

FINTECH SECTOR: A REVIEW OF RESEARCH TRENDS FOR THE PERIOD OF 2015-2022

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Purpose: The aim of this paper is to present a bibliometric study of the FinTech sector on the basis of the existing scientific data that has been collected and reviewed. Different aspects and matters within this area are discussed, and its development is critically analyzed.

Design/methodology/approach: Research data, namely 900 publications published between January 2015 and July 2022, was sourced from the Scopus database. Based on these, a bibliometric study was carried out using R software with Bibliometrix and Biblioshina codes.

Findings: The analysis of publications indicates that blockchain (and, first and foremost, cryptocurrencies), artificial intelligence and financial exclusion were topics most frequently examined by scholars in 2020-2021. Research findings also point to certain future trends in the FinTech area; these are mainly sustainable development, and economic and social effects.

Research limitations/implications: The main limitations of the conducted analysis are related to the study being based on the Scopus database and focused on specific disciplines, namely Business, Management and Accounting, Economics, Econometrics and Finance.

Originality/value: The paper analyzes FinTech trends in selected disciplines. The paper also provides information about the identified growth trends that are likely to grow and which of them will becoming less relevant. It identifies how various new technologies and sustainability development can change organizations and management.

Keywords: bibliometric study, financial inclusion, sustainability finance, financial education, blockchain.

Category of the paper: testing of data.

1. Introduction

FinTech has been one of the buzzwords of the past several years. Nevertheless, no consistent definition has been formulated thus far. The etymology of the word FinTech is “Financial Technology”. We can define FinTech as a group of companies that employ new business models and new technologies with a view to providing new products and services that have a significant impact on the financial market and the supply of financial services.

This article aims to provide an analysis of the FinTech sector based on the available data on its current developments. Data has been collected and reviewed by the author in order to present the theoretical and conceptual framework of FinTech. In 2019, the results of a bibliometric study were published in the *Electronic Commerce Research and Applications* journal; it summarized academic publications related to the FinTech sector. The number of articles found in the two most famous, international scientific databases (Web of Science and Scopus) totaled no more than 221 of publications. A more detailed analysis showed that more than half (54%) of articles concerned this sector in general, while the rest focused on its specific aspects (Milian et al., 2019). The study revealed an important research gap in this area; existing studies tend to be of terminological nature, or focus solely on certain aspects of this sector.

In 2020, the outbreak of the COVID-19 epidemic pressured the world into an accelerated process of digitization and forced it to adopt new technologies within a short space of time. Rapidly advancing digitization of the financial sector may have been one of the reasons for record amounts of financing received by FinTech companies (CB Insights, 2022), which proved a strong driver of an even faster technological development. As customers begin to use these innovations, their expectations and demands when it comes to the usability, digitization and democratization of financial services increase. Therefore, we can assume that this area will continue to develop and become more interesting, also in terms of academic research.

The main research questions posed in this paper are as follows:

Q1: What are the global trends in scientific publications relating to FinTech? What research areas can be identified?

Q2: In the light of the existing research trend, which areas of this sector remain unexplored?

Q3: What are the potential research development directions?

In order to answer these questions, a bibliometric study shall be carried out. Bibliometry is a set of research techniques used for the quantitative analysis of publications, including academic publications and patent documentation (Klincewicz et al., 2012). The main contribution of this paper is the bibliometric analysis of the FinTech sector on 900 publications and the presentation of its findings and conclusions.

In the second part of the paper is presented definition and classification of FinTech companies, and aims to provide a perspective on the scale of this phenomenon and the trends both within and around it. The database and the method of analysis employed in order to answer research questions are discussed in the third part. Results of the bibliometric study are presented in the fourth part. In the fifth part, findings are discussed and conclusions are drawn; a FinTech terminology framework, based on the literature review and the results of the analysis, is also proposed. The article ends with a discussion of research conclusions.

2. FinTech – definition and classification

The word FinTech only became widely known a few years ago. Technological novelties in the financial sector emerged much later, and entrepreneurs remained reticent about revolutionizing this sector of the economy, which can be accounted for by strict limitations imposed on the financial market. It is a thoroughly regulated area of the economy, and financial data is highly sensitive. At the same time, the development of such services may contribute to the development of society itself. Throughout the world, millions remain deprived of access to financial services, such as bank accounts and digital payments. They still rely on cash payments (Demirgüç-Kunt et al., 2020), while new financial technologies could greatly facilitate access to such services.

In his 2018 study, Bernardo Nicoletti analyzed the FinTech sector in terms of its subject and form. He emphasized that the word must not be associated only with startups, but rather with technologies that may be supplied also by mature enterprises (Nicoletti, 2017). Therefore, FinTechs are companies that use technology to operate outside of the traditional business model of financial services, striving to change the way financial products and services are provided (Fortnum et al., 2017; Milian et al., 2019).

The Financial Stability Board, which is a body that monitors the stability of the global financial system, defines FinTech as a technological and financial innovation related to new business models, as well as applications, processes or products that have a significant impact on financial markets and institutions, as well as the provision of services on this market (Dudley, 2017). Interestingly, the above definition emphasizes that it is related to new business models; the same was concluded by Bernardo Nicoletti. To sum up, the term describes a variety of innovative business models and new technologies that have the potential of transforming the sector of financial services (Al-Ajlouni, Al-Hakim, 2018), or provide solutions to improve it. Leong and Sung argue that FinTech is an interdisciplinary sector that combines finance, technology management and innovation management, and believe that it can be extended to cover “any innovative ideas that improve financial service processes by proposing technology solutions according to different business situations, while the ideas could also lead to new business models or even new businesses” (Leong, Sung, 2018).

Various classifications of this sector can be found in literature. According to Thakor, FinTech covers the following broad areas:

- credit, deposit and capital raising services,
- payment, clearing and settlement services including digital currencies,
- investment management services (including trading) and insurance,
- technological solutions, with blockchain as one of the main technologies (Thakor, 2020).

According to another interesting classification, the sector can be divided into two categories:

- Sustainable FinTechs - established financial service providers, striving to create new technologies in the financial sector to secure their position on the market through the use of information technology.
- Disruptive FinTechs - companies and start-ups that challenge established financial service providers by offering new products and services within this sector. These enterprises have new business models characterized by a greater flexibility, security, efficiency, and more opportunities compared to traditional financial services (Gomber et al., 2017; Milian et al., 2019).

This market is developing very quickly, and the challenges that arise are only accelerating this revolution. The COVID-19 pandemic constrained users of the financial sector to adopt digital solutions faster, and many processes had to be automated. Russia's aggression against Ukraine also triggered the adoption of new technology solutions that contribute to the security of this sector. It should also be emphasized that the use of these technologies, along with other innovations, is aimed, *inter alia*, at lowering the costs of searching for the interested parties to the transaction, achieving economies of scale in collecting and using large amounts of data, and benefitting from cheaper and safer information transmission, or reduced verification costs (Thakor, 2020). Another important aspect of FinTech development is a greater access to the financial sector of those who have thus far been excluded from it, which means that its development contributes to the fulfilment of one of the goals of sustainable development adopted by the United Nations¹.

3. Database and Research Method

The paper presents a bibliometric study of the FinTech sector based on the existing studies, collected and reviewed, with a view to creating a theoretical framework within which FinTech can be defined. Key trends and potential research gaps shall also be indicated.

Q1: What are the global trends in terms of scientific publications relating to FinTech?

What research areas can be identified?

Q2: Which areas of this sector remain unexplored given the existing research trends in this domain?

Q3: What are the potential research development directions?

¹ Refers to the goals of sustainable development and sustainable finance.

In order to answer these questions, a study shall be carried out in four stages: (1) core data selection, (2) data analysis, (3) visualization and, finally, (4) interpretation, which are presented with details on Figure 1.

