DISCUSSION

EXPLORING THE INTERRELATION: A BIBLIOMETRIC ANALYSIS AND SYSTEMATIC LITERATURE REVIEW OF THE CURRENT LANDSCAPE AND FUTURE TRAJECTORIES OF FINTECH AND SUSTAINABILITY

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Abstract

To identify the most recent trends in the literature about the convergence of FinTech and Sustainability, this study combines bibliometric analysis with a thorough literature review using documents from the Scopus database. The current body of literature in a particular topic of research is thoroughly and methodically examined on a systematic literature analysis. One quantitative technique that makes it easier to identify current trends and underlying ideas in a subject is bibliometric analysis. Trends, evolution, bibliometrics, mapping, and qualitative content analyses serve as the foundation for the analysis. By following all inclusion and exclusion criteria, 116 papers that were taken from the Scopus database were bibliometrically reviewed in order to identify popular keywords, notable authors, institutions, and countries. WordStat was used for content analysis, and Biblioshiney and VOSviewer were used to determine the most cited papers. The results identified five noteworthy clusters. The results show a significant increase in the examination of the connection between FinTech and Sustainability starting in 2021, highlighting the significance of technological advancements and financial innovations in the corporate sphere.

Implications for Central European audience: The study's conclusions have significance for sustainability research as well as FinTech, stressing the importance of relevant research methods and the part FinTech plays in developing and putting sustainable practises and initiatives into reality. The study outlines the development of the literature on the connection between sustainability and fintech, offering insights into influential writers, countries, organisations, and journal sources. The study's insights help to direct future research in this field by providing a road map for more investigation and comprehension of the changing dynamics between sustainability and FinTech.

Introduction

FinTech uses technology to supply financial services and products and applies it to strategy (Alrawashdeh et al., 2022). Information technology (IT) helps in this matter a lot. IT improves business productivity, lowers resource input and increases efficiency (Liao, 2023). Globally, the financial sector is facing challenges due to technological innovation and digitisation. When new technology is applied to financial services, it's known as fintech (Abad-Segura et al., 2020). It alludes to recent technological advancements meant to enhance and mechanise the provision of financial services. In particular, over the past ten years, the financial industry has seen a number of changes to its operational model, including the introduction of Internet banking services and automated teller machines (ATMs) (Najaf et al., 2023). The financial services industry is currently facing new challenges, chief among them the growing concerns of consumers regarding the sustainability and environmental responsibility of the goods and services they buy and use (Vergara & Agudo, 2021). Environmental, social and governance (ESG) aspects and corporate social responsibility (CSR) are the main ways that new management trends are expressed (Najaf et al., 2023).

The previous ten years have seen a significant evolution in financial technologies because of advances in digitisation. Many technologists and financial professionals have been interested in the rise of new technologies like blockchains, which has led to the creation of new tactics and approaches (Zhao et al., 2019). Due to the adoption of these technologies by banks, the financial industry is currently the primary user of them (Dozier & Montgomery, 2020). These technologies have made the development of substitute payment systems easier.

There are two main ideas that explain the rise of FinTech companies. First is the tenet of the consumer theory, which holds that when customers have a certain desire, new services can successfully replace older ones (Aaker & Keller, 1990). Second, disruptive innovation suggests that there is a real possibility for new players in the industry to gain market share by providing more effective and affordable services (Christensen et al., 2006). At the same time, national and international stakeholders are observably adopting sustainability and performance techniques at a faster rate.

With great attention, this study focuses on the relationship between Fintech and sustainability. The majority of research has focused on FinTech as a result of blockchain and artificial intelligence technologies' development and expansion (Fernandez-Vazquez et al., 2019; Kumar et al., 2023). This research centres on FinTech and sustainability, given their growing significance in light of the digital revolution and the introduction of the Sustainable Development Goals (SDGs). Researchers studying the effects of digitisation as well as governments seeking to guarantee strict adherence to SDGs have developed a keen interest in FinTech and sustainability (Ellili, 2022). Previous research has been presented by academics, focusing solely on fintech and sustainability (FT&S) throughout the last three decades and offering a small number of bibliometric analyses and comprehensive literature reviews. The majority of the systematic literature reviews and bibliometric analyses focus on particular topics, including "fintech" (Firmansyah et al., 2022;

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Pandey et al., 2024; Sánchez-Obando et al., 2023; Milian et al., 2019). Carolina Rezende de Carvalho Ferreira et al. (2016) carried out a thorough study of the literature on finance and sustainability. Moreover, only a small number of fintech meta-analyses, like those by (Bommer et al., 2023; Wu, 2017; Bergmann et al., 2023). The study's unique contribution is supported by the small number of studies that address the scope of FT&S. However, a limited number of studies covering questions like how fintech applications play a crucial role in achieving sustainability and furthermore, we were unable to locate and select any studies that provide light on the philosophical and intellectual underpinnings of this expanding field of inquiry. In order to compile the body of existing literature and offer precise directions for further research, these gaps necessitated a thorough bibliometric and systematic literature evaluation integrating qualitative and quantitative methodologies. To comprehend the present status of FT&S research, a quantitative study of the top authors, best papers, best country, and most frequent keywords is conducted. This study's main goal is to provide insightful information to regulators, practitioners, academics, governments, and financial institutions by compiling the most recent advancements in this developing field. Network analysis, which includes co-citation, citations, and keyword occurrences, is used to assess theoretical frameworks and identify possible research directions in the FinTech and Sustainability area. It is anticipated that the study will offer a sneak peek at the new information that scholars, politicians, and regulators can soon anticipate learning. In conclusion, the study suggests a framework for future academic research in fintech and sustainable fields.

We want to address the following six research questions in this review paper:

RQ1: What is the current trending order of authors, fields, journals, time, affiliated nations, and institutions for fintech and sustainability publications?

RQ2: Which publications, authors, and sources are at the top of the field of fintech and sustainability research?

RQ3: Which research has been cited the most about the interrelation between sustainability and fintech?

RQ4: What are the different phases of the evolution of fintech?

RQ5: Which key themes emerge from the interrelation of fintech and sustainability?

RQ6: Which way does fintech help to achieve sustainability?

From the aforementioned research questions, the following study objectives are formed:

Objective

1. Mapping the intellectual landscape of sustainability and fintech research requires bibliometric analysis.

2. To pinpoint important themes, approaches, evolutions and knowledge gaps in the body of current research, do a thorough assessment of the literature.

3. To investigate the way fintech helps to achieve sustainability.

4. To Specify future research directions for this field.

This study's objective is to clarify a particular area of research. This study adds to the body of literature by analysing the most pertinent FinTech topics. The findings of the study, which are based on a range of bibliometric analyses combined with content analyses, emphasise three important fintech and sustainability themes that are mostly studied by academic researchers. The five main focuses are Sustainability performance, blockchain technology, green finance, digital economy and financial inclusion. Value drives institutional investors with individual interests and has significant long-term effects. From these results, we provide a number of future study directions for academics, practitioners, politicians, regulators, and sustainable investors. The findings also show how research on FinTech's role in sustainability has changed over time, with a notable increase in the number of publications and citations on this subject, indicating FinTech's substantial significance in the sustainability space. This study uses document articles from the Scopus database to determine the most important writers, countries, organisations, and references.

The remainder of the paper is organised as follows: Section 2 covers the evolution of fintech. Section 3 presents the literature review, and section 4 presents the research methodology. Sections 5,6,7,8,9 and 10 present the results, content analysis, main themes, discussion, future research, important conclusions, limitations and implications, respectively.

Evolution of Fintech

Prior to the late 1990s and early 2000s, there was no fintech industry (Sreekala et al., 2023). However, the development of computer systems and the rise of electronic banking in the financial services sector in the 1970s and 1980s can be considered the forerunners of fintech. These early developments paved the way for fintech's ascent and development in the second half of the 20th century and beyond. Because of its rapid and dynamic growth, the fintech industry has seen enormous yearly changes.

Based on their distinguishing characteristics, three main periods can be used to divide the history of fintech. Fintech 1.0 refers to a time when the financial industry mostly used analogue methods. Globalisation is the main focus of Fintech 2.0, which is a collection of computational and digital technologies used by the financial sector to improve operational processes. Fintech 3.0 is defined by the coexistence of startups and established institutions such as banks, whereas Fintech 3.5 denotes a stage in which significant tech corporations (TechFins) and financial startups work together to drive digital innovation. The most recent period, dubbed FinTech 4.09 (Arner et al., 2021), marks the advent of hegemonic digital finance systems.

2.1 FinTech 1.0 (1866-1967): about Infrastructure/ Analogue Industry

The first wave of fintech emerged in the early years of global financialisation. The first ATM was established by Barclays in 1967, which is a noteworthy milestone on this timeline, and it comes after the first transatlantic cable link between Europe and America was established in 1866 (Setiawan & Maulisa, 2020). The first transatlantic cable was implemented in 1866, and Fedwire, the first electronic payment transfer system using the telegraph and Morse

code, debuted in 1918. These were two significant occurrences that occurred during this century. Credit cards were created in the 1950s as a way to reduce the hassle of carrying cash (Sreekala et al., 2023).

The financial sector has adopted outdated analogue technologies such as steamships, railroads, canals, and telegraphs during this period. These systems made it possible to facilitate cross-border financial links and the rapid international transfer of payments, financial data, and transactions. Diner's Club introduced its credit card in 1950, followed by the American Express Company in 1958.

2.2 Fintech 2.0 – Digitalization (1967–2008)

Fintech 2.0 has become more popular since the ATM was created. 1967 through 1987 is considered the second Fintech period (Giglio, 2021). In the latter part of the 1970s, there was a rapid change in electronic payment methods. The Interbank Payments System, developed by the Federal Reserve Bank of New York in 1970, transitioned to an electronic system through Fedwire in the early 1970s (Federal Reserve Bank of N.Y., 2015). In 1990, the formation of the BIS Payments and Settlements Committee was decided. The pivotal moment for the securities industry occurred with the founding of the National Association of Securities Dealers Automated Quotations (NASDAQ) in the US in 1971, signalling a shift from physical securities trading dating back to the late 1600s (Giglio, 2021). The advent of online banking for financial consumers commenced in 1995, with Wells Fargo launching the first Internet banking protocols via the World Wide Web (www), marking the onset of the online banking era. This milestone marked the continuation of the trajectory. As part of the UK financial market plan, the first branchless banks appeared in 2005, with ING Direct and HSBC Direct setting the standard. More established financial institutions like insurance companies and banking conglomerates are particularly referred to as fintech 2.0. (Arner et al., 2016; Arner et al., 2018).

