3.2.1. Most frequent keywords

Keywords analysis offers insights into popular themes in the domain of research. The word cloud of 50 most relevant keywords shows Fintech, financial services, financial inclusion, blockchain, and financial technology as the most important keywords. In addition, crowdfunding, innovation, mobile money, and artificial intelligence are the most important words. That is consistent with the accelerated pace of digitization worldwide, especially since the breakout of Covid19. The role of AI and ML has been increasing exponentially. The word cloud in Figure 4 also shows other emerging themes such as regtech, cryptocurrency, machine learning, bitcoin, digital currency, and digital economy.

3.2.2. Co-occurrence analysis of the authors' keywords

Co-occurrence analysis offers insights into the dominant themes in Fintech (digital) and financial services. Some of the most prominent keyword pairs are financial inclusion and Fintech, blockchain and Fintech, blockchain and financial services, Fintech, financial services and artificial intelligence, financial services and innovation, Fintech and regtech and Fintech and crowdfunding, blockchain and cryptocurrency. Analysis of keyword co-occurrence network following major themes emerged (Figure 5).

Table 6. Most relevant documents by global citations and local citations

Document	GC	Document	LC
Zheng et al., 2018, INT J WEB GRID SERV	1109	Gomber et al., 2017, J BUS ECON	25
Gomber et al., 2018, J MANAGE INF SYST	302	GOMBER P, 2018, J MANAGE INF SYST	19
Wang et al., 2019, IEEE TRANS SYST MAN CYBERN SYST	292	Ozili, 2018, BORSA ISTANB REV	14
Au & Kauffman, 2008 ELECT COMMER RES APPL	271	Gai et al., 2018, J NETWORK COMPUT APPL	12
EMEKTER R, 2014, APPL ECON	265	Au & Kauffman, 2008, ELECT COMMER RES APPL	11
Gomber et al., 2017 J BUS ECON	244	Anagnostopoulos, 2018, J ECON BUS	11
Fanning & Centers, 2016, J CORP ACCOUNT FINANCE	199	Gozman et al., 2018, J MANAGE INF SYST	9
MORKUNAS VJ, 2019, BUS HORIZ	191	Scott et al., 2017, RES POLICY	8
Ozili, 2018, BORSA ISTANB REV	188	Milian et al., 2019, ELECT COMMER RES APPL	7
POLASIK M, 2015, INT J ELECT COMMER	164	Hu et al., 2019, SYMMETRY	7
CHANIAS S, 2019, J STRATEGIC INFORM SYST	143	Zalan & Toufaily, 2017, CONTEMP ECON	6
Gai et al., 2018, J NETWORK COMPUT APPL	142	Zheng et al., 2018, INT J WEB GRID SERV	5
Yeoh, 2017, J FINANC REGUL COMPLIANCE	130	Yum et al., 2012, ELECT COMMER RES APPL	4
Yum et al., 2012, ELECT COMMER RES APPL	126	Liu, Kauffman, Ma, et al., 2015, ELECT COMMER RES APPL	4
SIYAL AA, 2019, CRYPTOGR	120	GIMPEL H, 2018, ELECTRON MARK	4
SINGH S, 2020, SUSTAINABLE CITIES SOC	118	Larios-Hernández, 2017, BUS HORIZ	4
ARNER DW, 2017, NORTHWEST J INTL LAW BUS	117	Kauffman & Riggins, 2012 ELECT COMMER RES APPL	4
ANAGNOSTOPOULOS I, 2018, J ECON BUS	109	Palmié et al., 2020, TECHNOL FORECAST SOC CHANGE	4
Karjaluoto et al., 2019, INT J INF MANAGE	102	Senyo & Osabutey, 2020, TECHNOVATION	4
Milian et al., 2019, ELECT COMMER RES APPL	99	Huei et al., 2018, INT J ENG TECHNOL	4

Notes: GC—Global citations; LC—Local citations

- Fintech (in the context of disruptive innovation, banking and financial services, digital transformation, and decentralized finance enabled by blockchain technology)
- Financial Services and Financial Technology (in the context of e-commerce, banking, and the role of e-commerce)
- Financial Inclusion (enabled by mobile money, mobile payments, and digital finance)
- Application of Big data, AI, and ML (in the context of design, delivery, and consumption of financial services
- Regulation of Fintech and mobile payment, and role of digital money and digital currency

3.2.3. Thematic map and thematic evolution

The thematic map prescribed by Callon et al. (1991) offers insights into the thematic evolution of the field. The thematic map places the themes according to Callon centrality (x-axis) and density (y-axis). Centrality measures the theme's relevance and the strength of its links with the other themes; density measures the strengths of links between the nodes within the theme and shows how well the theme is developed. Based on the relative position of a theme on the development-centrality map, themes are divided into motor themes, Basic themes, Niche themes, and Emerging or declining themes. Figure 6 presents the thematic map.

Motor Themes: Motor themes are highly developed themes connected to other themes in the first quadrant. They are the most significant themes. Fintech and financial services enabled by blockchain and other technologies have been among the most significant and highly developed themes. E-commerce in the digital economy and regulation of Fintech and financial services and digital economy has become a highly developed theme. Given the rapid pace of digitization and exponential growth in e-commerce, governments and regulators worldwide have been busy putting in place an appropriate regulatory framework to ensure the stability of the banks, financial systems, and e-commerce platforms. The digital economy needs new regulations, and the debate about appropriate regulatory regimes and frameworks for digital financial services and Fintech has gained traction. The theme has become highly developed given its importance and has increasingly become central and well connected to other major themes. The role of blockchain technology and the evolution of cryptocurrencies in financial services and emerging security concerns has been evolving into a motor theme from a niche theme.

Basic Themes: Basic themes are the themes located in the fourth quadrant. They have high relevance for the overall body of research. They are well connected to other themes; however, they see stagnation and do not develop well. Financial inclusion backed by mobile money and digital financial services, innovation in Fintech led by innovation such as crowdfunding and the application of Artificial intelligence emerged as basic themes central to Fintech (digital) and financial services. These are important themes and are closely linked and connected to other themes.

Niche Themes: Niche themes are placed in the top left quadrant, and these are highly developed and specialized themes, not highly relevant and weakly connected to other themes. Covid19 played an important role in accelerating Fintech adaptation and digitalization of financial services; hence, the role of Covid19 has emerged as a niche theme in Fintech and digital financial services research.

Emerging or declining themes: Emerging and declining themes are the marginal themes, neither well developed nor highly relevant and well connected to the other themes. Such themes are either emerging or declining themes. The ever-increasing role of Fintech in digitalizing financial services pushed banks and financial institutions to look for digital transformation, which has emerged as an emerging theme.

