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Blockchain technology-based crypto assets: new insights into the evolution of the understanding of digital entrepreneurship

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Abstract

Purpose – The study aims to shed light on the concepts most addressed in scientific research, which blockchain topics are of most interest, how relevant are these tools for academia, and how relevant are they?
Design/methodology/approach – The authors have developed a bibliometric study of scientific publications on blockchain made since 2016. For the analysis, the VOSViewer software version 1.6.19 has been used, which allows a statistical analysis of scientific publications on the subject.
Findings – The study manifest the relevance of Initial Coin Offering, growth of research interest in this field and the relevance of blockchain technology in the development of entrepreneurial projects.
Originality/value – This study provides a complete and updated picture of the scientific research on blockchain for the subsequent transfer of knowledge to the business world.

Keywords Bibliometric analysis, Blockchain technology, Crypto assets entrepreneurship, Digital evolution, Entrepreneurial finance, Startup financing

Paper type Literature review

1. Introduction

Blockchain is a technology that has introduced technological disruption on a global level. Blockchain is not only disruption at the financial level; it is a technology that is changing processes in multiple fields of action and industries (Cai, 2018). The very nature of the blockchain has implications that transcend the merely technological. According to Nakamoto (2008), we can define blockchain as a distributed ledger technology that enables the storage and transmission of information in a secure, transparent and decentralized manner. It consists of a chain of interconnected blocks containing data verified and validated through cryptography and network consensus.

The decentralization, transparency and anonymity of blockchain systems (Huang *et al.*, 2022; Zheng *et al.*, 2017) give it characteristics of efficiency, expansion of the space of civil liberties, and reduction of dependence on imperfect and sometimes biased regulatory systems, which encourage innovation and technological development. Likewise, blockchain

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technology, either through crypto assets or through the implementation of the technology in applications and processes (Chen, 2018).

Thanks to the application of blockchain in the financial sector, a large number of entrepreneurs have been able to finance their projects through Initial Coin Offers (ICOs). The boost to project finance is not limited to specific sectors, such as finance/FinTech but has an impact on a wide range of sectors with a high impact on the economic reality of many countries, such as tourism, industry or publishing, among many others (Prados-Castillo *et al.*, 2023; Tappuni, 2020).

This innovative method of raising funds to finance business projects through the issuance of tokens has also been beneficial for the competitiveness of the financial sector in general (Larios-Hernández, 2017). The more sources of financing there are in the market, the greater the competition in the market, and therefore the more efficient it will be, which will make it easier for entrepreneurs to finance new projects (Sgroi, 2022). In this sense, according to previous studies by Augusto *et al.* (2019), we see how blockchain networks enable collaborative business, build partnerships, align incentives and build synergies that enhance their companies. The generation of these blockchain-based environments drives innovation and digital entrepreneurship, as well as socially responsible business models (Al-Omoush *et al.*, 2023). One of the keys for the blockchain to establish the ideal collaboration framework for the generation of collaborative professional environments is the high degree of trust and security provided by the technology. In this sense, through smart contracts, a multitude of contracts can be developed agilely, monitor or establish the traceability of operations and processes, among other advantages. This contractual framework enables and encourages the development of corporate partnerships and makes them more agile and efficient by reducing the bureaucratic burden and automating processes (Di Ciccio *et al.*, 2018).

In this regard, it is estimated that two billion people have no or very limited access to financial resources. In this sense, blockchain technology, fully decentralized and accessible to everyone with Internet access, is boosting the financing of new projects (Larios-Hernández, 2017). This decentralization essentially seeks to dispense with financial intermediaries (Kaşkaloğlu, 2014). It also enables access to financing for financially underdeveloped regions, for economic, social, political or regulatory reasons, including market power in the case of highly banked financial markets that operate under a monopoly, quasi-monopoly or excessive concentration regime.

In this sense, through blockchain technology it is possible to raise funds globally by issuing tokens. As we will develop in greater depth later, the issuance of tokens consists of issuing representations of virtual property rights hosted on a decentralized blockchain around the world. Until now, entrepreneurs have traditionally relied on the banking sector, venture capital entities, investment funds and other traditional financial instruments to finance their businesses. In this sense, people based in financially underdeveloped environments did not have access to these opportunities. These barriers are beginning to dissipate with this technology, generating a very positive impact on economic growth and the development of the entrepreneurial ecosystem (Saura *et al.*, 2022; Rawhouser *et al.*, 2023). As a result of the development of the entrepreneurial ecosystem, digital sustainable business models are generated that contribute to generate more resilient businesses, boosting the digital transformation, productive labor and the economy of a region or country (Cheng *et al.*, 2023; Isensee *et al.*, 2023; Li *et al.*, 2023a, b).

It is also worth highlighting the potential of the application of this technology to corporate fundraising and the generation of communities (Wilson *et al.*, 2022). In a way, those participating in the project generate a sense of community associated with the project, also boosting loyalty and brand value. It also drives and incentivizes early adopters and developers to develop complementary products (Parker *et al.*, 2016). The FinTech environment of innovation and financial digitalization generates an ideal atmosphere for

the implementation of blockchain technology in the financial area of the company. This introduction of blockchain technology in finance is relatively recent, and it is essential to study and diagnose its implementation.

