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# Digital financial inclusion. Visualizing the academic literature

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ABSTRACT

Financial inclusion, which requires granting an affordable, adequate and widespread access to a sufficient range of financial products and services, has often been considered one of the cornerstones of social development, as it can contribute to poverty reduction, narrow the income gap, lead to wiser financial decisions, help to enlarge savings, increase the productive investment and foster a greater gender equality. Information and communication technologies have shown a major potential to contribute to financial inclusion, giving birth to digital financial inclusion. Using bibliometric techniques, this paper disentangles the intellectual structure of the research on digital financial inclusion, revealing the most influential sources, authors and areas inside this research stream. The results of this paper show that we are dealing with a critical demand of current society, which is attracting a growing attention of the academic literature and should be in the spotlight of both private and public institutions.

## 1. Introduction

Financial inclusion (FI) is currently a major concern for some of the main international economic institutions. One of the objectives pursued in developing countries is to reduce poverty, which can be achieved increasing FI (Anon, 2010). According to Hannig and Jansen (2010), the main goal of FI is to promote the access to financial services and products at an affordable cost to a vulnerable section of the population traditionally excluded from their use (Ozili, 2018).

Burgess and Pande (2005) have remarked many positive impacts of FI: poverty reduction, a narrower income gap, wiser financial decisions, larger savings, more productive investment and a greater gender equality. Therefore, FI can be considered an engine of economic growth in developing countries (Sethi and Acharya, 2018; Pradhan and Sahoo, 2021). On the other hand, financial exclusion, a poor access to financial products and services, is frequently associated with inequality and poverty (Beck et al., 2007), both at an individual and a geographical level (Demirgüç-Kunt and Klapper, 2013).

In the last decade, we are witnessing a dramatic increase in the development and use of information and communication technologies (ICTs). Their adoption is affecting every area of our daily lives. Specifically, the use of Internet and smartphones has

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transformed the financial industry, changing both the supply side (new products, services and agents) and the demand side (consumer behaviour). Internet and the smartphones can put many products and services in the hands of some potential users who were previously unbanked, generating what has been called digital financial inclusion (DFI). In this sense, digital financial services offer a unique opportunity for the FI of vulnerable groups of the society by overcoming obstacles of cost, distance and transparency to meet their financial needs (Kulkarni and Ghosh, 2021).

The key role of ICTs in order to reach FI has given birth to a new research stream, which is increasingly growing. There are some recent bibliometric analyses dealing with FI (Gálvez-Sánchez et al., 2021; Chhatoi et al., 2021) which mention the role of digital money as a tool to promote it. Some other works have analysed the literature about microfinance, which is related with FI (Gutiérrez-Nieto and Serrano-Cinca, 2019; Maia et al., 2019; Nogueira et al., 2020). From the technological point of view, bibliometric studies like Nugroho and Hamsal (2021) and Li and Xu (2021) have boarded the role of digital innovation in banking. Aziz and Naima (2021), in turn, have published a brief analysis of the literature about digital banking and FI. Nevertheless, there is still a need for a comprehensive study analysing the literature about the role of ICTs in the promotion of FI. This article aims at filling this gap.

Bibliometric analysis helps to identify development lines, novel applications, research priorities and references within a subject, according to their geographical location and research network (Wang et al., 2014). This kind of techniques allows scholars to study a specific research area analysing citations, co-citations, geographical distribution and word frequency, in order to draw useful conclusions, providing the researchers with different tools to assess the academic productivity, its impact and its relative influence; to define the intellectual structure of the research topic as well as its evolution; and to identify the different subtopics and its conceptual framework. We can sum up these goals in the following questions:

1. RQ1. What is the historical evolution of the literature about ICTs and FI?
2. RQ2. Which are the most productive journals addressing ICTs and FI?
3. RQ3. Who are the most productive authors dealing with ICTs and FI?
4. RQ4. Which are the most prominent documents in the field of ICTs and FI?
5. RQ5. Which are the main documents that have influenced the intellectual structure of the topic ICTs and FI?
6. RQ6. Which are the main journals on which the research topic of ICTs and FI has been built?
7. RQ7. Which are the hot topics and patterns in the field of ICTs and FI?

This paper is organized as follows: Section 2 presents a theoretical framework stressing the relevance of FI and DFI. Section 3 describes the data source and methods used. Section 4 presents the main results, including both relational and evaluative techniques. Finally, Section 5 summarizes the key findings of the research, including the discussion, conclusions, limitations and future research lines.

## 2. Theoretical framework

Financial inclusion (FI) is currently a major concern for some of the main international economic regulators. According to the World Bank (2014), FI refers to the proportion of households and companies that use financial services. The International Monetary Fund (IMF) defines it as the use and access to financial services at an affordable price for the most vulnerable segments of society (Sahay et al., 2015). From an academic perspective, FI is a situation where no one is denied the access to basic financial services for reasons of efficiency (Mialou et al., 2017). Hannig and Jansen (2010) conclude that the main goal pursued by FI is to offer the unbanked the opportunity to access the financial system.

When households or individuals cannot access financial products and services, they fall into a situation of financial exclusion (Kumar and Mishra, 2011). Financial exclusion can generate a poverty trap, increasing the inequality (Beck et al., 2007). Furthermore, this problem affects not only developing countries, but also disadvantaged regions and groups in developed countries (Demirgüç-Kunt and Klapper, 2013).

Therefore, one of the objectives pursued in developing countries is to reduce poverty increasing FI (Anon, 2010; Marron, 2013; Neaime and Gaysset, 2018; Chao et al., 2021). The IMF has related FI with some macroeconomic outcomes, including economic growth, stability and equality (Sahay et al., 2015). The academic literature has also found some positive impacts of FI. A greater access to formal financial services can reduce income inequality (Park and Mercado, 2018; Honohan, 2008), facilitate better financial decisions (Mani et al., 2013), increase the households' savings (Aportela, 1999), foster productive investment (Dupas and Robinson, 2009) and promote women's empowerment (Ashraf et al., 2010).

Nevertheless, as Demirgüç-Kunt and Singer (2017) state, the relationship between FI, inequality, and macroeconomic growth is not yet well understood, and there is relatively limited research on the topic, mainly due to the lack of data availability, as the majority of public policies pursuing FI have been recently implemented. Additionally, the existence of a potential trade-off between the FI of the unfavoured and the profitability of the credit institutions is another challenge frequently revealed by the academic literature (Cull et al., 2011; Ben, 2012; Awaworyi Churchill, 2020).

There are different drivers of financial exclusion. Lyons and Kass-Hanna (2021) found that financially vulnerable people had less possibilities to access financial services. According to Schuetz and Venkatesh (2020), the main obstacles to reach FI are the absence of geographical access, the high costs of using products and services and the lack of appropriate financial products and financial illiteracy. Also, a critical element to foster FI is the design of a regulatory framework that promotes the construction of an independent and competitive financial system, which reduces transaction costs through innovation and competition, while protecting and taking into account the needs of the excluded (Honohan and Beck, 2007). Financial institutions, both formal and informal, should be able to

provide financial services to financially excluded individuals (Zulkhibri, 2016; Hussain et al., 2018). Governments and supranational organizations also have the responsibility to promote FI, in order to alleviate economic inequality.

