DOI: https://doi.org/10.37075/EA.2026.1.11 Economic Alternatives, 2026, Issue 1, pp. 233-255

Blockchain and Decentralized Finance: A Systematic Review of the Transformation of Financial Services

Received: 27.03.2025
Available online: 30.03.2026

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Abstract

Blockchain technology and decentralised finance (DeFi) are reshaping financial services by eliminating intermediaries, automating transactions through smart contracts, and expanding global access to capital. Initially designed for cryptocurrencies, blockchain has evolved into a transformative ecosystem that optimises resource management and democratises finance. This study explores the impact of blockchain and DeFi on financial services, focusing on adoption opportunities and challenges. It addresses key gaps in the literature, particularly platform interoperability, security in decentralised environments, and adoption in emerging markets. Using the PRISMA 2020 methodology, the research ensures a rigorous selection and critical evaluation of scientific articles to identify trends, barriers, and potential developments. Findings indicate that blockchain and DeFi can enhance financial inclusion, improve transparency, and strengthen decentralisation. However, they also present challenges such as regulatory uncertainty, technical complexity, and security risks. Overcoming these obstacles requires innovative solutions and strategic collaboration among governments, financial institutions, and technology developers. By shedding light on these dynamics, the study contributes to a deeper understanding of how blockchain and DeFi can reshape financial services, paving the way for a more inclusive, efficient, and secure financial ecosystem.

Keywords: Financial inclusion; smart contracts; interoperability; tokenization; transparency

Jel: G23, G32, O33

INTRODUCTION

The advent of blockchain technology and decentralized finance (DeFi) has precipitated a profound transformation in the traditional financial services sector. Blockchain is a technology that facilitates the secure and decentralized recording of

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transactions through a linked series of blocks. Blockchain technology was initially developed as a means of supporting cryptocurrencies such as Bitcoin, but it has since been applied in a number of other areas. However, its application has evolved into other domains, resulting in the emergence of DeFi, a digital financial ecosystem that eliminates the need for traditional intermediaries, such as banks or financial institutions, and instead relies on decentralized entities (Ajayi et al., 2024). DeFi facilitates direct financial transactions between users via smart contracts that are automatically executed upon the fulfillment of specific conditions, thereby eliminating the necessity for a trusted third party (Ahmad et al., 2023).

Blockchain and DeFi are distinguished by their capacity to provide novel solutions across a range of domains. Firstly, transparency is a crucial aspect of blockchain technology, as the transactions recorded on the blockchain are visible and accessible to all participants, thereby reducing the risk of manipulation (Far, Rad, & Asaar, 2023). Secondly, accessibility is another notable advantage, as the ecosystem is open to participation from any individual with internet access, without geographical limitations (Singh, 2024). Moreover, the security of transactions is reinforced through the deployment of sophisticated cryptographic techniques and the immutable nature of the blockchain record (Brühl, 2021; Casey et al., 2018; Paramesha, Rane, & Rane, 2024).

The implementation of blockchain and DeFi in the financial sector has been the subject of numerous academic analyses. However, industry reports have also highlighted a number of practical challenges. According to Deloitte (2023), while blockchain enhances the efficiency and transparency of financial transactions, its adoption faces barriers such as scalability and platform interoperability. These factors affect the ability of decentralised systems to integrate with traditional financial infrastructures, an aspect that requires greater attention in the academic literature.

DeFi has the potential to transform the global financial sector, offering accessible and decentralized alternatives to traditional financial services. DeFi has the potential to facilitate broader access to capital and transform the manner in which financial transactions are conducted on a global scale, thereby creating novel economic opportunities for individuals and businesses (Singh, 2024). The research problem is the lack of articulation and understanding of the effective implementation of blockchain technology and DeFi in the financial sector. Notwithstanding the acknowledgment of their disruptive potential, considerable obstacles impede their widespread adoption. These include a lack of regulation, security concerns, and resistance from traditional financial institutions to modify their business models (Abdulhakeem & Hu, 2021; Sriman & Kumar, 2022). Moreover, the technical complexity of blockchain and DeFi represents a significant challenge to their integration into existing financial frameworks, impeding their acceptance and comprehension among users and regulators (Caldarelli & Ellul, 2021; Derviz, 2021; Kumar, Nikhil, & Singh, 2020).

The existing literature on blockchain and DeFi remains limited and is still in a developmental phase, leaving gaps in knowledge about their actual impact on the financial sector. The majority of studies focus on the potential advantages of these technologies. However, there is a dearth of research examining the practical impediments and prospective long-term consequences of

their implementation (Schär, 2021; Javaid et al., 2022). This underscores the imperative for comprehensive studies that examine both the opportunities and challenges presented by these technologies, with the aim of gaining a balanced understanding of their viability in transforming financial services.

Numerous studies have examined the impact of blockchain and DeFi on financial services (Meyer, Welpe, & Sandner, 2022). However, gaps in the literature limit a comprehensive understanding of their implementation (Dos Santos et al., 2022). In particular, challenges related to DeFi platform interoperability, adaptive regulation, and smart contract security have been identified as key factors for mass adoption. Furthermore, the majority of studies have focused on developed markets, thereby creating a knowledge gap concerning the role of DeFi in financial inclusion in emerging economies (Dos Santos et al., 2022). Consequently, the present study aims to provide a more comprehensive perspective by analysing these dimensions and their impact on the transformation of financial services.

The present study adds value to the analysis of blockchain and DeFi adoption by delving deeper into the interrelationships between their technological characteristics, issues, and challenges, in contrast to previous studies such as that of Alamsyah et al. (2024). While that work provides a general overview of the DeFi ecosystem, focusing on its applications and operating models, this research emphasizes the importance of key factors such as transparency, cryptographic security, and user privacy, not only in terms of frequency, but also in their impact on accessibility and technology adoption. In addition, the present study incorporates a visual approach through radar charts and comparative diagrams that facilitate the understanding of the interrelationships between different elements, allowing for a more holistic assessment of the DeFi ecosystem. Specific recommendations for the design of adaptive regulatory frameworks and risk mitigation strategies are also included, aspects that are not developed in the same level of detail in the work of Alamsyah et al. (2024). In this way, this research not only extends the theoretical understanding of the phenomenon, but also provides practical tools for its effective implementation in the financial sector.

In this sense, the objective of the research is to examine the impact of blockchain and DeFi technology on the transformation of financial services, with a particular focus on the opportunities and challenges associated with their adoption. In order to achieve the aforementioned objective, a series of guiding questions will be posed throughout the course of the research.

1. How are blockchain and DeFi transforming current financial services?
2. What are the main challenges of implementing blockchain and DeFi in the financial sector?
3. What factors influence the uptake of DeFi in diverse financial markets?
4. What impact does regulation have on the growth of blockchain and DeFi within the global financial system?
5. What implications do these technologies have in terms of accessibility and security for users?

In order to address these issues, the article proposes a structure comprising several sections. Initially, the Introduction is presented, which contextualises the research and raises the problem. Subsequently, the Methodology section describes the systematic literature

review approach based on PRISMA-2020. Thereafter, the Results section analyses previous studies on blockchain and DeFi. The Discussion section addresses the implications of the findings, and finally, the Conclusions and recommendations for future research in this field are presented.

Methodology

The PRISMA 2020 methodology, as outlined by Page et al. (2021), provides a comprehensive framework for conducting systematic reviews across diverse research domains. It is designed to guarantee a comprehensive and rigorous selection of pertinent studies, employing specific criteria. This approach prioritises the documentation of each stage of the study selection process, from initial identification to final inclusion, thereby promoting transparency and reproducibility. In this review, the application of PRISMA is essential to organise and synthesise studies on blockchain and DeFi under a scheme that facilitates the critical evaluation of sources and allows the identification of patterns and trends in the scientific literature (Page et al., 2021).

