Coupling of Cryptocurrency Trading with the Environmental Goals: Is it on the Cards?

Fairouz Mohammed Khaled Mustafa
Brunel University
Brunel Business School
Kingston Lane, Uxbridge,
Middlesex UB8 3PH, UK
Contact No: +44 (0) 1895274000
Email:.FairouzMohammedKhaled.Mustafa@brunel.ac.uk

Suman Lodh
Middlesex University
Middlesex University Business School
The Burroughs, Hendon, London
NW4 4BT, UK
Contact No: +44 (0) 2084115584
Email: s.lodh@mdx.ac.uk

Monomita Nandy
Brunel University
Brunel Business School
Kingston Lane, Uxbridge,
Middlesex UB8 3PH, UK
Contact No: +44 (0) 1895268300
Email: Monomita.nandy@brunel.ac.uk

Vikas Kumar**
Bristol Business School
University of the West of England
Bristol, BS16 1QY, UK
Contact No.: +44-1173283466
Email: Vikas.Kumar@uwe.ac.uk

**** Corresponding Author**

Coupling of Cryptocurrency Trading with the Sustainable Environmental Goals: Is it on the Cards?

Abstract

Following the systematic review and bibliometric analysis of current literature, this paper attempts to investigate whether the wealth generated through cryptocurrency trading can assist in attaining the United Nation's (UN) Sustainable Development Goal (SDG) 7, affordable and clean energy and UN SDG 13 related to climate action. The critical analysis of literature indicates a growing interest in cryptocurrency, the UN's SDGs and the negative effect that crypto mining has on the use of enormous energy. However, there is a clear gap in the literature that focuses on the possibility of using the wealth generated through cryptocurrency trading in financing environmentally friendly projects and attaining the UN's SDG 7 and SDG 13. The findings and the future research direction of this study aim to firstly expand the academic literature related to SDG 7 and SDG 13 and secondly, to examine the relationship between cryptocurrency and sustainability even during an uncertain period. This study provides evidence pertaining to the theoretical models that can be applied within discussion of the complex relationship between cryptocurrency, clean energy and climate action. Our findings will provide policymakers with information regarding actions that need to be taken in order to convert cryptocurrency generated wealth, and consequently attaining sustainable socio-economic goals in the future.

Keywords: Affordable and clean energy; Climate Action; Covid-19; Cryptocurrency; Loose Coupling; SDGs; TOE.

1. Introduction:

The sustainable agenda of the United Nations (UN) is set for 2030. Most of the sustainable development goals (SDGs) are either directly or indirectly related to sustainable green energy and climate change risk (Mio et al., 2020; Taghizadeh-Hesary & Yoshino, 2019). However, researchers are not convinced that the UN's SDGs can be achieved by the deadline (Yoshino et al., 2021). At the same time, the popularity of cryptocurrencies to generate a higher amount of capital in the digital financial market is paid huge attention within the literature, mainly because trading in cryptocurrencies is easier compared to traditional trading (e.g., Giudici et al., 2020; Ricci, 2020; WEF, 2018). Companies are obliged to generate enough funds to attain non-financial targets such as SDGs (Aswani et al., 2021).

Motivated by the financial gain achieved if companies adhere to SDGs and how companies can arrange finance to achieve the non-financial targets (Gitsham et al., 2021), we examine, within this paper, whether the trading outcome of cryptocurrency can be advantageous in accomplishing the UN's SDGs, in particular SDG 7 and SDG 13[1].

There is an urgent call for companies to work on the environmental and societal issues collectively so that materialisation of SDG achievement can be attained by 2030. As per the UN global agenda, companies should focus on generating and using renewable energy and carefully minimising the emission of carbon dioxide in the environment; this invites further, more detailed research to be undertaken on SDG 7 and SDG 13, examining how efficiently companies can introduce funds to a low-carbon sustainable energy system to combat the adverse impact of climate change (Wong & Ngai, 2021; Cho & Berry, 2019).

Extant literature highlights that one major challenge related to non-attainment of sustainable energy and desirable Greenhouse Gas (GHG) levels is the inadequate investment in SDG 7 and SDG 13; this follows the Paris Climate Agreement (Rubio et al., 2020; Franke et al., 2020). However, prior literature also highlights that when advanced technology-based wealth is available to stakeholders of an economy it can overcome the challenges related to the cost that is associated with the attainment of SDGs (Miralles-Quirós et al., 2019; Ardito et al., 2021). The challenges mentioned above are

[1] The United Nations Sustainable Development Goal 7 refers to affordable and clean energy, and the United Nations Sustainable Development Goal 13refers to climate action. In this paper we us SDG 7 and SDG 13 instead of repeating the definition of SDG 7 and SDG 13.

severe in emerging countries[2] because of the complexities of SDGs in general and SDG 7 and SDG 13 in particular (Gerged, 2021). A lack of hard currency to invest in sustainability, unavailability of relevant technological infrastructure to support financial inclusion together with weaker governance that was greatly exacerbated during the Covid-19 pandemic, are all factors that impose new challenges related to the adoption of SDGs in the emerging markets of these countries (World Bank, 2020, 2000).

During the pandemic, we observed a sharp rise in cryptocurrency trading among individual and institutional investors (Mnif et al., 2020; Corbet et al., 2020). Higher volatility in traditional stock markets and difficulty in finding a safe haven during the pandemic allowed investors to focus more on the internet-based cryptocurrency trading facilities (Iqbal et al., 2021; Yoshino et al., 2021; Kethineni & Cao, 2020). Recent studies show that emerging countries have managed to generate wealth by participating in cryptocurrency trading during the pandemic (Borri & Shakhnov, 2020; Bouraoui, 2020). In most countries across the world, investing in SDGs was not mandatory in the pre-Covid 19 periods. Several studies show that the scarcity of capital has been a major reason for the lack of interest in implementing SDG 7, SDG 13 and other sustainable development goals, especially in emerging markets (Singh & Delios, 2017; Nandy et al., 2020). Thus, the above contrasting situation of slower attainment of SDG 7 and SDG 13 and the growth of wealth generated from cryptocurrency during the pandemic, including the emerging market, motivates us to examine the following research question; can the wealth generated from crypto trading be used to achieve the purpose of SDG 7 and SDG 13 generating a socio-economic benefit during economic uncertainties in the future?

To find the answer to the above question, we theoretically apply the '*Loose Coupling Theory*', widely used in the context of research related to the emerging country (Ferreira & Otley's 2009). There is a need for economic diversification in emerging countries to promote socio-economic activities (Gopal et al., 2021); this is only possible when some companies/countries prefer to take the lead in SDG 7 and SDG 13. In addition, we also use the 'technology-organisation-environment theory' (TOE) to discuss the common barriers found when adopting and applying cryptocurrency trading wealth for SDG 7 and SDG 13 (Clohessy et al., 2019; Bai and Sarkis, 2020; Kouhizadeh et al., 2021). When a new block is introduced in cryptocurrency trading, it is linked with its predecessor, making any such

[2] In this paper we follow Helden and Uddin (2016) to define emerging countries.

technology-dependent trading more traceable, easily verifiable and secure for the traders (Dinh & Thai, 2018). However, such block-based and highly computational crypto-trading consume high energy (Fairley, 2017) and this raises questions; how can advancement in cryptocurrency trading influence the sustainable attitude of the corporate or individual investors, especially during the time of economic uncertainty and how we can explain this relationship with the help of the existing theories? These important questions remain unanswered and are open for discussion.

We will, therefore, contribute to the emerging literature on cryptocurrency and sustainability. We will distinguish and separate our analyses from the previously used systematic literature review and bibliometric analyses in several ways. Usually, in literature, we find evidence of the positive and negative effects of blockchain technology on sustainability goals in general, or on a group of SDGs instead of a specific focus on energy and climate aspects (Calza et al., 2021). It is true that the use of recent technology-based trading, like cryptocurrency, will consume energy and if more renewable energy is not used, there will be an adverse impact on climate change (Li et al., 2019). However, how the wealth generated from the popularity of cryptocurrency trading can be directed towards bearing the cost of generating renewable energy and mitigating the climate risk is not yet discussed in detail.

Within the existing discussions concerning the application of advanced technology in the attainment of environment sustainable goals, there is no clear indication about the theoretical models that can be applied, both for developed and emerging countries. The theoretical models are essential to empirically explain the complex relationship between technology and SDGs which is currently missing in the existing literature. There is a need for an interdisciplinary attitude to capture, in depth and using one model, the environmental, societal and business relationship between cryptocurrency and energy consumption (Di Vaio et al., 2021; van Zanten & van Tulder, 2021). The existing discussions about cryptocurrency and energy literature mainly criticise heavy energy consumption and its adverse impact on climate change (Fadeyi et al., 2020; Mora et al., 2021). Thus, we aim to observe the positive dimension of the above relationship from a systematised interdisciplinary perspective; this will be achieved by linking SDG 7 and SDG 13 with the wealth generated from cryptocurrency trading and by developing a new research enquiry for the future. To achieve our aim, we conduct a systematic literature review and bibliometric analysis (Dabić et al., 2020) that examines the possibility of transferring wealth from cryptocurrency trading that will support emerging countries in attaining SDG 7 and SDG 13.

The findings of this research will have practical implications on investors, corporations and regulators. Individual investors interested in cryptocurrency trading will strengthen the financial growth, thus translating the wealth generated within the economy for environmental sustainability. This will, in turn, result in the positive progression of society. Thus, the positive vibes generated in this paper will bring in confidence among corporate investors as they will have a wide pool of individual cryptocurrency investors to invest in their business, which can support the growth agenda of the corporate towards sustainable energy and climate action. The understanding of the relationship between cryptocurrency wealth and SDG 7 and SDG 13 will assist the regulators in strengthening their argument in the context of the on-going consultation on cryptocurrency and SDG related matters.

The rest of the paper is organised as follows: in the following section, we critically analyse the relevant literature and justify the theoretical framework. This is followed by the bibliometric analysis, and ultimately, in the final section, we highlight the main findings and indicate a road map for future studies.

2. Methdology

The purpose of this study is to determine whether the attractive return from cryptocurrency trading can motivate companies to follow more sustainable and environmentally friendly practices by overcoming the limitations associated with the lack of available money during economic uncertainty; to give example; the Covid-19 pandemic.