2.3 Fintech 3.0 (2008–2014) is about startups

An important turning event that may have contributed to the development of the Fintech 3.0 period was the global financial crisis of 2008. In fact, the perception of banks' soundness and brand image have been damaged since 2008 (Giglio, 2021). The quick pace of technological advancement and the evolving identities of financial service providers are the primary differentiators of FinTech 3.0 (Arner et al., 2018). Offering speciality services to customers, corporations, existing financial institutions, startups, and technology companies has put conventional financial institutions under pressure. An important development that significantly altered the financial scene was the 2009 release of Bitcoin v0.1. Numerous cryptocurrencies quickly emerged as a result of this evolution, and the 2018 great cryptocurrency crash served as a notable marker for this age. At the same time, customers' principal means of accessing the Internet and using a variety of financial services have been replaced by smartphones (Sreekala et al., 2023).

2.4 Fintech 3.5 (2014–2017) about globalisation

Fintech 3.5 marks a break from the Western-dominated financial system with a focus on the internationalisation of digital banking through fintech innovations (Sreekala et al., 2023). It emphasises the analysis of internet user behaviour and usage trends in emerging nations, highlighting in particular how markets like China and India, which have not had the chance to build up the same physical banking infrastructure as the West, have shown a speedier openness to novel ideas. The rise of multiple new competitors and their advantages as late entrants characterise this time.

2.5 FinTech 4.0: Moving Toward a New "Too-Big-to-Fail" Digital Landscape in Finance

The proliferation of scale within the context of financial platformization, which is the hallmark of FinTech 4.0, is fueled by the disruptive entry of BigTech businesses, the growth of FinTechs and TechFins and the involvement of significant incumbents in Big Finance (Feyen et al., 2021). The primary contention of the thesis is that the financial industry has become more concentrated and dominant in both technology and finance as a result of the datafication and digitisation of finance, network effects, and economies of scope and scale over several decades. A new class of businesses that are thought to be "too big to fail" and possibly even "too big to regulate" has emerged as a result of this trend (Buckley et al., 2022). According to Frost et al. (2019), big tech companies are defined as technology businesses that have a strong presence in the digital services industry and are best represented by successful digital platforms. Prominent companies in this sector include Alibaba and Tencent in China, as well as Amazon, Facebook, and Google in the United States. American companies have not yet achieved significant traction in the financial services market compared to their Chinese competitors. The obstacles that BigTech companies bring to the banking industry differ greatly from those that FinTech companies bring. A FinTech company is usually a niche business that competes with a certain bank product line (Stulz, 2019). For example, a FinTech company focused on credit seeks to overtake banks in a particular area of the credit market. As an alternative to targeting certain niches, BigTech companies might launch a frontal assault by competing with banks across numerous product lines. On the other hand, the term "TechFin" originates from the attack of technology-focused businesses rather than financial businesses (Vohra, 2020). Whether you run a large bank or a tiny fintech company, investing in technology is one of the most crucial things you can do for the financial industry. Bankers are obviously skilled at managing businesses and generating revenue. On the other hand, tech businesses have been prosperous lately. Companies like Amazon, Alibaba, Apple, Facebook, Google, Baidu, Tencent, and others are regarded as TechFins. While TechFins won't replace banks, they do have a more significant and important impact on how consumers interact with their money.

Figure 1 | Evolution of Fintech

Source: AILabPage

3 Literature Review

Fintech is a catch-all phrase that covers creative financial solutions made possible by IT (Puschmann, 2017). It also frequently refers to start-up businesses that supply these solutions, while it also includes established financial services providers like banks and insurers. This viewpoint is reinforced by a recent review of the literature, which identifies the three most frequently mentioned subjects in fintech publications as (1) services, (2) startups, and (3) the use of IT in finance (Wagner & Wagner, 2012). In actuality, the majority of contemporary Financial Service Institutions (FSIs) use IT-related strategies to assist in providing financial services. This issue has compelled researchers today to address the cyber threats that occur at all stages of the financial industry's technological process, spanning the public and private sectors. Therefore, compiling recent FinTech accomplishments is essential (Gai et al., 2018). Fintech developments hold the potential to enable underprivileged individuals to obtain financial services like insurance, credit, savings, and payments (Lagna & Ravishankar, 2022). The United Nations' Sustainable Development Goals (SDGs), particularly SDG1 (no poverty), SDG2 (zero hunger), SDG8 (decent job and economic growth), and SDG 10 (reduced inequalities), seem to have given rise to a vision of fintech-led financial inclusion (UNSGSA, 2018). Gomber et al. (2017) examine the state of the art in research on these cutting-edge and unique business operations in digital finance and state that technological advancements, as well as the responses of policymakers and regulators to these advances, will influence the direction of FinTech solutions in the future. On another aspect, recent research has also focused on how FinTech is upending wealth management and investing. Robo advising services are thought to be more appropriate for traditional investing than for more sophisticated investing (Km Poornima & Chitra, 2022).

The concepts of sustainability and, in particular, sustainable development were derived from more extensive scholarly discussions across several fields (Scoones, 2007). Three

main objectives of sustainable development are social responsibility, economic prosperity for the organisation and its stakeholders, and environmental stewardship (Placet et al., 2017). Businesses and stakeholders can establish long-term development using a common foundation provided by sustainable development goals (Al Hammadi & Nobanee, 2019). FinTech has the ability to realign money to support long-term prosperity and hasten the creation of inclusive and green financial markets (Al-Okaily et al., 2021). As a relatively young industry with distinct features from the old financial industry, fintech is also seen as a driver of sustainable economic growth. Global Fintech investments have expanded dramatically due to high expectations for the expansion of Fintech (Ryu & Ko, 2020). FinTech financing solutions are lowering financial exclusion and income inequality (Demir et al., 2022) and making healthcare services affordable and accessible to people with low to moderate incomes (Khezr et al., 2019). In the context of central Europe, nations are investigating how blockchain technology can improve sustainability. This is because blockchain technology provides transparent transactions, validates sustainable practices, and enables automated, trustless agreements that lower administrative costs and boost supply chain efficiency. The study's most significant finding was that when the Financial Development Index and the Global FinTech Index were used as benchmarks, fintech applications had a favourable impact on nations' financial development (Lavrinenko et al., 2023). The research examines the factors associated with cashless payment practises, emphasising the importance of consumer financial literacy within the Poland context (Świecka et al., 2021), and the results showed the range of factors influencing consumer behaviour. One of the most important personal traits of the clients that affected their payment decisions was their financial literacy. Nguyen et al. (2020) enumerated the following five barriers to fintech development: The legal corridor, infrastructure, fintech companies, clients, and human resources are the first five. Significant barriers also exist in a number of other aspects also, such as lack of trust, strict laws, or outmoded customs that leave holes in the infrastructure and regulations. These problems pose a severe risk to financial access and digital transformation as well. As per prior research, the majority of central European nations such as Poland, the Slovak Republic, the Czech Republic, and others are becoming more digitally engaged in the fintech space, but most of the population is still unclear and untrustworthy because they don't understand financial technology (Ádám Kerényi, 2018). So, it requires proper awareness and attention, and a thorough study is necessary.

A thorough analysis of Fintech continuation goals is necessary to ensure the industry's sustainable development and expansion (Ryu & Ko, 2020). The study needs all aspects, as we discussed earlier, not only from an industry perspective. To address all the above issues, this study investigates the interrelation of fintech and sustainability through bibliometrics and literature reviews. That's taken into consideration; the present study attempts to combine such literature and review the interrelation between fintech and sustainability.

4 Research Methodology

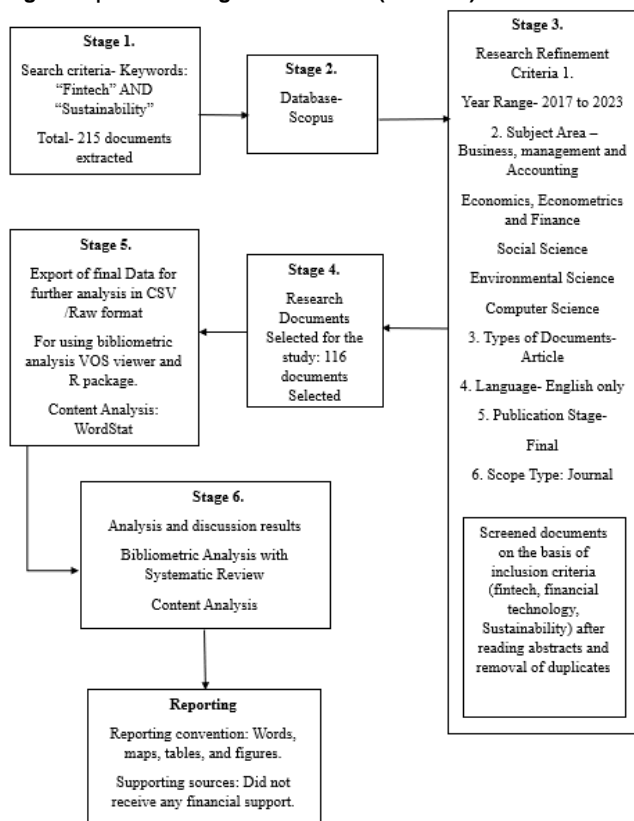## 4.1 Database, Keywords, Methods, Inclusion and Exclusion Criteria

Utilising bibliographic data, bibliometric analysis is a commonly used technique to look into a specific field of study (Bashar et al., 2021; Rabbani et al., 2021) since it uses scientific mapping techniques and explicit network analysis (Cobo et al., 2011) to analyse the general trend of a domain (Noyons et al., 1999; van Raan, 2005). Its user-friendly graphical display also makes it easier to examine the domain's development over time, as well as the cooperation of scholars and collaboration between universities and nations (Kumar et al., 2021; Gu et al., 2019). In order to better understand citations, co-citations, trending phrases, and pertinent subjects in their fields of interest, scholars utilise this tool. Using keywords that were carefully chosen based on the literature analysis on our topic, we gathered the data using the Scopus database. In line with previous research, the Scopus database offers a thorough index of a wide variety of scientific literature for bibliometric study (Herrera-Franco et al., 2020; Gorraiz & Schloegl, 2008). This paper used both systematic and bibliometric content analysis. The idea of a literature study, which is closely linked to the SLR and is frequently used in information systems research to ascertain the current state of the art of a certain issue, is also relevant (Suryono et al., 2020).