Likewise, according to studies by Bakcerzak *et al.* (2022), the transparency of technology and its decentralization facilitate the work of good corporate governance of the company, interconnecting decision-making processes, building cognitive computational systems, optimizing the time and security of transactions or offering decentralized payment systems. In short, the entrepreneurial ecosystem is significantly boosted at a global level. Previous works by Bedin *et al.* (2021) have concluded that the application of blockchain helps to generate collaborative economy ecosystems. These ecosystems are characterized by more efficient and cost-effective customer experience processes. Furthermore, blockchain technology finds valuable applications in transactions within smart cities, enabling the monitoring of processes and events in near real-time. In other aspects related to social life and how with this technology application channeled through the business world, philanthropic initiatives are also emerging, trying for example to maximize social welfare through an app based on Ethereum, in a clear demonstration of the Corporate Social Responsability (CSR) potential of this technology.

Therefore, it is clear that technology has an intrinsic value capable of generating major disruptions in the business world; however, it is essential to comment that it will be the implementation and generalization among the set of companies that will determine the success of this transition (Morkunas *et al.*, 2019).

1.1 Study contribution and objectives

The approach of this article is to provide the scientific and business community with an updated and real picture on the scientific research carried out so far on blockchain technology in its application in business and entrepreneurship. During the last few years, blockchain technology and its application in the financial field through crypto assets have attracted the attention of the academic and business world; however, a lack of information about the global state of research in this area has been detected.

That is why, we propose this study with the objective of presenting an updated report on blockchain research applied to the business world. The analysis has been developed using bibliometric techniques accepted and endorsed by the scientific community, so the results presented are of maximum reliability. Another objective of this study is to investigate in depth which areas, techniques or modalities of business and industrial blockchain have been studied so far, so that we can provide this information to the scientific and business community, to enhance research in those areas where sufficient research is being done, and also to boost research in those areas where there may be a lack of knowledge. Ultimately, the aim of this article is to promote global and transversal research on blockchain applied to business and industry, and to encourage the transfer of knowledge between the academia and business.

In this research, we will first address a literature review in Section 2, "Theoretical Background," in which we will establish the bases established so far in academia about blockchain technology, and the main tools of the technology applied to the corporate and industrial world. Subsequently, in Section 3 "Methodology," we will develop the methodology used in the analysis, as well as the software used, and the parameters introduced for the analysis. In Section 4, "Results," we will analyze the results obtained from the bibliometric study, as well as make the relevant interpretations of them. Finally, in Section 5, "Conclusions," we will draw the main conclusions of the analysis and comment on the main limitations and possible lines of future research.

2. Theoretical background

The first blockchain network was launched by Satoshi Nakamoto (pseudonym of a person or group of people unidentified at the time of writing this article). This groundbreaking network laid the foundations for the creation of the bitcoin cryptocurrency, which was destined to change the paradigm of the contemporary monetary system. Additionally, this technology gave rise to a new class of financial products known as crypto assets (Alzhrani *et al.*, 2022). We can define it as a decentralized and distributed accounting system, specifically a general ledger, in which all transactions are recorded in blocks of information, which are part of the chain. In this way, a blockchain of information is configured, public and accessible to all (Nakamoto, 2008).

However, it is worth mentioning one of the main disadvantages of the technology: the high level of resources consumed at the computational level by the "Proof-of-Work (PoW)" algorithms, which in turn is accompanied by high energy consumption and the need for specific equipment to perform these functions (Wolfskehl, 2018). PoW is a consensus protocol used in blockchain to validate transactions and add new blocks to the chain. In PoW, network participants must solve a difficult cryptographic puzzle, known as a "PoW," to demonstrate that they have devoted a certain number of computational resources to validating the transaction. The first participant to solve the puzzle and validate the transaction receives a reward in the form of cryptocurrency (Nakamoto, 2008; Pass *et al.*, 2017). Despite this, it is worth noting that the amount of energy consumed by a blockchain network varies depending on the nature of the network. First, if it is a blockchain with PoW or not, or if it is an enterprise blockchain, in which case it consumes less than the previous two. As has been established in previous studies on the subject, it is the PoW that is the differentiating element in terms of energy consumption of the blockchain (Sedlmeir *et al.*, 2020). At the same time, it is worth mentioning that a different mechanism is being developed to guarantee the immutability and security of the systems, the Proof-of-Stake (PoS), which has been shown to significantly reduce energy consumption in the verification processes of transactions and operations, although lower levels of reliability and fairness are still observed than with the PoW mechanism (Zhang and Kin, 2020). PoS is a consensus protocol used in blockchain to validate transactions and add new blocks to the chain. Unlike PoW, in which participants must solve difficult cryptographic problems to prove that they have dedicated computational resources to validate transactions, in PoS, participants prove that they have a certain number of cryptocurrencies, which are blocked as collateral, to be eligible to add blocks to the chain. This improves the efficiency and energy sustainability of cryptocurrency mining, as it does not require the use of large amounts of computational resources like PoW (Buterin, 2014; Ge *et al.*, 2022). The blockchain technology is in continuous development, trying to optimize its operation in every way, in order to increase the pace of its mass adoption.

2.1 Role of blockchain in entrepreneurship

Blockchain technology is democratizing the entrepreneurial environment globally (Rawhouser *et al.*, 2022). As we outlined earlier in the introductory section of this paper, blockchain and digital finance open the doors for entrepreneurs based in geographic locations where the financial sector is underdeveloped or uncompetitive to access funds from investors around the world to develop their projects (Cowen, 2020; Li *et al.*, 2023a, b). Likewise, the blockchain applied to finance, especially to fundraising through instruments such as ICOs or security token offerings (STOs) is an element of financial inclusion. The decentralized and accessible nature of the technology enables access to capital and credit for entrepreneurs residing in regions with underdeveloped financial systems (Larios-Hernández, 2017). Likewise, these instruments enable the support of a community of investors to an entrepreneurial project in a sustained manner over time, and promote innovation,

encouraging early adopters to participate in open-source-based communities and open projects (Chen, 2018).