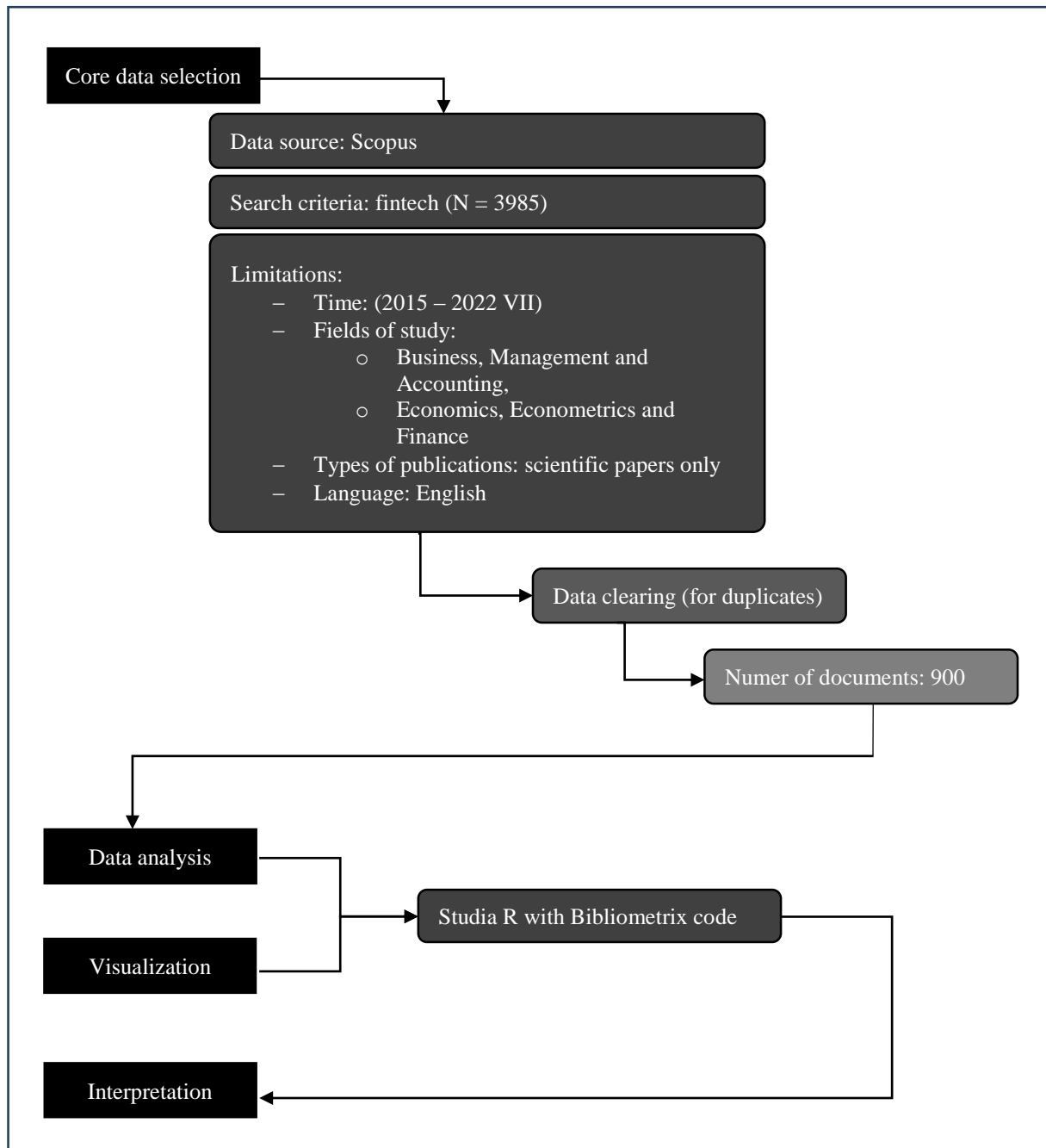


Figure 1. General scheme of the study.

Source: author's own.

The first stage consists in sourcing a database of scientific publications from the Elsevier SCOPUS global database available online. SCOPUS is considered the largest abstract indexing database; it provides advanced search options. It is a useful tool for researchers who wish to draw a list of relevant literature sources (Abbas et al., 2022).

Within it, a thematic query was carried out; it resulted in a list of 900 publications with the term “FinTech” in the title, in the summary and in keywords. The following limitations were applied:

- Time: between January 2015 and July 2022.
- Fields of study: Business, Management and Accounting, Economics, Econometrics and Finance.
- Types of publications: scientific papers only.
- Language: English only².

The result of the data collection stage was the creation of a “.bib” file, which was used in the following stage, which consisted in using R software with Bibliometrix and Biblioshina codes. Prior to creating a general summary of the bibliometric study, tables and matrices, the database was checked for repetitions and errors. The number of articles remained unchanged. In the third phase, classifications were made and all the documents examined are sorted out. “Biblioshins”, or the bibliometrix web interface, were also used to build a network and a co-citation map (Abbas et al., 2022; Campra et al., 2020).

4. Results

4.1. General information on the analyzed literature

Table 1.

Main database statistics summarizes information sourced from the database downloaded from Elsevier SCOPUS. The total number of publications is 900, and the study covers the period between 2015 and 2022 (18 July 2022). The year-on-year increase in the number of publications is very high: 76.68%. As indicated in figure 2, in 2015 the number of publications related to FinTech was 4 per year. A sudden increase in this number took place in 2020, which may be accounted for by the impact of the Covid-19 pandemic that sparked interest in this area of research. The pandemic accelerated considerably the digitization of various areas, including the financial sector. It is worth noting that the FinTech sector delivers its solutions directly or indirectly, by selling its services/products to large institutions; by doing so, it has accelerated the automatization and digitalisation of the entire financial sector. In figure 3 a downward trend can be observed, starting in 2020. This proves that authors of new articles referred to a very small number of existing studies, while new publications had yet to be cited. The analyzed articles were written by a total of 2024 authors. The average number of authors

² Limitations entered in the Elsevier SCOPUS database on 18 July 18 2022 – “TITLE-ABS-KEY (fintech) AND (LIMIT-TO (DOCTYPE, “ar”)) AND (LIMIT-TO (SUBJAREA, “BUSI”) OR LIMIT-TO (SUBJAREA, “ECON”)) AND (LIMIT-TO (LANGUAGE, “English”))”.

per publication is 2.7. As many as 27.33% of publications are the result of international cooperation. Interestingly, the average age of the analyzed articles is less than 1.67, which confirms that it is a very new field of research. The total number of publications cited in the bibliographies of the analyzed articles is 46,401.

Table 1.

Main database statistics

| | |
|--|-----------|
| Main information about the data | |
| Timespan | 2015:2022 |
| Sources (journals, books, etc.) | 398 |
| Documents | 900 |
| Annual growth rate (%) | 76.68 |
| Average age of documents | 1.67 |
| Average number of citations per document | 10.73 |
| References | 46,401 |
| Document contents | |
| Keywords plus (ID) | 1,116 |
| Author's keywords (DE) | 2,381 |
| Authors | |
| Authors | 2,024 |
| Authors of single-authored docs | 154 |
| Authors collaboration | |
| Single-authored docs | 181 |
| Number of co-authors per document | 2.7 |
| International co-authorship (%) | 27.33 |
| Document types | |
| Article | 900 |

Source: author's own.

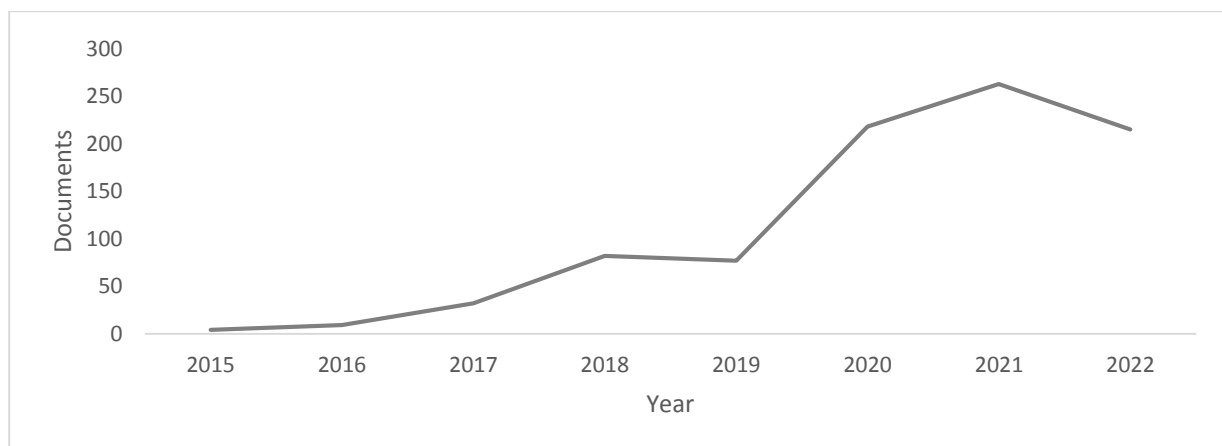


Figure 2. The number of analyzed articles published in 2015-2022 (VII).

