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ORIGINAL ARTICLE

Digital financial inclusion as a catalyst for innovation, economic growth, and sustainability: A bibliometric analysis (2014-2024)

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ABSTRACT

Objective. This study aimed to conduct a bibliometric analysis of keywords to identify strategic topics in digital financial inclusion (DFI) and their relationship with sustainability and economic growth between 2014 and 2024.

Design/Methodology/Approach. A bibliometric analysis was conducted on a sample of 1,234 academic articles indexed in Scopus using the Bibliometrix tool in R. Keyword co-occurrence was examined using multiple correspondence analysis and K-means clustering to reveal thematic structures.

Results/Discussion. A total of six thematic clusters were identified: (1) threshold effect, (2) digital transformation, (3) central bank digital currencies (CBDCs), (4) sustainable development, (5) financial and digital literacy, and (6) fintech. These clusters demonstrated the evolution of DFI from its initial role as a technological enabler, such as fintech and blockchain, to its current impact on economic development, growth, and sustainability. This analysis proposed a conceptual model of DFI. In this model, digital literacy and fintech functioned as enablers. Meanwhile, CBDCs and blockchain technology served as structural tools. Digital financial inclusion was defined as a mechanism for inclusive economic development.

Conclusions. The findings contributed to an understanding of how financial digitization is linked to sustainability strategies and long-term economic growth.

Originality/Value. This research provided insights based on a comprehensive bibliometric mapping of DFI, incorporating literature on economic sustainability and digital innovation. This empirical approach, which differed from narrative reviews and isolated case studies, enabled the visualization of the conceptual structure of the field and the identification of research gaps

Keywords: bibliometrics; co-word analysis; financial inclusion; digital inclusion; fintech; blockchain; sustainability.

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1. INTRODUCTION

In recent decades, digital financial inclusion (DFI) has emerged as a pivotal phenomenon for understanding economic development in contexts of rapid technological transformation. However, despite the growing body of literature on the subject, few studies synthesize the main trends and conceptual cores that articulate this emerging field. Digital financial inclusion has the potential to bring about substantial change for underserved and underbanked populations, including low-income families, women, migrants, older adults, indigenous populations, rural communities, small businesses, and microenterprises (BID Invest, 2024). For a considerable portion of the 20th century and the early 21st century, economic growth was regarded as the primary catalyst for development. The prevailing assumption was that an increase in GDP would inherently result in a reduction in poverty and the promotion of greater social equity (Kuznets, 1955). This perspective was founded on neoclassical growth models, which placed significant emphasis on capital accumulation and technological progress as the primary catalysts of economic growth (Solow, 1956). However, it is worth noting that economic growth alone does not invariably result in equitable improvements in wealth distribution. This prompted a reassessment of the role of inclusion in economic development studies.

Beginning in the 1990s and with greater force in the 21st century, literature began to recognize that social and financial inclusion was not only a result of economic growth but also a determining factor in its sustainability (Sen, 1999). In this context, financial inclusion emerged as a pivotal mechanism for reducing inequalities, as it facilitates access to formal financial services and promotes entrepreneurship and economic stability in marginalized communities (Beck *et al.,* 2007). According to the findings of Demirgüç-Kunt and Klapper (2013), empirical evidence has demonstrated that societies with higher levels of financial inclusion have experienced more sustained growth and less structural inequality. In a digital society, the concept of financial inclusion has evolved to encompass a more expansive model that integrates access to digital tools as a fundamental component of ensuring equitable participation in the economy. Moreover, digital inclusion has become an indispensable requirement for financial inclusion, as digital technologies have transformed the provision of financial services, facilitating banking, access to credit, and efficient resource management through technological platforms (Arner *et al.,* 2020). However, according to the WEF (2024) and the World Bank (2024), approximately 1.4 billion people worldwide lack access to financial services, representing a significant gap in financial inclusion within the global financial landscape.

Digital financial inclusion is defined as the utilization of digital technologies to facilitate cost savings, thereby extending formal financial services to currently excluded and financially underserved populations. These services are tailored to the specific needs of the target population and are delivered responsibly, ensuring affordability for customers and sustainability for providers (BID Invest, 2024; CGAP, 2015). Despite the proliferation of literature on financial inclusion and its digital transformation, there is a paucity of studies that have systematized this thematic convergence from a structural perspective, particularly about its associations with aspects such as sustainability and economic growth. The extant body of work is predominantly composed of empirical studies and narrative reviews. However, there is a paucity of bibliometric analyses that facilitate the visualization of the thematic and conceptual dynamics that articulate this emerging field. Despite the proliferation of academic research on DFI, systematic reviews of this literature remain limited. A total of five reviews were identified as notable. These include a bibliometric analysis of the historical evolution of DFI by Gallego-Losada *et al.* (2023), a systematic review of digital financial literacy by Gumilar *et al.* (2024), a study of financial inclusion/exclusion in developed countries by Fernández-Olit *et al.* (2020), and a qualitative analysis of microfinance institutions and fintech approaches to addressing digital literacy barriers by Koefer *et al.* (2024) (Table 1).