Eligibility criteria

The eligibility criteria were established with the objective of ensuring the inclusion of relevant and high-quality studies on blockchain and DeFi. In order to ensure that the conclusions reflect the current state of these emerging technologies, articles published in English or Spanish within a recent period were selected. In order to ensure a comprehensive and relevant analysis, the included studies were required to focus specifically on blockchain, distributed ledger technology (DLT), and DeFi. Related terms such as open finance and decentralised financial services were also considered in order to encompass research directly linked to the transformation of financial services.

The exclusion process was conducted in three phases with the objective of achieving a rigorous and efficient selection. In the initial phase, duplicate records or those with indexing errors were removed, facilitating an organised approach in subsequent stages. In the second phase, studies lacking access to the full text were excluded, thereby ensuring comprehensive review of all included sources. In the third phase, qualitative criteria were applied to evaluate the relevance and quality of each study. This phase excluded studies that, although they met the basic requirements, did not offer substantial information or presented methodological limitations that could affect the robustness of the findings. The three-phase approach enabled the construction of a set of relevant and high-quality studies, in accordance with the objectives of this review on blockchain and DeFi.

Sources of information

In order to conduct this review, the Scopus and Web of Science databases were selected for their capacity to provide comprehensive and high-quality coverage of the subject matter, namely blockchain and DeFi. Both databases are notable for their extensive scope and reliability in the inclusion of peer-reviewed articles. Scopus is widely acknowledged as one of the most comprehensive databases, with a particular focus on high-impact journals and a diverse range of literature. Web of Science, meanwhile, is distinguished by its rigorous approach to the selection of publications, with a particular orientation towards high-quality, world-renowned research across multiple disciplines (Mongeon & Paul-Hus, 2016).

The integration of Scopus and Web of Science permits a more profound and extensive examination, with a heterogeneous array of academic sources that serves to reinforce the comprehensiveness of this research. This dual approach facilitates the collection of robust and contemporary studies on blockchain and DeFi, thereby enhancing the integrity of the findings. The combination of both sources allows for the identification of patterns and trends in the literature, thereby providing a comprehensive and reliable view of the impact of blockchain and decentralised finance on financial services.

Search strategy

In this review, a bespoke search equation was defined for each database, in accordance with the pre-established inclusion criteria. The equation used in Scopus employs key terms present in the titles and keywords of the authors, including "Blockchain", "Distributed Ledger Technology" (DLT), "Decentralized Finance" (DeFi), "Open Finance", and "Decentralized Financial Services", in order to capture pertinent studies on these subjects. In Web of Science, the search equation was constructed in accordance with the database's formatting conventions, utilising "TS=" for the title and "AK=" for keywords. This approach involved adapting the Scopus operators to align with the specific requirements of the research objective, namely, to analyse the influence of blockchain and DeFi on financial services. The keywords and operators were selected with precision to enhance the accuracy and relevance of the results.

Selection process

The selection of pertinent studies was conducted in accordance with the PRISMA methodology, thereby ensuring a systematic and transparent process. In the initial phase, studies that were duplicates or did not meet the basic inclusion criteria were excluded. Subsequently, the titles and abstracts of the remaining studies were reviewed to exclude those that did not address topics directly related to blockchain, distributed ledger technology (DLT), and DeFi. In the final phase, the full texts of the remaining studies were subjected to a thorough evaluation to confirm their relevance and quality. This rigorous process enabled the construction of a robust foundation of studies aligned with the research objectives concerning the impact of blockchain and DeFi on financial services.

Figure 1 depicts the flowchart recommended by the PRISMA 2020 statement, which illustrates the selection process from the initial identification of studies to the final selection.

Data processing

The data was processed using Excel, which enabled the organisation, analysis and synthesis of the information obtained from the selected studies. The utilisation of this tool enabled the categorisation of the data by key variables, thereby optimising the comparison of results and the identification of relevant patterns pertaining to blockchain and DeFi. Furthermore, Excel facilitated the graphical representation of the data, thereby enabling the identification of significant trends and relationships across the selected studies. The categorisation and analysis process ensured a coherent structure for interpreting the findings on the impact of blockchain and DeFi on financial services.

Risk of bias

The potential for bias in the selected studies was evaluated through a critical

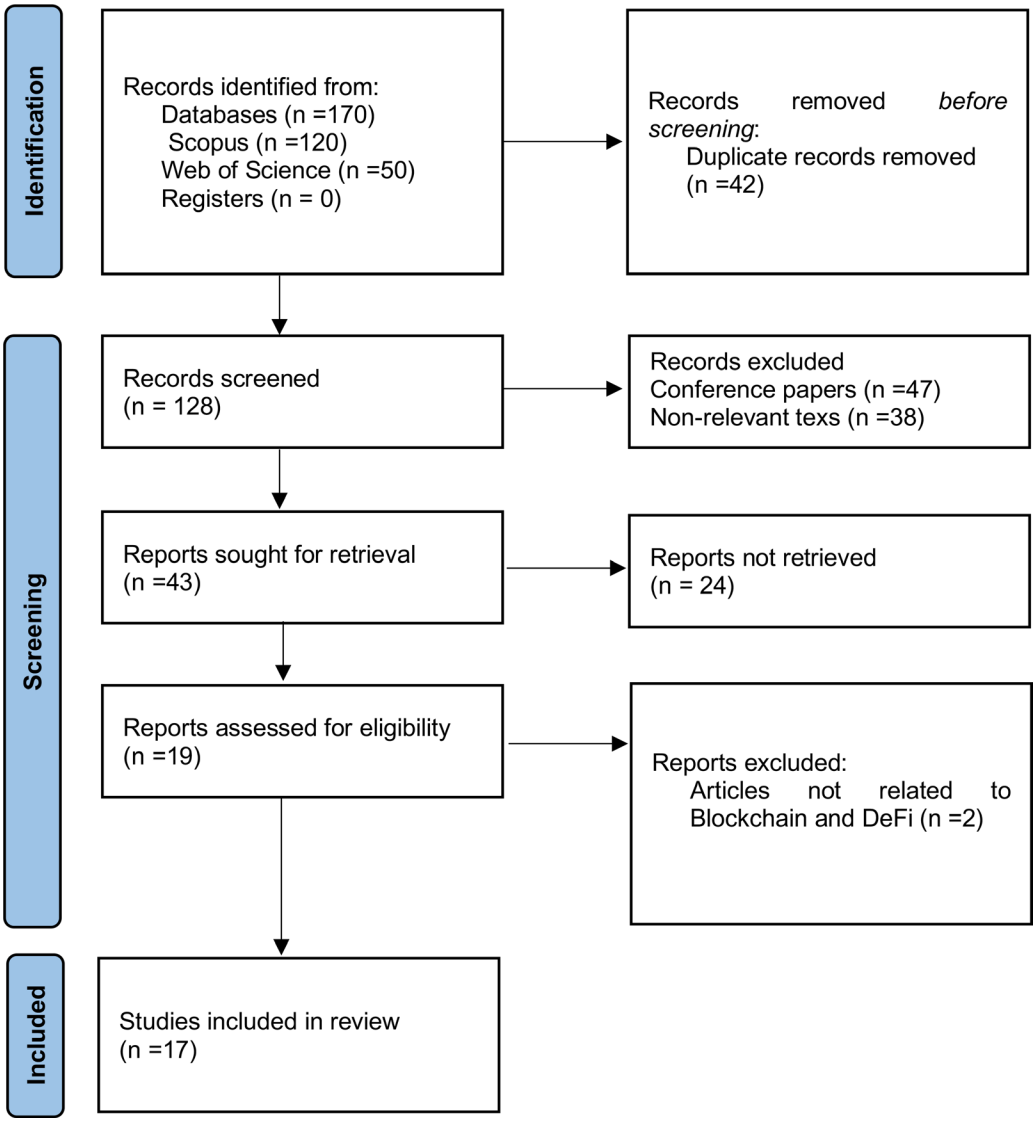

Figure 1. PRISMA flowchart. Own elaboration based on Scopus and Web of Science

analysis of their methodologies and designs, with the objective of identifying potential publication and design biases. Studies that might emphasise positive or relevant results were given particular attention, while those that yielded less prominent results were excluded. Furthermore, the potential for bias resulting from the selection of databases, such as Scopus and Web of Science, as well as the use of specific terms in the search strategy, was taken into account. These factors could restrict the inclusion of studies employing alternative approaches or unpublished results. The objective of this analysis was to minimise the limitations and ensure the integrity of the

findings on the impact of blockchain and DeFi on financial services.