One of the first instruments used to promote FI was microcredit or microfinance. According to Morduch (1999), microcredits are small loans granted to people in a situation of economic exclusion. Despite their boom, they have been sometimes criticized for their speculative nature (very high interest rates and fees). Also, even the potential of microcredits has been called into question. A review of six randomized evaluations of the impact of microcredit found modestly positive, but not transformative, effects of microcredit as a development tool (Banerjee et al., 2015b).

Jenik et al. (2017) stress the role of crowdfunding in FI. Following their research, crowdfunding could improve the access to finance by excluded and underserved individuals and small firms, allow for innovations of existing models like microfinance and mobile financial services and give access to more complex investment products. Nevertheless, this high potential has been undermined by some limitations such as inadequate legal and regulatory frameworks, untested credit scoring models, limited access to technology, and lack of awareness and trust.

Digital access to financial services has shown a high potential as an accelerator of the process of FI (Yawe and Prabhu, 2015; Liu et al., 2021). Digital finance can grant individuals access to payments, savings, and credit facilities at an affordable cost via Internet, without the need to visit a bank branch (Ozili, 2018). There is empirical evidence of the positive role that technology plays in promoting access to the financial system for the most vulnerable groups of the population (Claessens, 2006). Diniz et al. (2012) found positive impacts of branchless bank implementation on economic growth for a set of projects taking place in some developing countries. Aziz and Naima (2021) state that "financial inclusion is provided in advance through digital banking".

In this sense, the contribution of ICTs to FI has given birth to what has been called digital financial inclusion (DFI), an extension of FI where all financial operations are performed in a cashless mode (Banna and Alam, 2020). The literature defines DFI as the digital access to formal financial services by a sector of vulnerable population that traditionally remained excluded (Anon, 2015). Gabor and Brooks (2017) stressed that the expansion of mobile technologies in developing countries offers the technological infrastructure to reach the unbanked, increasing the opportunities for democratizing financial services and accelerating FI. Using DFI the implementation and execution of FI will be faster, more efficient and cheaper, and DFI will enable the sustainability of financial products provided to customers at an affordable cost (Gomber et al., 2017).

However, the academic literature has also found some drawbacks. There is empirical evidence suggesting barriers to the sustainability of the DFI, such as poor net connectivity and digital illiteracy (Grohmann and Menkhoff 2017; Serbeh et al., 2021; Aziz and Naima, 2021). Additionally, as Loufield et al. (2018) state, in spite of the great potential of the new types of data and analytics tools (machine learning, cloud computing), still some issues, such as data fragmentation, the readiness of traditional financial institutions and the availability of an adequate regulatory framework have to be addressed (Yawe and Prabhu, 2015). Lu et al. (2021) suggested that the use of non-traditional alternative data can provide an interesting additional information that could grant lower-income and "thin-file" users the access to financial services.

## 3. Data collection and method

This study aims at providing a bibliometric overview of the research about the role of ICTs to foster FI, what has been called DFI. In order to do so, a systematic review of the previously published studies about the topic has been carried out. This method ensures that the synthesis of the literature is made in a rigorous, transparent and reproducible manner (Gomezelj, 2016).

Bibliometric methods are frequently used to evaluate the development of a given research field (Liao et al., 2018), analysing a specific scientific domain through bibliographic data, using two main approaches: performance analysis and science mapping (Noyons et al., 1999; Van Raan, 2005; Cobo et al., 2011). Amongst the advantages of bibliometric methods, we can remark that: (i) they present an overview of the scientific literature; (ii) they can generate a more objective summarization of the selected scientific papers than traditional techniques (e.g., literature review); (iii) they are catching a growing attention of the scientific community (Corsini et al.,

**Table 1**
Bibliometric methods used to analyse the research topic.

| Techniques | Objective | Research questions | Bibliometric method | Analysis |
|---|---|---|---|---|
| *Evaluative techniques: SCI-mat* | *(1) To assess academic impact and relative influence* | RQ1. Historical evolution literature | *Measures of productivity* | Historical evolution of publications |
| | | RQ2. Most productive journals | | Distribution of articles by journal |
| | | RQ3. Most productive authors | | Distribution of articles by author |
| | | RQ4. Most prominent documents | *Impact metrics* | Citation analysis |
| *Relational techniques: VOS Viewer* | (2) *To determine intellectual structure* | RQ5. Main documents influencing intellectual structure | *Co-citation* | Co-citation analysis: documents |
| | | | | Co-citation analysis: authors |
| | (3) *To identify thematic organization* | RQ6. Main journals around which the research topic of is organized | | Co-citation analysis: journals |
| | (4) *To identify conceptual structure* | RQ7. Patterns and hot topics | *Co-occurrence* | Co-word analysis |

2019). So, bibliometric analysis provides scholars with a powerful tool to study a specific research area analysing citations, geographical distribution, co-citations, and word frequency. The specific methods used to carry out this analysis area detailed in Table 1.

We have based our search on the Web of Science (WoS) database, one of the most recognized ones in the field of Social Sciences, which provides keywords, references and citation information.

The selection of the publications stems from a keyword search of the literature. This technique is automatized, preventing from any potential researchers' bias. The papers selected included only scientific works published in peer-reviewed journals belonging to the Web of Science (WoS) Core Collection. Amongst them, we decided to keep only articles, excluding book chapters, preprints and other kinds of documents.

The search strategy is critical in this kind of studies. In order to avoid a potential elimination of relevant works, we decided to use an extensive search, including different synonyms and terms related with the topic. The terms selected were 'financial inclusi* ' or 'microfinance' or 'microcredit' AND 'digit* ' or 'fintech' or 'fin-tech' or 'mobile money' or 'electronic money' or 'ICT* ' or 'internet finance* ' or 'demoneti* ' or 'tecnolog* ' or 'artificial intelligence' or 'machine learning' or 'internet of things' or 'industry 4.0′ or 'big data'). The search chain was performed over the subfields 'title', 'abstract', and 'keywords'. The period of the search was from 1-January-1990–31-December-2021.

This initial selection included a total of 580 articles. The works belonging to this first group were double-checked, discarding those that did not fit the subject of the study. To foster objectivity, all the authors participated in this second screening, obtaining a final sample which includes 387 articles. The selection process is detailed in Table 2.

After the selection, the bibliometric analysis was performed. Firstly, we have used Sci-mat software (https://sci2s.ugr.es/scimat/) (Cobo et al., 2012) to carry out a productivity analysis, evaluating the evolution of the number of publications, as well as the distribution of articles by country, institution, journal and individual author. In order to determine the impact and influence of the different papers, we have selected the most cited articles, considering the absolute and relative number of citations.

Secondly, in order to identify the structure of the research topic we have used relational techniques, through a bibliometric mapping approach using VOS Viewer software (https://www.vosviewer.com/) (Van Eck and Waltman, 2010), which enables us to visualize diverse networks resulting from co-word and co-citation analyses of documents and journals.