In contrast, this study proposes a structural bibliometric review focused on the interrelationships between DFIs, sustainability, and economic growth, based on a broader sample (1,234 articles in Scopus between 2014 and 2024). In addition to identifying strategic

Author(s) / year	Study title	Type of review	Database / sample	Main focus	Differences from this study
Gallego-Losada *et al.* (2023)	*Digital Financial Inclusion. Visualizing the Academic Literature*	Bibliometric (SciMAT + VOSviewer)	387 articles (WoS, 1990-2021)	Structural mapping and historical evolution of the DFI field	Does not analyze sustainability or economic growth; does not apply MCA or thematic clustering.
Gumilar *et al.* (2024)	*Digital Financial Literacy and Digital Financial Inclusion in the Era of Digital Disruption*	Systematic literature review (SLR)	35 articles (Scopus, 2020-2024)	Impact of digital financial literacy on inequality and well-being	Does not propose a conceptual model or thematic structure analysis; focus is limited to digital financial literacy only.
Fernández-Olit *et al.* (2020)	*Financial Inclusion and Exclusion in Developed Countries*	Systematized review	52 articles (2009-2018)	Financial inclusion/exclusion in developed countries	Does not address digital inclusion or emerging technologies; does not use bibliometric analysis or clustering.
Koefer *et al.* (2024)	*Addressing Financial and Digital Literacy Challenges for Inclusive Finance*	Qualitative review (interviews)	Case studies of microfinance institutions and fintechs in Europe	Differences between educational and technological approaches to inclusion	Not a systematic or bibliometric review; it does not map the field but instead explores practical strategies.
This research	*Digital Financial Inclusion as a Catalyst for Innovation, Economic Growth, and Sustainability: A Bibliometric Analysis (2014-2024)*	Structural bibliometrics (MCA + K-means)	1,234 articles (Scopus, 2014-2024)	DFI + sustainability + economic growth	Integrates literacy, technology, and sustainability, proposing a conceptual model with a broader thematic and methodological scope.

Table 1. Main academic reviews on DFI (2014-2024).

themes through the use of keywords, multiple correspondence analysis (MCA), and K-means clustering, a conceptual model is proposed that articulates digital literacy, emerging technologies, and inclusive development. Consequently, the research problem that is addressed by the bibliometric analysis is to identify the main thematic clusters and their evolution in recent literature on DFI and its impact on sustainability and economic growth.

The research question guiding this work is as follows: What are the strategic, emerging, and consolidated issues in the field of DFI, at its intersection with sustainability and economic growth, during the period 2014-2024? Unlike qualitative approaches or focal empirical studies, bibliometric analysis is relevant because it allows us to map the conceptual structure of the field and detect thematic gaps or areas of specialization, synthesizing large volumes of scientific information while revealing conceptual patterns, relationships between key topics, and thematic knowledge structures (Donthu *et al.*, 2021). This approach is particularly relevant given the rise of fragmented research that hinders a strategic view of accumulated knowledge. Therefore, this research applies co-word analysis, MCA, and K-means clustering to identify and classify the main trends in the field. The objective of this study is, therefore, to identify the strategic, emerging, and consolidated themes that articulate the relationship between DFI, sustainability, and economic growth through a bibliometric analysis of keywords. Based on the empirical results obtained, a conceptual model is proposed that integrates these components into a structured thematic architecture.

2. SOCIAL INCLUSION AND DIGITAL FINANCIAL INCLUSION

Social inclusion is defined as the ability of individuals to participate fully in society and overcome conditions of marginalization and deprivation by taking advantage of available opportunities (Sen, 1999). In contrast to

approaches that prioritize the alleviation of poverty or material inequalities, social inclusion demands the establishment of institutional mechanisms that preclude the emergence of structural exclusion (Atkinson, 1998). This process entails cultivating collective solidarity through the equitable distribution of essential resources, thereby facilitating the effective integration of all individuals into society (Silver, 1994). The notion of an inclusive society hinges upon the notion that each individual is capable of exercising their social and political rights in a meaningful way through equitable and specific opportunities (Levitas, 2005). Consequently, social cohesion is identified as a pivotal condition for fostering the balanced and active involvement of societal members, thereby fortifying collective stability and resilience (Jenson, 1998). Conversely, financial inclusion is defined as the access to and effective use of formal financial services by individuals and businesses, thereby enabling them to manage their economic resources efficiently (Demirgüç-Kunt & Klapper, 2013). In contrast to perspectives constrained by fundamental financial inclusion, this concept expands its scope by emphasizing the need to ensure that access to financial services is not only basic but also timely and sufficient for all social sectors. This emphasis is particularly pronounced in the context of including vulnerable or traditionally disadvantaged populations (Sarma, 2008). From this perspective, financial inclusion is presented as a crucial mechanism for promoting structural poverty reduction and fostering sustained economic growth through broad and equitable access to formal financial services (Beck *et al.,* 2007).

Accessible and adequate use of formal financial services directly reduces economic barriers, thereby promoting the effective participation of marginalized groups in productive economic activities (Cámara & Tuesta, 2014). However, effective financial inclusion entails more than mere availability and access; it necessitates that these services be pragmatic and economical, thereby facilitating the alleviation of economic and social inequalities as an integral component of human development (Allen *et al.,* 2016). Furthermore, it has been demonstrated to promote a more equitable distribution of financial resources in society (Beck *et al.,* 2007). Conversely, the concept of digital inclusion aims to bridge the digital divide by facilitating effective access to digital technologies and cultivating the competencies necessary to maximize their benefits (Warschauer, 2004). Digital inclusion is defined as the full participation in the digital age, encompassing both physical access to technological tools and the cultivation of digital skills. It is imperative to address the barriers that impede digital participation, particularly those related to digital literacy and engagement in the information society (Van Dijk, 2006). Therefore, digital inclusion is not merely a matter of technological availability; it necessitates an understanding of the social, economic, and cultural factors that influence access to and effective utilization of these technologies (Selwyn, 2004).