RESULTS

The findings of this study are presented in accordance with the research questions that were initially posed, thereby offering a comprehensive overview of the impact of blockchain and DeFi on the financial services sector. Each subsection addresses key elements, including the transformation of current services, the benefits and challenges of their implementation, the factors driving their adoption in different markets, the regulatory effect on their expansion, and the implications for accessibility and security for users. This approach enables a comprehensive examination of the multifaceted aspects of blockchain and DeFi utilisation within the financial sector. Table 1 provides a summary of the studies included in the analysis.

Table 1. Studies included in the research.
Prepared by the authors based on Scopus and Web of Science

Title	Authors
A Blockchain-Based Financial Instrument for the Decarbonization of Irrigated Agriculture	Pombo-Romero & Rúas-Barrosa (2022)
A new blockchain investment and energy certificate platform	Han et al. (2023)
Axiomatization of Blockchain Theory	Goncharov & Nechesov (2023)
Blockchain-Based Automated Market Makers for a Decentralized Stock Exchange	Dodmane et al. (2023)
Building DeFi Applications Using Cross-Blockchain Interaction on the Wish Swap Platform	Tsepeleva & Korkhov (2022)
Decentralized payment clearing using blockchain and optimal bidding	Amini, Bichuch, & Feinstein (2022)
Digging into primary financial market: The issues of primary financial market issuance and investigations from the perspective of blockchain	Liu et al. (2022)
Hedging Volumetric Risks of Solar Power Producers Using Weather Derivative Smart Contracts on a Blockchain Marketplace	Alao & Cuffe (2022)
Proposal of Decentralized P2P Service Model for Transfer between Blockchain-Based Heterogeneous Cryptocurrencies and CBDCs	Park & Youm (2022)
“Technopian but lonely investors?”: Comparison between investors and non-investors of blockchain technologies, cryptocurrencies, and non-fungible tokens (NFTs) in Artificial Intelligence-Driven FinTech and decentralized finance (DeFi)	Jin (2024)
Blockchain disruption and decentralized finance: The rise of decentralized business models	Chen & Bellavitis (2019)
Decentralized finance: on blockchain-and smart contract-based financial markets	Schär (2021)
EnviroCoin: A Holistic, Blockchain Empowered, Consensus-Based Carbon Saving Unit Ecosystem	Shokri et al. (2022)
Financing decentralized digital platform growth: The role of crypto funds in blockchain-based startups	Cumming et al. (2025)
NAGA: multi-blockchain based decentralized platform architecture for cryptocurrency payment	Sawarnkatat & Smanchat (2022)
The Taxonomy of Blockchain-based Technology in the Financial Industry	Alamsyah & Syahrir (2023)
Tokenization and the banking system: Redefining authority in the blockchain era	Goghie (2024)

Figure 2 provides an overview of the principal transformations initiated by blockchain and DeFi in the financial services sector. The most frequently reported categories include carbon credit tokenisation and P2P payment systems, with a frequency of four each. Additionally, stock market decentralisation and financial disintermediation are notable, with a frequency of 3 each. Other observed transformations, with a frequency of 2, include asset decentralisation, blockchain swaps, weather derivatives, and digital asset tokenisation.

Figure 3 provides an overview of the principal challenges associated with the implementation of blockchain and DeFi in the financial services sector. The results indicate that transparency is a key concern, with a frequency of 7, followed by improved governance and transaction efficiency, each with a frequency of 5. Furthermore, user accessibility and adoption complexity are also relevant, with a frequency of 4. Security risks, user convenience, and volatility are equally important, with a frequency of 3 each.

Figure 4 presents the principal factors driving the adoption of blockchain and DeFi in the financial services sector. The results indicate that market demand, occurring with a frequency of 5, is the most prevalent driver. Other significant factors include institutional positioning, with a frequency of 3, as well as various categories with a frequency of 2, such as investor attraction, technological readiness, blockchain scalability, and compatibility with decentralised finance. Additionally, blockchain interoperability, stakeholder trust, and stakeholder engagement have been identified.

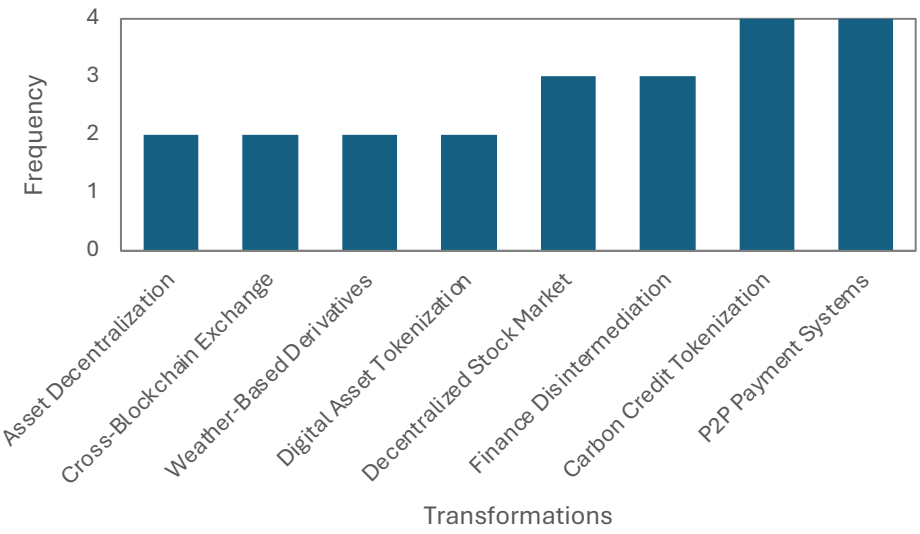

Figure 2. Main transformations in financial services
(Compiled by the authors based on Scopus and Web of Science).

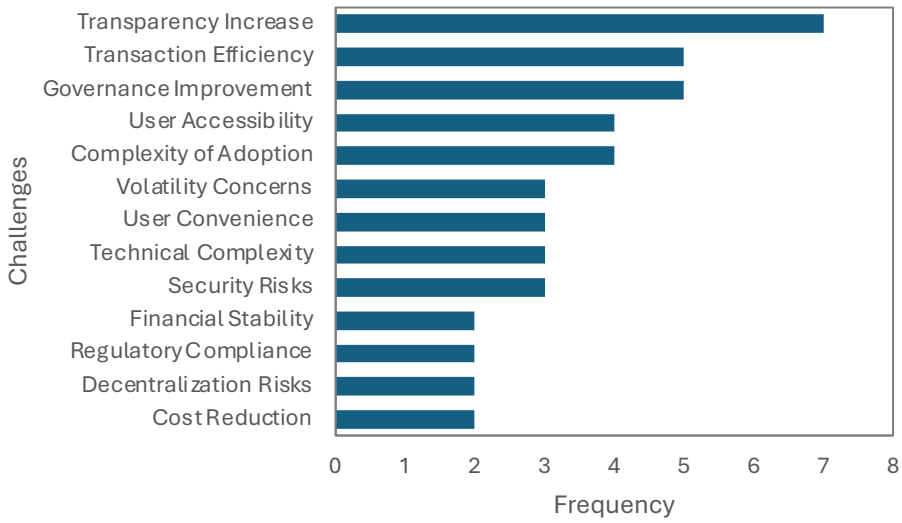

Figure 3. Main challenges in blockchain and DeFi
(Developed by the authors from Scopus and Web of Science).

