A Methodology for Systematic Bibliometric Literature Reviews:
General Approach and Application to Digital Finance and FinTech Literature

Jascha-Alexander Koch, University of Siegen, Siegen, Germany,
jaskoch@wiwi.uni-frankfurt.de, ORCID: 0000-0003-0015-8855

Martí Sagarra, University of Barcelona, Barcelona, Spain,
martisagarra@ub.edu, ORCID: 0000-0003-2938-7395

Keivan Amirbagheri, Escola Universitària Salesiana de Sarrià, Barcelona, Spain,
kamirbagheri@euss.cat, ORCID: 0000-0001-7708-583X

Peter Gomber, Goethe University Frankfurt, Frankfurt am Main, Germany,
gomber@wiwi.uni-frankfurt.de, ORCID: 0000-0001-9789-3041

Abstract

Due to the availability and easy usability of bibliometric computer tools, the number of bibliometric literature reviews has soared – especially in active and dynamic research fields like Digital Finance and FinTech. This leads to the paradox situation of a high number of bibliometric literature reviews with diverging quantitative results – which ultimately results in confusion instead of conformity and clarity. To counter this trend and in order make results comprehensible and reproducible, we propose a methodology for systematic bibliometric literature reviews to trigger a discussion in the academic community of how to conduct bibliometric literature reviews systematically. We apply this methodology to the literature on Digital Finance and FinTech, present our findings, and discuss existing research gaps. Thereby, we contribute both to the analysis of the evolution of Digital Finance and FinTech literature and to the methodological foundation of systematic bibliometric literature reviews.

Introduction

Bibliometric analysis is regularly used as a tool in many fields of research. The bibliometric analysis quantitatively reviews the available academic literature to provide a comprehensive overview of the state-of-the-art in a specific field and to help researchers to design their research agenda. This is of special importance for dynamically growing academic fields, like the field of Digital Finance and FinTech.

Due to the availability of easy-to-use computer tools that take make quantitative analyses less cumbersome, the number of bibliometric analyses has soared in the last years. According to Web of Science, the number of papers dealing with bibliometric analyses has risen from 86 in the year 2000 to 518 in the year 2010 and to 5,368 in the year 2022. In only two years – from 2020 (3,113) to 2022 – the numbers have almost doubled.

Systematic and unsystematic literature reviews put their focus on the presentation of academic papers' contents, and summarize and condense the results to provide an overview of the academic status quo. In the case of systematic and unsystematic literature reviews, several existing literature reviews can be combined to create a bigger picture on the topic. Bibliometric literature reviews, however, rely on quantitative figures to describe a selected set of literature. As a consequence, the distinctly different approaches of these bibliometric literature reviews, especially regarding the identification of the applied search keywords, lead to a variety of different results that are likely to contradict instead of complementing each other (see Table 1). If metrics are based on different sets of literature, quantitative results are likely to deviate. Such unsystematic bibliometric reviews reveal different results for the same questions even if they address almost the same time ranges: compare, e.g., the number of publications per year in Table 3 of Ahmi et al. (2020) with Figure 2 of Abad-Segura et al. (2020), the knowledge maps in Figure 4 of Ahmi et al. (2020) with Figure 4 of Abad-Segura et al. (2020) and with Figure 7 of Li and Xu (2021). Therefore, the rising number of bibliometric literature reviews contribute to diverging results and, ultimately, to confusion instead of conformity and clarity.

Despite this shortcoming, research regarding the question of "[h]ow to conduct a bibliometric analysis" is utterly scarce. To the best of our knowledge, only Donthu et al. (2021) provides guidelines for bibliometric analyses and suggest a basic procedure. However, we find no paper dealing with the question of how to systematically select the literature to be analyzed. Moreover, information is missing on how to systematically select the search keywords and of how to systematically develop the search string. Therefore, in order to make results of bibliometric literature reviews more comprehensible and reproducible, we propose a new methodology for conducting systematic bibliometric literature reviews to trigger a discussion in the academic community of how to build bibliometric literature reviews.

We apply our approach to the research field of Digital Finance and FinTech to evaluate our methodological approach and to paint a systematic and more detailed picture on the evolution of research in this field.

The remainder is organized as follows. In the next section, we describe the research background. To motivate our methodological approach, we characterize bibliometric literature reviews and discuss the inconsistencies among the available bibliometric literature reviews in the field of Digital Finance and FinTech to motivate our approach. In section 3, we present our proposal for a methodology of a systematic bibliometric literature review. Next, we apply this methodology to the literature on Digital Finance and FinTech, present our results, and discuss the findings. Finally, we summarize and conclude.

With our paper, we contribute both to the methodological discussion on bibliometric literature reviews and to the analysis of the evolution of Digital Finance and FinTech literature that serves as a show-case for our methodological proposal.

Research Background

Bibliometric Analysis

According to Pritchard (1969), the bibliometric analysis first appeared in the work of Hulme (1923) as "statistical bibliography". There are different definitions of bibliometric analysis that came up during the years from various scholars (Bar-Ilan 2008; Broadus 1987; Hood and Wilson 2001; Mutschke et al. 2011). All these definitions refer to bibliometric analysis as a literature review that quantitatively analyses a certain academic subject. As one of the very first comprehensive definitions, Raisig (1962, p. 450) defines "bibliographic analysis" as: "The assembling and interpretation of statistics relating to books and periodicals […] to demonstrate historical movements, to determine the national or universal research use of books and journals, and to ascertain in many local situations the general use of books and journals."

While "scientometrics" and scientometric analyses consider the "quantitative study of science and technology" in general (van Raan, Anthony F. J. 1998, p. 5), bibliometrics concentrate on "the processes of written communication and of the nature and course of development of a discipline (in so far as this is displayed through written communication)" (Pritchard 1969, p. 348). Bibliometrics, thus, concentrate on publications, such as "books and journals" (Raisig 1962, p. 450).

During the last couple of decades, bibliometric analyses have experienced a considerable enhancement as comprehensive databases and sophisticated bibliometric tools were used to provide analyses that were not feasible before. Bibliometric analysis, thus, became a powerful method that can be used in a wide range of research subjects. This method is both used for analyzing a specific topic and for analyzing the performance of different journals over time.

Examples for bibliographic analyses are Merigó and Yang (2017), who reviewed the publications of accounting research, Merigó and Núñez (2016), who concentrated on the influential journals in health research, and Geissdoerfer et al. (2017), who used bibliometric analysis to investigate the state of the art in the field and synthesized the similarities, differences, and relationships between the circular economy and sustainability. Fahimnia et al. (2015) conducted a comprehensive bibliometric study on the concept of green supply chain management. In the finance domain, Pan et al. (2020) reviewed the financial industry against the background of the digitalization. Finally, Choijil et al. (2022) applied a bibliometric analysis to review the herd behavior in financial markets. A presentation of (un-)systematic literature reviews and bibliometric literature reviews on Digital Finance an FinTech is provided in the following subsection.

Regarding the performance of journals, e.g., Merigó et al. (2016) conducted a bibliometric analysis to review the first thirty years of the International Journal of Intelligent Systems. In another work, Cobo et al. (2015) reviewed 25 years of the journal Knowledge-Based Systems. Finally, Kazemi et al. (2019) applied bibliometric methodology for analyzing the reverse logistics and closed loop supply chain management studies published in the International Journal of Production Research.

Bibliometric literature reviews are especially helpful to analyze an academic field that has already reached an advanced status and reveals a considerable number of publications. While classic literature reviews are well capable to analyze the content of a manageable number of publications, they have limited power to deal with greater numbers of publications. As a consequence, "numbers of included articles in bibliometric analyses are usually much higher than those of systematic [literature] reviews" (Hiebl 2021, p. 9). Donthu et al. (2021) compare the differences between the commonly used review methods: systematic literature review, meta-analysis, and bibliometric analysis. They state that systematic literature reviews are appropriate for a small scope of studies and work well with qualitative analysis techniques. The other two methods, meta-analysis and bibliometric analysis, are appropriate for quantitative techniques. The meta-analysis is especially suitable when the empirical relationship between variables is of interest. Bibliometric analyses are especially designed to review very broad

scopes and to summarize large amount of bibliometric data. Therefore, in this study, we apply bibliometric analysis.

For systematic literature reviews, the difficulty is to form a set of papers that is "systematic" but also of a size that can be handled concerning a content analysis. For this selection process, academic literature provides advice on how to form such a systematic set of publications (e.g., Hiebl 2021; Ngai et al. 2011). For systematic bibliometric literature reviews, however, the aim is not to identify a set of publications of a reduced and manageable size but to systematically form a set of as many relevant publications as possible in order to end up with an analysis that is of utmost completeness. Gutiérrez-Nieto and Serrano-Cinca (2019, p. 185) argue that "[w]hen selecting keywords organized in query structures does not provide reliable results, the most common solution is following a backward procedure, which means performing an iterative review of the references of an initial set of papers". However, to the best of our knowledge, there is no established procedure that describes how to conduct a comprehensive systematic set of publications for a bibliometric literature review. To close this gap, we first highlight the inconsistencies and problems with existing bibliometric literature reviews using the example of the Digital Finance and FinTech reviews in the next section. Then, in the methodology section, we propose a methodology for systematic bibliometric literature reviews.

(Un-)Systematic Literature Reviews and Bibliometric Literature Reviews on Digital Finance and FinTech

In the last years, several systematic and unsystematic literature reviews were published that analyze the research regarding Digital Finance and FinTech (e.g., Caciatori (jun.) and Cherobim 2020; Gai et al. 2018; Gomber et al. 2017; Hassan Sarhan 2020; Sangwan et al. 2019; Takeda and Ito 2021). These reviews focus on the presentation of content of the reviewed literature and provide a qualitative overview over the academic field. While unsystematic literature reviews on Digital Finance and FinTech do not rely on strict standards (e.g., Sangwan et al. 2019; Takeda and Ito 2021), systematic literature reviews (see Ngai et al. 2011) follow clear and precise steps when selecting and reviewing the papers (e.g., Gomber et al. 2017).

The advantages of systematic literature reviews lie in the clear and precise procedures that make such reviews more comprehensive and replicable. However, in times of soaring publication numbers, it is impossible to analyze all available literature of a certain domain manually. Moreover, the qualitative style of such reviews focuses on analyzing and presenting the publications' contents – but such reviews do not allow for comprehensively observing the development and emergence of literature over time.

The strength of a bibliometric literature review lies in its ability to cover high numbers of publications. Therefore, bibliometric literature reviews focus on quantitative approaches for analyzing the relevant academic literature. In the last years, several authors have published bibliometric literature reviews on Digital Finance and FinTech. Some of these bibliometric papers focus on a closed subsets in the Digital Finance and FinTech domain, for example, on blockchains and cryptocurrencies (e.g., Ante 2021; Guo and Donev 2020; Merediz-Solà and Bariviera 2019; Miau and Yang 2018; Secinaro et al. 2021), on lending and crowdfunding (e.g., Basha et al. 2021; Martínez-Climent et al. 2018), or on InsurTech (e.g., Milanovic et al. 2021). Other bibliometric literature reviews embrace the whole domain of Digital Finance and FinTech (Abad-Segura et al. 2020; Ahmi et al. 2020; Caciatori (jun.) and Cherobim 2020; Chen and Peng 2020; Iman 2020; Li and Xu 2021; Liu et al. 2020; Milian et al. 2019; Molina-Collado et al. 2021; Pan et al. 2020; Suryono et al. 2020; Wu 2017; Xu et al. 2020; Zhang et al. 2019).

One outstanding difficulty of bibliometric literature reviews that try to cover a whole domain is the definition of a systematic set of search keywords for the selection of publications under consideration. A comparison between the different existing bibliometric literature reviews on Digital Finance and FinTech reveals striking differences between the chosen methodologies for keyword selection. Some bibliometric literature reviews choose only high-level search keywords like "fintech", "fin-tech", and "financial technology" (e.g., Ahmi et al. 2020; Iman 2020; Li and Xu 2021). However, this has the disadvantage that all papers are ignored that cover topics from the domain of Digital Finance and FinTech (e.g., Bitcoin or crowdfunding) that do not explicitly use these high-level terms (e.g., fintech, financial technology) explicitly. There is no scientifically sound reason why all relevant papers on, e.g.,

Bitcoin or crowdfunding, should also use a high-level expression, such as "fintech", at least once throughout the paper. As a consequence, other reviews try to tackle this obvious shortcoming by including more specific keywords to cover the relevant topics that exist under the wide umbrella of Digital Finance and FinTech (e.g., Liu et al. 2020; Milian et al. 2019) which is a demanding task because it is difficult to argue or proof when the right number of specific keywords is reached.

Sometimes authors start enthusiastically and define search parameters to embrace as many publications as possible – but then process the search findings in a way that sorts out many of the initially found papers. For example, Caciatori (jun.) and Cherobim (2020) claim to consider six academic literature databases and to conduct a review based on an origin of 1,749 papers. However, after several steps of cleaning, they just keep 43 papers for their review.