This technology is also enabling the development of projects in sectors or activities prohibited by the different governments of the world. This factor can have a double impact. On the one hand, it can be positive as it breaks the entrepreneurial barriers of dictatorial countries or countries with autocratic governments, but on the other hand it can also make possible the financing of illegitimate or illegal activities in practically all countries, such as drug trafficking, prostitution or arms trafficking (Sanders *et al.*, 2018; Bogus *et al.*, 2020).

Likewise, the blockchain enables a boost in regulatory update and optimization. The speed and transparency of data exchange, coupled with the low transaction barriers of this technology, also enable competition between different regulators (Novak, 2019). The creation of more favorable conditions for doing business, the relaxation of bureaucratic requirements and even the integration of different blockchains from different agencies make it possible to boost economic activity and accelerate the development of an advanced legal framework appropriate to market circumstances (Markey-Towler, 2018).

2.2 Initial Coin Offerings and startup financing

This philosophy of continuous improvement and process optimization, coupled with the immutability, transparency and security features of blockchain, makes it a perfect technology to be combined with the business world. It has the potential to drive value generation and foster the development of new and innovative business models. The first concept we are going to analyze in this study is the ICOs. A term that was born closely related to the monetary and financial nature of the first blockchain, and that has managed to revolutionize the raising of funds for the development and creation of companies today.

Currently, it is worth highlighting the importance of blockchain technology in industry and in venture financing. As the previous studies by Frizzo-Barker *et al.* (2020) show, the implementation of this technology in the area of financing entrepreneurial projects has grown significantly in recent years. This generalization of the technology also has implications at the economic level on the importance of institutional and financial decentralization, competitiveness within the industry and the importance of a regulatory framework that provides security and innovation capacity to companies (Kher *et al.*, 2021). Some authors have highlighted the similarities of ICOs with another relatively innovative financial fundraising instrument, which has already been on the market for a significant number of years: crowdfunding. In this sense, both models seek to raise funds to develop a project (or continue it) through a community of investors and require a minimum level of funding to achieve a successful campaign (Sanchez, 2017). This tool allows entrepreneurs to raise funds through the sale of a cryptocurrency/crypto asset to the investment community (Hsieh and Oppermann, 2021). In an ICO, a company or project issues a cryptocurrency or token and sells it to investors in exchange for another cryptocurrency, such as Bitcoin or Ethereum, or fiat money, such as dollars or euros. In exchange for their investment, investors receive a certain amount of tokens that can be used on the project's platform or exchanged on the cryptocurrency market (Zhang *et al.*, 2022). It is an interesting tool, which has become increasingly popular in recent years, because thanks to the decentralization that characterizes it, it allows the generation of communities of stakeholders (investors, founders, developers, employees etc.) with direct contact and the ability to interact through digital media that allow a communicative fluency ideal for these agents (Brochado and Troilo, 2021). Some of the main advantages of ICOs are the ability to trade the tokens acquired in the issue in secondary markets, with the consequent liquidity characteristic that this implies, and that, on the contrary, instruments such as crowdfunding do not count. Likewise, it is a tool that allows quick and unbureaucratic funding acquisition, as opposed to

traditional project financing models, associated with traditional banking or the capital market (Debler, 2018; Rohr and Wright, 2019). Given that ICOs have experienced several fraud events (Sharma, 2021). It is especially necessary to explore the potential factors that could explain the success of ICO campaigns in the present and in the future. Studies on the subject by Belirski and Boreiko (2021) show the importance of a functional regulation of crypto assets, the need to publish whitepapers of the projects, as well as their codes, and the need to receive back up from investors during the pre-sale.

Given the importance of ICOs in the landscape of the application of blockchain technology to the entrepreneurial world, we consider it relevant to take stock of the situation in terms of academic publications related to token issuances.

2.3 Smart contracts

Smart contracts have gained significant importance in the blockchain and cryptocurrency landscape since their huge development in recent years. We can define smart contracts as executable codes that are developed on a blockchain and that allow the establishment that enables a contractual framework between different parties, without the need for the intervention of a public fiduciary figure, such as a notary (Khan *et al.*, 2021). Smart contracts are contracts between parties that will be executed automatically when certain circumstances set forth in the contract occur. For example, let's assume that a smart contract has been signed in which it is established that when a certain price level is reached, the order to sell a specific asset will be executed. This sale order will be executed automatically when that price level is reached, all the conditions initially signed being incorruptible, unalterable and transparent, so that the transactional security conferred by this type of contracts to the operations that frame them is very high. The contractual information is stored in the blockchain, which keeps the immutability and irrevocability characteristics of the technology. Smart contracts can be developed on various blockchains, such as Ethereum or Cardano. Each of the different platforms on the market to develop smart contracts has different characteristics in terms of programming, security levels, execution speed etc. (Osterland and Rose, 2020).

Although these smart contracts currently have a regulation in the legal systems of the different countries that cannot be considered as developed and adequate to the speed at which technology advances, it has been established in previous works by Gilcrest and Carvalho (2018), the potential transformations and legal benefits that could lead to the massive adoption of smart contracts in our daily operations. In this sense, it opens the door to the tokenization of assets through smart contracts to establish the property rights on that underlying, in all Business2Business, Business2Consumer or Consumer2Consumer transactions to try to ensure the good end of the same, monitoring the progress in the execution of signed projects . . ..

Therefore, we can establish smart contracts as a fundamental mechanism in the application of blockchain technology to the entrepreneurial and business landscape, especially in terms of the legal and security framework for agreements and transactions between parties. In this sense, in the following section, we will study the current state of scientific publications on the subject, in order to make a research diagnosis on this important topic of the entrepreneurial and industrial blockchain.

