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BIBLIOMETRIC ANALYSIS OF THE TRANSFORMATIVE SYNERGIES BETWEEN BLOCKCHAIN AND ACCOUNTING IN THE UPROOTING OF ECONOMIC CRIMINALITY

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Abstract. The impact of globalization and the growing digitalization of the economy is becoming increasingly felt in the area of economic criminality, and we therefore believe that it is a matter of urgency to seek viable and effective solutions to manage this area of concerns, thus preventing the contamination of the borderline that currently separates legal and illegal technologies, depending on how they are regulated or not. In this light, the aim of our paper is to explore those instances in which blockchain accounting has the potential to be a viable solution to guarantee the security and legality of economic and financial transactions, thereby significantly mitigating the impact and frequency of economic criminality. The main objectives we pursue are to define the nature of the interrelation among the concept of blockchain, accounting and economic criminality and to evaluate the potential advantages of implementing blockchain technology in the accounting system. The main findings are a comprehensive mapping of the network that links blockchain technology, accounting and economic criminality employing the clustering method. These are likely to be of valuable assistance not only for the legislator, but also for the shaping of future research paths in this field and, last but not least, for an essential group of stakeholders such as computer scientists, accountants, auditors and national governments.

Keywords: Blockchain; accounting system; economic crime; digitization; bibliometric analysis

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1. Introduction

Our global economic system is defined by a significant level of cross-border transactions of varying degrees of complexity, which are driven by the substantial values involved, the level of security provided and the efficiency of the system for exchanging economic and financial information among the multiple actors involved. In this respect, the legality and morality of the operations entailed in these transactions are questionable, as they very often conceal cases of economic delinquency with massive prejudice. In view of these reasons, we considered it appropriate in this paper to investigate to what extent the blockchain accounting system may be the most suitable response to this global challenge that significantly affects national economies. The implementation of blockchain into the operational system of economic entities has proven that it can play an essential role in protecting data from possible manipulation, while also ensuring that the software meets the legal requirements for keeping accounting data, which has obviously led to a higher level of data protection and security than other previous technologies.

It is already evident that blockchain will emerge as a central feature of the digital economy and will be employed in all contexts where it is crucial to guarantee the integrity of digital values and information. Like other technologies, blockchain is frequently used without full knowledge of the implications and consequences; for example, there are companies that have made advances in the use of these technologies and others that still do not recognize the intensity of the changes that have taken place in today's global economy. In terms of eradicating the phenomenon of economic criminality by applying blockchain accounting, this will certainly be achievable, as the vanishing of cash transactions (cash flow) will be regarded as the main way of tackling fraud and tax evasion. Of course, one should not overlook the potential negative effects that the application of blockchain may have on stakeholders. In this contextual framework, the aim of our paper is to explore those scenarios in which blockchain accounting might be a feasible tool to ensure the security and legality of economic and financial transactions, thus significantly mitigating the impact and frequency of economic criminality, while at the same time enhancing the transparency and the immutability of accounting information. The main objectives are focused on (O1) establishing the relationship among the concept of blockchain, accounting and economic criminality in SCOPUS and Web of science and (O2) ascertaining the advantages of applying blockchain technology in the accounting system.

2. Literature Review

Blockchain technology can best be described as a distributed peer-to-peer digital ledger used to record all transactions since its creation in a sequential and continuous manner. As a peer to peer distributed ledger, there is no central authority or entity controlling the processing of transactions (Ma, Deng, He, Zhang & Xie, 2021; Atanasovski, Trpeska & Lazarevska, 2020). The use of this technology in accounting is an extensively discussed topic, because at its core, blockchain is a digital ledger of accounting records (Hong & Rong, 2018; Deloitte, 2016), and its application will lead to major changes in accounting and even auditing (Pedreño, Gelashvili & Nebrada, 2021). There have been many technological innovations affecting accounting over the past decades, but the traditional method of double-entry bookkeeping has not changed (we still need a third party to provide credibility to transactions), thought the implementation of blockchain technology could lead to a fundamental change. The third party can be substituted by a mechanism relying on the mutual consent of all parties in the ledger, i.e. all users of blockchain technology. In order for a transaction to be authorised via blockchain technology, it will have to go through a verification and validation process from all nodes involved: producer, supplier, customer, investor, CEO, financial institution, public authority and others (Bonsón & Bednárová, 2019), which enhances its security, transparency and legality, which provides stakeholders with a trustworthy accounting record that shows the actual origin and destination of the resources exchanged.

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In this way, blockchain technology ensures transparency of transactions while simultaneously eliminates the possibility of manipulation of inputs (Schmitz & Leoni, 2019; O'Leary, 2017; Dai & Vasarhelyi, 2017), thereby contributing to the fundamental change and improvement of what is known as triple-entry accounting (O'Leary, 2017; Brandon, 2016). Therefore, we then conclude that the use of blockchain technology will have a powerful impact on the accounting field, changing the way information is gathered, reported and audited (Fullana & Ruiz, 2021). Moreover, the implementation of blockchain technology in the accountancy profession would make it impossible to manipulate, falsify or destroy any accounting transactions, as each transaction is cryptographically sealed (Bonsón & Bednárová, 2019), becoming permanent, incorruptible and irreversible (Cai & Zhu, 2016). This is the context in which the first research objective is grounded, namely, the nexus among blockchain technology, accounting and economic criminality.

One of the major benefits of blockchain technology is the substitution of the traditional invoicing, processing, recording, inventory and payment method by the employment of a digital ledger that will be synchronized by the parties who use it (Kwilinski, 2019). Jayasuriya Daluwathumullagamage & Sims (2021) consider smart contracts, which we may describe as a feature of blockchain technology, the key to the development of this technology, as they are capable of automatically executing the contractual terms and clauses encoded in the procedure, i.e. carrying out automated transactions without the intervention of an intermediary. Of course, such significant benefits that this technology entails for the accounting system and accounting operations have not gone unnoticed by researchers in the field. They have also attracted the interest of the world's four largest accounting services companies (The Big Four), which have actively engaged in projects to implement blockchain technology in order to transform the traditional way of delivering accounting services as well as the way businesses operate (Bajpai, 2017), and foresee this as the next level that the accounting and auditing industry will need to reach and navigate (Madden, 2020). These were the premises that led to the second objective of this paper, namely, to establish the expected gains from the integration of blockchain technology into the accounting system.

For this particular reason, it is understandable why the adoption of blockchain technology will be transformative for the accounting field and, after a review of the literature, the following implications and insights are highlighted in Tab. 1.

Tab. 1*:* Meta-analysis of the literature on the Blockchain-Accounting-Economic Criminality triad

Author, Year	Purpose/ objectives	Results	Effect	Comments
Pedreño, Gelashvili & Nebrada, 2021	The application of blockchain technology is one of the most debated topics in literature, as it is expected that its application could change the mission of accountants and auditors. Therefore, the main objective of this paper was to review the existing literature on the role and importance of blockchain technology.	The literature review reveals that the benefits of technology will transform accounting and therefore the accounting profession and even the auditing profession.	Entities will no longer need to have an internal accountant, external auditor or expert to issue supporting documents. In addition, the identity of the accounting records made by the *stakeholders* is guaranteed, so there will be no need to issue a proof for final verification of the exchange of assets. The accounting information will not be able to be altered, which will act as a conflict minimization mechanism and increase the level of stakeholder confidence.	We see that the use of blockchain technology will improve the fight against fraud and corruption, with data being impossible to alter and stakeholders having access to it in real time.

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Idehen & Mayor, *2021*	To examine the use of blockchain technology for fraud prevention in small and medium-sized enterprises.	Blockchain technology, with all its features such as decentralization, immutable records, auditability, accuracy, verifiability and real-time information exchange, has the potential to transform Nigeria's business environment.	Blockchain technology, for all its attributes, has the potential to be transformational for business. Peer-to-peer connectivity can help detect network fraud. The capacity to exchange information in real time and the involvement of all network participants will curb fraud and some economic malpractices. Owners will be able to validate the authenticity and legitimacy of financial statements, as they will have access to all transactions of the entity.	Transparency and trust will be enhanced with the application of blockchain technology in accounting, which will lead to a decline in fraud and economic criminality. Since everything is transparent, including all entity transactions, owners will no longer have to depend on the verdict of auditors.
Basu, 2021	To study how blockchain technology, together with cloud technology, can help to achieve a platform where errors or fraud attempts are minimized.	Technology inclusion will be embedded everywhere in business by 2030.	The accountant's new role will be oriented towards the accounting management side. Auditors will have to adapt and use new digital tools and their role will change, focusing more on performing a real-time audit to prevent risks of digital crime, deletion, compromise, etc. of information held by the entity as efficiently and quickly as possible.	We agree with the conclusions of this study. We believe that in the future accountants will have the role of centralizing and analyzing data on the blockchain, and auditors will have the role of monitoring operating activity in real time, so with blockchain technology, crime and fraud will be much reduced and deterred.
Alkan, 2021	To Assess the benefits of blockchain technology by examining the effect of decentralization on the accounting information system.	The potential benefits of blockchain-based accounting have been identified and grouped into 4 focus points: transparency, trust, smart contracts, and continuous audit.	Blockchain technology will disrupt AIS, generating datasets that are verifiable in real time. Moving AIS from a periodic system to a continuous, i.e. real-time system will also implicitly result in a change of the way the audit mission is performed from a periodic inspection to one that can be performed in real time, leading to a decline in economic delinquency.	Economic crime will also be reduced through the use of *smart* contracts, an attribute of blockchain technology. These contracts allow assets to be transferred automatically when certain conditions stipulated by the parties are met. So smart contracts, together with real-time auditing will reduce fraud and economic crime attempts.
Nhat & Van Dung, 2020	To develop an insight into blockchain technology and examine the relationships between accounting, accounting information systems and blockchain technology.	Transactional instruments that use blockchain technology will enable the development of a platform. This platform will substitute the traditional bookkeeping methods.	Blockchain technology will provide new tools and platforms that will change the accounting field and the accounting information flow. There will be a more transparent, accurate and secure treatment because of the records made on the blockchain and their tracking will be much easier, with the role of accountants in the	Accountants will use the new platforms and tools to interpret data and to support the executive staff in making decisions in the life of the entity. At the same time, recording transactions on a common digital ledger reduces the risk of fraud and economic