Thematic Evolution: The thematic map provides a snapshot of and categorizes themes as it stands. However, one needs to study relevant themes across different timeframes to see the evolution of

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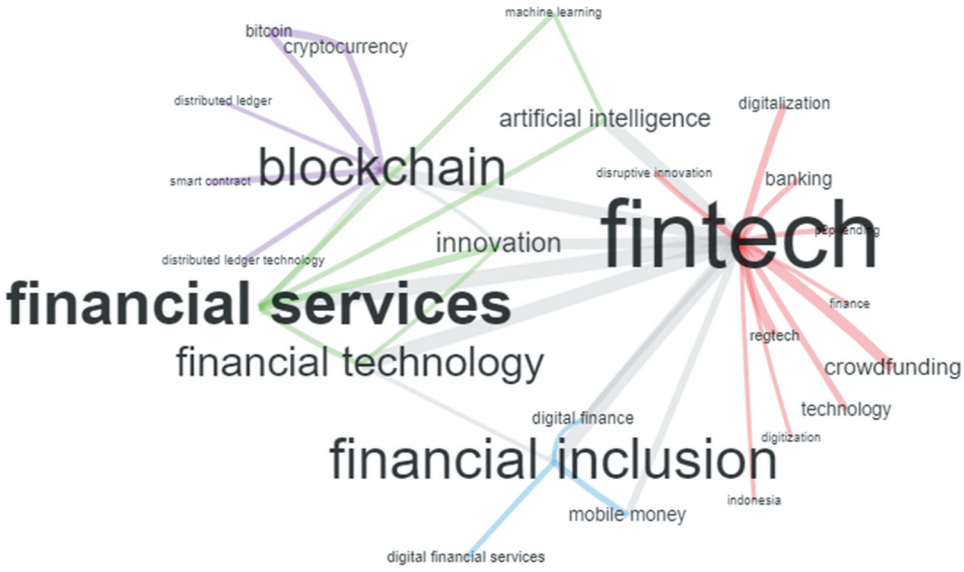
Figure 5. Keyword co-occurrence network.



themes over the years. It is relevant, especially in the research field that evolved rapidly over the years. Fintech and digital financial services are such fields.

As we see in Figure 7, mobile penetration and Fintech, mobile banking, and mobile payment have helped narrow down the digital divide, and this theme has lost relevance. Mobile money has transformed itself into a broader digital currency theme. Fintech and digital financial services business models emerged as a significant theme in 2018-19. Regulation of Fintech and financial services in the digital era emerged as another important theme in the same period. Come 2020-21, with the increased pace of digitalization, security of financial transactions has become an emerging theme, and regulatory frameworks that maintain financial stability emerged as a critical concern. AI and ML have found their applications in most fields, and financial services are no exceptions. Big data, artificial intelligence, and blockchain technology in Fintech and digital financial services emerged as important themes in 2020-21 and will evolve further (Sadok et al., 2022). Last but not least, mobile and internet penetration, cheap data availability, and government push

Figure 6. Thematic map.

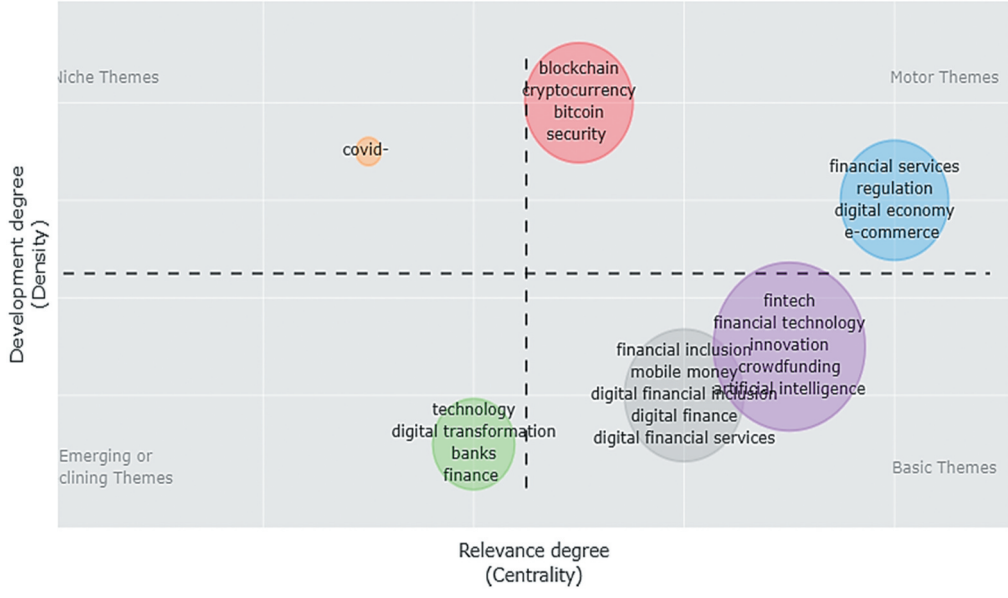
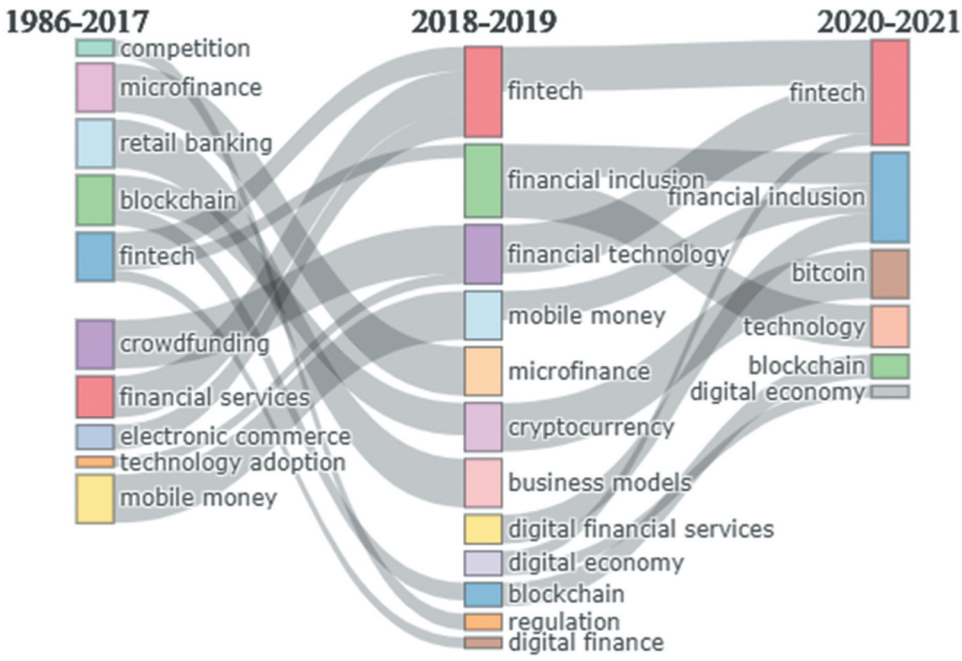


Figure 7. Thematic evolution map



for digital economy aided by Covid19 induced lockdown led to quick adoption of Fintech and digital financial services.