Source: author's own.

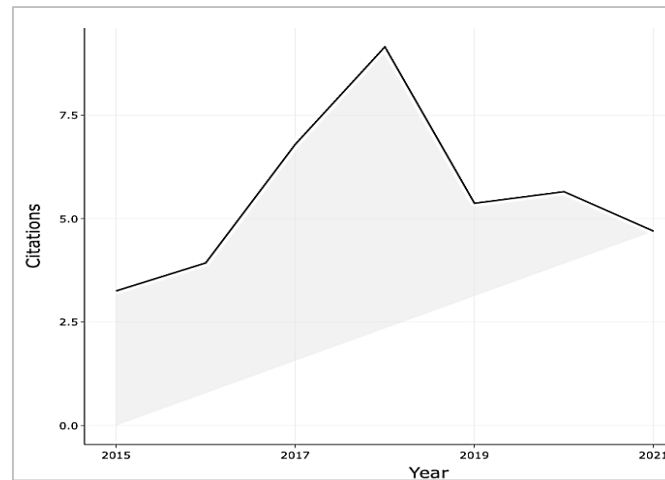


Figure 3. Average annual number of citations of the analyzed articles in 2015-2022 (VII).

Source: author's own.

4.2. Country-specific bibliometric research

The bibliometric analysis covered the countries of origin of researchers who authored the analyzed articles. The results show their geographic origin, as well as the total number of citations and the cooperation network.

Figure 4 presents countries in which articles about FinTech were published. As many as 43% of them were published in the US, China and the UK. The United States top the list of countries with the greatest number of articles relating to the subject (140), with China following as a close second with only one publication fewer (139).

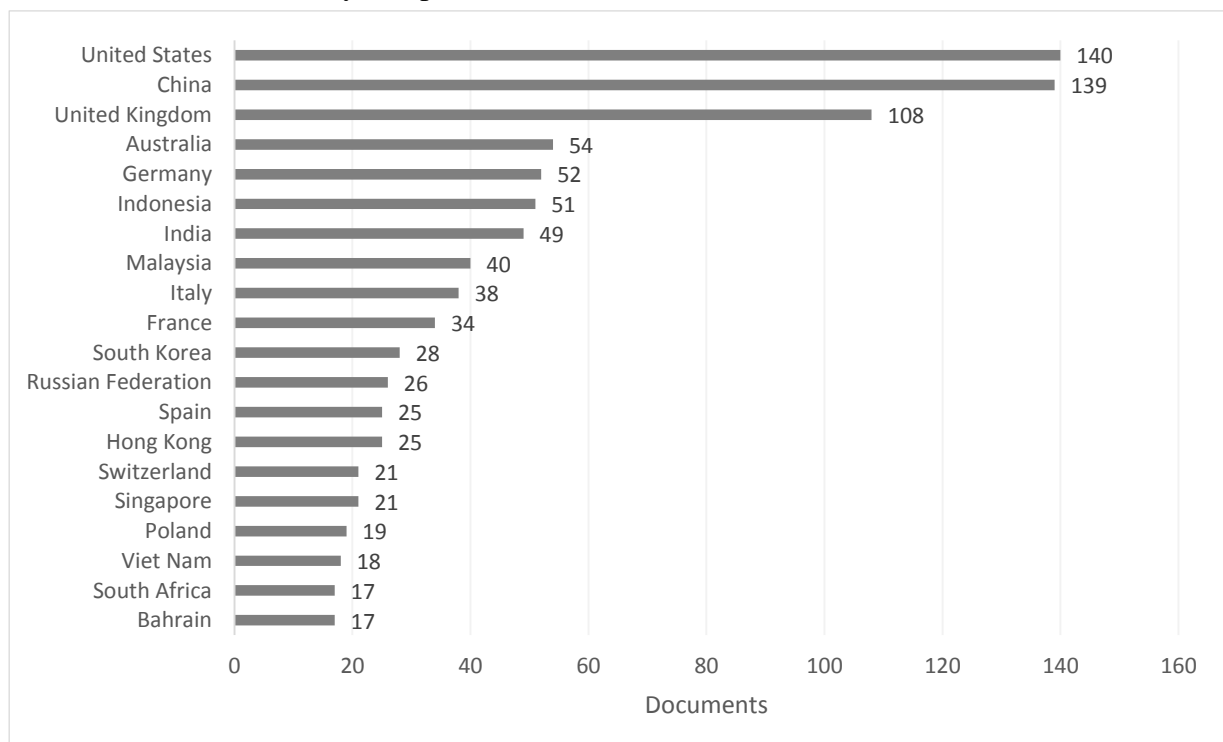


Figure 4. Country of publication of the analyzed articles, 2015-2022 (VII).

Source: author's own.

The first analysis focused on cooperation between countries (figure 5). The network has two central nodes (China and the US), and a minor one in the UK. These three countries are at the forefront of the research carried out in this area and link three continents. The number of articles published in the remaining countries represents fewer than 50% of those published in the US, China and the UK. These three leaders are followed by Australia, Germany, Indonesia and India.



Figure 5. Cooperation between countries in FinTech research.

Source: author’s own.

4.3. Bibliometric research pertaining to authors

This section presents the authors of articles from the analyzed database. Those most prolific in terms of the number of publications, and those who are most cited are analyzed, along with the authors' keywords. The graph below (figure 6) presents researchers who have authored the greatest number of publications from the analyzed database.

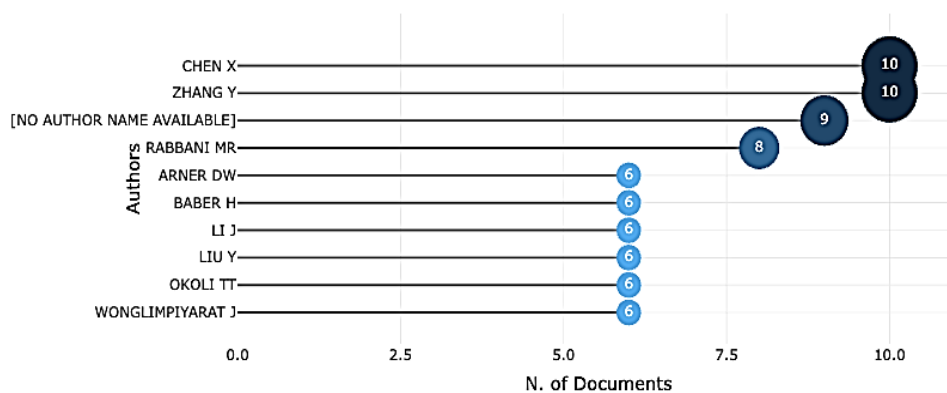


Figure 6. Ten authors with the greatest number of articles relating to FinTech.

Source: author’s own.

According to the Graph 5, Chen and Zhang have the greatest number of publications (10); they account for 2.2% of the analyzed base. They are followed by Rabbani, who has authored 8, and Arner, Baber, Li, Liu, Okoli and Anglompriyarat (6 publications each). The next graph (figure 7) allows us to assess the productivity of the best authors over time, as it does not only show the number of their articles and dates of publication, but also the number of citations (detailed data is provided in the Appendix, in Table 2). The size of the circle in a given year reflects the number of publications, while the saturation of blue – the frequency of citation in a given year (it is easier to compare publications year on year from 2015 to 2021). In 2020, Rabbani published 5 articles, with the average number of citations totaling 32.67 per year. Arner published 3 articles in 2020; the annual number of citations was 26.