## 4. Results

Bibliometric studies are normally categorized into three groups: Review techniques, evaluative techniques, and relational techniques (Benckendorff and Zehrer, 2013).

Evaluative techniques measure the academic impact and relative influence of a topic. This group includes different productivity measures, such as the historical evolution of the number of publications, the distribution of articles by journal and individual author, and the analysis of the most cited authors (Hall, 2011). The distribution of the contributions per author also helps to analyse the relative maturity of a research topic (Keathley-Herring et al., 2016). These analyses have been carried out using SciMAT software (Cobo et al., 2012), as well as the information generated by WoS itself.

Relational techniques, such as co-citation, co-authorship and co-word analyses, are frequently used to reveal the intellectual structure of a research topic. Both co-citation and co-word techniques seem to be adequate in our case in order to analyse the works selected, identifying patterns and detecting hot topics (Zupic and Čater, 2015). The VOS-Viewer software (Van Eck and Waltman, 2010) provides with a mapping tool that represents the results of this bibliometric technique in a gentle and visual way.

### 4.1. Publication growth analysis

Fig. 1 shows the evolution of the number of academic articles per year regarding the topic for the period 1990–2021, which in fact means 2010–2021. After an initial period between 2010 and 2015, when some of the seminal papers were published, there is a clear

**Table 2**
Search protocol and results.

| **Database** | Web of Science (WoS) |
|---|---|
| **Geographical scope** | Global scientific production |
| **Characteristics** | Quality indicators: JCR impact factor; Immediacy index; Times cited; Quartile |
| **Search criteria** | Topic |
| **Inclusion criteria** | Article |
| **Data range** | All years to 2021 included |
| **Search date** | 3 January 2022 |
| **Search terms** | TS: ("financial inclusi*" or microfinance or microcredit)<br>AND TS: (digit* or fintech or "fin-tech" or "mobile money" or "electronic money" or "internet finance*" or demoneti* or tecnolog* or "artificial intelligence" or "machine learning" or "internet of things" or "industry 4.0" or "big data") |
| **Initial number of documents** | 580 |
| **Filtered process** | Selection carried out by all the authors, checking the abstract of the papers |
| **Final number of documents** | 387 |

trend of growth which lead to the publication of 130 works in 2021. FI through the use of ICTs is clearly a hot topic.

The two first works regarding this subject were both published in 2010 in the Journal of Electronic Commerce in Organizations (Estapé-Dubreuil and Torreguitart-Mirada, 2010; Assadi and Hudson, 2010). Since these first articles, this research line was not mainstream in the following 5 years, though it caught the attention of some specialized researchers. Since 2016, a major boost in the scientific production can be identified. 2020 finally meant a definitive impulse in the publication of papers related with this topic, which has been confirmed in 2021.

There could be many reasons backing this rapid growth. Probably, the main one is related with the increasing adoption of different technological solutions. Nowadays, smartphones are widely spread all along the world, empowering the access to a huge range of services through the internet, including financial ones. Currently, most of the banking operations take place online, while in 2010 this could even be considered unusual. Electronic credit cards, electronic money or mobile bank transfers, which were not frequent in the past, are here to stay for the forthcoming generations.

The major jump that took place in 2020 could also be caused by the health crisis generated by the pandemic of COVID-19. The lockdowns and curfews that have been affecting the vast majority of the world's population have meant an ultimate impulse for electronic commerce and non-presential economic activities, which in turn has accelerated the process of financial digitalization. The researchers cannot ignore such trend in their studies.

This kind of evolution reveals a relative lack of maturity of this field of knowledge. Probably some of the main research lines will consolidate in the next few years, while some other ones may be abandoned or reduce their importance, probably affected by obsolescence.

### *4.2. Countries and Universities with the highest number of articles*

A relevant proportion of the authors (18.9%) are working for US universities. Amongst the most represented countries, we can clearly distinguish some developed economies, such as the UK (15.5%), Australia (5.7%) or France (5.4%); and developing countries like South Africa (7.2%) or Nigeria (5.2%). Though China (15.3%) and India (11.1%) have strong economies, the unbalanced distribution of incomes between their inhabitants creates a need for FI in many regions and social strata that has been studied by local researchers.

The authors of the literature analysed are linked with different universities and institutions, though the degree of concentration is relatively low. The critical importance of this topic for developing countries, as well as their relatively lower number of universities, fosters the presence of institutions like the Pan Atlantic University (Nigeria), the Makerere University (Uganda) or the South African universities in the top places of the table. Meanwhile, in the developed countries, the study of the topic is more spread amongst different institutions. We can also remark the presence of the World Bank, aligned with its concern about economic development. (Tables 3 and 4).

### *4.3. Core journals and research areas with number of articles*

These 387 articles were published in 261 journals, out of which 200 (76.6%) published just one paper; 31 (11.9%) published two papers; and 30 (11.5%) included three or more papers. Focusing the attention on the most productive journals, Table 5 shows the sources which have published three or more articles on the research topic.

These nine journals gathered 61 articles, a 15.8% of the ones included in this revision. The journal with the highest number of

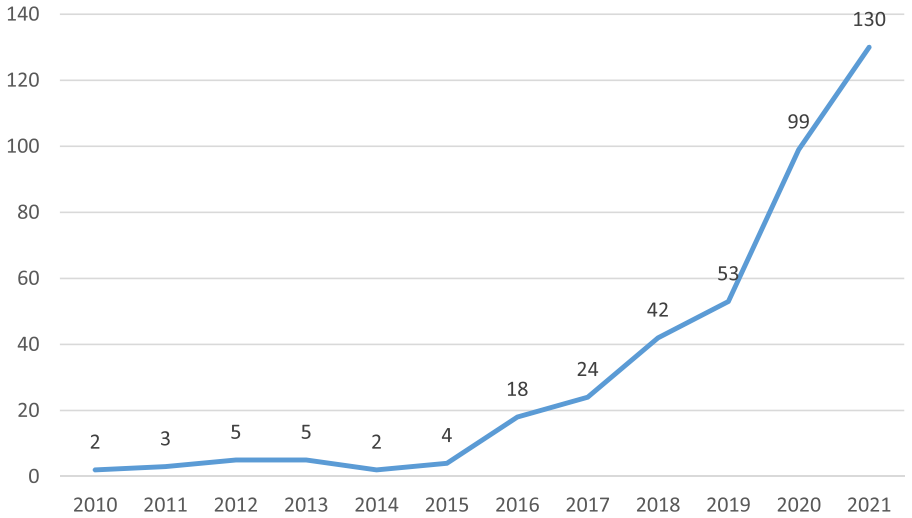


**Fig. 1.** Historical evolution of publications.

**Table 3**
Most influential countries in the selected literature.

| Countries | Number of articles | Percentage (N/387) |
|---|---|---|
| United States | 73 | 18.9% |
| UK | 60 | 15.5% |
| China | 59 | 15.3% |
| India | 43 | 11.1% |
| South Africa | 28 | 7.2% |
| Australia | 22 | 5.7% |
| France | 21 | 5.4% |
| Nigeria | 20 | 5.2% |
| Malaysia | 16 | 4.1% |
| Canada | 14 | 3.6% |