In order to develop a scientific understanding of the above possibility, we will conduct a systematic literature review and bibliometric analysis to assess what we already know about the relationship between cryptocurrency trading with SDG 7 and SDG 13 attainment and how an integrative theoretical model can enhance awareness in academia and provide evidence to apply the concept in practice, especially within the setting of an emerging market.

2.1. Systematic Literature Review

The systematic search is based on the Scopus database; this allows us to focus on a database with a comprehensive search criterion. The Scopus search also helps to minimise the possibility of omission of relevant results and eliminate any bias (Pizzi et al., 2020). For cross-validation of the suitability of the Scopus database, we follow the literature and check the EBSCO Business Premier and Web of Science databases (Pizzi et al., 2020; Di Vaio et al., 2020; Parmentola et al., 2021).

We apply a robust search criterion to capture relevant literature related to SDG 7 and SDG 13 and the exponential growth in cryptocurrency trading. The search timeframe for this research starts from 2014 and research shows that the popularity of cryptocurrency trading increases after 2014.

In addition to this, during the Paris Agreement in 2015, world economies observed the urgency of SDGs more astutely than before and began to find ways of introducing SDG 7 and SDG 13 along with other SDGs in their operational strategy (Ioannou & Serafeim, 2017). Thus, in this research, the longer timeframe allows us to observe changes in stakeholders' attitudes towards SDG 7 and SDG 13 after the Paris Agreement.

To conduct the systematic literature review, we begin the search with relevant keywords related to cryptocurrency. As of 2 May 2021, we find 174 keywords from 152,997 papers. We endeavour to find out about discussions occurring around cryptocurrency and sustainability goals in general at the next stage and we find 120 mutual keywords.

The study focuses only on the articles and the subject areas of 'social science', 'business, management and accounting, 'economics, econometrics and finance' in order to retrieve the related papers. The purpose of the paper is to strategically find out how feasible it is to link wealth from cryptocurrency trading towards SDG 7 and SDG13, instead of developing a complex model of application. One model with certain features may not be able to be applied within different industries, but with minor modification our proposed model could be useful in practice.

During the study, we consider the above subject areas and we also apply a condition to limit the search to papers written in English, a condition that is supported by Pizzi et al. (2021). The search criterion shows the appearance of the keywords in the 'abstract, title, and keywords' and also in the full text. The search result shows 1701 papers. The lists of keywords that are used at different stages of the search are mentioned in Appendix 1 and the search outcome is similar to the existing literature based

on a systematic literature review related to cryptocurrency and sustainability (Casino et al., 2019; Liu et al., 2021).

The focus of the study is to check if the outcome from cryptocurrency trading can influence the stakeholder of the economy to focus more on SDG 7 and SDG 13. As such, we replace the general SDG keyword with any synonyms that cover the scope of SDG 7 and SDG 13. We follow the UN definitions to identify the relevant keywords for SDG 7 and SDG 13; for example, 'SDG 7', 'affordable clean energy', 'development goal 7', 'clean energy', 'SDG 13', 'climate action', 'development goal 13', 'zero carbon', 'renewable energy'. The result shows 574 papers. We found fewer articles on SDG 7 than SDG 13 when we added the keywords related to cryptocurrency. In the literature we find evidence of different challenges in achieving SDGs and the differences in popularity of cryptocurrency trading in developed and emerging markets (Rubio et al., 2020). Thus, we advance our search by including keywords used in the literature related to developed and emerging markets (Akyildirim et al., 2020).

The results show a radical growth in related publications from 2019, and this finding is quite similar to the study that relates to blockchain technology-based research (Paremntola et al., 2021).

The search result comprises 385 papers when we add 'developing market', 'emerging market', 'emerging count', 'emerging economy*'. However, we find 127 papers when the search contains keywords related to developed markets: for example, 'developed count*' or 'developed economy*'. The difference between the above two numbers shows there is a need for more research to be conducted regarding the differences between emerging and developed markets which supports the need highlighted in the literature (de Villiers et al., 2020).

Before proposing the possibility of using the wealth generated through cryptocurrency trading for SDG purposes, we need to understand the cost-benefit aspect of the mentioned strategy in every market (Choi, 2020). We extend the search to check if there is a trade-off possibility between the energy consumption in the cryptocurrency mining process and the use of generated capital by companies and countries that focus on environmental SDGs identified in this study. We add other keywords to the search, namely, 'cost* benefit', 'cost', 'charge', 'damage', 'expenditure*', 'value', 'worth', 'welfare', 'gain', 'profit'. This result shows 319 papers in both emerging and developed markets.

The sustainability efforts followed by the Paris Agreement helped the governments to agree that to sustain planet earth, the global warming rate should be less than 2-degree Centigrade (Tolliver et al., 2020; Amankwah-Amoah, 2020). The solution includes setting up low-carbon energy systems. However, the global uncertainty during the pandemic negatively influenced the corporate attitude towards adopting and reporting low carbon strategies because of financial constraints (Amankwah-Amoah, 2020; Hörisch, 2021). Uncertainty in the world economy also influenced the behaviour of the individual investor, which made the cryptocurrency market highly volatile during the time of the Covid-19 pandemic. However, how the change in cryptocurrency investment influenced the change in attitude of corporate from different countries towards SDG 7 and SDG 13 during Covid-19 is not evident in the literature. Therefore, to capture the above change in attitude towards SDG 7 and SDG 13 and the growing interest in cryptocurrency trading during the pandemic, we add related keywords following the literature; for example, 'Reporting', 'Disclosure', 'Voluntary disclosure', 'strategy' and 'performance'. From this search, we find 146 papers. The PRISMA of the systematic literature review is presented in Figure 1.

Insert Figure 1 here

To conduct the systematic literature review, we adjust some inconsistencies, for example, homogenising the spelling of keywords. To better understand the critical points related to the research topic, we code, tag, and group each paper into a related cluster, even when a lesser number of the reviewed research papers fall under more than one cluster (Tranfield et al., 2003). The relevant parts of the paper text are used for the tagging procedure with the exact keywords that appear in the text and content. The categorising of relevant information allows us to find new tags relevant to the research questions. This approach is similar to prior studies (e.g., Pizzi et al., 2020; Guthrie et al., 2012).

In Table 1, the relevant clusters are reported.

Insert Table 1 here

2.2. Analysis of Systematic Literature Review

2.2.1. SDG Cluster

The environmental SDGs are always a priority in the 2030 agenda. Humans, businesses, and countries all traverse the sustainable path when the environmental goals are achieved. The emergence of Covid-19 proves the necessity for strategies to support sustainable development on a par with the ecosystem (Elavarasan et al., 2021; Pizzi et al., 2021). However, we observe that SDG7 and SDG13 are not widely considered in the literature. Table 2 highlights the interest in the literature about environmental issues. Literature perceives SDG 7 and SDG 13 as possible goals to attain affordable clean energy even in the emerging markets because of the value relevance of these SDGs. Many studies have underlined the relevance of environmental SDGs in the context of circular economy (Schroeder et al., 2019; Fatimah et al., 2020). Most of the research papers address the relation between blockchain and industry four technology with SDGs and their direct impact on the environment (Kimani et al., 2020; Dantas et al., 2020). This research shows that even after considering the advancement in technology, there is a possibility to form a new evidence-based approach for sustainability scholars.

Insert Table 2 here

This cluster shows the search results using SDG 7 and SDG 13 after being combined with cryptocurrency-related literature. First, we consider all SDGs and cryptocurrency related keywords to check the consistency of our study with the existing studies. The search results mainly show that there is already an interest in the literature about SDGs and Cryptocurrency together. We obtained 1071 papers in this category. Even after including transparency, governance, blockchain, cryptocurrency and sustainability related keywords we found consistent results with the literature (de Villiers et al., 2020; Parmentola et al., 2021).

Figure 2 shows the extent of discussion related to cryptocurrency and SDG 7 and SDG 13 in the previous studies (e.g., Li et al., 2019; Fadeyi et al., 2020). However, there is no clear indication in the literature about how cryptocurrency trading can be utilised for SDG purposes, in particular relating to the production of alternative energy to attain SDG 7 and SDG 13. Figure 2 supports the possibility of contributing towards clean energy, climate

2.2.2 Cryptocurrency Cluster

Money leads the economy (Carlstrom & Fuerst, 1995; Burton action and related activities with wealth generated from cryptocurrency.

Insert Figure 2 here

& Brown, 2014). Bitcoin, for example, is one of the alternative forms of money that runs under peer-to-peer payment mechanisms to preserve transparency via blockchain technology (Papadis & Tassiula, 2020).

In the search results of SDG 7 and SDG 13 with cryptocurrency in general, we find 574 papers. Makarov & Schoar (2020) argue that Bitcoin (BTC), Ethereum (ETH), and ripple (XRP) are the most popularly traded cryptocurrencies. Consequently, a more customised search is conducted which focuses on the types of cryptocurrency (Bitcoin, Ethereum, Litecoin, Ripple and Zcash) that are traded worldwide, and this search shows 515 papers out of the 574 papers mentioned above. For example, in Figures 3, we show how Bitcoin is related to SDG 7 and SDG 13. The findings confirm the possibility of marrying between cryptocurrencies and the above two sustainable goals.

Insert Figure 3 here

2.2.3. Performance Cluster

Companies play an essential role in achieving SDGs for sustainable growth and the betterment of the environment. Companies can help their countries to achieve SDG goals set up by the UN by accelerating the adoption of sustainable practices. The use of innovative technologies to achieve SDGs allows companies to abandon traditional production methods and address the demand of new market needs (Nerini et al., 2019; Dantas et al., 2020). However, within the literature, there is no clear evidence about how adopting a new production method can support the companies to progress financially and therefore generate enough funds to support their non-financial activities (de Villiers et al., 2020). With this in mind, we set up the performance cluster to check if a better performance assists the company to invest more in non-financial activities and how the goodwill created by attention towards the environment can affect a company's performance.

First, the analysis of the performance cluster is conducted using 146 papers (See Table 3). In this analysis, the papers relating to strategy, disclosure and non-financial reporting are considered. However, whilst aiming to find what the particular interest in the literature is about, we also check if the studies are concerned only about performance, or if there is a specific trend in certain industries; we include in our search 'performance', 'firm performance' or 'non* financial performance and 'industry', and we find 119 papers.