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			industry changing radically.	crime to a minimum.
Supriadi et al., 2020	To research the current use of blockchain technology and its applications, with a focus on economic and financial information.	Blockchain technology will change the old ways of recording, sorting, confirming and transmitting data. More and more applications based on this technology are emerging, but its use on a global scale has not yet been achieved.	Blockchain technology will be employed in the foreseeable future by entities focused on data quality, accuracy and the capability to upgrade accounting information systems.	As the technology is used, the accuracy and quality of economic data will be improved, which will increase stakeholder confidence. Over time, this technology will be embraced by more and more entities, leading to the use of a universal register, while economic crime will be significantly curbed.
Tan & Low, 2020	To discuss the prospects for the blockchain technology and the subsequent evolution of accountancy.	Certain features of Blockchain technology have not been thoroughly explored in the literature, and these may have a strong influence on the implementation of the technology, with related implications for the accounting profession.	Blockchain technology will change AIS (*accounting information systems*) at the basic level, i.e. it will change the way data is compiled. This and other changes will reduce honest errors and the immutability of the blockchain will deter fraud. Accountants will no longer be the central authority, but will remain responsible for financial reporting, with a strong influence on entity policies. Audit work will continue to be essential, with professionals expressing their opinion on the truth of financial statements.	While digitization and Blockchain technology in AIS will reduce the error rate, and the immutability of the Blockchain will reduce the opportunity for fraud, it will not guarantee that the financial statements will be accurate and true, because the preparation of financial statements is largely based on the entity's policies and the judgment of the accountants.
Kwilinski, 2020	To test the hypothesis that blockchain technology in accounting will ensure quality, transparency, efficiency and security of accounting and auditing processes.	The findings anticipate a complete automation of accounting in the future, with traditional double-entry bookkeeping disappearing.	Blockchain technology will allow both parties to simultaneously record the transaction in real time in a private ledger.	Synchronizing accounting records between entities will reduce economic crime and automate auditing. Auditors will only deal with complex non-standardized operations where their own professional judgment will be needed.

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Kahyaoglu, 2019	To review the current audit procedures in practice for financial transactions using blockchain technology and recommend best practices.	Blockchain technology will add value to economic entities by enhancing the security, quality and accuracy of accounting data.	As a result of adopting blockchain technology, every asset, contract, process, mission, expense or any other transaction will have a digital record and signature, that can be authenticated, validated, stored and shared. The authors believe that there will be no need for intermediaries such as accountants, auditors, lawyers, brokers, bankers, etc. One drawback to the technology is the trade-off between transparency and privacy	We expect that intermediaries will not be eliminated, but rather they will adapt to the new challenges that will emerge with the adoption of this technology. There will be concerns both during the introduction of the technology and afterwards, and professional judgement will be essential even in an automated world.
ICAEW, 2018	To assess the level of importance of blockchain technology in the future of accounting.	Ascertain blockchain's potential by cutting costs, attesting the validity of the entity's asset information.	The ownership transfer will be reshaped by blockchain technology and smart contracts. In addition, the operations of the accounting department will be streamlined or automated with the help of this technology.	This will increase the efficiency of accounting and significantly reduce the risk of unintentional errors, which will rise the need for other skills of the accounting professionals.

As shown in Tab. 1, most authors in the literature agree that blockchain technology will significantly change accounting and, of course, business in general. Considering the implications/effects of this technology as mentioned in Tab. 1, it is extremely important for professionals to understand the benefits and potential drawbacks. We agree that blockchain technology will decrease the risk of fraud and economic crime, but in order for this to happen, current and future professionals need to become familiar the technology and understand it, and through the use of new and emerging tools, these benefits envisioned in the literature may be fully achieved. This paper focused on the interrelationships of the Blockchain-Accounting-Economic Crime triad, in an attempt to capture an accurate picture of the impacts blockchain technology will have on accounting and its role in mitigating and controlling economic criminality.

3. Research Methodology

In order to achieve the research objectives, in our paper we have chosen bibliometric screening, performed with VOSviewer software on 5,584 papers in the research fields relevant to the selected topic, papers that were listed on the Web of Science and Scopus platforms between 2015 and 2021. Both of these platforms are known internationally for the quality of the papers they indexed.

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The main phases of the research protocol are as below:

a) Data collection

At this stage, articles considered to be of interest for the purpose of building the archive were selected from both Web of Science and Scopus, as shown in Tab. 2.

Tab. 2: Collection of items

Platform	**Web of Science**		**Scopus**	
Topic	Blockchain	Economic Crime	Blockchain	Economic Crime
Period	2015-2021		2015-2021	
Results	1167 papers	595 papers	2942 papers	880 papers
Total articles	5.584			

Source: own research

The criteria for the selection of papers were based on a filtering approach. Thus, for papers on the Web of Knowledge platform, the search was carried out according to the topic blockchain and economic crime, and the most relevant areas were selected for the period 2015-2021. The search engine identified 1167 articles for the topic blockchain and 595 for economic crime. Similarly, on the Scopus platform, a search of relevant papers of interest to our research and published in the period 2015-2021 was performed according to the topic blockchain and economic crime, resulting in 2942 papers on the topic of blockchain and 880 papers on economic crime. Thus, our database consists of 5584 papers on the topic of blockchain and economic crime that were published between 2015-2021.

b) Bibliometric analysis

In order to detect and evidence the associations among blockchain technology, economic crime and different economic concepts found in the gathered scientific literature, as detailed in the previous section, a bibliometric approach, which is a quantitative method of retrospective analysis and description of published works (Ding, 2019) during the previously established period, i.e. 2015-2021, was carried out. The processing of the bibliometric indices resulting from the selection of articles (according to the research fields and the time period in which they were published) was carried out using the VOSviewer software and involved the accomplishment of the subsequent steps, which can be visualized in Fig. 1:

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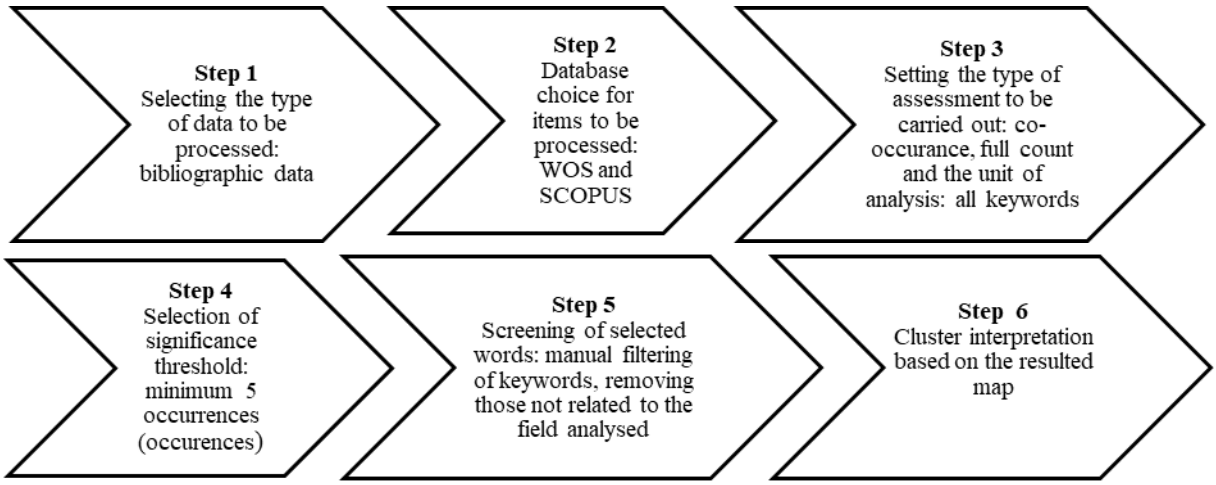

Fig. 1: Processing of collected papers in VOSviewer
Source: Own elaboration

Consequently, the aforementioned database has been subjected to the six steps illustrated in Fig. 1, with the final aim of exploring the relationship of economic crime and accounting - blockchain technology. The data processed resulted in a number of different clusters, depending on the key concept under analysis and the research platform where the papers in which these terms appear have been indexed; each cluster has a number of distinct elements in terms of nature and frequency, the structure of which will be reported in the results and discussion section.

4. Results and Discussions

4.1 Overall trends in research streams on blockchain and economic crime

In case of papers from the Web of Science database, during the paper gathering stage we identified 1167 papers on Blockchain and 595 on Economic Crime, whose profiles are depicted in Fig. 2.