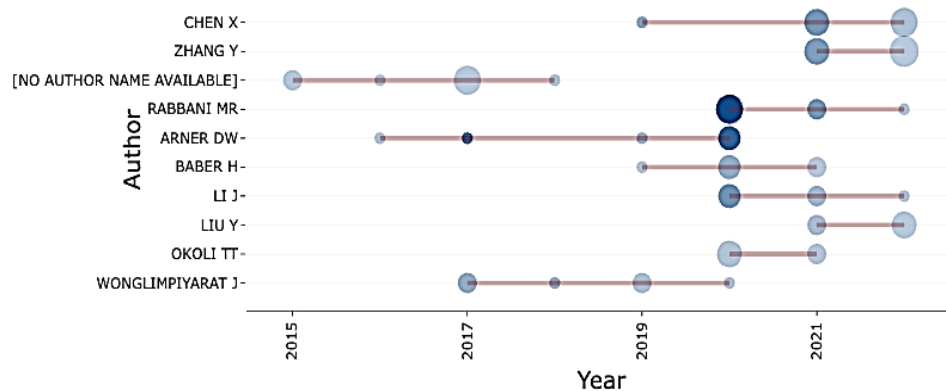


Figure 7. Ten authors with the greatest output over time.

Source: author's own.

Figure 8 presents the most cited authors. It is clearly noticeable that none of the above authors is present. The most cited authors are: Ab- Rahim, Jing, and Zheng (90 citations each), Polinesi and Recchioni (69), Mariani (68), and Deng (67).

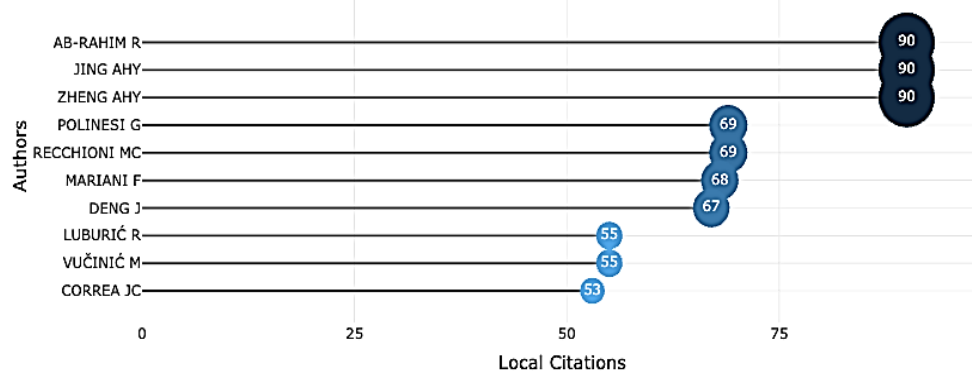


Figure 8. Ten most cited authors of articles on FinTech.

Source: author's own.

Figure 9 presents the distribution of Lotka's law, where the abscissa shows the number of articles, while the ordinate – the percentage of authors. In the figure 9, Lotka's law is illustrated with a dashed line. Over 87% of the authors included in the figure 9 have written at least one

article (detailed data is provided in the Appendix, in Table 3). The percentage of authors of several articles is less than the accepted quarter of the total. The number of articles on FinTech and the number of authors only approaches the dashed line in the graph (figure 9), which is consistent with Lotka's law. This proves that many authors have published a single article (Abbas et al., 2022; Ahmad et al., 2019).

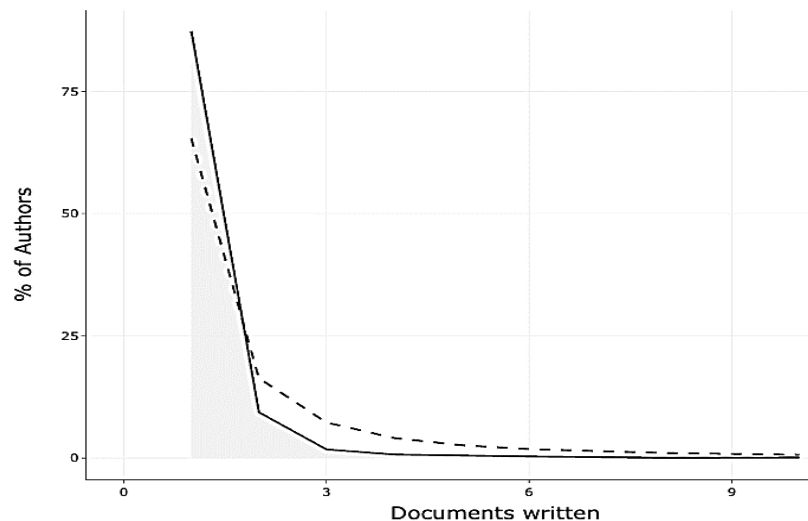


Figure 9. Distribution of Lotka's law.

Source: author's own.

4.4. Trends based on Keywords Plus, authors' keywords and titles

In this part, an analysis of the authors' keywords, Keywords Plus and titles contained in the selected documents shall be presented. It is necessary in order to assess the current research trends and to select areas that are most often analyzed. Additionally, an attempt will be made to identify gaps in FinTech research. On the basis of these results, we shall also try to define potential future directions of research. The analysis is mostly based on Keywords Plus, as they provide a very effective form of document indexing. The authors' keywords and titles are defined by authors based on their intuition and judgment. Keywords Plus are derived from a study by Irving Sher, who investigated the possibility of improving title word indexing by using title information in cited sources. As a result of these experiments, combined with experience in using procedures similar to algorithmic naming, he identified a system called Keywords Plus (Garfield, Sher, 1993). It was described in detail by Garfield in 1990 (Garfield, 1990). Currently, Keywords Plus are identified by Thomson Reuters editors; using a semi-automatic algorithm, they scroll through the titles of all references and highlight any other relevant, yet overlooked keywords that have not been mentioned by authors. As opposed to authors' keywords, the Keywords Plus field is standardized. Keywords Plus terms capture the content of an article with more depth and variety (della Corte et al., 2019).

Words and phrases from titles are summed up, and various algorithms are used to select and classify the best three-word, two-word, and one-word candidate terms. The system ascribes these terms to KeyWords Plus for each source element (Garfield, Sher, 1993).

The Figure 10 shows the difference between the title, the authors' keyword and the Keywords Plus. A search based on keywords resulted in 100 articles. In comparison, Keywords Plus searches yield a different set of roughly the same size (102 articles). Among these, approximately 44 articles overlap, while 58 additional and articles are found. Let us compare them with respect to authors' keywords.

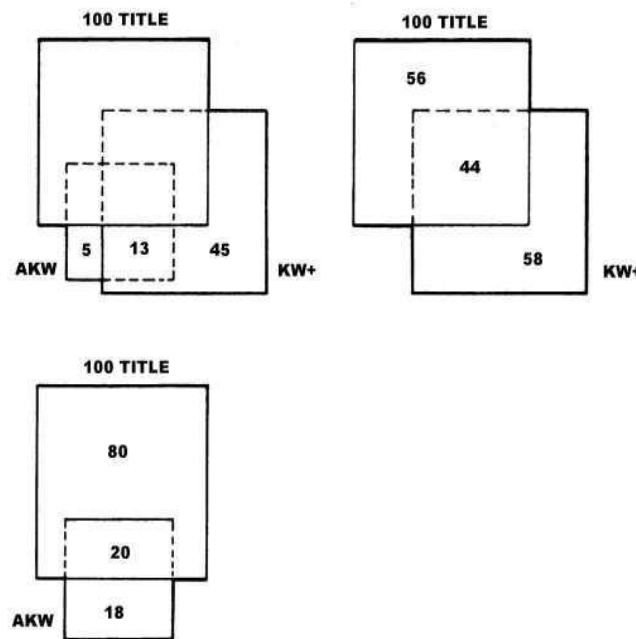


Figure 10. Percentage overlap in retrieval between title words, authors' keyword or Keywords Plus. Source: (Garfield, Sher, 1993).

First, we shall present 15 most common words based on the titles of the analyzed documents, authors' keywords, and Keywords Plus. The three graphs below (figure 11-13) present the results of the analysis. In the case of the 15 most common words/phrases found in the titles, "evidence" and "impact" seem most frequent. They are typical of the titles of academic articles and could appear in works from any research discipline. Therefore, we shall focus primarily on the analysis of Keywords Plus and on authors' keywords. On the basis of figure 13, we can determine areas of the FinTech sector on which research was focused. "FinTech", "finance" or "technology" are obvious terms for the base being analyzed, and therefore we shall, therefore, omit them at a later stage when discussing the results.

