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Fintech & Risks. A Bibliometric Analysis

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Abstract

Our study highlights a literature map on Fintech and the risks associated with this technological innovation in the financial sector. Considering all the studies published from 2014 to 2021 in "Scopus", we resort to econometric techniques to create our map. Our results show the recent attention of academics and researchers, mainly belonging to the technological and IT areas, towards Fintech. In particular, the studies focus on the issue of emerging technologies applied to investment and credit processes linked to the assessment of customer insolvency risk. For this reason, the existing analyzes adopt a mainly technical approach with very limited attention to strategic, organizational and managerial aspects typical of financial intermediation. Future studies could investigate the issue of Fintech behavior and relations with incumbent banks, as well as the risks that the applications of emerging digital technologies have on the sound and prudent management of these operators. In addition, further analysis can capture the risks of Fintech for clients, taking into account financial education. These are important aspects for the growth of Fintechs themselves, for the sustainability of the incumbent banks, with which they increasingly collaborate, and obviously for the banking supervisory authorities, attentive to the stability, efficiency and competitiveness of the financial sector as a whole.

Keywords: financial intermediaries, technology innovation, fintech, risks, bibliometric analysis.

1. Introduction

Technological innovations in the financial sector, better known by the term Fintech, are increasingly widespread (FSI, 2020). These are technologies classified as disruptive, that can subvert the market by changing the business models, the risks, the sector performances, and the competitive dynamics between operators. In fact, we are witnessing the entry into the market of new operators, who favor a wider diversification of financial products and services, improving the efficiency of organizational processes and performance, in the face of exposure to greater and new risks for the overall financial system (Minto *et al*., 2017).

These technological innovations expose financial intermediaries to new risks, which can compromise sound and prudent management, threatening the stability and efficiency of the system and, therefore, the protection of customers (Vučinić, 2020). The Basel Committee on Banking Supervision (2018) assessed the implications of FinTech on the banking system, examining the risks and underlining the urgency for banks to implement procedures for the adjustment and assessment of risks. For the reasons of prudential supervision, the Supervisory Authorities have developed, among other things, a mechanism known as the "regulatory sandbox", through which a Fintech operator can test new proposals for financial products/services on the market, with the support of the Authorities, to anticipate or reduce potential risks and protect customers. There is still no common international regulatory framework for all countries (Agathokleous, 2019).

While the attention of researchers and scholars on the opportunities offered by Fintech is particularly high (e.g. Philippon, 2016; Romānova and Kudinska, 2016), studies on the risks related to Fintech are less widespread, probably because the topic is new and it is not easy to understand the real possible risky events linked to technological and innovative processes in the financial sector. However, this is an issue on which there is growing attention from the Authorities committed to protecting customers and the stability of the sector, as well as consequent control needs by financial intermediaries.

In this perspective, this study aims to increase knowledge on the change that is affecting the financial sector by outlining the state of the art on the topic of risks in Fintech, through a mapping of the studies currently available. To this end, the co-occurrence analysis between keywords indexed by Scopus is used to identify the main clusters of topics covered and an overlay view to identify the main trends in academic research.

The results of our analysis allow us to understand the state of scientific knowledge on the topic of Fintech & Risks and, consequently, to seize any gaps on which future studies could focus in order to increase knowledge of the risks that can compromise the spread of digital technology in the financial sector.

The paragraphs are distinguished as explained below. Par. 2 describes the research methodology applied to carry out bibliometric analysis. Section 3 illustrates the results of the analysis and discusses the map of the existing studies. Par. 4 concludes and points out future areas of investigation.

2. Research methodology

2.1 Databases and keywords

The bibliometric analysis was carried out on a set of documents extrapolated from the "Scopus" database. The analysis sample was constructed by searching and selecting all the documents that contained the words "risk" or "risks" and "fintech*" within the title or in the abstract or within the keywords. The choice of a few words was helpful in incorporating as many documents as possible into our analysis and avoiding the results being skewed by a limited sample. The selection of these words generated an output of 274 documents, published between 2014 and 2021. The selection of the sample was made in February 2021.

