FINANCIAL INSTRUMENTS IN THE CONTEXT OF THE DIGITAL AGE AND OPEN INNOVATIONS

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Abstract:

Digital technology is a fact especially in the field of the financial industry, and in the context of this fact, by means of regulations at the European level, attempts are made to limit the risks as much as possible. The digital age has been regulated by the European Commission since 2018, with the emergence of the European Digital Strategy. However, in the financial field, innovations know a specific dynamism, and the risks are directly proportional to this dynamism, which is why two unique sets of rules were made, namely the Digital Services Act (DSA) and the Digital Market Act (DMA) to be adopted at the level of all member states.

The digital market according to existing data at the level of the European Commission knows "the size of the global market of the virtual world estimated to increase from EUR 27 billion in 2022 to over EUR 800 billion by 2030", which is why during this period a new strategy on Web 4.0 and virtual worlds on technological transition.

In this paper, we propose, starting from the purpose of these European strategies "to ensure an open, safe, reliable, fair and inclusive digital environment for EU citizens, businesses and public administrations", to inventory the existing regulations at the European level on the one hand in terms of the digital era with a direct focus on the financial field, as well as to identify innovative financial instruments with a direct impact on the development and sustainability of the national economy and in the context of open innovations.

Keywords: *financial instruments, open innovation, sustainability*

JEL classification: *G23, O360, Q5*

Introduction

Regulation (EU) 2022/2065 on a single market for digital services and amending Directive 2000/31/EC (Digital Services Regulation) and which will enter into force on 17 February 2024, will accelerate financial innovations, thus leading to a resettlement of the Fintech market at European and national level. Therefore, in addition to the elements of the conceptual type, it is necessary to know how fintech's are reflected in the specialized scientific literature and what are the financial innovations supported and promoted by the management of these fintech's.

The concept of Fintech can be found in scientific literature since the beginning of the 1900s, but the association between digital technologies and the financial industry can be said to have appeared after the 2010s, especially in the context of the definition of the transfer of financial services through technologies (Cai, 2018). The term Fintech is currently very well-known and is associated with a digital financial product (PwC, 2016). The acceleration moment is given on the one hand by the approval of the European Digitalization Strategy in 2018, as well as the approval in 2021 by the Commission of the plan towards Europe's Digital Decade. It is very evident that the acceleration of digitization has been reinforced by the outbreak of the COVID-19 pandemic.

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In accordance with the papers published by Deloitte (2020), the pandemic led to a direct contribution to the development and emergence of new financial digital technologies in various sectors of activity, including traditional ones. The year 2018 was the year in which more and more fintech's appeared, and the analysis based on the performance indicators of the Fintech company showed for the first time that the performance indicators of traditional institutions were exceeded, the pandemic making this gap even wider visible (Deloitte, 2020) [3]. According to Statistica (2021), total investment in Fintech reached USD 33.9 billion by the first quarter of 2019. Additionally, nearly 75% of global consumers had some interaction with Fintech in 2019 (Statista, 2021), while Deloitte (2020) predicts that global revenues of Fintech companies will grow by 11.7% from 2019 to 2024.

This rapid growth of the Fintech industry was the date and result of the target segment addressed by this industry, namely the segment of the unbanked target group, which the existing financial institutions, because of regulatory norms and financial prudence, do not include in the desired target group. Moreover, because of the digitization of financial services, the Fintech industry has optimized the financial costs for the services provided, making them more affordable in terms of costs. At the same time, innovation and new business models have allowed Fintech to spread throughout the industry and enter the customer segment of existing financial service providers. Therefore, Fintech is an excellent illustration of the disruptive innovation theory introduced by Clayton, M. Christensen in 1995 (Christensen & Euchner, 2015). According to this theory, disruptive innovation is a process that occurs when a small firm with limited resources enters the market by targeting customers neglected by incumbents. By doing so, the small firm adopts innovative solutions and gradually expands its customer base in existing businesses (Christensen & Euchner, 2015).

Methodology and Data

The paper presents a bibliometric analysis with the subject of Fintech research in the context of the digital era. Bibliometric analysis is a relatively new research method that has gained popularity in several academic fields, including finance. It is part of the broader discipline of science-metrics, defined as the study of the quantitative features of science and scientific research (Biancone et al., 2020).

The methodology of bibliometric analysis involves the processing of bibliometric data, such as sources of publications or documents, using quantitative techniques (Donthu et al., 2021). At the same time, following the publication of research works in the open space, it is known that the publications are in an exponential growth, and the evaluation of the content of the relevant scientific literature has become an extremely laborious process. The different visualization techniques allow us to simplify the process of reviewing the related academic literature (Borner et al., 2003). Moreover, the bibliometric analysis allows us to better visualize and understand research on a relevant topic, by systematizing the academic literature directly oriented to the analyzed topic (Aria & Cuccurullo, 2017). Consequently, the researcher can efficiently sort information through the visual map of published literature. Thus, bibliometric analysis helps in finding and classifying relevant information (Borner et al., 2003).

To visually process the identified data, globally there are newly developed and specialized software that allows the comfort and efficient execution of the bibliometric analysis. For example, we used the bibliometrics open-source R Package, which allows data analysis and provides data visualization through different types of mapping (Aria & Cuccurullo, 2017).