3.3. Intellectual structure of Fintech (digital) and financial services research

In order to answer RQ3 (What is the existing intellectual structure of Fintech (digital) and financial services research?), we presented a co-citation network and content analysis of the most relevant documents.

3.3.1. Co-citation and content analysis

Co-citation illustrates the number of times two articles are cited together (Small, 1973). This analysis is beneficial for illustrating the structure, directions, and developments in a research field (ZLiu et al., 2015).

Figure 8 presents the co-citation network of documents in Fintech (digital) and financial services. The node size represents the number of citations, and the link's thickness between two documents shows the strength of the co-citation. There are seven clusters of co-cited documents that emerged.

The largest cluster in pink is dominated by documents providing theoretical or methodological bedrock for Fintech (digital) studies and financial services. Fornell et al. (1991) on Structural Equation Modelling), Ajzen (2002) on the Theory of planned behavior, Venkatesh et al. (2003) on user acceptance of information technology, Davis (1989) on perceived usefulness of Information Technology along with initial studies on mobile money by Donovan (2012) and Chauhan (2015).

The second-largest cluster in red emerges as an important cluster. Gai et al. (2018) study a survey of Fintech; Gomber et al. (2017) article on the literature review of digital finance and Fintech; Gomber et al. (2018) on forces of the Fintech revolution and Gabor and Brooks (2016) on the digital revolution in financial inclusion have been the most influential documents.

Cluster 3 is dominated by mobile money, mobile banking, and digital money articles. Au and Kauffman (2008) on stakeholders' issues in mobile payments, Bruhn and Love (2014) on the real impact of financial access emerged as the most influential articles.

Analyzing closeness centrality, betweenness centrality, PageRank Analysis of the documents' co-citation network reveals the documents' importance and reputation in the network. Closeness centrality shows the dominant position of the document in the network and the influence on the network; Betweenness centrality measures the importance of the documents. Documents with high betweenness centrality might not be the heart of the network. However, these documents are vital connections between two network parts that would have remained isolated otherwise. PageRank analysis measures the article's prestige. It goes beyond the number of citations and co-citations of the document and measures the quality of the documents citing the article. More citations by quality documents show the high prestige of the article. Hence, page rank analysis helps assess the article's reputation in a given network. To this end, we use co-citation and content analysis to understand the intellectual structure of product characteristics research.

Table 7 reports the cluster-wise distribution of the most relevant article in the co-citation network with closeness and betweenness centrality and PageRank analysis scores. Gai et al. (2018), Gomber et al. (2017), Gabor and Brooks (2016) from cluster 2, Au and Kauffman (2008), and Bruhn and Love (2014) from cluster 3 emerged as the most influential articles.

4. Thematic literature review

Based on word cloud, co-occurrence (of keywords), thematic map, thematic evolution, and co-citation network analysis, and a full-text review of curated most influential journal articles, we identify the following four streams:

(1) Regulation of FinTech and Digital Financial Services
(2) Role of Technology in Digital Transformation of Financial Services
(3) Digital Financial Inclusion (enabled by mobile money, mobile banking, and digital finance)
(4) Technology adoption in digital financial services (niche theme)

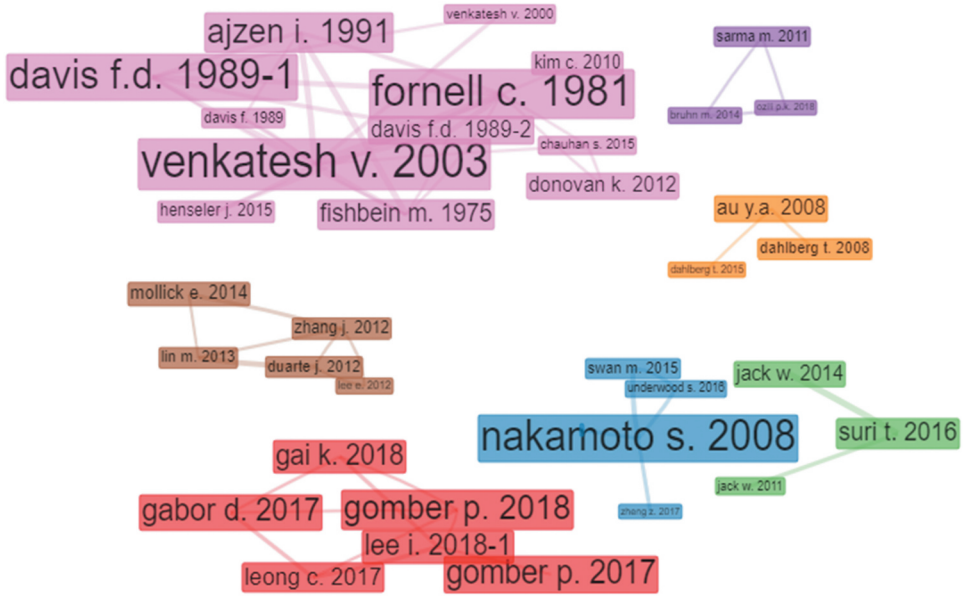


Figure 8. Co-citation network of documents.

Table 7. Co-citation network of documents and clusters

Documents	Cluster	Betweenness	Closeness	PageRank
Gabor & Brooks, 2016	1	0	0.002057613	0.029239766
Gai et al., 2018	1	0	0.002057613	0.029239766
lee 2018-1	1	2	0.002066116	0.054093567
Leong et al., 2017	1	2	0.002066116	0.054093567
nakamoto 2008	2	5	0.002173913	0.08138558
swan 2015	2	0	0.002164502	0.043088521
underwood 2016	2	0	0.002164502	0.038805001
Zheng et al., 2018	2	0	0.002159827	0.022527116
christidis 2016	2	0	0.002159827	0.022527116
suri 2016	3	1	0.001976285	0.060810811
jack 2014	3	0	0.001972387	0.037263514
jack 2011	3	0	0.001972387	0.026925676
Davis, 1989-1	4	0.533333333	0.002538071	0.045441585
Venkatesh et al., 2003	4	8.944444444	0.00255102	0.078733508
Fornell et al., 1981	4	2.522222222	0.002544529	0.064261997
Ajzen, 2002	4	6	0.002538071	0.05298734
fishbein 1977	4	0	0.0025	0.019761772
Davis, 1989-2	4	0	0.002525253	0.033973063
henseler. 2015	4	0	0.002518892	0.02328878
venkatesh 2000	4	0	0.002512563	0.014885288
mollick 2014	5	0	0.001890359	0.041666667
Tan et al., 2021	5	0	0.001890359	0.041666667
duarte. 2012	6	0	0.001890359	0.041666667
lin 2012	6	0	0.001890359	0.041666667

Milian et al. (2019), in a review of 179 papers on Fintech, note that 115 papers focused on Fintech in the context of financial services. The prominent areas are the financial institutions' businesses, operations, and financial services regulations, financial inclusion, and innovations in products, services, and business models.