2.4 Industrial blockchain

In the previous sections, we have seen how the nature of blockchain technology gives it a special attraction in the field of entrepreneurship, fundraising and the legal framework for conducting business operations and formalizing agreements between parties. However, blockchain is also finding application and development in the industrial sector (Al-Jaroodi

and Mohamed, 2019). First of all, it is worth commenting on the application of blockchains to the supply chain. In this sense, the traceability allowed by the blockchain in which it is possible to observe during the whole process the transactions, operations and actions that take place allows to increase the transparency of the processes (Ivanov *et al.*, 2019). Also, previous studies by Cole *et al.* (2019) have theorized and demonstrated the added value of using blockchain in industry, especially in terms of improving product safety.

Also, the technology allows for greater efficiency, in that the need for intermediaries (and thus transaction costs) is reduced. Moreover, the application of this technology implies the improvement of product quality management, as well as the optimization of and reduction of errors in inventory management (Li *et al.*, 2021). Previous studies by Tanwar *et al.* (2022) have theorized about the potential of the blockchain on security and reliability issues in the deployment and generalization of 5G and future 6G technology with reduced upfront capital input and reduced operational costs. Likewise, the Industrial Internet of Things (IIoT) is digitally transforming the manufacturing industry. The need to manage the set of data generated and collected through the IIoT with security conditions and guarantees that meet the regulatory and elementary standards of privacy and data management of third parties position the immutable and secure blockchain technology as a key lever for the promotion and generalization of the IIoT (Zhang *et al.*, 2020).

In this sense, the industrial applications of blockchain are proving to be (and will become even more) key to the development of a digitized, intelligent and sustainable industry. We consider it essential to study the scientific publications to date on this subject, because of its important role in entrepreneurship and the business world.

2.5 Security token offering

STOs have been gaining significant importance in the entrepreneurial landscape, especially after the cryptocurrency boom, and the ICOs mentioned in the first section of this literature review. STOs have some similarities with ICOs, in the sense that both represent investment in a project/asset registered through a blockchain (Blandin *et al.*, 2019). The main difference between STOs and ICOs is that STOs are subject to regulation, and under the jurisdiction of the laws of the country where they operate (Lambert *et al.*, 2022). In other words, tokens issued in an STO are considered regulated securities, in the same way as other types of regulated financial instruments, such as shares or bonds listed on stock exchanges. In this sense, STOs are a fundraising tool with greater security for investors than ICOs, and also with greater legal coverage as they are covered by the financial laws established by each regulator.

Another factor to take into consideration in the business area when raising funds through an STO is what the white paper should include. The white paper is the document that includes the main characteristics of the project, its objectives, values, mission, description of the company, information on partners, financial, legal, organizational or technological aspects, among others. In this sense, according to analyses by Bongini *et al.* (2022), it seems to indicate that technological projects applied to health sciences seem to be performing well. There are also fundamental variables common to all sectors that can determine the success of an STO, such as the correct communication, the concreteness and brevity of the white papers or the environmental impact of the project.

Next, we will perform a bibliometric analysis of the number of publications on the subject of this concept, as well as the three previous ones, with the aim of quantifying the studies carried out and exploring those fields that need further scientific development.

3. Methodology

This section describes all the phases used to obtain the scientific publications made since 2016 and using a bibliometric method accepted by the scientific academy. Currently, bibliometric analysis tells us where the spearhead of research is and where science is moving, facilitating a scientific mapping along with co-authorship networks, the basis of this research is in text mining. It should be noted that this is a bibliometric study based on the impact of publications as measured by the citations obtained, as opposed to a bibliographic study based primarily on the studies of internationally influential authors (Anwar *et al.*, 2023). Bibliometric analyses have become popular as rigorous methodologies for the treatment of large volumes of scientific data. The advantage it brings lies in showing the evolution of the different scientific fields according to the analysis of what the scientific community is researching, focusing on the most emerging fields.

Bibliometric studies of scientific literature are usually focused on the use of this database (Web of Science, WoS), using different texmining software, which have been analyzed by different authors (Donthu *et al.*, 2021; Moral-Muñoz *et al.*, 2020), the most relevant being Bibexcel, Biblioshiny, BiblioMaps, Citespace, CitNetExplorer, SciMAT, Sci2 Tool and VOSviewer, the latter developed by Leiden University in 2019.

In our work, we have chosen the two main scientific databases, WoS and Scopus, for the reliability of the scientific information deposited in them and for being the main providers of publication metadata and bibliometric indicators (Pranckutė, 2021) and in both cases, we have used the open-source software VOSviewer, which provides us with a visual analysis showing the terms grouped and forming different clusters taking as reference the selected documents according to the selected criteria.

First, the analysis of publications on blockchain in the WoS database is shown, which currently belongs to Clarivate Analytics and for two fundamental factors: (a) the large volume and variety of journals and therefore of articles that are deposited in it, certified in its more than 21. The database contains more than 21,000 journals published since 1990, and (b) the excellent quality of the content of the articles published in this database, the vast majority of which are in English, backed by the high impact factor of the journals, as demonstrated by the high level of citations referenced in them.

Second, the Scopus database, created by Elsevier in 2004, has been analyzed, where not only the enriched metadata of the scientific articles have been recorded, but Scopus also offers complete profiles of authors and institutions. Its reliability makes it a source for bibliometric data analysis, as is our case. Enabling large-scale analysis in research evaluations, research landscape studies, science policy evaluations and university rankings (Baas *et al.*, 2020).