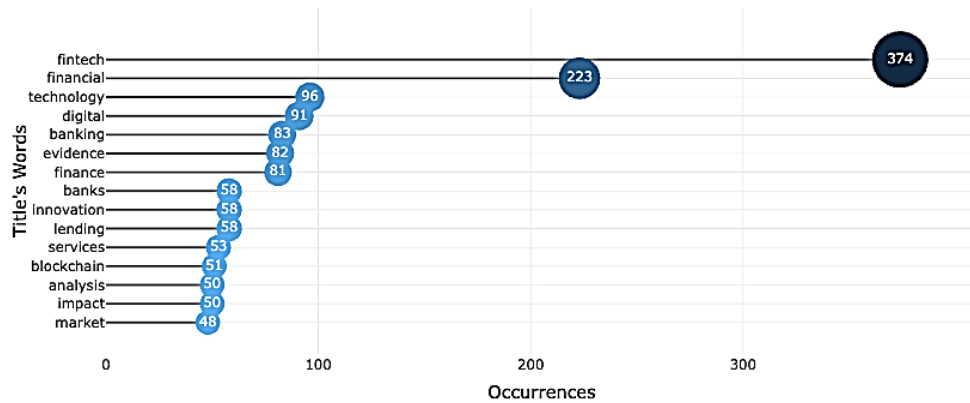


Figure 11. Fifteen most frequent words based on the titles of the analyzed documents.

Source: author's own.

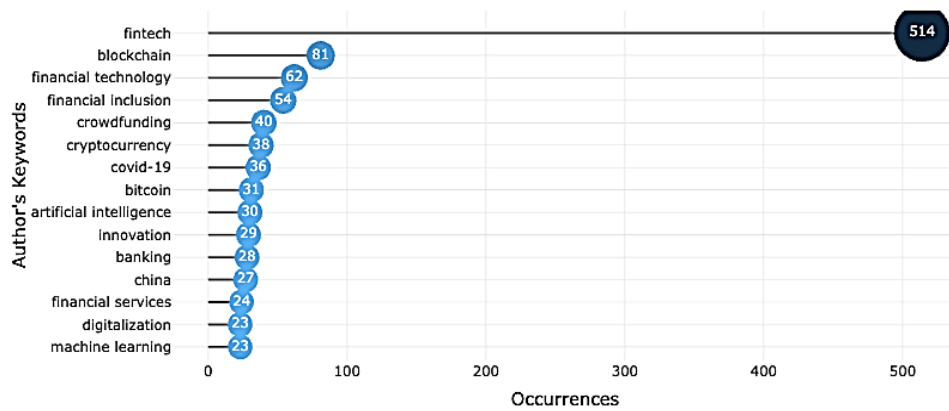


Figure 12. Fifteen most frequent authors' keywords in the analyzed documents.

Source: author's own.

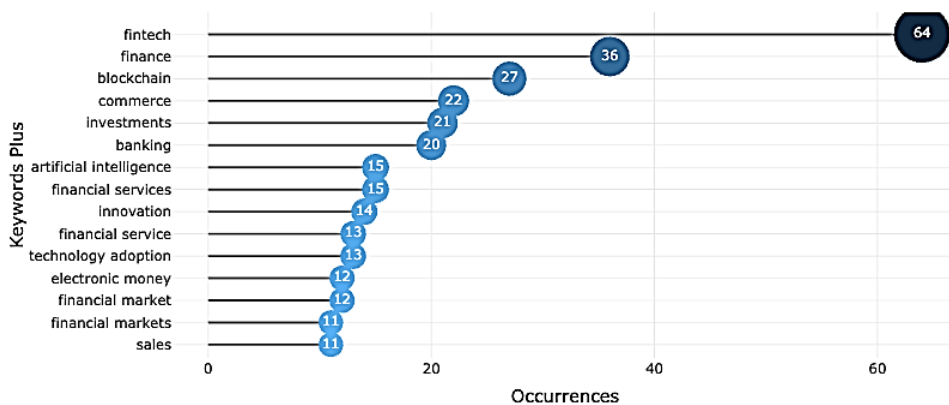


Figure 13. Fifteen most frequent Keywords Plus in the analyzed documents.

Source: author's own.

The analysis of the above graphs (figure 11-13) points to the following: blockchain (second among authors' keywords, and third among Keywords Plus), bitcoin and cryptocurrency. One of Keywords Plus is electronic money, which confirms that certain researchers focus in their work on the topic of electronic money, cryptocurrencies as an alternative to cash, or non-cash money. Banking, artificial intelligence, innovation, financial service are other common phrases. Financial inclusion ranks very high among authors' keywords, as it is a crucial

aspect of the FinTech concept. The issue of financial exclusion has been relevant since 2011, when the Global Findex Database published by the World Bank became a source of data on how people throughout the world use financial services (including payments, savings and loans, expenses, loss of income, etc.) (Demirgüç-Kunt et al., 2020). Research on this subject is regularly published by the World Bank and reflects changes in terms of the financial exclusion. The available data provides evidence for gaps in the access and use of financial services by women and the poverty-stricken, yet access to innovations in the financial sector seem to improve the situation. The Findex global database has become the backbone of global efforts to promote financial integration. It is used extensively by policymakers, researchers and development practitioners. Global Findex data is used to track progress in attaining the United Nations' Sustainable Development Goals (Demirgüç-Kunt et al., 2020).

Figure 14 presents thirty Keywords Plus that are most frequently used in the analyzed FinTech documents. Fifteen most frequently used terms coincide with those presented in figure 13. At the same time, it is worth noting that “financial markets” should rank much higher in figure 13, because this term appears in two forms, i.e. in singular and in plural. With a total of 23 occurrences, it would rank 4th in terms of frequency.

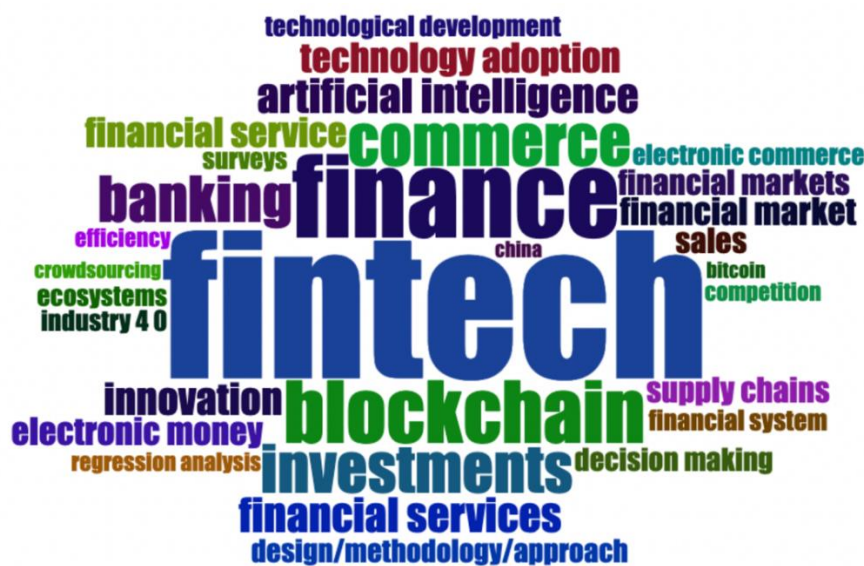


Figure 14. Thirty most frequent Keywords Plus in the analyzed FinTech articles.

Source: author's own.

The next step in the authors' keywords and Keywords Plus analysis is the trend analysis based on the phrases used in the FinTech database. In the bibliometric study, two assumptions were made: in order to show the trends regarding a given phrase in the graph, its minimum frequency was 4 in general and 3 per year. Figure 15 presents the results of this study for Keywords Plus, while figure 16 – for authors' keywords. The results for Keywords Plus show that "sustainable development" and "economic and social effects" are among the most frequently used new phrases, which indicates the growing interest of academics in financial inclusion. The analysis of trends suggests that the topic of blockchain and artificial intelligence

was of the most interesting to academics in 2020 and 2021. In the first half of 2022, these phrases did not appear with a sufficient frequency in FinTech-related articles. As for authors' keywords, they indicate that lately, researchers have shifted their attention to the topics of financial literacy, financial inclusion, mobile payments and, still, COVID-19. Interestingly, technology adoption and innovation were very popular topics in 2019. COVID-19 has greatly accelerated the process of adopting new technologies, which may be the reason why this phrase appeared less frequently in scientific research. In an article from 2020, the sudden increase in the number of downloads of FinTech applications during the Covid-19 pandemic was discussed (Fu, Mishra, 2020). This increased interest can clearly be attributed to the lockdown and minimal direct contacts among people. It is worth pointing out once again that those who do not switch to new technologies will, eventually, become socially excluded. Hence the importance of education in this field. The challenge lies in the fact that although part of society is very advanced technologically, a great number of people still do not have their own bank account.