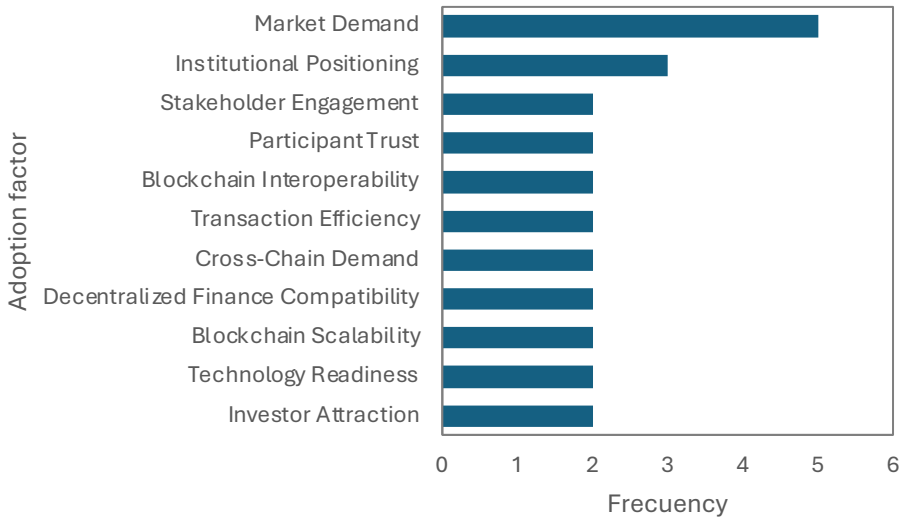

Figure 4. Main adoption factors in blockchain and DeFi
(Developed by our own experts from Scopus and Web of Science).

Figure 5 illustrates the principal impacts of regulation on the adoption of blockchain and DeFi in the financial services sector. The results indicate that new regulatory frameworks are of significant importance, with a frequency of 4. Other notable categories include standardisation and frameworks for decentralised services, each with a frequency of 3. Less frequently occurring factors include consensus reliance, risks from a lack of regulation, and the necessity for regulatory adaptation, along with support for voluntary markets and the influence of central banks and lobbying.

As illustrated in Figure 6, the primary components of technological accessibility in the implementation of blockchain and DeFi within the financial sector are demonstrated. Utilizing a radar chart, the frequency with which these components have been identified in the reviewed literature is presented, thereby facilitating the clear visualization of the relative prominence of each aspect. The analysis reveals that blockchain transparency and cryptographic security emerge as the most recurrent factors, followed by security in smart contracts, user privacy, and decentralized resilience.

It is imperative to acknowledge that the graph does not aspire to depict the interrelations between these elements; rather, it serves to provide a relative ranking of the importance accorded to each factor within the extant literature. The objective of the graph is to present a quantitative representation of the aspects within the blockchain and DeFi technologies that have been the subject of most studies. To gain a more nuanced understanding of the interplay among these factors, it would be advantageous to complement this analysis with qualitative approaches or network graphs that depict the connections between them.

Consequently, this graph serves as a valuable instrument for identifying the predominant trends in research on technological accessibility in Blockchain and DeFi, thereby providing a substantial foundation for future research that will delve more profoundly into the relationships

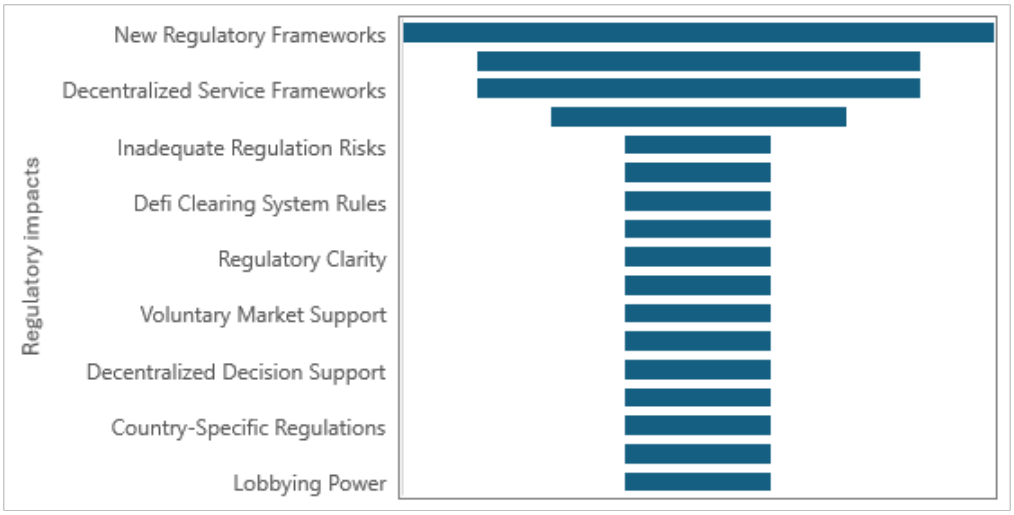

Figure 5. Main impacts of regulation on blockchain and DeFi
(Own elaboration based on Scopus and Web of Science)

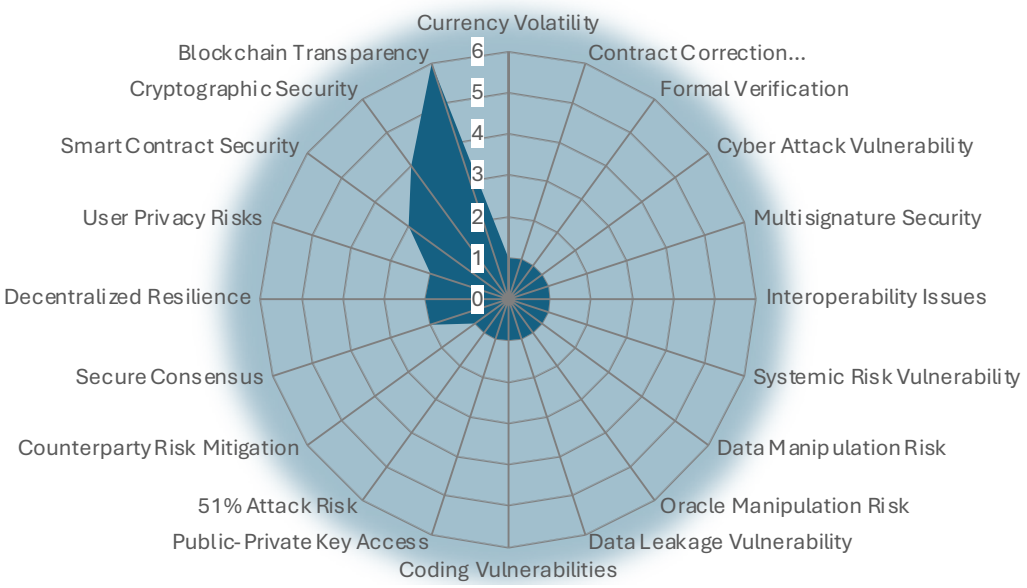

Figure 6. Main aspects of technological accessibility in blockchain and DeFi (Developed by our own authors based on Scopus and Web of Science).

between these factors and their impact on the adoption of these technologies.

The findings of this study are structured according to the research questions posed, thereby providing a comprehensive overview of the impact of blockchain and DeFi on the financial services sector. The analysis identifies a number of key transformations, benefits, challenges, drivers of adoption, regulatory impacts and aspects of technological accessibility. These elements reflect the trends, opportunities and obstacles associated with the integration of blockchain and DeFi in the financial sector, thereby providing a comprehensive overview of the current dynamics and critical factors that impact their effective and secure adoption.

DISCUSSION

The following section presents a discussion of the key findings of the research, contextualising them within the broader landscape of how blockchain technology and DeFi are transforming financial services. A critical comparison of the results with those of previous studies is made in order to identify similarities, differences and advances in the field. A conceptual framework is also proposed, based on the results of the study, which synthesises the main contributions and provides a basis for future research. Moreover, the theoretical, policy, and practical implications derived from the findings are presented, emphasizing their relevance for actors within the financial ecosystem. In conclusion, the study's methodological and empirical limitations are analysed, and future research opportunities are explored based on these limitations and the identified implications.

