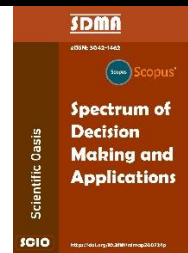




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Cryptocurrency Research and Decision-Making: A Multi-Framework Systemic Review and Future Agenda

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ABSTRACT

This study addresses the growing importance of cryptocurrency (CC) as a financial asset and its increasing popularity as an investment option. Given the rapid expansion of research in this field, the main objective is to systematically synthesize the existing literature on cryptocurrency investment and decision-making, focusing on its intellectual structure, dominant themes, theoretical foundations, and emerging research trends. To achieve this, a hybrid review framework is employed, combining a theory-based systematic literature review with bibliometric analysis, following PRISMA guidelines. The analysis covers 1,184 articles indexed in Scopus and published between 2015 and 2025. Additionally, the study integrates the TCCMR, ADO, and PICO frameworks to provide a comprehensive, multidimensional evaluation of the selected body of literature. The findings reveal that cryptocurrency research is predominantly focused on volatility, market connectedness, portfolio diversification, and behavioral aspects of investment. The results also indicate a strong reliance on econometric and predictive modeling approaches. Emerging research directions highlight increasing attention to sustainability concerns, regulatory challenges, and the application of artificial intelligence in investment analytics. Based on these insights, the study proposes a future research agenda emphasizing theoretical integration, methodological diversification, sustainability perspectives, and decision-oriented modeling. The implications of the research are relevant for investors, regulators, and financial institutions, as they provide a deeper understanding of risks, governance, and decision-making processes in cryptocurrency markets. This study contributes to the literature by offering a comprehensive knowledge structure and research roadmap, representing one of the first attempts to combine bibliometric mapping with TCCMR, ADO, and PICO frameworks in the context of cryptocurrency investment research.

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1. Introduction

The role and position of cryptocurrency (CC) in the world financial market are unique. The market for CC has grown exponentially and reached \$3 trillion in market capitalization. This market was made popular because of certain features, including quicker and easier peer-to-peer transactions, fewer intermediaries, decentralized technology, and confidentiality. Although there are many players in this market, Bitcoin, which is the first open-source digital currency, dominates this market by half, and demand and supply relationships for this currency determine its price. There was an increase in interest in CCs among practitioners, regulators, and academics, thus contributing to their economic value. The study on CCs was contributed to by experts from other domains as well, including information technology, law, sustainability, and behavioral sciences. The study on CCs was conducted on various aspects, including price discovery, volatility, hedging, efficiency, and spillovers. Various findings were noted by the scholars.

Another area of literature explored was the interconnectedness of CCs in global markets. Various researchers have studied the connectedness among CCs, stocks, commodities, and energy markets, especially during periods of uncertainty. Pamucar *et al.*, [1], Kayani *et al.*, [2], Narayan and Kumar [3] studied the connectedness of CCs, stocks, commodities, and energy markets during uncertain times. CCs are characterized by high volatility and face systemic risks. As a result, there is a sharp decline in the market value. However, researchers were concerned about systemic risks, investors, and governance. Nevertheless, researchers evaluated the efficiency, return predictability, and volatility of CCs. The researchers wanted to evaluate whether CCs present a safe haven or are merely speculative assets. Dobrynskaya *et al.*, [4] and Podhorsky [5] studied the efficiency, predictability of returns, and volatility of CCs. The literature indicates the interconnectedness of CCs with the stock, commodity, and energy markets. CCs have transformed from mere speculative assets into investment assets, and they increasingly correlate with traditional markets, especially during periods of uncertainty. However, unlike traditional assets, Bitcoin is highly volatile and subject to investor sentiment and media coverage. Various scholars, such as Dobrynskaya *et al.*, [4], Chen and Nguyen [6] have studied the characteristics of CCs, especially Bitcoin.

Another set of research contributions was made in relation to the behavioral and decision-oriented context. The researchers Chen and Nguyen [6], Gemayel and Preda [7], and Anaza *et al.*, [8] studied how factors such as investor sentiment, herding, and media and social media influence CC price fluctuations. Behavioral factors play an important role in the acceptance of CC as an investment option. Investors, particularly retail investors, may lack the necessary knowledge to invest in CC markets. Most retail investors are often influenced by peer pressure, herd effect, and fear of missing out, as mentioned by Anaza *et al.*, [8] and Ryu [9]. This leads to contagions in both conventional and digital markets, causing price volatility [7].

Environmental sustainability is another thrust area, which highlights green CCs and their relationship with energy markets. The researchers examined the impact of sustainability issues on CC pricing [10-12]. As digital assets, CCs require significant energy, which in turn necessitates proof of work and calls for green digital assets. The focus is on integrating CCs into sustainable investment portfolios [10-11]. It is now imperative for researchers, practitioners, and policymakers to understand the economic, behavioral, and environmental implications of CCs as they evolve and come under the spotlight from organizations and institutions.

Nevertheless, a top-level review of the literature reveals that the previous studies on CCs have largely relied on empirical analysis, whereas the development of theory has taken a back seat. In the prior literature, there has been a scattered use of prominent theoretical frameworks such as behavioral finance theory and the efficient market hypothesis (EMH) [4,13]. In prior literature, researchers have emphasized the development of diagnostic or predictive analyses, whereas

prescriptive analysis has received little attention. In prior literature, researchers have largely used returns or volatility as parameters for analyzing the performance of CCs [9,14]. The broader societal or governance aspects have received little emphasis. In prior literature, CCs have gained increasing prominence as retail investors have taken an interest in these assets. However, the retail environment is highly speculative and is coupled with low financial literacy levels [9,15]. The institutional environment has also faced difficulties in risk management or regulatory compliance [16-17]. Experts such as Jabbour and Mansour-Ichraikieh [18], Kreuzer *et al.*, [19] emphasized the need to balance innovation, stability, investor protection, and sustainability. All these factors necessitate a critical analysis of previous studies to highlight the current theory, context, and consequences of choice for researchers, investors, and policymakers. However, the current literature lacks holistic reviews of CC-related studies.

The study aims to bridge the gap in the existing literature by conducting an exhaustive bibliometric analysis of studies published in Scopus until mid-2025, as well as a systematic literature review of significant studies in this area. The study employed various bibliometric tools, such as Microsoft Excel, VOSviewer, Microsoft Power BI, and Python with Anaconda, to apply advanced bibliometric techniques, such as co-author network analysis, keyword co-occurrence analysis, compute frequency statistics, and theme density mapping, to identify significant research themes, theoretical foundations, and new research directions in the CC domain. Further, the current work conducts an SLR that synthesizes three distinct frameworks: TCCMR (theory, context, characteristics, method, and research type), ADO (antecedents, decisions, and outcomes), and PICO (population, intervention/exposure, comparison, and outcome). The TCCMR framework discovers the theoretical foundations, contextual applications, research designs, and methodological varieties. The ADO framework is used to understand the decision-making context through causal logic. Lastly, the PICO framework is based on a population- and comparison-oriented approach. The symbiosis of these frameworks offers a comprehensive summary of the evidence, with depth and wide coverage.

The current research aims to find answers to the following research questions:

- i. RQ1. What is the current status of CC research in terms of publication trend, intellectual contributions, thematic focus, co-occurrence, and used keywords?
- ii. RQ2. What are the key contextual applications, established theories, and methodological frameworks found in the past studies?
- iii. RQ3. What are the key antecedents, decisions, and outcomes revealed in the past studies?
- iv. RQ4. How has CC research evolved across various economic and regulatory contexts and events?
- v. RQ5. What do the past studies imply for market behavior, volatility, cross-asset connectedness, spillover across the markets, sustainability alignment, governance, and decision making?
- vi. RQ6. What are the potential research gaps related to investment in CC for scholars to explore in the future?

The current work offers several contributions to the growing body of literature, summarized below.

- i. The present work offers a comprehensive introspection of the fragmented theoretical landscape in the past contributions on CC research. Through rigorous bibliometric analysis and a well-defined, theory-grounded SLR, the current work offers a theory-driven synthesis that enhances conceptual clarity and establishes a foundation for future explanatory and prescriptive models.
- ii. This is a distinct contribution that uses a detailed bibliometric analysis alongside three SLR frameworks, including TCCMR, ADO, and PICO.

- iii. The current study advances theoretical development by focusing on the contributions to EMH, safe-haven discussions, and volatility interconnectedness. It provides a comprehensive analysis of decision-support approaches, behavioral aspects, theoretical frameworks, market outlooks, investment, portfolio management, risk, sustainability, governance, and macro-financial spillovers. The earlier reviews focused on specific themes.
- iv. The present work provides a holistic roadmap for the researchers, practitioners, investors, and policy makers by highlighting the need for improved integration with behavioral finance, systemic risk, and sustainability economics.

This paper is organized into four additional sections after the Introduction. Section 2 discusses the background, outlining the current state of the CC field and some classical review papers. Section 3 discusses the methodology for data retrieval and analysis. Section 4 presents the findings of the bibliometric analysis. Section 5 presents the summary of the findings and discusses various aspects covered in the past studies vis-à-vis the research questions. It also discusses some limitations of the current work. Section 6 outlines the research roadmap for the future. Section 7 highlights the research implications. Finally, Section 8 includes the concluding remarks to close the paper.

2. Background

2.1 Cryptocurrency

CC is a tradable digital, virtual, or internet currency that exists only online and uses cryptography to authenticate and secure transactions. Compared with traditional financial markets, the CC market is relatively new. In recent days, it has delivered the most remarkable and significant application of distributed ledger technology, the blockchain. The CC market was thriving with investors and traders since 2017, but in 2018, it witnessed an 80% price drop and entered a prolonged 'Crypto Winter' [20]. During this period, the prices of major CCs such as Bitcoin and Ethereum fell abruptly [21]. As the Crypto Winter came to pass, two of the most prominent CCs, Bitcoin and Ethereum, have emerged as popular tools. There are presently over 1,000 CCs worldwide, and their supporters see them as the "key to a fairer future economy" [22]. Blockchain is a current technological breakthrough with broad applications in e-commerce, banking, insurance, and many other industries. The study on blockchain technology is exceptional, as all related information is publicly accessible in the form of the history of each transaction executed on the network [23].

2.2 Investment in Cryptocurrency

The first and one of the most dominant CCs is Bitcoin, founded by Satoshi Nakamoto [24] and popular for its high return on investment. This is based on the principle of encrypted transactions. Some key factors, such as its high growth potential, a highly liquid market, ease of peer-to-peer transactions without a middleman, and volatile returns, underpin its success [25]. Argentina and Chile considered Bitcoin as a payment method for specific transactions [26], whereas El Salvador recognized Bitcoin as legal tender alongside the US Dollar [27].

However, the flip side is that not all CCs are liquid, and there are various security and privacy risks to investing in Bitcoin [20,28-29]. The report also showed that more than 46,000 people have lost over \$1 billion in crypto to scams, making bitcoin a double-edged sword [30]. Since CC is a broad topic, the present research focuses mostly on literature relevant to its status as an asset class, rather than its technological and legal components. Some of the earlier reviews on CC research are exhibited in Table 1.

Table 1
Summary of past studies on Cryptocurrency

Sr. No.	Study Reference	Style of Review	Focus of the Literature Review
1	Almeida and Gonçalves [31]	Literature Review	The analysis focuses on investor behavior in cryptocurrency markets, using literature drawn from journals recognized in the ABS 2021 ranking framework
2	Bartoletti <i>et al.</i> , [32]	Systematic Literature Review	It understands cryptocurrency-based scams observed over the last ten years by assembling and homogenising information from different public sources
3	Fang <i>et al.</i> , [33]	Comprehensive Survey	It focuses on various aspects of cryptocurrency trading (such as predicting volatility and return, building crypto-asset portfolios, etc.).
4	Kyriazis <i>et al.</i> , [34]	Systematic Review	It presents the bubble dynamics of cryptocurrency prices mostly during 2013 and 2017.
5	Wu <i>et al.</i> , [35]	Network Analysis	It provides a cryptocurrency transaction network analysis based on some specific terms.
6	Fauzi <i>et al.</i> , [36]	Narrative Review	It discusses challenges, opportunities, and the future path of Bitcoin and Cryptocurrency.
7	Suratkar <i>et al.</i> , [37]	Narrative Review	It reviews multi-currency wallets, highlighting factors like supported currencies, anonymity, cost, platform support, etc.
8	Amsyar <i>et al.</i> , [38]	Systematic Literature Review	It delivers an up-to-date review of Information systems (IS) research on cryptocurrency adoption and future research directions.
9	Zohuri <i>et al.</i> , [39]	Narrative Review	It identifies the stability and threat aspects of cryptocurrency in today's market.
10	Alzahrani and Daim [40]	Literature Review	Examines the present cryptocurrency adoption level, adoption-influencing aspects, and its pitfalls.

3. Methodology

Scopus is a widely used source across numerous modern research domains [41-42]. It is a comprehensive database containing academic documents on various intellectual issues [43]. To meet our research objective, we follow the path paved by Tranfield *et al.*, [44], which initiates with the planning stage and concludes with the reporting stage (Figure 1).

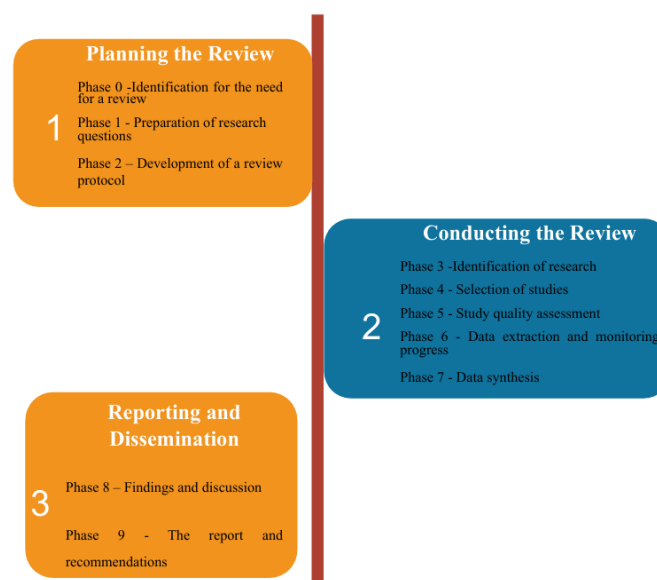


Fig. 1. Stages of Research Process

3.1 PRISMA Framework

We systematically reviewed journal articles from 2015 to Mid-2025 from the Scopus database, in adherence to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines by Jain *et al.*, [45] and Moher *et al.*, [46], as shown in Figure 2. PRISMA has its intrinsic characteristic of reliability, reproducibility, and exhaustiveness [47]. The process consisted of four stages: identification, scholarly categorization, article screening, and final inclusion [48].