2.2 Analysis tools

The first phase of the analysis, carried out with the R software using the "Bibliometrix" package, made it possible to obtain the main information of the extracted sample, such as the trend of publications over time, the most cited documents, the most cited authors, and the most productive countries (Aria & Cuccurullo, 2017). For the second phase of the analysis, the VOSviewer software was used to conduct the co-occurrence analysis to identify the relationships between the keywords, highlighting, through a clear and interactive representation, the clusters representative of the topics covered by the literature. The analysis was performed through the full counting

method with which each link has the same weight. To ensure the identification of clusters as representative of reality as possible, keywords with an occurrence value of at least 6 were selected for the analysis. The analysis was carried out on 32 keywords indexed by Scopus (Index keywords).

3. Results and discussion

3.1 Historical series analyses

The first step in the bibliometric analysis is to identify the main information of the sample extrapolated by Scopus, as shown in Table 1. The selected documents are 274, of which only 264 contain complete information. The publication period runs from 2014 to 2021.

Table 1
General information on the sample (period 2014-2021).

Documents area	***N°***
Documents	274
Sources (Journals, Books, etc.)	201
Keywords Plus (ID)	904
Author's Keywords (DE)	756
Average citations per documents	3.223
Authors area	***N°***
Authors	616
Author Appearances	687
Authors of multi-authored documents	551
Single-authored documents	83
Documents per Author area	***Percent***
Documents per Author	0.445
Authors per Document	2.25
Co-Authors per Documents	2.51
Collaboration Index	2.88

Source: authors' elaboration.

Each paper was cited on average 3 times. The keywords provided by the authors and those indexed by Scopus are on average 3, for each document. The sample includes 83 articles written by single authors and 191 articles written by multiple authors. On average, each article was written by 2 authors, as can also be seen from Table 2.
Fig. 1 shows a growing trend in scientific production on the topic of Fintech & Risks. This result shows that the attention to the Fintech phenomenon has grown considerably in the financial sector, to the point that university researchers have developed several research questions on technological innovation in financial processes. The evolution of the phenomenon was also considered for the risk aspects, linked to the applications of Fintech in the main areas of financial intermediation, such as payments, credit, insurance, wealth management (FSI, 2020).

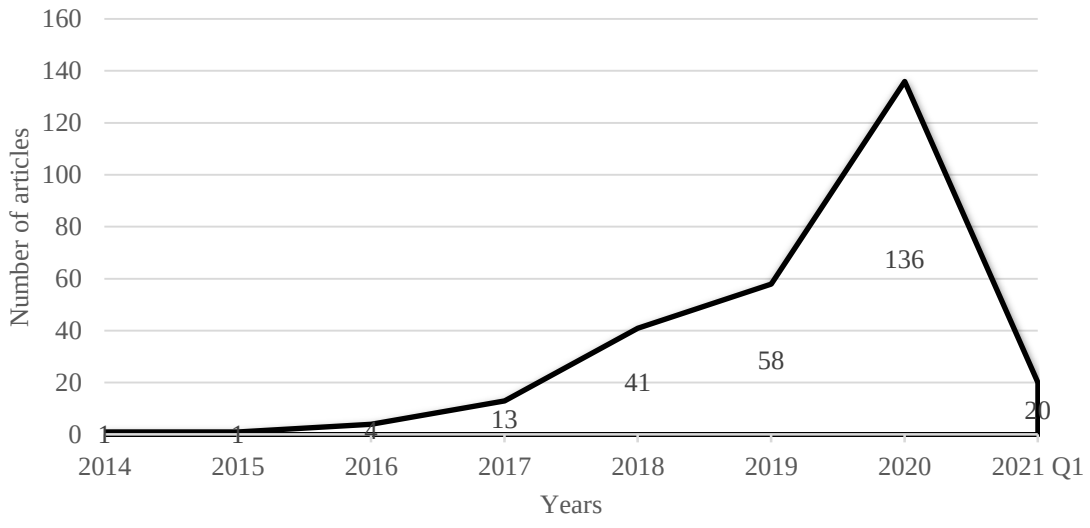

Fig. 1. Annual scientific production since 2014. Source: Source: authors' elaboration.

3.2 Publication output

Among the 274 documents analyzed, 151 were published in scientific journals (55.1%), 76 in the form of conference papers (27.7%), 18 in the form of book chapters (6.6%), 16 in the form of reviews (5.8%), 7 in the form of conference reviews (2.6%) and the remainder in other types (2.2%).