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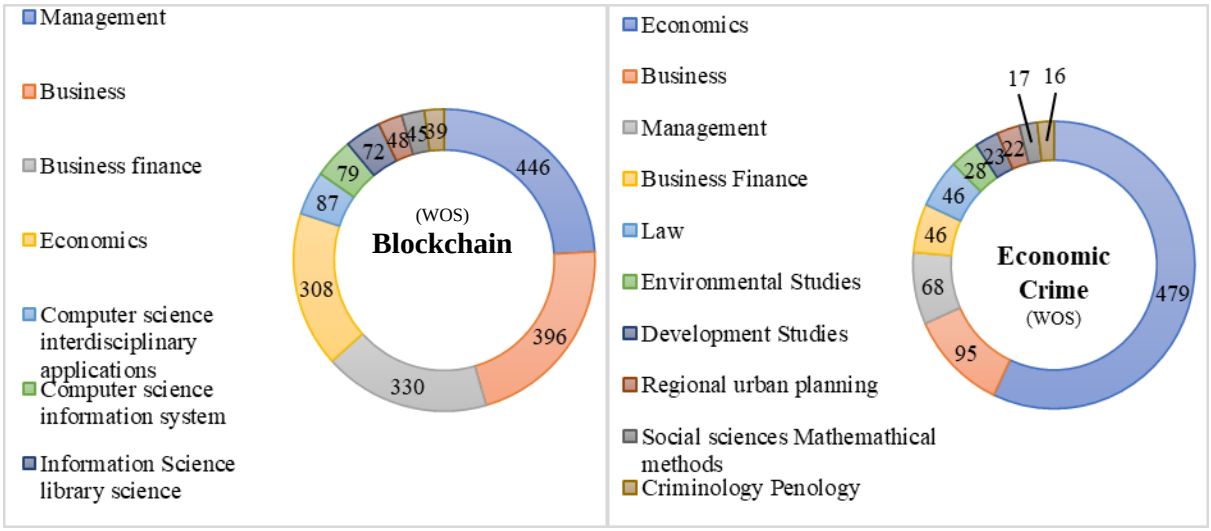

Fig. 2: Study areas interlinked with the topic of blockchain and economic criminality on the Web of Knowledge

Source: Own processing based on Web of Science data

The areas with which blockchain technology has the most impact/relationship are management, business, finance and economics, followed by IT and others, which highlights the considerable weight of this technology for the development and optimization of economic and financial processes in the context of a progressively growing digitalization of this field. With regard to the topic of *economic crime*, we can see that most articles related to economic crime correspond to the fields of Economics, Business and Management, which suggests that most situations of illegality are found in this area of business, with all that it implies: management, transactions, bookkeeping and others, as can be seen if we look back at the many cases of financial scandals that have been generated by non-compliance with the fundamental principles of bookkeeping and accounting, which highlights the need to implement a digital accounting system that no longer allows illicit entries or changes, that has a high level of security and verifiability and that ensures the mirroring of the real financial situation of an entity.

Over the last several years, there has been a growing interest in researching blockchain technology in conjunction with the economic and financial areas, which suggests a growing openness to the applicability of this technology in these areas of interest as well, while also highlighting the importance of our research in this paper. The evolution of the number of publications is depicted in Fig. 3.

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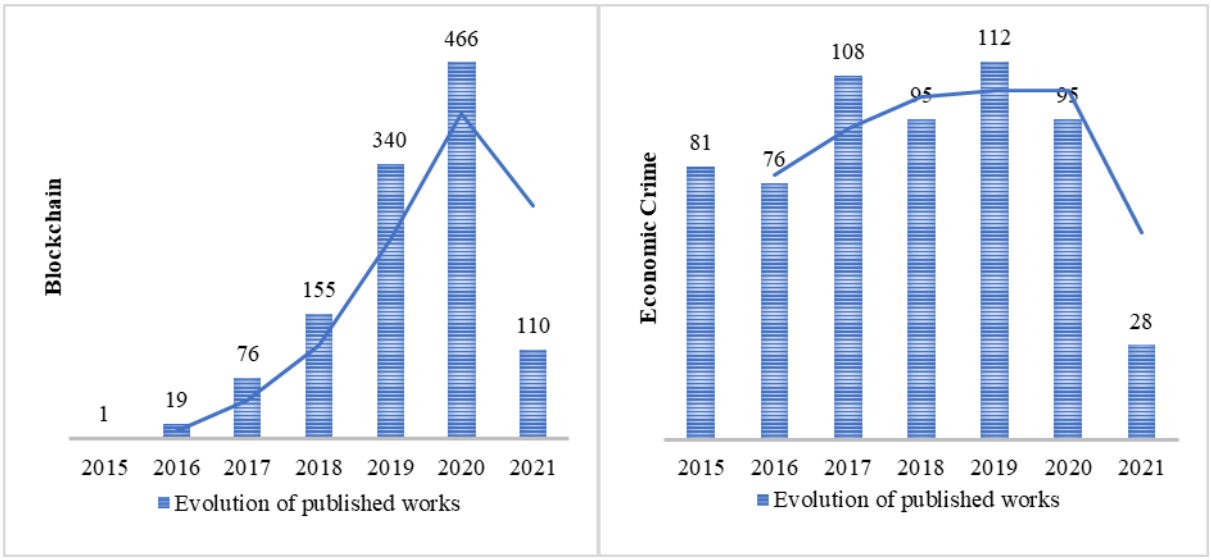

Fig. 3: Trends in the number of papers related to blockchain and economic criminality on the Web of Knowledge

Source: Own processing based on Web of Knowledge data

Unlike the papers related to blockchain technology, which experienced a permanent upward trend during the period 2015-2021, on the Web of Knowledge platform, publications related to economic crime show some fluctuations during the analysis period, with researchers' interest being less focused on the evolution of this phenomenon and more on ways to combat it. However, in the Scopus database, there is a different hierarchy of the impact of blockchain technology, with different areas of focus, as shown in Fig. 4, with the top place held by business, management and accounting, followed by decision science, computer science and others, which again highlights the significance of blockchain technology for the economic field. It is important to point out that many papers, although accepted for publication, encounter difficulties in publication and therefore indexing. Therefore, we are witnessing an atemporalisation of the dissemination of the latest scientific results.

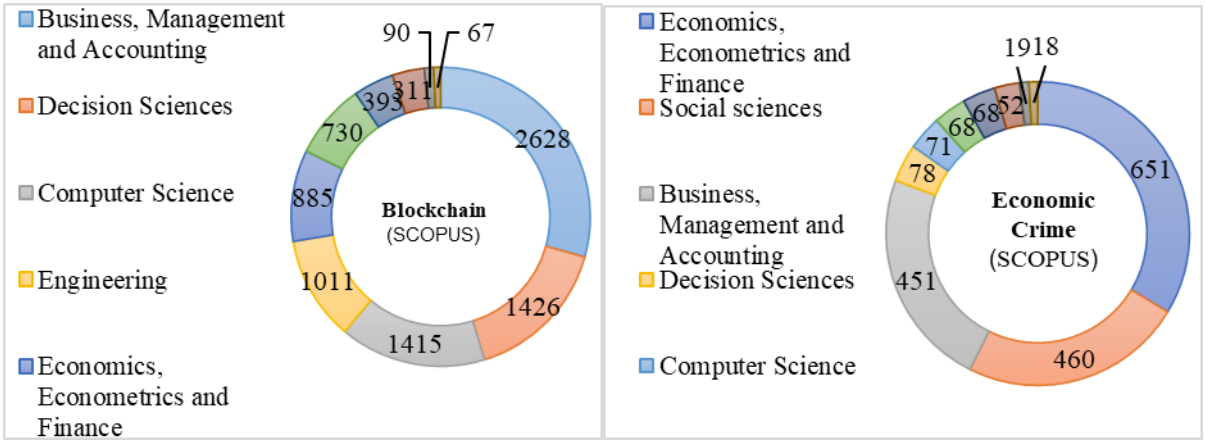

Fig. 4: Study areas interlinked with the topic of blockchain and economic criminality in the Scopus database

Source: Own processing based on Scopus data

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Concerning the papers on the topic of economic crime within the Scopus database, we observe that, as in the case of the papers within the Web of Knowledge database, the most of the papers are related to Economics, Econometrics and Finance. As regards the trend in the number of papers in Scopus, as in the case of the Web of Science, papers dealing with blockchain technology have begun to emerge since 2015, with the number of papers growing steadily since then, but more than double the number in Web of Science, which is a prerequisite for the development of a novel research and knowledge/information framework that suggests new directions of insight into the effectiveness and applicability of this technology. This increase in papers from the Scopus platform is graphically displayed in Fig. 5.