Research has underscored the notion that the digital divide encompasses not only physical access to technology but also structural limitations related to education and civic participation (Van Dijk, 2006). In a similar vein, it highlights how digital exclusion disproportionately affects young people and vulnerable communities, thereby exacerbating existing inequalities in access to information and digital financial services (Livingstone & Helsper, 2007). Following these perspectives, it is proposed that digital inclusion serves as a fundamental prerequisite for sustainable financial inclusion (Warschauer, 2004). The degree of digital inclusion is contingent on two factors: the availability of technological resources and the acquisition of specific skills that enable full participation in digital contexts. This is especially relevant for groups facing greater disadvantages or structural barriers (Livingstone & Helsper, 2007). This phenomenon, termed "digital financial inclusion," signifies the integration of financial inclusion and digital inclusion, underscoring the pivotal role of access to financial services through the effective utilization of digital technologies. This process entails facilitating the provision and efficient use of digital financial services to provide timely and affordable access, particularly to populations that have been historically excluded from the conventional financial system (Ozili, 2018).

Digital financial inclusion is not confined to technological or financial access; instead, it actively promotes the participation of individuals and businesses through digital tools that foster

their effective economic and financial integration (Gabor & Brooks, 2017). The integration of digital financial technologies has emerged as a pivotal element in mitigating the structural impediments that have traditionally constrained the economic engagement of vulnerable segments. This integration contributes to the enhancement of long-term economic and social stability (Arner *et al.,* 2020). In this regard, it is noteworthy that the adoption of technologies associated with Industry 4.0, such as artificial intelligence, is enabling more efficient and customized processes in the delivery of digital financial services (Mhlanga, 2020). Conversely, a global review suggests that DFI, driven by fintech, has become a pivotal strategy for mitigating financial exclusion and promoting macroeconomic stability in emerging countries (Ozili, 2021).

3. METHODOLOGY

This study employed a bibliometric co-occurrence analysis, using keywords selected by the authors from publications published over the last 10 years on DFI (Donthu *et al.,* 2021). The analysis considered the algorithm of Porter (1980), which only took lexical roots into account. The terms were classified using MCA and the K-means algorithm, where MCA facilitated the analysis of categorical data using multivariate techniques (Greenacre & Blasius, 2006). The interpretation of the results was based on the distribution and location of the terms within the generated dimensional space (Cuccurullo *et al.,* 2016). For the visual representation of the maps and the bibliometric analysis, the Bibliometrix package in R was applied (Aria & Cuccurullo, 2017), following an analytical approach in the selection, collection, and processing of the sample (Donthu *et al.,* 2021). The search was conducted in Scopus using the Boolean string: *TITLE-ABS-KEY(digital AND financial AND inclusion).* The research was limited to the results of academic articles published between 2014 and 2024, excluding duplicate documents, literature reviews, conferences, and books. The search was restricted to documents written in English and Spanish. Keywords defined by the authors were excluded. Initially, 1,308 documents were obtained; however, after applying filters and eliminating 74 records without keywords, the final sample consisted of 1,234 articles.

To explore the semantic structure of the field, co-word analysis was employed, as this technique enables the identification of the main thematic lines and their conceptual interrelationships (Donthu *et al.,* 2021). The selection of MCA is predicated on its capacity to graphically represent complex relationships between multiple categorical variables, thereby facilitating the projection of key terms in a two-dimensional space (Greenacre & Blasius, 2006). Consequently, the thematic map provides a visual representation of the research field. This representation facilitated the identification of the relevance and degree of development of the various subjects comprising a specific domain of knowledge. Subsequently, the K-means algorithm was applied to group the terms into homogeneous clusters, based on the criteria of proximity within the MCA space. The thematic distribution on the map exhibited a two-dimensional structure, with the horizontal axis denoting the centrality of the theme, reflecting its level of connection with other concepts within the field of study. The vertical axis indicated the theme's density, defined as its degree of development and internal cohesion (Aria & Cuccurullo, 2017).

To ensure the robustness of the analysis, the density and centrality values of each thematic cluster were calculated and graphically represented using the thematic map generated in Bibliometrix. Employing this methodology, four types of thematic clusters were identified. The consolidation and strategic themes exhibited high centrality and density, signifying their sophistication within the field of study and their robust connections to other fundamental concepts. The centrality and density of emerging or declining topics were found to be low, suggesting that these topics may be in the early stages of development or in the process of becoming obsolete. Conversely, topics that are highly developed yet peripheral exhibit high density but low centrality. This suggests that, despite their high level of specialization, their influence on the broader knowledge structure is constrained. Basic topics demonstrate high centrality but low density, indicating that they are fundamental concepts that articulate the field of study. However, their specific degree of

development is still incipient (Aria & Cuccurullo, 2017). This study is subject to certain methodological limitations. First, the analysis is based exclusively on the keywords provided by the authors; therefore, it may exclude relevant terms that are not explicitly tagged. Second, the Scopus database was the sole source of literature, potentially resulting in the exclusion of relevant literature from other sources such as Web of Science or Google Scholar. The decision to restrict the analysis to documents in English and Spanish may potentially impact the overall representativeness of the phenomenon.