The data also shows a good dialectic on these issues, at the level of conferences and scientific meetings, in addition to the articles published.

During the observation period, the most relevant sources were ACM International Conference Proceeding Series (11), Advances in Intelligent Systems and Computing (6), Journal of Physics Conference Series (5), Electronic Commerce Research and Applications (4), Lecture Notes in Computer Science (4) and Perspectives in Law Business and Innovation (4).

By analyzing the most relevant sources, it is clear that the topic of Fintech & Risks interests not only researchers with economic and legal education but also technical-scientific ones.

Traditional banking and financial journals, even with a managerial approach, are not very present in the classification. In fact, the risks are not merely of an economic and legal nature but can also be of a technological and IT type.

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The data also show a high scientific debate on these issues, at the level of conferences and workshops, in addition to published articles; it is a signal linked to the novelty of the theme and the complexity of the change that Fintech generates in a sector that is not used to change; this seems to require scientific comparison and discussion even before supporting robust empirical analyzes. Furthermore, this data is also linked to the fact that there is no data available on Fintech, as is the case with incumbent banks.

The absence of datasets therefore makes it more difficult to publish research works based on real and valid data from the financial market.

During the period, the most relevant sources were ACM International Conference Proceeding Series (11), Advances in Intelligent Systems and Computing (6), Journal of Physics Conference Series (5), Electronic Commerce Research and Applications (4), Lecture Notes in Information Technology (4) and Perspectives in Law, Business and Innovation (4). These sources show how the focus of the topic, up to now, is mainly focused on technological issues.

Management journals, which typically welcome studies from the perspective of financial intermediaries, are very few. On the one hand this is positive, as it is inevitable that the study of Fintech and its risks requires a transversal study approach, both technical-digital and management; on the other hand, existing publications seem to show almost a delay in research on the management aspects of Fintech and its risks.

Traditional banking and financial journals, even with a managerial approach, are not very present in the classification. The risks associated with Fintech, in fact, expose the operators and the system to negative events of a technological and IT type (typically cyber risks), but it is important to adopt a study of risk management in Fintech, also of an economic and legal nature, for the customer protection and the stability of the overall banking system.

3.3 Productivity analysis

In total, 616 different authors carried out the existing studies. As shown in Table 2, most publications are written by 2 authors (27.74%), one author (26.64%), and three authors (19.34%).

Table 2

Authorships per paper

Authorship	*Frequency*	*Percent*
Single author	73	26.64%
Two authors	76	27.74%
Three authors	53	19.34%
Four authors	36	13.14%
Five authors	14	5.11%
> 5 authors	12	4.38%
Authors do not appear	10	3.65%
Total	274	100%

Source: authors' elaboration.

The 10 most productive authors published an average of 4 articles per year (Table 3).

An interesting fact that emerges is the high number of authors who have affiliations with research institutes in China; this data highlights that the highest attention to Fintech and its risks is placed by Chinese researchers, as demonstrated by the liveliness of China for technological innovations in finance (Bartels, 2020).

This figure also shows a strong commitment to scientific research in the development of technological application solutions, rather than in the analysis of strategic and managerial behaviors, and in the monitoring of the related risks.

Table 3
Most productive authors

	Author Name	*Head office of affiliation*	*Affiliation*	*N° of documents*
1	*Li J.*	Beijing, China	Chinese Academy of Sciences	5
2	*Ozili P. K.*	Abuja, Nigeria	Central Bank of Nigeria	4
3	*Serrano W.*	London, United Kingdom	Electrical and Electronic Engineering Imperial College London	4
4	*Wang S.*	Beijing, China	Chinese Academy of Sciences	4
5	*Wang Y.*	Beijing, China	Beijing University of Technology	4
6	*Xu D.*	Beijing, China	Du Xiaoman Financial	4
7	*Arner D. W.*	Hong Kong	University of Hong Kong	3
8	*Buckley R. P.*	Sydney, Australia	UNSW Sydney	3
9	*Fernando E.*	Jakarta, Indonesia	Bina Nusantara University	3
10	*Li L.*	Beijing, China	Beijing University of Posts and Telecommunications	3

Source: authors' elaboration.