VOSviewer is another software program that was used in this work, and which helps to visualize the results of the bibliometric analysis. This software works with different data sources and generates images that reflect data with various characteristics. The software organizes the data into clusters, represented by nodes and connected lines (Janik et al., 2020). The

clustering technique of VOSviewer is based on the local smart motion algorithm introduced by Waltman and Van Eck (Janik et al., 2020).

To perform the bibliometric analysis, the Scopus database was chosen, due to its academic reputation, as well as due to the multidisciplinary database of abstracts and citations. Scopus, part of the larger analytics and information company Elsevier, provides easy access to peer-reviewed academic publications, including books, journals, and conferences.

Metadata used in this paper can be defined as summarized basic information about the data (Open Data Soft, 2016). Publishers provide metadata, which includes author(s), affiliation(s), document title, year, electronic identifier (EID), source title, volume/number/pages, number of citations, source, document type, and identifier digital object identifier (DOI), among others. According to the Elsevier website, the Scopus content repository stores 3.7 TB of data, corresponding to 1.4 billion cited references. Considering the aforementioned information, Biancone et al. (2020) state that the Scopus database provides a high-quality and reliable basis for bibliometric analysis. The bibliometric analysis in the paper represents a snapshot of research data about Fintech in the context of the digital age. To collect applicable data, keywords were entered into the Scopus database, such as: "Fintech" or "FinTech" or "Financial Technologies" AND "Disrupt*" or "Transform*".

To answer the research question, the paper uses three types of bibliometric analysis techniques: performance analysis; scientific mapping and network analysis (Donthu, 2021).

Performance analysis defines the contribution of research factors (authors, journals, countries) to the subject of Fintech in the context of the digital age, based on the number of relevant publications and citations (Donthu, 2021). This technique defines the most cited or productive journals, authors, and papers. Citation and publication count help define the significance of the research topic, researchers, and journal (Shibata et al., 2008).

Applying the technique of scientific mapping, the paper demonstrates the relationship between different research factors on the given topic. This technique defines the relationship between publications, underlying themes, and relationships between topics, using citation and co-citation analysis and co-word and co-author analysis; among others (Donthu, 2021). And the third bibliometric analysis is network analysis, it allows visualization of different results through clustering and network metrics.

Results

The data collected are presented in table 1. and show us that most documents identified on the topic of Fintech in the context of the digital age, are articles (46% of all documents) and conference papers (33%). Books constitute only 2% of the total documents, which could lead us to the hypothesis related to the relative novelty of the subject.

Table 1.

Main data information, time frame 1984–2021

Description	Results
Document types	
Article	166
Book	9
Book chapter	39
Conference paper	120
Conference review	4
Editorial	6
Review	19
Document contents	
Keywords plus (ID)	1207
Author's keywords (DE)	1029
Authors	
Authors	896
Author appearances	970
Authors of single-authored documents	83
Authors of multi-authored documents	813
Authors collaboration	
Single-authored documents	91
Documents per author	0.405
Authors per document	2.47
Co-authors per document	2.67
Collaboration index	2.99

Source: Scopus, developed in Biblioshiny/ Aysan, A.F.; Nanaeva, Z. Fintech as a Financial Disruptor: A Bibliometric Analysis. FinTech 2022, 1.

Starting from 1984 until 2016, the number of publications was insignificant, after which their volume began to increase and reached its peak in 2020 (Figure 1). Moreover, the annual growth in the number of publications accelerated after 2016 and almost doubled in 2020 year-on-year, as can also be seen in the figure below.

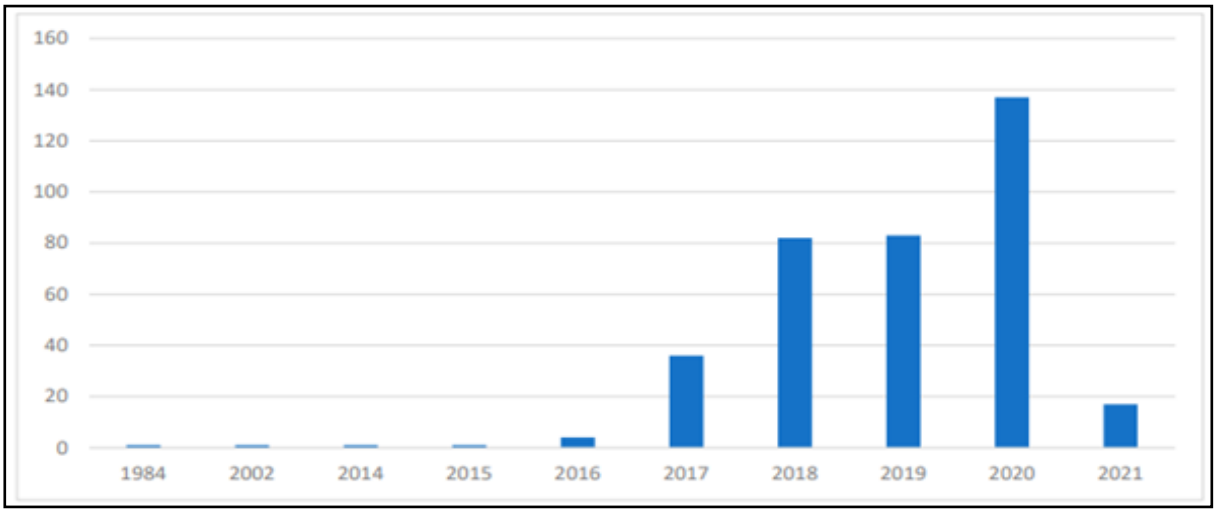

Figure 1. Presentation of annual scientific production between 1984 and 2021

Source: Scopus/ Aysan, A.F.; Nanaeva, Z. Fintech as a Financial Disruptor: A Bibliometric Analysis. FinTech 2022, 1.