The first stage in bibliometric analysis is keyword selection, which involves using a range of keywords in various combinations to make sure no article on the topic is overlooked. "Fintech" AND "Sustainability" are the keywords employed in this study. The first search, yielding 215 articles, uses the Boolean logic of "AND" in the title, abstract, and keyword combinations. The search was conducted from 2017 to 2023. Only articles with comprehensive information are included. Duplicates and those without author details are eliminated. For the analysis, we took into account only empirical works; working papers, reviews, conference proceedings, book chapters, newspaper articles, and commercial articles were not included. In order to ensure objectivity during this second screening, all of the results from the first search were verified twice to rule out any possible inconsistencies. 116 articles made up the final sample after all these criteria were applied to papers that were screened based on inclusion and exclusion criteria. Following this, the analysis was carried out. The inclusion criteria further stipulated that research articles' abstracts and bodies must continue to be in line with the core theme. The R package's bibliographic application is used to identify the most productive writers, production by nation, journal contribution, and field expansion in order to estimate the bibliographic data. The raw data from 116 publications has been uploaded to Biblioshiny for further research. Bibliometric data can be obtained in graphical formats using the Biblioshiny tool. The data can then be saved as a picture or into Excel for use in different arrangements (Moral-muñoz et al., 2020). Use the VOSviewer tool to determine the co-citation network, bibliographic coupling, and nation collaboration displayed in network mapping for scientific mapping and network analysis. This study analysed content analysis to find out the most frequent themes in this field. Whether you need text mining tools for quickly identifying themes and patterns or

sophisticated quantitative content analysis tools for exact and meticulous measurement, WordStat is a versatile and user-friendly text analysis programme (Guide, 2021).

4.2 Overview of Analysis Method

There are many different kinds of systematic review publications. These include framework-based reviews (Paul & Benito, 2018), hybrid narratives that incorporate a framework for directing future research directions (Gilal et al., 2019), bibliometric analyses (Randhawa et al., 2016), and structured reviews that focus on commonly accepted concepts, procedures and frameworks (Rosado-Serrano et al., 2018: Paul & Mas, 2019). This study combines a thorough literature review with bibliometrics. Study subjects are assessed using bibliometrics, which is acknowledged as the most widely used technique for mapping the knowledge structure of a research field (Blanco-Mesa et al., 2017). To summarise the body of research and reduce bias, systematic literature reviews are utilised (Tranfield et al., 2003) and identify any potential gaps in the literature (Kumar et al., 2019). Bibliometric analysis is done in order to delve deeper into the domain, and then the primary themes' material is analysed (Kent Baker et al., 2020). Wordstat, Biblioshiny, and VOSviewer are the programmes utilised for analysis. The distance between elements on a map provided by VOSviewer can be used to determine how linked they are to one another (Goyal & Kumar, 2021). The closer two objects are together, the shorter their distance from one another (van Eck & Waltman, 2010). The "visualisation of similarities" is the foundation for this (VOS). The VOSviewer has been used for keyword analysis, co-citation, and citation. Wordstat software for content analysis (Guide., 2021). Additionally, content analysis has been used to explore the relationship between sustainability and fintech and make suggestions for further study.

Figure 2 | Methodological flowchart (PRISMA) framework

Stage 1.

Search criteria- Keywords: "Fintech" AND "Sustainability"

Total- 215 documents extracted

Stage 2.

Database- Scopus

Stage 3.

Research Refinement Criteria 1.

Year Range- 2017 to 2023

2. Subject Area – Business, management and Accounting

Economics, Econometrics and Finance

Social Science

Environmental Science

Computer Science

3. Types of Documents- Article

4. Language- English only

5. Publication Stage-

Final

6. Scope Type: Journal

Screened documents on the basis of inclusion criteria (fintech, financial technology, Sustainability) after reading abstracts and removal of duplicates

Stage 5.

Export of final Data for further analysis in CSV /Raw format

For using bibliometric analysis VOS viewer and R package.

Content Analysis: WordStat

Stage 4.

Research Documents Selected for the study: 116 documents Selected

Stage 6.

Analysis and discussion results

Bibliometric Analysis with Systematic Review

Content Analysis

Reporting

Reporting convention: Words, maps, tables, and figures.

Supporting sources: Did not receive any financial support.
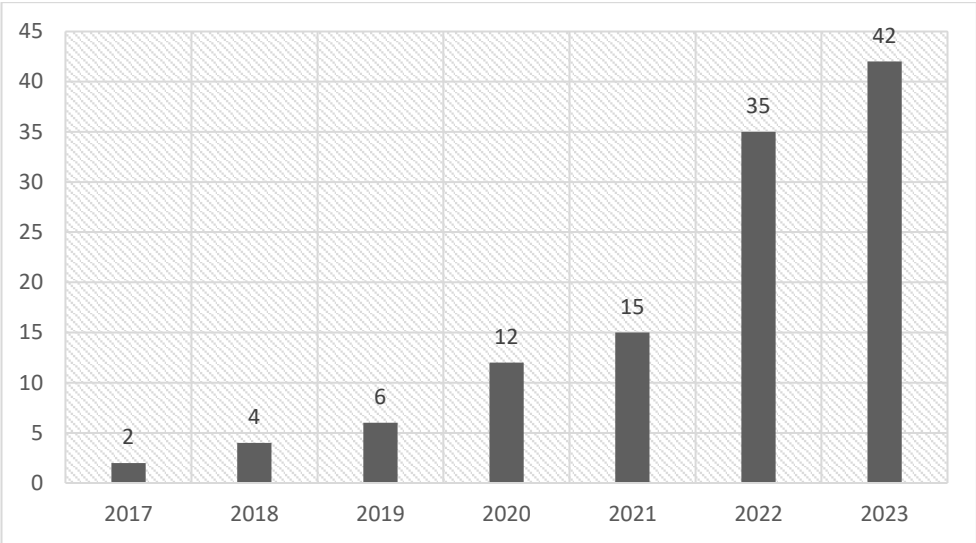
Source: Authors

5 Results

5.1 Trend of publications throughout time

Figure 3 shows the development of articles on the intersection between fintech and sustainability that are accessible in the Scopus database in the period 2017-2023. Publications have increased, with 42 articles published in 2023 compared to just two in 2017. There has been a sharp increase in research on the relationship between fintech and sustainability since 2019. The number of articles is growing, indicating that interest in this association among academic scholars is growing. Papers released in 2023 were taken into consideration for this trend analysis up until October. The increased awareness of the significance of the relationship between FinTech and sustainability principles at both the micro and macro levels is another factor contributing to the rise in publications on this subject. From 2017 to 2020, 24 papers were published; this is shown by the production trends from 2017 to 2023 in Figure 3. 50 articles were released concurrently in the 2021–2022 decade that preceded it. 42 articles were produced up to the month of October 2023.

The graph shows how production is increasing exponentially at the fintech-sustainability junction.

Figure 3 | Publication pattern of studies on the interrelation between fintech and sustainability (FT&S)
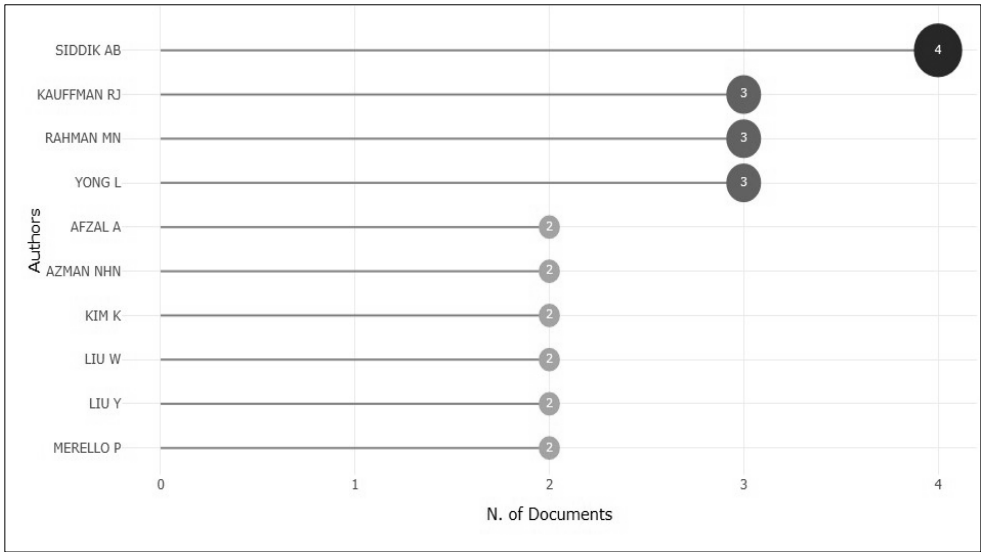

Source: Authors

5.2 Most prolific author

Based on the number of papers published, co-authorship, and citations received, this analysis provides insight into the authors' total body of work, with prolific authors being the most significant contributors to the field of study (Kumar et al., 2021a). An author's total number of articles authored serves as the basis for this study. With four publications, Siddik AB is the most active researcher in the area of fintech and sustainability, followed by Kauffman RJ, Rahman MN, and Yong L, whose rank stands second with each of the three scholarly contributions depicted in Figure 4.