Fig. 2 shows the 10 most productive countries on the Fintech & risk theme and, for each of them, the Single Country Publications (SCP) and Multiple Country Publications (MCP) indicators are provided.
The SCP indicator represents the number of publications resulting from the collaboration between authors from the same country, while the MCP represents the number of publications resulting from the collaboration between authors from different countries.
Fig. 2 reflects what has already emerged in Table 3, i.e. China appears to be the country where the research on Fintech & Risks, expressed by 37 articles, is relevant. Continuing in the ranking, there are two European countries, such as Germany, in 4th place with 6 articles; Italy, in 6th place with 5 articles.
The comparison between the SCP and MCP indicators shows a substantial tendency to collaborate with authors who have affiliations in the same country, with the exception of Australia, which instead shows a wider openness of researchers to collaborate also with researchers from other countries, probably for fill the knowledge on financial innovation that can generate the geographical distance from the main international economic and financial centers.

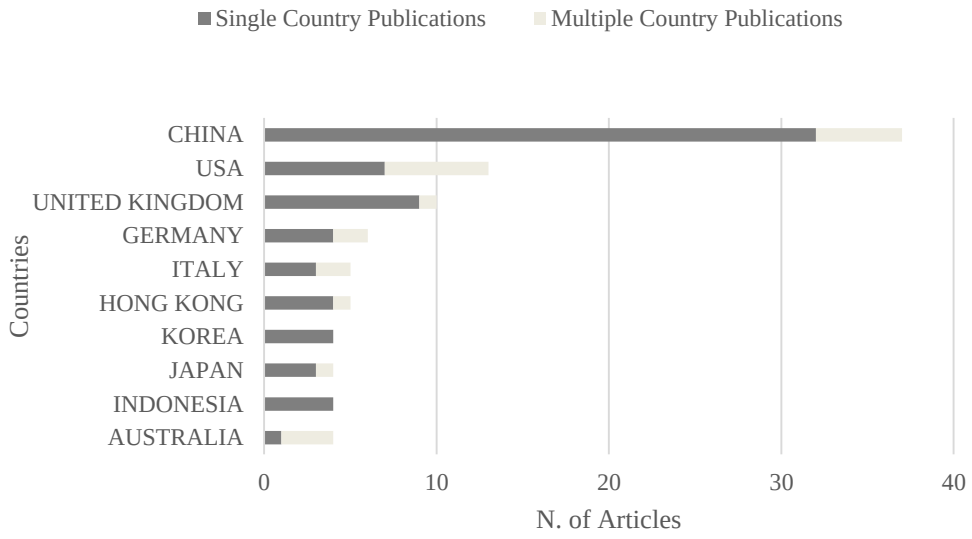

Fig. 2. Most productive countries. Source: authors' elaboration.

3.4 Keywords analysis and discussion

The analysis of keywords represents a fundamental step in bibliometric synthesis, as it allows to map the macro themes currently studied in the literature, thus outlining the existing fields of study and the gaps or areas that today need attention or more insights. Through the co-occurrence of keywords, it is possible to identify macro-areas made up of similar or related themes.
Specifically, this analysis was carried out on the keywords indexed by Scopus (Index keywords) to identify the main lines of study present in the literature.
This analysis also returns a temporal representation from which it is possible to identify the main trends in the literature.
Fig. 3 identifies the keywords adopted in the works and outlines the distribution in the five clusters in which it is possible to distinguish the existing literature on Fintech and risk.
The cluster in red, identified by the keywords "bank", "economy", "financial institution", "information system", "risk assessment", "risk management", "sales" and "service industry", is refers to the use of technological innovation applied to the processing of

information to monitor the financial situation of companies and therefore the credit risk. In this context, for example, Sang (2020) evaluates the credit risk in loans to SMEs using a genetic algorithm linked to artificial intelligence. Hu (2020) discusses various AI technologies for supply chain financing and risk management. Mutamimah (2020) addresses the issue of E-Corporate Governance for the reduction of the credit risk of SMEs. The cluster in green, identified by the keywords "big data", "business modeling", "electronic money", "financial risks", "fintech", "perceived risks" and "risk perception", refers to the use of large datasets of information to examine the risks deriving from the use of fintech (Wiradinata, 2018; Razzaque and Hamdan, 2020). Furthermore, this cluster also groups articles that have addressed the topic of banking business models, i.e. how Fintech is indirectly changing the business model of financial intermediaries (Wang, 2019; Syah et al., 2020).