As a consequence, we find a lot of bibliometric literature reviews that all follow different ways of selecting the respective literature and end up with completely different (quantitative) results. In Table 1, we present bibliometric literature reviews on Digital Finance and FinTech. In this table, we characterize the search parameters and the number of selected publications for the analysis in the respective paper. From this table, we observe two main points. First, the approaches are considerably different regarding search keyword selection and, therefore, the number of selected papers. Second, against the backdrop of a very dynamic field with rapidly rising numbers of publications, the bibliometric literature reviews shown in Table 1 mostly reveal relatively low numbers and, in total, a very high variance of publications included in the respective bibliometric analyses (ranging between 43 and 2,877 publications).

bibliometric literature review	period	keywords / search	search in	selected papers	data base(s)
Abad-Segura et al. 2020	1975 - 2019	"finance" AND "technology" AND "management"	title, abstract, keywords	2012	Scopus
Ahmi et al. 2020	until April 2020	"fintech" OR "fintechs" OR "fin-tech" OR "fin-techs" OR "financial technology" OR "financial technologies" OR "finance technology" OR "finance technologies"	title of the article	486	Scopus
Brika (2022)	2006 - 2020	"Digital Finance" OR "e-Finance" OR "FinTech" OR "Fintech"	title, abstract, keywords	343	ScienceDirect
Caciatori (jun.) and Cherobim 2020	2014 - 2018	"FinTech" OR "FinTechs" OR "Fintec*" ("financial Technologies" or equivalent was not adopted because of the scope of the concept, which does not necessarily cover only the articles associated with FinTechs)	[not specified]	43	Emerald, ProQuest, Science Direct, Scopus, Web of Science, Google Scholar
Chen and Peng 2020;	2005 - 2018	"financial innovation" AND "bank"	[not specified]	98	Web of Science
Iman 2020;	[not specified]	"fintech" OR "financial technology"	title, abstract, keywords	61	Web of Science
Li et al. (2020)	2008 - 2018	("Internet Bank" OR "Online Bank" OR "Electronic Bank" OR "E-Bank" OR "Internet-Based Bank") OR	title, abstract, keywords	2,877	Web of Science

		("Internet Banking" OR "Online Banking" OR "Electronic Banking" OR "E-Banking" OR "Internet-Based Banking") OR ("Internet Financ*" OR "Online Financ*" OR "Electronic Finance*" OR "E-Financ*" OR "Internet-Based Financ*")			
Li and Xu 2021;	1900 - Aug. 2020	"financial innovation"	title, abstract, keywords	1,341	Web of Science
Liu et al. 2020;	1995 - 2017	"financial technology" OR "finance technology" OR "FinTech" OR "Fin-tech" OR "e-finance" OR "P2P lending platform" OR "peer to peer" OR "online lending" OR "crowdfunding" OR "Crowdfund investing" OR "Transaction terminals" OR "payment terminals" OR "cashless payments" OR "Paypal" OR "Alipay" OR "personal finance management" OR "blockchain" OR "smart contract" OR "digital currency" OR "bitcoin" OR "cryptocurrency" OR "mobile payment" OR "mobile point of sale" OR "robo-advisors" OR "automated portfolio management" OR "e-banking" OR "online bank" OR "mobile bank" OR "InsurTech"	title, abstract, keywords	629	Web of Science
Milian et al. 2019;	1980 - Feb. 2018	("fin*tech*" OR "financial* technolog*" OR "bank* start up*" OR "bank* start-up*" OR "bank* startup*" OR "banking* start up*" OR "banking start-up*" OR "banking startup*" OR "financial* start*up*" OR "start up* financial" OR "start-up* financial" OR "startup* financial" OR "startup* bank*" OR "start-up* bank*" OR "startup* bank*" OR "start up* banking*" OR "start-up* banking*" OR "startup* banking*") NOT ("*finetech*" OR "findings*tech*" OR "financial, technological" OR "financially, technologically") -> search for Web of Science (search for scopus is different)	title, abstract, keywords	179	Web of Science, Scopus

Molina-Collado et al. 2021;	2000 - 2020	keywords such as "advisory, wealth management, mutual funds, insurance, current account, savings account, retirement account, deposit, debit cards, credit cards, payment services, pension plans, life insurance, loan, mortgage, crowd-funding, peer-to-peer lending, investment products, Internet banking, mobile banking, e-commerce, innovation, mobile payment, e-services, mobile commerce and e-payment combined with banking, financial services and consumer"	title, abstract, keywords	1,227	Social Science Citation Index, Emerging Sources Citation Index, SCOPUS
Pan et al. 2020a;	1984 - Feb. 2020	"financial technology" OR "Fintech" OR "fin-tech" OR "Digital finance*" OR "Internet finance*" OR "financial computing" OR "insurance technology" OR "insurTech" OR "regulatory technolog*" OR "RegTech"	title, abstract, keywords	285	Web of Science
Suryono et al. 2020;	2014 - 2019	"fintech" OR "financial technology" AND ("trends" OR "problems" OR "adoptions" OR "innovations")	[not specified]	111	SCOPUS, ACM, ScienceDirect, IEEE Xplore
Wu (2017)	2015 - 2017	[only specified as "fintech-related" keywords]	title, abstract, keywords	885	Web of Science
Xu et al. 2020;	until Dec. 24, 2019	"Fintech" OR "Financial computing" OR "Digital finance*" OR "RegTech" OR "Internet finance*" OR "financial technolog*"	title, abstract, keywords	494	Web of Science

Table 1: Bibliometric Literature Reviews on Digital Finance and FinTech

For literature reviews that focus on an analysis of the research content, we find clearly defined attributes that systematic literature reviews should fulfill. They should be structured, comprehensive, and transparent (Hiebl 2021). We also find methodologies for systematic literature reviews that can be adapted to fulfill these attributes (e.g., Ngai et al. 2011; Webster and Watson 2002b). The focus of systematic literature reviews is to arrange a systematic collection of high-quality papers that is of a limited size that can be manually analyzed and presented. For bibliometric literature reviews, however, the focus is on a set of relevant papers that is as comprehensive as possible (Hiebl 2021). So far, we only find Donthu et al. (2021) who suggest a procedure for conducting bibliometric literature reviews. However, we find no advice on how to systematically select the literature to be analyzed, how to systematically define the search keywords, and how to systematically develop the search string. Therefore, in the following, we propose a methodology for conducting systematic bibliometric literature reviews.

Methodology

In the existing bibliometric literature reviews (see Table 1), we observe two basic approaches used by the authors. One group of authors (e.g., Ahmi et al. 2020; Brika 2022; Xu et al. 2020) prefers to define high-level search terms, like "FinTech" and "financial technology", for their search. In contrary, another group of authors (e.g., Liu et al. 2020) engages in considering nearly all possibly relevant terms in the field of Digital Finance and FinTech, like "crowdfunding", "electronic banking", "digital payments" etc. While the first approach ignores a substantial amount of literature because not all relevant publications use the high-level expressions, the second approach bears the problem of incomplete lists of specific search keywords. For systematic bibliometric literature reviews, this problem may be even worse if the authors have a specific background so that they often enumerate keywords connected to their fields while adding less keywords of unfamiliar fields which bears the risk of distinct biases in the results.

In other words, bibliometric literature reviews start with different sub-sets of all existing literature on a specific topic. As long as bibliometric literature reviews start from different sub-sets of literature, their results will deviate. A valid path towards aligning bibliometric analyses is increasing the sub-set of literature analyzed. The bigger sub-sets of the existing literature are, the more similar are they and so are the results.

General Methodology for Systematic Bibliometric Literature Reviews

We rely on the basic steps of a systematic literature review as proposed by Ngai et al. (2011) and adapted by Gomber et al. (2017) – and further extend these basic steps accordingly. We propose a two-stage search process with eleven research steps to ensure that the final set of search keywords is comprehensive and systematically derived to ensure receiving a comprehensive set of relevant literature for the bibliometric literature review. Our methodology can easily and without any loss of generality be transferred to any field of application. We describe our methodology in the following and depict our systematic approach in Figure 1. The numbers in brackets refer to the respective steps in Figure 1.

[1] In the first step, Ngai et al. (2011) requires to define the **research area** of the literature review.

[2] Next, the **goal and scope** of the systematic bibliometric literature review are to be defined.

(I) First Stage:

[3] A **list of initial search keywords** is formed directly based on the defined research area (step [1]). This initial list of search keywords has to be formed using only high-level keywords directly connected to the research area. More specific terms, e.g., concerning concrete sub-topics, specific business models, or product names, need to be excluded at this stage. The logic behind this step is to avoid a bias coming from an imbalanced set of too specific search keywords. We advise to thoroughly form as much different writing notations of the high-level keywords as possible in order to account for different writing styles throughout the literature. This also concerns different writings in American and British English and notations with and without spaces, or with and without hyphens.

[4] The list of high-level keywords is transformed to a search string. This search string is, then, used for **searching the chosen online academic database(s)**. Therefore, first, a *time range* has to be defined which is strictly considered for the selected literature. Second, the appropriate *document types* have to be selected, e.g., "articles" and "reviews". All papers of other document types are to be excluded. All papers that fulfill the defined criteria are included in the set of selected publications.

After this search, all papers need to be thoroughly checked. The online literature databases typically suggest all publications that contain one or more of the search keywords. As a consequence, the set of selected papers will also include papers that just mention the search keywords without dealing with these. We advise to rigorously delete those papers that only briefly touch the search keywords but do not deal with the topic. This is important to continue only with the relevant papers.

The intention behind this first-stage search is to generate a set of papers that are directly connected to *research area*. In the second stage, this set of papers is used as the starting point for deriving a list of more specific search keywords.

(II) Second Stage:

So far, the procedure is comparable to the procedure suggested by Donthu et al. (2021). This second stage, however, goes beyond their basic procedure. An important step that is regularly performed in literature reviews to enlarge the corpus of literature analyzed is the so-called "forward/backward search" (Webster and Watson 2002a): Besides the literature that is already part of the corpus, all publications cited by the corpus literature ("backward search") and also all publications that refer to the corpus literature ("forward search") are screened and – if relevant – added to the corpus. This step tries to assure that relevant papers which had not yet been part of the corpus are incorporated in the second stage. This procedure, however, is not the way to go if we consider the much larger size of sets of literature of bibliometric literature reviews. Taking into consideration all literature of the forward/backward search would go far beyond what can be handled in the context of a regular research project. So far, bibliometric literature reviews just dropped this important step. However, we incorporate this important step in our methodology by doing the following.

[5] In the next step, the papers selected in the first stage are used for a **keyword analysis**. We suggest to use the VOSviewer software (van Eck and Waltman 2017) to systematically identify all keywords that are regularly used throughout the set of selected papers. The VOSviewer software is a powerful tool that can be applied to (textual) databases to conduct a coupling and co-occurrence of keyword analysis to deeply explore and examine the intellectual structures of the addressed research field (Vallaster et al. 2019). The VOSviewer software generates a list of keywords that reveals a certain co-occurrence across the selected papers. Key to our approach is the ex-ante and transparent specification of this *minimum number of occurrence parameter (occ)*. It determines the keywords by accepting all keywords that occur at least *occ* times. The higher *occ* is selected, the fewer keywords result from this step. All keywords are systematically stored. The selection of *occ* depends on the given case, needs to be thoroughly chosen by the researchers, and has to be transparently communicated in the respective review paper.

Rule of thumb: *occ* should be selected as that number, that is the first number for which the resulting amount of keywords is be below 1000. If the resulting list of keywords is beyond 1000, it can hardly be handled. Numbers up to 1000 can be screened manually – even if it takes some time. However, *occ* should never be selected to occ = 1 because otherwise all keywords are included without any filtering for relevance.

[6] Typically, the list of keywords from step [5] also includes irrelevant keywords which, however, fulfill the occurrence criterion. For **defining the list of final search keywords**, we advise to rigorously check the keywords and to delete the terms that are off topic (e.g., general terms, names, company names). Moreover, it is important to systematically form general expressions from the keywords using place holders " * ". For example, the keyword "bank*" will also account for "banker", "banks", and "banking". We also suggest augmenting the set of keywords by obviously missing forms and ways of writing, e.g., by systematically adding forms with/without space or with/without hyphen. Furthermore, we suggest validating the resulting list of keywords by benchmarking against keyword lists, e.g., of existing literature reviews. For the sake of completeness, the missing keywords are added in this step.

Performing steps [5] and [6] augments the search keywords considerably and replaces the "forward/backward search", which is regularly applied for literature reviews but which is hard to handle in the context of large-scale sets of literature.