Based on the quantity of publications, Figure 5 lists the most active authors in the interrelation between fintech and sustainability. It is said that not many of the early contributors on this topic have changed since the early 2010s. Throughout the time, the majority of the articles were contributed by the author, Kauffmann RJ., who has remained active. The development of the scientific framework for this study was also aided by Kim K., another reliable author. From 2020 onward, this discipline attracted a large number of other researchers who are routinely investigating the many facets of the field.

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Figure 4 | Most prolific authors on FT&S

Source: Authors

**Figure 5 | Most prolific authors on FT&S**
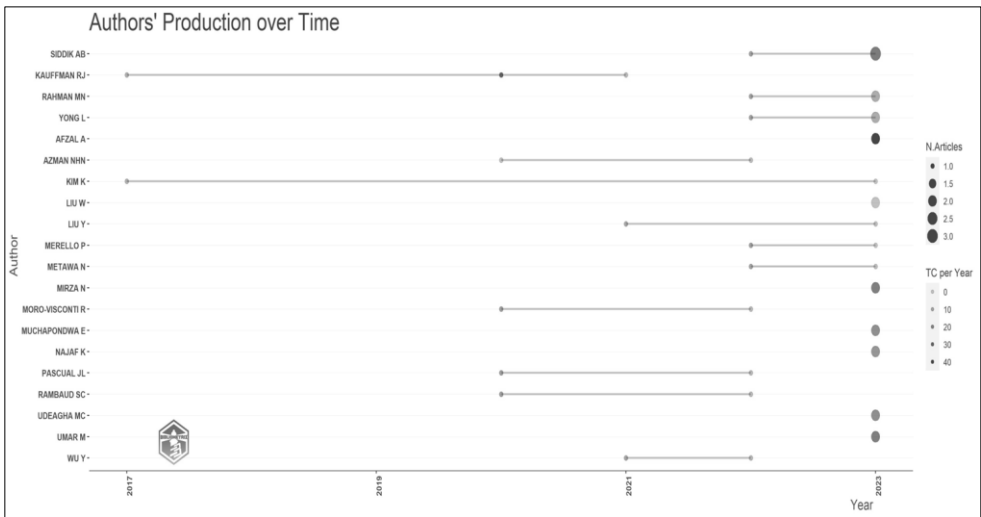
Source: Authors

5.3 Most globally cited documents

The papers that have been cited the most times worldwide are the most impactful. The important documents demonstrate how a specific subject theme is investigated and developed further (Kumar et al., 2021b). Figure 6. displays the top 20 most influential documents. The article "Sustainability, FinTech and Financial Inclusion", written by (Arner et al., 2020), has received the greatest citations, drawing researchers to expand their investigation into sustainability, fintech, and financial inclusion. Another significant addition, " How should we understand the digital economy in Asia? Critical assessment and research agenda" by Maurizio Naldi, Robert J. Kauffman, Dan J. Kim, Karl R. Lang, Kai Li, was published in 2020. It provides excellent insights into the digital economy (K. Li et al., 2020; Sidorov & Senchenko, 2020).

Most of the important papers centre on financial technology (Sangwan et al., 2020; Au & Kauffman, 2008). Among the notable documents, blockchain technology (Efanov & Roschin, 2018; Zheng et al., 2017; Andoni et al., 2019) and innovation with sustainable development constitute another significant sub-theme (Silvestre & Ţîrcă, 2019; Kardos, 2012; Henry & Stiglitz, 2010; Posch & Steiner, 2006).

Figure 6 | Majority of globally cited documents
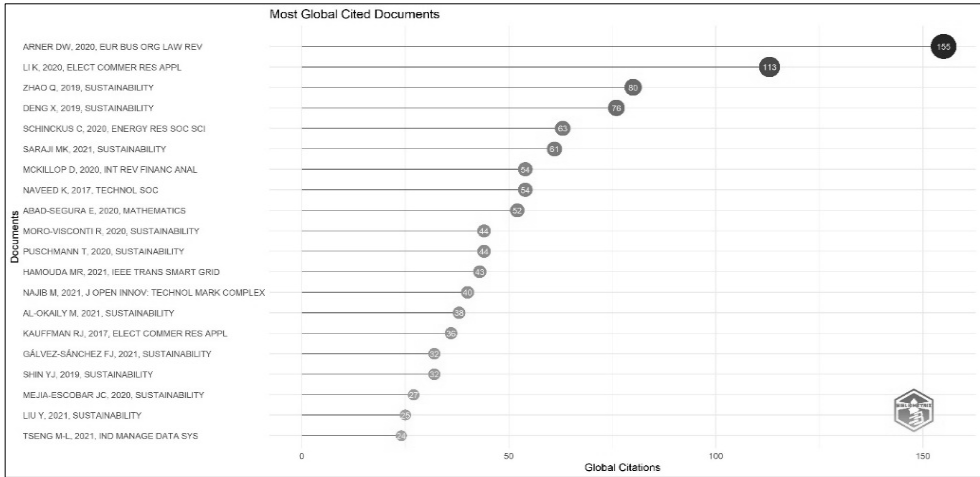
Source: Authors

5.4 Most Prominent Source

The evolution of a stream of research is significantly influenced by its origins. The top 20 sources are displayed in Table 1. according to the total number of articles. Citations and an h-index can be used to evaluate a journal's quality (Naeem et al., 2023). The attention an article receives in the form of citations from scholars determines its relevance. The greatest number of scientific articles with an H-index or higher are those that receive h or more citations (Leo Egghe, 2008). The G-index shows the maximum number (n) of articles with at least square (n × n) citations (Nalubega and Evans, 2015). The h-index can also be mentioned using the M-index. It displays the annual h-index as of the publication's debut year (L. Egghe, 2008). On the list, the journal Sustainability has the most citations (555)

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and 24 papers. Its publication in this field began in 2018, and it continues to rank first, which is an intriguing fact. There are just three publications published by the Journal of Islamic Monetary Economics and Finance, which was established in 2019. This publication does, however, have a very low h-index with only 11 citations. The journal Economic Analysis and Policy is another well-known publication. Its h-index is 2, and despite producing just two papers, it has been cited 39 times.

Figure 8 illustrates the expansion of the sources that confirm that there was little research done in the fintech and sustainability fields in the 2017s. The stream gained popularity in the early part of 2018 and experienced significant growth during that time. The field interrelation of fintech and sustainability has experienced exponential growth, and research publications in this area have been published in the sustainability journal on a consistent basis. However, the Resources Policy Journal and Environmental Science and Pollution Research with the Journal of Risk and Financial Management are expanding, albeit slowly, and appear to continue expanding in the near future.

Table 1 | Top 20 most influential sources on FT&S

| Journal	H-Index	G-Index	M-Index	TC	NP	PY-Start
Sustainability (Switzerland)	12	23	2	555	24	2018
Journal Of Islamic Monetary Economics and Finance	3	3	0.6	11	3	2019
Economic Analysis and Policy	2	2	1	39	2	2022
Electronic Commerce Research and Applications	2	2	0.286	149	2	2017
Environmental Science and Pollution Research	2	4	2	21	4	2023
European Business Organization Law Review	2	2	0.5	167	2	2020
Journal Of Open Innovation: Technology, Market, and Complexity	2	2	0.667	63	2	2021
Resources Policy	2	6	2	36	6	2023
Technological Forecasting and Social Change	2	2	1	25	2	2022
Technology In Society	2	2	0.286	57	2	2017
Abac Journal	1	1	0.333	3	1	2021
Asian Academy of Management Journal of Accounting and Finance	1	1	0.333	2	1	2021
Business: Theory and Practice	1	1	0.333	5	1	2021
Competitiveness Review	1	1	1	13	1	2023
Computer Law and Security Review	1	1	0.2	18	1	2019
Contemporary Economics	1	1	0.167	24	1	2018
Development Policy Review	1	1	0.5	5	1	2022
Economic Change and Restructuring	1	1	1	2	1	2023
Emerald Emerging Markets Case Studies	1	1	0.167	1	1	2018
Energy Research and Social Science	1	1	0.25	63	1	2020

Source: Authors

Figure 7 | Sources linked bibliographically on FT&S
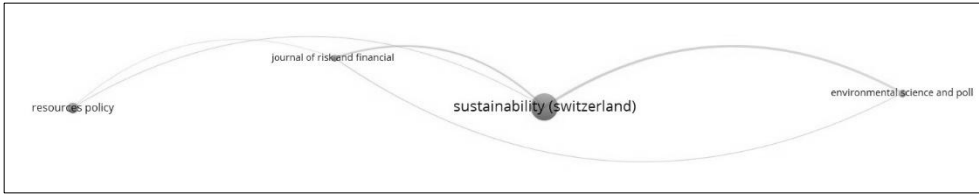
Source: Authors

Figure 7 displays the bibliographically connected map of sources. A thorough way to determine how similar the sources are to one another is through bibliographic coupling. If two documents are bibliographically coupled or quote the same third document, they are bibliographically connected (Garfield, 2004). Bibliographic coupling allows for the inference of connections or intellectual similarities between publications. When making bibliographic maps, which help determine the similarities between papers referring to the same work, VOSviewer is a very helpful tool (Moral-muñoz et al., 2020). The minimal quantity of documents from a source (three) and the minimum quantity of citations from a source (two) serve as the entry criteria for sources on the map. Figure 7 map demonstrates that it is composed of four items that are divided into two groups. Cluster 2 (green colour) has only one source, while Cluster 1 (red colour) has three sources. It is clear from the chart that sustainability is one of the main factors and is closely related to the other three components. Because the red cluster has more connectivity with others, journals that come under that cluster have similar topics and disciplines and cite similar works. This indicates that the red cluster has more bibliographic coupling power, particularly the larger circle one, than the green clusters. The larger circle size, the sustainability journal, agrees with the results in Table 1.