The cluster in blue, identified by the keywords "commerce", "e-commerce", "financial markets", "forecasting", "learning systems" and "machine learning", groups the studies that develop new algorithms and machine learning systems to support e-commerce, to be able to reduce the risk of forecasting errors (Wang and Yu, 2019; Chen et al., 2020; Saifan et al., 2020; Ma et al., 2020).

The cluster in yellow, on the other hand, is identified by the keywords "decision making", "deep learning", "information management", "investments", "learning algorithms" and "neural networks"; the studies that refer to it focus on neural networks to support economic decisions. For example, Serrano (2019) addresses the topic of automation of investment and management decisions through the development of an algorithm capable of emulating the human brain.

The cluster in purple, identified by the keywords "artificial intelligence", "blockchain", "finance", "financial sectors" and "financial services", groups studies that treat blockchain technology as a mitigator of risks inherent in financial services (Deng et al., 2020).

Fig. 4 shows the most recent and used keywords from 2018 to 2019. The use of the terms, over time, can offer the trajectory of the increasingly broad perspective of analysis adopted in the existing literature, which corresponds to the different and increasing financial areas of application of new digital technologies in the financial field.

At the end of 2018, the most used keywords were "finance", "information management", "financial service" and "perceived risk". From the analysis conducted on the keywords indexed by Scopus, the research focuses on addressing the problems relating to the perception of risk deriving from the use of new technologies to support financial services (Ryu, 2018). In the first half of 2019, the most used keywords in the papers were "learning systems", "learning algorithms", "information systems", "neural networks", "financial sectors", "e-commerce", "deep learning", "investments", "electronic money", "sales", "decision making", "fintech", "financial markets", "commerce", "financial institution", "business modeling" and "economics". This period demonstrates that the attention of researchers to the topic of Fintech has increased and ranges from changes related to production processes to commercial ones, also including the theme of automation applied to the field of investments and online trading (Wang and Yu, 2019; Serrano, 2019). This trend also includes some studies that evaluate Fintech as a tool for social inclusion in favor of customers (Wang, 2019). Subsequently, in the second half of 2019, the most frequent keywords are "big data", "blockchain", "artificial intelligence", "machine learning", "banks", "service industry", "risk perception", "forecasting", "risk assessment", "risk management", "financial risks". In this period, the literature has focused on the different digital technologies underlying Fintech, such as big data and blockchain to support customer evaluation in corporate banking (Jain et al., 2019). The topic of artificial intelligence and machine learning systems to support financial activity linked to financial risk measurement models is also discussed. The studies examined how emerging technological innovations can support the measurement and control of traditional financial risks also to favor more efficient processes. Studies in the micro sector, aimed at examining the riskiness of Fintech operators in general, as well as the risks for customers approaching new high-tech financial services, are completely absent. These are research perspectives on which future studies should pay more attention to greater stability, efficiency and competitiveness of the financial sector.