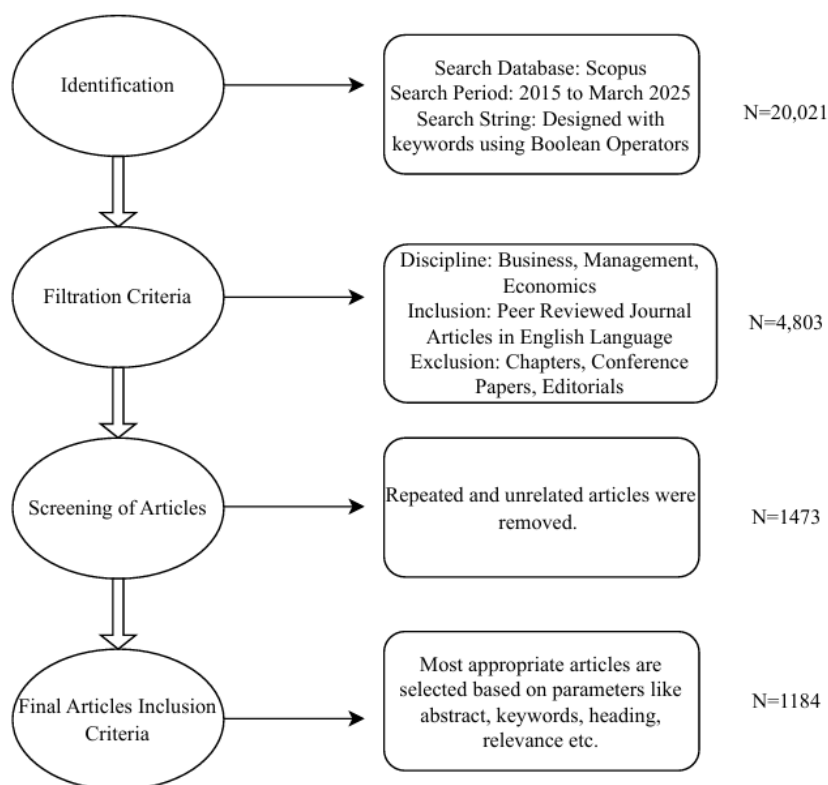


Fig. 2. Article Collection Stages based on PRISMA guidelines

Stage 1. Identification: We primarily design a keyword array utilizing Boolean operators (AND, OR) to recognize the appropriate articles in the Scopus database based on search terms as keywords in the article title, abstract, or keywords listed up to March 2025. The search string included the key words: cryptocurrency* AND investment* AND portfolio AND (LIMIT-TO (EXACTKEYWORD , "Cryptocurrency") OR LIMIT-TO (EXACTKEYWORD , "Cryptocurrencies") OR LIMIT-TO (EXACTKEYWORD , "Bitcoin") OR LIMIT-TO (EXACTKEYWORD , "Investment") OR LIMIT-TO (EXACTKEYWORD , "Investments") OR LIMIT-TO (EXACTKEYWORD , "Blockchain") OR LIMIT-TO (EXACTKEYWORD , "Portfolio Managements") OR LIMIT-TO (EXACTKEYWORD , "Financial Market") OR LIMIT-TO (EXACTKEYWORD , "Finance") OR LIMIT-TO (EXACTKEYWORD , "Financial Markets") OR LIMIT-TO (EXACTKEYWORD , "Block-chain") OR LIMIT-TO (EXACTKEYWORD , "Portfolio Management") OR LIMIT-TO (EXACTKEYWORD , "Portfolio Diversification") OR LIMIT-TO (EXACTKEYWORD , "Performance") OR LIMIT-TO (EXACTKEYWORD , "Investment Decisions") OR LIMIT-TO (EXACTKEYWORD , "Digital Assets") OR LIMIT-TO (EXACTKEYWORD , "Geopolitical Risk") OR LIMIT-TO (EXACTKEYWORD , "Safe-haven")). This string was added to the search database, and a preliminary total of 20,021 items was found in .CSV format after executing the retrieval procedure.

Stage 2. Scholarly Categorization: At this stage, scholarly categorization was based on a systematic depuration process. We considered research papers only from the business, management, and economics domains and excluded book chapters, editorials, and conference proceedings papers. We also employed language filtration and included only articles written in English. After performing the inclusion and exclusion criteria, 4803 articles remained.

Stage 3. Articles Screening: Next, we manually reviewed the titles, abstracts, and keywords for each article and excluded duplicates and unrelated articles. At the end of this process, 1,473 articles remained.

Stage 4. Final Inclusion: In the final step, we pooled and verified the articles in line with our research objective. Then we have selected articles related to investing in cryptocurrency. Finally, the most appropriate papers are selected based on parameters like [49]:

- Relevance (i.e., papers which are mostly inclined in the domain, like Bitcoin, Blockchain, Digital Assets, Investment Decisions, etc.)
- Rank of journal: Articles available in international-level journals
- Citation: Articles with a high citation index are also considered in the ultimate list, irrespective of the ranking of the journal

Finally, a total of 1,184 articles is considered.

3.2 Bibliometric Analysis

Bibliometric analysis is a straightforward analytical technique that delivers insights into worldwide collaboration, research productivity, and the intellectual contributions of prominent scholars [50]. This is a powerful tool for analyzing scientific publications and citations to reveal patterns and trends within academic discourse. This technique has diverse practices such as citation analysis, bibliographic coupling analysis, co-word analysis, and co-citation analysis [51].

The visual presentation through VOSviewer displays various nodes and links. The color of the bubble represents its cluster, whereas the bubble and font size indicate the number of associations. The thickness of the lines (the strength of links) indicates the degree of collaboration.

Cocitation analysis is a method that quantifies associations and networks among articles by measuring how often two articles are cited by a third [50]. Bibliographic coupling is an evaluation of the association between two documents through “coupling strength.” Two papers are said to be bibliographically coupled if they both cite one or more documents in their bibliographies [52]. The degree of “coupling strength” of two specified documents is higher the more citations to other documents they share [53]. In short, bibliographic coupling examines citing articles, whereas co-citation analysis focuses on cited documents [54]. The blending of bibliographic coupling analysis and co-citation analysis can elucidate the intellectual structure of disciplines [55] (see Figure 3).

Citation analysis is used to measure the influence of individual works, researchers, institutions, and trends in the entire field of study. Citation analysis has a dominant part in the bibliometric evaluation of journals, conferences, institutes, and individual researchers [56]. To verify the information and build credibility of this manuscript, we have also conducted the citation analysis based on two indexes: the global and local citation analysis. The global citation is the total number of citations an author has received from all the disciplines and research areas, whereas the latter is when others cite one publication within the 1184-node network [57]. In this paper, we have also conducted citation analysis to study the frequency and patterns of citations of the documents related to investment in cryptocurrency. However, our study does not aim to examine the merits of qualitative features, so only the quantitative aspects are reviewed here.

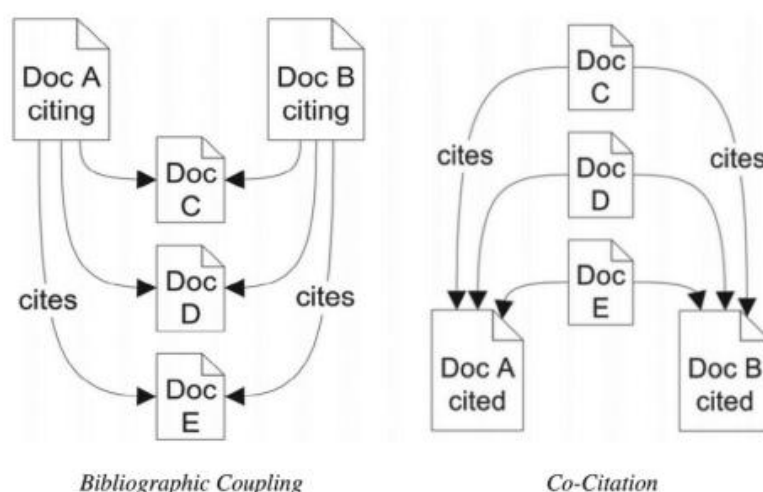


Fig. 3. Co-citation Analysis and Bibliographic Coupling Analysis

Citation analysis mainly emphasizes the acceptance of a publication grounded on its citation times in the field of cryptocurrency investment. PageRank [58] is a technical and widely used ranking algorithm to evaluate both the popularity and prestige of a specific node in a cited network. We have applied the PageRank algorithm to understand the publications with high popularity and prestige [57]. The 'prestige' is frequently calculated by the number of times a publication is cited by other highly cited papers [59]. We have calculated PageRank based on the document, citations, and total link strength. In the 1184-node network, it was assumed that paper A was cited by other publications T1 through Tn. The PageRank score $PR(A)$ of the paper A can be measured by the following equation [58]:

$$PR(A) = \frac{(1-d)}{N} + d \left(\frac{PR(T_1)}{C(T_1)} + \dots + \frac{PR(T_n)}{C(T_n)} \right) \quad (1)$$

d = Damping factor (0, 1) that is the fraction of random walks that remain to propagate along with the citations. We have considered the damping factor as 0.85, based on the traditional PageRank algorithm [58]; N = The total number of publications in the network; $C(T_i)$ = The citation times of the publication T_i .

PageRank naturally reflects the number and quality of links (citations) to a page. The concept of the PageRank algorithm was first coined for application on the Google search engine to understand the higher quality web pages for consumers. In our case, we have taken citations as incoming links, and total link strength as the weight or quality of those links.

Co-Authorship Analysis is a method for understanding collaboration between authors through their publications. It evaluates scientific interface and relations amongst networks, teams, institutions, and countries. It can recognize, calculate, and present the number of links established by individual researchers [60].

Co-occurrence refers to the understanding of the scenario in which two or more words appear together within a specific text or body in the context of keywords. "All keywords" is a wide term that includes every keyword linked with an article, including both author keywords and index keywords. In consonance, author keywords are selected by the author(s) of a text to define the core ideas and content of their study. Keyword analysis and content analysis are systematic approach that shapes

associations and informs the theoretical structure of the field based on the words used in articles. It can be applied to complete documents, abstracts, keywords, and paper titles. The fundamental idea behind this method is that the frequent co-occurrence of words in a document specifies a near relationship among the thoughts behind words. The correctness of the content analysis outcomes is based on numerous features, such as the quality of the keywords, the complexity of the statistical methods used for analysis, and the choice of the database used [61].

Table 2 exhibits various bibliometric methods, along with their advantages and disadvantages [60]. Additionally, there are other bibliometric methods; however, Table 2 showcases only the approaches employed in this study.

Table 2
Summary of Bibliometric Techniques

Sl No.	Techniques	Description	Units of Analysis	Strengths	Weaknesses
1	Bibliographic coupling	When two papers find conceptual similarities in citing a document.	Author document journal	-It Reveals Thematic Similarities -It is not affected by citation delays	- It is less effective for older articles -It does not reflect evolving research trends over time.
2	Citation analysis	This approach assesses research impact by examining citation frequencies across a range of academic journals.	Author document journal	-It provides a quantitative measure to evaluate the influence of a research paper, author, or journal.	Recent publications sometimes do not have enough citations to reflect their actual impact.
3	Co-authorship analysis	When two or more authors collaborate on a document, it connects them.	Author	-It recognizes Research Collaboration Networks -It offers research visibility and impact	- It does not always depict the actual contribution of the authors - It has a bias in collaboration patterns
4	Co-citation analysis	The connectedness of papers is measured by the number of times they have been referenced together, which is known as co-citation.	Author document journal	-It uncovers hidden thematic links between research areas. - It maps research clusters and trends	-If any domain has low citation rates, co-citation patterns are weak or misleading. - It lags in detecting recent trends.
5	Keyword analysis	It connects keywords if they appear in a similar keyword list	Word	-It identifies research trends and active research areas -It discloses commonly used terms, representing dynamic research ranges.	- It sometimes does not differentiate between unlike uses of the same term -The innovative buzzwords may dominate long-standing but less trendy keywords.

Table 2

Continued

Sl No.	Techniques	Description	Units of Analysis	Strengths	Weaknesses
6	Content analysis	This involves methodically examining the textual and metadata elements of academic research to reveal inclinations, themes, and effects within a domain.	Abstract	- It delivers an organized performance for analyzing vast volumes of data. - Its clear coding frameworks permit other researchers to verify findings.	- It is time-consuming - Sometimes, academics' individual beliefs influence coding categories.

4. Findings

This section presents the complete results, including several key dimensions such as sources, prominent authors, journal countries, institutions, cited works, and the thematic evolution of keywords.

4.1 Initial data statistics

Table 3 presents the annual distribution, percentage share, and growth trajectory of publications on cryptocurrency investment over nine years. A relatively modest research output is evident in the early phase (2015–2017), indicating limited scholarly attention during the formative years of the field. From 2017 onward, however, publication activity expanded markedly, rising from just three studies to 316 by 2024. The peak is observed in 2024, which accounts for 26.69% of the total publications, followed by 2023 with 245 articles (20.70%). The growth rate appears negative for 2025 because the data is up to the middle of the year. However, based on current trends, the figure is expected to be positive once the full-year data is considered. A particularly notable acceleration occurs between 2019 and 2021, suggesting a shift in research momentum. This surge can be reasonably interpreted as a response to growing market maturity, heightened investor interest, and the broader legitimization of cryptocurrency within academic discourse.

Table 3
Number and Growth of Publications

Year	No of publications	% Publications	Growth
2025	88	7.432%	-0.722
2024	316	26.689%	0.290
2023	245	20.693%	0.184
2022	207	17.483%	0.278
2021	162	13.682%	0.688
2020	96	8.108%	0.882
2019	51	4.307%	3.250
2018	12	1.014%	3.000
2017	3	0.253%	0.000
2016	3	0.253%	2.000
2015	1	0.084%	

In terms of citation, the data demonstrates a clear rise-and-fall pattern in citation counts, peaking in 2020 (7501 citations) and declining sharply afterward. Citations grew exponentially from 280 (2015) to 7,501 (2020), signifying a development of a highly dominant research domain (Figure 4). Around 50% of papers were published between 2022 and 2024.

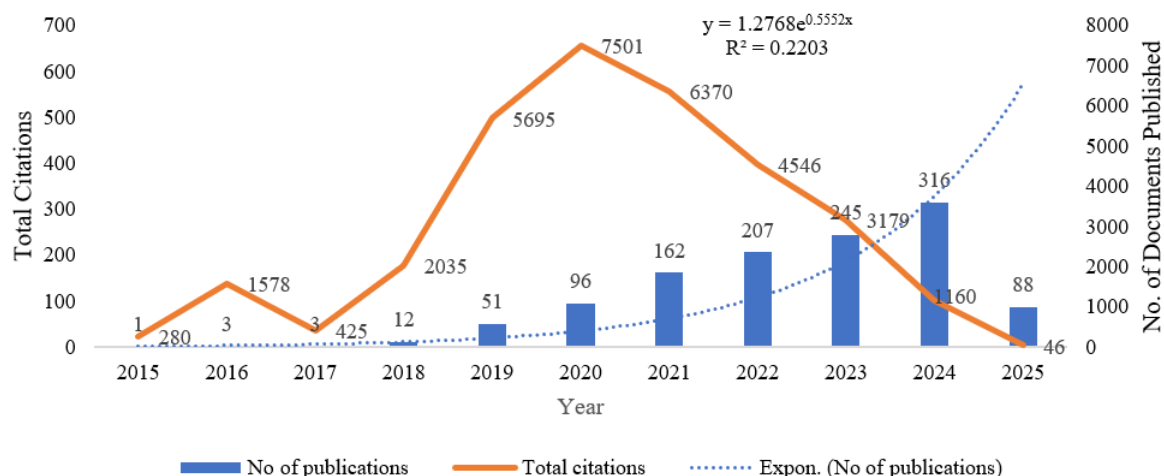


Fig. 4. Number of publications and citations year-wise and Publication Tendency

Figure 4 highlights the number of publications in the field of CCs along with citations from 2015 to March 2025. The overall trend of the publications follows an exponential growth ($y = 1.2768e^{0.5552x}$; $R^2 = 0.2203$) after mathematical exponential adjustment. The R^2 value indicates that total citations explain approximately 22% of the variability in the number of publications, suggesting a weak relationship between the two. Table 4 presents a research journal matrix of the top 10 journals in our research domain, along with several key components, such as Citation per Publication (CPP), Source Normalized Impact per Paper (SNIP), Scimago Journal Ranking (SJR), H-Index, etc. The results show that these top 10 journals account for more than 37% of the publications. Furthermore, the top five journals are Finance Research Letters, Research in International Business and Finance, International Review of Financial Analysis, Financial Innovation and Journal of Risk and Financial Management.

Table 4

Top 10 Contributing Journals

Journal Name	TP	%	TC	CPP	SNIP*	CS*	(SJR)**	H-Index**
"Finance Research Letters"	81	6.84%	4527	55.89	2.279	11.10	1.711 Q1	123
"Research in International Business and Finance"	68	5.74%	2547	37.46	1.927	11.20	1.415 Q1	86
"International Review of Financial Analysis"	53	4.48%	4507	85.04	2.052	10.30	2.288 Q1	110
"Financial Innovation"	48	4.05%	995	20.73	2.129	11.40	1.287 Q1	57
"Journal of Risk and Financial Management"	38	3.21%	551	14.50	0.875	4.50	0.961 Q1	65
"Technological Forecasting and Social Change"	33	2.79%	2013	61.00	2.945	21.30	3.472 Q1	209
"Journal of International Financial Markets, Institutions and Money"	32	2.70%	945	29.53	1.483	6.60	1.522 Q1	89
"Resources Policy"	31	2.62%	983	31.71	2.083	13.40	2.381 Q1	138
"North American Journal of Economics and Finance"	30	2.53%	810	27.00	1.232	7.30	0.961 Q1	65
"Applied Economics"	27	2.28%	512	18.96	0.900	3.80	0.616 Q2	121

Notes: *Taken from <https://www.scopus.com/>; **Take from <https://www.scimagojr.com/>; (TP: Total Publications; TC: Total Citations; SNIP: Source Normalized Impact Per Paper; CS: Cite score; SJR: Scimago Journal Ranking)

While understanding the results of the publishers' contribution, we have observed that Elsevier Ltd is in the first position with 18.83% contribution, followed by Elsevier Inc. with 12.92% (Figure 5).