4. RESULTS

A close examination of the 10 most salient keywords reveals a predominant focus on the impact of financial technologies (fintech) and digital financial services (digital financial services, mobile money, digital finance) on reducing financial and economic barriers. Moreover, the term "financial literacy" signifies an academic concern with cultivating competencies to ensure effective and sustainable inclusion. The advent of the term "central bank digital currency" signifies an emerging interest in the role of digital monetary policies and their potential influence on inclusion and economic growth within a macroeconomic context. The advent of the term "COVID-19" can be attributed to the rapid acceleration of the digitization process, which has led to a significant increase in the use of financial technologies in contexts where conventional methods previously dominated. Table 2 presents the 10 most frequently occurring keywords.

Palabras clave	Ocurrencias
Fintech	138
Digital finance	93
Financial literacy	52
Digital financial services	46
Mobile money	46
Central bank digital currency	40
Economic growth	37
Financial technology	36
COVID-19	30
Digitalization	29

Table 2. Most frequent keywords.

The academic topics are grouped into six clusters: (1) threshold effect, (2) digital transformation, (3) central bank digital currencies (CBDCs), (4) sustainable development, (5) financial and digital literacy, and (6) fintech. Figure 1 shows the thematic map by clusters.

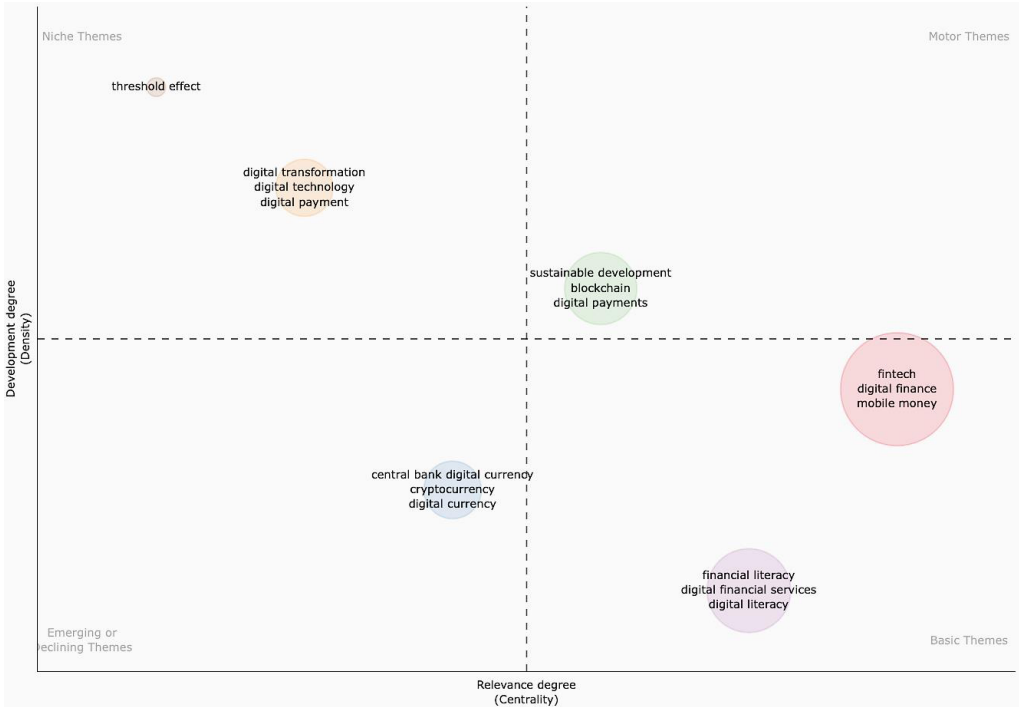

Figure 1. Thematic map by clusters.

4.1. Analytical interpretation of clusters

The MCA and the K-means algorithm were used to identify six thematic clusters that structure the field of research on DFI and sustainable development. These clusters were positioned within the thematic map according to two analytical dimensions: centrality, which indicates the level of connection of the topic with the rest of the field, and density, which reflects its degree of internal development. Each of the identified clusters is described below, taking into account their thematic profile, theoretical contributions, and future prospects.

Cluster 1, designated "threshold effect," is situated within the niche topic category, exhibiting characteristics such as high density and low centrality. This cluster comprises studies that, despite their robust theoretical underpinnings, persist in a state of peripheral engagement within the broader discourse. The thematic focus of this study revolves around the concept of threshold, understood as the critical point at which DFI begins to have a significant impact on macroeconomic variables such as growth or employment (Hansen, 2000). A multitude of studies have demonstrated that upon attaining a specific threshold of digital financial service adoption, multiplier effects are initiated, which become particularly evident in rural or emerging economies (Geng & He, 2021; Liu *et al.,* 2021).

Cluster 2, which is entitled "digital transformation," is also classified as a niche. However, it possesses the potential to evolve into a structural element, given its increasing interconnectedness with the central axes of the digital ecosystem. This cluster focuses on research endeavors related to emerging technologies, including, but not limited to, artificial intelligence, chatbots, and automation, with a particular emphasis on their applications within the financial system. These tools are redefining access to financial services by removing traditional barriers, especially among excluded or hard-to-reach populations (Abdulquadri *et al.,* 2021). In this context, blockchain technology has emerged as the primary catalyst of financial transformation. It facilitates the redefinition of intermediation, security, and access processes through decentralized structures that reduce costs, increase transparency, and improve operational efficiency (Arner *et al.,* 2020; Nakamoto, 2008). This technological revolution has driven the emergence of new models, such as initial coin offerings and smart contracts, which facilitate access to financing without intermediaries and promote the inclusion of traditionally excluded sectors (Buterin, 2014; Harvey *et al.,* 2021; Zohar, 2015). Conversely, their integration with fintech platforms signifies a comprehensive augmentation in the provision and accessibility of digital financial services.