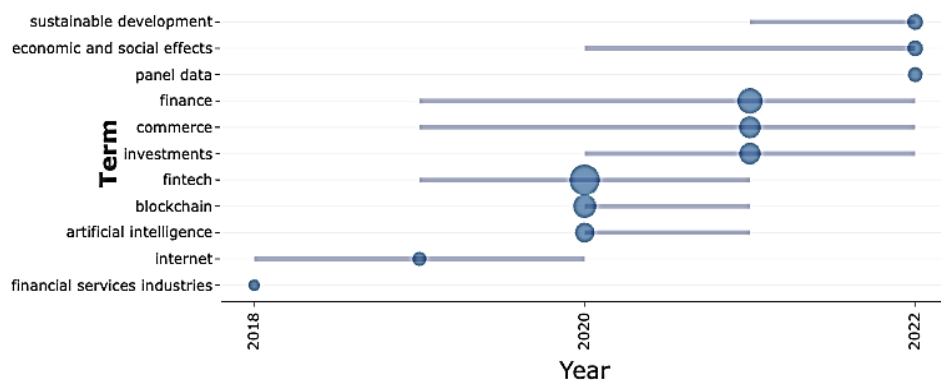


Figure 15. Trend Topics at: Word Minimum Frequency – 4, Number of Words per Year – 3 (Keywords Plus).

Source: author's own.

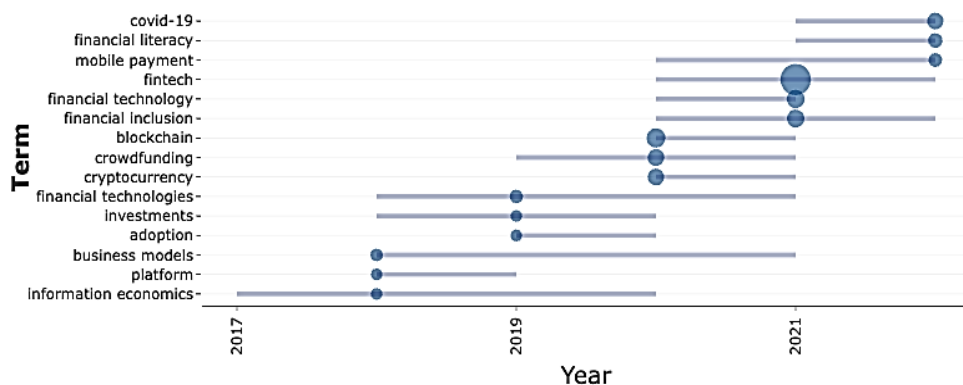


Figure 16. Trend Topics at: Word Minimum Frequency – 4, Number of Words per Year – 3 (authors' keywords).

Source: author's own.

A thematic map, also known as a strategic diagram, is presented below. Topics are classified into four groups (see figure 17), depending on the quadrant in which they are mapped:

- upper right quadrant: motor themes – the map indicates "hot topics", those that are developing and important for defining the conceptual framework of the studied issue,
- lower right quadrant: core themes – topics relevant for the field and cross-cutting topics that encompass different areas within it,
- upper left quadrant: very specialized/niche topics - highly developed, but marginal for the analyzed field,
- lower left quadrant: emerging or disappearing themes, often referred to as peripheral themes, not fully developed or marginally interesting for the field being studied (Aria et al., 2022; Cobo et al., 2011).

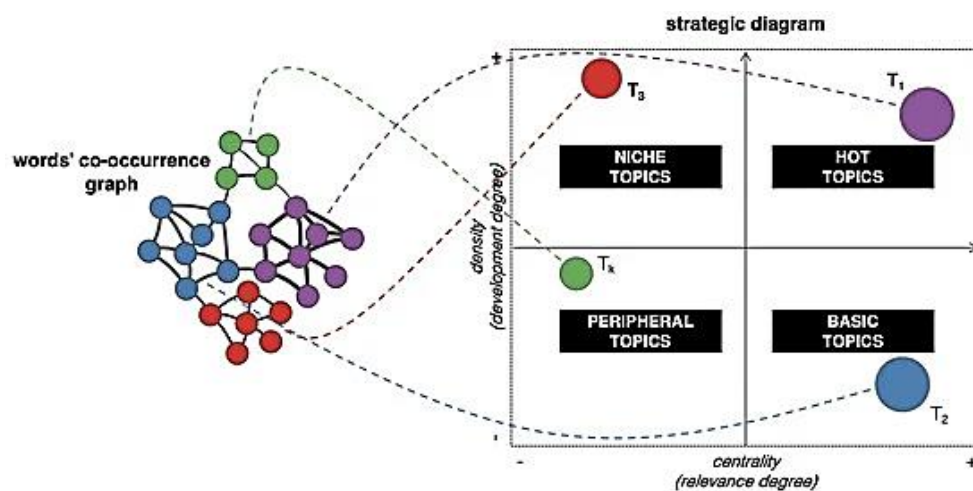


Figure 17. Theoretical framework of the strategic diagram (thematic map).

Source: Arner et al., 2020.

A strategic diagram of the FinTech field is presented below (figure 18). It was created on the basis of 100 Keywords Plus phrases, with the indication that it is to suggest a minimum of five clusters for this field. Then, a bubble chart (figure 19) was drawn up, where topics that can be classified within the discussed thematic clusters are already defined in detail and the relationships between them are clearly visible.

The FinTech thematic map indicates the following phrases in the part that contains topics that expand the discipline: efficiency, regression analysis, economy and social effects (red cluster, see figure 18). "Efficiency" can be interpreted as the result of any actions undertaken, described as the ratio of the effects obtained to the expenditure incurred. Efficiency is the subject of numerous studies, as confirmed by the results presented in the diagram. The second phrase in this cluster is "regression analysis"; it is a simple statistical test method of measuring relationships between two or more variables. It may be the most popular method of analysis in publications related to the FinTech sector. "Economy and social effects" is what scientists strive to determine in relation to the FinTech sector and potential changes that may occur together with the development of new technologies in the financial sector (Ajide, 2021; Malakhova

et al., 2018; Phuthong, 2022). A closer examination of the bubble chart allows us to see that there are other methods of verifying the hypotheses in the analyzed documents (panel data, empirical analysis, forecasting, generalized method of moments, machine learning). In addition, sustainable development, technological change and economy development appear. These keywords are important for research on the FinTech ecosystem in the context of the digitization of the financial sector and socio-economic results of digital transformation (Costa-Climent, Martínez-Climent, 2018; Vovchenko et al., 2019), technology development and environmental protection (Campanella et al., 2022; Costa-Climent, Martínez-Climent, 2018); this is related to the perception of FinTech as a key driver of financial integration which, in turn, is the basis of sustainable development (Arner et al., 2020).

FinTech, finance and blockchain are keywords on the verge of main and developing topics (purple cluster, see figure 18). This only confirms that these are basic concepts, and that they remain crucial for this field. The bubble chart also contains such terms as financial services, technology adoptions, investments, financial market, and industry 4.0.

Emerging and disappearing topics (orange cluster, see figure 18) include such terms as the internet (no longer perceived as a new technology, but rather as a service used by all new technologies). After nearly two years of restrictions related to the COVID-19 pandemic, it has now little impact on the FinTech area. Nevertheless, it ought to be emphasized that the influence of COVID-19 on the adoption of new technologies was immense (Akpan et al., 2022; Daqar et al., 2021; Miethlich et al., 2021).

The cluster on niche topics, which often means very specialized subjects, includes electronic money, ecosystem and financial service (green cluster, see figure 18). A closer examination indicates phrases such as data mining, peer-to-peer lending, crowdfunding and mobile payments (see figure 19).