The robustness of VOSviewer is demonstrated by the relevance of the papers published in recent years and the number of different scientific fields analyzed: supply chain management (Katoch, 2021), urban sustainability (Sharifi, 2021), engineering (McAllister *et al.*, 2021), blockchain and coronavirus disease 2019 (Covid-19) (Guaita Martínez *et al.*, 2022), Covid-19 and business (Carracedo *et al.*, 2021) or crowdlending (Ribeiro-Navarrete *et al.*, 2021), among others.

In the Wos analysis, the search criteria were selected as follows:

TOPIC-TITLE-ABS (“initial coin offering” OR “smart contracts” OR “industrial blockchain” OR “corporate blockchain” OR “security token offering”) AND (LIMIT-TO (DOCTYPE, “ar”)) AND (LIMIT-TO (LANGUAGE, “English”)),

which resulted in 1,606 initial references, and which is represented in Figure 1, 1,603 between 2016 and 2022, since 3 remain between 2000 and 2015, not offering this information in the figure due to its low relevance over the total.

In the Scopus analysis, the search criteria were selected as follows:

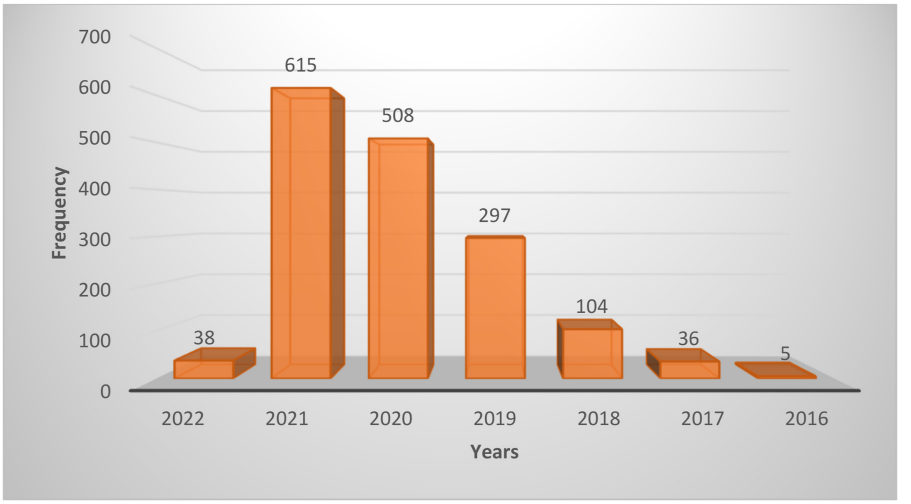

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Figure 1.
Time Horizon WoS 2016–2022

TOPIC-TITLE-KEY ("initial coin offering" OR "smart contracts" OR "industrial blockchain" OR "corporate blockchain" OR "security token offering") AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English")),

which resulted in 2,413 initial references, and which is represented in Figure 2, 2,410 between 2016 and 2022, since 3 remain between 1997 and 2015, not offering this information in the figure due to its low relevance over the total.

In the case of both databases, there is an increase in the number of articles researched on our analyzed topic, taking into account two items, one the databases are not the same (Scopus

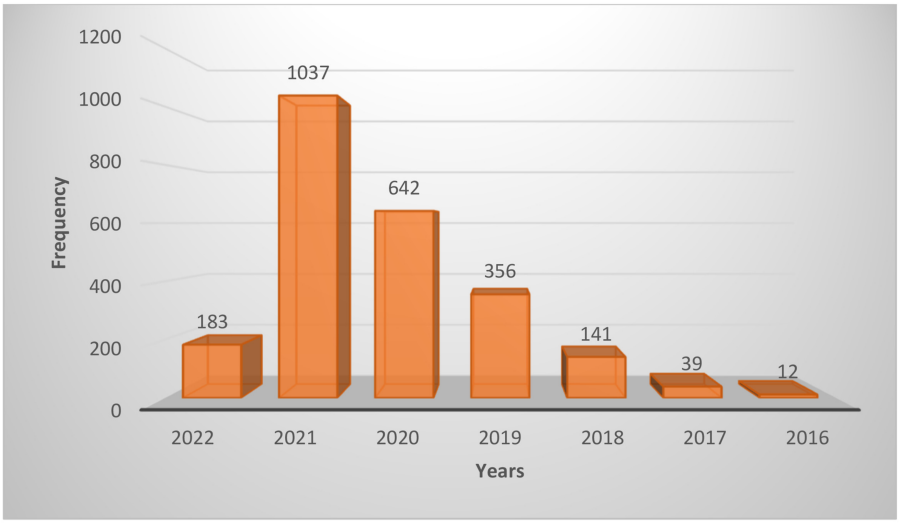

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Figure 2.
Time Horizon WoS 2016–2022

vs WoS) and the search criteria even using the same words, WoS allows searching by topic, title and Abstract while Scopus offers the possibility of choosing the criteria of topic, title and keywords, this criterion being different with Wos.

Next, based on the databases analyzed, the different research areas in which the different studies on the topics investigated have been developed are detected, with Figures 3 and 4 showing the separate analysis in Wos and Scopus, respectively. We have taken into account all those research areas that have had a frequency $\geq 2\%$ of the total, being 4,734 in WoS and 5,015 in Scopus, noting that an article can share several thematic lines.

In both WoS and Scopus, Computer Science and Engineering are the research areas with the highest number of published articles. The third position shows the first major difference, since in Scopus, Business, Management and Accounting is shown with 341 articles, while in WoS, Telecommunication occupies this position with 579 articles, and the fourth most researched subject area is Business Economics with 441 in WoS. The last major thematic area is energy, in both cases with 98 in WoS and 134 in Scopus.