The subject of Fintech is very varied, multidisciplinary and includes various thematic areas. Many publications (22%) are in the field of computing science, followed by the field of business, management and accounting (19%), and by a small margin the field of economics, econometrics and finance (13%). This distribution confirms PwC's definition of Fintech as a

combination of technology and financial services, where it is difficult to tell where technology ends, and financial services begin (PwC,2016).

Subject Area	# of Results	%
Computer Science	165	0.22
Business, Management and Accounting	144	0.19
Economics, Econometrics and Finance	98	0.13
Social Sciences	80	0.11
Engineering	77	0.10
Decision Sciences	51	0.07
Mathematics	31	0.04
Environmental Science	27	0.04
Energy	24	0.03
Biochemistry, Genetics and Molecular Biology	6	0.01
Earth and Planetary Sciences	6	0.01
Pharmacology, Toxicology and Pharmaceutics	5	0.01
Physics and Astronomy	5	0.01
Materials Science	4	0.01
Multidisciplinary	4	0.01
Psychology	4	0.01
Others	12	0.02

Figure 2. Presentation of the thematic areas of the publications between 1984 and until 2021

Source: Scopus/ Aysan, A.F.; Nanaeva, Z. Fintech as a Financial Disruptor: A Bibliometric Analysis. FinTech 2022, 1.

Figure 3 shows the twenty most cited sources of publications on Fintech, with dark blue defining the higher number of citations, and with the light shade the lower number of citations. The three most cited sources are the Journal of Management Information Systems, the Management Information Systems Quarterly (MIS Quarterly), and the Harvard Business Review, each with over 60 citations in this analysis.

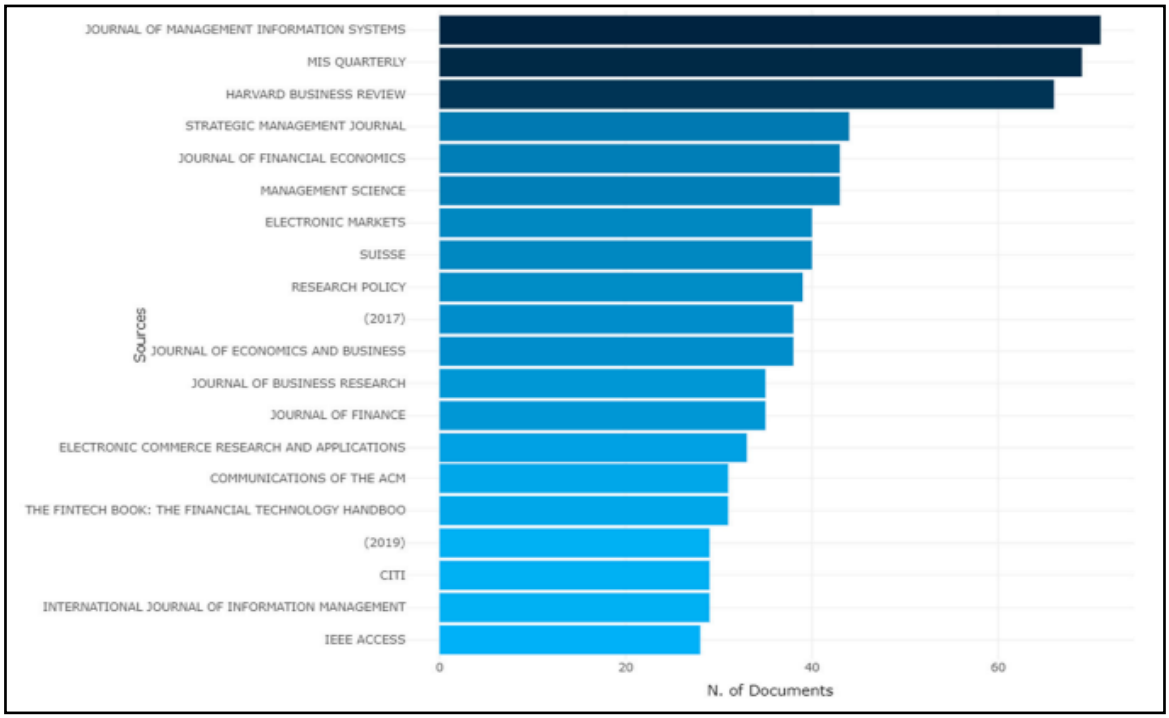

Figure 3. Presentation of the most cited publication sources

Source: Scopus, developed in Biblioshiny/ Aysan, A.F.; Nanaeva, Z. Fintech as a Financial Disruptor: A Bibliometric Analysis. FinTech 2022, 1.