Insert Table 3 here

2.2.4. Geographical Location

Limited attention among scholars about the relationship between the cryptocurrency and SDG 7 and SDG 13 indicates the need to analyse separate discussions about the above relationship within developed and emerging countries. Such separated detailed findings of developed and emerging markets will allow the policymakers and business leaders to learn more about the possibility of aligning the return from cryptocurrency trading with the mentioned SDG targets. The following figure shows which countries are mainly highlighted in the literature and which other countries need more attention to draw a road map of possibilities to establish the relationship between cryptocurrency and SDGs as proposed in the paper (Bebbington & Unerman, 2018). The following analysis also supports the need for country-specific research requested in the recent literature (Parmentola et al., 2021).

In the search, we find 574 papers where developed and emerging markets are considered together. However, when the relevant keywords related to emerging countries are added, we find 385 papers that focus on the cryptocurrency and SDGs in the context of developing and emerging markets. There are 127 papers when the search is focused on developed countries. The least group of the reviewed research papers are focused on a particular country or a group of countries, or the researchers consider all countries in general within their study.

The finding of this study covers 42 countries. However, 89.1% of 574 papers show no particular attention to any distinction between developed and emerging markets. We do find some interest in the discussion about South Asia and Europe and the findings in the European context may be influenced by two factors: result of the European Commission paying greater attention to SDGs in recent days and the implementation of reporting requirements by the companies (Wong, 2019).

The findings of this paper support other studies and their focus on European countries; for example, United Kingdom, Spain, France, and others (Bebbington & Unerman, 2018; Mio, Panfilo & Blundo, 2020).

Insert Table 5 here

We find four papers on Africa, three on South America and two papers on North America from the collection of papers. Even after focusing on filters related to cryptocurrency, SDG 7, SDG 13 and cost-benefit aspects involved in the relationship between cryptocurrency and SDG7 and 13, the findings are similar to other research (Rasul, 2016; Salvia et al., 2019). Figure 4 confirms that the result from the literature is mainly focused on China or South Korea (Li et al., 2019). The United States is shown as a big circle in the figure, indicating its popularity in literature, and the literature also mentions Germany and the United Kingdom. The results confirm a gap in country-level research in emerging countries, showing further studies are needed to close this gap within the literature..

Insert Figure 4 here

2.2.5 Theory Cluster

In order to build a comprehensive theoretical understanding about the relationship between the benefits generated from cryptocurrency and how the benefits can be used for sustainability purposes, we search 'Principal-Agent Theory' (e.g., Paliwal et al., 2020), 'Transaction Cost Analysis' (Dal Mas et al., 2020), 'Resource* Based* View' ('RBV theory') (Amankwah-Amoah., 2021), the 'Network Theory' (Pizzi et al., 2020) and 'Agency theory' (e.g., Paliwal et al., 2020). These are the theories usually used in a similar context in the previous literature. The agency theory appears 52 times, Network Theory appears 251 times. It is therefore evident that the above two theories are the widely used theories across the literature. The 'technology-organisation-environment' ('TOE') theory has been mentioned in 144 papers which is 34.3% of the overall citations. The Loose Coupling Theory is the least one and appeared only once within the search.

The main concern during the pandemic is a lack of investment. We observe a lack of resources and a break in the supply chain, mainly in the emerging market during Covid (Jribi et al., 2020; Ibukun & Adebayo, 2021; Amankwah-Amoah., 2021). The uncertainty created by the pandemic raised another major concern about investment in sustainability. Thus, the new concern in this research context is to check if it is still possible to apply Resource-Based View (RBV) or Network theory during Covid-19

or during economic uncertainty, to address the challenge of investment constraint in sustainability in emerging markets. By applying the above two theories, we open up a new discussion around the need for a revised theoretical framework in the research on SDGs during the pandemic.

Insert Table 6 here

2.3 Methodology - Bibliometric Analysis

In social science, bibliometrics analysis is a popular tool to identify any scientific activity's statistical importance in any research field (Zupic & Cater, 2015). In other research on SDGs and blockchain technology, we find the use of systematic literature review and bibliometric analysis together because of the complex and various dimensions of discussion about the topic (Ante et al., 2021). In this study, we focus on SDG 7 and SDG 13 instead of considering 17 UNSDGs together. Such a research setup motivated us to conduct bibliometric analysis and systematic literature review in order to focus on the particular parameters of the search and conduct a detailed sensitivity test about the topic (Wong, 2019). The analysis helps us not only to understand the general discussion in the literature but also to highlight the need for improved understanding about SDG7 and SDG 13 in certain regions and countries. The bibliometric analysis allows us to conduct performance analysis and science mapping procedures. The performance analysis focuses on the papers' volume and impact, which is relevant for this study. The 'citation analysis', 'authorship', and 'country grouping' details' are examples of the techniques that are used in the performance analysis widely in the literature (Marzi et al., 2017). In addition to the performance analysis, we use science mapping to understand better the dynamic and structural organisation of the research related to the topic. Science mapping considers the relationship between the first and second generation of citations, which provide a longitudinal representation of how different scientific elements are related in the field of research. Following Farrukh et al. (2020), Zhao et al. (2018), Boyack & Klavans (2010), we use 'bibliographic coupling', 'co-citation' and 'co-occurrence' of the identified keywords which are the indicators for the current analysis to avoid any limitation. We use the co-citation analysis to investigate how an article independently cites two articles to check the consistent importance of the topic in the literature. As our research question is not discussed in depth in the literature, we use bibliographic coupling to conclude that when two papers cite a third paper they both discuss a shared topic.

Following van Eck & Waltman, 2010; Pizzi et al., 2020, we use VOSViewer software to calculate these indicators. In VOSViewer, the graphs show an element as a circle and all the circles are connected to build a network. The size of a circle varies based on its importance. The circles' spatial position and colours indicate the relevance of the clusters mentioned in this research.

2.4 Results of Bibliometric Analysis

The bibliometric analysis strengthens our argument posed within the systematic literature review research as it reveals that wealth generated from cryptocurrency trading can be used to achieve SDG 7 and SDG 13. In addition, we find that if a proper arrangement of priorities can be made between the consumed energy in the mining activities and the support of other environmental projects such as using renewable energy, then it is possible to focus on the link between cryptocurrency trading with the achievement of SDG 7 and SDG 13. Finally, the analysis shows that as sustainability becomes a challenge and, because of the uncertainty created by the pandemic, the emerging markets can use the above findings proposed in this study for future developmental purposes and mitigate the risk of limitation of wealth.

2.4.1. Activity Indicators

The analysis of literature shows a radical shift in the attention of researchers and trend towards focusing on the integration of cryptocurrencies and SDG 7 and SDG 13 in the literature during the years 2019 to 2021 *(see Fig. 6).* Specifically, the analysis reveals the outstanding growth in 2020, with 362 papers, and the first five months of 2021 with 178 papers, which is consistent with literature (Parmentola et al., 2021; Pizzi et al., 2020). It is evident from the literature that there is an ongoing debate about the link between cryptocurrency trading and sustainability.

However, from our analysis, we conclude that there is a need to study the relationship between cryptocurrency trading and certain types of SDGs instead of SDGs in total. Research mostly indicates a negative relationship between cryptocurrency and sustainability (Fairley, 2017). However, other research suggests that popularity of cryptocurrency can generate positive interest in renewable energy projects (Li et al., 2019).

Insert Figure 5 here

2.4.2. Co-citation analysis

Co-citation analysis is the case of citing one article that can be found in many academic papers. The co-citation analysis reflects on how the articles are related logically. Following literature, we conduct the co-citation at articles, journals, and authors levels (Boyack & Klavans, 2010; Pizzi et al., 2020).

2.4.2.1. Articles

In the analysis of this paper, we found approximately 255 journals; 87 of these journals published at least one paper about SDGs and cryptocurrencies, and for 292 of the journals, there was more than one citation.

The average number of citations for an article is 14.16 (SD 37.736). It is evident from these numbers that the research in SDGs has gained more importance over the years, but the main cluster of these high impact studies are concentrated in only a few journals.

In Table 7, we investigate the rank of the journals to find which ones in particular place more importance on SDG 7 and SDG 13 during the study period of this research. We focus our search on the Association of Business School Journal ranking (ABS) and other relevant journal rankings. We also consider the impact factor of each journal. The findings are reported in Table 7.

Insert Table 7 here

Table 8 supports Table 7, where the most cited journals are presented. Table 8 explains the top 20 cited papers related to the focus of our topic, SDG 7, SDG 13 and cryptocurrency. In Table 8, we apply a filter of only papers with more than three citations following Pizzi et al. (2020) to reduce the error in search and avoid inconsistency. The dataset set includes 574 articles.

The results of Table 8 show that "Bitcoin: Economics, technology, and governance" is the most cited paper. It has 477 citations. The second cited paper is " Assessing ICT global emissions footprint: Trends to 2040 & recommendations "with 115 citations.

Insert Table 8 here

2.4.2.2. Authors Analysis

Table 9 indicates the most prolific authors. Identifying these authors helps to find the most specialised experts linked with the journals that focus on SDG 7, SDG 13 and cryptocurrency topics. The focus on experts' profiles leads to better identification of the gaps in the literature from their standpoint,

where they conduct a deep analysis in their area. The papers that focus on SDG 7, SDG 13 and cryptocurrencies have 365 cited authors with a total of 5254 citations. Only 62 are cited more than 20 times. 25 authors are cited more than 40 times.

Also, in our search, we find 7 authors are cited more than 100 times. The search result is reported in Table 9.

Insert Table 9 here

We produce the density diagram (Figure 6) to report the analysis of the author co-citation and to highlight the most connected references.

Insert Figure 6 here

2.4.2.3 Journals

In addition, we conduct a robust scrutiny of our pervious results by researching the top cited journals related to SDG 7, SDG 13 and cryptocurrency. We find consistent results. The Journal of Economic Perspectives, Sustainability, International Journal of Information Management, Journal of Cleaner Production and Supply Chain Management are popular because their aims and objectives are closely linked with SDG 7 and SDG 13 and cryptocurrency. Thus, we find evidence of the impact of technology in attaining sustainability.

3. Conclusion

The UN agenda to attain SDGs by 2030 challenges governments, mainly in emerging markets, where resources are limited. According to Akyildirim et al. (2020), the wealth generated through advance technology can influence the performance of corporations. It is therefore essential to ascertain whether the trading outcome related to cryptocurrency can be employed to attain SDG 7 and SDG 13. The popularity of cryptocurrency worldwide motivates us to examine whether there it is possible to use the wealth generated from cryptocurrency trading to attain sustainable goals. However, cryptocurrency mining is dependent on heavy energy consumption that can be a threat to a sustainable future (Li et al., 2019). This study applies a qualitative methodology focused on systematic literature review and bibliometric analysis to assess to what extent researchers are confident about the possibility of positively linking the outcome of cryptocurrency trading with the attainment of SDG 7 and SDG 13.