**Table 4**
Distribution of articles by authors' affiliation.

| Institution | Country | Number | Percentage (N/257) |
|---|---|---|---|
| Pan Atlantic University | Nigeria | 8 | 2.07% |
| University of South Africa | South Africa | 8 | 2.07% |
| University of London | UK | 8 | 2.07% |
| University of California | USA | 8 | 2.07% |
| Indian Institute of Management IIM System | India | 7 | 1.81% |
| Makerere University | Uganda | 7 | 1.81% |
| Peking University | China | 7 | 1.81% |
| University of Johannesburg | South Africa | 7 | 1.81% |
| The World Bank | | 6 | 1.55% |
| University of New South Wales Sidney | Australia | 5 | 1.29% |
| University of Warwick | UK | 5 | 1.29% |
| Erasmus University Rotterdam | Netherlands | 5 | 1.29% |
| University of Cape Town | South Africa | 5 | 1.29% |
| University of Southampton | UK | 5 | 1.29% |

publications, *Sustainability*, including a total of 13 papers, can be considered a generalist one, namely included in the categories of Environmental Studies and Green and Sustainable Science and Technology.

The majority of these journals can be considered high quality publications, included mainly in the top 3 quartiles of the Journal of Citation Report (JCR). They are linked with different research areas, such as Development Studies (e.g., Development in Practice),

**Table 5**
Distribution of articles by journal.

| *Journal* | *Articles* | *Impact Factor (2020)/Categories* |
|---|---|---|
| **Sustainability** | **13** | 0.56 (JCI)<br>Environmental Studies (Q2)<br>Green and Sustainable Science and Technology (Q3) |
| **Information Technology for Development** | **7** | 1.45 (JCI)<br>Development Studies (Q1)<br>Information Science and Library Science (Q2) |
| **Telecommunications Policy** | **7** | 1.12 (JCI)<br>Communication (Q2)<br>Telecommunications (Q2)<br>Information Science and Library Science (Q1) |
| **Review of International Political Economy** | **6** | 2.05 (JCI)<br>Political Science (Q1)<br>Economics (Q1)<br>International Relations (Q1) |
| **Development in Practice** | **6** | 0.38 (JCI)<br>Development Studies (Q4) |
| **International Journal of Social Economics** | **6** | 0.35 (JCI)<br>Economics (Q3) |
| **Cogent Economics Finance** | **6** | 0.43 (JCI)<br>Economics (Q3) |
| **Applied Economics Letters** | **5** | 0.43 (JCI)<br>Economics (Q3) |
| **Technological forecasting and social change** | **5** | 2.07 (JCI)<br>Business (Q1)<br>Regional and Urban Planning (Q1) |

Information Science and Library Science (e.g., Telecommunications Policy), Economics (e.g., International Journal of Social Economics) or Business (e.g., Technological forecasting and social change). Some of these journals, very remarkedly Information Technology for Development, lay in fact in the intersection of some of these research areas, showing the different groundings of this literature. Table 6 sums up the classification of the 387 articles by Research Area.

### 4.4. Author analysis

The 387 articles were written by 828 different authors. The majority of these authors (89.0%, 737 of them) have participated in just one publication; 7.7% of the authors (64) published two; and 3,3% (27) are credited in three or more publications. Table 7 displays the most productive ones, who have taken part in four or more articles on the research topic.

There are some research teams, mainly concerned about the effects of FI on development, which are specially represented in Table 7. George Okello Candiya Bongomin's lab at the Makerere University (Uganda), which also includes John C. Munene and Joseph Mpeera Ntaye, is very prolific in this topic, and so is the group of Olayinka David-West and Nkemdilim Iheanachor at the Pan-Atlantic University (Nigeria). Ross P. Buckley, from the University of New South Wales (Australia) works frequently with colleagues from institutions settled in different countries. Yang Liu, from Wuhan University of Technology, is the most prolific author in China, one of the top 10 countries in the study of this field. Nevertheless, the degree of concentration is relatively low, so we can consider that there is not a key reference in this area of research, but some groups of authors that are boarding it from different points of view and/or countries.

### 4.5. Most cited papers

The number of citations provides a good hint about the quality of a paper. In a bibliometric analysis, this measure reveals which are the key articles and documents dealing with a specific topic (Tahamtan et al., 2016). The analysis of citations identifies the number of times a publication has been referenced in the WoS. The papers included in Table 8 have the highest number of citations in absolute terms (>50) and are ordered by citations per year (C/Y) to compensate the effect of the year of publication.

The most cited paper in relative terms is a relatively recent one (Ozili, 2018), and was published in the Borsa Istanbul Review. It has received an average of 28.0 citations per year since its publication, and it is a deep analysis of the main concepts related with both FI and DFI, along with the benefits and pitfalls of the digitalization of finance. The most cited paper in absolute terms (139 cites) was published in the Journal of Marketing (Galak et al., 2011), being one of the first articles belonging to this topic. This paper analyses the profiles preferred by the lenders of online microcredits when choosing the borrowing projects.

Further than the opportunities given by microfinance, Gabor and Brooks (2017) analyse the role of the technologies in profiling and determining potential borrowers of FI programmes. Bongomin et al. (2018), as well as Munyegera and Matsumoto (2016), analyse the role of mobile money in the development of rural communities in Uganda. Nevertheless, the study of the role of mobile money in FI for development purposes is not so new, as some other works (Maurer, 2012; Donovan, 2012) reflected on it previously.

The role of Fintech can also be critical in order to foster FI (Leong et al., 2017). The authors point out that digital technologies offer the financial firms the capabilities to occupy new niches in the financial market, enabling them to rate potential users through alternate rating scores. Diniz et al. (2012) had previously reflected on the potential of branchless digital banking to empower low income people. Finally (Larios-Hernández, 2017), blockchain entrepreneurship can provide the excluded with an alternative way to access financial services.

### 4.6. Degree of concentration of selected variables

After considering the most prolific countries, universities, journals, research areas and authors, it is interesting to evaluate and compare the degree of concentration of the literature studied considering the different productivity variables which have been analysed.