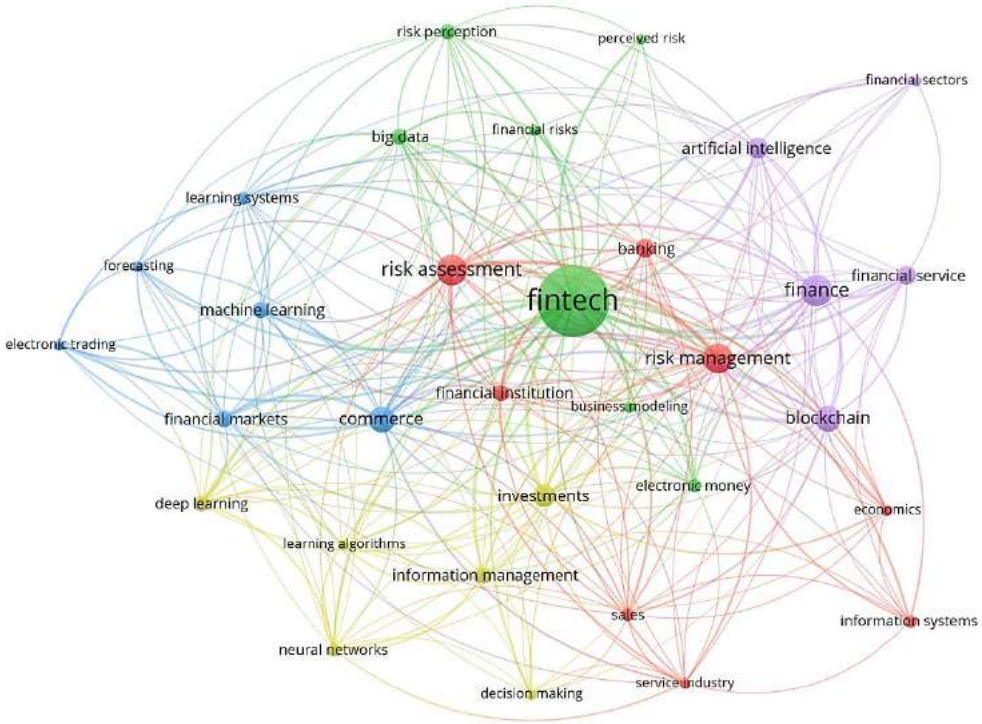

Fig. 3. The 32 most frequent Index Keyword co-occurrences. Source: authors' elaboration.

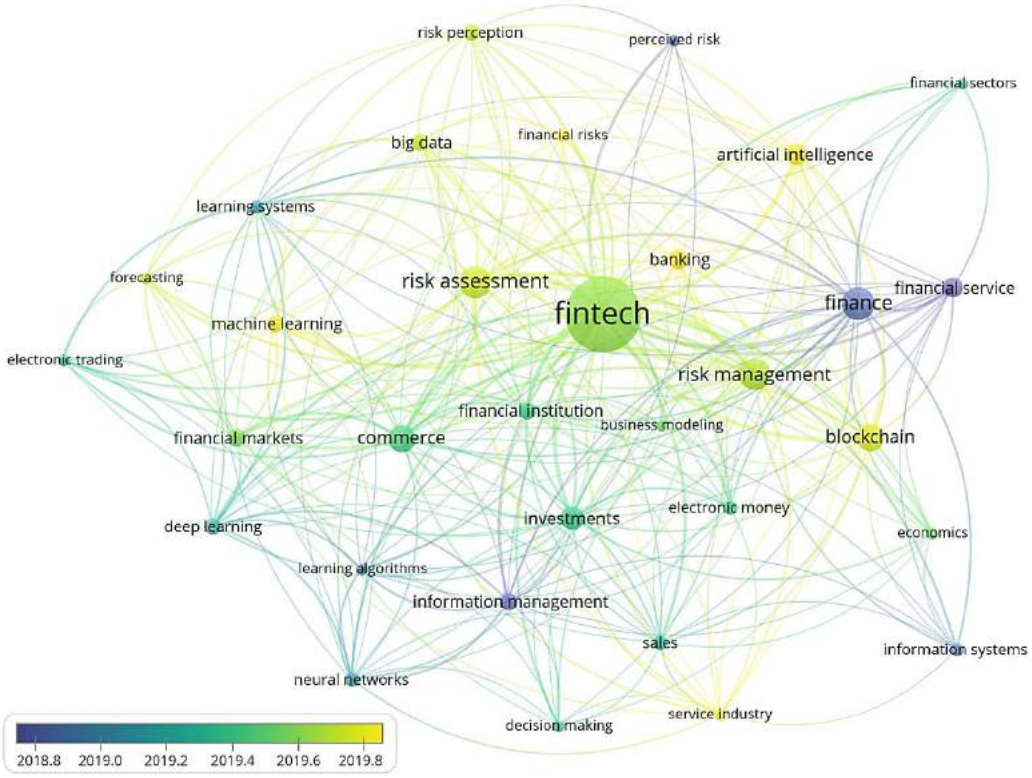

Fig. 4. Temporal trend of the 32 most frequent Index Keyword co-occurrences. Source: authors' elaboration.

4. Conclusions, Limits and Further Research

Our study analyzed the papers on the topic of Fintech and its risks available in Scopus, from 2014 to 2021, in order to illustrate the knowledge and research conducted and therefore highlight the known scientific areas, those less and not known. The sample, consisting of 274 documents, was analyzed using two bibliometric analysis software, R and VOSviewer.