The thematic review presented below provides insights into major themes.

4.1. Regulation of Fintech and digital financial services

Systemic characteristics of financial institutions change due to implementing fintech innovations and resultant changes in coalitions and market size (Wonglimpiyarat, 2017). Gai et al. (2018) support this argument and claim that integrating technology in financial services brings revolutionary changes rather than incremental ones. Given the impact of technology on financial services, it becomes imperative to study the regulatory aspects of financial services dominated by digital and Fintech. Chaudhry et al. (2022) analyze the tail risk and systemic risk of the technology firms vis-a-vis finance firms and conclude that while technology firms face a higher tail risk, finance firms face a higher systemic risk. However, Gozman and Willcocks (2019) note that the fintech revolution requires more robust regulatory frameworks for technology firms similar to financial institutions to ensure financial stability. Fenwick et al. (2019) emphasize the need for platform governance similar to corporate governance in an era wherein most businesses, owing to digitalization, are working as platforms. Yuan (2022) calls for the up-gradation of financial

supervision methods by developing a big data supervision platform, improving the technical knowledge of supervisors, and strengthening network security. It is in line with the Arner et al. (2020) call for using regtech for regulatory monitoring, reporting, and compliance. Moreover, as the regulatory frameworks become dynamic, even financial services firms are mandated to modify their technology to comply with the regulations (Currie et al., 2018).

Various studies study the risks present in specific fintech products such as digital currency (Latimer & Duffy, 2019), cryptocurrency (Dupuis & Gleason, 2021; Ukwueze, 2021), Initial Coin Offering (ICO) (Gurrea-Martínez, 2019; Momtaz, 2020), P2P lending (Basha et al., 2021; Syamil et al., 2020), crowdfunding (Bajakić et al., 2021; Soni & Bagchi, 2014; Wolfson & Lease, 2011) among others. The new regulatory framework needs to strike a delicate balance between protecting the interest of customers and investors and avoiding stifling the innovativeness of Fintech and big-tech firms in revolutionizing the way financial products and services are designed, developed, delivered, and consumed. Tsai and Peng (2017) and Liu et al. (2015) pitch for a light-touch regulatory attitude toward Fintech. Yeoh (2017) finds that the hands-off regulatory approach used in the EU and USA works favorably for innovative technology contributions to financial services. Anagnostopoulos (2018) extends this argument and recommends that the regulator steps into action only when the overall risk posed by the technology surpasses systemic proportions or when red signals are flashed by a change in the systemic status of an individual company. Fenwick et al. (2019) argue that regulators must become participants in the system to build an appropriate regulatory framework. It is fair to conclude that many studies have discussed the need for a new regulatory regime in the era of digital financial services and Fintech. However, there is no consensus on the new regulatory regime's nature, scope, scale, and shape. Table 8 presents descriptive review of this theme.

Fintech-enabled digital financial services have blurred the difference between technology and finance firms. Regulating large technology firms in the fintech and financial services space is essential to ensure financial stability. However, excess regulations often stifle innovations. Therefore, regulators worldwide need to follow soft-touch regulation that strikes the delicate balance between promoting innovation in financial services and ensuring financial stability.

4.2. Role of technology in digital transformation of financial services

This theme covers studies from two sub-streams a) applications of Big Data, AI & ML, Benefits & Limitations, and b) Digital Transformation.

Disruptive innovation has played a vital role in building the fintech ecosystem and has revolutionized the entire range of financial services (Gozman et al., 2018; Palmié et al., 2020). AI and data science are revolutionizing financial services with the help of smart fintech applications, intelligent and autonomous financial systems, and customized financial services (Cao et al., 2021). Pau (1991) documents how AI can deliver financial services, including front-office, general support, and service-specific functions. AI has reshaped banking, insurance, and investment businesses (Qi & Xiao, 2018). Similarly, big data applications facilitate frequent and meaningful monitoring of real-life phenomena cost-effectively and improve financial services (Awan et al., 2021; R. M. R. M. Chang et al., 2014). The application of blockchain technology in financial services has been an area of interest for scholars and practitioners. Studies depict blockchain applications in record-keeping, innovative product offerings, and the resultant positive impact on operational efficiency, decision-making processes in terms of saving in time and cost, improved accuracy levels, and resultant benefits for all key stakeholders of the financial industry. Blockchain allows innovation and decentralization of financial services (Chen & Bellavitis, 2020). Wang et al. (2019) emphasize the effective usage of blockchain in making smart contracts, while V. Chang et al. (2020) call for blockchain application in structured knowledge sharing in the financial services industry.

Table 8. Descriptive Review of Theme 1—Regulation of FinTech and Digital Financial Services

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
1	(Gomber et al., 2018)	Journal of Management Information Systems	1	Conceptual	NA	Technology integration in financial services is a revolution than a set of influential changes. Fintech improves the efficiency, customer centricity & informed-ness of financial service providers.	28	A*
2	(Gozman & Willcocks, 2019)	Journal of Business Research	1	Conceptual/ Discussion	Multi-country	The paper focuses on understanding specific risks in relation to Cloud adoption, and the regulations and penalties for non-compliance should be in place.	8	A

(*Continued*)

Table 8. (*Continued*)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
3	(Fenwick et al., 2019)	European Business Organization Law Review	1	Conceptual	NA	Emphasized the need to move from corporate governance to platform governance. Offered strategies to make platforms more open and accessible and make changes in regulations accordingly.	6	Important
4	(Currie et al., 2018)	Journal of Information Technology	1	Longitudinal/ Mixed-method	UK	Challenges arise in the financial service sector due to regulatory technology. Ever-changing regulatory landscape forces financial firms to change their financial technologies.	19	A*
5	(Latimer & Duffy, 2019)	Federal Law Review	1	Conceptual / Discussion	Australia	Regulatory reforms are required to include digital financial products including digital currencies.	2	A*

(*Continued*)

Table 8. (*Continued*)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
6	(J. Liu, Kauffman, Ma, et al., 2015)	Electronic Commerce Research and Applications	1	Conceptual	NA	Organization-level factors such as firm heterogeneity and competitive strategy and industry-level factors including government regulations and technology standards jointly contribute to shaping and evolution of m-payments technology.	55	Important
						Industry-specific patterns are affected by competition, cooperation, and regulation.		
7	(Yeoh, 2017)	Journal of Financial Regulation and Compliance	1	Qualitative	EU & USA	The regulatory approach used by EU & USA enables innovative technologies like the blockchain to integrate smoothly into financial services and offer better access.	130	C