There are some different indexes and techniques to measure the degree of concentration. One of the most frequently used in social

**Table 6**
Distribution of articles by research area.

| Research areas | Articles | Percentage (N/387) |
|---|---|---|
| Business Economics | 220 | 56.85% |
| Development Studies | 34 | 8.79% |
| Information Science/Library Science | 34 | 8.79% |
| Government Law | 25 | 6.46% |
| Science Technology Other Topics | 25 | 6.46% |
| Computer Science | 24 | 6.20% |
| Environmental Sciences Ecology | 24 | 6.20% |
| Social Sciences Other Topics | 17 | 4.39% |
| Public Administration | 15 | 3.88% |
| Area Studies | 14 | 3.62% |
| International Relations | 14 | 3.62% |

**Table 7**
Most prolific authors in FL and Retirement.

| Rank | Name of Author | Country of author | University/Institution | Number of publications |
|---|---|---|---|---|
| 1 | Bongomin, G.O.C. | Uganda | Makerere University Business School | 6 |
| 2 | David-West, O. | Nigeria | Pan-Atlantic University | 5 |
| 3 | Buckley, R.P. | Australia | University of New South Wales | 4 |
| 4 | Iheanachor, N. | Nigeria | Pan-Atlantic University | 4 |
| 5 | Liu, Y. | China | Wuhan University of Technology | 4 |

**Table 8**
The 10 most frequently cited publications in FL and Retirement Planning.

| R | Title | Authors | Country (1st aut) | Journal | Impact Factor (2020) | TC | (C/Y) |
|---|---|---|---|---|---|---|---|
| 1 | Impact of digital finance on financial inclusion and stability | Ozili (2018) | UK | Borsa Istanbul Review | 1,27 (JCI) Business, Finance (Q2) Economics (Q1) | 112 | 28.0 |
| 2 | The digital revolution in financial inclusion: international development in the fintech era | Gabor and Brooks (2017) | UK | New political Economy | 2,19 (JCI) Political Science (Q1), Economics (Q1), International Relations (Q1) | 134 | 26.8 |
| 3 | Mobile Money and Financial Inclusion in Sub-Saharan Africa: The Moderating Role of Social Networks | Bongomin et al. (2018) | Uganda | Journal of African Business | 1,47 (JCI) Business (Q1) | 75 | 18.8 |
| 4 | Mobile Money, Remittances, and Household Welfare: Panel Evidence from Rural Uganda | Munyegera and Matsumoto (2016) | Japan | World Development | 2,01 (JCI) Economics (Q1) Development Studies (Q1) | 100 | 16.7 |
| 5 | Nurturing a FinTech ecosystem: The case of a youth microloan startup in China | Leong et al. (2017) | Australia | International Journal of Information Management | 4,90 (JCI) Information Science and Library Science (Q1) | 72 | 14.4 |
| 6 | Microfinance Decision Making: A Field Study of Prosocial Lending | Galak, Small and Stephen (2011) | USA | Journal of Marketing Research | 1,53 (JCI) Business (Q2) | 139 | 12.6 |
| 7 | Blockchain entrepreneurship opportunity in the practices of the unbanked | Larios-Hernández (2017) | Mexico | Business Horizons | 1,60 (JCI) Business (Q2) | 60 | 12.5 |
| 8 | Mobile Money: Communication, Consumption and Change in the Payments Space | Maurer (2012) | USA | Journal of Development Studies | 0,83 (JCI) Development Studies (Q2) Economics (Q2) | 107 | 10.7 |
| 9 | Mobile Money for Financial Inclusion | Donovan (2012) | UK | Information and Communications for Development 2012: Maximizing Mobile | | 87 | 8.7 |
| 10 | Triggers and barriers to financial inclusion: The use of ICT-based branchless banking in an Amazon county | Diniz, Birochi and Pozzebon (2012) | Brazil | Electronic Commerce Research and Applications | 1,23 (JCI) Business (Q2) | 56 | 5.6 |

Abbreviations: R=rank; TC=Total citations; C/Y=Citations per year.

sciences, especially in order to evaluate the concentration of a market, is the Herfindahl-Hirschman Index (HHI) (Rhoades, 1993). It is calculated as the sum of the squared shares of each of the elements analysed, according to the formula. The values achieved rank from 0 (no concentration) to 10,000 (monopoly), where the values below 1500 represent a low degree of concentration and those over 2500 show the presence of a relative oligopoly.

$$HHI = \sum_{i=1}^{n} (MS_i)^2$$

**Table 9**
Herfindahl-Hirschman Index of the main analysis variables.

| | | |
|---|---|---|
| Country | 1200.98 | Low concentration |
| Institution | 62.21 | Low concentration |
| Journal | 81.31 | Low concentration |
| Research area | 3640.00 | Very high concentration |
| Author | 23.03 | Low concentration |

Table 9 gathers the values of HHI for the variables analysed. As it can be expected, the highest levels of concentration are reached by the research areas (as just one single area, Business Economics, includes more than half of the articles) and country (as the authors of a vast majority of the papers belong to the top 10 countries). On the other hand, the degree of concentration can be considered low regarding the authors, journals and institutions. This is a reflection of a topic which still shows a lot of potential, that will surely catch the attention of an increasing number of researchers in the forthcoming years.

### 4.7. Citation, sources and authors graphs

Through co-citation analysis we can identify the most influential works in a research field and establish their interrelationships (Small, 1973), detecting and analysing the intellectual structure of a research topic. Co-citation happens when a given articles cites simultaneously two different documents, revealing certain degrees of similarity between the cited papers. Co-citation can be based on different units of analysis: journals, documents (Small, 1973) and authors (McCain, 1990).

There was a total of 17,136 cited references in the 387 documents analysed, out of which 29 met the threshold of a minimum of 15 citations per paper. Each node (Fig. 2) represents a single reference, and its size indicates the number of citations per document. A link between two nodes reveals a co-citation relationship. The thicker the link between two nodes, the higher the strength of their relationship. Finally, the nodes belong to different clusters depending on the degree of similarity between them.

The map shows the existence of three groups of works. The blue cluster, which is the most central one, includes 8 documents which are mainly related with development and economic growth, that can be considered one of the expected outcomes of DFL. The most cited paper, Jack and Suri (2014), deals with the effects of the adoption of mobile money in Kenya (M-PESA) on the risk sharing behaviours of the consumers through a reduction of the transactions costs, assessing the potential of technologies, and specifically mobile money, to transform the lives of people in developing countries. The publications of the World Bank related with FI in developing countries (Demirgüç-Kunt and Klapper, 2012; Demirguc-Kunt et al., 2018) are also an important source included in this cluster.

Though some of the works included in the red cluster are published in the same volumes as the previously analysed papers, their point of view can be considered a bit different, mainly focused on the adoption of ICTs. Starting from their potential to foster FI, Donovan (2012) analyses the key factors driving the growth of mobile money services, reflecting as well on the barriers that have to be overcome to establish a mobile money ecosystem. Morawczynski (2009) also reflects on the critical service design features that helped to spread the successful case of the use of mobile money in Kenya.

Finally, the articles grouped in the green cluster are more closely related with financial institutions and the banking ecosystem.