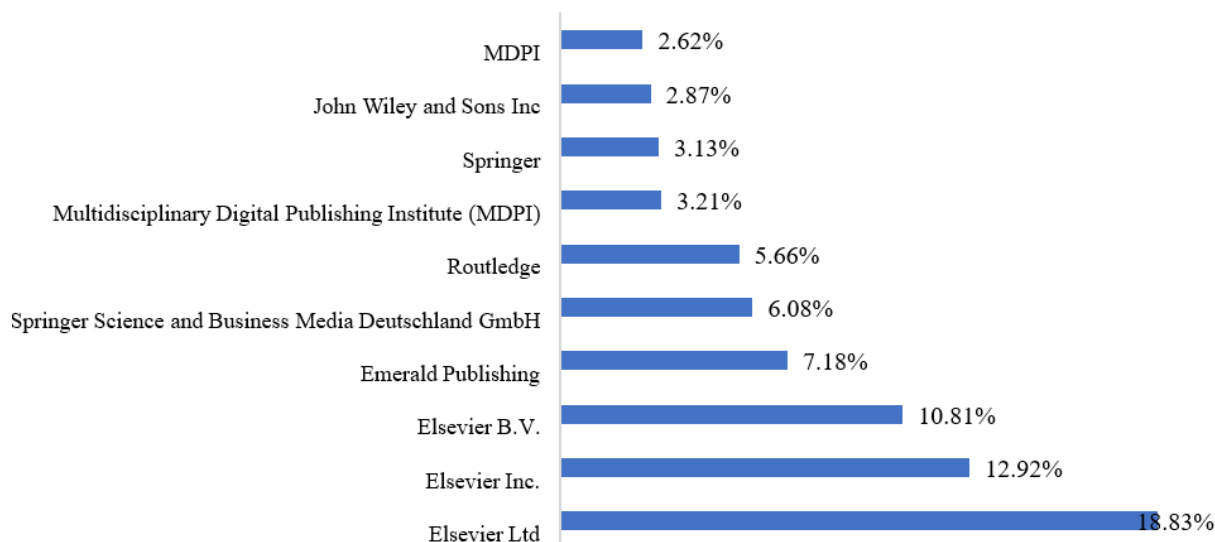


Fig. 5. Contributions of the Publishers

4.2 Bibliometric analysis

In this section, we have conducted various bibliometric analyses to disclose exclusive networks within a specified domain of study, along with providing an outline of the field.

4.2.1 Country Participation

The network analysis of co-authorship by country showed that a total of 99 countries are involved in the domain of investment in cryptocurrency, as evidenced by their publications. Based on the output of VOSviewer it can be noted that 59 countries have participated in the domain with a minimum of five documents and five citations. The top 10 countries are China, the United Kingdom, India, the United States, France, Tunisia, Germany, Lebanon, Turkey, and Pakistan, with publications of 185, 142, 133, 130, 98, 93, 74, 70, 70, 58, respectively. Table 5 shows the top 25 countries involved in our research publication outputs.

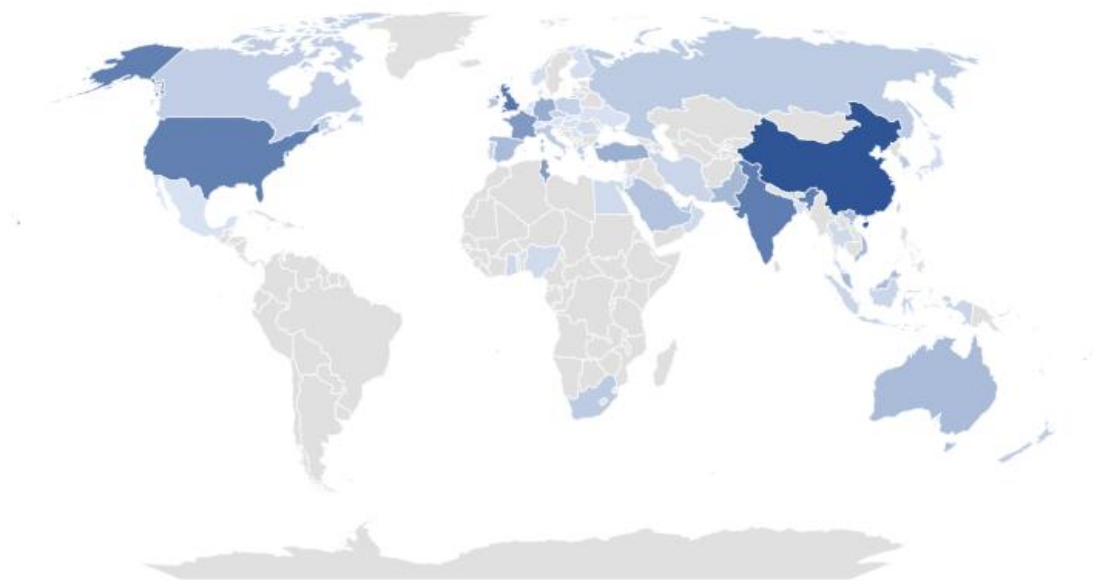
In terms of local citations, Ireland has a value of 109.66 (5,154 citations from 47 documents), followed by the Czech Republic (71.75; 2,009 citations from 28 documents) and then Lebanon (59.89; 4,192 citations from 70 documents).

Figure 6 demonstrates that the worldwide landscape of uniqueness research highlights the inconsistent contributions of a few leading nations. The top 5 countries are China, the United Kingdom, India, the United States, and France, with publications, global citations, and local citations of 185, 6179, 33.40, 142, 6374, 44.89, 133, 2395, 18.01, 130, 3334, 25.65, and 98, 5816, 59.35, respectively. It can be noticed that the top countries include G20 nations. The supremacy of these countries can be explained based on a variety of factors, including the country's reputable educational institutions, high research budgets, and strong global alliances. In relation to continental supremacy, Asia and Europe dominate, followed by North America, South America, Oceania, and Africa. The supremacy is likely to include a broader and diversified academic discourse with elements of knowledge derived from different social and geopolitical settings.

Table 5
Top Participating Countries in Cryptocurrency Investment

Country	Total Link Strength	Documents	Global Citations	Local Citations
China	430671	185	6179	33.40
United Kingdom	352586	142	6374	44.89
India	309911	133	2395	18.01
United States	283046	130	3334	25.65
France	278894	98	5816	59.35
Tunisia	297612	93	1801	19.37
Germany	142047	74	2539	34.31
Lebanon	213708	70	4192	59.89
Turkey	207777	70	1776	25.37
Pakistan	172179	58	1642	28.31
Viet Nam	188164	55	2160	39.27
Australia	154261	54	2044	37.85
Malaysia	121047	54	839	15.54
Spain	145951	54	1909	35.35
Ireland	153805	47	5154	109.66
Saudi Arabia	135245	44	896	20.36
United Arab Emirates	98919	40	1107	27.68
Russian Federation	90250	36	1510	41.94
South Africa	97921	36	1743	48.42
South Korea	118756	36	738	20.50
Italy	83235	35	1093	31.23
Greece	91495	33	785	23.79
New Zealand	106830	33	1399	42.39
Canada	77667	31	389	12.55
Czech Republic	82929	28	2009	71.75

(Considering a minimum of five documents and five citations)



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Fig. 6. Country-Specific Contributions
(Considering a minimum of five documents and five citations)

4.2.2 Bibliographic Coupling

While conducting bibliometric coupling, we performed further filtering based on citations, considering documents with a minimum of 10 citations. The documents having the highest total link strengths were pooled. Out of 1184 documents, 552 meet the threshold. Table 6 displays the documents with the highest link strength.

Table 6

Top 10 most Linked Documents

Document	Global Citations	Total Link Strength
Bariviera [62]	75	4097
Flori [63]	18	4047
Flori [64]	20	3321
Bedi [65]	31	3145
Ahmed [66]	14	2858
Ghorbel [67]	22	2733
Schellinger [68]	17	2723
Bhuiyan [69]	16	2700
Qarni [70]	26	2690
Corbet [71]	698	2619

(Considering a minimum of ten citations)

Since the link strength related to the network (country in this article) is indicative of research collaboration, it is evident that the article by Bariviera and Merediz-Solà [62] from Spain is the most dominant, with 75 global citations and a total link strength of 4097. It is followed by the work of Flori [63] from Italy. Figure 7 displays the clusters of those documents according to their publication year.

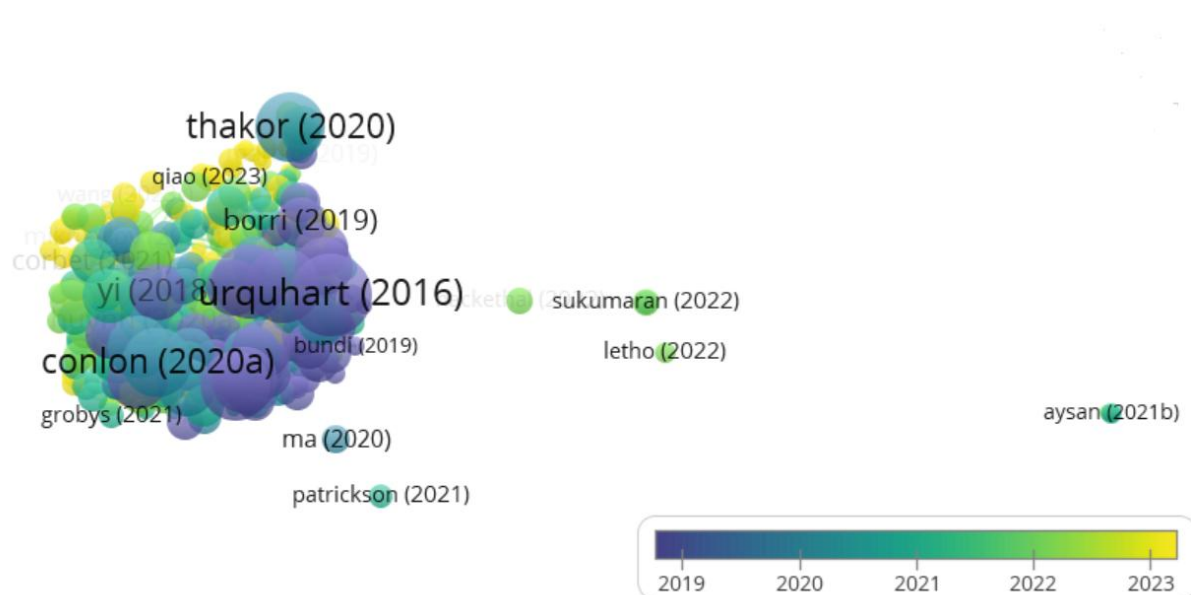


Fig. 7. Network of documents from bibliographic coupling
(Considering a minimum of ten citations)

From the software output, we also understand bibliometric coupling in terms of sources, considering a minimum number of documents and citations per source of 10 (Figure 8). The sources with the highest total link strengths were selected. Out of 290 sources, 24 were recorded as participating in this research. Research in International Business and Finance and International Review of Financial Analysis hold the first and second places in terms of total link strength.

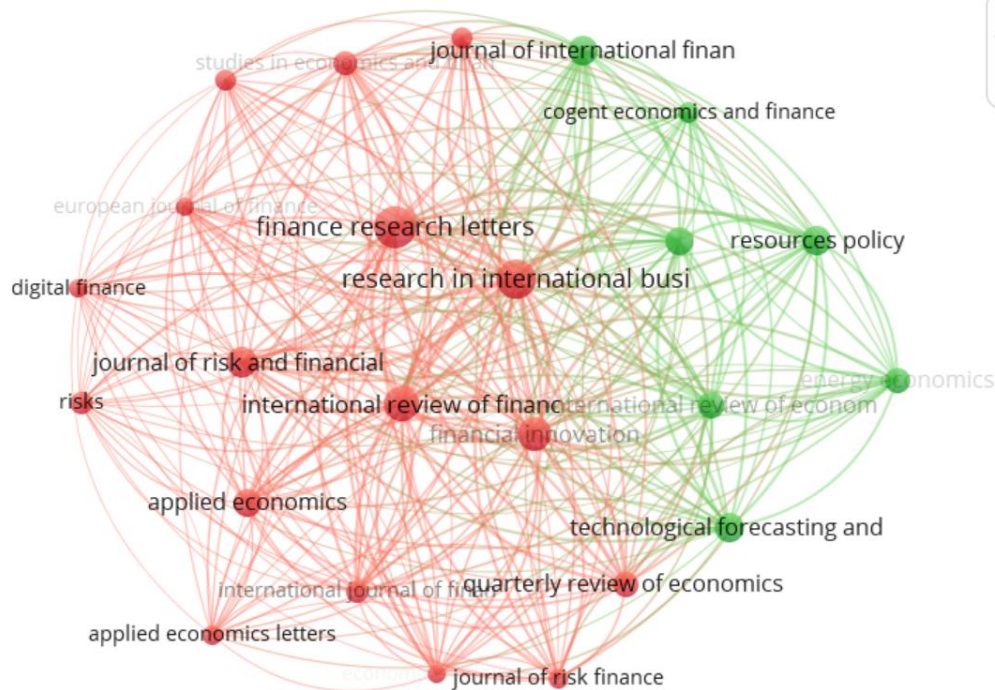


Fig. 8. Network of Sources from Bibliographic Coupling
(Considering a minimum of ten documents and ten citations)

We also recognize bibliometric coupling among 2468 authors, with a minimum number of documents and citations per source of 10 (Figure 9). Out of 2468 authors, 17 meet this threshold. The authors, having the highest total link strengths, were picked. Bouri Elie and Corbet Shaen grasp the first and second rankings in terms of total link strength from the School of Business, Lebanese American University, and DCU Business School, Dublin City University, respectively.

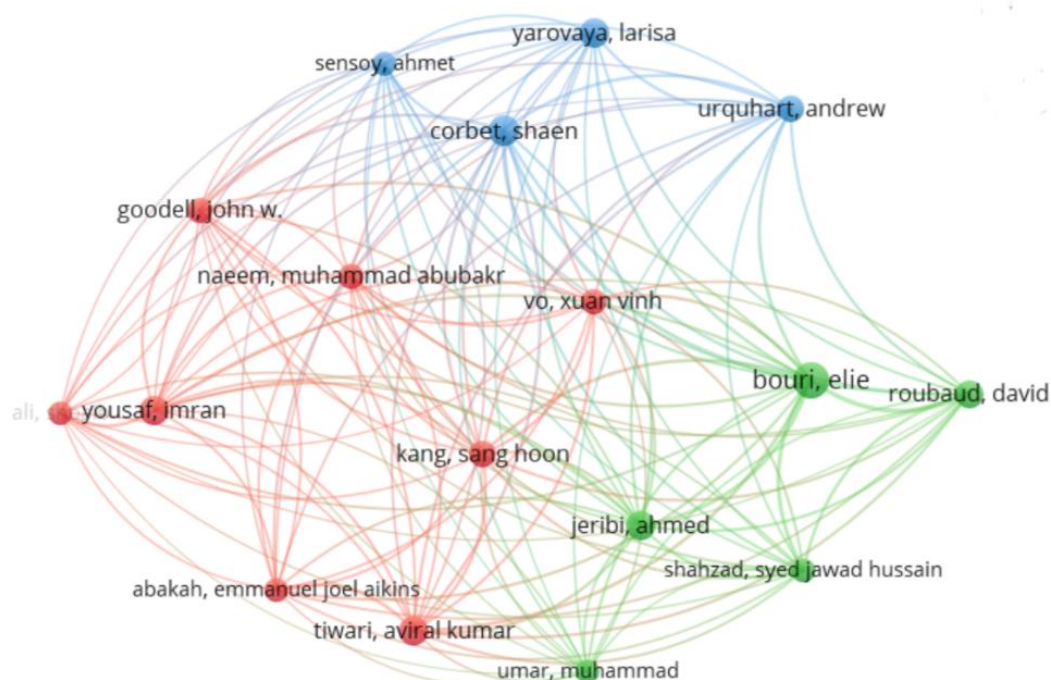


Fig. 9. Network of Authors from Bibliographic Coupling
(Considering a minimum of ten documents and ten citations)

4.2.3 Affiliation Statistics

We have also attempted to identify the most closely linked organizations, considering a minimum number of documents and a minimum of 5 citations. The analysis shows that a sum of 2549 organizations participated, out of which only 24 organizations meet the threshold (Table 7). A larger density of contributing organizations can be found in Ireland. From the geographical dispersion of these organizations, it can be noted that investment in the cryptocurrency domain has concerned organizations and research centers worldwide. The Dcu Business School, Dublin City University, and Adnan Kassar School of Business lead the cohort in terms of total link strength, representing strong research collaboration our identified domain. On the other hand, Usek Business School, Holy Spirit University of Kaslik, Jounieh, Lebanon, is the highest global citation, followed by Montpellier Business School, Montpellier, France. It can also be observed that the Indian Institute of Management, Bodh Gaya, from India, holds the eleventh ranking in terms of total link strength.