Analysis of results

The results demonstrate that the transformations driven by blockchain and

DeFi in financial services encompass carbon credit tokenisation, P2P payment systems, stock market decentralisation and financial disintermediation. These developments reflect an increase in the utilisation of decentralised solutions to address issues such as blockchain interoperability (Park & Youm, 2022) and the monetisation of environmental externalities (Shokri et al., 2022). Peer-to-peer systems facilitate the optimization of transfers between heterogeneous cryptocurrencies and central bank digital currencies. Additionally, tokenization enables the validation and monetization of carbon reductions through decentralized platforms.

The findings indicate the primary obstacles to the integration of blockchain and DeFi in the financial sector, including the necessity for enhanced transparency and improvements in governance and transactional efficiency. These issues reflect the inherent structural limitations of decentralised systems. Dodmane et al. (2023) emphasise that enhanced transparency and transaction velocity can be achieved through the implementation of sophisticated protocols. The accessibility and complexity of adoption represent significant barriers, particularly for non-specialist users, as evidenced by Alamsyah and Syahrir (2023). Moreover, security risks and volatility emerge as significant threats to the trustworthiness of these technologies.

The results identify market demand and institutional positioning as the principal drivers of blockchain and DeFi adoption in financial services, underscoring the necessity for strategies that are aligned with the expectations of key stakeholders. This is in line with Goghie (2024), who examines how conventional financial institutions leverage blockchain to reinforce their dominance within the financial ecosystem. Similarly, factors such as technological preparedness, scalability, and interoperability underscore the significance of robust technical solutions, as observed by Dodmane et al. (2023), who demonstrate that advanced architectures enhance performance and reinforce trust in these technologies.

The findings suggest that regulatory frameworks play a pivotal role in the adoption of blockchain and DeFi technologies within the financial services sector. The necessity for the establishment of novel regulatory frameworks and the implementation of standardisation procedures have been identified as priorities. As observed by Han et al. (2023), the development of innovative decentralised platforms can be facilitated by the implementation of transparent regulatory frameworks, thereby fostering the growth of sustainable markets. Similarly, factors such as regulatory adaptation and the influence of central banks present considerable challenges. Pombo-Romero and Rúas-Barrosa (2022) highlight the necessity for regulatory measures to mitigate the specific risks associated with decentralisation. These findings reinforce the notion that a balanced regulatory approach can mitigate risks while optimising benefits.

The results indicate that the accessibility of blockchain and DeFi technology is primarily contingent upon transparency and cryptographic security. Sawarnkatat and Smanchat (2022) emphasise that multi-blockchain platforms optimise the user experience through the implementation of secure and functional systems. Furthermore, the necessity to mitigate technological risks is reinforced by factors such as the security of smart contracts and user privacy. Nevertheless, obstacles such as vulnerability to 51% attacks and interoperability issues

impede the adoption of this technology. Cumming et al. (2025) posit that crypto funds can address these challenges by bolstering the technical capabilities of decentralised platforms.

In addition to its technological advantages, the implementation of DeFi gives rise to regulatory and security concerns. A report by Utimaco (2022) indicates that decentralisation can hinder the enforcement of financial regulations and increase risks associated with cyberattacks and smart contract fraud. This challenge has led several jurisdictions to develop regulatory frameworks that balance innovation with user security. However, further research is needed to assess the effectiveness of these regulations in different financial ecosystems.

Notwithstanding the aforementioned challenges, DeFi presents significant opportunities, particularly in terms of financial inclusion, a particularly salient issue in emerging economies where access to banking services remains limited. According to BBVA (2023), blockchain technology enables the creation of accessible financial platforms without the need for intermediaries, facilitating access to credit and other financial services for underserved populations. However, challenges related to financial education and digital connectivity persist, which must be addressed to achieve widespread adoption of these systems.

In order to comprehend the intricacies of DeFi, it is imperative to adopt a systematic approach that categorises its fundamental components. This study proposes a comprehensive taxonomy that classifies DeFi into three key pillars: risks, opportunities, and enabling technologies. Risks can be categorised further into technological risks, such as vulnerabilities in smart contracts and interoperability issues (Utimaco, 2022); regulatory risks, stemming from the lack of clear legal frameworks; and economic risks, including market volatility and the absence of asset-backed security in digital finance. Conversely, DeFi offers significant opportunities, including financial inclusion through direct peer-to-peer services, automation via smart contracts, and financial innovation driven by asset tokenisation (BBVA, 2023). Key enabling technologies include blockchain infrastructure and smart contracts as foundational elements, interoperability as a crucial factor for DeFi expansion, and security mechanisms based on advanced cryptography to ensure user protection (Deloitte, 2023).

Despite its transformative potential, DeFi faces significant challenges in achieving stability and widespread adoption due to technical, economic, and regulatory risks. The most pressing technological risks are related to vulnerabilities in smart contracts, which can be exploited by hackers due to coding errors or security flaws (Utimaco, 2022). Interoperability between different DeFi platforms is also a concern, due to the absence of common standards, which can result in execution failures and compatibility issues. From a systemic perspective, extreme crypto market volatility has the potential to compromise the liquidity of DeFi protocols, thereby undermining user confidence and the stability of decentralised financial systems (Deloitte, 2023).In order to mitigate these risks, it is essential to implement security and governance strategies.

From a technical standpoint, the development of smart contracts should undergo rigorous security audits and continuous testing before deployment (BBVA, 2023). Furthermore, the integration

of decentralised insurance mechanisms can serve as a safeguard against potential losses incurred due to smart contract failures. From a systemic perspective, the utilisation of reliable decentralised oracles can assist in mitigating dependence on vulnerable data sources and enhance the overall stability of DeFi protocols. Lastly, the establishment of balanced regulatory frameworks is imperative to foster a secure environment for DeFi adoption while preserving its decentralised nature.

Comparison of results with other studies

The findings of this study provide a comprehensive overview of the transformations, benefits, challenges, adoption drivers, regulatory impacts, and technological accessibility aspects related to blockchain and DeFi in financial services, facilitating relevant comparisons with previous research. It is noteworthy that both studies identify decentralization, transparency, and interoperability as essential features for transforming financial services. This is consistent with the conclusions of Chen and Bellavitis (2020), who emphasize the potential of these technologies to facilitate financial inclusion and eliminate intermediaries. Furthermore, the technological challenges, including vulnerability to attacks and interoperability issues, are consistent with the findings of Caldarelli and Ellul (2021), who identify the "oracle problem" as a significant barrier to decentralized applications.

In the context of regulation, this study underscores the imperative for transparent and coherent frameworks and standards to facilitate the adoption of blockchain technology. This finding is consistent with the observations of Trivedi et al. (2021), who have identified a lack of regulation as a significant barrier to the advancement of this technology. Similarly, the findings are in alignment with those of Dos Santos et al. (2022) regarding the significance of accessible and interoperable systems in facilitating the expansion of the DeFi ecosystem. However, there are methodological and contextual differences when comparing this study with research such as that of Meyer et al. (2022). The latter employs a theoretical framework organized into three levels (micro, meso, and macro), whereas this work takes a more practical approach oriented to current regulatory and technological aspects. This methodological difference may be the reason for the greater attention paid by this study to regulatory impacts and practical adoption factors.

Furthermore, previous research by Meegan (2020), Ozili (2022), and Schueffel (2021) also emphasizes decentralization and the associated risks and opportunities in DeFi, thus complementing the analysis presented in this study. Furthermore, Patel et al. (2022) and Treleaven et al. (2017) reinforce the pivotal role of blockchain technology in the finance sector, offering insights into its practical applications and challenges. Proelss, Sévigny, and Schweizer (2023) discuss the integration of blockchain with emerging financial technologies like NFTs, while Zheng et al. (2023) explore the broader scope of blockchain-based decentralized applications, highlighting their diverse functionalities in the evolving financial ecosystem. In conclusion, Kumar, Nikhil, and Singh (2020), Derviz (2021), and Varma (2019) address significant technological obstacles, including blockchain interoperability, thereby offering valuable insights into the ongoing discourse surrounding the challenges associated with DeFi adoption.