[7] Based on the resulting list of final search keywords, the search string is formulated. Subsequently, this search string is used for **searching the chosen online academic database(s)**. Therefore, again, the *time range* and the accepted *document types* are to be defined and strictly regarded. This second search is the main literature search that yields the publications for the systematic bibliometric literature review.

After this search, all these papers need to be thoroughly checked. We, again, advise to rigorously delete those papers that only briefly touch the search keywords but do not deal with the topic.

[8] From the steps above, the **final set of academic publications** is received.

[9-11] Based on the final set of publications, the respective **bibliometric analyses** are performed. The **results are presented and evaluated** based on goal and scope of the literature review.
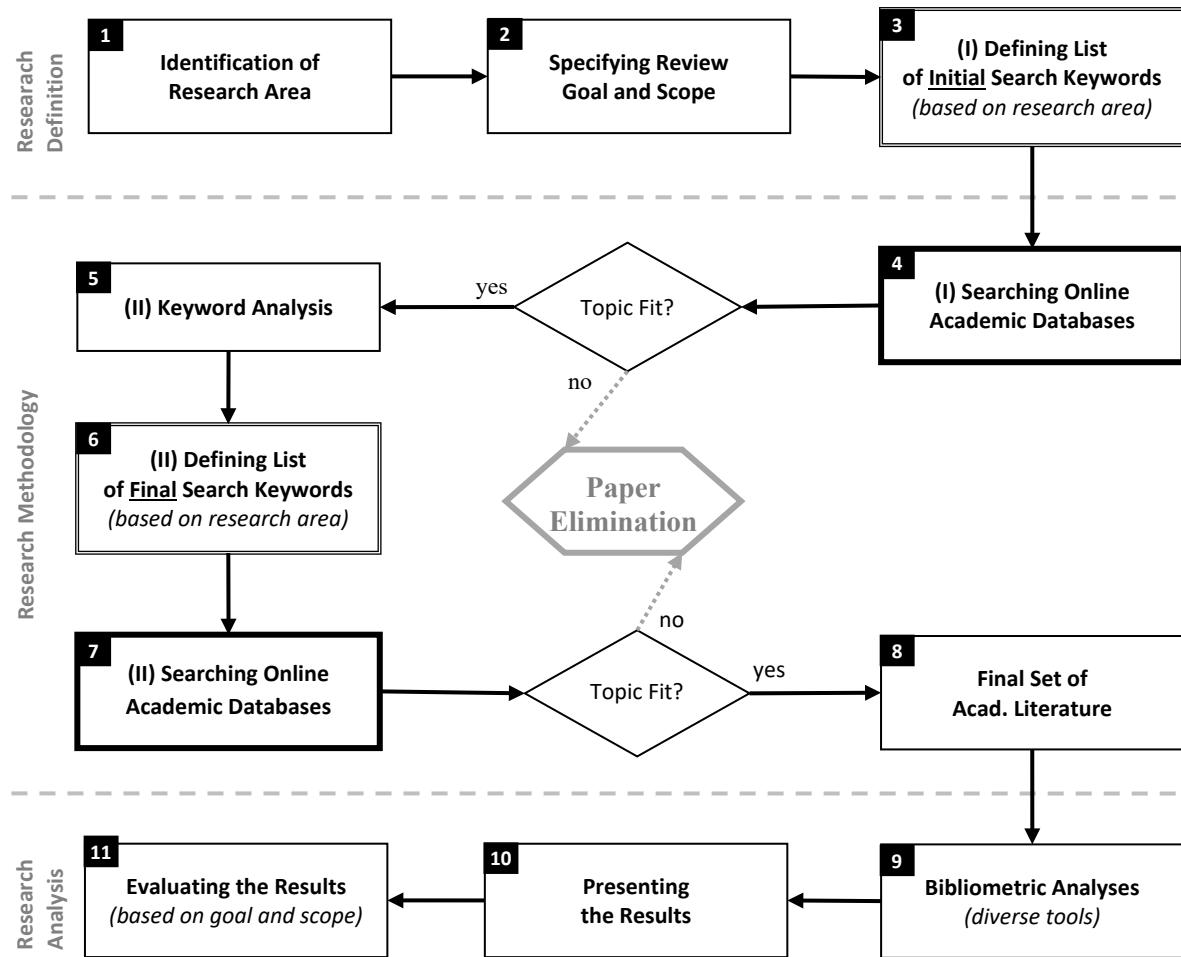
Figure 1: Process Diagram of Our Systematic Bibliometric Literature Review (based on Ngai et al. (2011) and Gomber et al. (2017))

Application of the Methodology to the field of Digital Finance and FinTech

While the bibliometric literature reviews presented in Table 1 reveal very different approaches and an inconsistent understanding of how to perform a bibliometric literature review for the same research area, we apply the methodology proposed above:

[1] First, we define the **research area** as "Digital Finance and FinTech". Thereby, we intend to include the whole field without excluding certain areas.

[2] The **goal and scope** of the systematic bibliometric literature review are defined as "analyzing the evolution of Digital Finance and FinTech research".

(I) First Stage:

[3] For the **list of initial search keywords**, we take the defined research area (step [1]) as a starting point and formulate high-level keywords closely related to "Digital Finance and FinTech". We intentionally exclude specific terms, like "crowdfunding", "electronic banking", or "digital payments" at this stage. Instead, we engage in finding as much general terms connected to "digital finance" and "fintech" as possible. We also take into consideration synonyms and closely related keywords, like

"digital finance", "online finance", and "mobile finance", and different possible ways of writing the keywords, e.g., "fintech" and "fin-tech".

[4] From this list of keywords, we form the search string: "fintech*" OR "fin-tech*" OR "digital financ*" OR "finance technolog*" OR "financial technology" OR "financial technologies" OR "electronic financ*" OR "internet financ*" OR "online financ*" OR "mobile financ*". This search string is used for **searching the online academic database** "Web of Science". As a *time range*, we choose the time before and including the year 2019. As *document types*, we accept "articles" and "reviews". The search was performed on 2020/03/10 and ended in a list of 890 papers. We went through all these papers manually and deleted those papers that only briefly touch the search keywords but do not deal with the topic. During this process, 166 irrelevant papers were deleted so that we kept a set of 724 papers dealing with Digital Finance and FinTech.

(II) Second Stage:

[5] Using the VOSviewer software, we performed a **keyword analysis** on the papers selected in the first stage. We follow the rule of thumb suggested above and accepted all keywords that occur at least in *occ* = 2 times. Moreover, we have tried different settings and found that the parameter *occ* = 2 indeed provides the most appropriate results in the given case. This resulted in a list of 634 keywords. With occ = 3 (occ = 4), we would lose a substantial part of the keywords and end up with just 339 (218) keywords.

[6] We, then, manually looked through all the keywords and deleted the terms that were off-topic (e.g., general terms, names, and company names) and kept only the relevant terms. We kept only those names that indicate a specific concept, like "Bitcoin" and "Ethereum", and deleted all names that just express a company, like "Kickstarter" and "Alipay". Moreover, we keep geographic names because these might be linked to specific phenomena in the context of Digital Finance and FinTech. In the next step, we systematically formed universal expressions from the terms using place holders " * " (from "digital banking" we formed "digital bank*" to also embrace "digital bank", "digital banks", "digital banker" etc.). Furthermore, we gathered all typically used adjectives that are connected to Digital Finance and FinTech (e.g., "digital", "electronic", "virtual", "Internet" etc.). Then, we used this set of adjectives to complete the sets of keyword families (i.e., "digital bank*", "electronic bank*", "virtual bank*" etc.). Doing so, we were able to systematically amplify our list of search keywords. After this step, our list comprises 166 keywords.

Next, we have benchmarked the resulting keyword list against existing keyword lists in the literature. Therefore, we used the existing literature reviews for completing our keyword list. When doing so, we observed that, while all keywords that were used in the other literature reviews were already included in our keyword list, only the systematic literature review of Gomber et al. (2017) suggested further keywords that had not yet been included by us. This observation underlines that our two-stage process is well able to gather a comprehensive amount of the relevant keywords. To further augment our keyword list, we add the so-far missing keywords from Gomber et al. (2017). Thereby, we again systematically augmented the set of keywords by using the list of adjectives connected to Digital Finance and FinTech (i.e., "digital", "electronic", "virtual", "Internet" etc.). Finally, we received a list of 255 specific keywords to complete step [6]: **defining the list of final search keywords**.

[7] Based on the resulting list of final search keywords, we formed a comprehensive search string for the systematic bibliometric literature review. Subsequently, the search string was used for **searching the online academic database** "Web of Science". In this search, we accepted all "articles" and "reviews" (*document types*) published in or before 2019 (*time range*). This search yielded a comprehensive set of 9,696 papers. Next, we thoroughly checked all these papers. Therefore, we manually screened titles and abstracts of all papers and deleted those papers that just mention the keywords but do not deal with then in the context of "Digital Finance and FinTech". In this step, we deleted 4,643 papers. We ended up with a final set of 5,053 papers for subsequent analysis. With the manual screening, we intend to eliminate adverse effects and biases caused by papers irrelevant for the Digital Finance and FinTech domain.

[8] Following these steps, we received the **final set of academic publications**.

[9–11] Based on the final set of publications, we perform the respective **bibliometric analyses** the results of which we present in the section "Results".

Compared to the other existing bibliometric literature reviews (Table 1), we see that our set of literature is the most comprehensive set that has been composed and analyzed so far in the context of a bibliometric literature review on Digital Finance and FinTech.

However, this work does not come without limitations. Our set of papers used for the analyses is dependent on the data quality of the database used: Web of Science. Journals that were not reported in this database could not be considered in the analyses. Moreover, Web of Science updates papers in their database regularly. This can lead to slight changes in the available papers if requests are repeated at a later point of time. These changes, however, concern a very few papers so that this effect is neglectable.

Furthermore, the resulting keyword list of our suggested two-stage process is dependent on the parameter *occ*, which defines in how many papers a keyword must appear to be selected in the second stage. The appropriate choice of *occ* is up to the researchers but we suggest the rule of thumb mentioned above.

Finally, the exact set of papers will depend on the quality of manual screenings. However, we argue that if the processes are conducted thoroughly, researchers will end up with largely equivalent results. Thereby, the methodology serves as a solid and common basis for performing systematic bibliometric literature review.

Results

In this section, we present the results obtained from the bibliometric analyses run on our comprehensive set of 5,053 research papers on Digital Finance and FinTech. First, we discuss the publication and citation structure across the articles. Second, the most influential papers and the top journals are reported. Third, the leading authors, institutions, and most productive countries are presented. Then, we present a thorough keyword analysis and the emerging trends to enable academics to identify the most active fields and possible strands for future research.

Publication and citation structure

In the first step, we analyze how research on Digital Finance and FinTech has developed over the last decades. Figure 2 graphically displays the evolution of articles over time. The first paper in the area of Digital Finance and FinTech was published in 1974 by Brandel and Gresham on electronic payments. Since this first paper, the number of published articles has grown exponentially. During the first 20 years, i.e., 1974–1993, the number of papers had never exceeded four. Since 1994, there had been a significant increase in the number of papers published. In general, the number of articles on Digital Finance and FinTech per year has grown relatively moderate up to the year 2014. However, since 2015 the numbers started to soar. From 2014 to 2015 the highest growth rate was reached when the number of articles per year almost tripled. The detailed numbers of published articles are shown in Table 2.
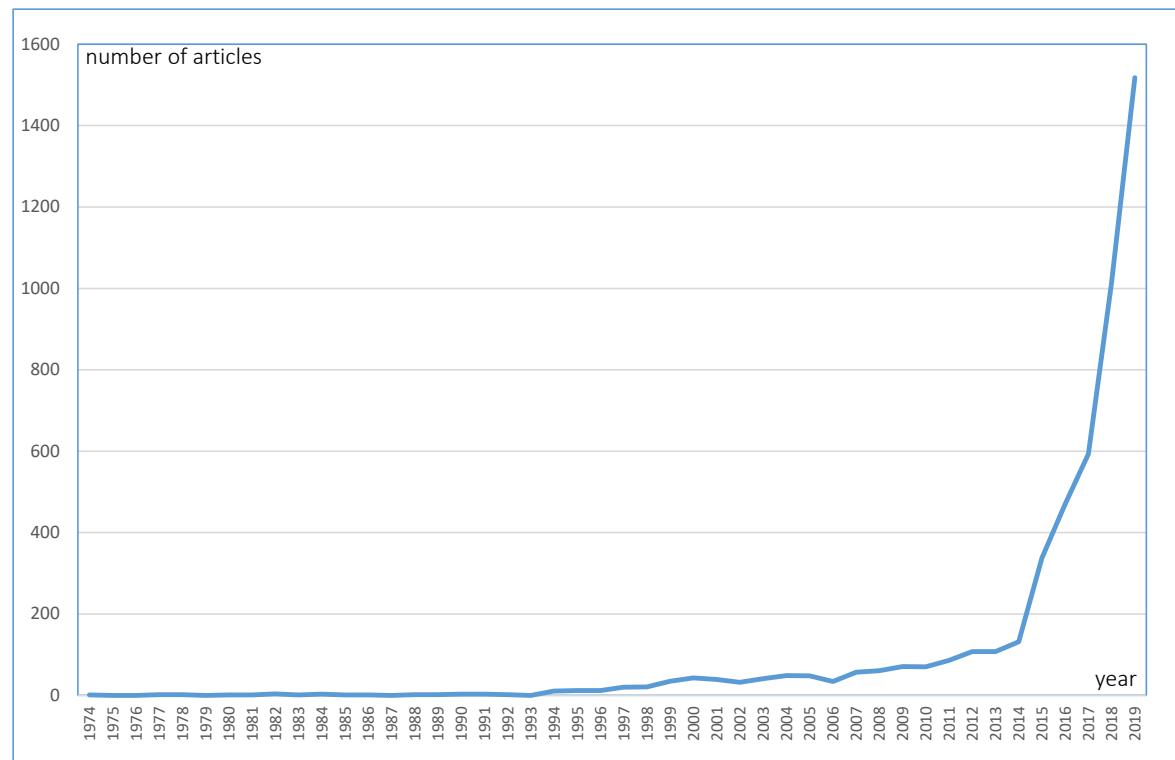
Figure 2: Number of published articles on Digital Finance and FinTech per year (1974–2019)