The main findings of the study indicate that there is a possibility of linking cryptocurrency trading wealth with sustainability. In addition, we critically examine the theories supporting the above argument during the uncertain period of the Covid 19 pandemic and the pre-pandemic period. The literature mainly focuses on the high-energy need for the mining activities of cryptocurrency; in other words, the negative impact of cryptocurrency trading on the environment is not avoidable. However, when the financial resources are limited, mainly in an emerging market (Crick & Crick, 2020), we observe the popularity of cryptocurrency trading in these markets, which can motive the miners to use renewable sources instead of fossil fuels. We suspect that emerging markets might benefit from the higher trading volume of the cryptocurrency and there is strong direction to allocate generated income from cryptocurrency trading in reusable energy projects (Li et al., 2019).

The Covid-19 pandemic exposed global economies to various challenges associated with the limitation of investment in sustainability. The theoretical understanding of the cryptocurrency and SDGs based on the logic of the resource-based view is questionable when there are limited resources. Even though the literature rarely employs the loose coupling theory in this context, the application is helpful when evidence shows that the developed nations take the initiative regarding support of the SDGs based on the income generated from alternative financial resources. Later, there is a high chance that the emerging market will follow their steps; in other words, when developed markets start implementing governance practices to mandate social responsibility and regulate cryptocurrency trading, this behaviour might help the emerging markets to act similarly. The low speed of changes in this challenging situation also motives the applicability of this theory.

The findings of this study discuss the environmental SDGs and the implications of cryptocurrency in attaining the same. The past literature generalises the idea and places its focus on digitalisation and modern technology; mainly the blockchain. The literature widely employs the network theory and resource-based views, but it ignores the challenges of discussing the lack of resources in a period of economic uncertainty; for example, during the pandemic it is important to understand how the emerging economies will make an essential progression towards attaining SDG 7 and SDG 13 for a sustainable environment growth with limited resources that might be applied for financial growth of the country. The study's findings will allow the decision makers of firms and regulators of countries to focus on and consider other options within their sustainability decision-making strategy. Individual investors might be interested in investing in cryptocurrency when they can observe that their

contribution is used for social benefits, like generating renewable energy, or climate change, to give two examples.

Policymakers can take the initiative and think about necessary policy intervention to support the corporate initiative in achieving the country level targets related to SDG 7 and SDG 13 and the sustainable economic growth goals that need to be achieved in the post-pandemic period. The findings of this study will encourage other researchers to conduct further country-specific studies considering the extreme uncertainty created by the pandemic and in the post-pandemic period and apply the findings in practice and the proposed theoretical model will take a step forward in future to conduct studies in a similar context.

The study's main limitation is the number of papers related to cryptocurrency and SDGs, especially SDG 7 and SDG 13 in business and management journals. The lack of numerical data limits the application of an empirical model for some SDGs.

As a future study, we expect to conduct an empirical analysis by comparing how the links established in this paper will benefit the developed and emerging markets to attain sustainable socio-economic growth.

References

Akyildirim, E., Corbet, S., Sensoy, A., & Yarovaya, L. (2020). The impact of blockchain related name changes on corporate performance. *Journal of Corporate Finance, 65*, 101759. https://doi.org/10.1016/j.jcorpfin.2020.101759

Allam, Z., & Dhunny, Z. A. (2019). On big data, artificial intelligence and smart cities. *Cities, 89*, 80-91. https://doi.org/10.1016/j.cities.2019.01.032

Amankwah-Amoah, J. (2020). Stepping up and stepping out of COVID-19: New challenges for environmental sustainability policies in the global airline industry. *Journal of Cleaner Production, 271*, 123000. https://doi.org/10.1016/j.jclepro.2020.123000

Ante, L., Steinmetz, F., & Fiedler, I. (2021). Blockchain and energy: A bibliometric analysis and review. *Renewable and Sustainable Energy Reviews, 137*, 110597. https://doi.org/10.1016/j.rser.2020.110597

Ardito, L., Raby, S., Albino, V., & Bertoldi, B. (2021). The duality of digital and environmental orientations in the context of SMEs: Implications for innovation performance. *Journal of Business Research, 123*, 44-56. https://doi.org/10.1016/j.jbusres.2020.09.022

Aswani, J., Chidambaran, N. K., & Hasan, I. (2021). Who benefits from mandatory CSR? Evidence from the Indian Companies Act 2013. *Emerging Markets Review*, *46*, 100753. https://doi.org/10.1016/j.ememar.2020.100753

Bai, C., & Sarkis, J. (2020). A supply chain transparency and sustainability technology appraisal model for blockchain technology. *International Journal of Production Research*, *58*(7), 2142-2162. https://doi.org/10.1080/00207543.2019.1708989

Bebbington, J., & Unerman, J. (2018). Achieving the United Nations Sustainable Development Goals: an enabling role for accounting research. *Accounting, Auditing & Accountability Journal*. https://doi.org/10.1016/j.ememar.2020.100753.

Belkhir, L., & Elmeligi, A. (2018). Assessing ICT global emissions footprint: Trends to 2040 & recommendations. *Journal of cleaner production*, *177*, 448-463. https://doi.org/10.1016/j.jclepro.2017.12.239.

Böhme, R., Christin, N., Edelman, B., & Moore, T. (2015). Bitcoin: Economics, technology, and governance. *Journal of economic Perspectives*, *29*(2), 213-38. DOI: 10.1257/jep.29.2.213

Bonilla, S. H., Silva, H. R., Terra da Silva, M., Franco Gonçalves, R., & Sacomano, J. B. (2018). Industry 4.0 and sustainability implications: A scenario-based analysis of the impacts and challenges. *Sustainability*, *10*(10), 3740. https://doi.org/10.3390/su10103740.

Borri, N., & Shakhnov, K. (2020). Regulation spillovers across cryptocurrency markets. *Finance Research Letters*, *36*, 101333. https://doi.org/10.1016/j.frl.2019.101333

Bouraoui, T. (2020). The drivers of Bitcoin trading volume in selected emerging countries. *The Quarterly Review of Economics and Finance*, *76*, 218-229. https://doi.org/10.1016/j.qref.2019.07.003

Boyack, K. W., & Klavans, R. (2010). Co-citation analysis, bibliographic coupling, and direct citation: Which citation approach represents the research front most accurately?. *Journal of the American Society for information Science and Technology*, *61*(12), 2389-2404. https://doi.org/10.1002/asi.21419

Burton, M., & Brown, B. (2014). *Financial System of the Economy: Principles of Money and Banking: Principles of Money and Banking*. Routledge. https://doi.org/10.4324/9781315699776

Carlstrom, C. T., & Fuerst, T. S. (1995). Interest rate rules vs. money growth rules a welfare comparison in a cash-in-advance economy. *Journal of Monetary Economics*, *36*(2), 247-267. https://doi.org/10.1016/0304-3932(95)01221-4.

Calza, F., Parmentola, A., & Tutore, I. (2021). For green or not for green? The effect of cooperation goals and type on environmental performance. *Business Strategy and the Environment, 30(1),* 267-281. doi/epdf/10.1002/bse.2620

Casino, F., Dasaklis, T. K., & Patsakis, C. (2019). A systematic literature review of blockchain-based applications: Current status, classification and open issues. *Telematics and informatics*, *36*, 55-81. https://doi.org/10.1016/j.tele.2018.11.006.

Choi, T. M. (2020). Creating all-win by blockchain technology in supply chains: Impacts of agents' risk attitudes towards cryptocurrency. Journal of the Operational Research Society, 1-16. https://doi.org/10.1080/01605682.2020.1800419.

Cho, Y. N., & Berry, C. (2019). Understanding the effects of retailer-and manufacturer-provided sustainability labels on product evaluations and purchase-related outcomes. *Journal of Business Research*, *100*, 73-85. https://doi.org/10.1016/j.jbusres.2019.03.019

Corbet, S., Hou, Y. G., Hu, Y., Larkin, C., & Oxley, L. (2020). Any port in a storm: Cryptocurrency safe-havens during the COVID-19 pandemic. *Economics Letters*, *194*, 109377. https://doi.org/10.1016/j.econlet.2020.109377

Clohessy, T., Acton, T., & Rogers, N. (2019). Blockchain adoption: technological, organisational and environmental considerations. In *Business transformation through blockchain* (pp. 47-76). Palgrave Macmillan, Cham.

Crick, J. M., & Crick, D. (2020). Coopetition and COVID-19: Collaborative business-to-business marketing strategies in a pandemic crisis. *Industrial Marketing Management*, *88*, 206-213.

Dabić, M., Maley, J., Dana, L. P., Novak, I., Pellegrini, M. M., & Caputo, A. (2020). Pathways of SME internationalisation: a bibliometric and systematic review. *Small Business Economics*, *55*(3), 705-725. https://doi.org/10.1007/s11187-019-00181-6.

Dal Mas, F., Dicuonzo, G., Massaro, M., & Dell'Atti, V. (2020). Smart contracts to enable sustainable business models. A case study. Management Decision. https://doi.org/10.1108/MD-09-2019-1266

Dantas, T. E. T., de-Souza, E. D., Destro, I. R., Hammes, G., Rodriguez, C. M. T., & Soares, S. R. (2020). How the combination of Circular Economy and Industry 4.0 can contribute towards achieving the Sustainable Development Goals. *Sustainable Production and Consumption*. https://doi.org/10.1016/j.spc.2020.10.005

de Villiers, C., Kuruppu, S., & Dissanayake, D. (2021). A (new) role for business–Promoting the United Nations' Sustainable Development Goals through the internet-of-things and blockchain technology. *Journal of Business Research*, *131*, 598-609. https://doi.org/10.1016/j.jbusres.2020.11.066

Di Vaio, A., Palladino, R., Hassan, R., & Escobar, O. (2020). Artificial intelligence and business models in the sustainable development goals perspective: A systematic literature review. Journal of Business Research, 121, 283-314. https://doi.org/10.1016/j.jbusres.2020.08.019

Dinh, T. N., & Thai, M. T. (2018). Ai and blockchain: A disruptive integration. Computer, 51(9), 48-53.