In order to do the bibliometric analysis and network visualization, the VOSviewer software, version 1.6.19 was released on 23 January 2023, was used. This tool constructs and displays these networks taking into account co-citation and co-authorship relationships and adding the co-occurrence criterion (Van Eck and Waltman, 2010). As Moral-Muñoz *et al.* (2020) explain in their review of bibliometric analysis software tools, VOSviewer builds its

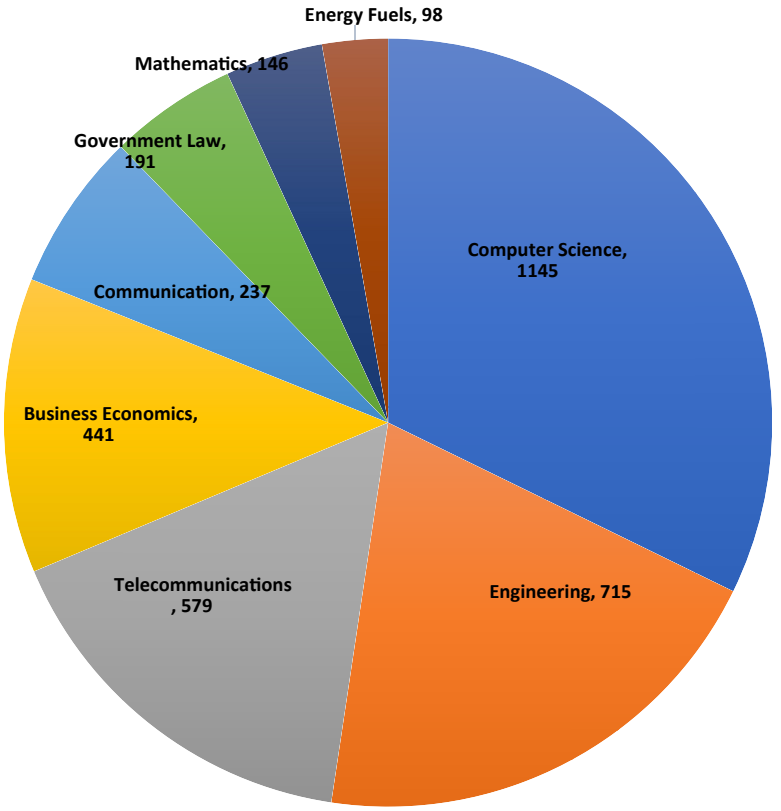

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Figure 3.
Thematic areas WoS

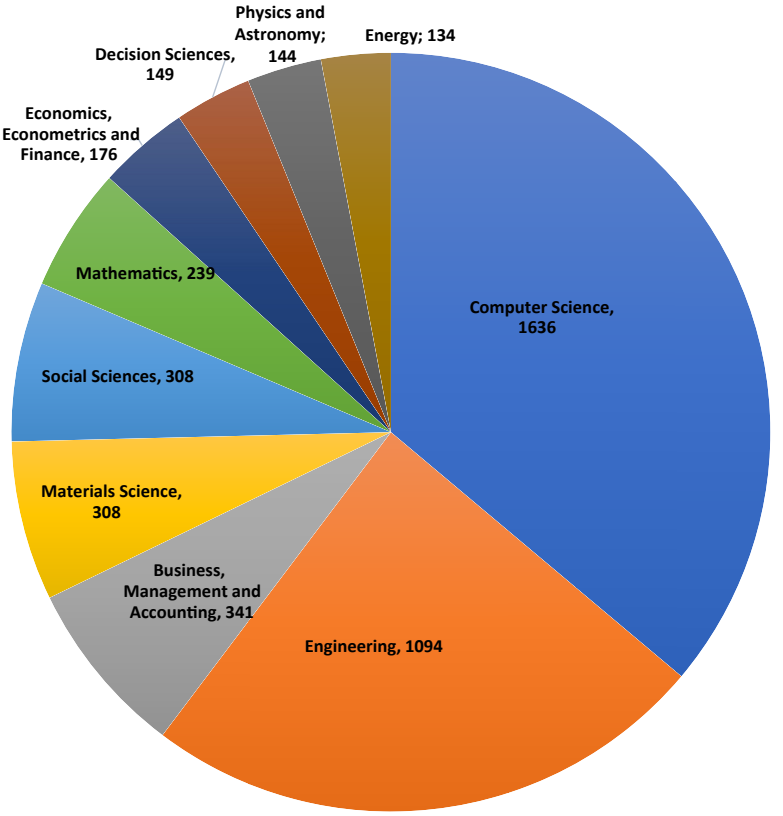

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Figure 4.
Thematic areas scopus

maps based on a co-occurrence matrix: similarity matrix, mapping technique and optimization problem correction, highlighting its great visualization and its ability to load and import data from many sources.

The term relevance in VOSViewer acquires prominence in the analysis since in the maps created with the article text data those general terms are excluded through a relevance scoring for each term (Van Eck and Waltman, 2011). The mapping of terms in VOSviewer allows the visualization of the relationship between the terms that appear most frequently in each of the articles, taking into account the criteria marked in the search engines of each database, in our case, WoS and Scopus. As a result, it shows a map of terms in two-dimensional form, linked to each other and where the distance between terms shows the relationship between them. Their relationship is marked by the co-occurrences in the analyzed articles. The letter size of each term, the number of interconnection lines with other terms and the thickness of these facilitate the relevance of each term. In this way, highly relevant networks of co-occurrences are grouped into clusters, and here the importance of this tool is established: each group or cluster can be considered as a relevant research topic (Van Eck and Waltman, 2014).