A further noteworthy discrepancy is evident in the priorities assigned to technological risks. While both papers acknowledge the importance of these challenges, this study places particular emphasis on the risks associated with 51% attacks and interoperability issues, whereas Caldarelli and Ellul (2021) direct their attention towards the issue of oracles. Moreover, this paper addresses economic aspects only in a tangential manner, whereas Chen and Bellavitis (2020) and Dos Santos et al. (2022) conduct a more in-depth analysis of the economic opportunities and emerging investment models in DeFi.

Proposal for a conceptual framework

Figure 7 presents a conceptual framework developed from the primary research findings. It is composed of five pillars: financial services transformation, challenges, adoption drivers, impact of regulation, and technological accessibility. Each pillar integrates key elements such as decentralisation, cryptographic security, and regulatory frameworks, organised to highlight their connections and role in blockchain and DeFi adoption. This model synthesises the findings and offers a practical approach to guide future research and implementation strategies.

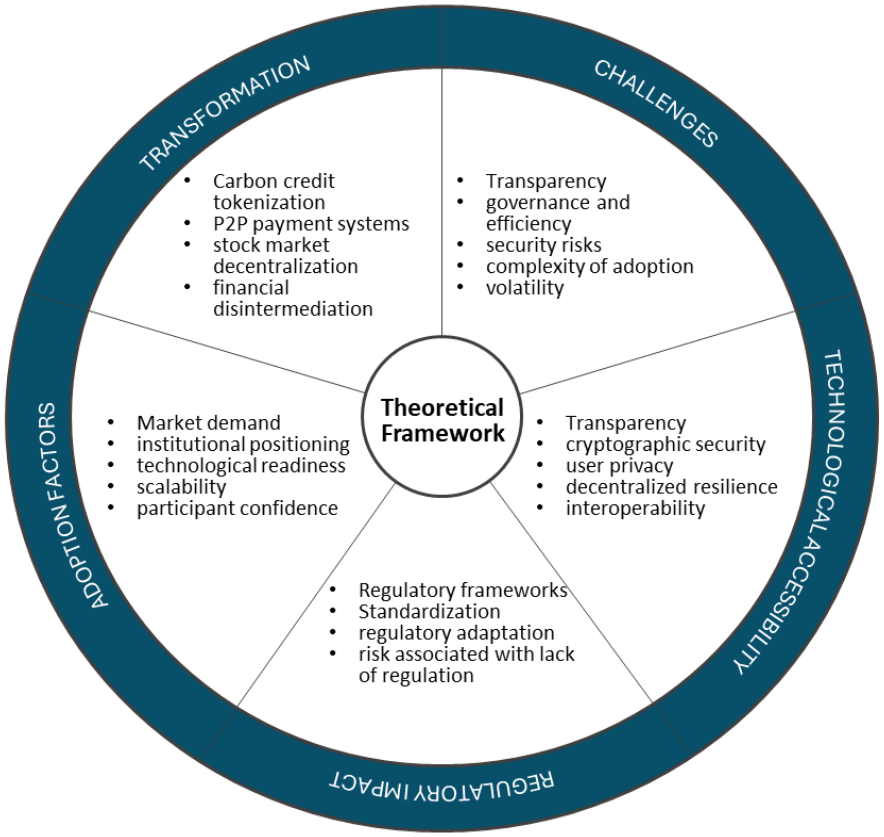

Figure 7. Conceptual framework for blockchain and DeFi. Own elaboration.

The financial services transformation pillar examines the profound impact of blockchain and DeFi on traditional models, with the introduction of decentralisation, transparency, and tokenisation. These technologies facilitate the elimination of intermediaries, thereby optimising costs and streamlining processes such as payments, value transfers, and asset management. Notable examples of this transformation include carbon credit tokenisation, P2P payment systems and financial disintermediation. These developments have the potential to facilitate the democratisation of access to financial services, even in regions with limited banking infrastructures.

The challenges pillar addresses the principal impediments to the implementation of blockchain and DeFi. These challenges include insufficient transparency in some cases, the complexity of adoption for non-technical users, and security risks, such as those posed by cyberattacks and vulnerabilities in smart contracts. Furthermore, market volatility and regulatory barriers are identified as significant challenges that must be overcome. This pillar underscores the necessity for solutions that integrate security, efficient governance, and a more intuitive user experience to facilitate the mass adoption of these technologies.

The adoption drivers pillar examines the factors that influence the acceptance of blockchain and DeFi in diverse market contexts. Market demand and institutional positioning are pivotal factors that facilitate the implementation of these technologies, whereas technological readiness and scalability are indispensable prerequisites for sustaining continued growth. Furthermore, the ability of blockchains to interoperate and the existence of trust among participants are essential for the creation of a reliable and functional ecosystem that can attract both investors and end users.

The regulatory impact pillar elucidates the manner in which regulations affect the uptake of these technologies. The absence of transparent regulatory frameworks and the lack of internationally agreed standards represent significant obstacles to the growth of this sector. This pillar proposes the necessity for regulations that strike a balance between innovation and user protection, addressing areas such as protocol standardisation, fraud protection, and the definition of clear criteria for interoperability. Such regulatory measures would serve not only to mitigate potential risks but also to facilitate the secure adoption of blockchain and DeFi in global markets.

The technological accessibility pillar emphasises the necessity of guaranteeing that blockchain and DeFi-based solutions are accessible to all and secure. It is crucial to ensure transparency, robust cryptographic security, and comprehensive user privacy in order to foster trust in decentralised systems. Furthermore, the resilience of the platform and the interoperability between networks guarantee a flexible and efficient ecosystem. This pillar emphasises the necessity for technologies that are not only sophisticated but also accessible to users with varying levels of experience and in diverse socioeconomic contexts, thus ensuring equitable and sustainable adoption.

Implications

The findings of this research have significant implications at the theoretical, political, and practical levels, providing a framework for understanding and enhancing the impact of blockchain and DeFi on financial services.

From a theoretical standpoint, the findings contribute to our understanding of the ways in which these technologies are transforming traditional financial services. This study identifies key pillars, including decentralisation, transparency, and tokenisation, which fundamentally alter the nature of financial intermediation and optimise processes such as value transfer and asset management. These results contribute to the expansion of knowledge regarding the interoperability of decentralised systems and cryptographic security. Furthermore, they highlight technological accessibility as a catalyst for mass adoption. This work integrates regulatory and technological elements, addressing technical, economic, and social challenges. It reinforces previous theories on technological disruption and identifies new areas of research, such as the risks of 51% attacks and the influence of institutional actors on adoption.

At the policy level, the results underscore the imperative for the formulation of bespoke regulatory frameworks for blockchain and DeFi. The absence of transparent standards and regulations constrains the adoption and expansion of these technologies. It is recommended that regulations be implemented that strike a balance between security and innovation, protecting users without impeding technological development. It is recommended that the regulations address the standardisation of protocols, the protection of users against fraud and cyberattacks, and the interoperability between blockchain platforms. Furthermore, it is recommended that governments and international organisations provide incentives, such as tax benefits for technology start-ups, funding for research and development, and the establishment of regulatory sandbox environments that permit innovative solutions to be trialled without immediate regulatory implications. It is imperative that these measures be implemented in order to facilitate the integration of DeFi in emerging markets, where its potential for financial inclusion is most pronounced.