Next, we analyze the development of the citation structure of the articles over the time. Therefore, we access the citation data base of Web of Science and analyze the citations of the articles in our data set. Table 2 provides the number of articles published and the articles' citations. The table also shows how many articles have received more than 500, 200, 100, 50, 20, 10, 5 and 1 citation(s) in a given year. The highest number of publications of our analyzed time period occurred in 2019 (1518 papers), while the highest number of citations occurred one year before in 2018 (17,418 citations). Citations should keep revealing a rising trend when articles do so. However, numbers of citations are dropping noticeably from 2018 to 2019. This might be a signal that the soaring numbers of publications makes it difficult for the academic community to find the relevant literature for their research topic.

Aggregated across all years, 4.20% of the papers have received more than one hundred citations (10.33% more than 50 citations and 76.17% more than one citation). For the years 2016–2019, the numbers of papers with many citations are shrinking while there are relative more papers receiving fewer citations.

Year	>500	>200	>100	>50	>20	>10	>5	>1	Papers	Citations
2019	0	0	9	35	196	385	646	1106	1518	14209
2018	1	5	21	88	240	387	538	761	1015	17418
2017	0	5	21	65	158	253	336	460	593	12235
2016	1	8	23	67	144	215	273	375	470	12417
2015	1	11	27	53	111	157	200	262	338	10346
2014	2	5	16	33	55	71	94	115	132	6735
2013	0	5	8	17	39	56	73	91	108	3815
2012	0	4	10	20	42	64	75	87	108	3700
2011	0	5	9	15	31	44	56	71	86	3461
2010	1	4	7	17	29	43	51	65	70	3687
2009	1	6	9	23	31	45	57	62	71	3777
2008	0	2	7	16	31	43	51	56	61	2621
2007	0	2	6	13	19	28	35	51	57	2225
2006	0	1	3	5	16	23	26	31	34	1168
2005	1	2	5	7	11	18	24	34	48	1775
2004	1	3	5	8	14	23	29	37	49	2153
2003	0	3	7	9	16	21	24	30	41	2093
2002	1	4	5	6	12	17	17	25	32	1790
2001	1	3	7	10	14	23	25	30	39	4458
2000	0	0	4	6	9	10	13	26	43	933
1999	0	0	2	4	9	10	14	24	35	698
1998	0	1	1	3	5	9	11	12	21	521
1997	0	0	0	1	2	3	6	11	20	152
1996	0	0	0	1	2	3	5	7	12	154
1995	0	0	0	0	1	1	1	4	12	44
1994	0	0	0	0	0	1	1	4	11	33
1993	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	1	1	2	7
1991	0	0	0	0	0	0	1	3	3	14
1990	0	0	0	0	0	0	0	1	3	2
1989	0	0	0	0	0	0	0	1	2	2
1988	0	0	0	0	0	0	0	1	2	2
1987	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	1	1	4
1985	0	0	0	0	0	0	0	0	1	0
1984	0	0	0	0	0	0	0	1	3	2
1983	0	0	0	0	0	0	0	0	1	0
1982	0	0	0	0	0	0	0	0	4	0
1981	0	0	0	0	0	0	0	1	1	2
1980	0	0	0	0	0	0	0	1	1	2
1979	0	0	0	0	0	0	0	0	0	0
1978	0	0	0	0	0	0	0	0	2	0
1977	0	0	0	0	0	0	0	1	2	2
1976	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0	0	1	1
Total	11	79	212	522	1237	1953	2683	3849	5053	112658
Percentage	0.22%	1.56%	4.20%	10.33%	24.48%	38.65%	53.10%	76.17%	100%	-

Abbreviations: >500 / >200 / >100 / >50 / >20 / >10 / >5 / >1 = number of papers with more than 500 / 200 / 100 / 50 / 20 / 10 / 5 / 1 citation(s)

Table 2: Annual publication and citation structure

Influential papers and top journals

After analyzing the citation structure across all papers, we identify the most influential articles in the area of Digital Finance and FinTech. Therefore, in this section, the top 30 most cited articles are presented. Table 3 reports the total citations received, the year of publication, and the citations received per year. With a total number of 2,704 citations, the paper by Bhattacherjee (2001) is the most influential paper. However, with 135 citations per year, this paper does not reveal the highest rate of citations per year (C/Y). Mollick (2014) has achieved 174 citations per year, and Zheng et al. (2018) even 194 citations per year.

R	TC	Title	Author/s	Journal	Year	C/Y
1	2704	Understanding information systems continuance: An expectation-confirmation model	Bhattacherjee, A	MIS Quarterly	2001	135.20
2	1219	The dynamics of crowdfunding: An exploratory study	Mollick, E	Journal of Business Venturing	2014	174.14
3	771	Crowdfunding: Tapping the right crowd	Belleflamme, P; Lambert, T; Schwienbacher, A	Journal of Business Venturing	2014	110.14
4	736	Toward an understanding of the behavioral intention to use mobile banking	Luarn, P; Lin, HH	Computers in Human Behavior	2005	46.00
5	636	Factors influencing the adoption of internet banking: An integration of TAM and TPB with perceived risk and perceived benefit	Lee, MC	Electronic Commerce Research and Applications	2009	53.00
6	608	Individual trust in online firms: Scale development and initial test	Bhattacherjee, A	Journal of Management Information Systems	2002	32.00
7	581	Blockchain challenges and opportunities: a survey	Zheng, ZB; Xie, SA; Dai, HN; Chen, XP; Wang, HM	International Journal of Web and Grid Services	2018	193.67
8	554	Integrating TTF and UTAUT to explain mobile banking user adoption	Zhou, T; Lu, Y; Wang, B	Computers in Human Behavior	2010	50.36
9	518	Consumer acceptance of online banking: an extension of the technology acceptance model	Pikkarainen, T; Pikkarainen, K; Karjaluoto, H; Pahnila, S	Internet Research	2004	30.47
10	512	Where Is Current Research on Blockchain Technology?-A Systematic Review	Yli-Huumo, J; Ko, D; Choi, S; Park, S; Smolander, K	PLOS ONE	2016	102.40
11	506	Signaling in Equity Crowdfunding	Ahlers, GKC; Cumming, D; Guenther, C; Schweizer, D	Entrepreneurship Theory and Practice	2015	84.33
12	487	Bitcoin and Beyond: A Technical Survey on Decentralized Digital Currencies	Tschorsch, F; Scheuermann, B	IEEE Communications Surveys and Tutorials	2016	97.40
13	444	Determinants of user acceptance of Internet banking: an empirical study	Wang, YS; Wang, YM; Lin, HH; Tang, TI	International Journal of Service Industry Management	2003	24.67
14	423	Examining multi-dimensional trust and multi-faceted risk in initial acceptance of emerging technologies: An empirical study of mobile banking services	Luo, X; Li, H; Zhang, J; Shim, JP	Decision Support Systems	2010	38.45
15	417	Understanding the Internet banking adoption: A unified theory of acceptance and use of technology and perceived risk application	Martins, C; Oliveira, T; Popovic, A	International Journal of Information Management	2014	59.57
16	415	Bitcoin: Economics, Technology, and Governance	Bohme, R; Christin, N; Edelman, B; Moore, T	Journal of Economic Perspectives	2015	69.17
17	406	Gender differences in the perceived risk of buying online and the effects of receiving a site recommendation	Garbarino, E; Strahilevitz, M	Journal of Business Research	2004	23.88
18	401	An empirical examination of factors influencing the intention to use mobile payment	Kim, C; Mirusmonov, M; Lee, I	Computers in Human Behavior	2010	36.45
19	398	Understanding consumer acceptance of mobile payment services: An empirical analysis	Schierz, PG; Schilke, O; Wirtz, BW	Electronic Commerce Research and Applications	2010	36.18
20	395	Bitcoin, gold and the dollar - A GARCH volatility analysis	Dyhrberg, AH	Finance Research Letters	2016	79.00
21	392	Crowd-funding: transforming customers into investors through innovative service	Ordanini, A; Miceli, L; Pizzetti, M;	Journal of Service Management	2011	39.20
22	385	The inefficiency of Bitcoin	Urquhart, A	Economic Letters	2016	77.00
23	374	Judging Borrowers by the Company They Keep: Friendship Networks and Information Asymmetry in Online Peer-to-Peer Lending	Lin, M; Prabhala, NR; Viswanathan, S	Management Science	2013	46.75
24	359	Speculative bubbles in Bitcoin markets? An empirical investigation into the fundamental value of Bitcoin	Cheah, ET; Fry, J	Economic Letters	2015	59.83
25	351	An empirical investigation of mobile banking adoption: The effect of innovation attributes and knowledge-based trust	Lin, HF	International Journal of Information Management	2011	35.10
26	346	The impact of customer trust and perception of security control on the acceptance of electronic commerce	Suh, B; Han, I	International Journal of Electronic Commerce	2003	19.22
27	345	Internal Social Capital and the Attraction of Early Contributions in Crowdfunding	Colombo, MG; Franzoni, C; Rossi-Lamastra, C	Entrepreneurship Theory and Practice	2015	57.50
28	336	Organizational change as discourse: Communicative actions and deep structures in the context of information technology implementation	Heracleous, L; Barrett, M	Academy of Management Journal	2001	16.80
29	333	Exploring consumer adoption of mobile payments - A qualitative study	Mallat, N	Journal of Strategic Information Systems	2007	23.79
30	315	On the hedge and safe haven properties of Bitcoin: Is it really more than a diversifier?	Bouri, E; Molnar, P; Azzi, G; Roubaud, D; Hagfors, LI	Finance Research Letters	2017	78.75

Abbreviations: R = rank, TC = total citations, C/Y = citations per year

Table 3: The 30 most cited articles

The table shows a high diversity of the authors across these top 30 cited papers. Moreover, a large diversity of journals can be observed. There is only one journal that appears three times (i.e., Computers in Human Behavior), and only six journals that appear two times. Based on this, we investigate the journals that publish most intensively on Digital Finance and FinTech. Table 4 reports the 20 top journals publishing articles on Digital Finance and FinTech and, thus, contribute most to the body of knowledge in this domain. The results are presented (1) by total publications and (2) by periods in order to discover potential trends. For (2), we divided the complete time range 1974–2019 into seven periods. Therefore, we formed a larger period of those years with only few publications (1974–1989) and six periods of equal five-year size: 1990–1994, 1995–1999, 2000–2004, 2005–2009, 2010–2014, 2015–2019. The seventh period, which is rather non-productive, extends from 1974 to 1989. From Table 4, we see that the International Journal of Bank Marketing published the highest total number of articles on Digital Finance and FinTech (82 articles). All these articles were published in the last five-year period, i.e., 2015–2019. The journals on ranks two and three published the respective articles across three (respectively four) five-year periods, i.e., over a much longer time range. The two journals among

the 20 top journals that started publishing on Digital Finance and FinTech at the earliest are the "Lecture Notes in Computer Science" and the "International Journal of Information Management". Looking at the focus of each journal we observe that journals in the area of computer science, information technology, and information management started earlier to address topics around Digital Finance and FinTech. Journals in the area of finance and human behavior addressed such topics much later. This reflects that topics around technology are first discussed in technology-focused journals – e.g., for discussing technical standards – and, in a later step, practical applications and user behavior are addressed.