In an emerging position, cluster 3 focuses on the debate surrounding "central bank digital currencies." Despite its low density, the growing centrality of this cluster indicates its future potential as a driver of systemic transformation. Central bank digital currencies signify an institutional response to the disruption caused by cryptocurrencies and blockchain technology, offering a regulated digital alternative with the potential to redefine payment systems, money issuance, and financial control (BIS, 2020; Gupta *et al.,* 2023). Indeed, numerous governments and central banks have initiated the development of pilots and regulatory frameworks supported by distributed technologies such as blockchain, underscoring their capacity to enhance the traceability, efficiency, and stability of the financial system (Auer & Böhme, 2021).

Cluster 4, designated as "sustainable development," is situated within the strategic themes, exhibiting high centrality and an articulating role among the other themes in the field. This cluster connects DFI with ecological sustainability, highlighting the roles of green finance, energy efficiency, and responsible natural resource management (Feng *et al.,* 2022; Wang *et al.,* 2022). The digitization of financial services has been demonstrated to expand their coverage, promote traceability, and enhance ecological efficiency and investment in sustainable projects. This development has been identified as a key tool for achieving the Sustainable Development Goals (SDGs).

In a fundamental and interconnected category, Cluster 5 integrates the themes of "financial and digital literacy" with financial services. This cluster of publications synthesizes foundational studies on the relationship between digital and financial competencies and the effective adoption of digital financial services,

particularly in vulnerable contexts. Its role is fundamental to understanding how technological inclusion becomes real economic inclusion (Demirgüç-Kunt & Klapper, 2013; Kass-Hanna *et al.,* 2022), acting as a bridge between digital transformation, social impact, and the fintech ecosystem.

In conclusion, cluster 6 signifies the structural core of the field, namely "fintech." This topic has been identified as having high centrality and density, thereby positioning it as a fundamental and articulating cluster within the DFI ecosystem. The collected literature encompasses the automation of financial services, the proliferation of digital platforms, and the conceptualization of alternative models of financial intermediation. Fintech has been demonstrated to drive innovation in the sector, as well as to reduce barriers to access and generate a significant impact on populations that have traditionally been excluded (Gálvez-Sánchez *et al.,* 2021; Mhlanga, 2020). It is acknowledged that while these innovations hold the potential to enhance women's financial inclusion, the development of public policies that address systemic inequalities and foster their active engagement in the digital economy is imperative (Di Vaio *et al.,* 2023). In this regard, DFI emerges as a pivotal instrument in the endeavor to mitigate gender disparities and foster sustainable development.

The findings, when considered collectively, demonstrate that emerging technologies such as blockchain have not only reconfigured the architecture of digital financial services but have also established themselves as foundational elements of the emerging financial inclusion paradigm. The application under discussion here extends beyond the domain of cryptocurrencies to encompass decentralized financing models, transaction traceability, digital identity, and smart contracts. This technological versatility has the potential to reduce the number of intermediaries, automate processes, and strengthen trust in financial systems that have historically excluded significant segments of the population. Empirical evidence suggests that the decentralization and security inherent in blockchain design yield direct benefits in contexts characterized by fragile institutions, weak regulatory frameworks, or populations lacking access to traditional banking services (Catalini & Gans, 2016; Ozili, 2021). Consequently, its integration into fintech solutions has facilitated microfinance initiatives, low-cost international transfers, and credit networks predicated on digital reputation, with a focus on rural populations, women, and young people. Moreover, the advent of blockchain technology has ushered in a new domain for innovation in the realm of financial governance and sustainability. This is because blockchain facilitates enhanced transparency in resource utilization, ensures traceability in green investments, and automates the monitoring of social and environmental indicators. The advent of programmable protocols and consensus algorithms has led to the development of platforms that seamlessly integrate profitability objectives with social impact metrics. This development marks a significant shift from traditional banking models. In this regard, multilateral organizations and central banks are exploring the application of blockchain technology in the design of CBDCs, with the aim of expanding access to reliable, traceable, and regulated digital money, without losing sight of inclusion and systemic stability (Arner *et al.,* 2020; Auer & Böhme, 2021).

Recent studies have emphasized the transformative potential of blockchain technology in promoting gender equality. The technology can create more transparent, accessible, and institutionally unbiased financial environments. By ensuring the integrity of digital identities, unalterable transaction records, and independent access to financial services, this technology has the potential to serve as a strategic instrument in addressing gender disparities in the digital economy (Di Vaio *et al.,* 2023). Its integration with inclusive policies has been demonstrated to expand opportunities for women and strengthen the economic fabric as a whole by adding historically marginalized perspectives to the financial innovation ecosystem. This thematic-structural classification does not stem from an editorial exercise; rather, it is the result of a rigorous empirical analysis based on reduction and clustering techniques. The six clusters, considered collectively, offer a comprehensive view of the mechanisms, tensions, and opportunities shaping the evolving domain of DFI. A focus on sustainability and equity characterizes this perspective. Table 3 provides a synopsis of the thematic characterization of the identified clusters.