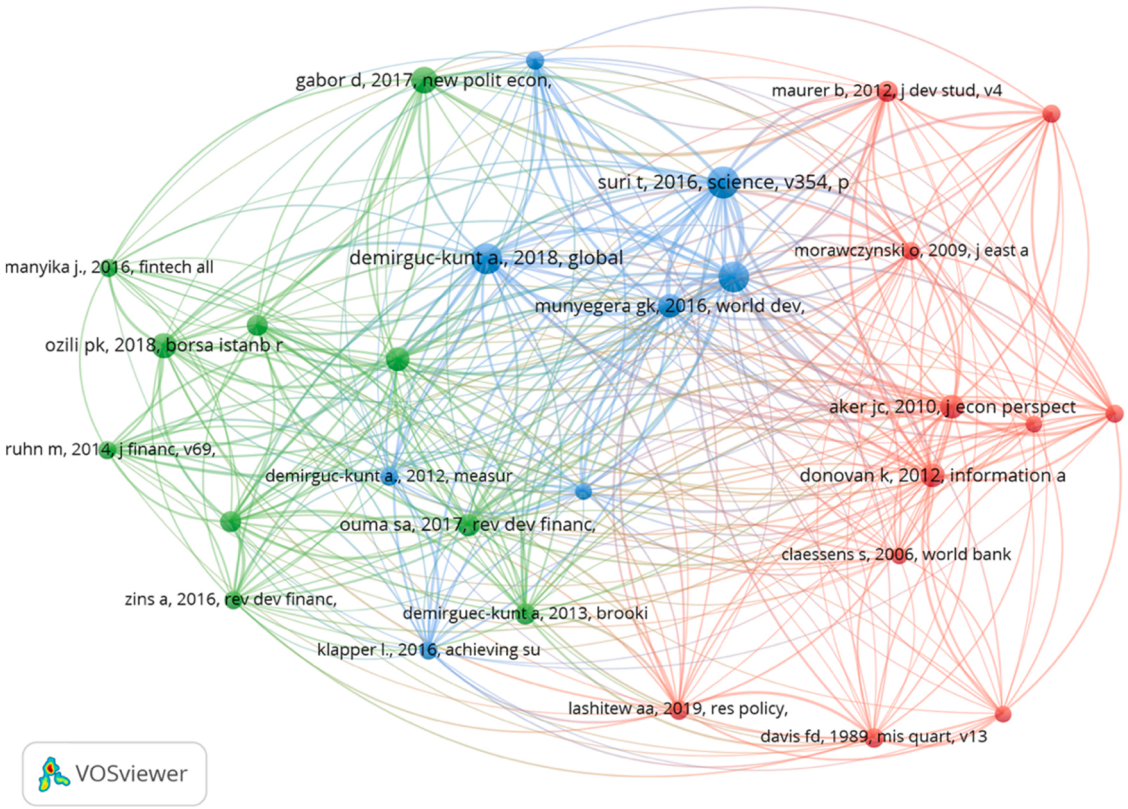


**Fig. 2.** Co-citation network of documents in the field of FL and retirement planning.

Sarma and Pais (2011) analyse the relationship between FI, a healthy financial system and development. Gabor and Brooks (2017) consider the role of technologies in profiling potential customers in banking.

Regarding the author co-citation, there were a total of 11,808 cited authors in the 387 documents analysed, out of which 18 met the threshold of a minimum of 40 citations. Fig. 3 shows the results of this analysis.

According to the previous analysis, the blue cluster includes the works of different authors which board this topic from a development perspective promoted by some of the main supranational institutions and organisations (World Bank, Consulting Group to Asist the Poor). The green cluster includes different institutional (Global System for Mobile Communications Association, GSMA) and individual (Venkatesh, Mas) authors, who mainly reflect on the conditions needed for a successful adoption of ICTs and the generation of a technology-based system which can foster FI. The red cluster includes the authors of some of the previously analysed references (Demirguc-Kunt, Beck, Sarma), concerned with the advances in FI and the reduction of the vulnerability of people in developing economies. An outstanding author included in this group is Asongu, the most prolific researcher dealing with sustainable development goal (SDG) #1 on poverty and SDG #10 on inequality, relevant foundations of the studies about DFI.

The journal co-citation analysis contributes to the study of the thematic organization of a research field (McCain, 1990). The frequency of citations from two sources together reveals similarities between the journals and their research areas. In our sample of 387 documents, a total of 9842 cited sources were identified, out of which 16 met the threshold of a minimum of 75 citations. Each node represents a journal, while the size of the node is proportional to the number of citations received. The closeness between two journals indicates their relatedness in terms of co-citation. The strongest co-citation links between journals are also represented by lines.

As can be seen in Fig. 4, the references about DFI are based on two main groups of publications. The red cluster, the most prominent one, gathers publications especially focused on development, such as World Development, the Journal of Development Economics or the Journal of Development Studies, along with some more financially based ones, such as the Journal of Banking and Finance. The green cluster includes journals which are mainly linked with ICTs and information systems as well as management, like MIS Quarterly and Management Science.