There is one more cluster contiguous with the square that features basic themes, located between the square of emerging and disappearing themes. This cluster contains such keywords as supply chains, sales, design/methodology/approach (blue cluster, see figure 18). Other phrases in this area relate to basic economic or methodological concepts, namely costs, managers, big data, decision making and surveys (see figure 19).

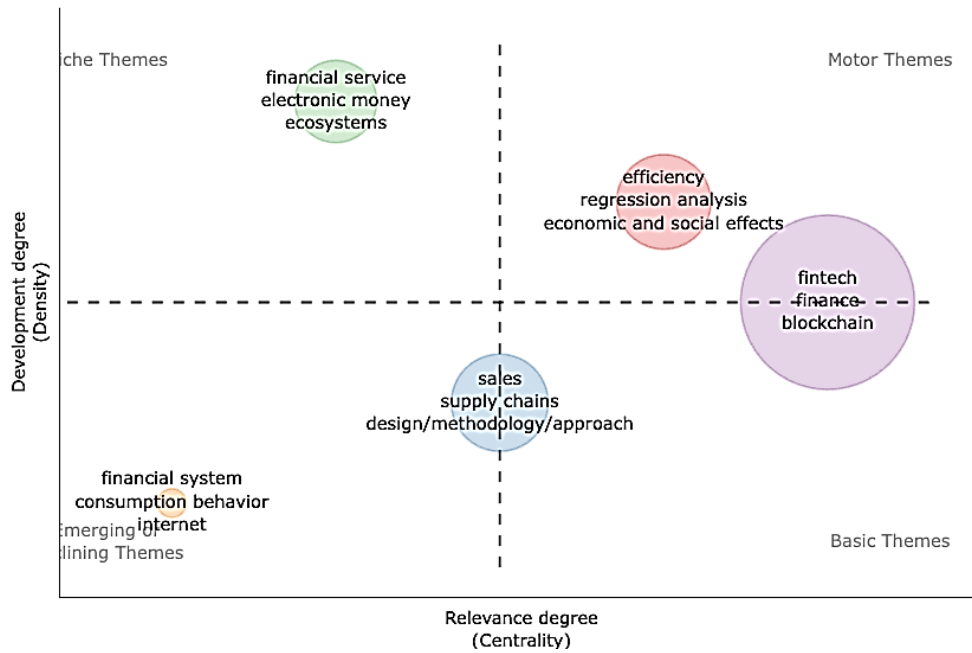


Figure 18. Strategic diagram of the FinTech field.

Source: author's own.

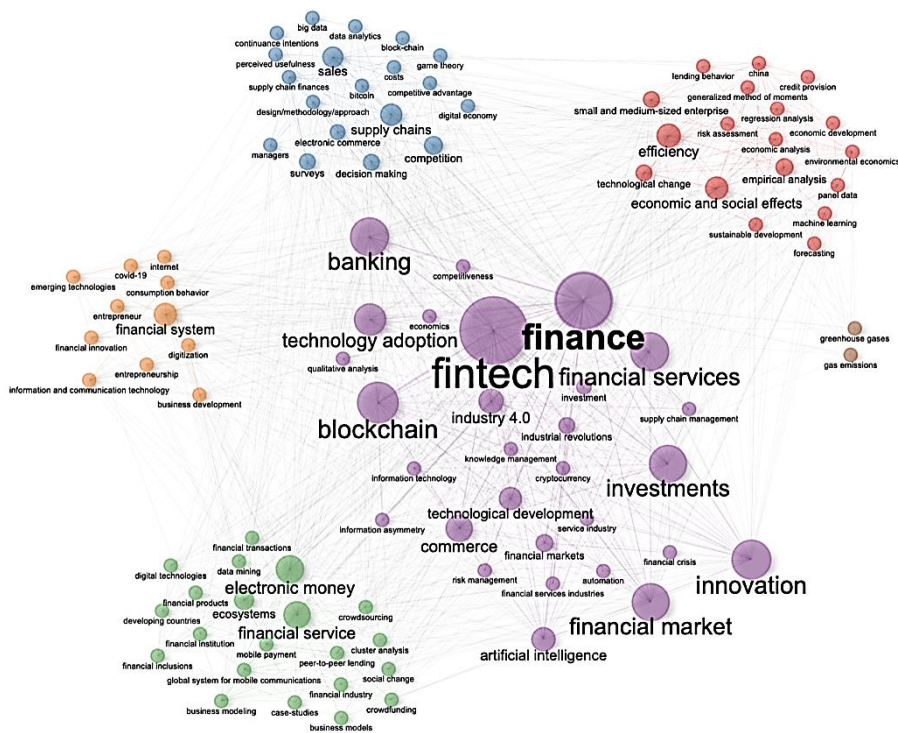


Figure 19. Co-word (Keyword Plus) network visualization; colors indicate word clusters.

Source: author's own.

Biblioshins for Bibliometrix allow the use of the "conceptual structure function" to perform multiple correspondence analysis (MCA) with a view to drawing a conceptual structure of the field and to classify together in order to identify groups with the same concepts (Huang et al., 2021). Results are interpreted on the basis of the relative positions of points and their

distribution along the dimensions; the more similar the arrangement of words, the closer they are represented on the map (Caparrós-Martínez et al., 2021). Parameters used in the analysis were groupings of a minimum of three areas; 50 was the maximum number of terms within them.

Figure 20 presents three areas of different conceptual groups. The blue group contains such terms as "bitcoin", "supply chain", "decision making", "supply chain finance" and "competition". This area relates to research on the possibilities offered by cryptocurrencies and ways in which blockchain can improve supply chains, as well as the way in which the quick settlement of cryptocurrencies can facilitate the decision-making process. Another area is green Industry 4.0, investment and industrial revolution. The type and scope of research into this area is easily imaginable: it will primarily concern investments in innovation, new technologies, as well as changes related to digitization and digital transformation of entities into companies using new technologies and becoming part of Industry 4.0. This area also includes research on the financing of companies producing innovations, i.e. start-ups providing this type of products and services. This is the last and the largest area related to FinTech and its concepts. Keywords generated by the R program include the major part of research and keywords contained in these publications.

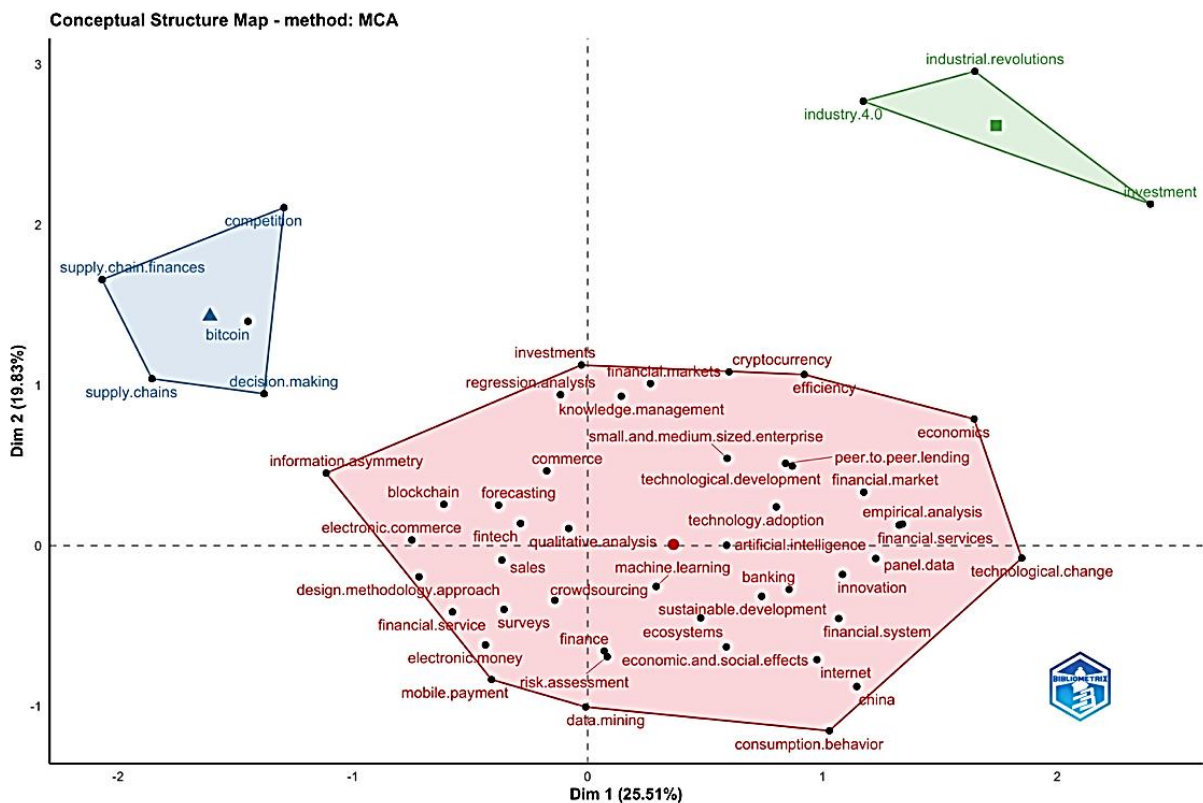


Figure 20. Conceptual structure map with correspondence analysis integrating and correlating knowledge about the current FinTech research.