Cluster	Theme type	Central thesis	Key references
Cluster 1: Threshold effect	Niche (low centrality and high density)	There is a critical point in financial digitalization where the economic impact becomes significant, especially in emerging contexts.	Hansen (2000), Liu *et al.* (2021), and Geng and He (2021)
Cluster 2: Digital transformation	Niche with structural potential	Technologies such as "artificial intelligence," "chatbots," and "blockchain" are redefining access to financial services and laying the foundation for inclusive and innovative ecosystems.	Abdulquadri *et al.* (2021), Aloulou *et al.* (2024), Nakamoto (2008), Arner *et al.* (2020), Zohar (2015), and Buterin (2014)
Cluster 3: CBDCs	Emerging (low density and growing centrality)	CBDCs emerge as institutional responses to the disruption of cryptocurrencies, with the potential to transform payment systems and enhance financial inclusion.	Gupta *et al.* (2023), BIS (2020), and Auer & Böhme (2021)
Cluster 4: Sustainable development	Strategic (high centrality)	Link between DFI and ecological sustainability through green finance, energy efficiency, and traceability in responsible investments.	Feng *et al.* (2022) and Wang *et al.* (2022)
Cluster 5: Financial and digital literacy + financial services	Basic (foundational and connector)	Digital and financial skills are essential prerequisites for digital inclusion to translate into genuine economic inclusion, particularly in vulnerable contexts.	Demirgüç-Kunt and Klapper (2013) and Kass-Hanna *et al.* (2022)
Cluster 6: Fintech	Basic (central and articulating)	Digital platforms, automation, and technologies such as blockchain drive new forms of financial intermediation, capable of reducing access barriers and closing gender gaps.	Gálvez-Sánchez *et al.* (2021), Mhlanga (2020), Ozili (2021), Di Vaio *et al.* (2023), and Harvey *et al.* (2021)

Table 3. Thematic characterization of identified clusters through MCA and K-means. Source. Own elaboration based on bibliometric analysis and the reviewed literature (Arner *et al.,* 2020; Di Vaio *et al.,* 2023; Geng & He, 2021; Ozili, 2021). **Note:** Cluster names were assigned based on the density of occurrences and the most representative terms identified through MCA and means analysis.

5. DISCUSSION

In recent years, the focus on economic growth has become the central axis of economic growth studies. The notion of inclusive growth has gained prominence by acknowledging that economic growth must be sustainable and equitable to ensure macroeconomic and social stability (Stiglitz, 2012). This theoretical framework has been reinforced by the United Nations SDGs, which underscore the significance of inclusion across multiple domains, including financial, digital, social, and gender aspects, to attain comprehensive economic development (UN, 2015). The advent of fintech has precipitated a paradigm shift, providing innovative tools that enable traditionally excluded sectors to access financial services with greater efficiency and security (Arner *et al.,* 2020). The COVID-19 pandemic has further exacerbated this trend, underscoring the pivotal role that access to digital solutions plays in ensuring the economic resilience and financial stability of households and small businesses (Fu & Mishra, 2022).

The results of this study corroborate and expand upon these earlier findings. The fintech cluster as a structural axis reflects how technological innovation has become a central mechanism for DFI, thereby strengthening not only transactional efficiency but also the democratization of financial access, in line with the findings of Gálvez-Sánchez *et al.* (2021) and Mhlanga (2020). Moreover, the identification of financial and digital literacy as a fundamental cluster underscores the importance of knowledge and training as prerequisites for effective inclusion, coinciding with the approaches of Demirgüç-Kunt and Klapper (2013) and Kass-Hanna *et al.* (2022). Conversely, the emergence of currencies such as CBDCs is an emerging cluster point to a recent trend that broadens traditional proposals on financial inclusion. Contrary to the prevailing focus in earlier research on access to banking infrastructure, our findings indicate a shift in the discourse toward

novel forms of digital currency. This emerging area of study remains in its nascent stages, as evidenced by research conducted by Gupta *et al.* (2023) and Auer and Böhme (2021).

The sustainable development cluster conceptually articulates the role of DFI as a mechanism to support the ecological efficiency and resilience of vulnerable communities, contributing to more balanced and sustainable growth. This finding aligns with the observations reported by Feng *et al.* (2022) and Wang *et al.* (2022), who have emphasized that financial digitization can enhance economic and environmental efficiency. Moreover, the identification of the threshold effect as a niche cluster serves to bolster the theoretical propositions advanced by Hansen (2000) and Liu *et al.* (2021). These theories suggest the existence of a critical juncture beyond which the incorporation of digital financial systems into economic activities results in a pronounced enhancement in returns on economic growth, particularly within the context of developing economies. The proposed conceptual model integrates these dynamics, thereby allowing for the visualization of how financial digitization does not act in isolation. Instead, it is dependent on enabling mechanisms (e.g., literacy) and structural technologies (e.g., blockchain or CBDCs) to translate into a real impact on economic and social sustainability. This approach represents a significant departure from previous, fragmented methodologies, offering an integrated perspective to inform the development of public policies and DFI strategies in the future.

Consequently, the narrative of economic growth has evolved from an approach based exclusively on GDP expansion to an inclusive, equitable, and sustainable model. Contemporary research has shifted its focus from the role of economic growth in promoting inclusion to the notion that inclusion serves as the fundamental foundation for stable and sustainable economic growth. This comprehensive strategy integrates macroeconomic stability with environmental sustainability and social equity (Figure 2).