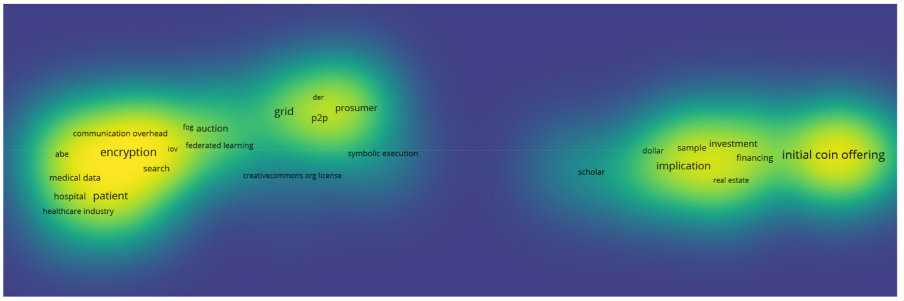

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Figure 5.
Map by density Scopus

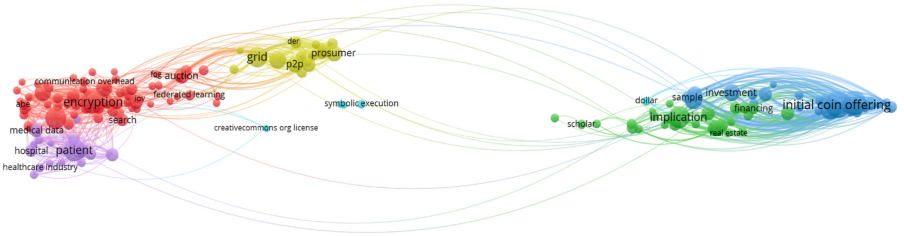

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Figure 6.
Map by network Scopus

4. Results

The results of the bibliometric analysis applied with the VOSViewer software to the two databases treated, Scopus and WoS, are shown below. Figures 5 and 6 visualize the most relevant terms according to the visualization capabilities of VOSViewer: Map by density and network map, in the Scopus database. The map density is particularly useful to get an overview, for each cluster separately, of the important areas of a map. Specifically, the color of a point in a map is close to the color of a certain cluster if there are a large number of items belonging to that cluster in the neighborhood of the point (Van Eck and Waltman, 2010). The network map is identical to the network visualization except that items are colored differently. The size of label and a circle is determined by the weight of the item so that the higher the weight of an item, the larger the label and the circle of the item. The color of a term is determined by the cluster to which the item belongs. At the end, lines between items represent links between them. The distance between terms in the visualization approximately indicates the relatedness of the items in terms of co-citation links (Van Eck and Waltman, 2011). In conclusion, the use of these maps is important as they provide a graphical representation of the relationships between the most relevant terms in our analysis.

In Scopus, five clusters are highlighted, which in turn form two large subgroups. The figure on the right shows the blue cluster, which includes the most relevant term: ICO, together with financing, investment, sample and dollar (Rajasekaran *et al.*, 2022). In the green color, the most relevant term is implication, together with real estate and solar. On the left side, there are three very close clusters, the yellow cluster is composed by the terms grid, p2p and prosumer (Samuel *et al.*, 2022), the red cluster by encryption, search, communication, overhead, learning (Xiang and Zhao, 2022) and finally, the purple cluster is supported by the terms patient, healthcare industry, medical data and hospital (Mamun, 2022).

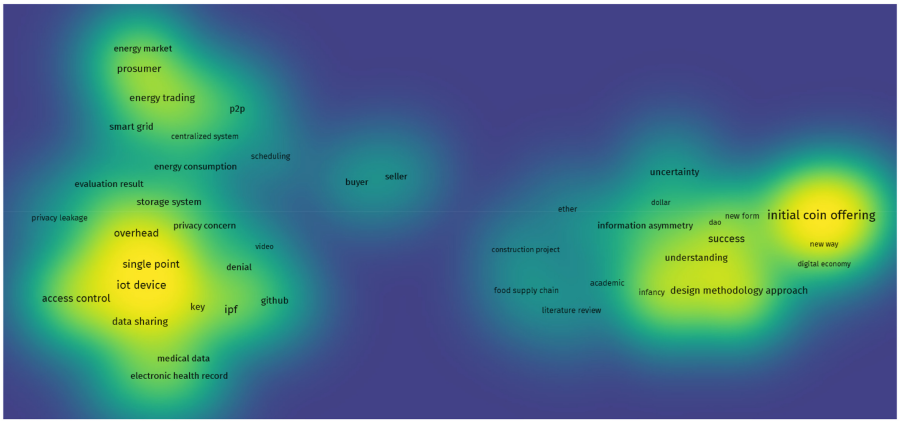

Figure 7.
Map by density WoS

Source(s): Figure by authors

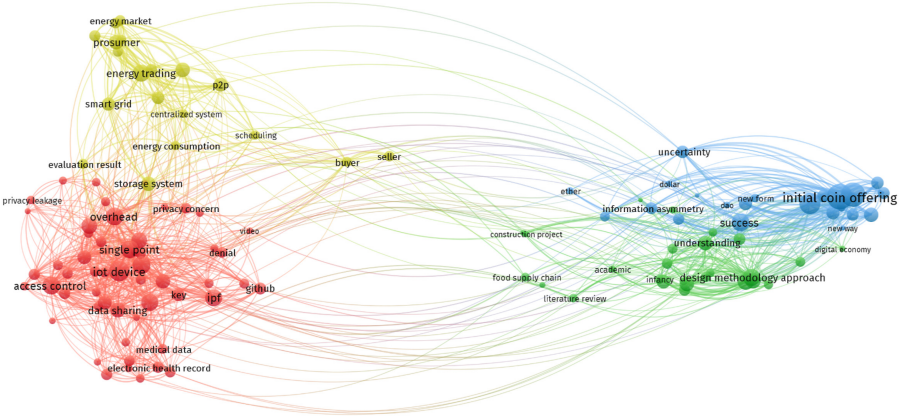

Figure 8.
Map by network WoS

Source(s): Figure by authors

Figures 7 and 8 visualize the most relevant terms according to the visualization capabilities of VOSViewer: Map by density and network map, in the WoS database.