Figure 8 | Evolution of the sources on FT&S
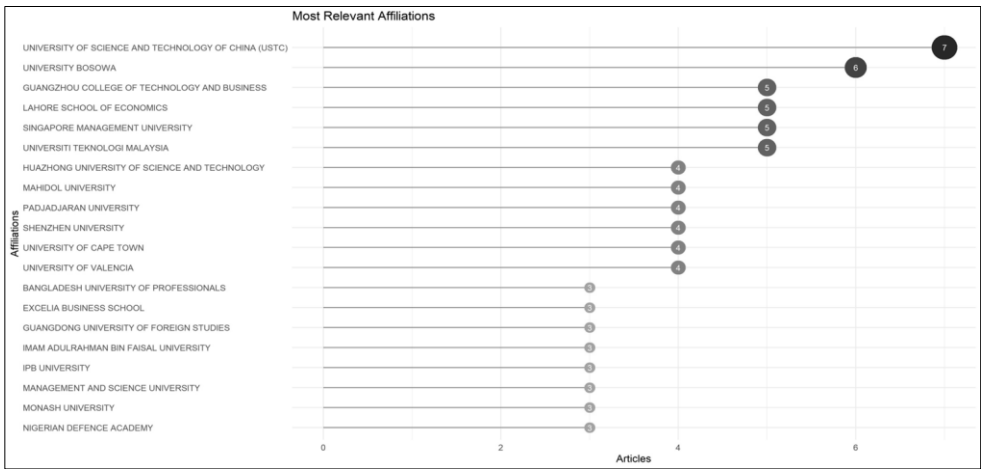

Source: Authors

DISCUSSION
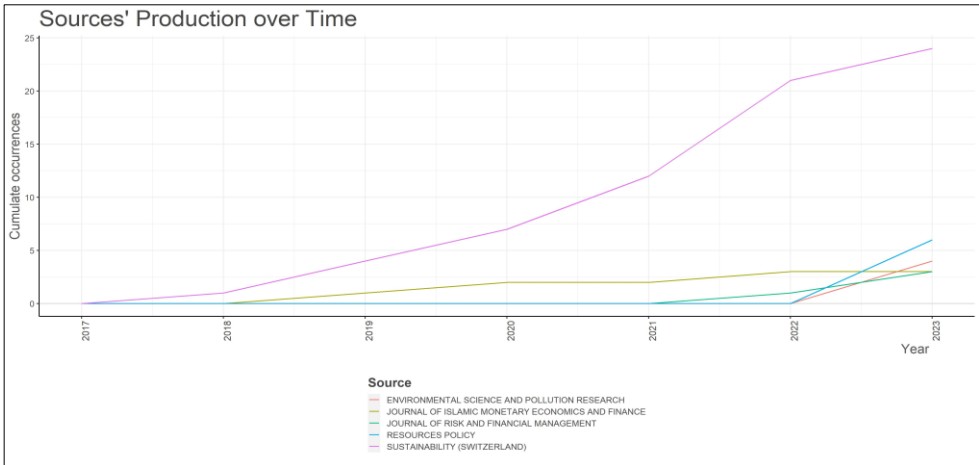
5.5 Top 20 affiliations that are most pertinent

Prominent associations within the field of fintech-sustainability research are indicated in Figure 9. With seven research articles, the University of Science and Technology of China is recognised as the top contributor. The University of Bosowa, Indonesia, is credited with six research articles, closely behind. At third place, with five scientific publications apiece, are the Guangzhou College of Technology and Business, China; Lahore School of Economics, Pakistan; Singapore Management University, Singapore; and Universiti Teknologi Malaysia, Malaysia.

5.6 Most pertinent nations

The affiliations demonstrate each nation's contribution to global scientific output. China, Indonesia, Malaysia, and Spain are the most influential nations among the top 20 countries contributing to the study on the interrelation between fintech and sustainability, as shown in Table 2. The accompanying chart shows the countries' collaboration as well, and it is clear that Spain, China, Indonesia, and Malaysia collaborate the most. Metrics based on productions from one country and many countries are available. The nations with the greatest output in a single country also have the greatest number of multiple collaborations.

Figure 9 | Top 20 influential affiliations on FT&S
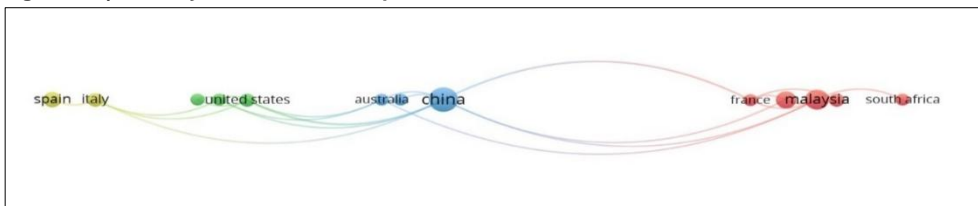

Source: Authors

Table 2 | Top 20 influential affiliated countries on FT&S

Country	Articles	SCP	MCP
China	23	15	8
Indonesia	9	5	4
Malaysia	8	3	5
Spain	8	5	3
Italy	5	3	2
Korea	4	3	1
South Africa	4	1	3
Germany	3	2	1
India	3	2	1
Singapore	3	1	2
Hong Kong	2	1	1
Jordan	2	2	0
Pakistan	2	1	1
Saudi Arabia	2	1	1
United Arab Emirates	2	0	2
United Kingdom	2	1	1
Australia	1	1	0
Canada	1	0	1
Colombia	1	1	0
Egypt	1	1	0

Source: Authors

Figure 10 shows the country collaboration map, which helps to understand how the countries are collaborating. The requirements for obtaining this map were limited to a country's minimum number of documents at five and its minimum number of citations at three. Just 13 of the 53 nations satisfied the requirements. The map makes it clear that authors from China, the USA, Malaysia, Australia, and Italy communicate closely and are investigating the intersection between fintech and sustainability.

Figure 10 | Country collaboration map on FT&S

Source: Authors

5.7 Top 20 most used words

The frequency of a word reflects the evolution and main concept of that subject of study (Kumar et al., 2021b). Understanding the dominant research stream and its substreams, as well as the common terms writers use in their titles, keywords, and abstracts, is made possible by the analysis provided in this paper (Wu et al., 2021). The Biblioshiny application generates a list of the most frequently used terms by applying a minimum frequency threshold of 20. Notably, Table 3 illustrates the terms that occur most frequently in this

domain: sustainability, sustainable development, finance, innovation, banking, economic development, and financial system emerge. It demonstrates how scholars are investigating these topics in light of the connections between fintech and sustainability, and some related fields.

Table 3 | Top 20 terms used most frequently on FT&S

Words	Frequency
Sustainability	34
Sustainable development	23
Finance	13
Innovation	12
Banking	10
Economic Development	10
Financial System	9
Economic Growth	8
Decision Making	6
Financial Services	6
Green Economy	6
Technology Adoption	6
Digitization	5
Financial Market	5
Fossil Fuel	5
Alternative Energy	4
Blockchain	4
Carbon Dioxide	4
Commerce	4
Economics	4

Source: Authors

5.8 Keyword co-occurrence analysis

Since keywords are the primary theme and hotspot in the topic of interest (Sethi et al., 2024). A map showing keyword occurrences is shown in Figure 11. The threshold requirement for minimum occurrence is set at 5, and only 25 out of 769 terms satisfied it. These keywords are organised into five clusters on the output map: Cluster 1 (red) contains eight keywords, Cluster 2 (green) has six, Cluster 3 (blue) has five, Cluster 4 (yellow) has 29 keywords, and Cluster 5 (violet) has two keywords.

The relationship between fintech and sustainability is seen in these clusters. The study streams in this subject that are centred around a particular theme are represented by these clusters.

Cluster 1: Sustainability - Eight keywords that integrate the studies pertaining to the relationship between fintech and sustainability research make up the most noticeable cluster (red). Scholars from all over the world have been drawn to the topic, and they have worked together to examine and assess related fields like financial inclusion, financial

services, the financial system, and decision-making. The primary focus of this cluster is the significance of sustainability achieved by following factors like financial inclusion, financial services, financial systems, digitalization, technology, etc. People living in rural areas are benefiting from technical advancements and digitalization, and various financial services are now available in remote areas. Which is termed as financial inclusion. The fact that this cluster is interconnected with other clusters demonstrates how these topics are integrated into other aspects of fintech.

Cluster 2: Green Finance - The terms associated with green finance and the range of green financial instruments utilised for sustainability are being accumulated by the second cluster, which is the green cluster. This cluster includes some noteworthy concepts, such as green finance, green economy, and finance. This cluster emphasize the importance of green finance helps to achieve sustainability. One is a green bond, a type of financial instrument that has positive effects on the environment together with rewards, whereas the focus of this cluster is on the different forms of financing and tools available for financing that are ecologically friendly. On the other hand, in this cluster, one theme is the green economy, which consists of six pillars: renewable energy, green buildings, clean transportation, water management, waste management and land management. These pillars also help to achieve sustainability.

Cluster 3: Sustainable Finance – The blue cluster emphasizes key themes found across various items, prominently featuring Sustainable Finance. Within this cluster, the prevalent terms include Sustainable Development, Banking, and Sustainable Finance. It reflects the ongoing research focused on the pivotal role of sustainable finance in fostering an eco-friendly environment, incorporating considerations of environmental, social, and governance (ESG) factors in investment decision-making. Notably, this cluster exhibits a strong correlation with other clusters.

Cluster 4: Fintech – The fourth cluster, which is otherwise known as the yellow cluster. The top keywords in this cluster are financial technology, fintech and blockchain. This cluster depicts the fact that research is being conducted on the importance of fintech adoption, and it helps to transparent the banking system with safety and security with easier transaction system. There are strong connections between this cluster and other clusters.

Cluster 5: Sustainability performance - Based on sustainability performance, the smallest cluster (yellow) in this network map was generated. The keywords sustainability performance and technology adoption are the most prominent in this cluster. Technological adoption not only helps to achieve sustainability but also helps to maximise profit in a firm or organisation with cooperation with making an ecofriendly environment. Also, there is strong connectivity between this cluster and other clusters, particularly the first one.