Elavarasan, R. M., Pugazhendhi, R., Jamal, T., Dyduch, J., Arif, M. T., Kumar, N. M., ... & Nadarajah, M. (2021). Envisioning the UN Sustainable Development Goals (SDGs) through the lens of energy sustainability (SDG 7) in the post-COVID-19 world. *Applied Energy*, *292*, 116665. https://doi.org/10.1016/j.apenergy.2021.116665

Fadeyi, O., Krejcar, O., Maresova, P., Kuca, K., Brida, P., & Selamat, A. (2020). Opinions on sustainability of smart cities in the context of energy challenges posed by cryptocurrency mining. Sustainability, 12(1), 169. https://doi.org/10.3390/su12010169

Fairley, P. (2017). Blockchain world-Feeding the blockchain beast if bitcoin ever does go mainstream, the electricity needed to sustain it will be enormous. IEEE Spectrum, 54(10), 36-59. DOI: 10.1109/MSPEC.2017.8048837.

Farrukh, M., Meng, F., Wu, Y., & Nawaz, K. (2020). Twenty-eight years of business strategy and the environment research: A bibliometric analysis. *Business Strategy and the Environment*, *29*(6), 2572-2582. https://doi.org/10.1002/bse.2521

Fatimah, Y. A., Govindan, K., Murniningsih, R., & Setiawan, A. (2020). Industry 4.0 based sustainable circular economy approach for smart waste management system to achieve sustainable development goals: A case study of Indonesia. *Journal of Cleaner Production*, *269*, 122263. https://doi.org/10.1016/j.jclepro.2020.122263

Ferreira, A., & Otley, D. (2009). The design and use of performance management systems: An extended framework for analysis. *Management accounting research*, *20*(4), 263-282. https://doi.org/10.1016/j.mar.2009.07.003.

Franke, L., Schletz, M., & Salomo, S. (2020). Designing a blockchain model for the paris agreement's carbon market mechanism. *Sustainability*, *12*(3), 1068. https://doi.org/10.3390/su12031068

Gaziulusoy, A. I., Boyle, C., & McDowall, R. (2013). System innovation for sustainability: a systemic double-flow scenario method for companies. *Journal of Cleaner Production*, *45*, 104-116. https://doi.org/10.1016/j.jclepro.2012.05.013

Gerged, A. M. (2021). Factors affecting corporate environmental disclosure in emerging markets: The role of corporate governance structures. *Business Strategy and the Environment*, *30*(1), 609-629. DOI: 10.1002/bse.2642

Gopal, S., Manikandan, K. S., & Ramachandran, J. (2021). Are There Limits to Diversification in Emerging Economies? Distinguishing between Firm-Level and Business Group Strategies. *Journal of Management Studies*. https://doi.org/10.1111/joms.12680

Gitsham, M., Nayak, A., & Gosling, J. (2021). How do business leaders account for what shapes Responsible leadership? Lobbying for SDGs. In *Academy of Management Proceedings* (Vol. 2021, 1, 15816). Briarcliff Manor, NY 10510.

Giudici, G., Milne, A., & Vinogradov, D. (2020). Cryptocurrencies: market analysis and perspectives. *Journal of Industrial and Business Economics*, *47*(1), 1-18. https://doi.org/10.1007/s40812-019-00138-6

Guthrie, J., Ricceri, F., & Dumay, J. (2012). Reflections and projections: a decade of intellectual capital accounting research. *The british accounting review*, *44*(2), 68-82. https://doi.org/10.1016/j.bar.2012.03.004

Hörisch, J. (2021). The relation of COVID-19 to the UN sustainable development goals: Implications for sustainability accounting, management and policy research. *Sustainability Accounting, Management and Policy Journal*. https://doi.org/10.1108/SAMPJ-08-2020-0277.

Ioannou, I., & Serafeim, G. (2017). The consequences of mandatory corporate sustainability reporting. *Harvard Business School research working paper*, (11-100).

Ibukun, C. O., & Adebayo, A. A. (2021). Household food security and the COVID-19 pandemic in Nigeria. African Development Review, 33, S75-S87. https://doi.org/10.1111/1467-8268.12515

Iqbal, N., Fareed, Z., Wan, G., & Shahzad, F. (2021). Asymmetric nexus between COVID-19 outbreak in the world and cryptocurrency market. International Review of Financial Analysis, 73, 101613. https://doi.org/10.1016/j.irfa.2020.101613

Jamwal, A., Agrawal, R., Sharma, M., Kumar, A., Kumar, V., & Garza-Reyes, J. A. A. (2021). Machine learning applications for sustainable manufacturing: a bibliometric-based review for future research. Journal of Enterprise Information Management. https://doi.org/10.1108/JEIM-09-2020-0361

Jribi, S., Ismail, H. B., Doggui, D., & Debbabi, H. (2020). COVID-19 virus outbreak lockdown: What impacts on household food wastage?. *Environment, Development and Sustainability*, *22*(5), 3939-3955. https://doi.org/10.1007/s10668-020-00740-y

Kamble, S., Gunasekaran, A., & Arha, H. (2019). Understanding the Blockchain technology adoption in supply chains-Indian context. *International Journal of Production Research*, *57*(7), 2009-2033. https://doi.org/10.1080/00207543.2018.1518610

Kethineni, S., & Cao, Y. (2020). The rise in popularity of cryptocurrency and associated criminal activity. *International Criminal Justice Review*, *30*(3), 325-344. https://doi.org/10.1177/1057567719827051

Kimani, D., Adams, K., Attah-Boakye, R., Ullah, S., Frecknall-Hughes, J., & Kim, J. (2020). Blockchain, business and the fourth industrial revolution: Whence, whither, wherefore and how?. *Technological Forecasting and Social Change*, *161*, 120254. https://doi.org/10.1016/j.techfore.2020.120254

Kouhizadeh, M., & Sarkis, J. (2018). Blockchain practices, potentials, and perspectives in greening supply chains. *Sustainability*, *10*(10), 3652. https://doi.org/10.3390/su10103652

Kouhizadeh, M., Saberi, S., & Sarkis, J. (2021). Blockchain technology and the sustainable supply chain: Theoretically exploring adoption barriers. *International Journal of Production Economics*, *231*, 107831.

Li, J., Li, N., Peng, J., Cui, H., & Wu, Z. (2019). Energy consumption of cryptocurrency mining: A study of electricity consumption in mining cryptocurrencies. *Energy*, *168*, 160-168. https://doi.org/10.1016/j.energy.2018.11.046

Liu, W., Shao, X. F., Wu, C. H., & Qiao, P. (2021). A systematic literature review on applications of information and communication technologies and blockchain technologies for precision agriculture development. *Journal of Cleaner Production*, 126763. https://doi.org/10.1016/j.jclepro.2021.126763

Makarov, I., & Schoar, A. (2020). Trading and arbitrage in cryptocurrency markets. *Journal of Financial Economics*, *135*(2), 293-319. https://doi.org/10.1016/j.jfineco.2019.07.001

Marzi, G., Dabić, M., Daim, T., & Garces, E. (2017). Product and process innovation in manufacturing firms: a 30-year bibliometric analysis. *Scientometrics*, *113*(2), 673-704. https://doi.org/10.1007/s11192-017-2500-1

Mio, C., Panfilo, S., & Blundo, B. (2020). Sustainable development goals and the strategic role of business: A systematic literature review. *Business Strategy and the Environment*, *29*(8), 3220-3245. https://doi.org/10.1002/bse.2568

Miralles-Quirós, J. L., Miralles-Quirós, M. M., & Nogueira, J. M. (2019). Diversification benefits of using exchange-traded funds in compliance to the sustainable development goals. *Business Strategy and the Environment*, *28*(1), 244-255. https://doi.org/10.1002/bse.2253

Mnif, E., Jarboui, A., & Mouakhar, K. (2020). How the cryptocurrency market has performed during COVID 19? A multifractal analysis. *Finance Research Letters*, *36*, 101647. https://doi.org/10.1016/j.frl.2020.101647

Mora, H., Mendoza-Tello, J. C., Varela-Guzmán, E. G., & Szymanski, J. (2021). Blockchain technologies to address smart city and society challenges. *Computers in Human Behavior*, *122*, 106854. https://doi.org/10.1016/j.chb.2021.106854

Nandi, S., Sarkis, J., Hervani, A., & Helms, M. (2020). Do blockchain and circular economy practices improve post COVID-19 supply chains? A resource-based and resource dependence perspective. *Industrial Management & Data Systems*.

Nandy, M., Lodh, S., Kaur, J., & Wang, J. (2020). Impact of directors' networks on corporate social responsibility: A cross country study. *International Review of Financial Analysis*, *72*, 101601. https://doi.org/10.1016/j.irfa.2020.101601

Nerini, F. F., Sovacool, B., Hughes, N., Cozzi, L., Cosgrave, E., Howells, M., ... & Milligan, B. (2019). Connecting climate action with other Sustainable Development Goals. *Nature Sustainability*, *2*(8), 674-680. https://doi.org/10.1038/s41893-019-0334-y

O'Callaghan-Gordo, C., & Antó, J. M. (2020). COVID-19: The disease of the anthropocene. *Environmental research*, *187*, 109683. doi: 10.1016/j.envres.2020.109683

723 Papadis, N., & Tassiulas, L. (2020). Blockchain-Based Payment Channel Networks: Challenges and
724 Recent Advances. *IEEE Access*, *8*, 227596-227609.DOI**:** 10.1109/ACCESS.2020.3046020.

725 Paliwal, V., Chandra, S., & Sharma, S. (2020). Blockchain technology for sustainable supply chain
726 management: A systematic literature review and a classification
727 framework. Sustainability, 12(18), 7638. https://doi.org/10.3390/su12187638.

728 Parmentola, A., Petrillo, A., Tutore, I., & De Felice, F. (2021). Is blockchain able to enhance
729 environmental sustainability? A systematic review and research agenda from the perspective
730 of Sustainable Development Goals (SDGs). *Business Strategy and the*
731 *Environment*, 1– 24. https://doi.org/10.1002/bse.2882

732 Pizzi, S., Caputo, A., Corvino, A., & Venturelli, A. (2020). Management research and the UN
733 sustainable development goals (SDGs): A bibliometric investigation and systematic
734 review. *Journal of Cleaner Production*, 124033.
735 https://doi.org/10.1016/j.jclepro.2020.124033.