Table 7

Top 15 most Linked Organisations

Organisation	Country	Documents	Global Citations	Total link strength	Local Citations
"Dcu Business School, Dublin City University"	Ireland	18	1768	9363	98.22
"Adnan Kassar School of Business, Lebanese American University, Beirut"	Lebanon	27	453	8647	16.78
"Montpellier Business School, Montpellier, France"		16	2560	8391	160.00
"School Of Accounting, Finance and Economics, University of Waikato"	New Zealand	16	940	8304	58.75
"Usek Business School, Holy Spirit University of Kaslik, Jounieh"	Lebanon	12	2599	6017	216.58
"Trinity Business School, Trinity College Dublin, Dublin 2"	Ireland	8	1630	4436	203.75
"Department Of Economics and Finance, College Of Economics And Political Science, Sultan Qaboos University, Muscat"	Oman	9	718	4361	79.78
"Institute Of Economic Studies, Faculty of Social Sciences, Charles University, Prague"	Czech Republic	6	1206	3631	201.00
"Smurfit Graduate School of Business, University College Dublin"	Ireland	7	1117	3542	159.57
"Institute of Business Research, University of Economics Ho Chi Minh City, Ho Chi Minh City"	Viet Nam	7	224	3399	32.00
"Indian Institute of Management Bodh Gaya, Bodh Gaya"	India	8	171	3221	21.38
"South Ural State University, Chelyabinsk"	Russian Federation	7	402	3134	57.43
"College Of Business and Public Management, Wenzhou-Kean University"	China	9	209	3051	23.22
"Faculty of Business and Management, University of Balamand, Tripoli"	Lebanon	5	82	2877	16.40
"Department of Economics, University of Pretoria, Pretoria, 0002"	South Africa	5	727	2752	145.40

(Considering a minimum of five documents and five citations)

4.2.4 Citation Analysis

The network analysis of article citations revealed that out of 1184 documents, 529 have more than 10 citations. Table 8 depicts the 20 most cited publications in our research domain.

Table 8
Top 20 Most Cited Articles

Documents	Author	Journal	Year	Global Citations
"The inefficiency of Bitcoin"	Urquhart A. [72]	"Economics Letters"	2016	901
"Cryptocurrencies as a financial asset: A systematic analysis"	Corbet <i>et al.</i> , [71]	"International Review of Financial Analysis"	2019	698
"Hedging capabilities of bitcoin. Is it the virtual gold?"	Dyhrberg [73]	"Finance Research Letters"	2016	664
"Fintech and banking: What do we know?"	Thakor [74]	"Journal of Financial Intermediation"	2020	577
"Safe haven or risky hazard? Bitcoin during the Covid-19 bear market"	Conlon and McGee [75]	"Finance Research Letters"	2020	570
"Bitcoin is not the New Gold – A comparison of volatility, correlation, and portfolio performance"	Klein <i>et al.</i> , [76]	"International Review of Financial Analysis"	2018	559
"Is Bitcoin a better safe-haven investment than gold and commodities?"	Shahzad <i>et al.</i> , [77]	"International Review of Financial Analysis"	2019	488
"Informational efficiency of Bitcoin—An extension"	Tiwari <i>et al.</i> , [78]	"Economics Letters"	2018	454
"Are cryptocurrencies a safe haven for equity markets? An international perspective from the COVID-19 pandemic"	Conlon <i>et al.</i> , [79]	"Research in International Business and Finance"	2020	415
"Is Bitcoin a hedge, a safe haven or a diversifier for oil price movements? A comparison with gold"	Selmi <i>et al.</i> , [80]	"Energy Economics"	2018	384
"Is Bitcoin a hedge or safe haven for currencies? An intraday analysis"	Urquhart and Zhang [81]	"International Review of Financial Analysis"	2019	361
"Safe haven, hedge and diversification for G7 stock markets: Gold versus bitcoin"	Hussain Shahzad <i>et al.</i> , [82]	"Economic Modelling"	2020	352
"The technology and economic determinants of cryptocurrency exchange rates: The case of Bitcoin"	Li and Wang [83]	"Decision Support Systems"	2017	350
"Bitcoin, gold, and commodities as safe havens for stocks: New insight through wavelet analysis"	Bouri <i>et al.</i> , [84]	"Quarterly Review of Economics and Finance"	2020	347
"Herding behaviour in cryptocurrencies"	Bouri <i>et al.</i> , [85]	"Finance Research Letters"	2019	329
"Volatility connectedness in the cryptocurrency market: Is Bitcoin a dominant cryptocurrency?"	Yi <i>et al.</i> , [86]	"International Review of Financial Analysis"	2018	320

The five most cited papers were published by Urquhart [72], Corbet *et al.*, [71], Dyhrberg [73], Thakor [74], and Conlon *et al.*, [75], with 901, 698, 664, 577, and 570 citations globally, respectively. It is worth mentioning that among the list of 20 most cited papers, three authors are affiliated with the Indian Institute; one is from Rajagiri Business School, Kochi, India, another two are from the Indian Institute of Management Raipur, Chhattisgarh, India, and from the Indian Statistical Institute, Kolkata, India. This further demonstrates that India is among the most active countries in

cryptocurrency investment. Table 9 represents the top ten publications based on the PageRank scores (See equation 1).

Table 8

Continued

Documents	Author	Journal	Year	Global Citations
"Time and frequency domain connectedness and spill-over among fintech, green bonds and cryptocurrencies in the age of the fourth industrial revolution"	Le <i>et al.</i> , [87]	"Technological Forecasting and Social Change"	2021	290
"Price fluctuations and the use of bitcoin: An empirical inquiry"	Polasik <i>et al.</i> , [88]	"International Journal of Electronic Commerce"	2015	280
"Does global economic uncertainty matter for the volatility and hedging effectiveness of Bitcoin?"	Fang <i>et al.</i> , [89]	"International Review of Financial Analysis"	2019	239
"Conditional tail-risk in cryptocurrency markets"	Borri [90]	"Journal of Empirical Finance"	2019	236

(Considering a minimum of ten citations)

Table 9

Top ten publications based on PageRank scores

Rank	Document	Citations	Total Link Strength	PageRank
1	Urquhart [72]	901	768	0.0085
2	Corbet [71]	698	2619	0.0066
3	Dyhrberg [73]	664	235	0.0063
4	Thakor [74]	577	18	0.0055
5	Conlon [75]	570	1621	0.0054
6	Klein [76]	559	1611	0.0053
7	Shahzad [77]	488	1544	0.0046
8	Conlon [79]	415	1618	0.0039
9	Selmi [80]	384	1096	0.0036
10	Urquhart [81]	361	1857	0.0034

The top four publications (i.e., Corbet [71]; Urquhart [72]; Dyhrberg [73]; Thakor [74]) are based on the PageRank scores. It can be noticed that the scores are almost consistent with those based on global citations (see Table 8).

We have also checked citation analysis for the authors. While performing the citation analysis, initially, we have done a manual calculation using Microsoft Excel to understand the number of times a specific article or author is cited in other publications, providing insights into the importance and implications of their work within a field. Table 10 illustrates the Top 25 influential authors based on their citations.

It can be noted that Bouri E. has the highest global citations, but Dyhrberg A.H. has the highest local citations. This indicates that Bouri E, has not only contributed to the field of cryptocurrency but also garnered more attention from other disciplines and research areas.

Furthermore, using the VOS viewer tool, the output shows that of 2468 authors, 17 have a minimum of 10 documents and citations (Table 11). From Tables 10 and 11, it is clear that Bouri E from Lebanon, and Roubaud D from France, are the most highly cited authors in the field. This aligns with the earlier results in the present study, which show that India is one of the productive countries

in our research domain. Tiwari A.K. from Rajagiri Business School, Rajagiri Valley Campus, Kochi, India, is among the top 10 most-cited authors.

Table 10
Top 25 influential authors based on Global Citation

Rank	Authors	Global Citation	Local Citation	No of Publications
1	Bouri E.	3646	110.48	33
2	Roubaud D.	2844	177.75	16
3	Urquhart A.	2399	171.36	14
4	Lucey B.	1929	241.13	8
5	Corbet S.	1880	89.52	21
6	Kristoufek L.	1553	194.13	8
7	Yarovaya L.	1402	82.47	17
8	Shahzad S.J.H.	1287	117.00	11
9	Gupta R.	1273	141.44	9
10	Conlon T.	1014	169.00	6
11	Tiwari A.K.	802	40.10	20
12	Mensi W.	767	69.73	11
13	Umar M.	744	74.40	10
14	Walther T.	708	236.00	3
15	Abakah E.J.A.	706	64.18	11
16	Klein T.	694	347.00	2
17	Dyhrberg A.H.	664	664.00	1
18	Yousaf I.	644	40.25	16
19	Wang G.-J.	620	155.00	4
20	Thakor A.V.	577	577.00	1
21	McGee R.	570	570.00	1
22	Pham Thu H.	559	559.00	1
23	Nasir M.A.	493	82.17	6
24	Goodell J.W.	492	41.00	12
25	Huynh T.L.D.	488	69.71	7

Table 11
Top 10 Most Cited Authors

Author	Global Citations	Country
Bouri, Elie	33	Lebanon
Roubaud, David	16	France
Urquhart, Andrew	14	United Kingdom
Corbet, Shaen	21	Ireland
Yarovaya, Larisa	17	United Kingdom
Shahzad, Syed Jawad Hussain	11	France
Tiwari, Aviral Kumar	19	India
Umar, Muhammad	10	Lebanon
Abakah, Emmanuel Joel Aikins	11	Ghana
Yousaf, Imran	19	China

(Considering a minimum of ten documents and ten citations)

Figure 10 depicts a density visualization of the most cited journals. The top five journals are Finance Research Letters, International Review of Financial Analysis, Research in International Business and Finance, Technological Forecasting and Social Change, and Energy Economics, with the local citation of 55.89, 85.04, 37.46, 61.00, and 55.95, respectively.

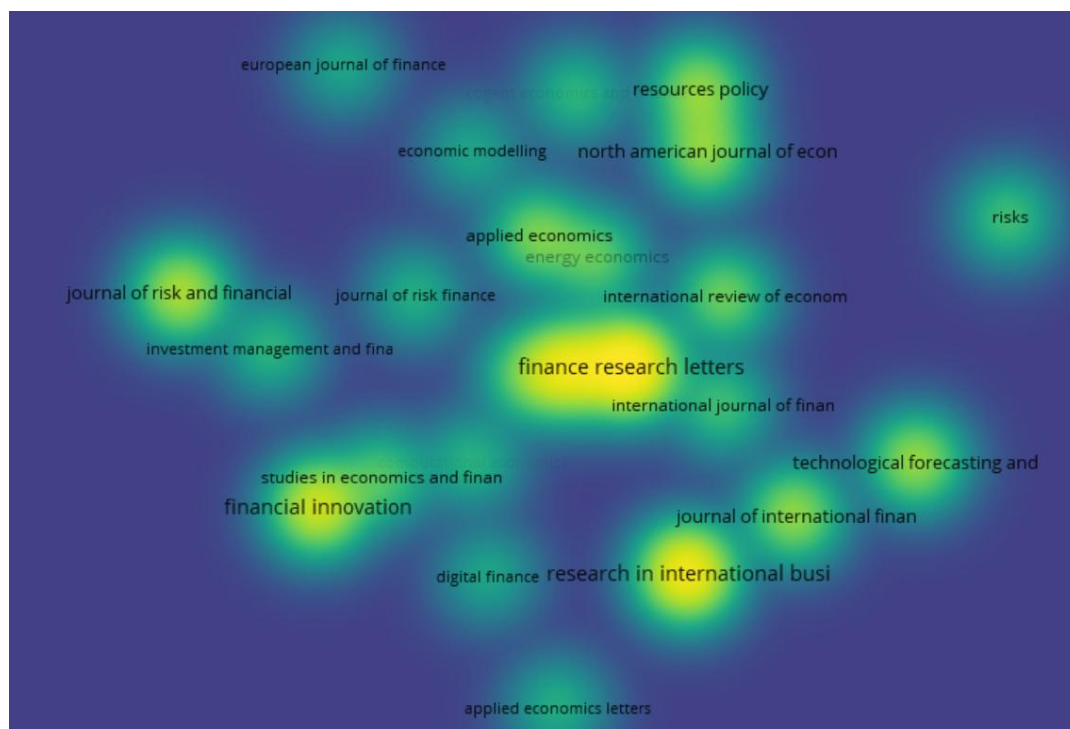


Fig. 10. Density Visualisation of Most Cited Journals
(Considering a minimum of ten documents and ten citations)

Figure 11 illustrates the citation network of countries. Among the total 99 countries, the top 5 most cited countries are the United Kingdom, China, France, Ireland, and Lebanon. India is holding the eighth position with a local citation of 18.01. From the bubble and font size, it can be commented that countries like Indonesia, Kuwait, Thailand, Finland, and Japan have fewer citations.

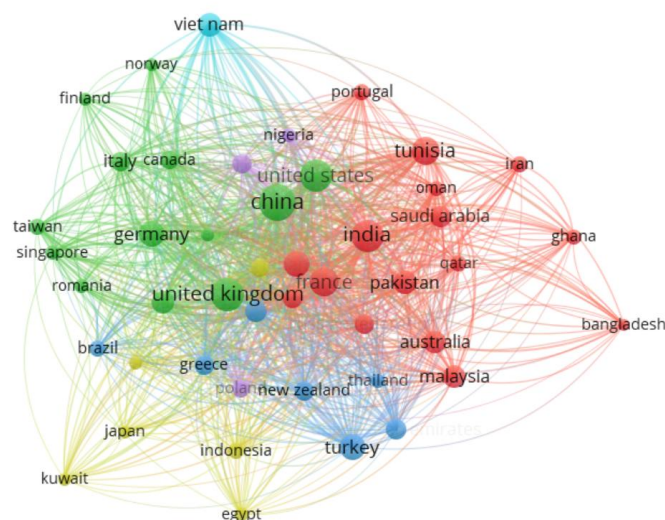


Fig. 11. Network Visualisation of Most Cited Countries
(Considering a minimum of ten documents and ten citations)

4.2.5 Co-Authorship Analysis

The co-authorship analysis indicates that, out of a total of 2,468 authors, a relatively small but significant collaboration network comprising 17 authors emerges when applying a threshold of a minimum of 10 documents and citations per author. This network is visualized in Figure 12. The thickness of the connecting lines reflects the strength of collaborative ties, with thicker links

indicating more frequent co-authored publications. Based on these linkages, the authors are organized into five distinct clusters, differentiated by the color coding of the nodes. Moreover, node size and label prominence suggest that authors such as Bouri E., Roubaud D., and Shahzad S.J.H. occupy central positions within the network, indicating a comparatively higher level of collaborative influence and research connectivity.