Source: author's own.

5. Discussion

Summarizing the above-presented results obtained on the basis of the bibliometric analysis, let us refer to research problems formulated above:

Q1: What are the global trends in terms of scientific publications relating to FinTech? What research areas can be identified?

Q2: Which areas of this sector remain unexplored given the existing research trends in this domain?

Q3: What are the potential research development directions?

The study shows a clear trend in articles published in 2020 and 2021, namely focus on blockchain. It is one of the most common topics examined in FinTech publications. The bulk of blockchain research was carried out in 2020. In the Keywords Plus analysis, blockchain ranked third (second among authors' keywords).

In the analysis of authors' keywords, bitcoin and cryptocurrency are the phrases that appear most often. Based on these results, it can be observed that, at the intersection of these two areas, namely FinTech and blockchain, research focused mainly on cryptocurrencies (Abdeldayem, Aldulaimi, 2020; Dupuis, Gleason, 2021; Saiedi et al., 2021; Wingreen et al., 2020) and less often on the distributed network and its application in finance (Drummer, Neumann, 2020).

Banking, artificial intelligence and innovation are also frequently referred to in FinTech publications. This trend is central to our analysis, and it is worth highlighting that generative artificial intelligence was extensively discussed in 2023, with the launch of the company Open AI (founded at the end of 2022), which created the Chat GPT app. At the beginning of 2023, the Chat GPT app became the most popular app, as it is estimated to have reached 100 million monthly active users in January 2023, just 2 months after the launch of Open AI. Compared to other apps, TickTock reached 100 million users after 10 months and Instagram after 1.5-2 years of operation (Hu, 2023). Generative AI is revolutionizing the way people search for information and use the results in their personal and professional lives. There are a growing number of solutions based on generative artificial intelligence to improve the performance of organizations and their managers (Korzynski et al., 2023).

“Financial inclusion” also ranks very high among the authors' keywords. This crucial topic is often associated with FinTech. On the basis of research carried out in 2018, Ozili proved that FinTech services have a positive impact on the “financial inclusion”, i.e. the inclusion into the financial system of people with low and variable income, mainly in developing and emerging economies. This is achieved thanks to the simplicity of these solutions, as well as lower costs compared to the costs of conventional bank services (Ozili, 2018). Unfortunately, this often creates challenges in terms of the security of the financial sector and financial resources of individual customers.

The next stage of the bibliometric analysis based on the documents entered into the program involved the identification of future trends; these are: financial exclusion, democratization of finance, financial education and, in the area of FinTech, sustainable development and economic and social effects. This confirms that FinTech is a key driver of financial inclusion which, in turn, underlies sustainable development (Arner et al., 2020). It also poses a challenge related to problems with the use of new technologies that can be attributed to the lack of necessary skills of specific groups of customers. This may hinder their access to the financial sector, as well as innovations in this field and, consequently, translate into their social exclusion.

6. Conclusions

The article examines – using bibliometric analysis methods – FinTech-related papers published in business and economic journals between 2015 and 2022. Social networks and cooperation between institutions, countries and regions over this period were inquired into, and a thematic analysis of the FinTech sector was carried out with a view to discussing its current state, outlining trends and indicating potential further research directions. For the purpose of this study, a total of 900 documents were retrieved from the Scopus database.

FinTech research has been developing dynamically in recent years. The analysis of the available sources showed a 76-percent year-on-year increase in the number of publications, with the greatest surge in 2020. The number of articles (900) and authors (2,024) proves that this area of research is developing and that the above figures are likely to increase further in the coming years. This assumption is confirmed by the average age of the studied articles (1.67 years). Research findings suggest that FinTech is the future of business, economy and information technology (Nasir et al., 2021).

The analysis was subject to several limitations. First of all, only sources from the Scopus database were selected for the study; the search was carried out on 18 July 2022. It is worth noting that academic publications are often naturally "delayed" due to the lengthy review process. Other limitation can be attributed to the fact that the surveyed publications pertained to a specific number of disciplines – Business, Management and Accounting, Economics, Econometrics and Finance – and that only publications in English were analyzed.

Based on the bibliometric analysis of the FinTech sector, the future direction of research has been outlined. I intend to explore the impact of the development of FinTechs on the democratization of finance, as well as any related challenges (technology adoption, regulations, and the security of the financial sector). The study of trends also brings to the fore the importance and the involvement of FinTechs and of traditional financial in financial education.

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Appendix

Table 2.

Ten authors who have published the greatest number of articles related to FinTech with the total number of citations and the number of citations per year

| Author | year | freq | TC | TCpY |
|----------------------------|------|------|-----|--------|
| ARNER DW | 2016 | 1 | 4 | 0.571 |
| ARNER DW | 2017 | 1 | 123 | 20,500 |
| ARNER DW | 2019 | 1 | 19 | 4.750 |
| ARNER DW | 2020 | 3 | 78 | 26,000 |
| BABER H | 2019 | 1 | 1 | 0.250 |
| BABER H | 2020 | 3 | 21 | 7,000 |
| BABER H | 2021 | 2 | 0 | 0.000 |
| CHEN X | 2019 | 1 | 28 | 7,000 |
| CHEN X | 2021 | 4 | 25 | 12,500 |
| CHEN X | 2022 | 5 | 2 | 2,000 |
| LI J | 2020 | 3 | 41 | 13,667 |
| LI J | 2021 | 2 | 8 | 4,000 |
| LI J | 2022 | 1 | 0 | 0.000 |
| LIU Y | 2021 | 2 | 5 | 2,500 |
| LIU Y | 2022 | 4 | 0 | 0.000 |
| AROUND TT | 2020 | 4 | 4 | 1.333 |
| AROUND TT | 2021 | 2 | 1 | 0.500 |
| RABBANI MR | 2020 | 5 | 98 | 32,667 |
| RABBANI MR | 2021 | 2 | 23 | 11,500 |
| RABBANI MR | 2022 | 1 | 0 | 0.000 |
| WONGLIMPIYARAT J | 2017 | 2 | 40 | 6.667 |
| WONGLIMPIYARAT J | 2018 | 1 | 25 | 5,000 |
| WONGLIMPIYARAT J | 2019 | 2 | 7 | 1.750 |
| WONGLIMPIYARAT J | 2020 | 1 | 2 | 0.667 |
| ZHANG Y | 2021 | 4 | 22 | 11,000 |
| ZHANG Y | 2022 | 6 | 0 | 0.000 |
| [NO AUTHOR NAME AVAILABLE] | 2015 | 2 | 0 | 0.000 |
| [NO AUTHOR NAME AVAILABLE] | 2016 | 1 | 0 | 0.000 |
| [NO AUTHOR NAME AVAILABLE] | 2017 | 5 | 0 | 0.000 |
| [NO AUTHOR NAME AVAILABLE] | 2018 | 1 | 0 | 0.000 |

Source: author's own.

Table 3.

Lotka's law distribution for the tested sample

| Documents written | No. of authors | Ratio of authors |
|-------------------|----------------|------------------|
| 1 | 1766 | 0.873 |
| 2 | 189 | 0.093 |
| 3 | 35 | 0.017 |
| 4 | 14 | 0.007 |
| 5 | 10 | 0.005 |
| 6 | 6 | 0.003 |
| 8 | 1 | 0.000 |
| 9 | 1 | 0.000 |
| 10 | 2 | 0.001 |

Source: author's own.