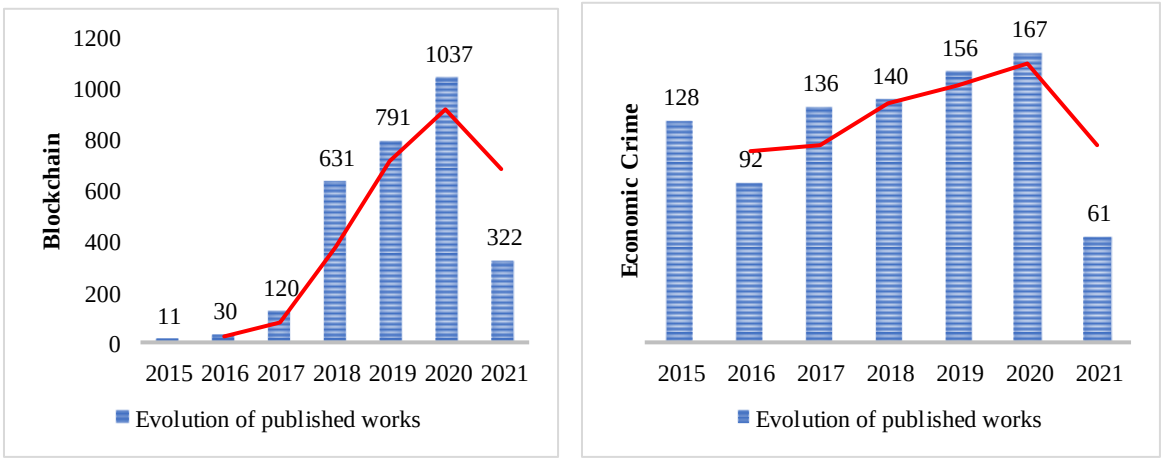

Fig. 5: Trends in the number of papers related to blockchain and economic criminality in SCOPUS

Source: Own processing based on data collected from Scopus

In the situation of the papers on economic crime in Scopus, we see a fluctuation of publications related to economic crime over the period 2015-2021, as in the case of those appearing on the Web of Science platform, with the highest number, of 167, in 2020. When looking at the output of publications at country level, the top 10 countries with the highest number of publications on both Web of Science and Scopus are depicted in Fig. 6.

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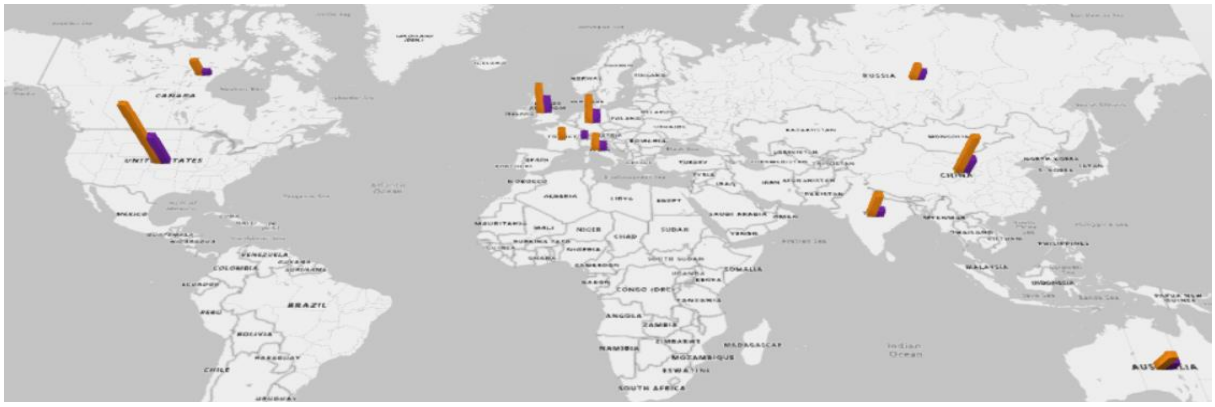

	USA	Australia	Canada	China	France	Germany	India	Italy	Russia	Switzeland	United Kingdom
SCOPUS	565	148	145	353	86	251	209	134	133		251
WOS	264	74	46	135		102	57	54	84	41	137

Fig. 6: Geographical distribution of blockchain technology papers retrieved from WoS and SCOPUS platforms

Source: Own data processing with PowerMap

First place on both platforms is taken by the USA, with 264 articles on WoS and 565 on Scopus. This is attributed to the increasingly widespread use of cryptocurrencies in various transactions, the level of digitization of accounting - and the economy in general - which is very high, and a strong academic research environment with researchers having easier access to information related to blockchain technology. We can see other countries in Europe, Asia and Australia, but none of them has more than half the publications of the US. China, the UK and Germany are next, with the ranking changing slightly depending on the platform under consideration. At a broader level, we can observe that almost the same countries - with small exceptions - are in the top 10 countries in respect of the number of subject-related papers on both platforms, which underlines the value and significant capacity of their human resources to conduct research, as well as their strong focus on innovation and development. Regarding the economic topic, the situation of papers published per country within both platforms is reported in Fig. 7.

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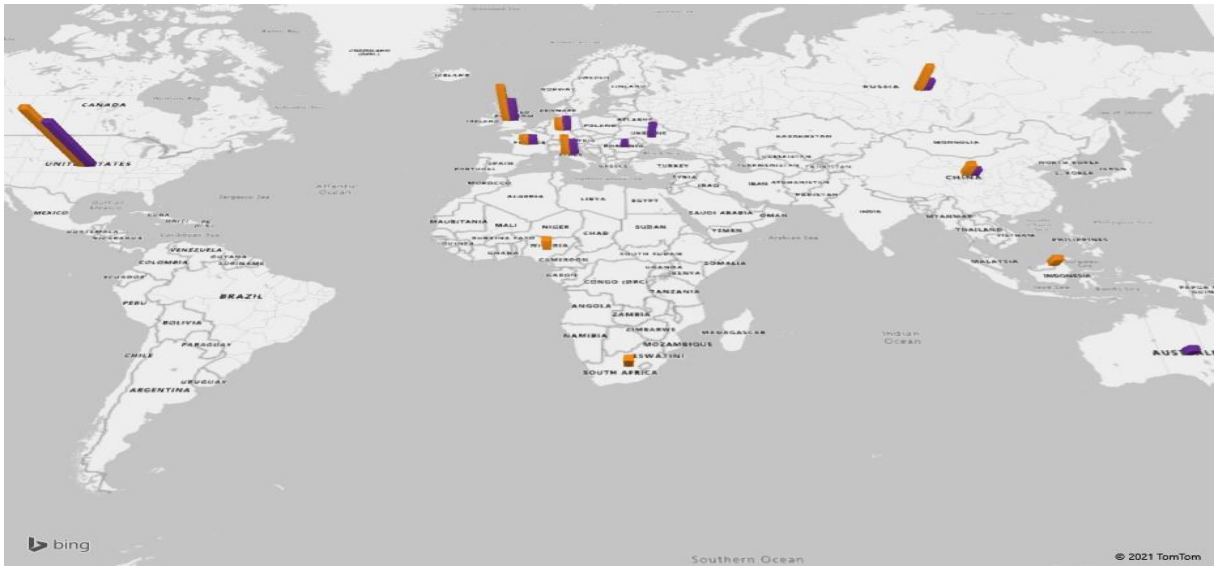

	USA	United Kingdom	Italy	Ukraine	Germany	Russia	France	Australia	China	Romania	Nigeria	South Africa	Malaysia
SCOPUS	150	62	42	41	37	31	23	20	19	18			
WOS	191	109	58		32	77	25		36		33	32	26

Fig. 7: Geographical distribution of Economic Criminality papers retrieved from WoS and SCOPUS platforms

Source: Own data processing with PowerMap

It can be noticed that the US and the UK rank first and second, with the most economic criminality related papers on both platforms. As in the other cases, the leader in terms of papers related to economic criminality is again the US, with 191 papers on Scopus and 150 on Web of Science. We consider that with this overview we have fulfilled our part of the review of the overall research trends on blockchain technology and economic criminality, and we will proceed to the next section, in which we have completed the bibliometric analysis using papers retrieved from both platforms.

4.2 Bibliometric analysis

As mentioned in the first part of this paper, blockchain technology is at an early stage of research, development and implementation, arousing the interest and curiosity of specialists and researchers who have identified various interconnections and applications of blockchain technology, predicting that this technology will be a viable solution for the security and efficiency of digital networks in many areas of existing activity, given that most areas of social and economic life are in the process of digitization. We can therefore consider that this technology is also a perfect solution to most of the problems related to economic criminality, which are largely caused by a deliberately erroneous financial-accounting approach that does not reflect the economic reality existing at the time.

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a) Web of Science

As pointed out in the research methodology section of this paper, in order to select the database for analysis, a query of papers in the Web of Knowledge platform was conducted using the terms blockchain and economic criminality.

When creating the cluster map related to blockchain technology, 236 keywords met the threshold of a minimum of 5 occurrences, of which only 170 were selected, and words considered irrelevant to our research, such as "design", "health", "behaviour", "energy", "gold", "china", "ecosystem" and others were eliminated. Fig. 6 displays the network formed by 9 clusters, each of them being assigned a specific color, allowing us to easily differentiate the keywords belonging to a particular cluster, as well as the meaning of their link with the basic keyword "blockchain", all of which are constructed from the values of the links attribute and the total link strength attribute, which reflect the frequency of connections of a particular keyword with other keywords, i.e. their strength. Thus, it can be seen that in the cluster network, the most prominent representation has the term "bitcoin", as it is the main virtual currency for trading within the blockchain technology, having a rather prominent history in the cryptocurrency market.

One can also observe a close connection between the terms "supply chain", "management" and blockchain, suggesting that the latter can be an effective management tool for supervising, controlling and securing activities, which would also simplify procedures within the supply chain process - especially when it is carried out with a new party - as a number of risks are eliminated, thus creating the concept of a "trustless" or "trust-free" transaction (Harz & Boman, 2019), i.e. the relationship between partners no longer needs to be based on trust, as blockchain technology ensures that the transaction is conducted in a fair, ethical and legal manner, in accordance with "smart contracts" or other predefined behaviours.

One can also see a quite significant link between the concept of blockchain and various notions in the field of digitization, automation or artificial intelligence, such as "digital currency", "digital economy", "machine learning", "internet of things", as well as "industry 4".0" that is considered by researchers as the "fourth industrial revolution" which, through connectivity/distance reduction and intelligence technologies, could bring radical changes to existing industrial, economic and social models (Lee & Lim, 2021). This underlines one more time that contemporary society is turning more and more towards digitization and automation, and these are widely considered as solutions for streamlining and optimizing operations, including in the field of finance and accounting, the one we are most focused on here (see Fig. 8).