Our results show a significant increase in Fintech studies starting from 2017, evidently linked to the greater diffusion of digital technology in the financial sector. Fintech and risk is a topic that particularly interests researchers in the technical and IT fields, for this reason the journals in which the studies are published refer mainly to these areas.

Logically, the researchers therefore focused on the initial stages of technological innovation in the financial sector or on how the technology is applied in practice to produce new services or products or to support activities. However, these initial studies must necessarily be followed by further studies or impact analyzes on the risks and behavior of financial intermediaries. This aspect requires the use of Fintech studies with a transversal vision, both technical and managerial, in order for research to contribute to the growth of the financial sector.

We also found that the studies on Fintech and risks are mainly signed by researchers working in China, a sign of this country's attention to technological innovation in the financial field. Furthermore, our results show a limited degree of collaboration from researchers from several countries, with the exception of Australian ones, who are likely to collaborate with researchers from other countries to learn more about Fintech.

On the contrary, a wider collaboration between researchers from different countries could broaden the perspectives of analysis and enrich knowledge on Fintech, highlighting case studies and best practices.

The use of keywords over the years also reveals a first interest on the part of researchers in the applications of financial innovations on financial processes and in specific fields. From a more general context referring to the initial years, in 2019, the studies analyzed how digital technologies, such as machine learning and artificial intelligence, can reduce investment risks; as well as blockchain and big data can reduce credit risks in loans, through better analysis of data on customer behavior.

Our work has some limits related to the time period, which in 2021 stops in February, and to the type of studies analyzed, which refer to the results of academic research published in journals. Our sample does not include studies or reports published by the Banking Supervisory Authorities. It should be noted, in fact, that the Authorities are carefully observing (and some concerns) the Fintech and the changes in the financial intermediaries' behaviour in order to facilitate the application of digital technologies in the banking sector, with particular attention to risks; an example are the Regulatory Sandboxes, used to test new Fintech tools.

Our map indirectly highlights an almost total lack of micro-economic studies related to Fintech and its risks, with reference to the strategic and organizational behavior of these financial intermediaries, as well as to the aspects of connection with incumbent banks. Furthermore, there are no studies that refer to the risks of Fintech for clients, especially in countries where the level of financial education is low.

In the future, research should pay more attention to these aspects, which favor the sound and prudent management of Fintechs and the protection of customers, two extremely important issues for banking supervision. In fact, these are future research prospects which, starting from the knowledge on the application of digital technologies already existing today, must pay more attention to the aspects of strategy, management and performance of Fintech; these aspects obviously have an impact on the stability, efficiency and competitiveness of the financial sector, therefore a better knowledge can spread Fintech and in this way support the recovery and economic growth in all countries.

References

Agathokleous, A. (2019). From FinTech to RegTech: How have European countries responded to the development of FinTech through regulation?. doi:10.13140/RG.2.2.20178.09928.

Aria, M. and Cuccurullo, C. (2017). Bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of Informetrics*. Vo. 11(4). pp. 959–975. doi:10.1016/j.joi.2017.08.007.

Bartels, J. (2020). Fintech in China: 2020 CB Insights China Fintech 50 List Released. Retrieved from https://www.biia.com/fintech-in-china-2020-cb-insights-china-fintech-50-list-released. Accessed February 2, 2021.

Basel Committee on Banking Supervision (2018). Implications of fintech developments for banks and bank supervisors. Bank for International Settlements. Retrieved from https://www.bis.org/bcbs/publ/d431.pdf. Accessed February 4, 2021.

Chen, Y., Liu, K., Xie, Y., and Hu, M. (2020). Financial Trading Strategy System Based on Machine Learning. *Mathematical Problems in Engineering*. pp. 1–13. doi:10.1155/2020/3589198.

Deng, Y., Xu, H., and Wu, J. (2020). Optimization of blockchain investment portfolio under artificial bee colony algorithm. *Journal of Computational and Applied Mathematics*, 113199. doi:10.1016/j.cam.2020.113199.

FSI (2020). Policy responses to fintech: a cross-country overview. FSI Insights on policy implementation, 23. Bank for International Settlements. Retrieved from https://www.bis.org/fsi/publ/insights23.pdf. Accessed February 4, 2021.