Finally, almost all journals reveal increasing numbers of publications, i.e., almost all journals show the highest number of publications in 2019 with the exception of the Lecture Notes in Computer Science journal. As it is the only journal among the top 20 journals that has its main focus on informatics and computer science, this gives an indication that topics around Digital Finance and FinTech are discussed less in the area of computer science today since the technical foundations are widely existing in this domain. Now, topics deal much more with the business models, economics, user behavior, i.e., the perspective on technologies' applications in this area.

R	Journal	1974 - 1989	1990 - 1994	1995 - 1999	2000 - 2004	2005 - 2009	2010 - 2014	2015 - 2019	TP
1	International Journal of Bank Marketing	0	0	0	0	0	0	82	82
2	Electronic Commerce Research and Applications	0	0	0	0	15	14	45	74
3	Lecture Notes in Computer Science	0	2	10	39	20	0	0	71
4	IEEE Access	0	0	0	0	0	0	70	70
5	Finance Research Letters	0	0	0	0	0	0	67	67
6	Physica A: Statistical Mechanics and its Applications	0	0	0	0	0	0	58	58
7	Sustainability	0	0	0	0	0	0	48	48
8	Economic Letters	0	0	0	0	0	3	44	47
9	Computers in Human Behavior	0	0	0	0	3	10	25	38
10	PLOS ONE	0	0	0	0	0	4	31	35
11	Journal of Business Research	0	0	1	0	4	8	20	33
12	Internet Research	0	0	0	3	8	6	14	31
13	Journal of Risk and Financial Management	0	0	0	0	0	0	31	31
14	International Journal of Mobile Communications	0	0	0	0	5	12	13	30
15	Decision Support Systems	0	0	0	0	8	5	16	29
16	Forbes	0	0	4	7	0	6	12	29
17	Financial Innovation	0	0	0	0	0	0	28	28
18	Electronic Commerce Research	0	0	0	0	0	10	17	27
19	International Journal of Information Management	0	2	1	4	5	5	10	27
20	Journal of Banking & Finance	0	0	3	4	8	5	7	27

Abbreviations: R = rank, TP = total papers

Table 4: Top 20 journals based on the number of published papers on Digital Finance and FinTech

Leading authors, institutions, and countries

In the next step, we analyze whether publications cluster around certain very active authors and institutions. Therefore, we identify the top authors, top institutions, and top countries. In our dataset, we have identified 10,814 authors across the 5,053 papers. Therefore, we checked whether authors of the same or of a similar name are the same person or different persons. If they were the same, we merged them.

Table 5 presents the thirty leading authors who have published articles on Digital Finance and FinTech. The list is organized by total publications (TP), and, in case of a tie, the author with most citations is ranked higher. We also report h-index, the author's affiliation, and residing country. It is worth noting that there is no country that stands out in the list of top authors. Based on the results, "Liebana-Cabanillas F" (rank 1), "Bouri E" (rank 2), and "Roubaud D" (rank 3) are the top authors based on the number of publications, while "Bouri E" is the most influential author in terms of total citations and has the highest h-index of the thirty leading authors. Please note that the h-index is calculated based on the data from Web of Science and might differ from other platforms, like Google Scholar.
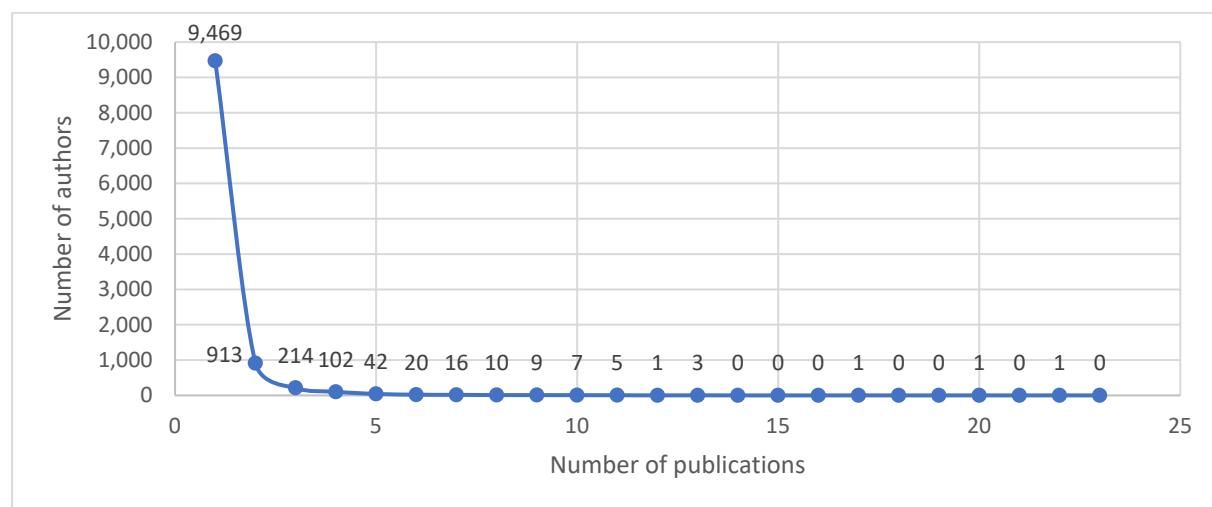
Table 4. Top 30 leading authors.

R	Name	Institution	Country	TP	TC	H	TC/TP
1	Liebana-Cabanillas, F	University of Granada	Spain	22	789	16	35.86
2	Bouri, E	Lebanese American University	Lebanon	20	1767	20	88.35
3	Roubaud, D	Montpellier Business School	France	17	1742	17	102.47
4	Kauffman, RJ	Copenhagen Business School	Denmark	13	879	11	67.62
5	Zheng, HC	South China University of Technology	China	13	490	9	37.69
6	Dwivedi, YK	Swansea University	UK	12	1018	11	84.83
7	Cumming, DJ	Florida Atlantic University	USA	12	908	11	75.67
8	Oliveira, T	Universidade Nova de Lisboa	Portugal	11	1521	11	138.27
9	Schwienbacher, A	Universite Cote d'Azur	France	11	1103	10	100.27
10	Muñoz-Leiva, F	University of Granada	Spain	11	542	10	49.27
11	Sánchez-Fernández, J	University of Granada	Spain	11	519	10	47.18
12	Urquhart, A	University of Reading	UK	10	1048	9	104.80
13	Karjaluoto, H	University of Jyvaskyla	Finland	10	1039	10	103.90
14	Lucey, B	Trinity College Dublin	Ireland	10	1015	10	101.50
15	Vismara, S	University of Bergamo	Italy	10	703	9	70.30
16	Tiwari, AK	Rajagiri Business School	India	10	509	9	50.90
17	Selmi, R	ESC PAU Business School	France	10	330	8	33.00
18	Zhang, W	Tianjin University	China	10	169	5	16.90
19	Asongu, SA	University of South Africa	South Africa	10	157	8	15.70
20	Zhou, T	Hangzhou Dianzi University	China	9	1518	9	168.67
21	Alalwan, AA	Al-Balqa Applied University	Jordan	9	753	8	83.67
22	Rana, NP	University of Bradford	UK	9	732	8	81.33
23	Shaikh, AA	University of Jyvaskyla	Finland	9	433	8	48.11
24	Hornuf, L	University of Bremen	Germany	9	396	9	44.00
25	Bouoiyour, J	ESC Pau Business School	France	9	320	7	35.56
26	Gleasure, R	Copenhagen Business School	Denmark	9	183	6	20.33
27	Marchesi, M	University of Cagliari	Italy	9	183	7	20.33
28	Corbet, S	Dublin City University	Ireland	8	861	8	107.63
29	Burtch, G	University of Minnesota System	USA	8	701	8	87.63
30	Hanafizadeh, P	Allameh Tabataba'i University	Iran	8	406	8	50.75

Abbreviations: R = rank, TP = total papers, TC = total citations, H = h-index, TC/TP = citations per publications

Table 5: Top 30 authors of papers on Digital Finance and FinTech

In Figure 3, we depict how many authors have contributed how many publications. Interestingly, 88% of the authors published only one paper on the topic. Further 8% of the authors published two papers. In total, 98% of the authors published one, two, or three papers while only 2% of the authors have published four or more papers.

Figure 3: Number of authors that contributed a certain number of publications

In the next step, we turn to the top institutions. Table 6 reports the thirty leading institutions in terms of total publications on Digital Finance and FinTech. The "University of Minnesota Twin Cities" (USA)

and the "Southwestern University of Finance and Economics of China" top the ranking, followed by the "Massachusetts Institute of Technology MIT" (USA) and the "City University of Hong Kong". The "University of Pennsylvania" leads with respect to total citations (rank 9 regarding total number of publications), followed by "Montpellier Business School" (rank 12 regarding total number of publications) and the "University of Minnesota Twin Cities" (rank 1 regarding total number of publications). Further bibliometric indicators are calculated for each institution, such as h-index (H), cites per paper (TC/TP), and number of papers with more than 50, 25 and 5 citations respectively. The "University of Pennsylvania" is first in terms of citations received per publication among these thirty leading institutions. Some universities at a lower rank concerning the total number of publications have a higher level of influence in terms of citations.

Moreover, two global rankings of universities (i.e., ARWU and QS) are presented, which reflect the general evaluation and reputation of the institutions in the list. This allows to make a comparison possible between ranking-based reputation and the table's publication-based ranking. The last column (TOP 30) shows the number of publications that each institution has among the top thirty most cited articles on Digital Finance and FinTech. From this, it can be observed how atomized the literature is on this topic among the institutions, even among the leading ones. It seems that an early and an ambitious engagement concerning research on Digital Finance and FinTech has helped lower-ranked universities to develop important positions in this field. In Table 6, we also observe that most of the leading institutions are from the USA (7) and China (7), followed by UK (5).

R	Institution	Country	TP	TC	H	TC/TP	>50	>25	>5	ARWU	QS	TOP 30
1	University of Minnesota Twin Cities	USA	31	1842	18	59.42	11	12	25	40	156	-
2	Southwestern University of Finance and Economics of China	China	31	1287	18	41.52	7	14	30	401-500	301-350	-
3	Massachusetts Institute of Technology MIT	USA	28	1559	15	55.68	8	12	21	4	1	-
4	City University of Hong Kong	China	28	969	15	34.61	5	11	21	201-300	52	-
5	Harvard University	USA	27	1236	12	45.78	7	9	22	1	3	1
6	University of Sydney	Australia	27	907	16	33.59	7	14	23	74	42	-
7	University of New South Wales Sydney	Australia	27	572	12	21.19	3	9	18	74	43	-
8	Peking University	China	27	396	12	14.67	1	5	20	49	22	-
9	University of Pennsylvania	USA	26	2555	15	98.27	9	10	19	19	15	1
10	University of North Carolina	USA	26	1177	14	45.27	9	13	19	30	90	-
11	University of Granada	Spain	26	788	17	30.31	3	11	23	201-300	501-520	-
12	Montpellier Business School	France	25	1992	21	79.68	16	19	25	151-200	-	1
13	New York University	USA	25	1169	13	46.76	6	9	18	27	39	-
14	University of Oxford	UK	25	327	11	13.08	1	3	18	9	4	-
15	International Islamic University Malaysia	Malaysia	25	111	7	4.44	0	0	8	-	651-700	-
16	Kyung Hee University	South Korea	24	1302	13	54.25	8	10	20	301-400	247	-
17	National University of Singapore	Singapore	24	977	13	40.71	4	6	17	80	11	1
18	London School of Economics and Political Science	UK	24	842	15	35.08	3	10	19	151-200	44	-
19	University of Hong Kong	China	23	941	11	40.91	5	7	14	151-200	25	-
20	Brunel University	UK	23	559	10	24.30	3	8	15	501-600	359	-
21	University of Science and Technology of China CAS	China	23	418	12	18.17	2	4	17	73	89	-
22	Zhejiang University	China	23	394	8	17.13	1	2	9	58	54	-
23	University of Manchester	UK	22	957	14	43.50	6	10	18	36	27	-
24	Copenhagen Business School	Denmark	22	418	13	19.00	1	8	17	801-900	-	-
25	University of Electronic Science and Technology of China	China	22	395	9	17.95	2	3	15	151-200	701-750	-
26	Centre National de la Recherche Scientifique CNRS	France	22	389	8	17.68	2	4	12	-	-	-
27	Erasmus University Rotterdam	Netherlands	21	1049	14	49.95	6	10	19	80	183	-
28	University of Pretoria	South Africa	21	961	11	45.76	9	10	15	401-500	551-560	-
29	Indiana University Bloomington	USA	21	574	13	27.33	5	7	17	101-150	312	-
30	University of Edinburgh	UK	21	476	11	22.67	3	6	16	42	20	-

Abbreviations: R = rank, TP = total papers, TC = total citations, H = h-index, TC/TP = citations per publication, >50 / >25 / >5 = number of papers with more than 50 / 25 / 5 citations, ARWU = Academic Ranking of World Universities, QS = QS University Ranking, TOP 30 = contributed papers among the 30 most cited papers

Table 6: The most productive and influential institutions

Next, we present a thorough analysis on the leading countries in terms of total publications. The results are reported in Table 7. Please, note that the indicators used for this table are the same as in previous tables. Moreover, the population of each country for 2019 (data: Worldbank, 2021) is added in order to compute publications per capita, giving more standardized results. The USA is by far the most productive and influential country, with a total of 1,104 publications, 37058 citations received, and an h-index of 92. Of the top thirty most cited articles, 11 are from the USA. Greater China (including China Mainland and Hong Kong) is on the second rank, the UK (including England, Scotland, Wales, and Northern Ireland) on the third, and Germany on the fourth rank in terms of total publications.