Figure 4. presents the twenty most relevant sources of publications with the largest number of documents about FinTech. For example, the most cited source, the Journal of Management Information Systems, published only two papers on the given topic. However, it has been cited in 71 papers. On the other hand, the ACM International Conference Proceeding series published 11 articles on the chosen topic but was cited in only one paper.

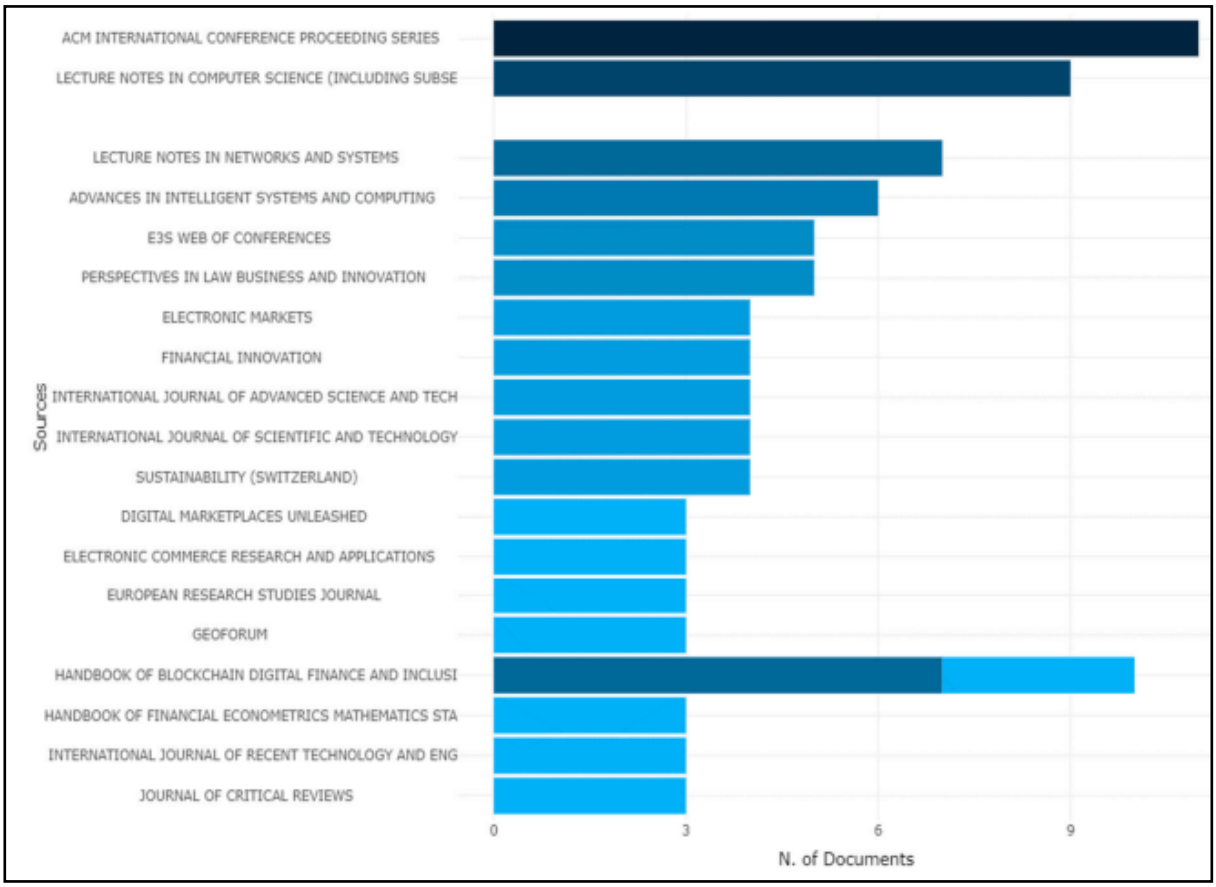

Figure 4. Presentation of the most relevant sources of publications

Source: Scopus, developed in Biblioshiny/ Aysan, A.F.; Nanaeva, Z. Fintech as a Financial Disruptor: A Bibliometric Analysis. FinTech 2022, 1.

Figure 5 shows the list of the most cited documents about Fintech. The most cited article was by Lee and Shin, "Fintech: Ecosystem, business models, investment decisions and challenges" (Lee & Shin, 2018). The article was published in 2018 in the journal Business Horizons and generated 128 citations. The article discusses different Fintech business models as well as the challenges facing Fintech startups and existing financial institutions. The second most cited article (with 126 citations) was “on the Fintech Revolution: Interpreting the Forces of Innovation, Disruption, and Transformation in Financial Services” by Gomber, Kauffman, Parker, and Weber (2018).