(*Continued*)

Table 8. (*Continued*)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
8	(Anagnostopoulos, 2018)	Journal of Economics and Business	1	Qualitative	Multi-country	Financial service regulators need to respond in a timely manner and RegTech can be used for the same. The views of all stakeholders should be taken into consideration while designing the financial infrastructure and regulation needs to be proportionate to their systemic size and obligations.	109	B
9	(Fenwick et al., 2019)	Singapore Journal of Legal Studies	1	Conceptual/ discussion	NA	In order to establish an effective ecosystem, regulators need to become active participants in these new ecosystems.	1	A

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Despite the varied applications and benefits of new technologies in the digital transformation of the financial services landscape, some studies caution against the potential demerits of technology-driven financial services. AI can be a potential source of systemic risk for organizations (Ashta & Herrmann, 2021; Kabza, 2020). Lu et al. (2020) document a series of positive and negative effects of utilizing chatbots on customer experiences and employees regarding productivity, autonomy, work burden, and more. Fanning and Centers (2016) caution financial institutions about the costs and risks attached to blockchain. Osmani et al. (2021) document increased operational costs like transaction costs, energy costs, and storage costs related to blockchain technology.

Hence, given the costs and risks scholars indicate a need for financial institutions to formulate a clear digital strategy and analyze the costs and benefits before integrating technology into their business models (Au & Kauffman, 2008; Chanias et al., 2019; Kumar et al., 2020). Niemand et al. (2021) further observe that a bank's clear vision of digitalization is more important in predicting the performance of the bank. Mogaji et al. (2021) support this by claiming that successful AI implementation requires understanding ethical implications, data, and modeling challenges. The timing of entry, design, and order of entry and expansion plays a vital role in the success of digital financial services providers (Staykova & Damsgaard, 2015).

Despite the risks, decentralized digital finance has potential to create robust and transparent financial structures and make a positive difference to the performance of financial services firms (Schär, 2021). Digital innovation adaptation and technology-empowered relationship marketing orientation (RMO) positively impact the long-term performance of banks (Scott et al., 2017; Wongsansukcharoen et al., 2015). Further, technology in finance provides opportunities to second-tier financial institutions (Hendrikse et al., 2020). Manser Payne et al. (2021) emphasize identifying proper linkages between customers, financial institutions, and Fintech to co-create value propositions while offering AI-enabled banking services. Hence, banks and other financial institutions must collaborate with Fintech and create a new ecosystem (Hornuf et al., 2021; Zalan & Toufaily, 2017). Table 9 reports the descriptive review of the articles pertaining to this theme.

Hence, while it is evident that blockchain big data, AI & ML, and related digital technologies will find myriad applications in financial services, they come with pros and cons. The financial service providers are advised to conduct a cost-benefit analysis before offering technology-based solutions. Further, the financial institutions must be strategically prepared to integrate technology into their operations and measures to mitigate the risks stemming from the same.

4.3. Digital financial inclusion

Financial inclusion is a starting point for the financial well-being of society. However, the debate about what exactly means by financial inclusion is yet to settle. According to Sarma (2012), financial inclusion means the accessibility, availability, and use of the formal financial systems by all agents of the economy. Siddik and Kabiraj (2018) argue that mere access is insufficient for financial inclusion. Wojcik (2021) argues that Fintech improves credit accessibility and positively influences financial inclusion. Financial inclusion is an important goal in most economies as it is a mediator between financial technology and income inequality, and Fintech helps reduce income inequality (Chinoda & Mashamba, 2021; Demirgüç-Kunt et al., 2020). The evidence suggests that Fintech and the digitalization of financial services have imported financial inclusion worldwide (Fernandes et al., 2021).

Financial system and innovation, financial stability, financial literacy, and regulatory frameworks are important factors that influence financial inclusion (Ozili, 2018). Fintech is the panacea for financial inclusion and, thereby, the reduction of income inequality (Demirgüç-Kunt et al., 2020; Lagna & Ravishankar, 2021). Larios-Hernández (2017) examines the role of non-monetary factors and informal financial practices in the habit formation of financially excluded. He concludes that blockchain would be very effective with its disintermediation feature. Kauffman and Riggins (2012) argue that microfinance institutions have the dual goal

Table 9. Descriptive Review of Theme 2—Role of Technology in Digital Transformation of Financial Services

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
Sub-Theme A: Applications of Big Data, AI & ML, Benefits & Limitations								
1	(Gozman et al., 2018)	Journal of Management Information Systems	2	Mixed method	Multi-country	The study offers new insights into the diversity and range of emergent innovations and technologies that are transforming the financial services industry worldwide.	43	A*
2	(Palmié et al., 2020)	Technological Forecasting and Social Change	2	Qualitative approach	Multi-country	Taking the example of the fintech ecosystem, the study shows that disruptive innovation ecosystems are not only in need of but also deserve further attention.	14	A
3	(Qi & Xiao, 2018)	Communications of the ACM	2	Conceptual/ discussion	China	AI has reshaped the insurance, investment, and banking businesses	5	A

(*Continued*)

Table 9. (*Continued*)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
4	(R. M. R. M. Chang et al., 2014)	Decision Support Systems	2	Qualitative	NA	Big data sets and data mining techniques allow frequent, controlled, and meaningful observations of real-world phenomena.	142	A*
5	(Awan et al., 2021)	Computers, Materials & Continua	2	Empirical	Multi-country	Big Data can be applied in predicting stock market prices with a high accuracy.	24	Important
6	(Chen & Bellavitis, 2020)	Journal of Business Venturing Insights	2	Conceptual	NA	Blockchain offers several benefits to decentralize financial services, innovate and interoperate.	28	A

(*Continued*)

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Table 9. (*Continued*)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
7	(Zheng et al., 2018)	International Journal of Web and Grid Services	2	Mixed method	Multi-country	Blockchain as a technology has varied real life applications in industry and academia.	1109	Important
						While blockchain offers numerous benefits like decentralization, anonymity, personalization, there are certain challenges associated with the same.		
8	(Wang et al., 2019)	IEEE Transactions on Systems, Man, and Cybernetics: Systems	2	Conceptual	Multi-country	Smart Contracts based on blockchain technology are finding many real time applications, especially in the field of Finance like Securities, Trade Finance and Insurance.	292	Important

(*Continued*)