DISCUSSION

Figure 11 | Keyword occurrence map on FT&S
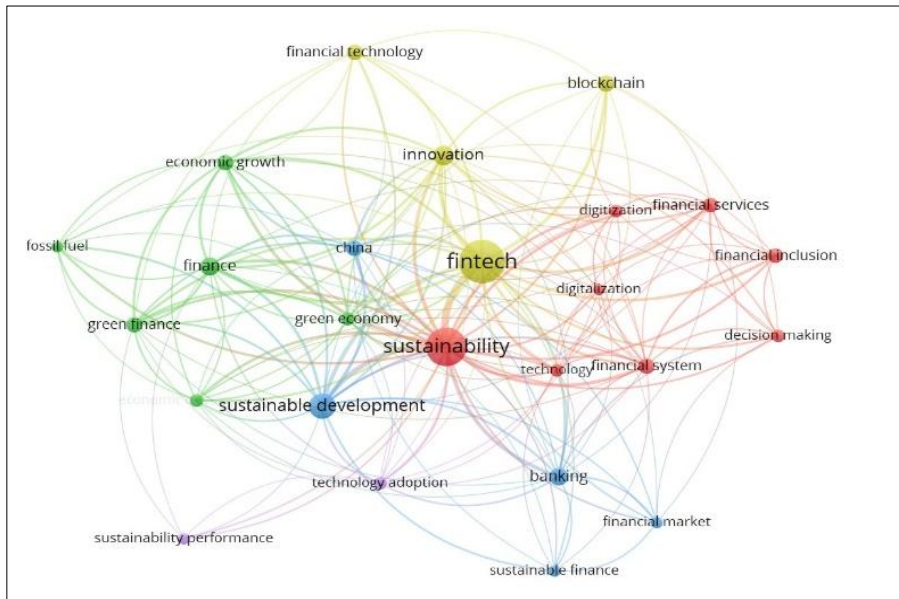
Note: The minimum occurrence of the keyword is kept at 5; out of 769, only 25 met the threshold.

Source: Authors

5.9 Word Cloud Analysis

The frequency of use of each term in this word cloud is indicated by its size. The most important sentences are given a large size and placed in the centre to stand out more, even though the phrases are arranged in a somewhat random order. The word cloud in Figure 12 displays the terms that were most commonly used in the paper's examination of the relationship between fintech and sustainability. The terms "sustainability," "sustainable development," and "finance," which rank first, second, and third, are the most often used ones. This suggests that scholars have examined this term and are concentrating more on it. More attention should be paid to this topic by researchers, and they should make connections with comparable fields that report smaller sizes.

Figure 12 | Visualization of the words that have been used the most frequently in articles on the interrelation of fintech and sustainability

Source: Authors

5.10 Co-citation analysis

The process of co-citation analysis is used to assess the intellectual coherence and resemblances between writers' works; the content of citations is not considered; rather, it simply takes into account the number of citations (Boyack & Klavans, 2010). It means the ability to identify similar papers mentioned together using the co-citation network is the primary advantage of co-citation analysis (Maharana & Panda, 2023). When similar authors cite similar works, clusters are created. Two writers who are mapped in the same cluster have both utilised similar references.

Only 50 authors out of the 12190 writers met the requirement of having at least 15 citations, according to the co-citation map analysis displayed in Figure 13. These authors were categorised into four distinct clusters. The most noticeable cluster, Cluster One (red), has 24 authors; Cluster Two (green) has 16 items; Cluster Three (blue) has 6 items; and Cluster Four (yellow) has 4 items. The clusters display the density of authors mentioning the same work as well as the domain's intensity.

Cluster 1: The largest cluster on the map, represented by the colour red, stands for the sustainability documents. Financial services, financial inclusion, digitalisation, etc, have been highlighted as the research's most important theme in the context of sustainability in the keyword map. The primary areas of this study are mostly payments, insurance, credit, savings, and transactions. This cluster's most prolific authors are Afjal A, Chen I, Chen X,

and Kauffman R.J. These authors have excellent network link strength and are the most connected inside with outside the cluster.

Cluster 2: The questions centre on Cluster 2 and pertain to the suitability and examination of the financial instruments (green) in the aspect of green finance. This cluster has examined issues with green bonds, green banking, and the green economy. The writers Arner D.W., Barberis J, Buckley R.P., and Cheng X looked into many facets of green finance from a sustainability standpoint. Strong ties exist between the writers and other clusters.

Cluster 3: The third cluster (blue) is one which represents the paper on sustainable finance. The foundation of this research is knowledge regarding the governance, social, and environmental aspects that individuals or any stakeholder take into account while making financial decisions. The majority of the authors who contribute to this cluster are Devis F.D, Hair J.F, and Ringle C.M. This cluster is majorly connected with the first cluster, which is a red cluster, but few connections with another cluster. It is clear that this cluster has few connections both inside and outside of it, and that it is still expanding.

Cluster 4: The significance of financial technology has been studied by authors Ngepah N and Pesaran M.H. These studies' main focus is on the effects of blockchain and financial technologies on environmental sustainability. There are not many links either inside or outside of this cluster, which is clearly still expanding. Thus, while addressing one of the most crucial facets of sustainability, fintech and blockchain studies are still in their infancy.

**Figure 13 | Cited authors' co-citation map on FT&S publications**
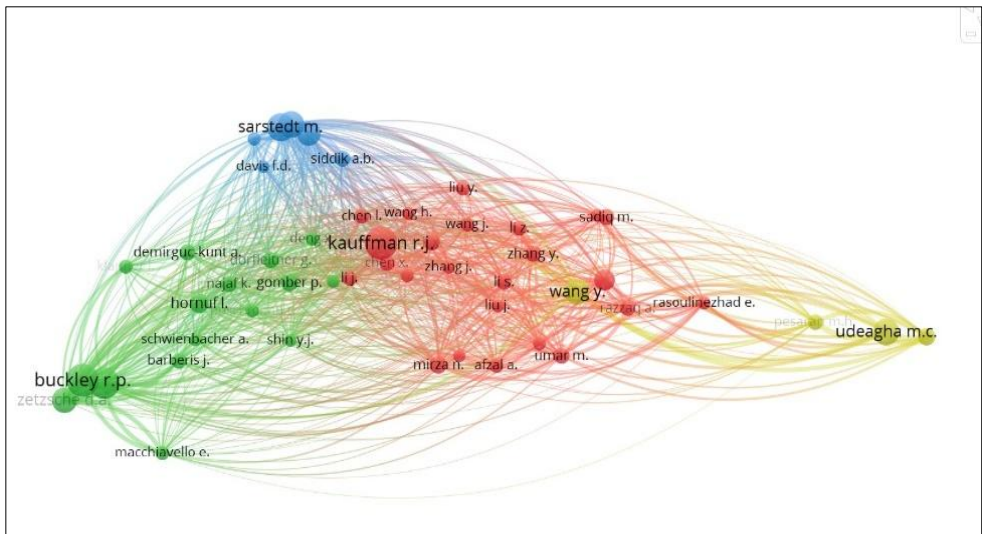
Note: Minimum number of citations of an author is 15. Out of 12190 met 50 authors met the criteria.

Source: Authors

5.11 Thematic map analysis

Figure 14 illustrates a thematic map based on the author's keywords within the selected dataset. The map comprises four quadrants: niche themes, motor themes, basic themes, and developing or declining topics. With varying degrees of centrality and density, each quadrant depicts a distinct combination. Centrality is represented by the X-axis, while density is represented by the Y-axis; a degree value that is closer to the origin is considered low, and a degree value that is farther from the origin is considered high (Gupta et al., 2023). Density indicates the development of the theme, while centrality indicates how the theme is related to the other themes (Paule-Vianez et al., 2020). Motor themes get strong scores in both dimensions, indicating well-developed concepts, whereas there is an absence of themes in basic and niche themes. On the other hand, emerging or declining themes have a low density with low centrality, which means they score the least on both parameters. The term "fintech" is highlighted in the green bubble on the emerging or declining theme, giving future scholars a chance to investigate further how fintech and the digital economy interact and what effect this has on the sustainability of the financial market. In addition, the larger the size of the bubbles, the more frequently they occur, so the pink and light blue colour bubbles in the motor themes indicate the greater importance of those themes. Sustainability and sustainable development in the financial arena have more importance. Next, the blue bubbles of the motor themes include financial systems, banking, and decision-making, which means the present study focuses more on this area with the connection of the pink bubble themes. On the other hand, the emerging and declining themes are too small in bubble size as compared to motor themes. There is more scope for future researchers to do research with connections to different aspects mentioned there and investigate how aspects like fintech, IT, and the digital economy impact sustainability and its policies and implications. Future researchers should explore it.

Figure 14 | Thematic Map based on author's keywords
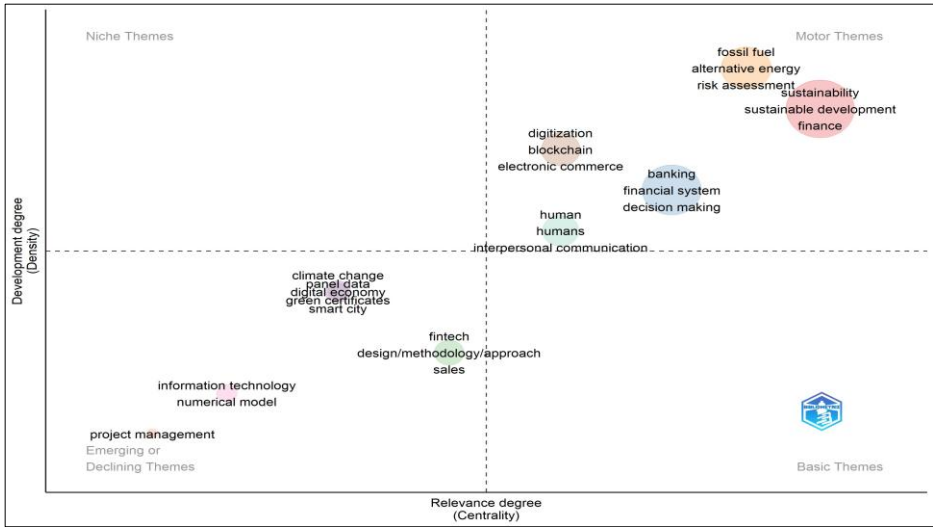
Source: Authors

6 Content analysis

WordStat was used to undertake a qualitative content analysis in addition to the systematic literature review and bibliometric analysis. The study indicates that the following five themes recurred most frequently in publications discussing the relationship between FinTech and sustainability. However, we distinguish between topics that combine two themes into one serial number and present them as distinct themes: green finance, sustainable development, financial inclusion, blockchain technology, digital economy, adoption of fintech, and sustainable performance. Table 4 presents the study's findings and the Wordstat statistics indicate the significance of those specific words and the most often discussed terms. The most common theme in research on the relationship between fintech and sustainability is the adoption of fintech and sustainability performance, which makes up 92.17 per cent of all themes. The study tested the effects of cyber risk management, business ethics, and data quality analytics on the operational performance of Fintech P2P lending organisations and how such effects might affect their corporate sustainability (Putra et al., 2022). Figure 19 shows that there are two words that are most commonly mentioned and have the greatest significance. It is discovered that sustainability performance and fintech adoption are the two most common terms.