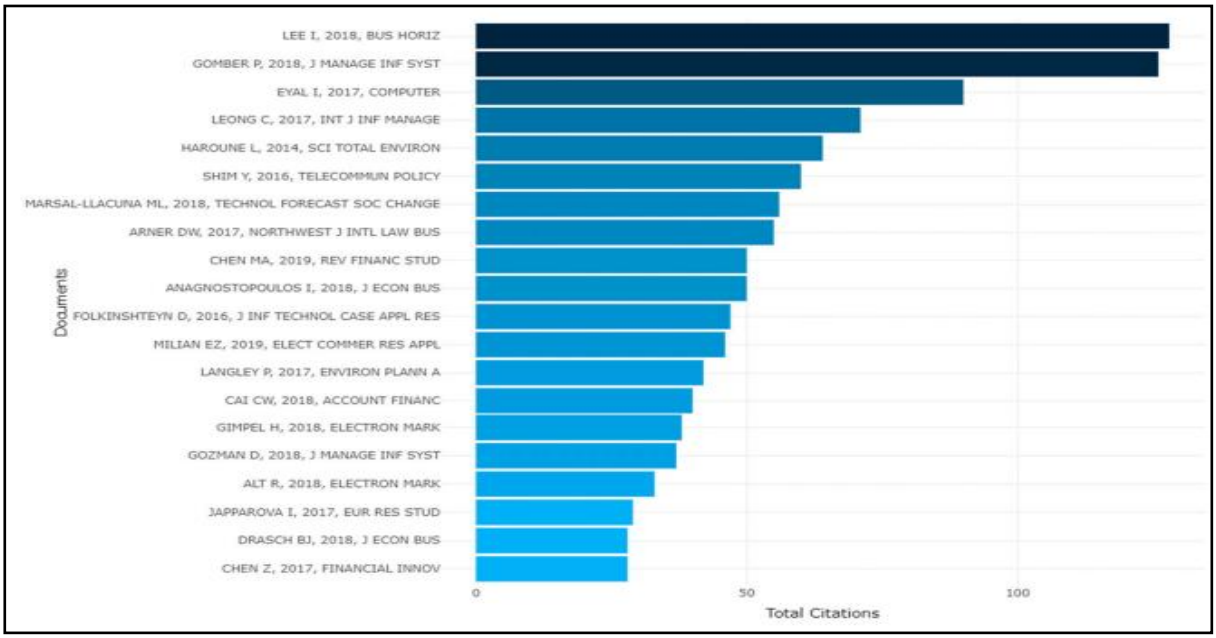

Figure 5. Presentation of the most cited scientific papers in the FinTech field

Source: Scopus, developed in Biblioshiny/ Aysan, A.F.; Nanaeva, Z. Fintech as a Financial Disruptor: A Bibliometric Analysis. FinTech 2022, 1.

Through the VOSveiwer program, the map of the citations of scientific works in the FinTech field is presented (Figure 6) and groups the 73 most cited published scientific works into 17 groups. The size of the bubble shows the number of citations. As mentioned earlier, the most cited papers by Lee and Shin (128 citations) and Gomber et al. (126 citations) were published in 2018, which allowed enough time to produce a large number of citations. The oldest of the most cited papers was “How Information Asymmetry Affects P2P Lending: Big Data Economics” by Yan, J. et al., which was published in 2015, generating 28 citations (Yan et al., 2015). The most recent of the most cited papers was "Blockchain disruption and decentralized finance: The rise of decentralized business model" by Chen and Bellavitis, which was published in 2020 in the Journal of Business Venturing Insights and has already accumulated 23 citations.

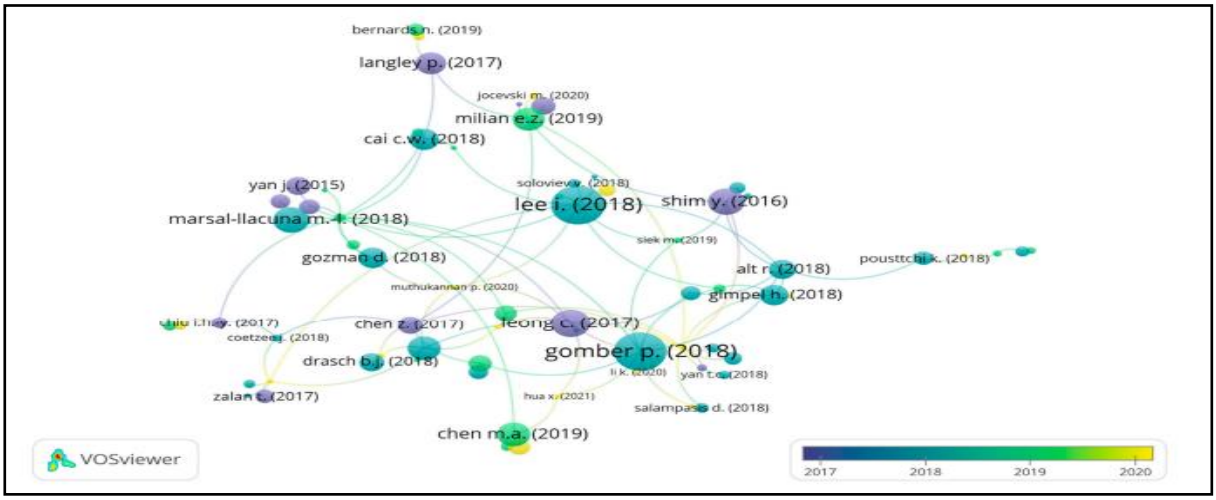

Figure 6. Presentation of citations of scientific papers in the FinTech field

Source: Scopus, developed in Biblioshiny/ Aysan, A.F.; Nanaeva, Z. Fintech as a Financial Disruptor: A Bibliometric Analysis. FinTech 2022, 1.