736 Pizzi, S., Rosati, F., & Venturelli, A. (2021). The determinants of business contribution to the 2030
737 Agenda: Introducing SDG Reporting Score. *Business Strategy and the Environment*, *30*(1),
738 404-421. https://doi.org/10.1002/bse.2628.

739 Rasul, G. (2016). Managing the food, water, and energy nexus for achieving the Sustainable
740 Development Goals in South Asia. *Environmental Development*, *18*, 14-25.
741 https://doi.org/10.1016/j.envdev.2015.12.001

742 Ricci, P. (2020). How economic freedom reflects on the Bitcoin transaction network. *Journal of*
743 *Industrial and Business Economics*, *47*(1), 133-161. https://doi.org/10.1007/s40812-019-
744 00143-9

745 Rubio, F., Llopis-Albert, C., Valero, F., & Besa, A. J. (2020). Sustainability and optimisation in the
746 automotive sector for adaptation to government vehicle pollutant emission
747 regulations. *Journal of Business Research*, *112*, 561-566.
748 https://doi.org/10.1016/j.jbusres.2019.10.050

749 Saberi, S., Kouhizadeh, M., Sarkis, J., & Shen, L. (2019). Blockchain technology and its relationships
750 to sustainable supply chain management. *International Journal of Production*
751 *Research*, *57*(7), 2117-2135. https://doi.org/10.1080/00207543.2018.1533261

752 Salvia, A. L., Leal Filho, W., Brandli, L. L., & Griebeler, J. S. (2019). Assessing research trends
753 related to Sustainable Development Goals: Local and global issues. *Journal of cleaner*
754 *production*, *208*, 841-849. https://doi.org/10.1016/j.jclepro.2018.09.242

755 Schroeder, P., Anggraeni, K., & Weber, U. (2019). The relevance of circular economy practices to
756 the sustainable development goals. *Journal of Industrial Ecology*, *23*(1), 77-95.
757 https://doi.org/10.1111/jiec.12732

Singh, D., & Delios, A. (2017). Corporate governance, board networks and growth in domestic and international markets: Evidence from India. *Journal of World Business*, *52*(5), 615-627. https://doi.org/10.1016/j.jwb.2017.02.002

Szomszor, M., Adams, J., Fry, R., Gebert, C., Pendlebury, D.A., Potter, R.W. and Rogers, G., 2021. Interpreting bibliometric data. *Frontiers in Research Metrics and Analytics*, *5*, p.30.

Taghizadeh-Hesary, F., & Yoshino, N. (2019). The way to induce private participation in green finance and investment. *Finance Research Letters*, *31*, 98-103. https://doi.org/10.1016/j.frl.2019.04.016

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British journal of management*, *14*(3), 207-222. https://doi.org/10.1111/1467-8551.00375

Tolliver, C., Keeley, A.R. and Managi, S., 2020. Drivers of green bond market growth: The importance of Nationally Determined Contributions to the Paris Agreement and implications for sustainability. *Journal of cleaner production*, *244*, p.118643. https://doi.org/10.1016/j.jclepro.2019.118643

Van Eck, N. J., & Waltman, L. (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *scientometrics*, *84*(2), 523-538. https://doi.org/10.1007/s11192-009-0146-3

van Zanten, J.A. and van Tulder, R., 2021. Improving companies' impacts on sustainable development: A nexus approach to SDGS. Business Strategy and the Environment. https://doi.org/10.1002/bse.2835

WEF. (2018). Blockchain, 4th Industrial Revolution: Mapping Global Transformation. World Economic Forum, co-curated with Imperial College London. Online at https://www.weforum.org/agenda/archive/blockchain.

Wong, D. T., & Ngai, E. W. (2021). Economic, organisational, and environmental capabilities for business sustainability competence: Findings from case studies in the fashion business. *Journal of Business Research*, *126*, 440-471. https://doi.org/10.1016/j.jbusres.2020.12.060

Wong, R. (2019). What makes a good coordinator for implementing the Sustainable Development Goals?. *Journal of Cleaner Production*, *238*, 117928. https://doi.org/10.1016/j.jclepro.2019.117928

World Bank, 2000. *World development report 2000/2001: Attacking poverty*. The World Bank.

World Bank. 2020. World Development Report 2020 : Trading for Development in the Age of Global Value Chains. World Bank, Washington, DC

Yoshino, N., Taghizadeh-Hesary, F., & Otsuka, M. (2021). Covid-19 and optimal portfolio selection for investment in sustainable development goals. *Finance research letters*, *38*, 101695. https://doi.org/10.1016/j.frl.2020.101695

Zhao, H., Zhang, F., & Kwon, J. (2018). Corporate social responsibility research in international business journals: An author co-citation analysis. *International Business Review*, *27*(2), 389-400.https://doi.org/10.1016/j.ibusrev.2017.09.006

Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organisation. *Organisational research methods*, *18*(3), 429-472.

Appendix (1): Keywords in search Results

Search Stage	Number of results	Keywords
Stage 1: Cryptocurrency and SDGs in general	1,071	cryptocurrency, bitcoin, crypto* currency, ethereum, litecoin, zcash AND sustainable development goals, sustainable development, sustainability, sdg*
Stage 2: Cryptocurrency and SDG 7 & SDG 13	574	cryptocurrency, bitcoin, (crypto* currency), ethereum, litecoin, zcash AND sdg 7 , sustainable goal 7 , affordable* clean energy, clean energy, sdg 13 , climate action, development goal 13, zero* carbon, renewable energy
Stage 3: Cryptocurrency and SDG 7 & SDG 13 in emerging countries	385	Cryptocurrency, bitcoin, crypto* currency, ethereum, litecoin , zcash AND sdg 7, sustainable goal 7, affordable* clean energy, clean energy, sdg 13, climate action, development goal 13, zero* carbon, renewable energy, AND developing

		market*, emerging market*, emerging count*, developing AND econom*
Stage 4: Cryptocurrency and SDG 7 & SDG 13 in developed countries	127	cryptocurrency, bitcoin, crypto* currency, ethereum, litecoin, zcash AND sdg 7, sustainable goal 7, affordable* clean energy, clean energy, sdg 13, climate action, development goal 13, zero* carbon, renewable energy AND developed market* , developed econom*
Stage 5: Cryptocurrency and SDG 7 & SDG 13 considering the cost and benefite generated	319	cryptocurrency, bitcoin, crypto* currency, ethereum, litecoin, zcash AND cost* benefit, cost, charge, damage, expenditure*, welfare, gain, profit AND sdg 7 , sustainable goal 7 , affordable* clean energy, clean energy, sdg 13 , climate action, development goal 13, zero* carbon, renewable energy
Stage 6: Cryptocurrency and SDG 7 & SDG 13 and performance	146	cryptocurrency, bitcoin, crypto* currency, ethereum, litecoin OR zcash AND performance, strategy, reporting, voluntary disclosure, disclosure AND cost* benefit , cost , charge, damage, expenditure* , welfare, gain, profit AND sdg 7, sustainable goal AND 7, affordable* clean energy, clean energy, sdg 13, climate action, development goal AND 13, zero* , carbon, renewable energy
Stage 7: Bitcoin and SDG 7 & SDG 13	219	bitcoin AND sdg 7, sustainable goal 7, affordable* clean energy, sdg 13, climate

		action, development goal 13, zero* carbon, renewable energy
Stage 8: Ethereum and SDG 7 & SDG 13	48	Ethereum AND sdg 7, sustainable goal 7, affordable* clean energy, sdg 13, climate action, development goal 13, zero* carbon, renewable energy
Stage 9: Cryptocurrency and SDG 7 & SDG 13 and theories		
Stage 9.1: Cryptocurrency and SDG 7 & SDG 13 and Agency theory	52	Agency theory, Principal* Agent Theory AND cryptocurrency, bitcoin, crypto* currency, ethereum, litecoin, zcash AND sdg 7, sustainable goal 7, affordable* clean energy, clean AND energy, sdg 13, climate action, development goal 13, zero* carbon, renewable energy
Stage 9.2: Cryptocurrency and SDG 7 & SDG 13 and RBV	123	Resource* Based* View, RBV AND cryptocurrency, bitcoin, crypto* currency, ethereum, litecoin, zcash AND sdg 7, sustainable goal 7, affordable* clean energy, clean AND energy, sdg 13, climate action, development goal 13, zero* carbon, renewable energy
Stage 9.3: Cryptocurrency and SDG 7 & SDG 13 and Network Theory	251	Network Theory AND cryptocurrency, bitcoin, crypto* currency, ethereum, litecoin, zcash AND sdg 7, sustainable goal 7, affordable* clean energy, clean AND energy, sdg 13, climate action, development goal 13, zero* carbon, renewable energy
Stage 9.4: Cryptocurrency and SDG 7 & SDG 13 and TOE	144	technology, organisation, and environment, TOE AND cryptocurrency, bitcoin, crypto* currency, ethereum, litecoin, zcash AND sdg

		7, sustainable goal 7, affordable* clean energy, clean AND energy, sdg 13, climate action, development goal 13, zero* carbon, renewable energy
Stage 9.5: Cryptocurrency and SDG 7 & SDG 13 and Loose Coupling theory	2	Loose Coupling theory AND cryptocurrency, bitcoin, crypto* currency, ethereum, litecoin, zcash AND sdg 7, sustainable goal 7, affordable* clean energy, clean AND energy, sdg 13, climate action, development goal 13, zero* carbon, renewable energy