As seen in Figure 17, 86.09 per cent of the subjects have something to do with financial inclusion. In addition to offering insightful information to practitioners, researchers, and regulators regarding the relationship between i-potential fintechs and sustainable income, Azman et al. (2020). The study emphasises the important roles that mobile money, crowdfunding, and peer-to-peer lending play in ensuring micro-entrepreneurs' ability to maintain a stable source of income. This compilation of research investigates the role that financial inclusion plays in attaining sustainable development, incorporating studies by Buckley et al. (2019) and Kangwa et al. (2021).

Out of all the themes, green finance and sustainable development accounted for 81.74 per cent as Figure 18 is depicts also. This study has a specific emphasis on tackling climate change and achieving carbon neutrality, offering a comprehensive analysis of the interplay between green finance and sustainable development (Fu et al., 2023). The research assesses the global causal relationship between green financing (GF) and sustainable development (SD) through the works of Wang et al. (2022), Saleem (2021), Zhang et al. (2022), and Zhou & Li (2022). It delineates the role of green finance in realizing sustainability.

Of the total topics, blockchain technology accounted for 57.39%, and Figure 16 depicts the importance of these words. It involves research on the evolution and expansion of artificial intelligence and blockchain technology (R.Wang et al., 2021: Mattos et al., 2020) as well as research on how digital transformation and information technology contribute to financial and economic success (Hossain, 2018: Dorfleitner et al., 2022) and addressing the issues of sustainability (Rana et al., 2019: Mishra & Kaushik, 2023).

53.04 per cent of all topics were related to the digital economy, which depicted the importance in Figure 15 also. Studies have examined the impact of the digital economy on sustainability (Jiao & Sun, 2021; Z. Zhou et al., 2022) and studied how the digital economy

better contributes to risk management in financial activities (Gasparian et al., 2021) and preventing internet financial risk (Y. Wang, 2021).

Table 4 | An analysis of the content of papers exploring the interrelation between FinTech and sustainability

SL. No	Topic	Keywords	Coherence (NPMI)	Freq	Cases	% Cases
1	Fintech Adoption Sustainability Performance	Sustainability; Performance; Adoption; Fintech; Innovation; Environmental; Firms; Green; Sustainability Performance; Fintech Adoption; Covid Pandemic; Green Innovation	0.518	362	106	92.17%
2	Financial Inclusion	Financial; Inclusion; Lending; Markets; Management; Services; Technologies; Risk; Fintech Cryptocurrency Markets; Financial Inclusion; Financial Services	0.432	380	99	86.09%
3	Green Finance Sustainable Development	Green; Sustainable; Economic; Growth; Finance; Development; Innovation; Fintech; Energy; Environmental Green Economic; Economic Growth; Economic Development; Sustainable Economic; Green Finance	0.505	336	94	81.74%
4	Blockchain Technology	Blockchain; Technology; Efficiency; Energy; Blockchain Technology; Business Intelligence Efficiency; Information Technology	0.372	158	66	57.39%
5	Digital Economy	Digital; Banks; Banking; System; Economy; Relationship; Adoption; Development; Efficiency; Digital Economy	0.455	130	61	53.04%

Source: Authors

Figure 15

Figure 16

Figure 19

Figure 17

Figure 18

Source: Wordstat

7   Main Themes (Fintech Towards Achieving Sustainability)

7.1 Financial Inclusion and Digital Payment

According to Babajide et al. (2015), financial inclusion is defined as "a process that indicates progress in quantity, quality, and efficiency of financial intermediary services," which enhances opportunities, boosts economies, and improves lives. Financial inclusion encourages local savings, which increases profitable investments in nearby companies (Babajide et al., 2015). Economic growth is both the cause and the effect of financial inclusion (Babajide et al., 2015). The influence of financial inclusion on economic growth in Nigeria was examined by Babajide et al. (2015) using annual data series spanning from 1981 to 2012. Delivering financial services has been transformed by fintech, particularly for underserved and unbanked people. Without the need for traditional banking infrastructure, users can access financial services through digital payment platforms and mobile banking services. This greater financial inclusion promotes poverty reduction and economic growth, which is consistent with sustainability objectives. In the case of a digital payment system, the electronic payment method increases the values that sustainable development upholds and generates sustainable demand, which in turn results in higher output, job creation, and profitability (Oghoghomeh & Ogbeta, 2014). The primary objective of sustainable development of our future cities is to deploy smart solutions for a higher quality of life while making effective use of resources (Lorena Bătăgan, 2011). The economics of payment systems around the world state that lessons learned from industrialised nations emphasise how digital payments are more affordable, effective, and sustainable in the long run, making them more accessible to consumers while also increasing income for financial institutions. Digital payments and financial inclusion support sustainable development by lowering poverty, empowering marginalised people, and fostering responsible financial behaviour. The use of digital payment technology, along with expanded access to financial services, lays the groundwork for more equitable and long-term economic growth.

7.2 Green Finance and Sustainable Investment

Green finance refers to sustainable banking and investing, wherein environmental screening and risk assessment serve as a basis for lending and investment decisions in order to satisfy sustainability standards. In addition, insurance services covering climate and environmental risks are included (Volz, 2018). Sustainable investment is the process of making investments after taking governance, social, and environmental factors into account. In order to develop and provide a variety of financial services and products, green finance entails working with traditional capital markets. These products benefit the environment in addition to producing investable income (Lee, 2020). In connection with the aforementioned are "green bonds," a particular kind of fixed-income instrument used only to refinance or partially finance qualified green projects. On other aspects, this is bringing environmental externalities into the fold and modifying risk perceptions to increase ecologically beneficial investments and decrease environmentally detrimental ones. Large-scale, commercially feasible green finance promotion ensures that green investments take precedence over conventional business ventures that support unsustainable development patterns (Lee, 2020). By facilitating the connection between investors and ecologically

sustainable projects, fintech platforms play a crucial role in advancing green finance. Individuals and organisations can invest in eco-friendly enterprises, renewable energy projects, and other sustainable endeavours through peer-to-peer lending, robo-advisors, and crowdfunding.

7.3 Blockchain for Transparency and Accountability

Anyone can view, send, and take part in the consensus/mining process to decide which blocks are added to the chain and the current state of the blockchain using a public blockchain approach like the Ethereum and Bitcoin public blockchains (Neisse et al., 2017). A group of entities controls the consensus process in a semi-public or consortium blockchain, where read access can be restricted or made public. In a private blockchain, writing permissions are controlled by a single central body, while read access can be either restricted or public (Neisse et al., 2017). Adoption of any of these strategies affects scalability, privacy, anonymity, performance, and resistance to censorship.

From the first generation to the third generation, blockchain has changed. While blockchain applications in the financial sector served as the foundation for both the first generation (blockchain 1.0) and the second generation (blockchain 2.0), the third generation (blockchain 3.0) is primarily focused on other industries (Ndayizigamiye & Dube, 2019). Numerous blockchain applications in the healthcare industry have demonstrated the multifaceted benefits of this technology. The fact that each block, or group of transactions, on the blockchain, is verified using hash algorithms, a type of encryption, may be its greatest benefit. As a result, before a new transaction starts, every block of transactions that came before it is validated. Because a transaction cannot be changed once it is encrypted, hash algorithms are used to guarantee the validity of every transaction on the blockchain. Because of this, transactions on the blockchain cannot be retrieved or changed, making them immutable (Ndayizigamiye & Dube, 2019). Blockchain is known as an append-only ledger since updating a record requires creating a new one. Furthermore, every transaction on a blockchain is time-stamped, which improves accountability and transparency in the transaction processes. By illuminating the complexities of intricate systems, exposing dangers for management, identifying best practices and hidden incentives to enhance conditions, and evaluating progress with the help of precise data and measurements, transparency can promote sustainability (Horner & Ryan, 2019).

7.4 Insurtech and Risk Mitigation

Insurance and prevention are two ideas that are inextricably linked. However, with the rise of "Insurtech" and new technology, the existing landscape for insurance businesses is shifting (Lanfranchi & Giorgino, 2020). Recently, the term "insurance technology" has gained popularity. The term "insurtech" is used to describe the impending disruptor of a vast, wealthy, unpopular, and impersonal sector whose products are purchased by consumers whose brand loyalty is really merely inertia, frequently in response to legal or financial coercion, without any excitement or emotion. All of this is about to change, as the Schumpeterian storm of insurtech upends or changes incumbents, enabling individualised insurance transactions through advanced AI, machine learning, social media marketing, behavioural tracking, big data analysis, and other technologies. Technology is being used by insurtech startups to revolutionise the insurance sector. Insurtech businesses are creating new insurance services and solutions that are more accessible, reasonably priced,

and tailored to the needs of specific clients. By creating novel insurance solutions that shield people and corporations from the dangers of social injustice and climate change, insurtech firms are also contributing to sustainable financing. For instance, certain insurtech firms are creating parametric insurance plans that offer benefits to people and corporations impacted by severe weather conditions (Colombage, 2023). On the same line, The insurance market helps manage the risks associated with natural disasters and offers a path for integrating technology into the insurance industry (Radosavljević, 2023).