In practical terms, the findings yield crucial recommendations for banks, startups, and governments. It would be beneficial for banks to investigate the potential of hybrid models that combine traditional features with the advantages offered by blockchain technology, such as enhanced transaction traceability and reduced operating costs. Such models could encompass the tokenisation of financial assets and the utilisation of smart contracts to facilitate processes such as loans and settlements. Start-ups should concentrate on developing accessible and secure solutions that address challenges such as interoperability and enhance the user experience. It is imperative that the market be educated and that strategic alliances with financial institutions be established if the innovations in question are to be scaled. It would be prudent for governments to implement blockchain-based public infrastructures that facilitate access to basic services, such as payments and financing for small and medium-sized businesses. It would also be advisable for them to provide training for their technical and regulatory teams, with a view to ensuring that they are able to provide tailored and effective oversight.

In order to facilitate the effective integration of decentralised finance (DeFi) into traditional financial systems, whilst concomitantly mitigating the associated risks, it is incumbent upon policymakers, regulators and financial institutions to adopt targeted strategies. For policymakers, it is imperative to establish

regulatory sandboxes that allow DeFi projects to operate within a controlled environment, thereby facilitating experimentation whilst ensuring compliance with financial legislation. This approach, which has been successfully implemented in jurisdictions such as the United Kingdom and Singapore, provides a means to balance innovation with consumer protection. The regulators should develop clear, adaptive frameworks that distinguish between centralized and decentralized financial activities, ensuring that DeFi platforms implement on-chain identity verification (KYC/AML measures) where necessary, without compromising decentralization.

Additionally, the integration of real-time audit mechanisms using blockchain analytics can enhance transparency and security. Furthermore, for financial institutions, collaboration with DeFi protocols through hybrid finance (HyFi) models – which integrate decentralised protocols with traditional banking infrastructure – can enhance liquidity, expand financial services and ensure greater market stability. Institutions should also invest in cross-chain interoperability solutions to facilitate seamless transactions between traditional and decentralised systems. These targeted measures will enable a smoother transition between centralized and decentralized finance, fostering a more inclusive and secure financial ecosystem.

Limitations

This study is subject to a number of methodological and empirical limitations. From a methodological standpoint, the utilisation of the PRISMA framework for data collection and selection, despite its rigor, may have resulted in the introduction of biases. The use of databases such as Scopus and Web of Science may result in the exclusion of pertinent research from alternative platforms or in languages other than English, thereby limiting the diversity of perspectives. Furthermore, the categorisation of information according to pre-established criteria may impede the identification of emerging trends that were not foreseen in the initial design. In terms of empirical representation, the results are limited in scope. The findings are often contingent on the specific contexts under examination, which limits the extent to which they can be generalized globally. The lack of consistent data precluded in-depth analysis of areas such as the adoption of these technologies in emerging markets or their social impact. These limitations underscore the necessity for a more expansive methodological and empirical approach to attain a more comprehensive and representative understanding of the impact of blockchain and DeFi on financial services.

While the figures presented in this study provide a quantitative overview of the key factors in Blockchain and DeFi adoption, their presentation is based on the frequency of appearance in the literature reviewed, which may lead to certain limitations in the interpretation of the results.

First, the graphs reflect the frequency with which certain aspects are mentioned in the reviewed sources, but do not capture the interaction and interdependence between them. These representations may be affected by biases in the existing literature, as some topics may be overrepresented due to prevailing research trends, while others may have received less attention, not necessarily due to lack of relevance, but due to the limited availability of specific studies.

To address these limitations, future research could complement this approach with methodologies that allow the exploration

of causal or correlational relationships between the identified factors. The use of co-occurrence network analysis or empirical data-driven modeling could provide a deeper understanding of how these elements interact within the blockchain and DeFi ecosystem.

Lines of future research

The limitations and findings of this study identify a number of avenues for future research. A significant area of interest is the impact of blockchain and DeFi in emerging markets, with a particular focus on their potential to promote financial inclusion and reduce barriers to accessing economic services. Furthermore, it is vital to assess the environmental impact of blockchain and DeFi, including an evaluation of the energy consumption of blockchain networks and an assessment of sustainable alternatives, such as more efficient consensus algorithms.

Methodologically, the utilisation of mixed approaches that integrate quantitative and qualitative analysis is recommended, including the conducting of interviews with key players within the ecosystem. The utilisation of disparate data sources, encompassing a spectrum of linguistic and socioeconomic contexts, would enhance the representativeness of the findings. Furthermore, emerging areas such as the tokenisation of physical assets and the development of decentralised solutions for global trade warrant further investigation, as they have the potential to extend the practical and strategic reach of these technologies across a range of sectors.

Another promising avenue for future research is to investigate how regulatory frameworks can be adapted to align with the distinctive requirements of blockchain and DeFi without impeding innovation. This entails examining case studies of regulatory sandbox environments across diverse jurisdictions and their influence on technological adoption. Additionally, it is crucial to examine how government policies can encourage the secure and efficient integration of these technologies, particularly in markets where regulatory frameworks are nascent or evolving.

The social impact of blockchain and DeFi represents another area of interest worthy of further investigation. Further research could concentrate on the ways in which these technologies contribute to the reduction of economic inequalities and the creation of opportunities in marginalised communities. Such studies could include the evaluation of pilot programmes in rural areas or among populations with limited access to financial services, with a view to measuring their effect on economic well-being and social inclusion. Furthermore, research could investigate how decentralised digital identities based on blockchain technology can empower individuals who lack access to traditional banking systems.

From a technological standpoint, it is imperative to conduct further research into the interoperability between blockchains, which represents a significant challenge in the pursuit of an integrated and efficient financial ecosystem. Future research could develop and test technical standards that facilitate seamless communication between disparate blockchain networks. Furthermore, the implications of full decentralisation versus hybrid models that combine decentralised and centralised features to achieve a balance between security, efficiency and control must be evaluated.

Finally, the development of metrics and models to measure the overall economic impact of blockchain and DeFi represents an

underexplored but crucial area of research. The analysis of how these technologies affect economic indicators, including employment, international trade, and investment attraction, could provide valuable insights for governments and businesses. This approach would assist in the identification of the macroeconomic conditions required to optimise the benefits of these innovations while mitigating any potential associated risks.

CONCLUSIONS

This study illustrates the manner in which blockchain and DeFi are transforming financial services, effecting a reconfiguration of traditional dynamics and the generation of new paradigms. The findings indicate that these technologies have the potential to foster a more inclusive, transparent, and decentralised financial ecosystem. However, there are challenges associated with their implementation, including the need to balance technological innovation with appropriate regulatory frameworks and sustainable adoption strategies.

The analysis demonstrates that the potential of blockchain and DeFi extends beyond their current applications. These technologies have the capacity to generate a significant impact in emerging markets by reducing financial gaps and facilitating access to essential services. Their success will depend on the ability of key players to overcome technical and regulatory barriers while prioritising security, interoperability, and sustainability.

Globally, blockchain and DeFi offer opportunities that redefine value exchange and resource management. To realise their transformative potential, collaborative efforts are required to overcome limitations and explore emerging areas.

References

Ajayi, A. A., Igba, E., Soyele, A. D., & Enyejo, J. O. (2024). Enhancing Digital Identity and Financial Security in Decentralized Finance (Defi) through Zero-Knowledge Proofs (ZKPs) and Blockchain Solutions for Regulatory Compliance and Privacy.