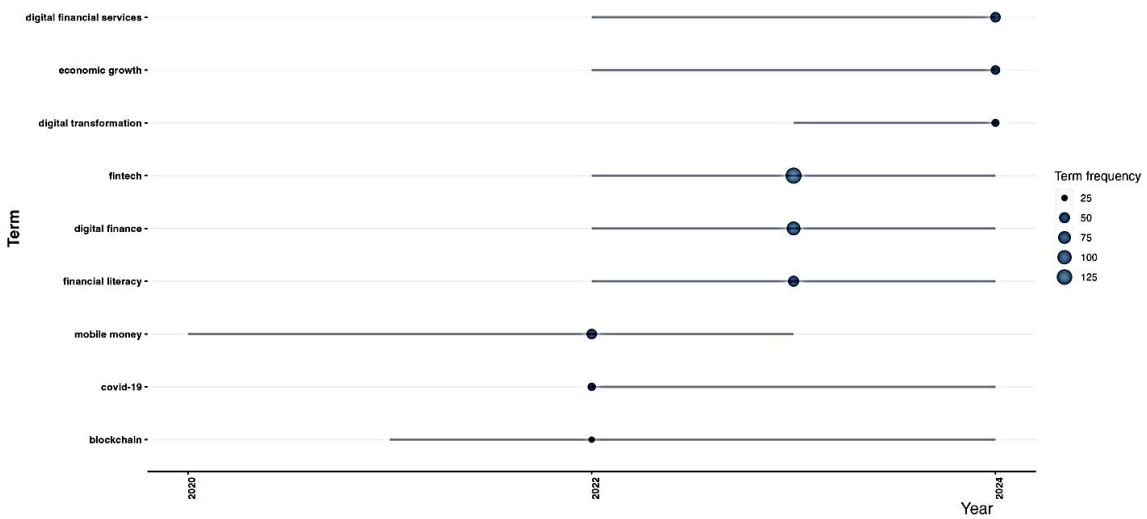

Figure 2. Temporal trend of terms appearing in more than 25 articles.

The contemporary financial ecosystem is undergoing a transformation in which digitization and emerging technologies have redefined financial intermediation, inclusion, and the sustainability of economic growth. The model under consideration is predicated on the relationship between traditional financial services and the development of fintech. The concept of financial inclusion, which refers to the scope and extent to which financial services are accessible to individuals and businesses within a given economy, is contingent upon two fundamental factors. First, there must be adequate access to formal financial services, which have been shown to be more readily available and effective in the context of digitization and technological solutions (Beck *et al.,* 2007). Digital transformation is a pivotal process in modernizing the financial industry (Arner *et al.,* 2020), which has not only led to greater efficiency in financial

services but has also enabled the adoption of blockchain. This decentralized system has redefined security and transparency in financial transactions (Nakamoto, 2008). The correlation between digital transformation and fintech is indicative of the fact that digital disruption has engendered the development of novel business models predicated on digital platforms, mobile payments, and alternative financing (Catalini & Gans, 2016; Leong *et al.,* 2017). Concurrently, digital transformation has an impact on digital literacy, as access to new financial technologies requires users to comprehend them to ensure optimal benefits (Kass-Hanna *et al.,* 2022).

Concurrently, blockchain has not only consolidated its position as a catalyst for fintech development but has also facilitated the emergence of CBDCs. These digital currencies represent a significant advancement in the realm of monetary exchange, having been introduced as a potential solution to enhance the efficiency of payment systems and strengthen financial stability (Auer & Böhme, 2021). The necessity of financial literacy for both fintech and CBDCs is well-documented; individuals must understand the functionality of these novel services and their economic ramifications (Lagna & Ravishankar, 2022). Digital and financial literacy are essential for DFI, as without these skills, barriers to accessing digital financial services will persist (Demirgüç-Kunt & Klapper, 2013). Digital financial inclusion has been identified as a key driver of economic and social sustainability. This is because it facilitates access to finance for marginalized groups, fosters entrepreneurship, and reduces income inequality (Arner *et al.,* 2020). A direct correlation has been demonstrated between DFI and economic growth, as the expansion of access to financial services fosters investment, innovation, and macroeconomic stability (Ozili, 2018). A failure to incorporate all stakeholders can impede the sustainability of economic growth, engender social instability, and exacerbate existing inequality gaps (Stiglitz, 2012). In this sense, the perspective of development as freedom is fundamental to understanding that DFI is not only a tool for growth but also a mechanism for strengthening individual capabilities (Sen, 1999). Figure 3 presents a conceptual model that analyzes DFI.