Table 9. (*Continued*)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
9	(V. V. Chang et al., 2020)	Technological Forecasting and Social Change	2	Qualitative	Multi-country	Knowledge hiding in Blockchain is common, financial service providers should manage knowledge sharing in a more structured way.	18	A
10	(Ashta & Herrmann, 2021)	Briefings in Entrepreneurial Finance	2	Conceptual	Multi-country	Financial service providers must check the feasibility of using Artificial Intelligence before resorting to merge with AI based fintech firms. While AI offers benefits of cost reduction and increased differentiation, the inherent risks of using AI must be taken into consideration.	9	Important

(*Continued*)

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Table 9. (*Continued*)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
11	(Fanning & Centers, 2016)	The Journal of Corporate Accounting & Finance	2	Conceptual	Multi-country	Blockchain technology in financial services can reduce the transaction costs significantly. However, the risks posed by blockchain applications must be considered before integrating the same.	199	B
Sub-Theme B: Digital Transformation								
1	(Chanias et al., 2019)	Journal of Strategic Information Systems	2	Qualitative-case study	Europe	Digital transformation strategy (DTS) is different from conventional strategic information systems planning; it requires ongoing learning and doing.	1	A*

(*Continued*)

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Table 9. (*Continued*)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
2	(Kumar et al., 2020)	Decision Sciences	2	Conceptual-case study	NA	Blockchain is a high-cost technology and businesses need to do a cost-benefit analysis before adopting it.	43	A*
3	(Zalan & Toufaily, 2017)	Electronic Commerce Research and Applications	2	Conceptual	Multi-country	Mobile payments are expected to reduce the use of currency notes as well as debit and credit cards. This will lead to a change in economic policies and a different set of cost-benefit variables to be considered before adopting the new technology.	271	C

(*Continued*)

Table 9. (*Continued*)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
4	(Niemand et al., 2021)	European Management Journal	5	Quantitative/ Empirical	Germany, Switzerland, Liechtenstein	A bank's clear vision on digitalization and innovation is more important than the actual level of digitalization when it comes to bank performance and profitability.	24	B
5	(Mogaji et al., 2021)	Australasian Marketing Journal	2	Qualitative approach	NA	Successful AI deployment requires an understanding of ethical implications, data, and modeling challenges.	43	A
6	(Staykova & Damsgaard, 2015)	Electronic Commerce Research and Applications	2	Qualitative approach	Denmark	Timing, order, and design of entry and expansion drive the success of digital financial service providers.	10	Important

(*Continued*)

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Table 9. (*Continued*)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
7	(Schär, 2021)	Federal Reserve Bank of St. Louis *Review*	2	Conceptual	Multi-country	Despite certain risks, decentralized finance has the potential to create a more dynamic and transparent financial infrastructure	19	Important
8	(Scott et al., 2017)	Research Policy	2	Empirical	Multi-country	Digital innovation adoption has a large and positive long-term effect on bank performance.	28	A*

(*Continued*)

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Table 9. (*Continued*)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
9	(Wongsansukcharoen et al., 2015)	Journal of Business and Industrial Marketing	2	Empirical	Bangkok	Significant relationships existed between social customer relationship management (CRM), relationship-marketing orientation (RMO), business strategies, and banking performance effectiveness. Social CRM and RMO have direct and indirect influences on banking performance effectiveness through the mediation of focus strategy or differentiation strategy.	8	A

(*Continued*)

Table 9. (*Continued*)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
10	(Hendrikse et al., 2020)	EPA	2	Qualitative-case study	Belgium	Finance and technology offer new opportunities for second-tier financial institutions.	70	A*
11	(Manser Payne et al., 2021)	Journal of Research in Interactive Marketing	3	Conceptual	Multi-country	Value co-creation can be done in AI-assisted banking activities by identifying proper linkages between consumers, financial institutions, and fintech offering AI services.	22	A

(*Continued*)

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Table 9. (*Continued*)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
12	(Zalan & Toufaily, 2017)	Contemporary Economics	5	Qualitative	MENA Region	Various regulatory, structural and cultural factors deter the adoption of fintech by the financial service providers. However, to counter digital disruption, banks will have to partner with fintech firms and create a new ecosystem.	38	C
13	(Hornuf et al., 2021)	Small Business Economics	5	Empirical	Canada, France, Germany, UK	Banks which want to follow a digital strategy are more likely to invest in small fintech firms, while building product-related collaborations with the bigger fintech.	22	A

of outreach and sustainability, and ICT is both the cause and the solution. The spread of the internet and mobile and digital financial services have significantly contributed to poverty alleviation and bridging the gender gap in financial inclusion (Adegbite & Machethe, 2020; Demirgüç-Kunt et al., 2020; Senou et al., 2019). The favorable impact of digitization in financial services on financial inclusion is a repetitive message emerging from several studies (Leong et al., 2017; Sadok, 2021; Senyo & Osabutey, 2020. In the Indian context, Ranade (2017) states how the Jan Dhan-Aadhar-Mobile phone trinity shall help Fintech serve the remotest regions. Kandpal and Mehrotra (2019) add that technology companies shall permeate rural areas with government support and mobile-led solutions. Digital financial inclusion has become possible due to the various benefits of convenience, affordability, and time-effectiveness of innovative fintech solutions (Ravikumar, 2019). Galvez-Sanchez et al. (2021) claim that Fintech as a means of promoting financial inclusion will likely attract much research interest.

However, Ozili, 2018) argues that lack of proper infrastructure, education bias, and high cost may deter even the digital financial service providers from entering specific markets. While Information and communication technology (ICT) can alleviate poverty by providing greater access to financial services, it can also result in a digital divide (Cecchini & Scott, 2003; Yartey, 2008). Hughes (2021) sheds light on the fact that the implications of Fintech on financial inclusion are two-fold: On one hand, it makes financial services accessible and affordable and hence, accelerates the pace of financial inclusion; on the other hand, it might be a potential source of systemic risk to the financial stability of the system. Finally, Joia and Cordeiro (2021) identify the four pillars of fintech growth, which facilitate financial inclusion: Expansion and modernization of the mobile and internet infrastructure, the spread of digital and financial education, creation of an environment of trust while using Fintech, and development and implementation of laws and regulatory framework for Fintech. (See Table 10 for descriptive review)

There is overwhelming evidence that the digitalization of financial services and the advent of Fintech have contributed to improved financial inclusion. However, there are concerns surrounding the possibility of a digital divide and increased systemic risk due to overreliance on technology.