Interestingly, Finland – on rank 22 regarding the total number of publications – is the leading country regarding citations received per article. Moreover, Finland has the second highest rate of total publications per capita, right after Singapore and ahead of Switzerland.

R	Country	Supraregion	TP	TC	H	TC/TP	Population	TP/POP	TOP 30
1	USA	North America	1,104	37,058	92	34	328,329,953	3.36	11
2	China	Eastern Asia	729	14,958	57	21	1,397,715,000	0.52	2
3	UK	Northern Europe	511	16,279	65	32	66,836,327	7.65	3
4	Germany	Western Europe	268	7,813	44	29	83,092,962	3.23	4
5	Spain	Southern Europe	230	4,412	36	19	47,133,521	4.88	-
6	India	Southern Asia	224	3,518	28	16	1,366,417,756	0.16	-
7	Australia	Oceania	219	5,012	40	23	25,365,745	8.63	-
8	South Korea	Eastern Asia	217	6,611	33	30	51,709,098	4.20	3
9	France	Western Europe	191	6,207	42	32	67,248,926	2.84	2
10	Italy	Southern Europe	180	4,482	35	25	59,729,081	3.01	2
11	Taiwan	Eastern Asia	172	5,321	32	31	23,773,876	7.23	4
12	Canada	North America	172	5,225	38	30	37,593,384	4.58	1
13	Malaysia	South-eastern Asia	119	2,236	25	19	31,949,789	3.72	-
14	Netherlands	Western Europe	110	2,620	24	24	17,344,874	6.34	-
15	South Africa	Africa	91	1,835	22	20	58,558,267	1.55	-
16	Brazil	Latin America	91	952	19	10	211,049,519	0.43	-
17	Russia	Eastern Europe	88	390	10	4	144,406,261	0.61	-
18	Switzerland	Western Europe	87	2,633	26	30	8,575,280	10.15	-
19	Iran	Western Asia	87	1,233	19	14	82,913,893	1.05	-
20	Singapore	South-eastern Asia	75	1,920	20	26	5,703,569	13.15	1
21	Belgium	Western Europe	70	2,533	20	36	11,488,980	6.09	1
22	Finland	Northern Europe	68	3,898	27	57	5,521,606	12.32	3
23	Japan	Eastern Asia	68	587	13	9	126,264,931	0.54	-
24	Turkey	Western Asia	66	1,480	18	22	83,429,607	0.79	-
25	Portugal	Southern Europe	61	2,123	19	35	10,286,263	5.93	1
26	Poland	Eastern Europe	61	442	10	7	37,965,475	1.61	-
27	Pakistan	Southern Asia	58	629	15	11	216,565,317	0.27	-
28	Ukraine	Eastern Europe	58	222	6	4	44,386,203	1.31	-
29	Greece	Southern Europe	57	1,004	21	18	10,721,582	5.32	-
30	Sweden	Northern Europe	56	1,188	20	21	10,278,887	5.45	-

Abbreviations: R = rank, TP = total papers, TC = total citations, H = h-index, TC/TP = citations per publication, Population = thousands of inhabitants, TP/POP = total papers per million inhabitants, TOP 30 = contributed papers among the 30 most cited papers

Table 7: The most productive and influential countries

Finally, Table 8 provides information based on the geographical region of the countries and includes total publications, total citations, the h-index, and the citations per publications. Based on this classification, Europe, Asia, and North America are the top regions for these indicators. In addition, the detailed results of every sub-region are shown in Table 8. The final item reported in this table is the share of each region among the top 30 most cited papers. It is important to highlight that, when all European countries are analyzed as one group, Europe is the most productive and influential region, with a total of 2,047 publications, 49,978 citations received, and an h-index of 100. Europe has also produced more than half of the 30 most cited publications.

Supraregions	TP	TC	H	TC/TP	Top 30
North America	1254	41045	95	32.73	12
Europe	2047	49978	100	24.42	16
Northern Europe	724	24197	78	33.42	8
Western Europe	692	19416	66	28.06	7
Southern Europe	541	11859	53	21.92	3
Eastern Europe	344	3112	28	9.05	-
Asia	1927	41962	92	21.78	11
Eastern Asia	1139	26824	72	23.55	9
Western Asia	361	9184	55	25.44	1
South-eastern Asia	277	5112	35	18.45	1
Southern Asia	307	4447	31	14.49	-
Oceania	255	5418	40	21.25	-
Africa	230	4208	34	18.30	-
Latin America	150	2137	25	14.25	-

Abbreviations: TP = total papers, TC = total citations, H = h-index, TC/TP = ratio of citations divided by publications

Table 8: Publications by supranational regions

Keyword analysis

Next, we dive deeper into the topics that the articles deal with. Therefore, in this section, we make use of a graphical visualization of the bibliographical material applying the VOSviewer software (van Eck and Waltman 2010). This software generates "knowledge maps" based on different criteria, e.g., co-authorship, bibliographic coupling, citation, co-citation, and co-occurrence of keywords (Merigó and Núñez 2016), and allows for analyzing the main topics of the publications graphically. In these knowledge maps, the nodes represent the different keywords. The size of a node represents the importance of the respective keyword (i.e., number of occurrences). Links between the nodes represent co-occurrences. Thereby, two keywords appear closer to each other in the map if they occur together in many publications, i.e., the distance between nodes is dependent on the number of publications in which the respective keywords occur together.

From a pre-analysis, we knew that some keywords are regularly expressed differently although they are effectively the same. For example, some keywords are represented by several synonyms (e.g., "e-factoring" versus "digital factoring"), are expressed in singular and plural forms (e.g., "bitcoin" versus "bitcoins"), or are just spelled differently (e.g., "fintech" versus "fin-tech"). To obtain accurate and clean knowledge maps, we make use of a so-called "thesaurus" that contains a comprehensive list which helps to merge variants of the keywords used in the literature. Finally, singular and plural forms, synonyms, and different spellings are systematically merged.

For creating the knowledge maps, we rely on the author keywords listed in the papers as this has led to much clearer maps. Another option would be to also consider titles and abstracts. This, however, has led in our case to knowledge maps flooded by masses of irrelevant keywords. Moreover, we only consider keywords that fulfill a certain threshold of occurrences. Keywords that occur less that this threshold were not included in the maps.

According to the VOSviewer analysis, the most frequent keywords are "fintech", "blockchain", "cryptocurrency", "bitcoin", "crowdfunding", "p2p lending", "innovation", "digital banking", "mobile payment", and "mobile banking". Keywords were assigned to clusters by maximizing a quality function, which is a variant of the Girvan-Newman algorithm (van Eck and Waltman 2017). These clusters form groups of related keywords.
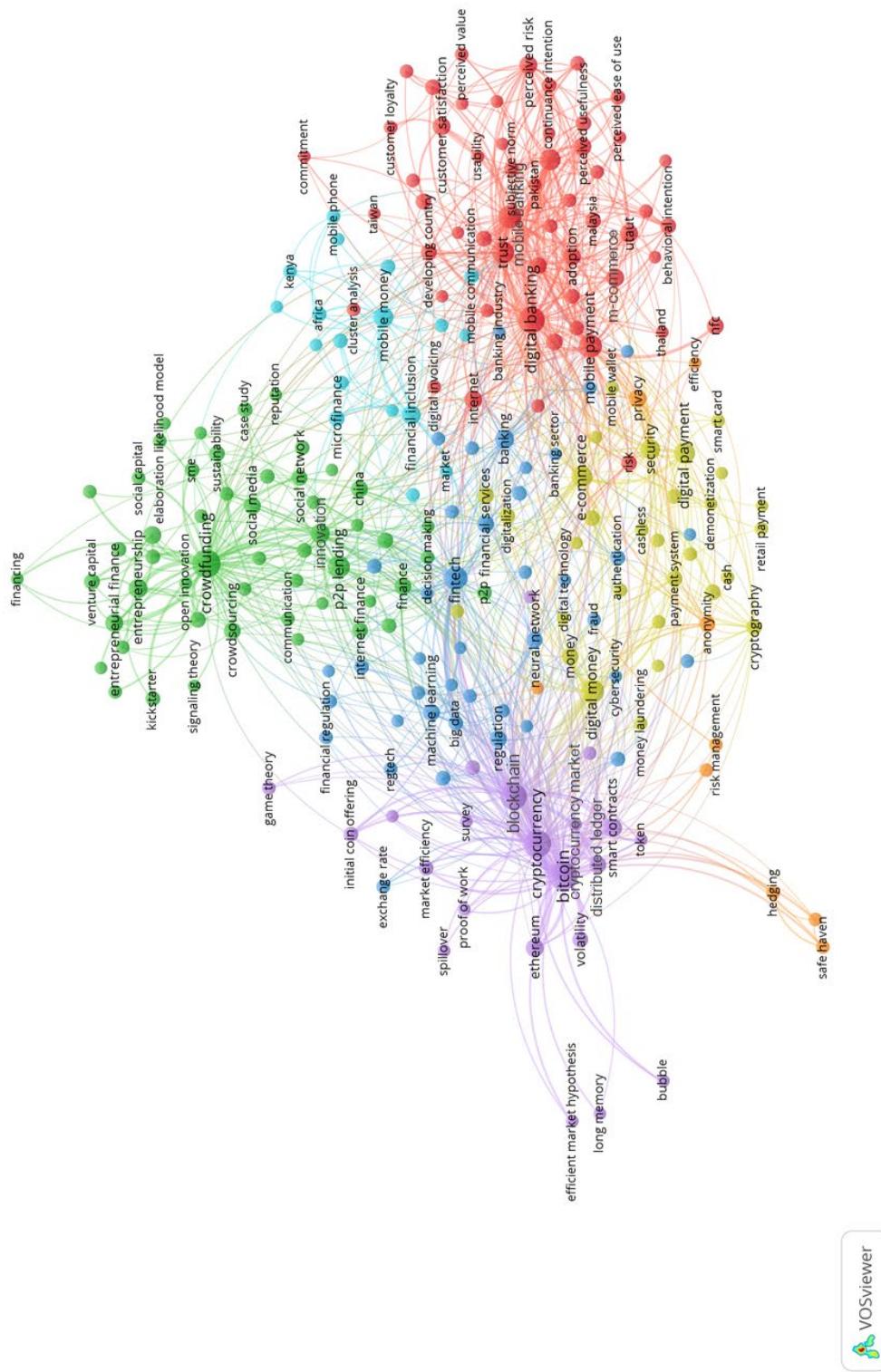
Figure 4: Knowledge map (1974-2019, minimum occurrence threshold of 10)

While Figure 4 depicts the whole time range, Figure 5 to Figure 8 present the knowledge maps obtained for certain periods (1974–2004, 2005–2009, 2010–2014, and 2015–2019) to identify changes over time. For the period 1974–2004, we can identify only a very limited number of keywords (Figure 5). The maps (Figure 6 to Figure 8) show that the number of keywords is increasing over time and keywords are getting more varied. The last period (2015–2019) – as depicted in Figure 8 – shows a great variety of different and interwoven research topics. In the knowledge maps, the different colors represent the clusters of related keywords. Each keyword is attributed to one specific cluster by the VOSviewer algorithm along the occurrences and connections of the keywords in the papers. However, one can observe several keywords that are closely connected to other clusters. For example, in Figure 5, digital banking and e-commerce are closely connected.

In the period 1974–2004, the keywords are in the context of digital banking, internet/banking, digital payment systems, digital money, and digital payments. These topics are arranged around e-commerce – an important driver of the development of digital payments. In this period, research mainly focuses on the online banking and online payments. The great variety of Digital Finance services that can be seen today did not exist and was, therefore, not addressed by research in these times.

In the period 2005–2009, research started to address the "mobile" aspects, like "mobile payment", "mobile banking", "mobile commerce", and "mobile communication". This research trend was pushed by the first smartphones comping up in 2007. Moreover, "digital trading" and aspects around "security" appeared on the academic agenda.