Alamsyah, A., & Syahrir, S. (2023). The taxonomy of Blockchain-based Technology in the Financial Industry. F1000Research, 12.https://doi.org/10.12688/f1000research.133518.2

Alamsyah, A., Kusuma, G. N. W., & Ramadhani, D. P. (2024). A review on decentralized finance ecosystems, Future Internet, 16 (3), 76.https://doi.org/10.3390/fi16030076

Alao, O., & Cuffe, P. (2022, August). A taxonomy of the risks and challenges of embracing blockchain smart contracts in facilitating renewable electricity transactions. In 2022 IEEE PES/IAS PowerAfrica (pp. 1-5). IEEE.10.1109/powerafrica53997.2022.9905345

Amini, H., Bichuch, M., & Feinstein, Z. (2023). Decentralized payment clearing using blockchain and optimal bidding. European Journal of Operational Research, 309(1), 409-420. https://doi.org/10.1016/j.ejor.2022.12.024

Brühl, V. (2021). German title: Decentralised Finance (DeFi)–wie die Tokenisierung die Finanzindustrie verändert (Decentralised Finance–The Impact of Tokenization on the Financial Industry). https://dx.doi.org/10.2139/ssrn.3843207

Caldarelli, G., & Ellul, J. (2021). The blockchain oracle problem in decentralized finance—a multivocal approach. Applied Sciences, 11(16), 7572. https://doi.org/10.3390/app11167572

Casey, M., Crane, J., Gensler, G., Johnson, S., & Narula, N. (2018). The impact of blockchain technology on finance: A catalyst for change.

Chen, Y., & Bellavitis, C. (2020). Blockchain disruption and decentralized finance: The rise of decentralized business models. Journal of Business Venturing Insights, 13, e00151. https://doi.org/10.1016/j.jbvi.2019.e00151

Cumming, D., Drobetz, W., Momtaz, P. P., & Schermann, N. (2025). Financing decentralized digital platform growth: The role of crypto funds in blockchain-based startups. Journal of Business Venturing, 40(1), 106450. https://doi.org/10.1016/j.jbusvent.2024.106450

Derviz, A. (2021). Decentralised finance, its prospects and limits: Is blockchain interoperability the only obstacle?. Occasional Publications-Chapters in Edited Volumes, 13-17.

Dodmane, R., KR, R., NS, K. R., Kallapu, B., Shetty, S., Aslam, M., & Jilani, S. F. (2023). Blockchain-based automated market makers for a decentralized stock exchange. Information, 14(5), 280. https://doi.org/10.3390/info14050280

Dos Santos, S., Singh, J., Thulasiram, R. K., Kamali, S., Sirico, L., & Loud, L. (2022, June). A new era of blockchain-powered decentralized finance (DeFi)-a review. In 2022 IEEE 46th Annual Computers, Software, and Applications Conference (COMPSAC) (pp. 1286-1292). IEEE. https://doi.org/10.1109/COMPSAC54236.2022.00203

Goghie, A. S. (2024). Tokenization and the banking system: Redefining authority in the blockchain era. Competition & Change, 10245294241258255. https://doi.org/10.1177/10245294241258255

Goncharov, S., & Nechesov, A. (2023). Axiomatization of Blockchain Theory. Mathematics, 11(13), 2966. https://doi.org/10.3390/math11132966

Han, C. S., Lotfi Ghahroud, M., Park, M. J., & Ghassemi Nejad, J. (2023). A new blockchain investment and energy certificate platform. Cogent Engineering, 10(2), 2260226.https://doi.org/10.1080/23311916.2023.2260226

Javaid, M., Haleem, A., Singh, R. P., Suman, R., & Khan, S. (2022). A review of Blockchain Technology applications for financial services. BenchCouncil Transactions on Benchmarks, Standards and Evaluations, 2(3), 100073. https://doi.org/10.1016/j.tbench.2022.100073

Jin, S. V. (2024). "Technopian but lonely investors?": Comparison between investors and non-investors of blockchain technologies, cryptocurrencies, and non-fungible tokens (NFTs) in Artificial Intelligence-Driven FinTech and decentralized finance (DeFi). Telematics and Informatics Reports, 14, 100128. https://doi.org/10.1016/j.teler.2024.100128

Kumar, M., Nikhil, N., & Singh, R. (2020, June). Decentralising finance using decentralised blockchain oracles. In 2020 International Conference for Emerging Technology (INCET) (pp. 1-4). IEEE. doi: 10.1109/INCET49848.2020.9154123.

Liu, J., Xu, Z., Zhang, Y., Dai, W., Wu, H., & Chen, S. (2022). Digging into primary financial market: The issues of primary financial market issuance and investigations from the perspective of blockchain. Frontiers in Blockchain, 5,

908912. https://doi.org/10.3389/fbloc.2022.908912

Meegan, X. (2020). Identifying key non-financial risks in decentralised finance on ethereum blockchain. MIP Politecnico di Milano.

Meyer, E., Welpe, I. M., & Sandner, P. G. (2022). Decentralized finance—A systematic literature review and research directions. ECIS. https://dx.doi.org/10.2139/ssrn.4016497

Ozili, P. K. (2022). Decentralised finance and cryptocurrency activity in Africa. In The New Digital Era: Digitalisation, Emerging Risks and Opportunities (pp. 3-11). Emerald Publishing Limited. https://doi.org/10.1108/S1569-37592022000109A001

Patel, R., Migliavacca, M., & Oriani, M. E. (2022). Blockchain in banking and finance: A bibliometric review. Research in International Business and Finance, 62, 101718. https://doi.org/10.1016/j.ribaf.2022.101718

Park, K., & Youm, H. Y. (2022). Proposal of decentralized P2P service model for transfer between blockchain-based heterogeneous cryptocurrencies and CBDCs. Big Data and Cognitive Computing, 6(4), 159. https://doi.org/10.3390/bdcc6040159

Pombo-Romero, J., & Rúas-Barrosa, O. (2022). A blockchain-based financial instrument for the decarbonization of irrigated agriculture. Sustainability, 14(14), 8848. https://doi.org/10.3390/su14148848

Proelss, J., Sévigny, S., & Schweizer, D. (2023). GameFi: The perfect symbiosis of blockchain, tokens, DeFi, and NFTs?. International Review of Financial Analysis, 90, 102916. https://doi.org/10.1016/j.irfa.2023.102916

Sawarnkatat, D., & Smanchat, S. (2022). NAGA: multi-blockchain based decentralized platform architecture for cryptocurrency payment. International Journal of Electrical and Computer Engineering (IJECE), 12(4), 4067-4078. DOI: 10.11591/ijece.v12i4.pp4067-4078

Schär, F. (2021). Decentralized finance: On blockchain-and smart contract-based financial markets. FRB of St. Louis Review. https://dx.doi.org/10.20955/r.103.153-74

Shokri, A., Shokri, A., White, D., Gelski, R., Goldberg, Y., Harrison, S., & Rashidi, T. H. (2022). Envirocoin: A holistic, blockchain empowered, consensus-based carbon saving unit ecosystem. Sustainability, 14(12), 6979. https://doi.org/10.3390/su14126979

Schueffel, P. (2021). Defi: Decentralized finance-an introduction and overview. Journal of Innovation Management, 9(3), I-XI. https://doi.org/10.24840/2183-0606_009.003_0001

Treleaven, P., Brown, R. G., & Yang, D. (2017). Blockchain technology in finance. Computer, 50(9), 14-17. doi: 10.1109/MC.2017.3571047

Trivedi, S., Mehta, K., & Sharma, R. (2021). Systematic literature review on application of blockchain technology in E-finance and financial services. Journal of technology management & innovation, 16(3), 89-102. http://dx.doi.org/10.4067/S0718-27242021000300089

Tsepeleva, R., & Korkhov, V. (2022). Building DeFi applications using cross-blockchain interaction on the wish swap platform. Computers, 11(6), 99. https://doi.org/10.3390/computers11060099

Varma, J. R. (2019). Blockchain in finance. Vikalpa, 44(1), 1-11. https://doi.org/10.1177/0256090919839897

Zheng, P., Jiang, Z., Wu, J., & Zheng, Z. (2023). Blockchain-based decentralized application: A survey. IEEE Open Journal of the Computer Society, 4, 121-133. doi: 10.1109/OJCS.2023.3251854

Deloitte. (2023). Blockchain para finanzas. Deloitte Insights. Recuperado de https://www2.deloitte.com

Utimaco. (2022). Tecnología blockchain en finanzas y banca. Recuperado de https://utimaco.com

BBVA. (2023). ¿Qué es 'blockchain' y cómo ha impulsado la descentralización? Recuperado de https://www.bbva.com