4.4. Technology adoption in digital financial services

The final theme focuses on the state of technology adoption in digital financial services in the fintech era. Financial inclusion would be possible if customers adopt the changes while consuming financial services, given the new technological developments. Studies in this theme focus on usage intention or adoption levels of varied fintech services, especially digital payments like mobile banking, internet banking, digital wallets, and more. Most of these studies focus on Asia and the Middle East, followed by African countries (Shaikh & Karjaluoto, 2015; Souiden et al., 2021). Souiden et al. (2021), in a systematic literature review of the adoption of mobile banking, noted that the Technology Adoption Model (TAM) followed by Unified Theory of Acceptance and Usage of Technology (UTAUT/UTAUT2) are the most prominent theories used by various studies. They identify perceived usefulness, ease of use and individual attitude, social influence, and trust as antecedents for intention to use and adopt a specific technology. Kitchen and Panopoulos (2010) document that age, trialability, and work experience are important factors for adopting the internet for public relations in financial services. Alkhowaiter (2020) documents that trust, perceived security, and perceived usefulness are the best predictors of mobile banking. Perry and Ferreira (2018) look into the behavior of digital currency users that supports mobile device payments and their understanding of the underlying system and its impact on usage. Performance and perceived efforts drive the intention to use mobile money services (Senyo & Osabutey, 2020). It is in line with empirical findings by Lutfi et al. (2021), Hu et al. (2019), Huei et al. (2018), Mortimer et al. (2015), Zhou (2011). Similarly, studies by Abu Daqar et al. (2021) and Jünger and Mietzner (2020) find trust, reliability, transparency, and ease of use as significant factors in the adoption of fintech services as a whole.

Table 10. Descriptive Review of Theme 3—Digital Financial Inclusion (enabled by mobile money, mobile banking, and digital finance)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
1	(Demirgüç-Kunt et al., 2020)	World Bank Economic Review	4	Empirical	Multi-country	Financial services help people escape poverty by facilitating investments in their health, education, and businesses; digital financial services hold potential for poverty alleviation.	9	A
2	(Demirgüç-Kunt et al., 2020)	European Journal of Finance	4	Empirical	Multi-country	Financial inclusion is a key channel through which fintech reduces income inequality.	3	A
3	(Fernandes et al., 2021)	Applied Economics	4	Empirical	Mozambique	Digital financial services play a crucial role in financial inclusion.	5	A
4	(Larios-Hernández, 2017)	Business Horizons	4	Empirical	Multi-country	Blockchain intermediation can be instrumental in creating financial inclusion provided the blockchain entrepreneurs understand the practices of the unbanked.	81	B

(*Continued*)

Table 10. (*Continued*)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
5	(Kauffman & Riggins, 2012)	Electronic Commerce Research and Applications	4	Qualitative approach	NA	As microfinance institutions face dual goals of outreach and sustainability, ICT can be the cause as well as the solution of the same.	43	Important
6	(Adegbite & Machethe, 2020)	World Development	4	Mixed method	Nigeria	Gender gap in financial inclusion can be reduced by digital financial inclusion.	8	A
7	(Senou et al., 2019)	Cogent Economics and Finance	4	Quantitative/ Empirical	West Africa	Beyond the specific effects of mobile phone penetration and Internet usage, the joint use of these two technologies is very key to financial inclusion in the WAEMU countries.	4	Important

(*Continued*)

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Table 10. (*Continued*)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
8	(Ozili, 2018)	Borsa Istanbul Review	4	Qualitative	Multi-country	While digital finance is positively associated with financial inclusion and offers several other benefits to individuals and the economy; it may also lead to greater income disparities. Also, systemic risk and data security breaches can lower consumer trust and can also lead to voluntary financial exclusion.	188	Important
9	(Yartey, 2008)	Information Economics and Policy	4	Empirical	Multi-country	Financial development is an important determinant of ICT diffusion.	34	A

Further, Karjaluoto et al. (2019) suggest that banks' investment in mobile financial services apps improves customer relationships and drives business growth. Li and Xu (2021) observe that customer satisfaction in internet banking services is driven by cloud services, security, e-learning, and service quality. However, lack of connectivity, social awareness, and financial literacy continues to prove as barriers to the actual use of accessible financial services in countries like Bangladesh (Aziz & Naima, 2021). However, customer relationship management strategies need realignment for better customer experience due to technological disruptions in the financial sector (Kotarba, 2016). Similarly, in the context of P2P lending and crowdfunding platforms, it is evident that more borrowers can be attracted by offering convenience and process transparency as these borrowers are not dissatisfied with the services offered by conventional banks but are also looking for flexible alternatives (Maier, 2016). On the supply side, while the same collaterals as offline lending are not available in the above mechanisms, investors can rely on collective wisdom initially and then shift to personal judgment as more information is available (Estrin et al., 2021; Yum et al., 2012). (See Table 11 for descriptive review).

Hence, as the supply side of Fintech increases with a growing number of traditional financial institutions indulging in enhanced technology, there is no doubt that the demand is also on the rise. Customers and investors embrace the new fintech services, albeit with some caution. Thus, we find much research on influencing users' intentions or adoption levels and customer satisfaction. It has implications for the financial service providers on gaining traction by using digitalized modes of providing services.

5. Discussion, future research directions, and conclusion

The study shows that despite ever increasing research activity in Fintech and the digitalization of financial services, some research gaps remain. To answer RQ4 (Which Fintech (digital) and financial services research areas need further research?), we analyzed the areas of research that need further investigation and are presented in Table 12.

5.1. Regulatory frameworks

While many papers have discussed the need to design a regulatory framework to address technology integration in financial services, there is still a need to review the existing rules and regulations and how risks are managed. It could be country-specific as different countries have different rules. At a broader level, one needs to study the efficacy of The Basel framework in dealing with digital and internet-only banking challenges. Future studies can focus on unique systemic risks from digital financial services and identify approaches to mitigate the same. Such studies could have policy implications for the financial regulators of the countries.

Secondly, the Thematic map shows that while the regtech theme is gaining currency, it lacks a strong connection with other themes to draw more relevance. Hence, one might need to explore the impact of regulations on the innovativeness of digital financial service providers or their business models. Further, the scholars must study the impact of regulations on digital financial inclusion and technology adoption going forward.

5.2. Adoption of digital financial services

While the theme of digital financial services adoption has almost stagnated, it is interesting to note that most studies focused on banking and payment services. There is a need to study the same in the context of insurance, wealth management, and other financial services also seeing a digital transformation, especially in developing countries, which can be studied for usage intention and actual adoption.