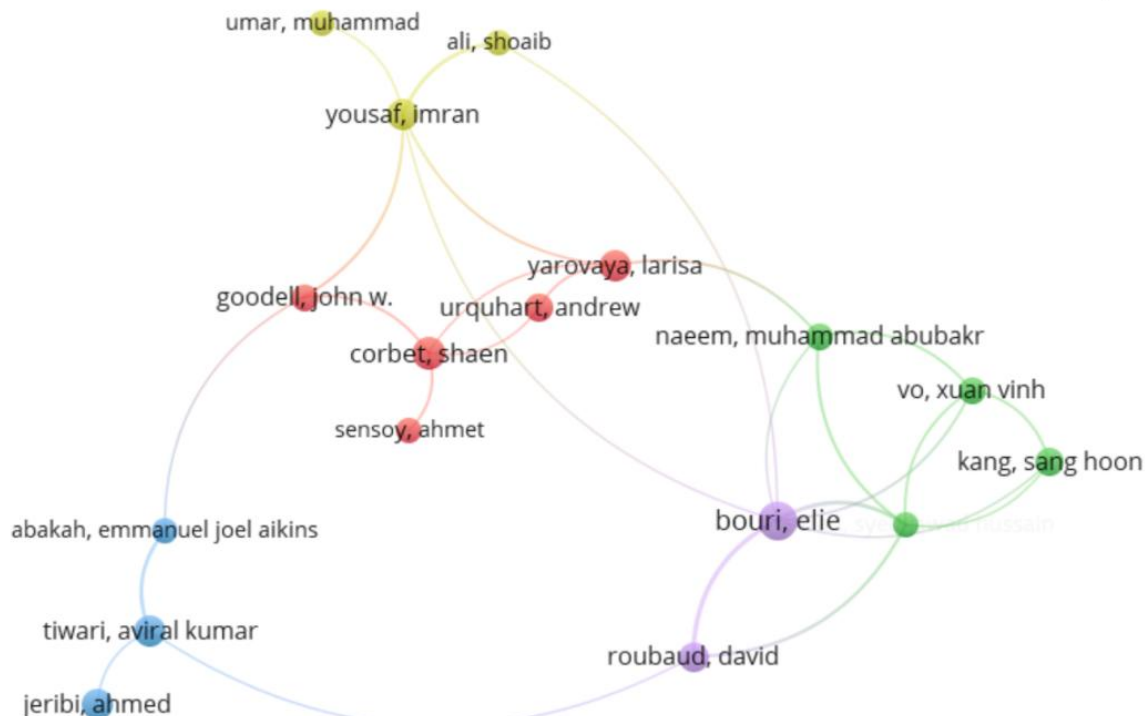


Fig. 12. Network Visualisation of Authors from Co-Authorship Analysis
(Considering a minimum of ten documents and ten citations)

The analysis of co-authors by organization, depicted by the bubble colors in Figure 13, revealed 6 clusters. From Figure 13, the scanty appearance of bubbles illustrates a poor network (regarding co-authorship) of institutions, representing that most of the institutions were not linked in terms of publication collaboration, except those within the same cluster (same bubble color).



Fig. 13. Network Visualisation of Organisations from Co-Authorship Analysis
(Considering a minimum of five documents)

4.2.6 Co-Citation Analysis

We have performed the co-citation analysis to measure the relationship between the two publications through citations [52]. Figure 14 visualizes the interconnectedness between authors who are commonly cited together in identity studies. Out of 51074 cited references, 158 have a minimum of 20 citations. This output reveals the number of times two authors are co-cited by other scholars. This indicates a weak relationship, as the distances between the citations are long.



Fig. 14. Network Visualisation of Authors from Co-Citation Analysis
(Considering a minimum of twenty citations)

Table 12 illustrates co-cited sources. Out of 13988 cited references, 392 have a minimum of 20 citations. The findings demonstrate that Finance Research Letters, International Review of Financial Analysis, and Economics Letters have the highest link strengths.

Table 12

Top 10 Co-Cited Sources

Source	Global Citations	Total Link Strength
"Finance Research Letters"	4417	192590
"International Review of Financial Analysis"	2032	102964
"Economics Letters"	1725	83869
"Research In International Business and Finance"	1085	55848
"Financ. Res. Lett."	1023	42830
"Energy Economics"	769	42498
"Int. Rev. Financ. Anal."	931	42182
"Finance Res. Lett."	1158	39838
"Resources Policy"	624	35886
"Physica A: Statistical Mechanics and Its Applications"	675	32508

(Considering a minimum of twenty citations)

4.2.7 Keyword Analysis

We have checked the co-occurrence of "All keywords" as well as "Author Keywords". A total of 2,473 Author Keywords are found, 194 of which co-occur more than five times (Table 13).

Table 13

Top 10 keywords from Co-occurrence analysis of author keywords

Author Keyword	Occurrences
Cryptocurrency	753
Bitcoin	505
Covid-19	129
Gold	95
Blockchain	81
Safe Haven	59
Volatility	58
Diversification	49
Ethereum	48
Hedge	41

(Considering a minimum of five citations)

The network map of the co-occurrence of author keywords is presented in Figure 15. A total of 3288 keywords are recognized, with 106 of them co-occurring more than ten times. The biggest bubble (green) and label size were recorded for ‘bitcoin’ as a keyword, with 505 occurrences. The total link strengths of 1,815, 1,448, 804, 767, and 701 were extracted for “cryptocurrency,” “bitcoin,” , “COVID-19,” and “gold,” respectively, as the five top-ranked keywords. The keyword network connections, implying interactions, are represented by the lines between the keywords in the figure. Adaptive Market Hypothesis (AMH), Behavioral Finance, Efficient Market Hypothesis (EMH), etc., are some theoretical backgrounds applied to our research domain.

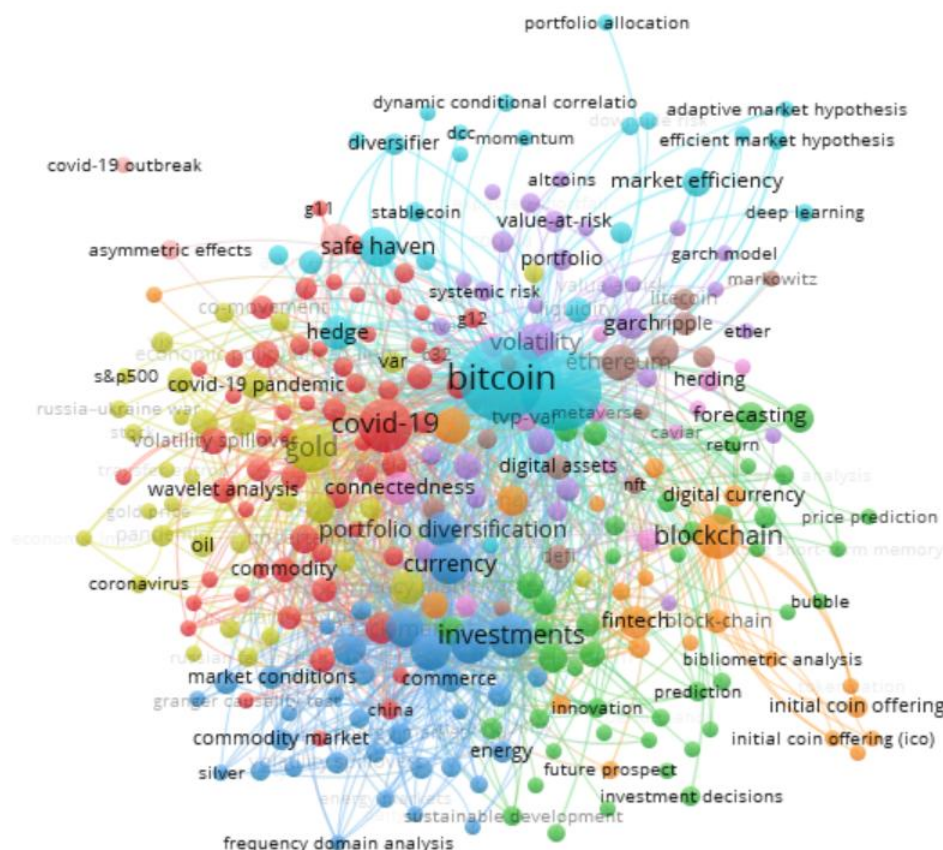


Figure 15: Co-occurrences network of high-frequency keywords
(Considering a minimum of ten times co-occurrence)

Some areas of research domains identified in Figure 15 are tabulated in Table 14.

The Tree Map in Figure 16 further analyzes the same data set using the binary tiling technique in Power BI and provides a comprehensible and quantified visual representation of the 50 most frequently occurring keywords in the data set. The larger tiles in the map, i.e., “cryptocurrency” (23.75%), “bitcoin” (15.91%), “covid-19” (5.47%), and “investment” (5.35%), are the same as the prominent keywords in the Network Density of the VOS viewer tool. Other terms such as “safe haven”, “blockchain”, “volatility”, “diversification”, and “ethereum” also seem prominent in the Tree Map, similar to the themes seen in the Network Density visualisation and Author Keyword (Table 11). The Tree Map, nevertheless, enhances a coating of precision by exhibiting the precise percentages, revealing a more refined apprehension of how often these keywords are used relative to each other.

Table 14

Research Domain based on Co-occurrence analysis of All author keywords

Research Domain	Keywords (Top 5 by Occurrences)	Research Area
Asset Classes	Altcoins; Green Bonds, Non-Fungible Tokens (Nfts); Cryptocurrency; Bitcoin; Ethereum; Stablecoin	This emphasis aligns with the discussion on various financial instruments or investments, mentioning various unique risk-return profiles and market behaviours, etc.
Financial Markets	Investment; Stock Market; Financial Markets; Portfolio Diversification; Risk Management	This area evolves around various financial markets where the buyers and sellers trade financial assets.
Risk & Volatility	Volatility; Spillover Effect; Safe Haven Hedging; Uncertainty Geopolitical Risk; Monetary Policy; Pandemic	The research focuses on fluctuating trends and various price movements, which can lead to benefits or losses for investors or traders.
Economic Policy & Analysis	Economic Policy; Digital Currency; Exchange Rate; Inflation	These studies analyze the impact of economic policies promoting innovation while safeguarding financial stability.
Commodities	Gold; Crude Oil; Commodity Market; Precious Metal; Oil Prices	The studies in this domain help investors, regulators, and economists understand the difficulties of digital assets in a wider financial background.
Technology & Innovation	Fintech; Machine Learning; Artificial Intelligence; Digital Asset; Decentralized Finance; Blockchain; Tokenization Decentralized Finance (DeFi)	Since cryptocurrencies are primarily based on groundbreaking technological developments, the manuscripts in this domain highlight how evolving technologies outline digital assets and their ecosystems.
Methodological Approaches and Research Design	Garch; Wavelet Analysis, Quantile Regression; Cointegration Analysis; Forecasting	These researches suggest different styles and methodologies of research design to examine complex technical, economic, and social aspects.



Fig. 16. The Tree Map 50 High-Frequency Keywords

The texts retrieved from Titles and Abstracts of Scopus and Google Scholar Database, based on VOSviewer and Python, were categorized into four thematic areas (Table 15).

Table 15

Clusters of Thematic Areas

Cluster Number and Areas	Key Terms
Cluster 1: Market Behaviour & Investment Strategies	The frequent appearance of terms such as "Initial Coin Offering (ICO)", "Cryptocurrency Investment", "Trading Strategy Bull Market", "Bear Market", "Profitability", "Abnormal Return", "Herding", "Speculation", "Investor Sentiment", "Retail Investor", "Technical Analysis", "Momentum", "Predictability", "Diversifier", "Hedge Ratio", "Optimal Portfolio", "Diversification Benefit", "Safe Haven (Weak/Strong)", "Precious Metal (Gold, Silver)", "Volatility Index (VIX)", "Downside Risk", "Tail Risk" etc.
Cluster 2: Technology & Quantitative Analysis	This cluster pointed towards terms like "Blockchain Technology", "NFT", "DeFi", "Machine Learning", "LSTM", "Algorithm", "Prediction", "GARCH Model", "DCC", "Quantile Regression", "Wavelet Analysis", "Dynamic Spillover", "Volatility Connectedness", "Time Series", "Artificial Intelligence", "Big Data", "High-Frequency Data", "ARDL", "NARDL", "TVP-VAR", "Granger Causality Test"
Cluster 3: Risk, Volatility & Market Efficiency	This cluster observes the presence of terms such as "Efficient Market Hypothesis", "Market Efficiency", "Volatility Spillover", "Dynamic Correlation", "Contagion Effect", "Economic Policy Uncertainty", "Geopolitical Risk", "Crisis Period", "Pandemic Crisis", "Russia-Ukraine War Crisis", "Structural Break", "Risk Measure", "CVaR", "Sharpe Ratio", "Extreme Market Conditions", "Asymmetric Effect", "Tail Dependence", "Jump", and "Bubble".
Cluster 4: Macro-Financial, Regulatory, and Sustainability Context	This cluster ties cryptocurrencies to broader economic/regulatory trends incline towards global markets, regulations, macroeconomic factors as reflected in terms such as "Regulation", "Central Bank", "Financial Stability", "Commodity Market", "Oil", "Gold", "Equity Market", "Bond Market", "US Stock Market", "Emerging Markets (Brazil, India, Russia)", "Economic Uncertainty", "Inflation", "Financial System", "Green Bond", "Clean Energy", "Sustainability", "Adoption", "Practitioner", "Government", "Stakeholder", "News", "Social Media (Twitter)", "Investor Attention" etc.

The largest cluster, Cluster 1, contains 163 terms. This cluster, which encompasses a large part of identity study, reflects investor activities and trading approaches, as shown by the regular occurrence of words such as. This cluster offers an approach to investor identities based on the formation of investors' financial decision-making processes and association with market mechanisms. This cluster deals with investor behavior, risk management, and investment allocation methods. This cluster summarizes a new approach to investment, which combines behavioral indicators, technical indicators, and current portfolio optimization, particularly in relation to the evolving nature of digital and conventional assets.

Cluster 2 is the second-largest cluster and includes 104 terms. The cluster combines computational and blockchain-based innovations with strong prominence given to data-based modeling, sophisticated econometric techniques, and AI-based forecasting blueprints. The cluster is similar to how conventional economic models are being re-engineered and extended through technological innovations and access to large-scale and high-dimensional data. The cluster is also characterized by methodological evolution that focuses on high-frequency and granular data analysis to enable more flexible and subtle understandings of markets.

The third largest cluster, Cluster 3, has 68 terms. The theme of Cluster 3 is volatility, crises, and statistical market properties. The theme of Cluster 3 is the dynamics of market effectiveness and risk, primarily in the context of economic, geopolitical, or structural disruptions. The theme of Cluster 3 emphasizes the role of risk measurement tools and performance evaluations, particularly the non-

linear or abrupt recoveries of financial markets, as well as the role of exogenous tremors or shocks on asset prices, volatility, or decision-making.

Cluster 4: The cluster centers on the relationship between markets, macroeconomic policy, and sustainability, with particular reference to the role of institutions, investors, and new global risks that are developing. This is essentially a systemic approach to understanding how markets function in relation to broader socio-economic and environmental backgrounds. This cluster also reflects the impact of media and public discourse on markets, as well as the growing interest in behavioral finance and sentiment analysis.

4.2.9. Thematic Analysis for Investment in Metaverse

Figure 19 represents the Three-factor analysis of the relationship among keywords (left), authors (center), and sources (right). The top 5 influential authors based on global citations are Bouri E., Roubaud D., Urquhart A., Lucey B., Corbet S., who had a relationship with five sources like Finance Research Letters, International Review of Financial Analysis, Economics Letters, Research in International Business and Finance, Energy Economics, etc. Furthermore, the authors and the sources have a strong relationship with the top trending keywords like bitcoin, blockchain, COVID-19, cryptocurrency, Ethereum, gold, green bond, etc.

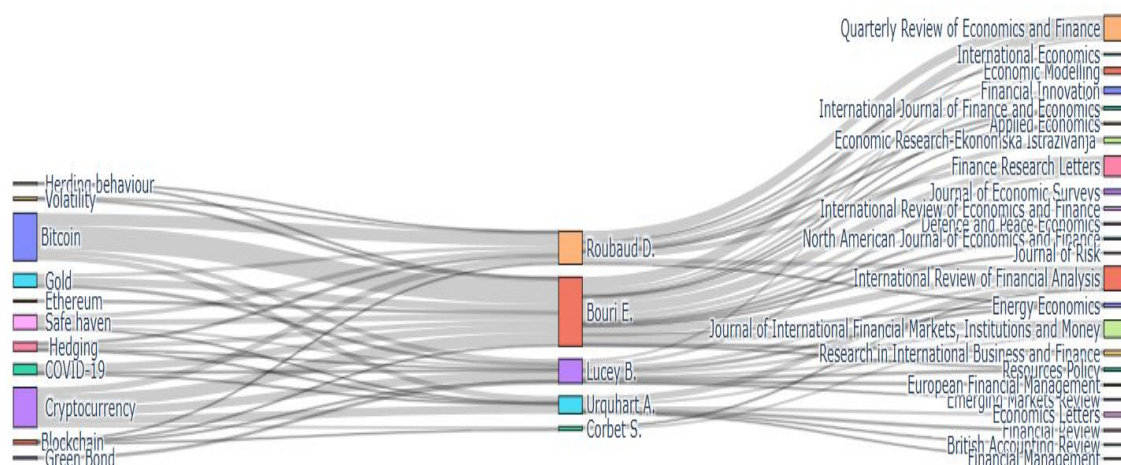


Fig. 19. Sankey Diagram among keywords (left), authors (center), and sources (right)

Figure 20 highlights the thematic evolution based on titles. It can be observed that the term cryptocurrency has been most frequently used in the titles of research works since 2021, followed by bitcoin and asset class. The term “NFTs” was not observed in the titles of research works until 2020. The research paper related to “Risk”, “Safe Heaven”, “Investment”, and “Asset Class” started from 2018 onwards.