The presentation of the VOSviewer map with the appearance of the most frequently used keywords by the authors is presented in Figure 8, within which the 50 most popular keywords used by the authors are grouped. The words "fintech", "blockchain" and "digital transformation" are indicated as the most popular.

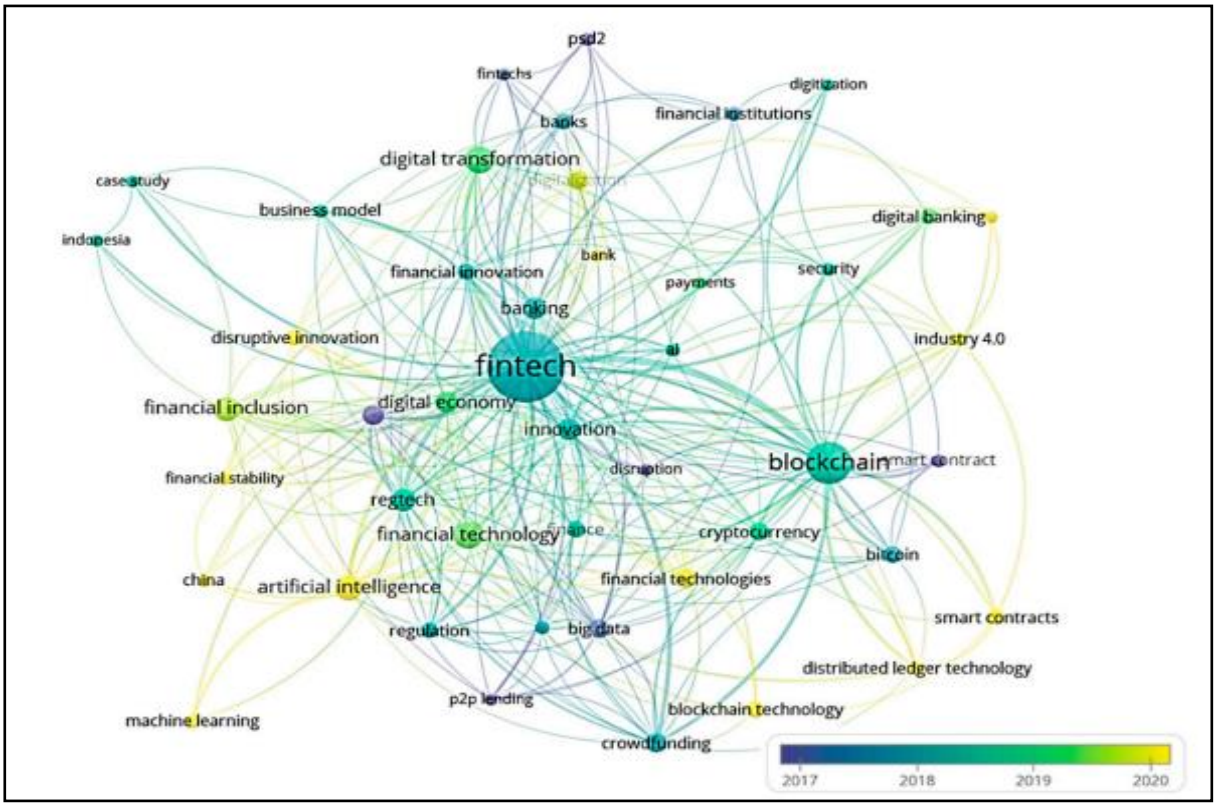

Figure 8. Presentation of the weighted occurrences of the words used by the authors of scientific works

Source: Scopus, developed in VOSviewer/ Aysan, A.F.; Nanaeva, Z. Fintech as a Financial Disruptor: A Bibliometric Analysis. FinTech 2022, 1.

In the context of multiple crises and scientific progress generated especially by artificial intelligence, we can say that in terms of financial innovations we are in an extremely fertile moment that generates financial innovations at every moment, depending on the two determining directions.

- The first direction is given by the existence of multi-crisis.