The insurance platform's digitization tackles the most important solutions to issues like how to eliminate paperwork completely, guarantee that the entire system is environmentally friendly, bring all key stakeholders online, bridge the gap between the insurance sector's development and preservation of natural resources, and determine the extent to which insurance sustainability principles can be used to ensure sustainable development. In addition to promoting sustainability, the digitisation of insurance operations aids in the achievement of sustainable development objectives.

7.5 Regtech for Compliance with ESG Standards

The information and reporting asymmetries that are present in environmental compliance are especially well-suited for RegTech advances to address. Indeed, recent technological developments have the potential to simplify and even completely transform a number of processes, including establishing more efficient carbon trading schemes, funding renewable energy projects, and energy consumption monitoring. This can be accomplished by installing "smart metres," which measure and report real-time data about a company's emissions, on the property of polluting businesses. Blockchain-enabled "smart contracts" are another tool for streamlining compliance; these self-executing contracts ensure that the parties to a contract automatically fulfil their reporting and monitoring responsibilities (Amesheva, 2019).

RegTech enables businesses that must comply with stringent regulations to take advantage of new technologies, such as blockchains, cloud computing, and machine learning, to satisfy their commitments and scale more quickly without requiring a large and expensive compliance operations infrastructure (Larsen and Gilani, 2017). Advances in hardware and distributed computing, along with machine learning and artificial intelligence, are enabling RegTech companies to develop solutions that are not constrained by programming constraints. However, programmes may be taught to recognise particular trends and patterns.

The quantity of data and the falling cost of cutting-edge technology are driving RegTech's rapid expansion. According to KPMG (2022), the RegTech sector is divided into three phases:

- RegTech 1.0 pertains to the period preceding the global financial crisis of 2008, during which financial firms took the lead in adopting innovative technologies to scrutinize and monitor regulatory risks or specific procedures (Narang, 2021).

- RegTech 2.0 describes the post-crisis era in which businesses used RegTech solutions to enhance their regulatory compliance and supervisory practises

(Johansson et al., 2019). The majority of RegTech applications concentrated on enhancing consumer protection and performing "know your customer" (KYC) checks (KPMG, 2022).

- This seems to be the beginning of a new era (Brando, 2019). "Know your data" (KYD) is becoming more important in RegTech 3.0, replacing "know your customer" (KYC) (Umalkar, 2021). Financial organisations employ data analytics and technology to forecast risks using predictive algorithms.

Financial institutions can better adhere to the constantly changing ESG requirements with the help of regulatory technology (RegTech) solutions. By automating the tracking and reporting of environmental, social, and governance parameters, these tools assist businesses in adhering to sustainability guidelines and showcasing their dedication to ethical behaviour. It has also been acknowledged that RegTech has the ability to increase the efficacy of environmental regulations (Amesheva, 2019).

Conclusion

The harm that economic activity causes to the environment has made sustainability a hot topic. Fintech can contribute to better resource utilisation and sustainable economic growth in this situation (Awais et al., 2023), this systematic literature study, which is enhanced by bibliometric analysis, is an objective effort to provide the most thorough perspective on the dynamic subtleties of the relationship between fintech and sustainability. This study offers valuable insights for policymakers, regulators, environmentalists, investors, and academic researchers seeking to comprehend the intricacies of the relationship between fintech and sustainability. It identifies areas deserving further exploration, particularly in a field that has seen a significant surge in studies over the past eight years, indicating rapid development. The increasing trend in publishing underscores the need for continued research in this domain (Maharana & Pal, 2023). Despite the growing interest, the primary challenge of this review lies in the limited number of articles addressing the relationship between FinTech and sustainability, given the novelty of the topic. This review aims to chart the intellectual connections among notable works from 2017 to 2023, shedding light on emerging trends in the interaction between fintech and sustainability. The review identifies five key clusters: fintech adoption, sustainability performance, green finance, sustainable finance, and sustainability. The most important cluster among them is sustainability, which also has a maximum frequency, and the Sustainability (Switzerland) Journal has more citations with the H and G index. The findings indicate that even though this subject is expanding, researchers should continue to investigate how sustainability can be attained using a variety of themes.

Recommendations for future research

The ways in which FinTech might help businesses sustain sustainable development are covered in this section. A greater focus should be placed on SMEs that make a substantial contribution to the sustainability and development of the economy, as the banking sector has explored incorporating FinTech in great detail.

DISCUSSION

Realisation of Sustainable Finance

Although the FinTech and sustainable finance pillars have historically been seen as distinct, they share characteristics and offer significant promise when combined. In particular, retail financing and environmental, social, and governance (ESG) disclosure are two problems that FinTech can solve in relation to sustainable finance frameworks (Macchiavello & Siri 2022). In order to improve the accomplishment of social and environmental objectives, it would be interesting to further investigate the relationship between Fintech and sustainability practises, which is seen to be an understudied study field.

Robust Corporate Governance

One of the main tools for minimising conflicts of interest inside a company is corporate governance. The majority of earlier research focused on how corporate governance affected financial performance; nevertheless, FinTech's potential contributions to fraud detection, corporate governance strengthening, profitability enhancement, and sustainability should receive greater emphasis (Ellili, 2022).

Creation of innovative technology

Financial innovations lower agency costs and associated risks, enabling businesses to operate more efficiently and thrive economically (Li et al., 2020). Future studies ought to look into how FinTech encourages innovation in technology. This will help businesses become more sustainable, increase their financial performance, and obtain a competitive edge.

Information asymmetry mitigation

FinTech's quick rise to prominence and rapid development have created new avenues for small firms to obtain financing. Peer-to-peer (P2P) lending is a form of crowdfunding that facilitates communication between individuals and businesses. On the other hand, knowledge asymmetry may have an impact on platform viability and transaction quality. By putting in place a number of measures, lenders and online P2P platforms have tried to lessen the impact of this problem (Cummins et al., 2019). It would be intriguing to learn more about how FinTech contributes to reducing information asymmetry, boosting corporate sustainability, and improving corporate efficiency.

Organisational resiliency

Numerous scholars have been interested in the COVID-19 pandemic since 2019 and have looked into how it may affect company performance. Furthermore, amid government lockdowns, the epidemic has led to a rise in the use of FinTech, particularly mobile applications (Fu & Mishra 2022). Further research on the function of FinTech in enhancing company resilience against any future crises and mitigating the detrimental effects of this pandemic on corporate sustainability is warranted.

Insurtech Adoption

To more precisely evaluate risks, Insurtech makes use of data-driven insights and sophisticated analytics. As a result, businesses are able to prevent losses and lessen their

harmful effects on the environment by identifying possible risks to their operations and taking proactive steps to mitigate them. IoT devices, like sensors and monitors, are frequently used in Insurtech to gather data in real-time on a variety of company operations-related topics. Risk assessment and identifying opportunities for sustainability improvements can be done with the help of this data. So future researchers should explore how it Insurtech can help to work as an eco-friendly in firms while reducing uncertain loss in firms.

Limitations and Implications

This study examines articles on the relationship between sustainability and fintech that have been published in Scopus journals in order to assess the development of this particular research area, pinpoint its fundamental theories and concepts, and offer suggestions for more research.

This study finds the most productive authors, organisations, and nations in the FinTech sector by utilising a variety of trends, bibliometrics, evolution, content studies and systematic reviews. Furthermore, this study identified five important research areas pertaining to sustainability, blockchain technology, green finance, financial inclusion, and fintech.

This study has consequences for theory and practice. The key areas show how fintech is developing in specific disciplines, with notable implications for practitioners and scholars alike. Firstly, it highlights the most pertinent subjects and gives a summary of the development and patterns of research on the relationship between FinTech and sustainability that have been published in the Scopus database. It also aids researchers in comprehending the newest subjects, papers, and citation analysis.

Third, FinTech researchers can utilise the study's findings to identify areas that warrant further investigation and where to focus their efforts going forward. To achieve development goals across several industries, they can, for instance, analyse a variety of FinTech-related challenges. Other industries that make substantial contributions to economic development and sustainability should receive more attention than the banking system, which has been the sole focus of the majority of prior research. It is imperative that scholars carry out investigations to expand their comprehension of the pivotal function of FinTech in augmenting sustainable economic growth. In addition, as we see in the earlier literature review part, most of the central European country digitally active in the case of fintech but still mistrust fintech in the general population and lack awareness along with the five obstacles we discussed earlier. Financial access and digital transformation are also seriously threatened by these problems and are barriers to sustainability. Our study helps to take one more step towards development in one aspect of achieving sustainability through this finding of the study by creating awareness and contributing to exploring more by providing extensive knowledge on this domain. Next, the ambiguity issue will be reduced, and people will gain more interest in fintech. On the other hand, researchers in Central European countries should focus on our future research scope and explore more.

Furthermore, a gap in the literature has been noted concerning the relationships between sustainability disclosure procedures and FinTech; this is seen as an undiscovered area of research pertaining to disclosure practices. FinTech may also be connected to many crucial business choices that enhance an organisation's financial performance. Additionally, further

research has to be done on how FinTech might lessen the COVID-19 pandemic's effects on the sustainability and efficiency of businesses (Ellili, 2022). Research on this will be very interesting in the future. This would make it easier to comprehend how FinTech might improve sustainable economic development and future economic resilience.

Future research looking at developments in the FinTech industry could take into account more databases (like Web of Sciences, dimension). This research solely looks at the Scopus database. Not with standing these drawbacks, the report offers a helpful summary of the most recent FinTech subjects. Secondly, although our study aligns with the objectives and values of bibliometric analysis, we recommend that future researchers utilize scientometric analysis, topographic views, and meta-analysis to provide a holistic understanding of the literature on FinTech and sustainability (FT&S). This approach would aid in identifying key variables influencing the relationships within this domain (Alhenawi et al., 2022). Thirdly, the search query encompassed general terms such as fintech and sustainability in the titles, abstracts, and keywords. We encourage future researchers to integrate these terms with other pertinent concepts in fintech and sustainability, thereby exploring comprehensive perspectives. Our study employs a blend of bibliometric analysis and systematic literature review to depict the current state and shed light on future directions in FT&S research.

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