In WoS, four clusters are highlighted, which, as in Scopus, form two large subgroups. In Figure 8, on the right side, the blue cluster appears, which includes as the most relevant term: ICO, together with success, uncertainty, information, asymmetry and dollar (De Andrés *et al.*, 2022). In the green color, the most relevant term is methodology, approach, design, academic, literature review and understanding (Kumutha and Jayalakshmi, 2022). On the left side, there are two distinct clusters, the yellow cluster is composed of the terms energy trading, energy consumption, prosumer, energy market, storage system, as the most prominent terms (Valdivia and Balcell, 2022) and finally, the red cluster is composed of IoT device, single point, data sharing, access control, and to a lesser extent medical data and health (Anitha and Haritha, 2022).

5. Conclusions

A bibliometric analysis has been applied through the WOSViewer software with the aim of studying the evolution of scientific research in relation to the topic of blockchain technology applied to the new business landscape. The study has provided not only the research landscape at the scientific level but also manifests what should be the public and private policies to support scientific research to optimize the resources of educational and university institutions.

One of the contributions of this study has been to perform a bibliometric analysis comparing the two most powerful databases of scientific dissemination: WoS and Scopus, showing the main research on blockchain technology and its application in different thematic areas as well as the transcendent linkage between the published research topics.

The results of the study manifest the relevance of ICO, and both databases visualize a cluster that suggests a growing evolution of blockchain technology in the financial sector. During the last 5 years, the emergence of ICOs as sources of financing for entrepreneurial projects has revolutionized the financial system, the ability to capture funding from the market, without the need to resort to intermediaries, traditionally banking, has enabled the creation of many innovative and disruptive projects.

As a point of coincidence in WoS and Scopus, there is a high level of study focused on the research lines themselves, the search for the state of academic research with new methodologies, projects, review of scientific literature, involvement of the scientific community, etc. A greater variety of scientific studies around blockchain technology is noted, not only by the number of articles since 2016 but also by their diversity and scientific depth.

Another relevant conclusion of the study lies in the application of blockchain technology itself. In Scopus, a powerful cluster is formed related to the healthcare sector, medical data, hospital and the healthcare industry. In this field, blockchain technology is developing multiple and innovative technological applications, driven by the growth of investments in this sector. In WoS, a relevant interest is detected in the Internet of Things (IoT), another field where blockchain technology is more developed, the implementation of blockchain technology in the industrial field, specifically through Smart contracts, is a very powerful tool to make business processes more efficient, and therefore, increase productivity. Its derivation to the consumer is related to another cluster where the term prosumer appears in both databases, although in WoS it is related to the thematic area of energy, where blockchain technology is representing a technological revolution closely related to climate change. In Scopus, prosumer appears strongly linked to p2p networks.

Finally, in Scopus, a last cluster appears linked to the encryption technology itself developed by the blockchain, a natural link as it is part of the blockchain industry.

As mentioned above, the results are very interesting at the academic level but also at the managerial implications level. As we can see, along with the market trend, blockchain technology as a lever for financing companies is becoming increasingly relevant in the financial sector. Also, according to the results obtained, we can see how the rise of this technology also brings with it concerns about the regulatory framework, the success factors of ICO campaigns and their environmental impact and energy consumption.

These aspects are relevant, since they are challenges to be addressed in the generalization of ICOs, STOs or other fundraising mechanisms based on blockchain, building sustainable and ethical business models that have a positive impact on all stakeholders.

Future research suggests an analysis of the optimization of the application of blockchain technology in all the most disruptive thematic areas: finance, IoT and medicine. Undoubtedly, three fundamental sectors in the economy of the 21st century. From here, an impact analysis should be produced to suggest innovation and entrepreneurship policies, generating employment by public and private institutions. The changes in the

financial sector, the industrial sector and medicine generate a new disruptive technological-entrepreneurial framework, which suggests immediate action with a view to the medium and long term. In this sense, it will be very interesting to advance in future research toward the analysis of the design of both public and private policies to encourage the generation of a financial innovation ecosystem that promotes credit for entrepreneurial projects. In this sense, it will be very positive to see how a public–private collaboration can be articulated to provide the sector with an adequate regulatory framework to give it legal certainty, and that the private sector can continue to develop efficient and agile blockchain-based financing solutions.

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Further reading

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Expression of concern: The publisher of Management Decision is issuing an Expression of Concern for the following article Ulrich, K., Guaita Martínez, J.M., Carracedo, P. and Soriano, D.R. (2023), "Blockchain technology-based crypto assets: new insights into the evolution of the understanding of digital entrepreneurship", *Management Decision*, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/MD-03-2023-0306, which was submitted to the guest-edited special issue 'Navigating the role of circular economy in entrepreneurship: Opportunities and challenges'. An investigation by the publisher found a number of articles with multiple concerns, including but not limited to compromised editorial handling and reviewing, undisclosed conflicts of interest, and lack of suitability for the scope of the journal. As a result of these concerns and as trust in the content is central to the integrity of the publication process, the Editor-in-Chief and publisher have taken the decision to publish an Expression of Concern for all articles within this special issue. The journal has not been able to confirm whether the authors were aware of these concerns. The authors of this article would like to note that they do not agree with the content of this notice. An investigation is ongoing and is currently unresolved. Further information will be provided by Management Decision as it becomes available.