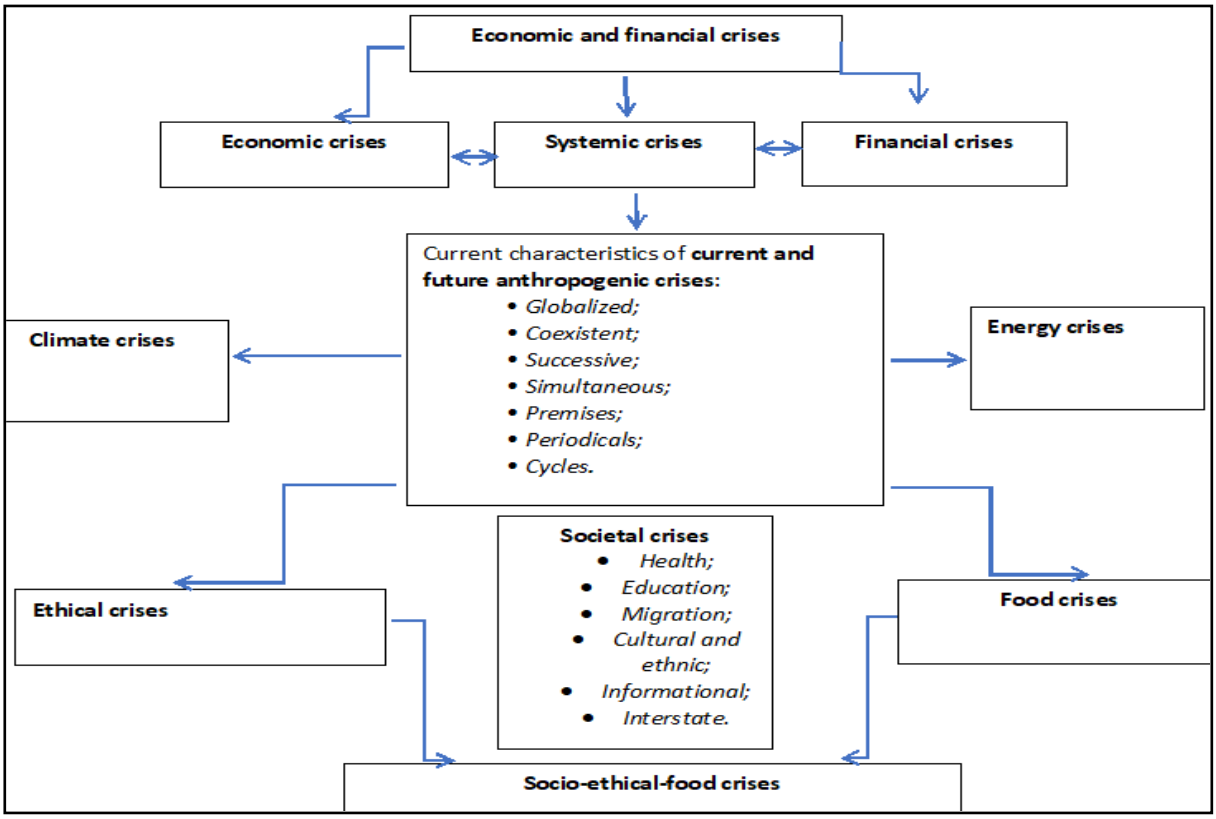

Figure 9. Presentation of multi-crises with direct impact on global financial innovations

Source: own contributions

❖ The second direction is given by the *implications of artificial intelligence in the dynamics of financial innovations.* One of the supporters of this direction is US-based research, innovation, and development group Accenture, with over 15 years of leadership in metaverse technology and experience capabilities and over 600 patents, bringing together over 800 of our skilled metaverse professionals and capabilities market leaders worldwide.

In developing innovative Metaverse Fintech applications, Accenture starts from:

❑ *Extended reality* **-** analysis and support of companies starting from the realities of the market in the current conditions (respectively of the digital and green eras, and of the multi-crises);

❑ *Digital identity* - it's a reality we're all part of. The optimization of processes, of resources, determines us to be more and more present in the digital world, to manage access to systems and data at an internal institutional level, but also at a global level, by means of security protocols.

❑ *Blockchain* **-** through technology access to complex networks, with the possibility of building supply and sales chains as complex as possible and directly oriented towards the optimization of economic and financial indicators, respectively their profitability.

❑ *Experience in customer service* **-** constantly re-adapting according to the constantly changing needs of customers, especially in the field of financial innovations such as FinTech's.

❑ *Technological innovation* **–** in the finance industry, designers of systems, products, and services, offer the right and oriented solutions to create competitive advantages and with a long-term strategic projection.

❑ *The transformation of technology* **-** causes company owners (especially financial ones) to turn

directly to the transforming technology, respectively to adapt their businesses to these extremely fast changes, the metaverse in fintech being one of the revolutionary changes of the innovative financial market**.**

In the context of the second direction regarding financial innovations, we could redefine one of the most famous formulas of the marketing mix, namely the one proposed by the father of marketing Philip Kotler, respectively the 4Ps of the marketing mix, we can redefine them in the context artificial intelligence for a FinTech. For example, regarding the product/service in the context of AI: it is defined at the level of a Fintech as a multidisciplinary set of services and products at the level of an AI application that serves the multiple needs of the consumer, banking financial services (including payments), health, management personal finance, etc.

Table 2.

The marketing mix- Fintech - proposal

The marketing mix - the formula of the 4Ps of marketing Philip Kotler	**The marketing mix - Fintech - proposal by author Otilia Manta**
***The product/service* offered to the consumer**	*AI Fintech application* - multidisciplinary services and products offered to the consumer through the application from different fields of activity (ex: finance, health, management, education, trade, etc.)
***Price* - the value of the product or service received**	*App cost* – transaction fee/monthly cost as a subscription
***Promotion* - classic channels**	*Promotion*- digital platforms, including metaverse applications, with optimized costs.
***Distribution* - the traditional value chain, with a clearly defined and limited time interval.**	*Distribution* - Global distribution in real time and with multiplier effect.

Source: own contributions

An example of digital financial innovation is Siam Commercial Bank (SCB), which reinvented itself at the level of technological infrastructure by using innovative elements (data migration to the cloud) and succeeding in becoming a digital bank. This strategic decision has enabled the bank to grow its digital app user base to over 13 million users in 2022, up from 2.5 million before the transformation program. Currently SCB has included in its reinvention strategy "fintech business group" - a technology company that offers customer-centric services, including banking services. Restructured into a new entity, SCBx, the firm plans to expand its reach to 200 million people. The company is investing in new technologies, including blockchain, metaverse and Web 3.0.