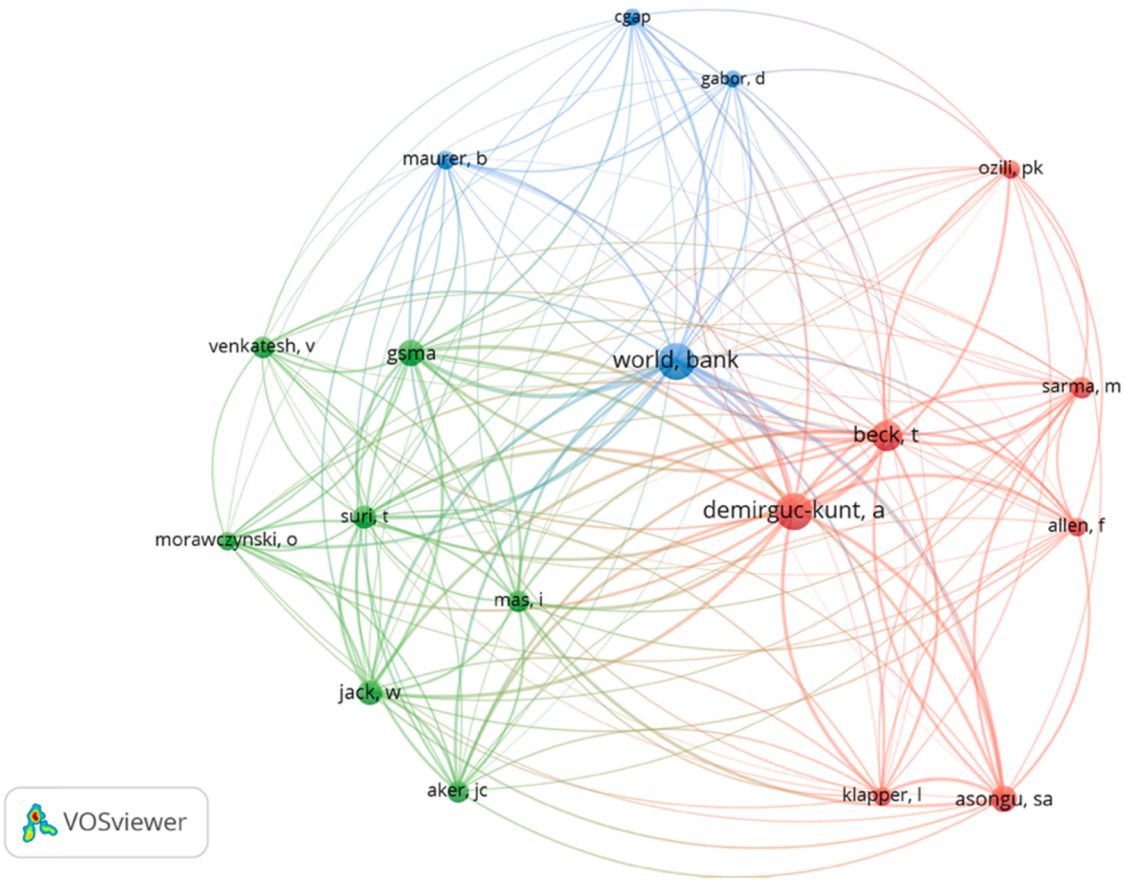


**Fig. 3.** Co-citation network of authors in the field of FL and retirement planning.

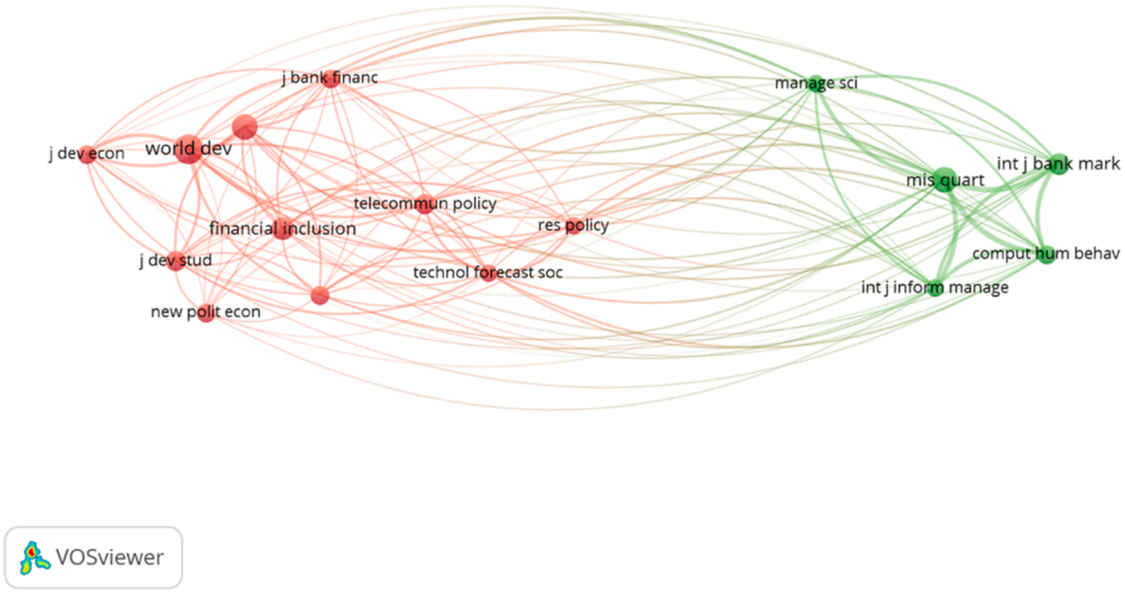


**Fig. 4.** Co-citation network of journals in the field of FL in retirement decisions.

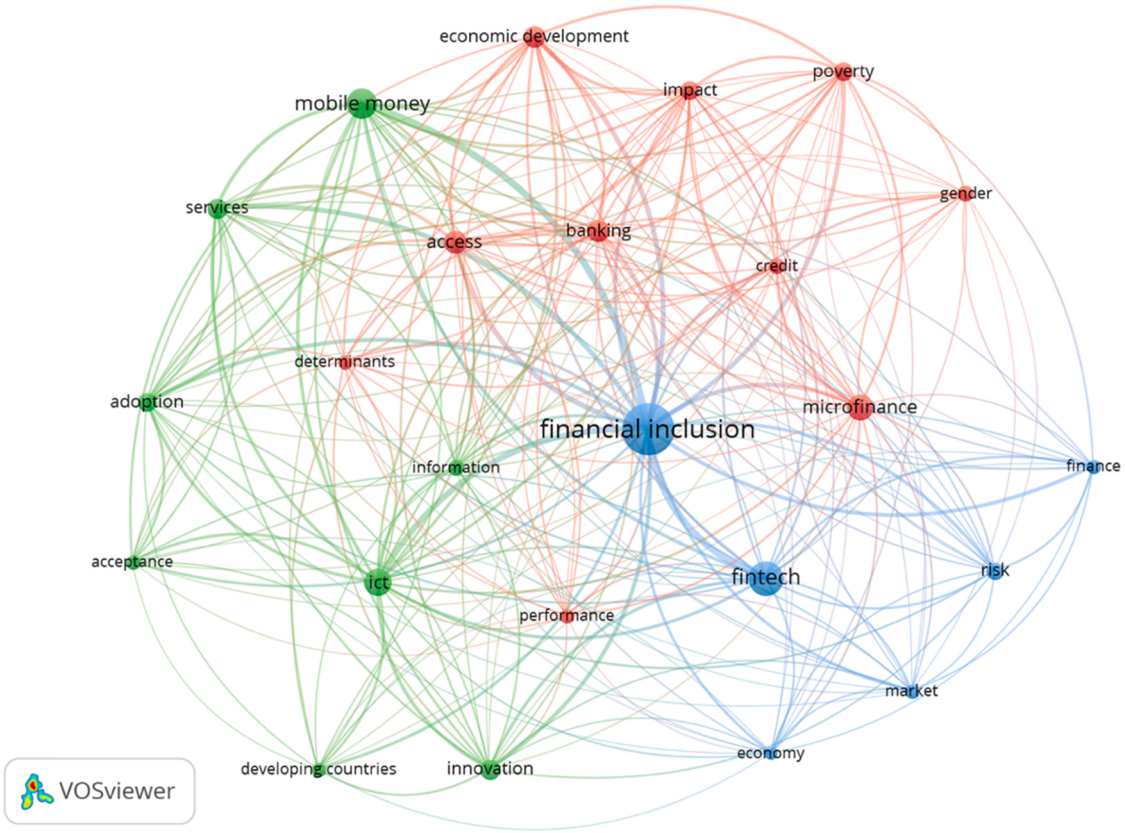


**Fig. 5.** Co-occurrence network of keywoeds in the field of FL and retirement planning

### 4.8. Thematic graph

Co-word analysis provides a deep evaluation of the main research trends and topics through the study of the most frequent keywords (Li et al., 2016). In the 387 articles analysed we obtained 1346 keywords, out of which 28 met the threshold of a minimum of 15 occurrences. The circles represent the occurrence of the keywords, while the distance between the circles represents their relationship (number of times that they occur together). Thick lines show stronger links between keywords.

Some of the most present keywords are the names of the countries where the studies have taken place. The most prominent ones are Kenya (17 occurrences), India (15) and China (13), as well as the generic references to Africa (20) and Sub-Saharan Africa (12). The strong presence of Kenya, Africa and Sub-Saharan Africa is strongly associated with the positive impact generated by M-PESA, while the size of the country and the number of microfinance experiences make China and India outstand. Nevertheless, for the purpose of the analysis, we have decided to remove these references from the keyword map, as they cannot be directly linked with the concepts that reflect the intellectual structure of the topic. (Fig. 5 and Table 10).