In the period 2010–2014, the topics "crowdfunding" and "p2p lending" became more relevant. Although there had been first initiatives for crowdfunding platforms (first for artists and musicians) between 2003 and 2006, it seems that crowdfunding was less in focus for researchers until platforms like Indiegogo (2008) and Kickstarter (2009) came into the play and fostered a hype around this type of innovative digital financing. Moreover, "digital invoicing" appears on the research agenda.

In the period 2015–2019, researchers turned to another hype topic: "blockchain". Consequently, topics around "bitcoin", "etherium", and "smart contracts" became relevant. "Ransomware" and "darknet" are further typical topics connected to this technology – which reflects the "dark side" of blockchain. Although bitcoin went live in 2009, it took several years until research turned towards this topic. The high volatility in 2013 and the increasing bitcoin price 2016 onwards might have been important drivers for addressing this topic in research.
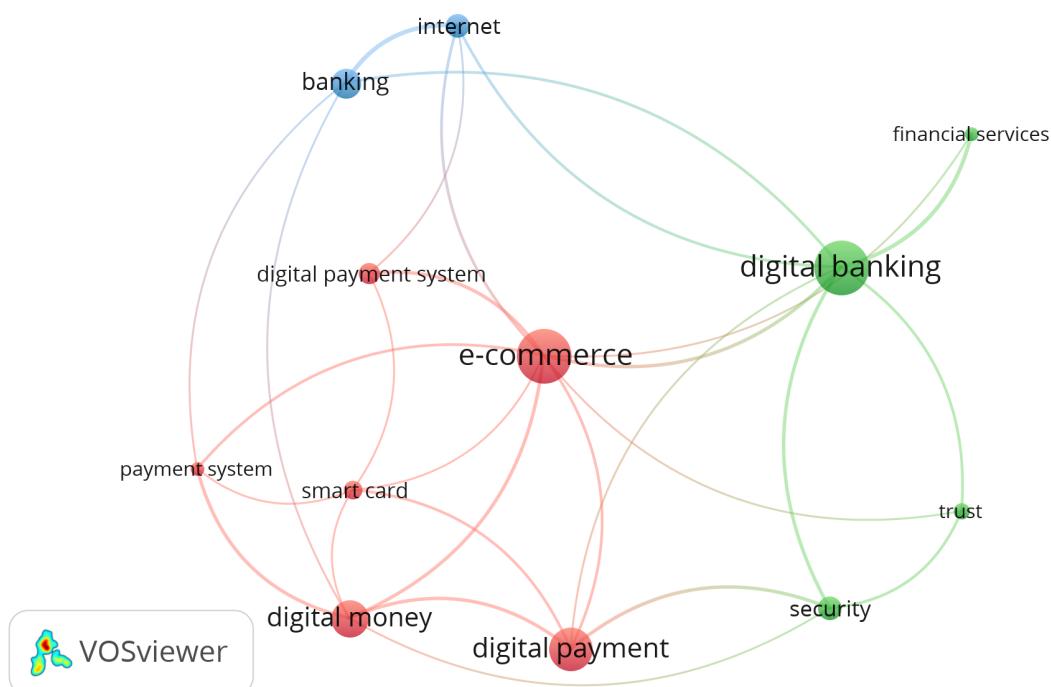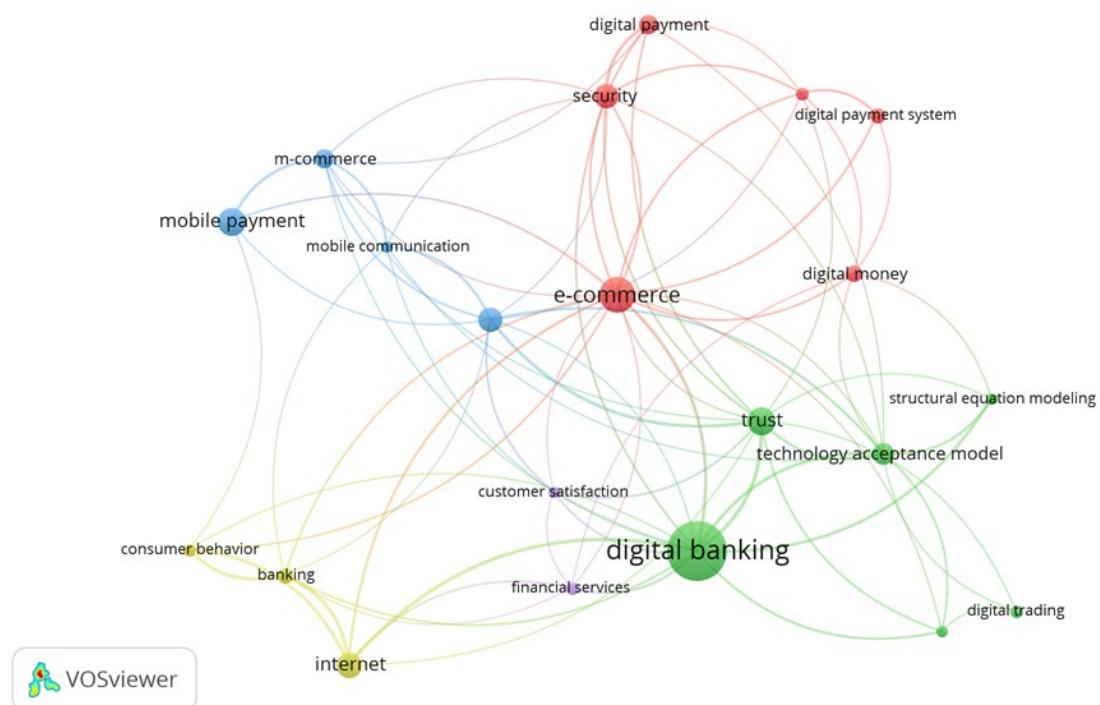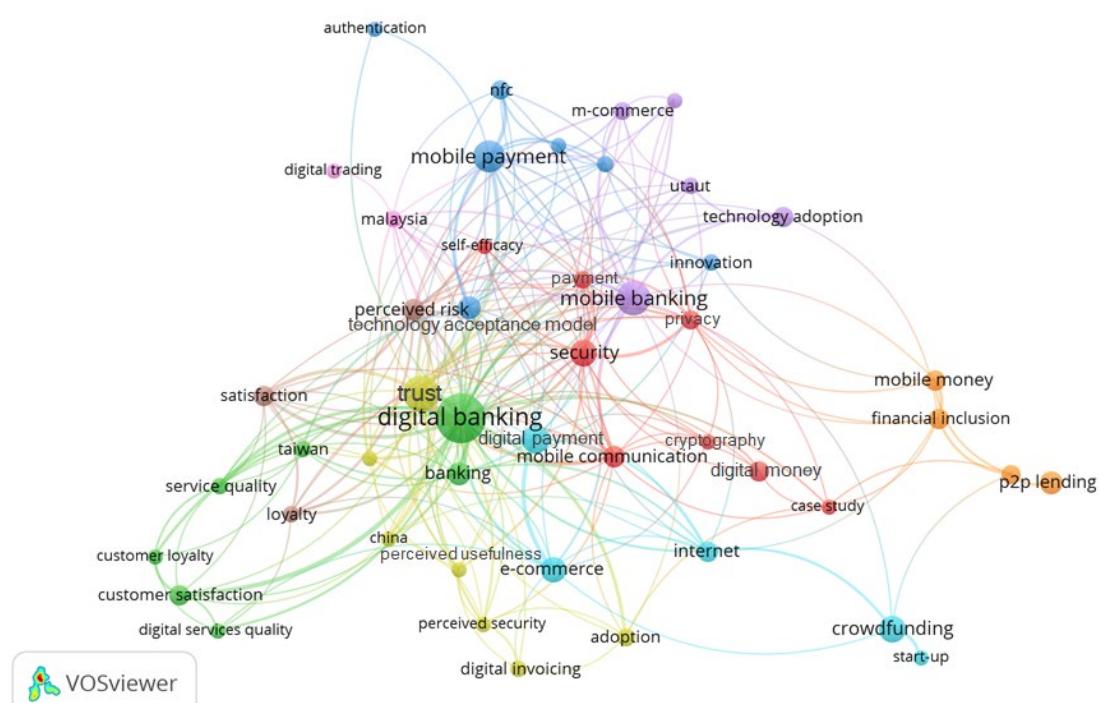
Figure 5: Knowledge map (1974–2004, minimum occurrence threshold of 5)

Figure 6: Knowledge map (2005–2009, minimum occurrence threshold of 5)

Figure 7: Knowledge map (2010–2014, minimum occurrence threshold of 5)
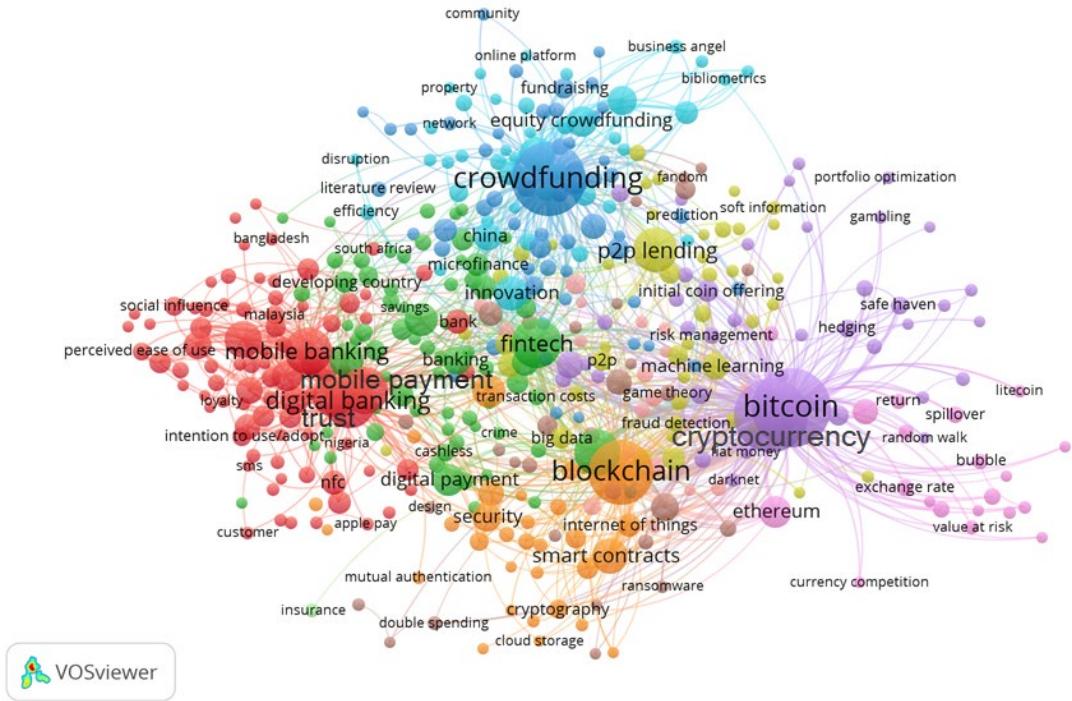
Figure 8: Knowledge map (2015–2019, minimum occurrence threshold of 5)

The strength of these knowledge maps lies in the opportunity to oversee the relevance and the connection of topics at one sight. However, using the knowledge maps, it is not easy to quantify the occurrences of the keywords. Therefore, we take a closer look on the keyword quantities. Table 9 displays the 30 most common keywords in the different periods analyzed in knowledge maps (Figure 5 to Figure 8) and the numbers of the keywords' occurrences. Table 9 confirms the findings from the knowledge maps. The numbers show how the interest in different topics has evolved. While there are some topics that remain in the focus of research over time, such as digital banking, digital payment, digital money, e-commerce, and security/trust, other topics are not addressed during the first years of the analysis. This quantitative analysis underlines, for instance, that the period 2005–2009 is testimony to the appearance of keywords such as "mobile payment", "mobile banking", "m-commerce", and "mobile communication", suggesting that this is the stage of the appearance of "mobile" digital finance and FinTech. The appearance of keywords such as "crowdfunding", "p2p lending", and "microfinance" in the period 2010–2014 suggests a stage oriented in the topic of microfinance, but also which consolidates topics of the previous stage with keywords such as mobile money. Finally, in the last period emerge the topic of "blockchain" and "cryptocurrency" (e.g., bitcoin, ethereum, etc.).