805

806

807

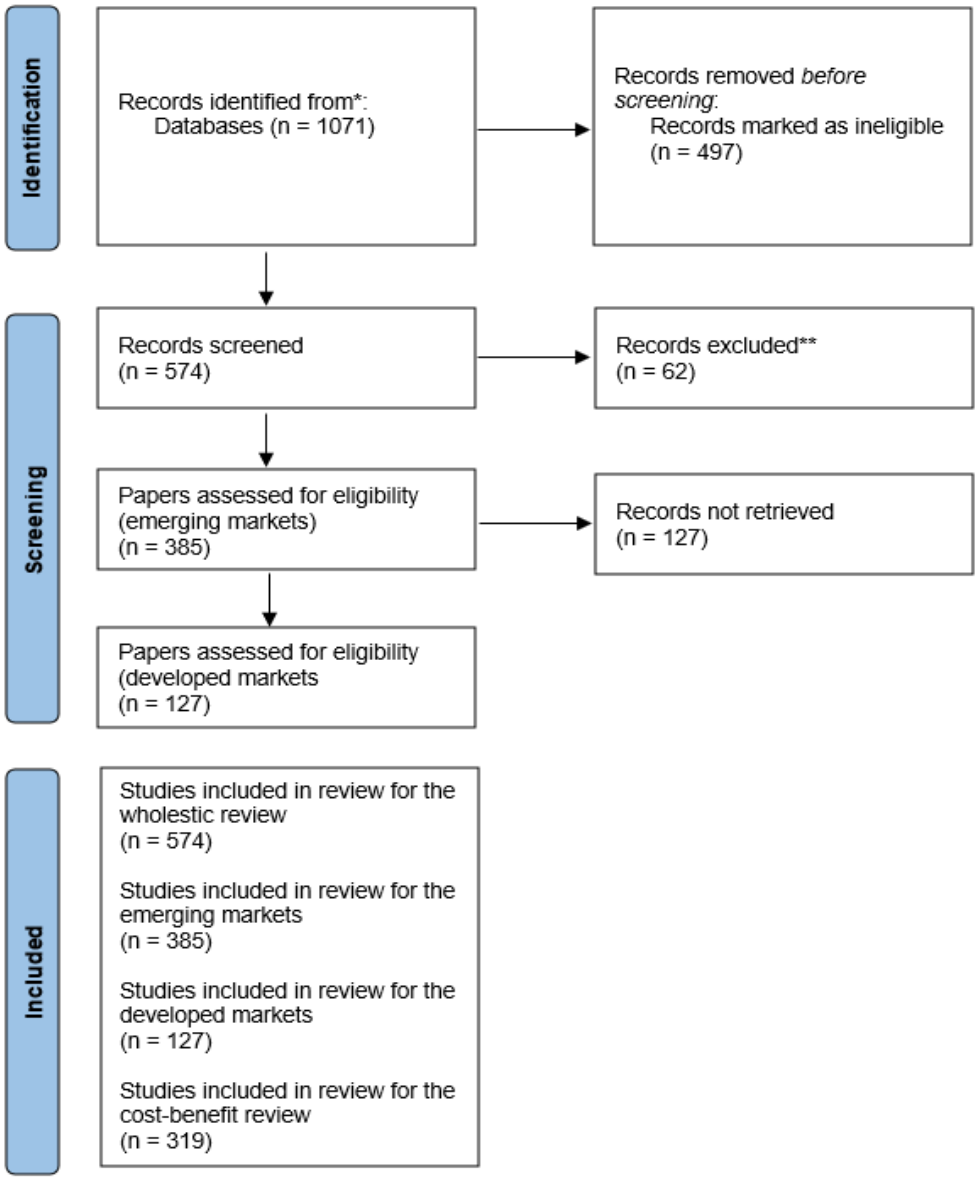


Figure (1): PRISMA of the systematic literature review

Table 1: System of article categorisation – SDG 7 and SDG 13 and Cryptocurrency

A. Focus on literature - SDGs Cluster

- SDG 7
- SDG 13
- Affordable clean energy
- Renewable energy
- Other (including SDGs in general)

B. Focus on literature - Cryptocurrency Cluster

- Cryptocurrency/Cryptocurrencies
- Bitcoin
- Other cryptocurrencies
- Energy
- Technology
- Cost-benefit

C. Performance Cluster

- Performance
- Disclosure
- Non-financial reporting
- Non-financial performance Measurement
- Firm Policy
- Performance measurement
- Strategy
- Sustainability
- Cryptocurrency Trading
- Investors
- Industry

D. Theory Cluster

- Resource-based view
- Network theory
- Agency theory
- Loose Coupling Theory
- Other theories

- Single Theory
- Multiple Theories.
- No theory

E. Geographical Location
• Developing (emerging) countries. • Developed countries • America • Europe • Asia

Notes: Table 1 shows how each paper is coded, tagged, and grouped into a related cluster. We show five different categories – focusing on SDG 7 and SDG 13 , cryptocurrencies, performance, theory, and geographical location.

816

817

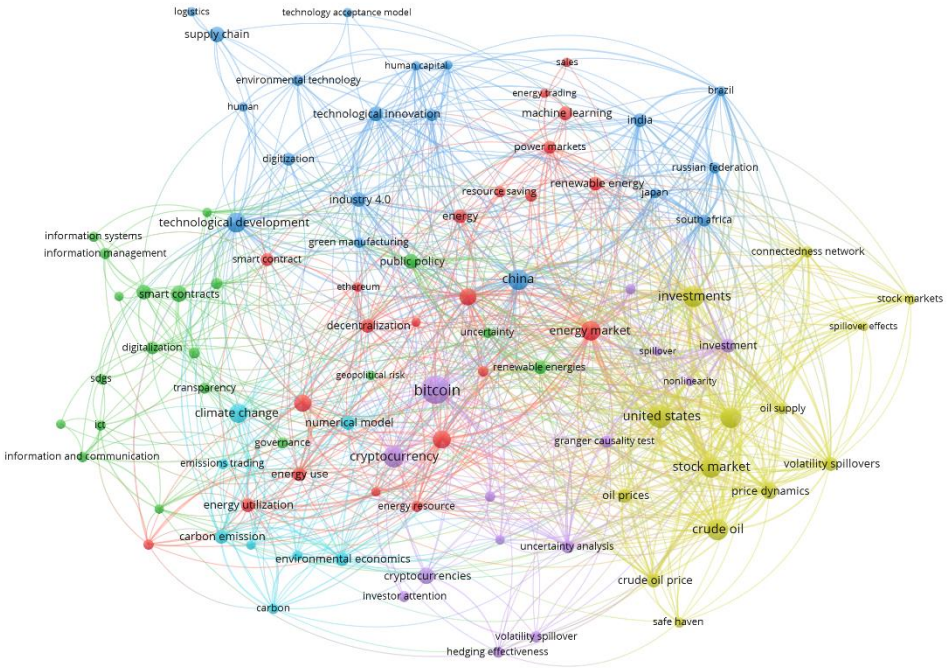
818 Table 2: Literature Focus - SDGs

	Papers	Cited	% Papers	% Citation
SDG 7	113	1830	19.6%	35.4%
SDG 13	63	613	10.9%	11.8%
Affordable clean energy	159	1231	27.7%	23.8%
Climate action	133	914	23.1%	17.7%
Other (environmental goals)	317	206	38.8%	3.9%

Notes: Table 2 shows the number of papers and combined citations of SDG cluster as mentioned in Table 1.

819

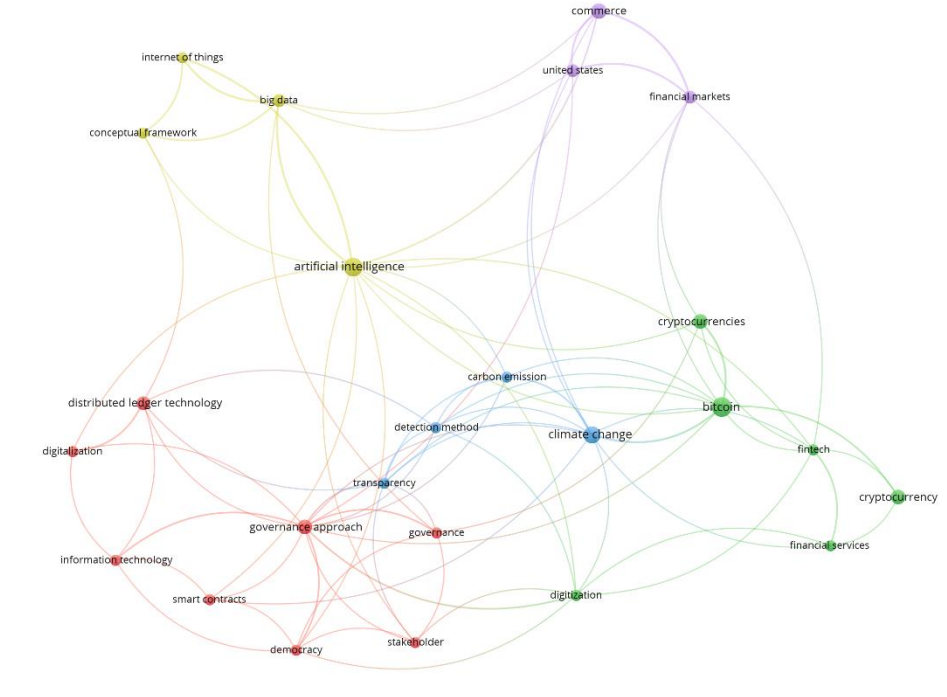
820



821

822 Figure 2 SDG 7 , SDG13 and Cryptocurrency

823



824

Figure 3: SDG 7 and SDG13 with BTC

Table 3: Literature Focus – Strategy, disclosure, and reporting cluster

	Papers	Cited	% Papers	% Citation
Strategy	134	1640	91.7%	97.6%
Disclosure	29	200	19.8%	11.9%
Non-financial reporting	3	2	1%	1%

Table 4: Literature Focus – Performance cluster

	Papers	Cited	% Papers	% Citation
Non-financial performance Measurement	29	172	24.3%	12.8%
Performance measurement	56	637	47%	47.5%
Industry	108	1536	93.1%	114.5%

Notes: Tables 3 and 4 show the number of papers and citations of categories relevant to performance cluster.

Table 5: Geographical Location

	Papers	Cited	% Papers	% Citation
Developing (emerging) countries.	385	1341	67%	25.9%
Developed countries	127	802	22.1%	15.5%
America	86	1066	14.9%	20.6%
Europe	136	665	23.6%	12.8%
Asia	142	760	24.7%	14.7%

Notes: Table 5 documents the distribution of papers by country.