Hu, Z. (2020). Research on Fintech Methods Based on Artificial Intelligence. *Journal of Physics: Conference Series*. 1684. 012034. doi:10.1088/1742-6596/1684/1/012034.

Jain, N., Agrawal, T., Goyal, P., and Hassija, V. (2019). A Blockchain-Based distributed network for Secure Credit Scoring. *2019 5th International Conference on Signal Processing, Computing and Control (ISPCC)*. doi:10.1109/ispcc48220.2019.8988510.

Ma, Y., Han, R., and Wang, W. (2020). Prediction-based portfolio optimization models using deep neural networks. *IEEE Access*. doi:10.1109/access.2020.3003819.

Minto, A., Voelkerling, M., and Wulff, M. (2017). The good, the bad and the ugly: Differentiating fintech from a financial stability perspective. *Law and Economics Yearly Review*. Vo. 6. pp. 104-143.

Mutamimah, M. (2020). Financial Technology and E-Corporate Governance Model for Small Medium Enterprises. In Complex, Intelligent, and Software Intensive Systems. Advances in Intelligent Systems and Computing. Barolli, L., Hussain, F. K., and Ikeda, M. (Eds.). pp. 907-913. doi:10.1007/978-3-030-22354-0_84.

Philippon, T. (2016). The fintech opportunity (No. w22476). National Bureau of Economic Research.

Razzaque, A. and Hamdan, A. (2020). Role of Financial Technology FinTech: A Survey. In Proceedings of the International Conference on Artificial Intelligence and Computer Vision (AICV2020). Hassanien, A.-E., Azar, A. T., Gaber, T., Oliva, D., and Tolba, F. M. (Eds.). pp. 112-117. doi:10.1007/978-3-030-44289-7_11.

Romānova, I. and Kudinska, M. (2016). Banking and Fintech: A Challenge or Opportunity? *Contemporary Studies in Economic and Financial Analysis*. Vo. 98. pp. 21–35. doi:10.1108/s1569-375920160000098002.

Ryu, H.-S. (2018). What makes users willing or hesitant to use Fintech?: the moderating effect of user type. *Industrial Management & Data Systems*. Vo. 118(3). pp. 541–569. doi:10.1108/imds-07-2017-0325.

Saifan, R., Sharif, K., Abu-Ghazaleh, M., and abdel-majeed, M. (2020). Investigating Algorithmic Stock Market Trading using Ensemble Machine Learning Methods. *Informatica*. Vo. 44(3). doi:10.31449/inf.v44i3.2904.

Sang, B. (2020). Application of genetic algorithm and BP neural network in supply chain finance under information sharing. *Journal of Computational and Applied Mathematics*. doi:10.1016/j.cam.2020.113170.

Serrano, W. (2019). Genetic and deep learning clusters based on neural networks for management decision structures. *Neural Computing and Applications*. Vo. 32(8). doi:10.1007/s00521-019-04231-8.

Syah, R., Nasution, M. K. M., Nababan, E. B., and Efendi, S. (2020). Optimization Metrics Model: The Mobile Wallet for Merchant Ecosystem. *Journal of Physics: Conference Series*, 1566, 012124. doi:10.1088/1742-6596/1566/1/012124.

Vučinić, M. (2020). Fintech and Financial Stability Potential Influence of FinTech on Financial Stability, Risks and Benefits. *Journal of Central Banking Theory and Practice*. Vo. 9(2). pp. 43-66. doi:10.2478/jcbtp-2020-0013.

Wang, W. and Yu, N. (2019). A Machine Learning Framework for Algorithmic Trading with Virtual Bids in Electricity Markets. *2019 IEEE Power & Energy Society General Meeting (PESGM)*. doi:10.1109/pesgm40551.2019.8973750.

Wang, Y. (2019). Analysis of Financial Business Model towards Big Data and its Applications. *Journal of Visual Communication and Image Representation*. Vo. 71. doi:10.1016/j.jvcir.2019.102729.

Wiradinata, T. (2018). Mobile Payment Services Adoption: The Role of Perceived Technology Risk. *2018 International Conference on Orange Technologies (ICOT)*. doi:10.1109/icot.2018.8705859.