Figure 21 point outs the thematic evolution on the basis of both author and index keyword. The term “cryptocurrency” remains at the top-most position from 2021 onwards followed by bitcoin. The keywords like “blockchain”, “safe heaven”, “Ethereum” and obviously “COVID-19” were missing before 2018.

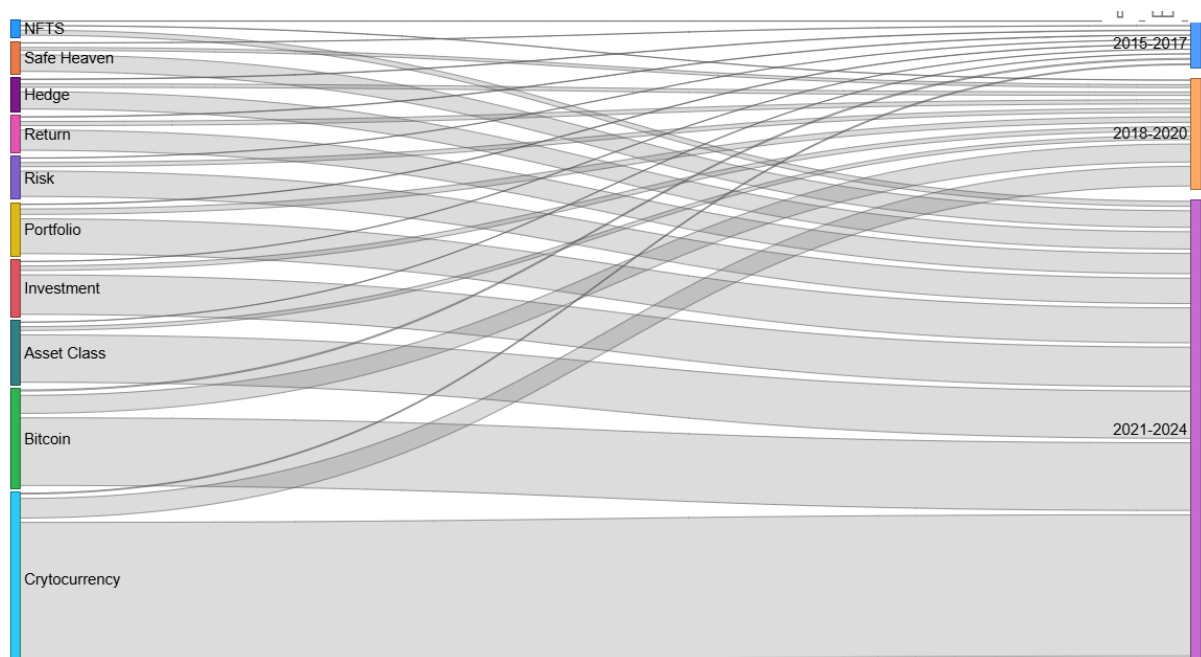


Fig. 20. Sankey Diagram among Titles (left) and Year (right)

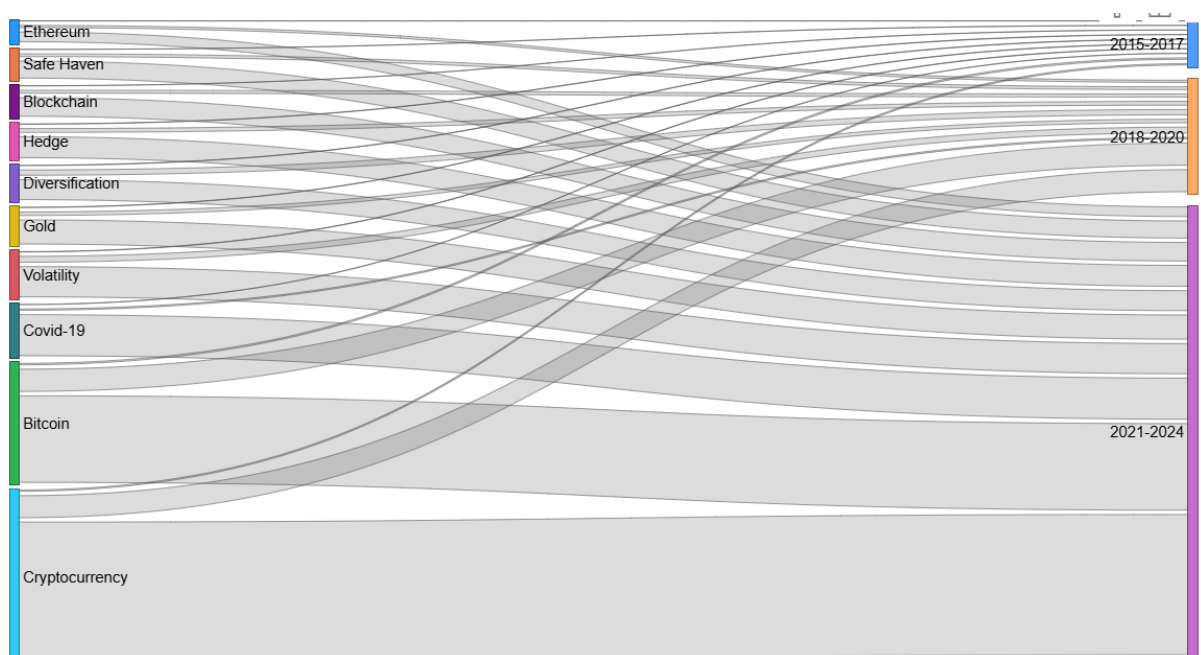


Fig. 21. Sankey Diagram among Keywords (left) and Year (right)

4.3 Systematic Literature Review

A Systematic Literature Review (SLR) focuses on identifying relevant primary papers, extracting the required data, analyzing, and synthesizing the results to gain further, broader insights into the investigated domain. After the bibliometric analysis, this paper conducts an SLR using three frameworks: TCCMR, ADO, and PICO. We target highly cited, recently published papers in reputable journals (Scopus-indexed, ABDC-A/A* listed). Accordingly, we reviewed 104 papers. The detailed SLR findings are presented in Appendix A (Tables A1-A13).. Necessary discussions of the findings are provided in the next section.

The use of multiple SLR frameworks, along with bibliometric analysis, fosters both structural mapping and causal synthesis in CC research. Bibliometric analysis unveils the knowledge

concentration and fragmentation, thematic clusters, and prominent contributions. However, to further elucidate theoretical aspects, profundity, or causal reasoning, SLR is used. The TCCMR framework uncovers the theory, context, characteristics, technique, and research types used in past studies. It ensures a comprehensive conceptual analysis, uncovers unexplored areas, themes, and methodological aspects.

Nevertheless, TCCMR does not explicitly explain the causal relationships among the antecedents and outcomes through decision-making models. The ADO framework (Tables A8-A10) supplements the TCCMR findings. On the other hand, the PICO framework (Tables A11-A13) offers an in-depth discussion on the populations under study, actions, comparative assessments, and multidimensional outcomes. Altogether, these frameworks offer a comprehensive in-depth review of past studies.

5. Discussion

Isaac *et al.*, [91] underscored that bibliometric research has expanded collective eminence by summarizing current research across numerous scientific fields. Given the significance of bibliometric studies, it is essential to continually refine and expand these methodologies to deepen our understanding of progress in this domain and to offer insights into current trends and future directions.

The primary objective of this study is to provide a comprehensive investigation of identity-related research using bibliometric techniques from 2015 to Mid-2025. The data reveal that there is a sluggish publication trend from 2015 to 2017. The number of publications increased from three in 2017 to 316 in 2024. The highest number of publications was recorded in 2024, followed by the second-highest in 2023. The highest growth rate was recorded between 2019 and 2021. There was a significant increase in citations between 2015 and 2020. This is due to the dominance of a very dominant research domain. Half of the publications were recorded between 2022 and 2024. Finance Research Letters and Research in International Business and Finance are ranked in positions one and two in the top 10 most published journals. Elsevier Ltd, Elsevier Inc., and Elsevier B.V. are among the major publishers in our research field. Among 99 participating countries, the top 5 countries are China, the United Kingdom, India, the United States, and France. In terms of local citations, Ireland, the Czech Republic, Lebanon, France, and South Africa are leading the race. At the continental level, emerging research hubs are developing in Asia and Europe. However, the rising contributions from North America, Africa, and Oceania suggest a steady shift in research outlooks beyond the traditional background. The top four publications are the articles by Corbet [71], Urquhart [72], Dyhrberg [73], and Thakor [74], which were validated based on global citations and PageRank scores. It is evident from the research output that the article by Bariviera's [62] "*Where Do We Stand In Cryptocurrencies Economic Research? A Survey Based On Hybrid Analysis*" from Spain is the most dominant, followed by the article of Flori's [63] "*Cryptocurrencies In Finance: Review And Applications*". Bouri Elie and Corbet Shaen are holding the first two positions in terms of total link strength from the School of Business, Lebanese American University, and DCU Business School, Dublin City University, respectively.

A total 2549 organisations have participated in our research domain, where *The Dcu Business School, Dublin City University, and Adnan Kassar School of Business* lead the cohort in terms of total link strength. Dyhrberg A.H., from University College Dublin, Dublin, Ireland, has the highest local citations. In contrast, Bouri E. has a higher global citation count, indicating that this author has not only contributed to the field of CC but also garnered attention from other disciplines and research areas.

Notably, among the list of 20 most cited papers, three authors are affiliated with the Indian Institute: Rajagiri Business School, Kochi, India; the Indian Statistical Institute, Kolkata, India; and the

Indian Institute of Management Raipur, Chhattisgarh, India. Tiwari A.K., from Rajagiri Business School, Rajagiri Valley Campus, Kochi, India, is among the top 10 most-cited authors. The Indian Institute of Management, Bodh Gaya, ranks 11th among the most linked organisations. This proves India's active participation in the identified area.

A poor network (regarding co-authorship) of institutions and co-citation (regarding co-authorship) were observed. The key thinkers are as Bouri, E.; Urquhart, A. and Corbet, S. whose work spread several disciplines and has made noteworthy contributions to the study of identity. Bouri, Elie and Roubaud, David are the most highly cited authors in the field.

A co-occurrence network analysis highlights that the most central terms are "bitcoin," "cryptocurrency," "investment," "COVID-19," "gold," etc. Keyword analysis suggests that the research evolves across domains such as asset classes, financial markets, risk & volatility, economic policy & analysis, commodities, technology & innovation, etc. The thematic analysis indicates that identity-related topics are of significant emphasis, including market behaviour, investment strategies, macro-financial, regulatory, and sustainability contexts, risk, volatility, and market efficiency.

This research's output portrayed essential insights into the present state of information on "*investment in cryptocurrency*". Along with SLR and bibliometric review, this study blends a framework-based analysis based on the Theory, Context, Characteristics, Research Type (TCCR) framework [92] in line with the TCCM (theory, context, characteristics, and methodology) framework of Paul and Rosado-Serrano [93], to highlight novel gaps relating to theories, contexts, characteristics, and research type for investments in CC. A detailed review using the TCCMR framework of the prominent papers is given in Table A1 (Appendix A).

5.1 Theory

We note that prior studies (Table A2) have mostly examined EMH (e.g., Urquhart [72] and Tiwari *et al.*, [78]) and safe-haven/hedging models [73, 84]. Fundamental studies examining informational efficiency [72,78] and hedging efficacy [73,77] have constituted the conceptual foundation of the discipline. Prominent research, such as Corbet *et al.*, [71] and Conlon and McGee [75], argued about safe-haven vs. risk assets, situating Bitcoin in relation to gold, stocks, and oil. We also note from the bibliometric coupling and co-citation networks that there is a theoretical concentration rather than diversity. The areas of behavioral finance, such as herding, investor sentiment, and overreaction, have been studied independently [8-9],[85]. However, theoretical integration is still insufficiently observed. Likewise, frameworks addressing uncertainty and macroeconomic risk [89] are utilized sporadically, devoid of integration with institutional or governance theories.

This review points out that the use of theory is mainly confirmatory in nature. However, there is no cohesive theoretical framework. Though this work provides a clear direction for future empirical work within the scope of this study, it recommends further study based on domain-specific benchmark datasets, along with pilot-scale validation. The above points emphasize the need to develop or extend existing paradigms such as EMH and AMH. There is limited research, like Conlon *et al.*, [79], that worked on crisis situations. However, the static nature of efficiency testing may not sufficiently capture the evolution of structures. Secondly, systemic risk and contagion theories are mainly applied in spillover analysis [86], without considering network-based financial stability approaches. Thirdly, sustainability economics and its link to the connectedness of energy consumption and green finance [10-11] remain outside the conventional asset-pricing theories.

5.2 Context

The contextual factor (Table A3) emphasizes that bitcoin investment behavior is highly contingent on the prevailing regime. The rise of publications intensified post-2020, aligning with financial uncertainty generated by the pandemic [75]. The research documents significant changes in hedging and diversification characteristics during crises [76,80]. Cross-asset spillovers amplify under increased uncertainty [1,3], indicating that cryptocurrencies increasingly correlate with traditional markets during periods of systemic stress.

However, contextual heterogeneity is still not well conceptualized. This is despite the investigation of COVID-19, geopolitical risk, and global economic policy uncertainty by [89]. The safe-haven role of cryptocurrencies is not consistent for developed and underdeveloped markets. Bibliometric results suggest that there is a focus on G20 nations, including the UK, China, India, and the US, owing to geographical bias.

Another area that is not well researched is the context of regulation. The institutional adoption and governance challenges [16,19] highlight the tension between financial stability and innovation. Yet, only a handful of works explicitly consider the impact of variations in regulation and policy on investment modeling. Sustainability-linked policy shifts, such as those on energy transition in proof of work systems, are rarely included in portfolio allocation models.

In the context of JIFMIM and TFSC positioning, the data indicates that cryptocurrency research should increasingly incorporate aspects such as institutional quality, regulatory divergence, competition from CBDCs, and macroprudential policy frameworks. Cryptocurrency has moved beyond being a speculative asset and has become an essential part of the evolving global financial architecture.

5.3 Characteristics

The "characteristics" section (Table A4) of TCCMR points to areas of focus: volatility, hedging capacity, diversification benefits, interconnectedness, and spillovers. The co-occurrence of keywords points to a significant emphasis on "volatility," "safe haven," "hedge," "gold," and "COVID-19." This points to a sustained interest in risk management. The empirical literature points to a high volatility level in Bitcoin relative to traditional assets [72-73], along with possible diversification benefits in typical market conditions [84]. However, in crisis conditions, risk levels are exacerbated [79],[90], which negates the notion of a safe haven. This dichotomy further points to asymmetric risk/return profiles in cryptos.

The next emerging trend revolves around the connection between energy and commodity markets [80]. This is because activities performed through digital mining require power consumption, which consequently affects the pricing of bitcoin through fluctuations in energy prices [11]. However, the integration of fintech, green bonds, and crypto-assets [87] points to an extension of the convergence between traditional and digital markets. However, the structural characteristics of the markets, including the dispersion of liquidity, diversity of exchanges, and inefficiencies in microstructures, are not sufficiently researched. This is especially considering the dominance of retail investors and the fluctuations in prices attributed to their sentiments [6]. Therefore, although the literature sufficiently explores return and volatility measures, an in-depth analysis of structural, institutional, and sustainability-related attributes is still absent. In the context of FRL and IRFA literature, the advancement of this dimension requires structural analysis based on microstructure rather than volatility-based approaches.