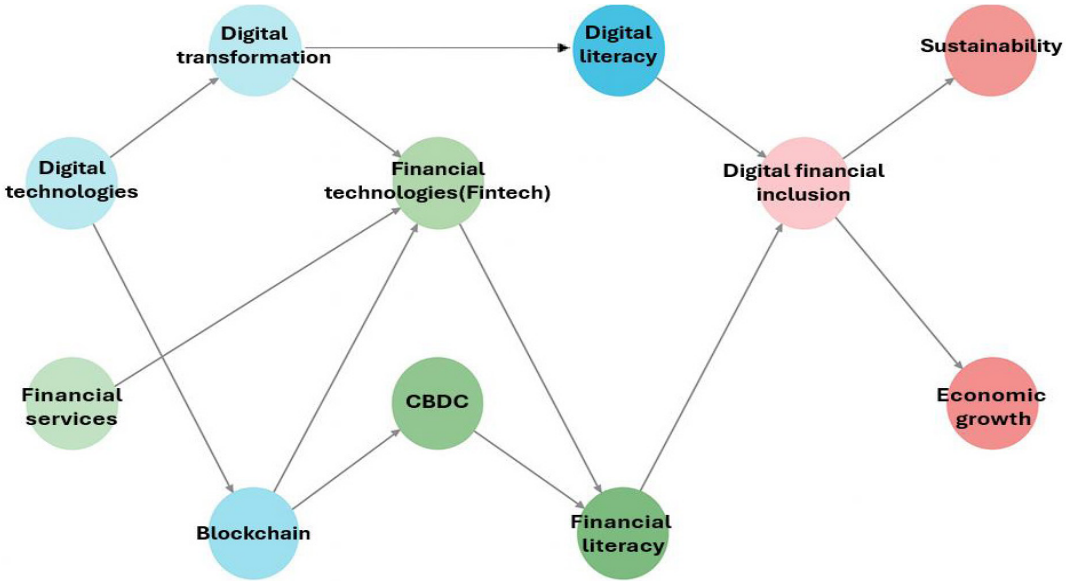

Figure 3. Conceptual model based on the analysis of DFI.

5.1. List of thematic clusters related to sustainability, equity, and growth

Based on the findings of the bibliometric analysis and the theoretical discourse presented, it is possible to establish a relationship between the identified thematic clusters and their impact on three key dimensions: environmental sustainability, equity (including a gender perspective), and economic growth. Table 4 provides a synopsis of the contributions of each of these clusters to the sustainable and inclusive development posited in this study.

Thematic cluster	Impact on sustainability	Impact on equity (including gender)	Impact on economic growth
1. Threshold effect	Improves energy efficiency and resource use	Can enhance inclusion in rural areas if the digital threshold is surpassed	Catalyzes growth after reaching the threshold
2. Digital transformation	Reduces ecological footprint through digital processes	Increases access to services for women and marginalized groups	Facilitates new business models
3. CBDCs	Reduces cash usage and promotes green payments	Improves financial inclusion by removing physical barriers	Modernizes payment systems
4. Sustainable development	Promotes green finance and responsible investment	Contributes to the social and financial inclusion of vulnerable groups	Supports balanced economic growth
5. Financial and digital literacy + financial services	Promotes responsible use of financial resources	Reduces gender and digital gaps	Enhances the economic resilience of communities
6. Fintech	Boosts efficiency in transactions and microfinance	Democratizes financial access and reduces exclusion	Drives innovation and entrepreneurship

Table 4. Relationship between clusters and impact. **Source:** Own elaboration based on bibliometric analysis and the reviewed literature (Arner *et al.,* 2020; Di Vaio *et al.,* 2023; Geng & He, 2021; Ozili, 2021).

6. CONCLUSIONS

The evolution of the concept of economic growth has led to an inclusive approach, in which digitalization and information and communication technologies play a central role. The nexus between financial and digital inclusion has been demonstrated to be a pivotal conduit for mitigating disparities and fostering more equitable and sustainable development. Moreover, DFI has been identified as a pivotal catalyst in the transition to green economies, as it enhances green efficiency and fosters innovation in sustainable finance (Feng *et al.,* 2022; Wang *et al.,* 2022). As fintech solutions and innovations, such as blockchain, continue to proliferate, digital and financial literacy become indispensable for ensuring that these advances benefit society. In this process, financial and digital literacy play a crucial role in ensuring the inclusive adoption of these technologies, particularly in contexts of low economic resilience (Kass-Hanna *et al.,* 2022; Mhlanga, 2020).

Nevertheless, the lack of financial inclusion persists as a salient global predicament. As long as individuals remain unable to utilize digital financial services, the DFI agenda will face delays. This is particularly salient among indigenous and rural communities, elderly populations, individuals with disabilities, women, and individuals with limited resources. Consequently, these groups will face challenges in achieving the SDGs by the 2030 target year (Tay *et al.,* 2022). The relationship between inclusion and economic growth is undergoing a paradigm shift. Rather than being considered a byproduct of development, inclusion is now recognized as a fundamental element that fosters macroeconomic stability and financial resilience. However, the study's results indicate a limited presence of the gender perspective in the academic discussion on DFI, despite its critical importance. To address this lacuna, further research is imperative, as is the implementation of public policies that promote gender equality in the adoption of financial technologies and ensure that digital transformation contributes to women's empowerment and the reduction of structural gaps.

Future research should focus on evaluating how the expansion of DFI can continue to drive economic growth while maintaining equity, ensuring that the benefits of digital transformation are accessible to all, and that gender inequalities are not perpetuated within the digital financial ecosystem. Moreover, recent studies indicate that financial technologies and blockchain have the potential to contribute to gender equality in access to financial services. However, this perspective has not yet been thoroughly explored in the extant literature (Di Vaio *et al.,* 2023). These elements are indispensable for the advancement toward sustainable and inclusive development, as emphasized in the United Nations' SDGs (UN, 2015) and cautionary remarks concerning the perils of entrenched inequality

for global economic stability (Stiglitz, 2012). The findings substantiate the notion that DFI has evolved into a multifaceted domain characterized by central, emerging, and peripheral concerns. Bibliometric analysis provides a means to visualize the evolution of research and to project future trends in research output. The proposed model integrates technological elements, social enablers, and development objectives, thereby providing a strategic basis for public policies and future lines of research.

Conflict of interest

The authors declare no conflict of interest.

Statement of data consent

The data are available upon request to the corresponding author.

Author contributions

Mayra Yvette Salazar-Uribe: Conceptualization, data curation, formal analysis, investigation, methodology, validation, visualization, writing – original draft, writing – review & editing.

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