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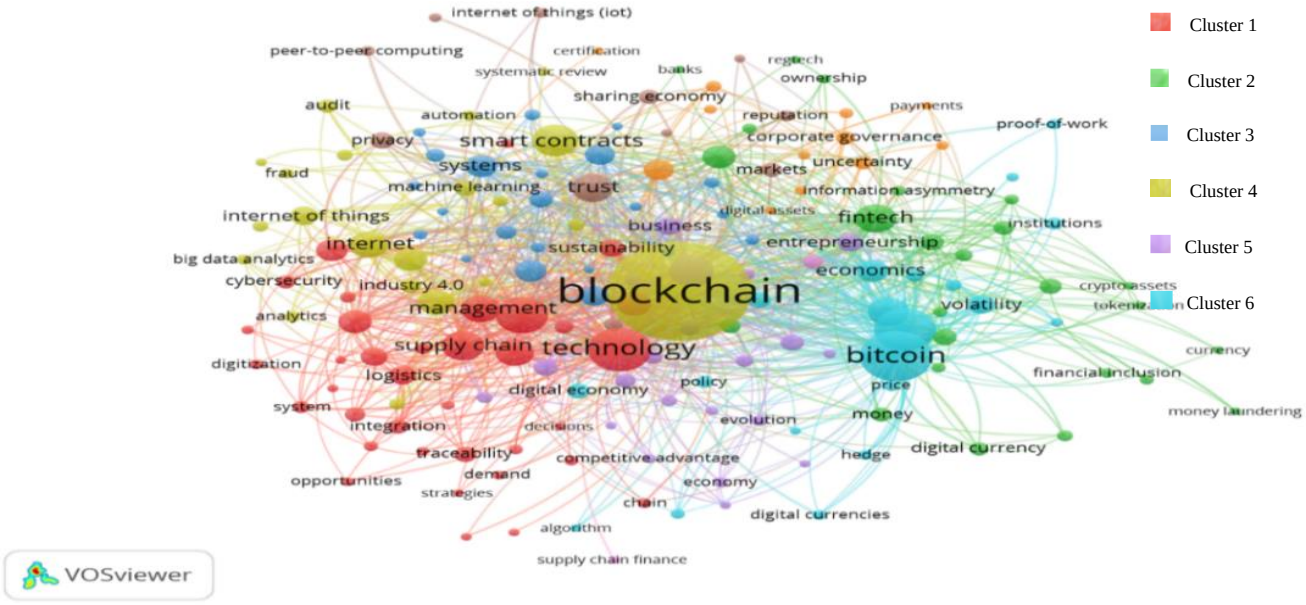

Fig. 8: Blockchain cluster network based to Web of Science
Source: Developed by the authors in VOSviewer software

Regarding the connection of the blockchain concept with the accounting domain, this can be seen in Fig. 8 in Cluster 4, which is highlighted in yellow. By not having a very prominent representation, i.e. the value of weight attributes (links: 24, total link strength: 38) is not a very high one, we can appreciate that within the papers selected for analysis, there is not much reference to the applicability of blockchain technology in accounting, the occurence indicator value being 10, which is understandable because it is not an area of study accessed by very many researchers, this being - as already mentioned - a fairly recently identified applicability that has not yet had enough time for substantiation, development and maturation, so there is not much scientific material available on this area either. However, we believe that in the next few years this situation will improve, as blockchain technology is of significant interest to the field of accounting and is considered an optimal solution especially now in the context of the global digitization of the economy, which generates new challenges to which this concept can provide a large majority of the necessary answers.

It can also be seen that there is a connection between the concept of blockchain and those of "accounting", "auditing", "fraud" (these being positioned in the same cluster) and "money laundering". This demonstrates that studies have been made highlighting the role of blockchain technology in mitigating or eradicating economic criminality by enabling the development and implementation of a secure, real-time audited accounting system that no longer allows or encourages economic corruption. Of course, this could also be about strengthening the legislative systems in this area by closing loopholes and eliminating the high degree of interpretability, but this is another vast area of research on which we will not focus our attention now. This relationship between blockchain technology, accounting and economic crime can also be analysed in other scientific works on the Web of

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Knowledge platform, such as that of Bonsón & Bednárová (2019), Roszkowska (2021) and Cai (2021). This kind of studies highlight the critical role of triple-entry accounting - which can be employed in the context of cryptocurrency transactions practiced in blockchain technology - in reducing the risk of fraud in that, for example, in addition to the debit and credit (entries that are generated in the case of double-entry bookkeeping) a third cryptographically secure entry is generated that verifies the validity of the transaction, resulting in the creation of an immutable transaction history, thus providing auditors and other stakeholders with a source of reliable information that reflects the financial reality existing at a given point in time. Other works that examine the relationship between blockchain technology, accounting and economic crime, highlighting a beneficial relationship for each of the parties involved, include McCallig, Robb & Rohde (2019), Tan & Low (2019), Schmitz & Leoni (2019), Byström (2019) and Yu, Lin & Tang (2018).

In the works of Søgaard (2021) and Karajovic, Kim & Laskowski (2019), blockchain technology has also been identified as a tool to reduce tax fraud, in particular value-added tax (VAT) fraud, which would be a real plus to the public budget and consequently a significant benefit to citizens to whom this plus is returned in the form of various services provided by the government. Esoimeme (2020) also find that blockchain technology is a key tool in the rapid detection of criminal/illegal activities by financial institutions, as it allows instant verification of the credentials of the parties involved in a given transaction, thus making it possible to identify any discrepancies in the information disclosed.

Regarding the cluster mapping the economic criminality, which can be viewed in Fig. 8, 115 words met the minimum threshold of 5 occurrences, of which 78 were actually selected for its generation, with the removal of some terms considered irrelevant to the research in question, such as "domestic violence", "women", "health", "civil conflict", "homicide", "cities", "incarceration" and the like, resulting a number of 7 clusters. Thus, we can observe a rather prominent connection between the concept of economic crime and the phenomenon of unemployment, which suggests that the former has a significant impact on the quality of people's lives and influences many aspects of their social life, potentially generating situations of inequality and poverty. Last but not least, there are also significant links between the concept of economic crime and that of organized crime, corruption, fraud, money laundering, shadow economy, tax evasion and social capital, all of which refer to the economic and financial field of interest here. That leads us to appreciate that when unethical and illegal interests exist they can be achieved through the use of various financial instruments to manipulate information or results, which has a direct impact on economic and social life as a whole. And this is precisely because the regulations and laws currently in force are not capable of addressing all the aspects and needs of a system based on a market economy that operates on the principle of free trade and therefore creates new contexts and challenges that need to be tackled.

Fig. 9 plots the average publication period of the papers that contain the keywords embedded in the cluster network, which supports the information displayed in Fig. 3, where it can be seen that most of the papers that formed the database were published in 2019 and 2020, thus evidencing the growing interest of researchers in this technology, which opens new horizons and possibilities for the analysis of this field.

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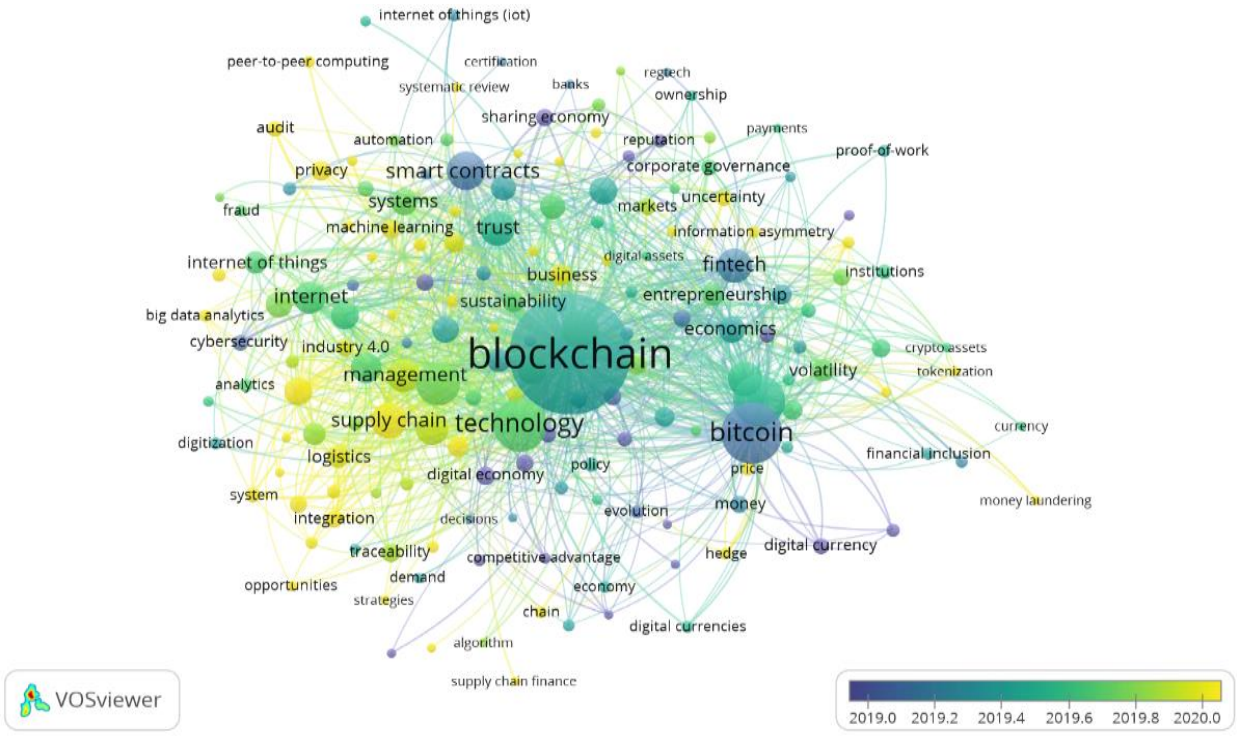

Fig. 9: Map of the average publication period of papers under consideration on blockchain technology in the Web of Science database

Source: Developed by the authors w VOSviewer software

We may notice that in the network of clusters in Fig. 10 there is no relation between the concept of economic crime and blockchain, but we do see connections with economic and financial concepts such as "fraud" and "money laundering" which may be considered as part of the broad spectrum of economic crime, also found in Fig. 9 and Fig. 10. This leads us to conclude that there is indeed an important causal relationship between these two concepts, even if it is not clearly highlighted in the figure below, thus pointing to the need for further research on this niche application of blockchain technology, as we have also aimed to do through this paper.