Years 1974-2004			Years 2005-2009			Years 2010-2014			Years 2015-2019		
Topics	Oc	%	Topics	Oc	%	Topics	Oc	%	Topics	Oc	%
digital banking	20	10.8%	digital banking	52	18.4%	digital banking	98	19.3%	**bitcoin**	556	14.0%
e-commerce	20	10.8%	e-commerce	25	8.8%	trust	41	8.1%	**cryptocurrency**	474	11.9%
digital payment	16	8.6%	**mobile payment**	17	6.0%	mobile banking	37	7.3%	crowdfunding	470	11.8%
digital money	14	7.5%	trust	17	6.0%	mobile payment	31	6.1%	**blockchain**	348	8.7%
banking	11	5.9%	internet	15	5.3%	digital payment	23	4.5%	digital banking	190	4.8%
internet	9	4.8%	**mobile banking**	14	4.9%	security	22	4.3%	**fintech**	173	4.3%
security	9	4.8%	security	14	4.9%	**crowdfunding**	21	4.1%	mobile banking	157	3.9%
digital payment system	8	4.3%	**technology acceptance**	12	4.2%	e-commerce	18	3.5%	mobile payment	151	3.8%
smart card	7	3.8%	digital payment	10	3.5%	banking	15	2.9%	digital money	145	3.6%
trust	6	3.2%	digital money	8	2.8%	technology acceptance mo	15	2.9%	p2p lending	130	3.3%
financial services	5	2.7%	banking	7	2.5%	**p2p lending**	14	2.8%	trust	106	2.7%
payment system	5	2.7%	digital payment system	7	2.5%	mobile communication	12	2.4%	technology acceptance mo	88	2.2%
electronic market	4	2.2%	consumer behavior	6	2.1%	perceived risk	12	2.4%	**smart contracts**	77	1.9%
information technology	4	2.2%	cryptography	6	2.1%	digital money	11	2.2%	**entrepreneurship**	73	1.8%
micropayment	4	2.2%	**digital trading**	6	2.1%	internet	11	2.2%	mobile money	72	1.8%
technology adoption	4	2.2%	financial services	6	2.1%	**mobile money**	11	2.2%	innovation	69	1.7%
world wide web	4	2.2%	**m-commerce**	6	2.1%	customer satisfaction	10	2.0%	e-commerce	63	1.6%
automated teller machine	3	1.6%	mobile commerce	5	1.8%	**financial inclusion**	10	2.0%	financial inclusion	62	1.6%
cash	3	1.6%	**customer satisfaction**	5	1.8%	**satisfaction**	10	2.0%	digital payment	59	1.5%
consumer behavior	3	1.6%	**mobile communication**	5	1.8%	technology adoption	10	2.0%	**ethereum**	59	1.5%
cryptography	3	1.6%	**perceived risk**	5	1.8%	**microfinance**	9	1.8%	utaut	53	1.3%
economic theory	3	1.6%	**structural equation mo**	4	1.4%	**nfc**	9	1.8%	**equity crowdfunding**	52	1.3%
electronic data interchange	3	1.6%	**commitment**	4	1.4%	privacy	9	1.8%	security	50	1.3%
mobile commerce	3	1.6%	**mondex**	4	1.4%	adoption	8	1.6%	**entrepreneurial finance**	48	1.2%
money	3	1.6%	**self-service**	4	1.4%	payment	8	1.6%	adoption	45	1.1%
payment	3	1.6%	**service quality**	4	1.4%	**innovation**	7	1.4%	perceived risk	44	1.1%
privacy	3	1.6%	smart card	3	1.1%	**malaysia**	7	1.4%	**distributed ledger**	43	1.1%
adoption	2	1.1%	adoption	3	1.1%	service quality	7	1.4%	banking	41	1.0%
anonymity	2	1.1%	**authentication**	3	1.1%	**utaut**	7	1.4%	**china**	41	1.0%
bank regulation	2	1.1%	**blind signature**	3	1.1%	**digital invoicing**	6	1.2%	structural equation modeli	40	1.0%

Abbreviation: Oc = number of author keyword occurrences

Table 9: Top 30 topics by the number of occurrences (in bold: the emerging topics)

Emerging research trends

We dive deeper into the emerging research trends by analyzing the most frequent keywords in recent years in Digital Finance and FinTech research. For each keyword, we calculate the "average publication year". Therefore, we weight every year with the respective keyword quantity. If a keyword appears, for example, two times in 2018 and three times in 2019, the average publication year is (2018*2 + 2019*3)/(2 + 3) = 2018,6. Table 10 shows the 30 most recent keywords based on the average publication year. The table also presents the number of occurrences, the number of citations, and the normalized citations. Because the papers published earlier had the opportunity to receive more citations, we present both the average citations and normalized citations. The normalized number of citations is calculated by the VOSviewer software as the number of citations of the document divided by the average number of citations of all documents published in the same year and allows for better comparing younger to older keywords. Table 10 shows emerging topics related to "blockchain" and "cryptocurrencies", such as "token", "initial coin offering", and "ethereum", with average publication years of 2019.0, 2018.7, and 2018.7, respectively, and the two later with remarkable number of normalized citations. We find "bitcoin" almost at the end of the list. This means that the research focus is beginning to be shifted partly away from "bitcoin" and put more on other innovative concepts connected to blockchain.

Keyword	Average Publication Year	Number of Occurrences	Average Citations	Normalized Citations
spillover	2019.0	11	49.5	3.4
deep learning	2019.0	11	19.9	1.7
token	2019.0	12	2.5	0.2
efficient market hypothesis	2018.7	11	35.4	2.4
market efficiency	2018.7	21	41.2	2.3
initial coin offering	2018.7	24	18.8	1.5
ethereum	2018.7	59	17.4	1.4
volatility	2018.7	34	54.1	3.0
smart contracts	2018.6	77	31.8	2.1
game theory	2018.6	13	18.0	1.5
decentralization	2018.6	10	17.0	1.3
credit scoring	2018.6	20	15.0	1.0
sentiment analysis	2018.6	10	14.3	0.9
artificial intelligence	2018.6	16	13.9	1.0
internet of things	2018.6	25	43.0	2.7
machine learning	2018.5	38	17.8	1.1
blockchain	2018.5	348	23.8	1.6
distributed ledger	2018.5	43	21.7	1.5
regtech	2018.5	13	8.2	0.5
cryptocurrency	2018.5	474	26.9	1.7
long memory	2018.5	11	59.7	3.5
digitalization	2018.4	27	13.4	0.8
hedging	2018.4	15	78.4	4.6
demonetization	2018.4	10	3.5	0.3
liquidity	2018.4	13	15.9	1.0
proof of work	2018.3	12	14.7	1.2
safe haven	2018.3	15	83.8	5.0
gold	2018.2	13	60.6	3.4
bitcoin	2018.2	560	31.3	1.8
fintech	2018.2	174	15.9	1.0

Table 10: Research trends from author keyword analyses

Research Gaps

Figure 2 and Table 2 show the dynamic rise in the numbers of publications on Digital Finance and FinTech. However, not all topics have been addressed at the same time windows and in the same intensity. For example in banking, digital banking was addressed before mobile banking, and, in financing, crowdfunding was addressed before initial coin offerings. In spite of the dynamics, we still find topics that have been addressed very rarely so far although respective platforms are active for years. In this section, we exemplarily highlight topics that lack research and, thus, constitute fields for future research. The reported occurrences are all based on our dataset of 5,053 publications on Digital Finance and FinTech.

In the area "social trading" (9 occurrences) we still observe rather few publications, although famous social trading platforms – which allow users to follow trades of other platform members like on social media platforms – are online since 2010 (e.g., eToro). Even less research activity can be identified on

"zero commission trading" (0 occurrences) and "neobroker" (0 occurrences). Although the well-known zero-commission trading broker Robinhood was founded 2013 and there was a big hype around zero-commission brokers due to the GameStop short squeeze, this topic was not in the focus of attention yet. Another topic that is rarely addressed is "robo advisor" (7 occurrences). We observe that research on this topic has increased towards the year 2019 – but there is still much space left for research. Moreover, research on "digital insurance" (4 occurrences) is still quite scarce. Neither "mobile insurance" (2 occurrences), nor "p2p insurance" (1 occurrence) have been actively researched by academia. Moreover, the topic of digital insurances has not been approached from the technological perspective, e.g., by "insurtech" (3 occurrences). Finally, "digital leasing" (2 occurrence) and "digital factoring" (0 occurrences) are further topics that have still not found their place in academic research, which might be explained by the fact that these topics mainly represent bilateral relationships between banks and their customers with very few empirical data available for research.

Limitations

This work does not come without limitations. Our set of papers used for the analyses is dependent on the data quality of the database used: Web of Science. Journals that were not reported in this database could not be considered in the analyses. Moreover, Web of Science updates papers in their database regularly. This can lead to slight changes in the available papers if requests are repeated at a later point of time. These changes, however, concern a very few papers so that this effect is neglectable. Moreover, this methodology can be applied to further databases as well.

Furthermore, the resulting keyword list of our suggested two-stage process is dependent on the parameter *occ*, which defines in how many papers a keyword must appear to be selected in the second stage. The appropriate choice of *occ* is up to the researchers but we suggest the rule of thumb mentioned above.

Finally, the exact set of papers will depend on the quality of manual screenings. However, we argue that if the processes are conducted thoroughly, researchers will end up with largely equivalent results. Thereby, the methodology serves as a solid and common basis for performing systematic bibliometric literature review.

Conclusion

During the last years, research on Digital Finance and FinTech has experienced an impressive boom among scholars. Due to the soaring numbers of publications, it has become barely impossible to review the existing literature based on a systematic literature review, in which the papers are examined and summarized manually. The technique of a bibliometric literature review has gained traction over the last years due to the availability of appropriate software tools. Such bibliometric literature reviews can handle high numbers of publications and analyze the publications quantitatively. The quality of bibliometric literature reviews, however, heavily depends on the quality of the set of papers to be reviewed. The set of papers needs to be as complete as possible to capture the whole field of interest. However, the field of Digital Finance and FinTech is very heterogeneous and embraces several different aspects around Digital Financing, Digital Investing, Digital Payments, Digital Money, Digital Financial Advice, and Digital Insurances. The greatest challenge is to define a comprehensive list of search keywords that helps to identify all the relevant literature. To this end, we propose a methodology for a systematic bibliometric literature review that fosters systematic, comprehensive, and reproducible results. This methodology is characterized by a two-stage search process that forms comprehensive lists of search keywords for identifying the relevant literature for the review.

In the next step, we apply our methodology to the field of Digital Finance and FinTech. Thereby, we systematically collect and review all publications available on the Web of Science until the end of 2019. In total, our set of papers embraces 5,053 publications on the topic – the most comprehensive set of papers reviewed in this field so far. This outstanding number of systematically selected publications underlines the effectivity of our proposed methodology. Moreover, the two-stage search process makes the selection process of the final keywords much more robust against omitted keywords: Keywords that

have been omitted in the first stage have a good chance to be included in the second stage. Following our proposed methodology for conducting systematic bibliometric literature reviews, our analysis regarding literature on Digital Finance and FinTech outperforms all other bibliometric literature reviews on this topic that have been conducted so far in terms of considered search keywords and included publications (compare Table 1).

We analyze the publication and citation structure, the most influential papers and top journals, and the leading authors, institutions, and countries. Moreover, we present a thorough keyword analysis and an analysis of emerging research trends.

Our results show that, around the year 2014, the numbers of publications on Digital Finance and FinTech started to rise drastically. The last year of our analyzed period, i.e., 2019, reveals the highest number of publications (1518 documents), while the highest number of citations was reached one year before in 2018.

Moreover, we find that the first publications on Digital Finance and FinTech were contributed by journals on computer science and information technology. Journals around finance and human behavior addressed these topics much later. 98% of the authors have contributed only very few publications (1–3 papers), while 2% of the authors have contributed four or more papers, indicating that many authors are from other fields and have touched the topic of Digital Finance and FinTech by single projects.

Research topics shifted considerably over time. 1974–2004, the keywords are in the context of digital banking, internet/banking, digital payment systems, digital payments, and digital payments. The upcoming e-commerce was an important driver of the developments around digital payments. 2005–2009, research started to address the "mobile" aspects, like "mobile payment", "mobile banking", "mobile commerce", and "mobile communication" – a trend that was pushed by the upcoming smartphones. 2010–2014, academics started to address topics around "crowdfunding", "p2p lending", and "microfinance". 2015–2019, research on topics around "blockchain", "bitcoin", "etherium", and "smart contracts" evolved.

Research on some topics is still scarce. We find that keywords like "social trading", "zero commission trading" and "neobroker", "robo advisor", "digital insurance" and "mobile insurance", "p2p insurance", "insurtech", "digital leasing", and "digital factoring" are topics that reveal significant research gaps.

The contributions of our work are twofold. Firstly, we contribute to the discussion on bibliometric literature reviews by proposing a two-stage methodology with eleven research steps for systematic, comprehensive, and reproducible bibliometric literature reviews. This methodology can be transferred to any field of research. Its main strength is its ability to deal with heterogeneous fields of research that are not easy comprehensively captured by search keywords. Secondly, we evaluate our proposed methodology by a comprehensive and systematic bibliometric literature review on Digital Finance and FinTech and identify research gaps to help academics designing future research project and to fill existing gaps.

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Data Availability Statement

The datasets generated and analyzed during the current study are based on publicly available data from Web of Science and they are available from the corresponding author on reasonable request.