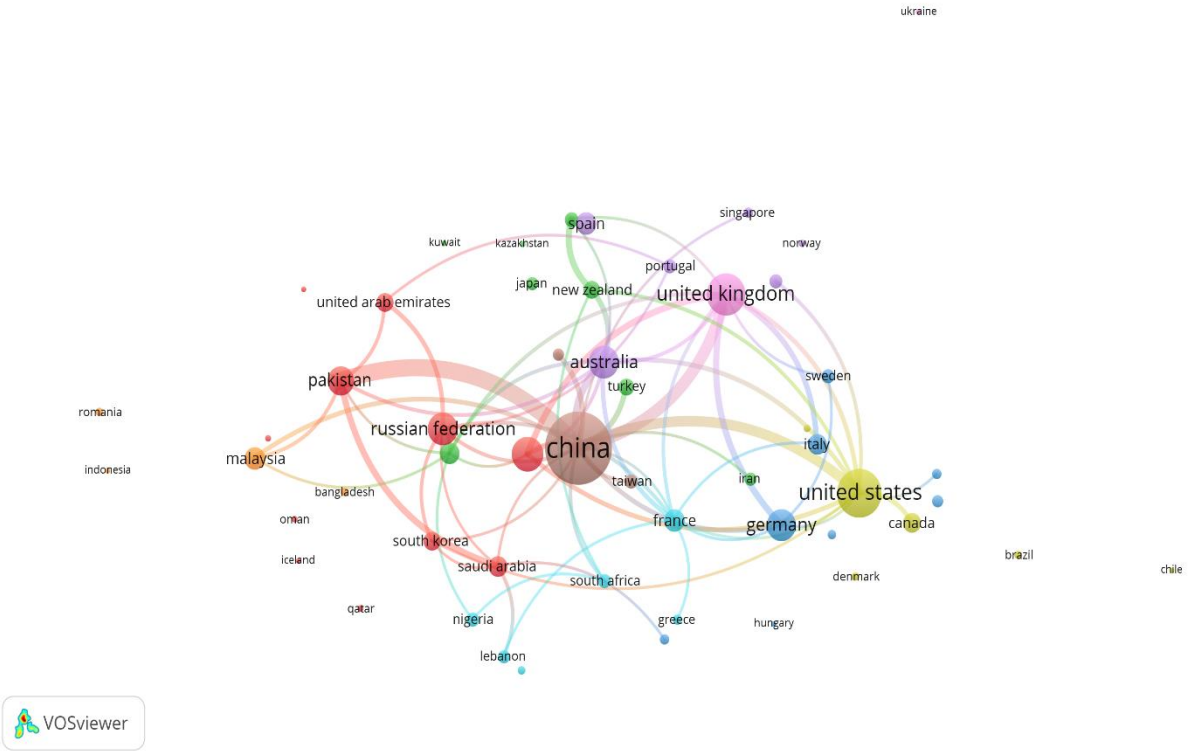


Figure 4: Geographical distribution cluster

Table 6: Theory Cluster

	Papers	Cited	% Papers	% Citation
agency theory	52	563	9%	10.9%
Resource* Based* View	123	1731	21.4%	33.5%
Network Theory	251	3059	43%	59.2%
TOE	144	1773	25%	34.3%
Loose Coupling theory	2	12	0%	0%

Notes: Table 6 shows the theories in papers in our search result.

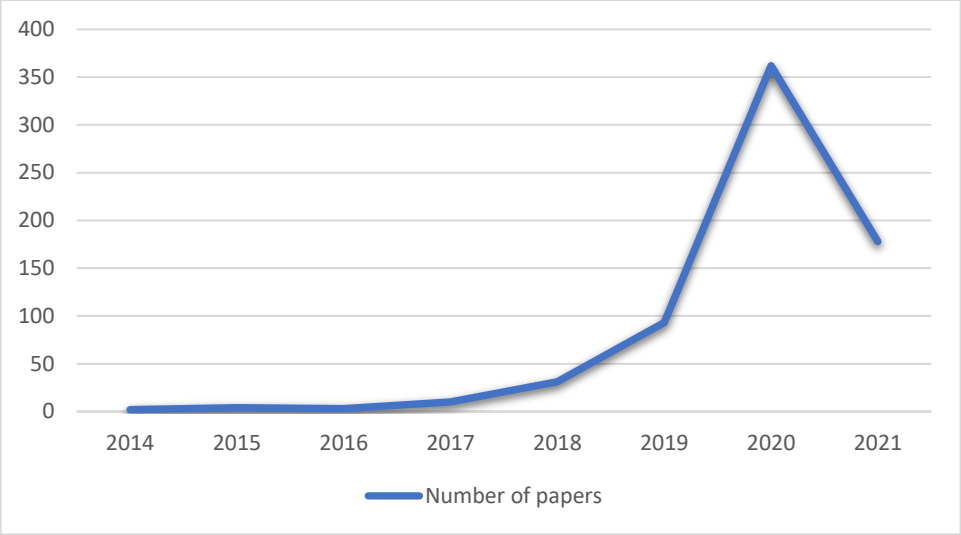


Figure 5: Publication per year

Table 7: Top cited journals (SDG 7, SDG 13 and Cryptocurrency)

	Articles	Cited By	Average citation*	Impact factor
Journal of Economic Perspectives	1	477	477	5.012
International Journal of Production Research	7	622	88.8	4.577
Journal of Manufacturing Technology Management	1	249	249	3.57
International Journal of Information Management	8	354	44.25	8.210
Sustainability (Switzerland)	55	661	12.01	2.576
Journal of Cleaner Production	20	308	15.4	7.246
Supply Chain Management	2	82	41	4.725
Journal of Purchasing and Supply Management	1	64	64	3.66
Energy Research and Social Science	4	67	16.75	4.771

Technological Forecasting and Social Change	20	114	5.7	5.846
International Review of Financial Analysis	12	112	9.33	2.497
Strategic Change	2	52	26	0.92
Economics Letters	1	51	51	1.745
Information Processing and Management	4	56	14	4.787
Energy Economics	20	120	6	3.199
Big Data and Society	3	64	21.3	0.66
International Journal of Energy Economics and Policy	24	179	7.45	1.43

Notes: The citation is as of 15th July 2021. Table 7 presents the top 20 cited journals. *Following Jamwal et al.,2021; Szomszor et al., 2021, the average citation is calculated as (Total Citations/ Total Publication).

847

848 Table 8: Top 20 cited papers (SDG 7, SDG 13 and Cryptocurrency)

Title	Cited by	Year
Bitcoin: Economics, technology, and governance	477	2015
Assessing ICT global emissions footprint: Trends to 2040 & recommendations	115	2018
On big data, artificial intelligence and smart cities	114	2019
Blockchain practices, potentials, and perspectives in greening supply chains	100	2018
A Survey on Blockchain for Information Systems Management and Security	81	2021
Blockchain technology: implications for operations and supply chain management	82	2019
Application of blockchain technology in sustainable energy systems: An overview	72	2018
Blockchain applications in supply chains, transport and logistics: a systematic review of the literature	71	2020
Blockchain and supply chain relations: A transaction cost theory perspective	64	2019
Price discovery in bitcoin spot or futures?	64	2019
Typology of future clean energy communities: An exploratory structure, opportunities, and challenges	59	2018
Future living framework: Is blockchain the following enabling network?	57	2018
Searching for safe-haven assets during the Covid-19 pandemic	56	2020
Blockchain for decentralised transactive energy management system in networked microgrids	54	2019

Blockchain for good?	52	2017
Return, volatility and shock spillovers of Bitcoin with energy and technology companies	51	2018
Price discovery in bitcoin spot or futures?	27	2019
Bitcoin and gold price returns: A quantile regression and NARDL analysis	14	2020
Digital Sustainability and Entrepreneurship: How Digital Innovations Are Helping Tackle Climate Change and Sustainable Development	14	2020
Crypto-economy and new sustainable business models: Reflections and projections using a case study analysis	10	2020
Notes: Table 8 shows the number of citations of the top 20 relevant papers. The citation is as of 15th July 2021.		

849

850 **Table 9:** Most cited authors

Authors	Number of papers	Citations
Allam & Dhunny (2019)	1	114
Böhme et al. (2015)	1	477
Saberi et al. (2019)	2	362
Bonilla et al. (2018)	1	125
Kamble et al. (2019)	1	119
Belkhir & Elmeligi (2018)	1	115
Kouhizadeh & Sarkis (2018)	1	100
Notes: Table 9 demonstrates the most cited authors.		

851

852

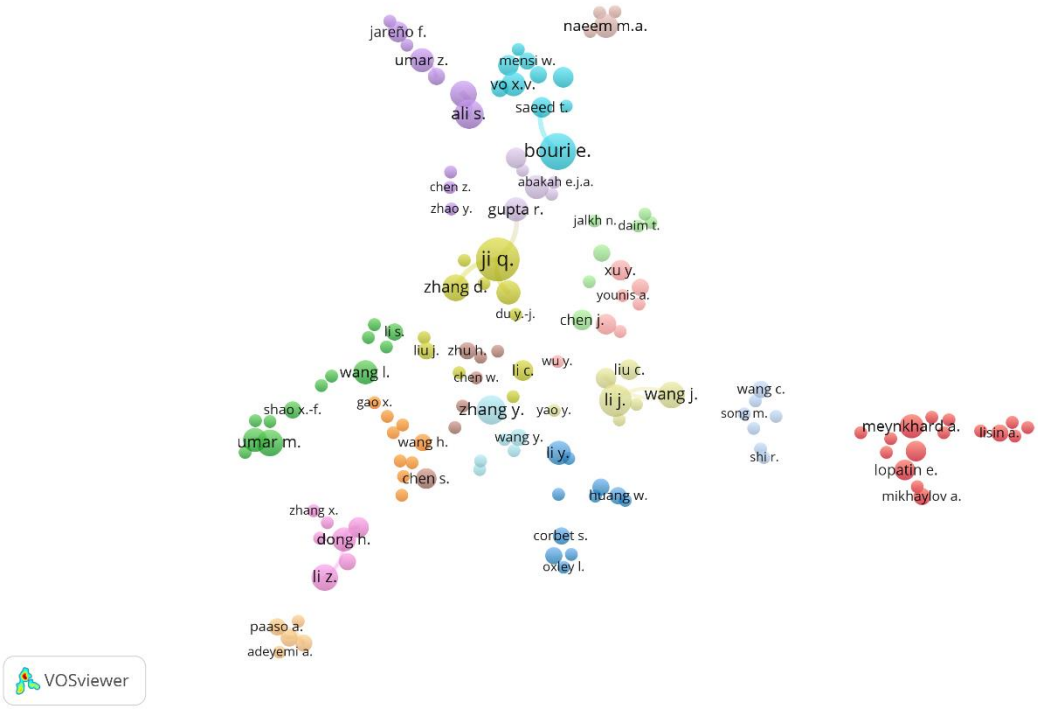


Figure 6: Density Diagram of most connected sets (Authors)