5.4 Research type

In fact, the TCCMR synthesis of cryptocurrency investing research (Table A7) reveals that it is mostly "empirical and explanatory in nature." Most of the research is based on secondary market data for testing theories of market efficiency, spillovers, and hedging. Predictive modeling, particularly in volatility forecasting, is more important now [33], whereas prescriptive and normative research is less represented. Most of the diagnostic research is on testing the safe-haven and hedge theories of Bitcoin [77,80]. Few research works investigate portfolio models that include environmental and governance constraints, and policy research on macrofinancial stability is limited.

In addition, conceptual or theory development research is limited in comparison to empirical testing research. The previous narrative reviews conducted by Fauzi *et al.*, [36] and Zohuri *et al.*, [39] were descriptive in nature and failed to incorporate an integrated theoretical framework. As depicted in the above synthesis, it is evident that despite the exponential increase in research output, the progress in research development is not commensurate. In the context of top-tier financial journals, research development requires a paradigm shift from safe-haven testing to structural modeling, institutional research, and scenario testing. In the context of TFSC, incorporating methodologies such as sustainability transitions and innovation trajectories in digital currency development will significantly increase the research's theoretical and practical implications.

5.5 Methodology

CC research has significant econometric capabilities but lacks diversity (Tables A5-A6). GARCH models, wavelet coherence, spillovers, VAR approaches, and quant reg are the most commonly applied methods in CC research [84,86]. These methods can efficiently explain the effects of volatility clustering and spillovers; however, they focus on short-term relationships. PageRank and bibliometric methods show intellectual route dependency on early studies of efficiency and safe-haven effects [72,73]. Machine learning and hybrid AI methodologies are emerging; however, they remain underexploited compared to conventional econometrics. Moreover, multi-criteria decision-making (MCDM), scenario-based stress testing, and sustainability-weighted portfolio optimization frameworks are infrequently used in conventional cryptocurrency research [94,95].

A further restriction concerns methodological uniformity across datasets. Much research relies on daily return series for dominant cryptocurrencies, such as Bitcoin and Ethereum, leading to asset concentration bias. The cross-sectional heterogeneity among altcoins, stablecoins, and NFTs has been insufficiently studied. Moreover, high-frequency intraday modeling remains constrained to a select number of studies [81].

6. Limitations and Future Scopes

6.1 Limitations

Although a robust, systematic approach was used to develop this literature review, we acknowledge some limitations of the study. First, the pooling of prevalence data from the Scopus database alone. So, the result may change when we extract data from our sources. Secondly, the quality of searching the literature may present a problem for the paper. Thirdly, the analysis using Gephi and Sci2 tools may help to enrich the results and outcomes of the research. Finally, although we proposed a holistic framework, we failed to test it statistically. Upcoming scholars may think of it and try to investigate the phenomenon through testing conceptual models.

6.2 Future Scopes

The pace of development of the literature on cryptocurrencies indicates an area of research developing faster than it is being consolidated from the theoretical point of view. Although the

bibliometric data suggest an expanding literature and an increasing number of citations, the intellectual structure of the literature appears fragmented, with the dominant topics being volatility, spillovers, and market efficiency, whereas decision-support research and prescriptive research are underrepresented. This indicates the next phase of the literature on cryptocurrencies should be from descriptive and diagnostic research to integrative, theoretical, and decision-oriented research. The present work indicates several avenues of future research.

- i. The TCCMR investigation found that there has been a substantial emphasis on EMH and other financial theories, but not much integration between different fields. Future study might improve comprehension by integrating perspectives from behavioral finance, institutional theory, complexity theory, and information asymmetry. Furthermore, the formulation of mid-range theoretical frameworks that examine the effects of technical trust, decentralized governance, and algorithmic transparency on investor behavior may foster cumulative theoretical advancement in bitcoin literature.
- ii. Future study on CC research may focus more on how people make decisions than only on predictive econometric models. Multi-criteria decision-making, hybrid AI-MCDM models, scenario optimization, and robust portfolio optimization frameworks are among the approaches that might help investors, regulators, and institutions obtain useful information to inform decisions rather than merely predict the future.
- iii. The ADO analysis highlights the fact that emotions and herding are recognized as influencers of decision-making. However, the extent of the influence is uncertain. In the future, the extent of the influence of cognitive biases, financial literacy, online communities, and algorithms may be explored. In addition, the changes made by investors may be explored when the market faces a sharp decline, thereby improving the extent of the learning process.
- iv. Past studies show a substantial focus on discerning the safe-haven property of the CCs. However, a detailed multi-period comparison of several financial instruments, integrating their market performance, investor sentiment, and long-term predictability, remains relatively underexplored. Future work may also concentrate on developing a novel comparative analysis framework of CCs based on the consensus mechanisms, such as Proof of Work (PoW), Proof of Stake (PoS), Delegated Proof of Stake (DPoS), Proof of Authority (PoA), Proof of History (PoH), and Proof of Burn (PoB). In fact, a comprehensive performance assessment framework for the CCs is quite rare in the literature.
- v. CCs, being the volatile assets, are influenced by short-term market events. Studies exist related to event-specific analysis. However, there is a need to assess the CC market's reaction to various heterogeneous events, including geopolitical risks. Most past studies used econometric models in event studies. Standalone, event-specific analysis using soft computing and MCDM models is rare in the literature. Further, short-term performance analysis using technical indicators could be a promising area for exploration.
- vi. CCs are digital assets. These digital assets require a significant amount of energy. However, no significant effort has been made to incorporate sustainability into CCs' analysis by linking energy efficiency measures to economic measures to compare them. Future studies can incorporate ESG scoring, carbon accounting, and energy efficiency into cryptocurrency analysis. This can be done particularly by developing a sustainability-adjusted portfolio where environmental externalities are considered as decision criteria instead of being considered as an afterthought. This can be done in line with the sustainable finance movement.

- vii. The bibliometric cluster shows that there is much emphasis on spillovers and interconnectedness, but there is a poor understanding of integration into macro-financial structures. Further studies could focus on interactions between CCs, monetary policy transmission, fintech lending platforms, and digital payment systems. Apart from that, comparative studies on developed and emerging economies could reveal whether CCs are being used as a speculation tool, for financial inclusion, and as alternative financial structures, depending on the maturity of financial systems.
- viii. It is reported that CCs have been chosen by investors from various strata of society. It is possible that future studies may be conducted to examine the antecedents of CC investment by using various demographic variables.
- ix. The review indicates that the views of regulators and institutions regarding cryptocurrencies are not very clear. It indicates that future research should be conducted on the clarity of regulations, taxation systems, and central bank digital currencies to ensure the stability of the market. It also indicates the need to research the governance of decentralized finance to establish its impact.
- x. Future research may also seek to examine the potential of the use of AI technology, blockchain analytics, and explainable AI-driven financial models to ensure the transparency and honesty of crypto investment models. In order to have a better view of the cryptocurrency system, researchers from various fields should work together to combine finance, computer science, and regulatory economics. In order to increase the external validity of the results, it is recommended to apply various methods using mixed designs.
- xi. At the same time, there is a need for research on new types of crypto assets, such as NFTs and tokenized real assets, to analyze new forms of investment. If one is to understand people's response to significant financial events, there is a need to analyze the stability of crypto markets. Lastly, there is a need to develop decision frameworks that focus on investors and are investor-specific to make bitcoin research more useful.

7. Research Implications

This section will outline the implications of the current study.

7.1 Managerial Implications

However, evidence points to the fact that bitcoin assets have varying characteristics in terms of hedging and diversification, as opposed to characteristics of safe-haven assets. It is important to note that in cases of systemic crises, the benefits of diversification tend to decline, and hence, spillovers in equity and commodity markets become more pronounced. It is therefore necessary for portfolio managers to employ regime-sensitive techniques for allocation, such as dynamic volatility models and cross-asset contagion indices. Additionally, behavioral factors such as herding and sentiments highlight the necessity for sentiment analysis in risk management. The energy consumption of mining is a sustainability issue for bitcoin, hence the necessity for ESG-based evaluations of portfolios.

7.2 Social Implications

CC markets have substantial cultural impact and can be viewed as agents of financial democratization; however, their volatility and speculative nature make them risky for less informed consumers. The issue of fraud and cybersecurity risks is a substantial consumer protection problem, and the high energy consumption of mining generates environmental externalities, creating a tension

between technological progress and environmental justice. It is suggested that future academic research will include financial literacy, digital disparity, and environmental justice in its models.

7.3 Policy Implications

The research implies that more complex rules in CC marketplaces may intensify systemic shocks during crises owing to interrelated volatility and contagion risks. There is a need to balance innovation and financial stability by including CCs in macroprudential regulation. The differing legislation poses arbitrage challenges, and there is a need for uniform disclosure and governance rules. New sustainability-linked regulations could affect asset valuations as environmental regulations become more stringent.

7.4 Technical Implications

Technological architecture is not well integrated into conventional financial models. The transparency of the technology makes it possible to analyze transactions and risks. However, conventional econometric models are still dominant. In future research, it is recommended to consider the incorporation of explainable AI, data from blockchain technology at high frequencies, and changes in consensus mechanisms. Moreover, the impact of cybersecurity resiliency and technology advancements, especially in the area of finance and energy-efficient technologies, is significant.

8. Conclusion

This current study is a comprehensive synthesis of cryptocurrency investment research through a combination of bibliometrics and a systematic review of existing research based on TCCMR, ADO, and PICO models. By integrating existing research on cryptocurrency investments, this systematic review helps in better understanding of the intellectual structure of cryptocurrency research, dominant research themes, and how cryptocurrency as a speculative digital asset is now increasingly viewed as a component of modern financial decision environments. The results of this systematic review of cryptocurrency research suggest that, despite significant progress in advancing volatility behaviors, market connectedness, and portfolio implications, theoretically integrated and prescriptively oriented cryptocurrency decision-support perspectives remain relatively less developed. Moreover, the dominant use of econometric models in cryptocurrency research also points toward potential for diversification of methods through behavioral, inter-disciplinary, and decision science models. Most importantly, this systematic review of cryptocurrency research points toward an evolution of cryptocurrency research from specific market analysis toward more general and integrated themes of sustainability, governance, and financial systems integration. Thus, in summary, this study makes a contribution by providing a structured knowledge map and a forward-looking research agenda that potentially helps academics, investors, and policymakers make sense of the dynamic cryptocurrency space. As cryptocurrencies become more developed as an asset class, theoretically grounded and decision-relevant research will be necessary for advancing both its relevance and relevance.

Appendix A

Table A1

Conceptual definitions of cryptocurrency

S/L	Conceptual Themes	Examples (Studies)
1	Decentralized digital exchange (monetary perspective)	Abakah <i>et al.</i> , [1]; Abdullah <i>et al.</i> , [96]; Apostolakis [97]; Bouri and Jalkh [98]; Cai and Zhao [99]; Conlon <i>et al.</i> , [100]; Dobrynskaya [4]; Guo <i>et al.</i> , [101]; Huang [102]; Kogan <i>et al.</i> , [15]; Liu and Yuan [103]; Meyer <i>et al.</i> , [104]; Narayan and Kumar [3]; Podhorsky [5]; Sharma <i>et al.</i> , [105]; Xiao <i>et al.</i> , [106]; Zhao <i>et al.</i> , [107]
2	Speculative/high-risk asset for investment/trading	Aliu [108]; Assamoi <i>et al.</i> , [109]; Bai <i>et al.</i> , [14]; Boubaker <i>et al.</i> , [110]; Bouteska <i>et al.</i> , [111]; Dobrynskaya [4]; Felföldi-Szűcs and Králik [112]; Kreuzer <i>et al.</i> , [19]; Kyriazis and Corbet [113]; Podhorsky [5]; Proelss <i>et al.</i> , [114]; Wang <i>et al.</i> , [115]; Yousaf <i>et al.</i> , [12]
3	Portfolio diversifier/hedging / safe-haven instrument	Batra <i>et al.</i> , [116]; Bouri and Jalkh [98]; Echaust <i>et al.</i> , [117]; Feng <i>et al.</i> , [118]; Gorman and Hughen [119]; Naeem <i>et al.</i> , [120]; Sila <i>et al.</i> , [121]; Umar <i>et al.</i> , [122]; Walker [123]; Yousaf <i>et al.</i> , [124]
4	Blockchain-driven digital instrument (Technological innovation)	Alharbi <i>et al.</i> , [125]; Almeida <i>et al.</i> , [126]; Asl <i>et al.</i> , [127]; Assaf <i>et al.</i> , [13]; Huang [102]; Hägele [128]; Sharma <i>et al.</i> , [105]; Subramanian <i>et al.</i> , [129]
5	Environmentally aligned green crypto assets	Ali <i>et al.</i> , [130]; Ali <i>et al.</i> , [131]; Arora <i>et al.</i> , [132]; Bajra <i>et al.</i> , [133]; Jiang <i>et al.</i> , [134]; Kayani <i>et al.</i> , [2]; Kliber and Będowska-Sójka [10]; Umar <i>et al.</i> , [122]; Wang <i>et al.</i> , [115]; Yousaf <i>et al.</i> , [124]
6	Cryptocurrency as a stable real-world asset	Feng <i>et al.</i> , [118]; Hoque <i>et al.</i> , [135]
7	NFTs — non-fungible blockchain-based tokenized digital assets	Behl <i>et al.</i> , [136]; BenMabrouk <i>et al.</i> , [137]; Kräussl and Tugnetti [138]; Wang <i>et al.</i> , [115]
8	Digital assets controlled by behavioral/psychological consumptions	Anaza <i>et al.</i> , [8]; Divakaruni and Zimmerman [139]; Jagolinzer [140]; Mathmann <i>et al.</i> , [141]; Ryu [9]; Gerritsen and de Regt [142]

Table A2

Theoretical frameworks used in the literature (TCCMR Framework)

Theoretical Aspect	Related Studies	Frequency
Efficient Market Hypothesis (EMH)	Assamoi <i>et al.</i> , [109]; Dobrynskaya [4]; Özer <i>et al.</i> , [143]; Podhorsky [5]; Sila <i>et al.</i> , [121]; Zhao <i>et al.</i> , [107]; Guo <i>et al.</i> , [101]; Proelss <i>et al.</i> , [114]; Horváth and Výrost [144]; Mercik <i>et al.</i> , [145]; Narayan and Kumar [3]; Huang [102]; Karim <i>et al.</i> , [146]; Apostolakis [97]; Bouri <i>et al.</i> , [147]; Roche <i>et al.</i> , [148]; Liu <i>et al.</i> , [149]; Chen <i>et al.</i> , [150]; Cai and Zhao [99]; Wang <i>et al.</i> , [115]	20
Modern Portfolio Theory (MPT)	Bouri and Jalkh [98]; Echaust <i>et al.</i> , [117]; Feng <i>et al.</i> , [118]; Gorman and Hughen [119]; Hoque <i>et al.</i> , [135]; Liu and Yuan [103]; Patel <i>et al.</i> , [151]; Umar <i>et al.</i> , [122]; Yu <i>et al.</i> , [17]; Xiao <i>et al.</i> , [106]; Kliber and Będowska-Sójka [10]; Alharbi <i>et al.</i> , [125]; Bajra <i>et al.</i> , [133]; Zięba [152]; Horváth and Výrost [144]	15
Financial Contagion / Spillover	Abakah <i>et al.</i> , [1]; Almeida <i>et al.</i> , [126]; Asl <i>et al.</i> , [127]; Asl <i>et al.</i> , [153]; Assaf <i>et al.</i> , [13]; Batra <i>et al.</i> , [116]; Chen <i>et al.</i> , [154]; Cheng <i>et al.</i> , [155]; Conlon <i>et al.</i> , [100]; Jiang <i>et al.</i> , [134]; Kayani <i>et al.</i> , [2]; Kyriazis and Corbet [113]; Lei <i>et al.</i> , [156]; Liu <i>et al.</i> , [149]; Lu <i>et al.</i> , [157]; Yang <i>et al.</i> , [158]; Yousaf <i>et al.</i> , [124]; Yousaf <i>et al.</i> , [159]; Naeem <i>et al.</i> , [120]; Sakariyahu <i>et al.</i> , [160]; Osman <i>et al.</i> , [161]	21

Table A2

Theoretical frameworks used in the literature (TCCMR Framework)