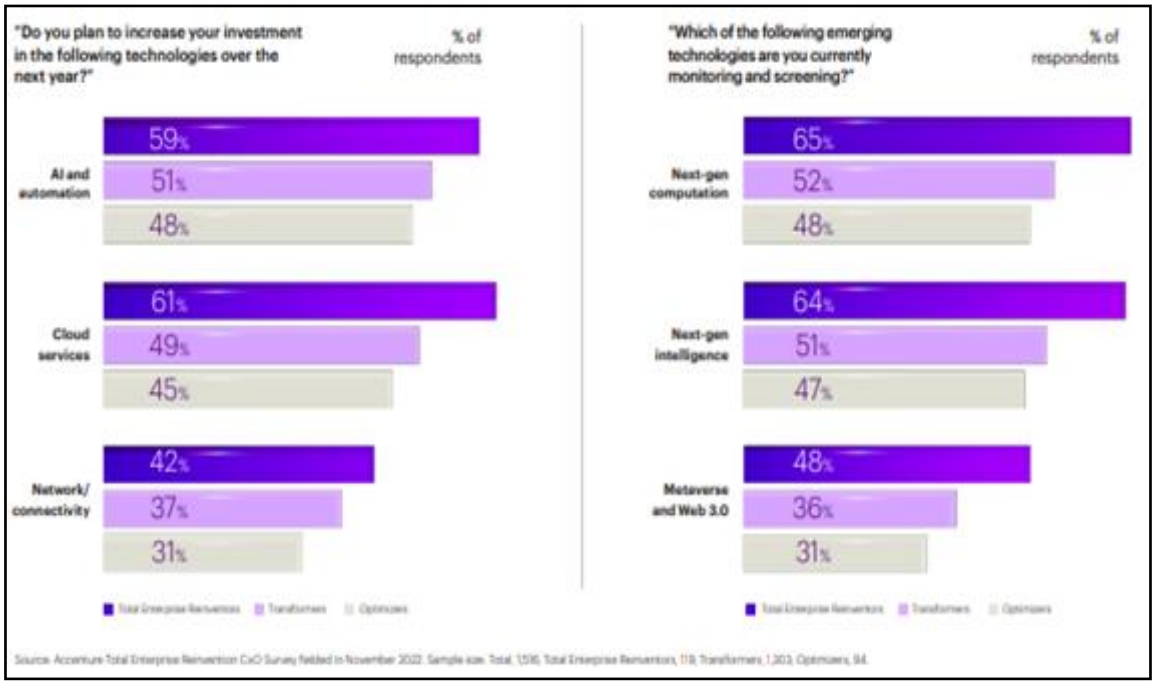

Figure 10. Reinventors continuously invest in their digital core

Source: Accenture Data, 2022

Conclusions and Future Directions

Bibliometric analysis on the subject of Fintech carried out in this paper, based on 363 documents identified in the Scopus database and published between 1984 and 2021, highlights the fact that the subject of Fintech is relatively new, but with a strong potential for further development.

Furthermore, according to the data presented, we can say that the growing number of publications in recent years, especially since 2020, demonstrates the growth in popularity of the Fintech topic. This popularity can be explained on the one hand by the transition to the digital age (see the European Strategy on Digitization), and on the other hand by the accelerated development of innovative solutions in the Fintech field, also accelerated by COVID-19. Publications in prestigious journals such as the Journal of Management Information Systems and the Harvard Business Review indicate strong academic interest. Analysis of the most frequently used words reveals that "Fintech", "blockchain" and "digital transformation" are the most popular keywords. The relative popularity of the keyword "blockchain" could be explained by the association of authors who study the financial disruption and advancement of blockchain technology. In addition, through the biblioshiny program, the term "digital transformation" was mapped among the primary themes that require further research. Similarly, a shift in trending topics such as "digital transformation" and "innovation" as seen in VOSviewer indicates relatively recent academic interest in the topic. Moreover, the bibliometric analysis revealed that Lee Kuo Chuen, Arner, D. and Buckley, R. are the authors with the highest impact as measured by the h-index. The fact that the most productive authors are affiliated with relatively unknown universities can be explained by the fact that "most productive" does not necessarily mean "most cited", as the analysis shows that a higher number of publications does not guarantee more citations.

A limitation of this study is that the analysis was based on a relatively limited number of publications, which is a potential shortcoming that can be attributed to the developing stage of

the subject. This limitation may affect the results of the bibliometric analysis compared to the potential results if it had been performed on a larger sample size. It is also possible that there were publications in languages other than English that were not considered. The progress of Fintech and its increasing impact on the financial system are expected to generate further academic interest and publications on the subject. Therefore, similar analyses can be performed at a later date, which could include a larger number of observations with which to compare the validity of the results presented in this paper, as well as the presentation of new trends and trends. The results of the analysis described in this paper represent an overview of the topic of Fintech as a financial disruptor. With this paper, the authors' goal and hope is to generate further interest and catalyze further research on this topic. The social and economic impacts of financial disruption caused by Fintech are particularly promising areas for future study.

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