As can be expected, "financial inclusion" (200 occurrences and 485 total link strength) is placed in the core of the map, strongly related with the vast majority of the keywords represented. Along with it, some other terms such as "fintech" (93 and 197), "mobile money" (70 and 210) and "ICT" (60 and 210) are also critical to understand the literature about this topic.

"Financial inclusion" is the most prominent word of a blue cluster which includes some concepts that can be associated with financial services and investment. Therefore, another relevant one is "fintech". The investment perspective is gathered in some traditional items ("market", "risk" and "finance"). So, the words included in this cluster sum up one of the main challenges in this field, previously referred in the theoretical background section: achieving the FI of the poor and the unbanked while keeping an eye on the traditional risk-return perspective, considering the trade-offs between inclusion and profitability.

The green cluster includes terms mainly related with technology. "Mobile money", one of the best examples showing how "ICTs" can promote financial inclusion, is in the centre of this group. "Innovation", as a generic concept related with the development of new technologies, is also present. Nevertheless, the "acceptance" and "adoption" of these new powerful devices and services is considered by the literature even more critical than their development. Having high potential tools is a necessary, but not sufficient, condition for DFI.

Finally, the red cluster reveals the main "impacts" of DFI: the "access" to "banking" and "credit" services is associated by the literature with "poverty" reduction, "gender" equality and, therefore, social and "economic development" at three different levels: individuals, communities and nations. So, promoting DFI is considered by part of the academic literature a critical issue in order to accelerate the achievement of the SDGs, and therefore it will more than likely become in a short period of time one of the hottest research lines in this topic.

## 5. Discussion and conclusions

According to the World Bank, around 1.7 billion adults are still unbanked, that is, they do not have an account at a financial institution or through a mobile money provider (Demirguc-Kunt et al., 2018), due to different problems (Schuetz and Venkatesh, 2020), mainly related with the lack of geographical access, the high costs of transactions, the lack of appropriate products and financial illiteracy. So, though the access to financial services is frequently given for granted, financial exclusion is a relevant unsolved problem for many people.

The fundamental purpose of FI is to remove financial barriers, promoting an access to financial services and products at an affordable cost to a vulnerable section of the population traditionally excluded from their use (Ozili, 2018). FI contributes to overall economic growth and income equality (Beck et al., 2007; Kim, 2021; Park and Mercado, 2018; Kamal et al., 2021). Empirical research has found that FI produces a list of positive effects, not only enhancing national or regional economies, but helping the households and individuals (Kabakova and Plaksenkov, 2018). Therefore, FI is directly aligned with eliminating poverty, the 1st Sustainable Development Goal of United Nations. Nevertheless, there could be some trade-offs between FI and profitability which pose additional challenges that should be addressed (Demirgüç-Kunt and Singer, 2017).

The Global Partnership for Financial Inclusion, created by the G-20, highlights the role of digital technologies for expanding access to financial services for the unbanked. As the GPFI states, "digital technologies can help connect more people at lower cost – including those living in rural and remote areas – to critical financial services that help them manage their financial lives and, ultimately, offer a pathway out of poverty".

Though the importance of FI has frequently been studied by the academic literature, DFI is still a blooming topic that is progressively attracting the attention of many researchers. This paper provides an overview of this relatively young research stream, synthesizing the academic literature on DFI through a systematic review of published studies.

Though the first two papers were published in 2010, the topic didn't catch a major attention of the academic community until 2016, when the literature experienced a clear burst in its productivity. As the analysis of the subtopics shows, two forces can be considered the main drivers of this awakening: the concern of supranational institutions (World Bank, United Nations, G-20…) about FI and the opportunities delivered by different technological innovations applied to banking and finance.

From then on, the increase in the number of yearly publications has been exponential, generating a new peak every year. The maximum of 130 articles published in 2021 can more than likely be considered a direct consequence of the impact of COVID-19 crisis in the massive use of ICTs in finance. Nevertheless, both the attractiveness of the research field and the relatively high opportunities for publication can anticipate the consistency of this growth trend.

Reflecting the importance of DFI in order to reach development goals, the literature analysed rests basically on three main fields:

**Table 10**
Top 10 keywords.

| Keywords | Frequency |
|---|---|
| Financial inclusion | 200 |
| Fintech | 93 |
| Mobile money | 70 |
| ICT | 60 |
| Microfinance | 51 |
| Access | 42 |
| Economic Development | 35 |
| Banking | 35 |
| Services | 33 |

development studies, information and technological innovation and economic policy. Therefore, we can consider that the achievement of a high degree of DFI depends both on technological development and the establishment of adequate economic policies and regulatory frameworks by the authorities of the developing countries, counting on the support of supranational institutions.

The implementation of M-Pesa, which has furtherly been the origin of other digital financial services, meant a revolution in DFI. The literature has reflected this successful story (especially in the case of Kenya), studying its origins, the requirements for the implementation and adoption of such service and the positive impacts that it has generated (Maurer, 2012; Jack and Suri, 2014).

The most frequent keywords used by this research stream are also aligned with these concerns. Financial inclusion itself, fintech and even risk and market can be easily associated with a financial concern, while some other ones (ICT, mobile money, innovation, adoption or acceptance) are closely related with the process of developing and successfully implementing digital technologies in finance. A third group (impact, poverty, economic development, gender) reflects the positive expected effects of DFI.

This paper makes a significant contribution to the state of the art, summing up and organizing the existing literature, as well as remarking the strength and relevance of this research stream, which cannot be ignored by policymakers, financial institutions, and technological companies. The analysis shows that DFI is a critical demand of our society, and a necessary road to reach sustainable development, though, as it has been remarked in the theoretical framework, there are still relevant issues, such as the availability of an adequate regulatory framework, the trade-offs between inclusion and profitability and the use of some specific technological tools (e.g., alternative data), that should be addressed.

The main limitation of this article stems from the selection of documents to be analysed. Web of Science, a reference when dealing with academic literature, includes the majority of the most prominent publications in this research stream, though some relevant studies could have potentially not been considered. Also, even if it is not frequent, some of the papers analysed may not include keywords, influencing the results of the co-word analysis. Finally, the conclusions reached are unavoidably affected by the subjectivity of the authors.

As we have stated before, the increase in the academic interest about this topic has just started. The burst of the crisis of COVID-19 has pushed both the need for DFI and the academic interest about it. If COVID-19 has taught the world a lesson, it is the need to protect the most vulnerable when facing a crisis if we want to create a society that is worth living in.

## CRediT authorship contribution statement

**Rocío Gallego-Losada**: Conceptualization, Resources. **Rocío Gallego-Losada, Antonio Montero-Navarro**: Writing – original draft preparation, Supervision. **María-Jesús Gallego-Losada, Elisa García-Abajo**: Writing – review & editing, Visualization. **Elisa García-Abajo**: Methodology. **María-Jesús Gallego-Losada, Elisa García-Abajo, Antonio Montero-Navarro, Rocío Gallego-Losada**: Validation. **Elisa García-Abajo, Antonio Montero-Navarro**: Formal analysis.

## Conflicts of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Data availability

No data was used for the research described in the article.

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