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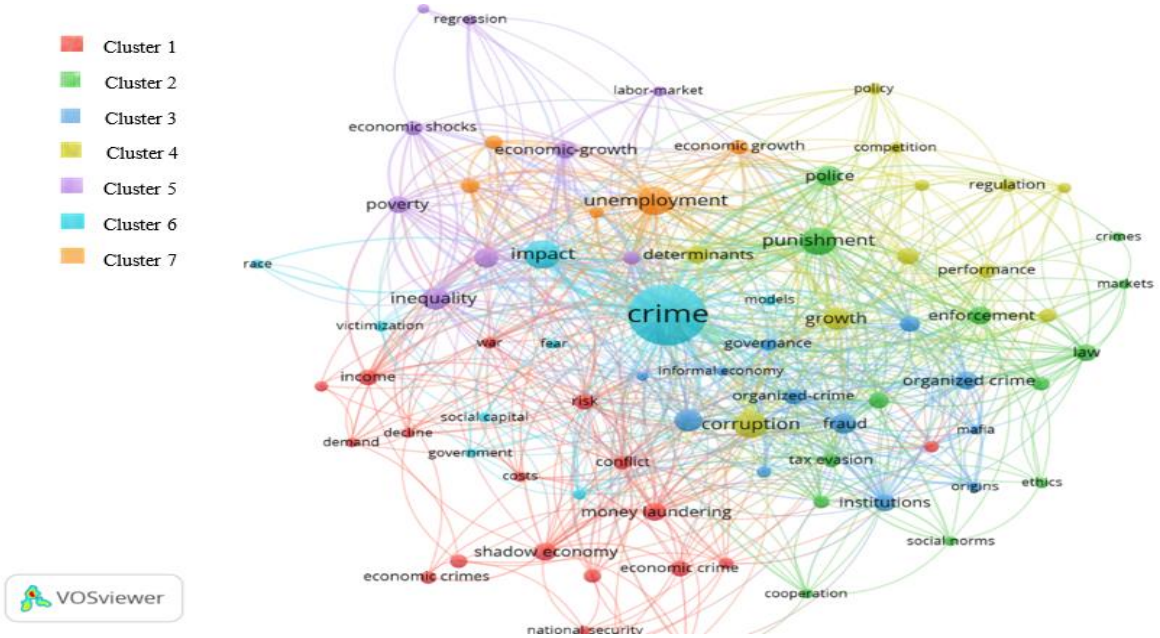

Fig. 10: Economic crime cluster network according to Web of Science

Source: Developed by the authors in VOSviewer software

Therefore, we can assert that in the substance of the Web of Knowledge papers the beneficiary impact of blockchain technology on accounting systems and on the level of economic delinquency has been evidenced quite consistently, which recommends it as a sustainable solution for the development, security and efficiency of the entire economic and financial system.

(b) Scopus

In a further effort to provide a broader picture of the level or magnitude of research on the link among blockchain technology, accounting and economic crime, we have also performed a bibliometric analysis of the scientific papers in this field found in the Scopus database, as we mentioned in the research methodology section of this paper. Out of the 2942 scientific papers from the Scopus database identified during the database generation for the purpose of this research, only the keywords related to the first 2000 papers were exported, i.e. 8928 words, of which only 531 reached the minimum threshold of 5 occurrences and 155 words were selected to actually shape the cluster map. Some words considered to be irrelevant to the research in question were removed, such as "crowdfunding", "ecosystems", "electricity transmission networks", "food supply", "healthcare", "machine learning" and others. Like in the cluster network on blockchain technology based on the data gathered from the Web of Knowledge we can see that also in this case, among the terms with the most prominent representation we can mention "bitcoin" (with a number of 162 occurrences, a link attribute value of 92 and a total link strength attribute value of 422) which is part of the "cryptocurrency" family, thus re-emphasizing the importance of this cryptocurrency for the workability of blockchain technology. Also representative links can be observed with terms from the field of digitisation or artificial intelligence, such as "digital economy", "internet of things", "cryptography", "digital finance", "distributed networks", "cryptoassets", "tokenization", all highlighting (as in the

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case of the Web of Knowledge cluster network) the advanced level of digitisation required to support the functionality and development of blockchain technology, which is built around digital network systems. However, this extensive digitization process also demands a high level of transaction, information and database security, on which research papers on the Scopus platform have focused more than those on the Web of Knowledge platform, as shown by the representation in the cluster map of several security-related concepts, such as "information security", "cybersecurity", "data privacy", "data security", "privacy protection", "traceability systems" and "inviolability". One can also see a significant connection of the blockchain concept with the notions of "smart contract" and "supply chain management", whose role has been discussed above.

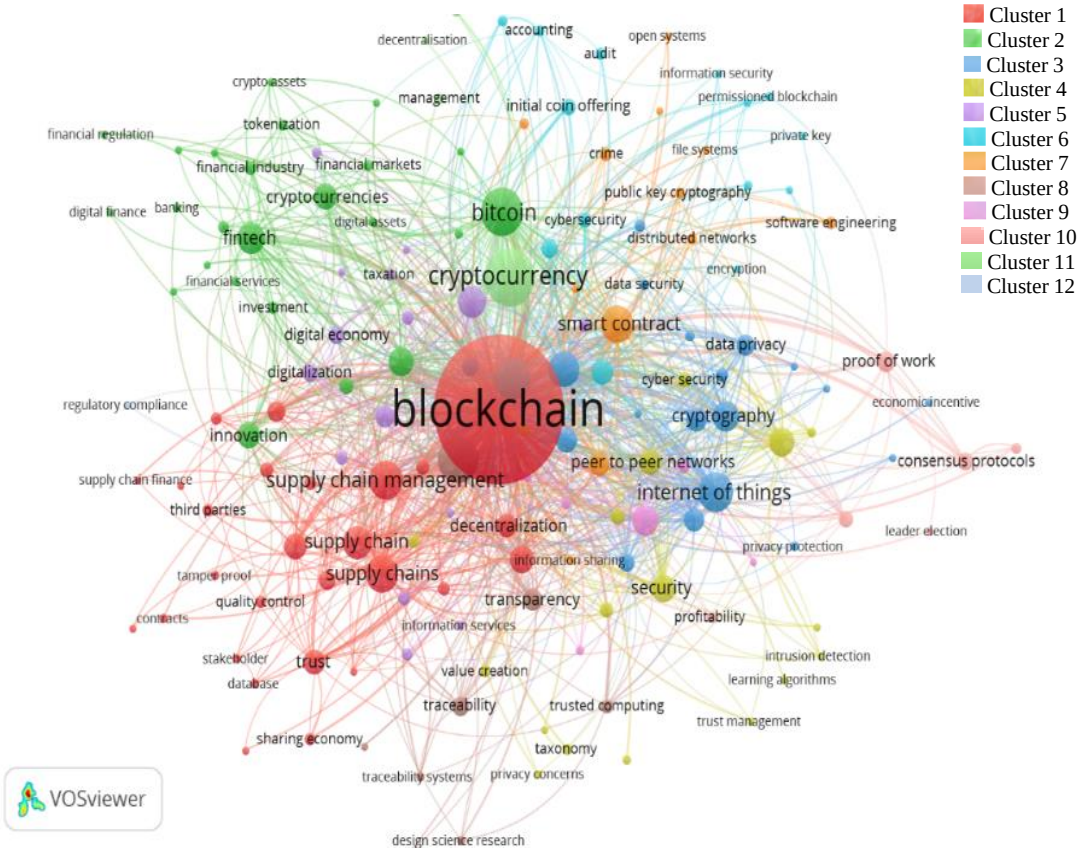

Fig. 11: Scopus blockchain cluster network

Source: developed by the authors in the VOSviewer software

As for the link between the concepts of blockchain and accounting, it is weaker than the one existing on the Web of Knowledge platform, with values of the weight attribute as follows: links - 14 and total strength of links - 29, which can be visualized in Cluster 6 represented in the map by light blue color. As in the previous case, the rather low representation of this link highlights the need for further research on it, as we believe it is of utmost importance for securing and optimizing any economic systems, while bringing economic and social equity to a higher level through the impact it produces. This cluster map also refers to the concept of "money laundering", a concept that is covered by the broad field of economic criminality, which is also rather poorly represented, with a

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value of 10 for the link indicator and 22 for the total link strength indicator, and which can be viewed in Fig. 11, alongside "auditing" and "accounting", thereby fostering and challenging research activity in this field, as new ideas and niches for applying this technology to make the management and management of economic criminality phenomena more efficient will surely be found.