5.3. Addressing aspects of "security" and "trust"

Studies claim "security" and "trust" are the main factors affecting financial services' usage. The same factors may act as proponents or deterrents in the case of digital financial services. Hence, future studies may utilize trust-based models and explore customers' adoption intention, especially in the under-researched areas of insurance, wealth management, and more. At the same

Table 11. Descriptive Review of Theme 4—Technology adoption in digital financial services (niche theme)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
1	(Kitchen & Panopoulos, 2010)	Public Relations Review	5	Empirical	Greece	Age, trialability, and working experience are related to the adoption of the internet for public relations (PR) purposes in the financial service sector.	69	A
2	(Perry & Ferreira, 2018)	ACM Transactions on Computer-Human Interaction	5	Mixed method	England	The study examines the patterns of behavior of users of a mixed media (digital and analog) currency that supports mobile device payments and explores the impacts of its users' understanding of the systems that underlie these transactions, the technical constraints on their potential for action, their practices of use, and the social interactions around that.	12	A*
3	(Senyo & Osabutey, 2020)	Technovation	5	Empirical	Ghana	Performance and effort expectancy has a significant relationship with the intention to use mobile money services.	37	A
4	(Lutfi et al., 2021)	Sustainability	5	Quantitative/ Empirical	Jordan	Perceived usefulness and perceived financial cost are important determinants of behavioral intention to use mobile-payment system	9	Important
5	(Hu et al., 2019)	Symmetry	5	Quantitative/ Empirical	China	User's trust is a significant driver of user's attitude for adoption of fintech services.	63	Important

(*Continued*)

Table 11. (*Continued*)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
6	(Huei et al., 2018)	International Journal of Engineering & Technology	5	Quantitative/ Empirical	Malaysia	Factors like usefulness, ease of use, competitive advantage, perceived risk and perceived cost influence customers' attitude towards usage and adoption of fintech products and services.	24	Important
7	(Jünger & Mietzner, 2020)	Finance Research Letters	5	Quantitative/ Empirical	Germany	Adoption of fintech services by households is significantly driven by trust, transparency and financial expertise.	35	A
8	(Karjaluoto et al., 2019)	International Journal of Information Management	5	Empirical	Finland	High-perceived value of mobile financial services apps increases consumer satisfaction and commitment to the bank. Self-congruence and new product novelty are the main drivers of perceived value.	129	A*
9	(F. Li et al., 2021)	Technology in Society	5	Quantitative/ Empirical	NA	Customer satisfaction in e-banking services is significantly affected by cloud services, security, e-learning and service quality.	32	C

(*Continued*)

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Table 11. (*Continued*)

Sr.	Document	Journal Name	Theme	Method	Geography	Insights	Citations	Journal Category (ABDC classification)
10	(Maier, 2016)	Journal of Retailing and Consumer Services	5	Empirical	Europe	Enterprise borrowers switch to crowdfunding platforms for greater convenience and process transparency whereas consumers invest based on economic performance.	123	A
						Mismatches exist between the demand and supply of funds on P2P platforms; more borrowers can be attracted by offering convenience and process transparency.		
11	(Yum et al., 2012a)	Electronic Commerce Research and Applications	5	Empirical	South Korea	P2P lenders rely on the wisdom of the crowd for initial judgment but switch to their own judgment as transaction history is created.	89	Important

Table 12. Future research directions emerging out of each theme and article

Theme	Future Research Directions	Article
Regulatory Framework	With an increased connectedness between banks and fintech platforms, one could further study: • the degree of combined risk (incorporating the degree of correlation amongst these entities) • types of risk • scope of existing regulations • probable regulatory changes	(Anagnostopoulos, 2018)
	The regulatory frameworks can be looked at from the perspective of different geographies: • differences between developed and developing countries and the need to customize regulations* The following regulatory aspects need further examination: • impact of regulations on innovation • impact of regulations on digital financial inclusion • impact of regulations on the adoption of digital financial services (incorporating "trust" and "security" based models) Internal risk assessment of regtech*	(Wójcik, 2021)
Impact of Technology on Financial Services	Usage of GIS and AI in financial decision-making*	(Wójcik, 2021)
	Use of AI and ML in predicting high accuracy, stability, and robustness of financial models, financial markets, and financial institutions*	(Li & Xu, 2021)
	Comparison of costs, benefits, opportunities, and risks of integrating Big Data/ AI/ ML/ Blockchain for different industries under the BFSI sector Process, success, risk, and failures of digital transformation*	(Osmani et al., 2021)
	A longitudinal study evaluating the digital transformation strategy of a pre-digital organization*	(Chanias et al., 2019)

(*Continued*)

Theme	Future Research Directions	Article
Digital Financial Inclusion	Role of fintech in increasing the access to credit and further whether this excess borrowing leads to delinquencies	(Anagnostopoulos, 2018)
	Possible risks of financial inclusion and the role of fintech (fintech here may inhibit risk by creating accurate predictive models or increase risk by making financial data more vulnerable, higher transaction costs, etc.)	(Ozili, 2018)
Adoption of Digital Financial Services	Use of qualitative approaches or phenomenological perspective Inclusion of affective components, biological age, prior experience while studying adoption levels Cross-country comparison of factors affecting the adoption levels (may incorporate factors like religion, culture, language) *	(Souiden et al., 2021)
	Longitudinal data to observe changes in adoption and use behavior over time (this is essential as COVID19 pandemic may have spurred the adoption levels, but that needs to be sustainable)	(Suryono et al., 2020)
	Post-adoption sustainability of usage/ satisfaction level	(Alkhowaiter, 2020)
Interdisciplinary Research	Role of fintech in geopolitical events/ issues	(Wójcik, 2021)

**Can also be clustered in interdisciplinary research*

time, the security aspect can be looked at in conjunction with the design of the regulatory framework for such digital financial services.

5.4. Inter-disciplinary research

Since Fintech as a topic itself is inter-disciplinary, there is potential for researchers from Finance and technology domains to join hands in future studies. They can contribute to the theme of technology (AI, ML, Blockchain, etc.) applications and their impact on a financial product or service design, model of financial service providers, customers, and regulatory agencies.

5.5. Longitudinal studies

There is a dearth of longitudinal studies on all the themes discussed in Section 4. A sudden spurt in the use of digital financial services triggered by the Covid19 pandemic has warranted such studies. However, customers may revert to traditional practices as the restrictions are lifted. Hence, a longitudinal study would help discover whether Fintech leads to financial inclusion or digital financial inclusion in its true sense.

5.6. Use of the different combinations of keywords

The study identified the intellectual structure and the conceptual structure of Fintech or Digital financial services with the help of bibliometric analysis. Moreover, the thematic map drawn using bibliometric analysis gets further elaborated by a thematic literature review. Such an approach offers an extensive idea about focal points of various studies on the respective themes and their contribution to the body of literature in the field. It also paved the way for understanding the research gaps for future studies.

Hence, our study provides a clear picture of research on Fintech using bibliometric analysis and a thematic literature review. However, it has certain limitations. The literature from 1984 to 2021 is considered. While there is a minimal possibility of ignoring prominent papers in the field due to the time duration, this filter applies to the present study. The keywords used were specific to the topic under investigation. One might also look at a combination of other keywords to gain further insights.

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Notes
1. EMEA is an acronym for Europe, Middle East, and Africa regions.
2. APAC is an acronym for Asia Pacific region.

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