For example, of the papers on this topic published on the Scopus platform that highlight the significant and effective impact of blockchain technology on the accounting system in general and, implicitly, on reducing the possibility of fraud through the use of financial-accounting tools, we can cite: Bakarich, Castonguay & O'Brien (2020), Inghirami (2020), Bonyuet (2020), Rien & Susilowati (2019), ALSaqa, Hussein & Mahmood (2019) and Kwilinski (2019), Smith (2018), together with Søgaard (2021), Roszkowska (2021), Cai (2021), McCallig, Robb, & Rohde, (2019), Karajovic, Kim & Laskowski (2019) and Schmitz & Leoni (2019), which were also found on the Web of Knowledge platform. As Tiron-Tudor, Deliu, Farcane, & Donțu, (2021) evidence through their research, it can also be assessed that in a world that is increasingly moving towards digitisation, it is essential that accounting and auditing service providers embrace blockchain technology as the basis for their business functionality - which implies the development through management of strategies, objectives and implementation tools - thus responding professionally to the demands of their clients. However, this can only be achieved by accounting and auditing professionals developing a set of skills and technical knowledge in managing advanced digital technologies, which according to Atayah & Alshater (2021) would be one of the new requisites in the job description of accountants and auditors, and this would almost completely change the traditional concept of accounting as it is currently known and practiced, an aspect also analysed by Fullana & Ruiz (2021) in their paper.

Sherif & Mohsin (2021) highlight in their recent study the significant impact of the trio of blockchain, Internet of Things (IoT) and artificial intelligence (AI) - all emerging technologies - on the quality of reasoning and decision-making of accounting and auditing professionals, mitigating the potential for intentional and forced fraud, with intentional fraud occurring under the influence of three circumstances: pressure, opportunity and reason, referred to by the authors as the "Fraud Triangle". According to them, each of the technologies indicated above entails certain benefits but also certain risks for the accounting system, yet when used together, most of the gaps generated by them can be closed, thus making it possible to achieve more efficient outcomes.

According to the research carried out on the scientific papers concerning the topic examined on the Scopus platform, we found that most of them focused on the features of blockchain technology and its applicability in the field of accounting and auditing, with little focus on its potential to reduce or eradicate the phenomena of economic criminality caused by the use of economic and financial instruments, an issue that was much more noticeable in the scientific papers on the Web of Knowledge platform.

Fig.12 plots an overview of the average years of publication of the papers mapped in the cluster, revealing that most of them were published in 2019 and 2020, which further supports the information displayed in Fig. 11, where a similar pattern is also evident. Therefore, we may again acknowledge that this field is becoming one of interest for researchers, which will undoubtedly open new horizons and opportunities for development.

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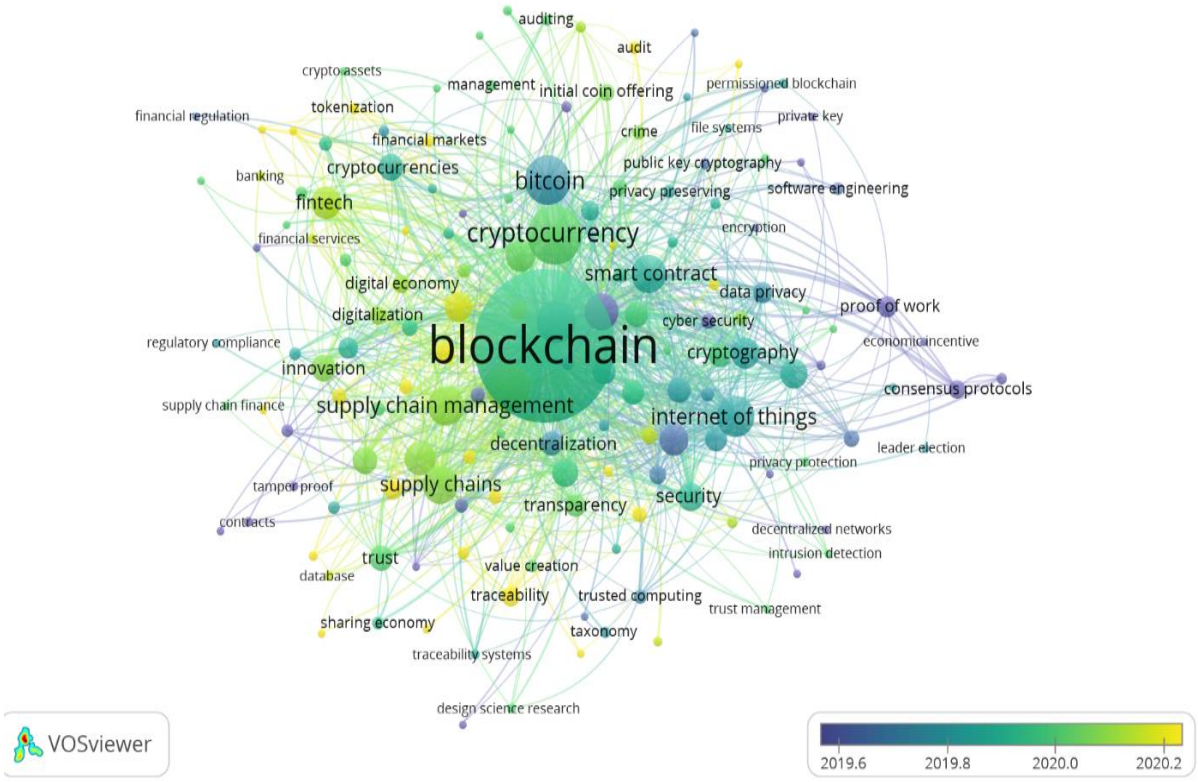

Fig. 12: Map of the average publication period of the articles under analysis related to blockchain technology on the Scopus platform

Source: developed by the authors in the VOSviewer program

As in the previous case, we also turn our attention to scientific articles related to economic crime - this time from the Scopus platform - again creating a cluster network related to it, in which 74 words out of 152 that reached the minimum threshold of 5 appearances were included, selected in turn from a total of 4096 words. Words such as "developing world", "gross domestic product", "panel data", "environmental regulations", "surveys", "policy making", "Africa", "Colombia", "United States", "deforestation", "drug trafficking" and similar words considered irrelevant to this research were excluded from the cluster network. Thus, we can see a clear link between the concept of economic criminality and issues that we could say that they significantly participate in its manifestation, having by their nature an illegal and immoral character, among which we can point out: "white-collar crime", "money laundering", "financial crime", "corporate crime", "economic crime", "fraud", "tax evasion", "the underground economy". All of these have a strong social and economic impact, potentially reflected in phenomena such as "immigration", '"migration', 'poverty', 'inequality', 'unemployment', that - as already mentioned - have a significant impact on the quality of social and economic life of ordinary people, which is much more fluctuating and sensitive than that of those with a certain social or financial status.

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Last but not least, we remark the link between economic crime and the concept of "accounting", which shows a value of 8 for the links indicator and a value of 10 for the total strength of links indicator, which we consider to be a surprisingly low level, given that almost all economic criminality phenomena are structured around illicit and immoral concepts of "accounting creativity", which would make us expect this link to be more obvious and more intricate (see Fig. 13).

Even in this cluster map there is no link between the concept of economic criminality and blockchain, but from all the insights outlined above, we can together estimate that there is undoubtedly a strong causal link between these concepts, the implications of which can only enhance and further strengthen the functioning and evolution of our society.

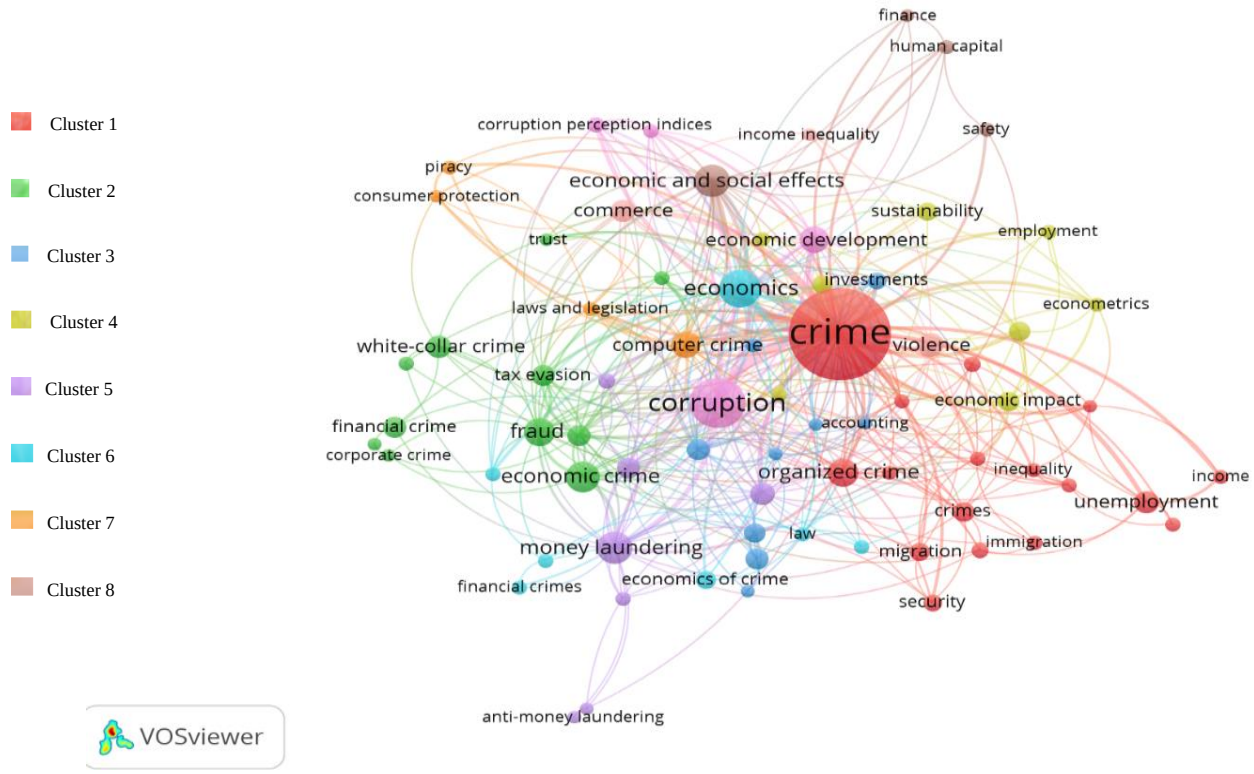

Fig. 13: Cluster network on the topic of economic crime based on Scopus

Source: developed by the authors in the VOSviewer program

As a result of the screening of scientific papers on the Scopus and Web of Knowledge research platforms - even if they are not in a highly representative number in regard to the field of analysis - numerous features have been revealed on both platforms by which the blockchain technology as applied to accounting can significantly mitigate the phenomena of voluntary or involuntary economic criminality. Of particular interest are the following:

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- A high level of security of transactions and of the database built within the network, ensured by the limited access of participants to information and actions within the network and, of course, by the way the network is structured and programmed, which contributes to its independence and security, while avoiding the accumulation of tasks at different stages of the transaction (initiation, verification, authorization and audit) for a single participant, which would encourage illicit behavior on their part;
- The permanence, incorruptibility and irreversibility of accounting transactions and operations recorded in the network do not allow unilateral or multilateral interventions and subsequent modifications, which makes it impossible to apply "creative accounting" techniques of whose results, on the one hand, illicitly benefit a certain "target group" and, on the other hand, harm another group that may be: owners/associates of the enterprise, business partners, financial institutions, state authority and others;
- Smart contracts technology brings with it a considerable simplification of the tasks and responsibilities of accounting professionals, as it automatically operates certain predefined contractual provisions, which also reduces the possibilities of human errors and mistakes that are quite common in the traditional accounting system;
- Blockchain technology is built in a way that allows transactions to take place under the concept of "trust-free" or " trustless", which alleviates or even avoids the pressure or stress related to the business partner's behavior, ensuring an ethical response from the other party, proper to the nature of the relationship developed;
- The triple-entry accounting system, which can operate within blockchain technology, assures the legality and objectivity of every accounting transaction, which would firstly minimize the potential for fraud and secondly greatly ease the responsibilities of auditors.

All of these advantages, as well as others that have been discussed throughout this paper, may be described in a more succinct form, as depicted in the figure that follows (see Fig. 14).

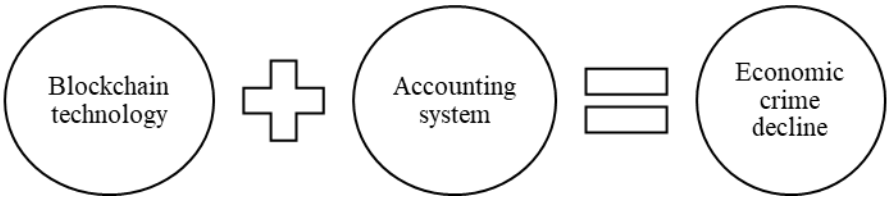

Fig.14: Equation between blockchain technology, accounting system and economic crime

Source: Developed by the authors

The research also uncovered many areas of applicability of blockchain technology, the most significant of which include emerging technologies, information systems and networks, the world of cryptocurrencies, security, digitization, management, business, finance, taxonomy, banking, auditing, accounting and others.

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5. Conclusions

Through the bibliometric review of the most relevant research papers on blockchain and economic criminality, we come to the conclusion that the advantages and solutions brought about by the adoption of blockchain accounting should not be disregarded, as contemporary society has to eliminate this cancer affecting national economies. These benefits have been identified mainly from the analysis carried out on the relationship and correlations among the topics of blockchain, accounting and economic criminality, an analysis that has enabled the delineation of three main standpoints, namely: blockchain technology as an engine for the development, streamlining and digitization of the accounting system; blockchain technology as a powerful enabler for detecting and tackling economic criminality; blockchain accounting as a prerequisite for resetting the perception or approach to the concept of economic criminality.

In terms of the first perspective we identified, we note that a link is being drawn between blockchain technology and accounting, acting as a tool to update and improve the accounting system, which will certainly boost the performance of this system's outcomes and not least "prepare" it for a digitised society in almost all aspects of economic and social life, where the expectations of the accounting profession and the understanding of its role and significance a will be greatly transformed - compared to what we know today - so that the profession will also be able to integrate and identify well its new responsibilities and development directions in such a changing society. Therefore, blockchain technology may be seen as an enabler or driver through which the accounting field is upgraded and streamlined so that it can respond to the needs and requirements of the society in which it operates.

The second perspective or insight identified highlights a link between blockchain technology and economic criminality phenomena that are at a worryingly frequent level, affecting not only the functionality of the global economic mechanism, but even the quality of social life of citizens around the world. In the context of this paper, we can see that blockchain technology has the potential to secure any transaction environment, to prevent - through various verification keys - the proliferation of economic criminality phenomena, and to detect their appearance in any applicable field, be it finance, banking, taxation or accounting, be it digital technologies and networks or a state's national security or international relations. Therefore, through its features and functionalities, blockchain technology has a significant role to play in dissuading the practice of economic criminality phenomena in any field, which is a timely solution in the context in which our society is facing the results of these phenomena, namely: lack of social and territorial justice that causes inequality in terms of development opportunities for states - as well as individuals - by depriving some of certain well-deserved rights and resources, which in turn causes high levels of migration phenomena, unemployment, poverty, etc.

Consequently, we may consider that blockchain technology is really an effective tool to tackle and mitigate economic crime. Looking at the third perspective, we see that this time it reflects a relationship between blockchain accounting and the concept of economic criminality, with the former having the ability and role to change the perception of the latter. Given that a large part of economic criminality is rooted in accounting illegalities, once they tend to decline due to the difficulty or impossibility of practicing them in the context of an accounting system using blockchain technology, then the perception of economic criminality will also change, as it will no longer be seen as an imminent and common occurrence, but perhaps only as an exception. It is certain that, as accounting and the economy in general evolve and digitise, the understanding of economic criminality will be completely different, because the forms of its manifestation that it has today will no longer be possible - or will only be possible at a fairly low level - so perhaps we will see the construction of a much more transparent and ethical society, in which every state and every individual will have equal freedoms and opportunities for development and in which economic crime will no longer be such a common phenomenon. Of course, the self-interested and ill-intentioned could find 'solutions' to fraud in almost any context, no matter how secure or well-designed, but surely the level of economic criminality would be much lower than it is today.

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To conclude, as we have at our command such an effective tool to solve one of the main concerns of contemporary society, namely the high level of economic criminality around the world, we believe that both researchers and accounting practitioners should increasingly focus on knowing, understanding and acquiring as much knowledge and skills as possible about what it would require to introduce blockchain technology into the traditional accounting system, in order to cope with the changes in the professional requirements of an accounting professional, which are certain to materialize in the foreseeable future. Even if this shift from the traditional accounting model to the digital or blockchain accounting model is a difficult, challenging, unknown and even "costly" one, we believe that it is fully rewarding all the effort and interest in this path, because the outcomes that will be reached will be a sufficient incentive to move forward, develop and improve this technology.

The main limitations of the research are:

- Our study has some limitations mainly due to the bibliometric algorithm, in the sense that only papers indexed in WoS and Scopus can be imported, processed, and interpreted, which excludes part of the existing literature on this topic and obviously omits the analysis of some pertinent contributions to our research area.

- Only scientific papers were considered, not books and book chapters or editorials (for the considerations mentioned above).

- Although the topic investigated in this paper is a very interesting and challenging one, but relatively new in the research field, the literature is not well advanced and we found that there is still no comprehensive and systematic review of the knowledge gained so far.

- It was only possible to consider papers published in English.

Future research directions may include:

- The topic of blockchain, accounting and corruption is currently enjoying increasing attention among practitioners, legislators, researchers and various other stakeholders and we can say that we are witnessing a rapid spread of these practices globally (e.g. cryptocurrency transactions, e-money platforms, e-business, etc.).

- The topic is particularly interesting, given that the specific connotations of this blockchain-accounting-corruption triplet currently concern almost all national governments, the European Commission, and not least, companies involved in large-scale transactions.

- The aim of this paper was not to provide a general understanding of how the blockchain-accounting-corruption triad works, but to provide a broad and systematic review of the literature on this topic that can serve as a stepping stone for new research directions, both quantitative and qualitative, research focused on the mechanism of operation of the blockchain-accounting-corruption system, on how this mechanism is taught by legislators, accountants and auditors, computer scientists, regulators, etc.

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