Theoretical Aspect	Related Studies	Frequency
Behavioral Finance	Anaza <i>et al.</i> , [8]; Chen and Nguyen [6]; de Almeida Junior <i>et al.</i> , [162]; Divakaruni and Zimmerman [139]; Drăgan <i>et al.</i> , [163]; Gemayel and Preda [7]; Gill-de-Albornoz <i>et al.</i> , [164]; Jagolinzer [140]; Kogan <i>et al.</i> , [15]; Lee <i>et al.</i> , [165]; Luo <i>et al.</i> , [166]; Mathmann <i>et al.</i> , [141]; Ryu [9]; Walker [123]; Beckmann <i>et al.</i> , [167]; Meyer <i>et al.</i> , [104]; Gerritsen and de Regt [142]	17
Asset Pricing (CAPM) / Risk–Return Trade-off	Abdullah <i>et al.</i> , [96]; Ali <i>et al.</i> , [130]; Ali <i>et al.</i> , [131]; Bai <i>et al.</i> , [14]; Dobrynskaya [4]; Karim <i>et al.</i> , [146]; Proelss <i>et al.</i> , [114]; Horváth and Výrost [144]; Wang <i>et al.</i> , [11]; Bouri <i>et al.</i> , [147]; Guo <i>et al.</i> , [101]	11
Institutional Theory / Regulatory	Bai <i>et al.</i> , [14]; Jabbour and Mansour-Ichraikieh [18]; Kreuzer <i>et al.</i> , [19]; Yang <i>et al.</i> , [158]; Hodula [168]; Jagolinzer [140]; Sakariyahu <i>et al.</i> , [160]; Osman <i>et al.</i> , [161]	8
Technology Acceptance / Innovation	Behl <i>et al.</i> , [136]; BenMabrouk <i>et al.</i> , [137]; Li <i>et al.</i> , [169]; Kräussl and Tugnetti [138]; Hägele [128]; Subramanian <i>et al.</i> , [129]; Xiao <i>et al.</i> , [106]; Naeem <i>et al.</i> , [120]; Assaf <i>et al.</i> , [13]; Arora <i>et al.</i> , [132]; Sharma <i>et al.</i> , [105]; Boubaker <i>et al.</i> , [110]	12
Others	Agnese and Rios [170]; Bouteska <i>et al.</i> , [111]; Bouteska <i>et al.</i> , [171]; Buse <i>et al.</i> , [172]; Cheng <i>et al.</i> , [173]; Harris <i>et al.</i> , [174]; Mizdrakovic <i>et al.</i> , [175]; Atree and Tripathy [176]	8
Total		104

Table A3

Various contexts of the studies on cryptocurrency (TCCMR Framework)

Context	Related Studies	Frequency
Cryptocurrency market dynamics	Abdullah <i>et al.</i> , [96]; Apostolakis [97]; Assamoi <i>et al.</i> , [109]; Dobrynskaya [4]; Karim <i>et al.</i> , [146]; Mercik <i>et al.</i> , [145]; Özer <i>et al.</i> , [143]; Podhorsky [5]; Sila <i>et al.</i> , [121]; Zhao <i>et al.</i> , [107]; Bouteska <i>et al.</i> , [111]; Bouteska <i>et al.</i> , [171]; Guo <i>et al.</i> , [101]; Proelss <i>et al.</i> , [114]; Roche <i>et al.</i> , [148]; Felföldi-Szűcs and Králik [112]; Mizdrakovic <i>et al.</i> , [175]; Harris <i>et al.</i> , [174]; Buse <i>et al.</i> , [172]; Chen <i>et al.</i> , [150]; Conlon <i>et al.</i> , [177]; Horváth and Výrost [144]; Mercik <i>et al.</i> , [145]	24
Specific crisis/uncertainty events	Aliu [108]; Bai <i>et al.</i> , [14]; Chen <i>et al.</i> , [154]; Cheng <i>et al.</i> , [155]; Conlon <i>et al.</i> , [100]; Divakaruni and Zimmerman [139]; Kreuzer <i>et al.</i> , [19]; Sakariyahu <i>et al.</i> , [160]; Yang <i>et al.</i> , [158]; Hodula [168]; Jabbour and Mansour-Ichraikieh [18]; Osman <i>et al.</i> , [161]; Feng <i>et al.</i> , [118]; Liu and Yuan [103]; Yang <i>et al.</i> , [158]	16
Energy/climate–sustainability focus	Agnese and Rios [170]; Alharbi <i>et al.</i> , [125]; Arora <i>et al.</i> , [132]; Asl <i>et al.</i> , [153]; Jiang <i>et al.</i> , [134]; Kliber and Będowska-Sójka [10]; Lei <i>et al.</i> , [156]; Lu <i>et al.</i> , [157]; Umar <i>et al.</i> , [122]; Wang <i>et al.</i> , [11]; Yousaf <i>et al.</i> , [12]; Yu <i>et al.</i> , [17]; Zięba [152]	13
Investor behavior	Anaza <i>et al.</i> , [8]; Cai and Zhao [99]; Chen and Nguyen [6]; de Almeida Junior <i>et al.</i> , [162]; Drăgan <i>et al.</i> , [163]; Gemayel and Preda [7]; Kogan <i>et al.</i> , [15]; Luo <i>et al.</i> , [166]; Mathmann <i>et al.</i> , [141]; Ryu [9]; Zhao <i>et al.</i> , [107]	11
Information / digital platforms	Beckmann <i>et al.</i> , [167]; Gerritsen and de Regt [142]; Gill-de-Albornoz <i>et al.</i> , [164]; Jagolinzer [140]; Lee <i>et al.</i> , [165]; Meyer <i>et al.</i> , [104]; Subramanian <i>et al.</i> , [129]	7
NFT / token / digital asset	Behl <i>et al.</i> , [136]; BenMabrouk <i>et al.</i> , [137]; Kräussl and Tugnetti [138]; Li <i>et al.</i> , [169]; Wang <i>et al.</i> , [115]	5

Table A3
Continued

Context	Related Studies	Frequency
Macro-financial environment/system	Abakah <i>et al.</i> , [1]; Ali <i>et al.</i> , [130]; Ali <i>et al.</i> , [131]; Almeida <i>et al.</i> , [126]; Asl <i>et al.</i> , [127]; Assaf <i>et al.</i> , [13]; Bajra <i>et al.</i> , [133]; Batra <i>et al.</i> , [116]; Bouri and Jalkh [98]; Bouri <i>et al.</i> , [147] ; Echaust <i>et al.</i> , [117]; Gorman and Hughen [119]; Hoque <i>et al.</i> , [135]; Huang [102]; Kayani <i>et al.</i> , [2]; Kyriazis and Corbet [113]; Leong <i>et al.</i> , [16]; Liu <i>et al.</i> , [149]; Narayan and Kumar [3]; Patel <i>et al.</i> , [151]; Xiao <i>et al.</i> , [106]; Yousaf <i>et al.</i> , [124]; Yousaf <i>et al.</i> , [159]	24
Reviews / conceptual	Feng <i>et al.</i> , [178]; Anas <i>et al.</i> , [179]; Jabeur <i>et al.</i> , [180]; Atree and Tripathy [176]; Hägele [128]; Sharma <i>et al.</i> , [105]	4
	Total	104

Table A4
Purpose and characteristics of the studies (TCCMR Framework)

Purpose / Characteristics	Related Studies	Frequency
Spillover & connectedness	Abakah <i>et al.</i> , [1]; Agnese and Rios [170]; Ali <i>et al.</i> , [130]; Ali <i>et al.</i> , [131]; Almeida <i>et al.</i> , [126]; Asl <i>et al.</i> , [127]; Asl <i>et al.</i> , [153]; Assaf <i>et al.</i> , [13]; Bajra <i>et al.</i> , [133]; Batra <i>et al.</i> , [116]; Chen <i>et al.</i> , [154]; Cheng <i>et al.</i> , [155] ; Conlon <i>et al.</i> , [100] ; Huang [102]; Jiang <i>et al.</i> , [134]; Kayani <i>et al.</i> , [2]; Kyriazis and Corbet [113]; Lei <i>et al.</i> , [156]; Liu <i>et al.</i> , [149]; Narayan and Kumar [3]; Yang <i>et al.</i> , [158] ; Yousaf <i>et al.</i> , [124]; Yousaf <i>et al.</i> , [159]; Naeem <i>et al.</i> , [120]; Bouri <i>et al.</i> , [147] ; Liu <i>et al.</i> , [149]; Lu <i>et al.</i> , [157] Abdullah <i>et al.</i> , [96]; Aliu [108]; Boubaker <i>et al.</i> , [110]; Dobrynskaya [4]; Horváth and Výrost [144]; Karim <i>et al.</i> , [146]; Osman <i>et al.</i> , [161]; Proelss <i>et al.</i> , [114]; Sakariyahu <i>et al.</i> , [160]; Sila <i>et al.</i> , [121]; Wang <i>et al.</i> , [11]; Yousaf <i>et al.</i> , [12] ; Wang <i>et al.</i> , [11]	27
Risk/volatility	Alharbi <i>et al.</i> , [125]; BenMabrouk <i>et al.</i> , [137]; Bouri and Jalkh [98]; Echaust <i>et al.</i> , [117]; Feng <i>et al.</i> , [118]; Gorman and Hughen [119]; Hoque <i>et al.</i> , [135]; Liu and Yuan [103]; Patel <i>et al.</i> , [151]; Umar <i>et al.</i> , [122]; Xiao <i>et al.</i> , [106]; Yu <i>et al.</i> , [17]; Kliber and Będowska-Sójka [10]; Yu <i>et al.</i> , [17] Anaza <i>et al.</i> , [8] ; Cai and Zhao [99]; Chen and Nguyen [6]; de Almeida Junior <i>et al.</i> , [162]; Divakaruni and Zimmerman [139]; Drăgan <i>et al.</i> , [163]; Gemayel and Preda [7]; Gerritsen and de Regt [142]; Gill-de-Albornoz <i>et al.</i> , [164]; Jagolinzer [140]; Lee <i>et al.</i> , [165]; Luo <i>et al.</i> , [166]; Mathmann <i>et al.</i> , [141]; Ryu [9]; Walker [123]; Zhao <i>et al.</i> , [107]; Hodula [168]; Kreuzer <i>et al.</i> , [19]; Meyer <i>et al.</i> , [104]; Subramanian <i>et al.</i> , [129] ; Osman <i>et al.</i> , [161]; Lee <i>et al.</i> , [165]; Ryu [9]	13
Hedging / safe haven property	Bouri <i>et al.</i> , [147] ; Bouteska <i>et al.</i> , [111]; Cheng <i>et al.</i> , [173]; Chen <i>et al.</i> , [150] ; Guo <i>et al.</i> , [101]; Harris <i>et al.</i> , [174]; Mizdrakovic <i>et al.</i> , [175]; Subramanian <i>et al.</i> , [129]	8
Investor behavior & decision-making	Apostolakis [97]; Assamoi <i>et al.</i> , [109]; Bouteska <i>et al.</i> , [171]; Felföldi-Szűcs and Králik [112]; Kräussl and Tugnetti [138]; Li <i>et al.</i> , [169]; Mercik <i>et al.</i> , [145]; Özer <i>et al.</i> , [143]; Podhorsky [5]; Roche <i>et al.</i> , [148]; Wang <i>et al.</i> , [115]; Zięba [152]	12
Sustainability / ESG focus	Arora <i>et al.</i> , [132]	1
Reviews	Anas <i>et al.</i> , [179]Atree and Tripathy [176]; Behl <i>et al.</i> , [136]; Hägele [128]; Sharma <i>et al.</i> , [105]; Kräussl and Tugnetti [138]	6
	Total	104

Table A5

Research methods used in the studies (TCCMR Framework)

Method	Related Studies	Frequency
Econometric models	Abdullah <i>et al.</i> , [96]; Abakah <i>et al.</i> , [1]; Agnese and Rios [170]; Ali <i>et al.</i> , [130]; Ali <i>et al.</i> , [131]; Aliu [108]; Apostolakis [97]; Assamoi <i>et al.</i> , [109]; Bai <i>et al.</i> , [14]; Batra <i>et al.</i> , [116]; Beckmann <i>et al.</i> , [167]; Bouri and Jalkh [98]; Chen <i>et al.</i> , [154]; Chen <i>et al.</i> , [150]; Cheng <i>et al.</i> , [155]; Conlon <i>et al.</i> , [100]; Divakaruni and Zimmerman [139]; Dobrynskaya [4]; Echaust <i>et al.</i> , [117]; Feng <i>et al.</i> , [118]; Gorman and Huguen [119]; Hoque <i>et al.</i> , [135]; Huang [102]; Jabbour and Mansour-Ichraikieh [18]; Karim <i>et al.</i> , [146]; Kreuzer <i>et al.</i> , [19]; Liu and Yuan [103]; Liu <i>et al.</i> , [149]; Mercik <i>et al.</i> , [145]; Narayan and Kumar [3]; Osman <i>et al.</i> , [161]; Özer <i>et al.</i> , [143]; Patel <i>et al.</i> , [151]; Podhorsky [5]; Proelss <i>et al.</i> , [114]; Roche <i>et al.</i> , [148]; Sakariyahu <i>et al.</i> , [160]; Sila <i>et al.</i> , [121]; Umar <i>et al.</i> , [122]; Wang <i>et al.</i> , [11]; Yang <i>et al.</i> , [158]; Zhao <i>et al.</i> , [107]; Kyriazis and Corbet [113]; Kayani <i>et al.</i> , [2]; Lei <i>et al.</i> , [156]; Lu <i>et al.</i> , [157]; Jiang <i>et al.</i> , [134]; Yousaf <i>et al.</i> , [124]; Yousaf <i>et al.</i> , [159]; Yousaf <i>et al.</i> , [12]; Leong <i>et al.</i> , [16]; Horváth and Výrost [144]	56
Statistical / Multivariate analysis	Anaza <i>et al.</i> , [8]; Cai and Zhao [99]; Chen and Nguyen [6]; de Almeida Junior <i>et al.</i> , [162]; Gemayel and Preda [7]; Kogan <i>et al.</i> , [15]; Luo <i>et al.</i> , [166]; Ryu [9]; Wang <i>et al.</i> , [115]	9
Machine Learning / AI	Boubaker <i>et al.</i> , [110]; Bouteska <i>et al.</i> , [111]; Bouteska <i>et al.</i> , [171]; Buse <i>et al.</i> , [172]; Cheng <i>et al.</i> , [173]; Feng <i>et al.</i> , [178]; Harris <i>et al.</i> , [174]; Mizdrakovic <i>et al.</i> , [175]; Naeem <i>et al.</i> , [120]; Subramanian <i>et al.</i> , [129]; Guo <i>et al.</i> , [101]; Cai and Zhao [99]; Xiao <i>et al.</i> , [106]; Yu <i>et al.</i> , [17]	14
Optimization models	Leong <i>et al.</i> , [16]; Xiao <i>et al.</i> , [106]; Yu <i>et al.</i> , [17]; Hoque <i>et al.</i> , [135]	4
Qualitative / Conceptual models	Arora <i>et al.</i> , [132]; Hägele [128]; Jagolinzer [140]; Kräussl and Tugnetti [138]; Sharma <i>et al.</i> , [105]; Walker [123]; Drăgan <i>et al.</i> , [163]; Gerritsen and de Regt [142]; Lee <i>et al.</i> , [165]; Mathmann <i>et al.</i> , [141]; Behl <i>et al.</i> , [136]; BenMabrouk <i>et al.</i> , [137]; Li <i>et al.</i> , [169]; Kräussl and Tugnetti [138]; Atree and Tripathy [176]	15
Others (bibliometric / review / descriptive)	Anas <i>et al.</i> , [179]; Atree and Tripathy [176]; Behl <i>et al.</i> , [136]; Hägele [128]; Sharma <i>et al.</i> , [105]; Kräussl and Tugnetti [138]	6
Total		104

Table A6

Analytical frameworks (TCCMR Framework)

Analytical Framework	Related Studies	Frequency
Predictive	Bouri <i>et al.</i> , [147]; Bouteska <i>et al.</i> , [111]; Bouteska <i>et al.</i> , [171]; Buse <i>et al.</i> , [172]; Cheng <i>et al.</i> , [173]; Chen <i>et al.</i> , [150]; Guo <i>et al.</i> , [101]; Harris <i>et al.</i> , [174]; Mizdrakovic <i>et al.</i> , [175]; Subramanian <i>et al.</i> , [129]; Feng <i>et al.</i> , [178]; Cai and Zhao [99]; Karim <i>et al.</i> , [146]; Horváth and Výrost [144]; Guo <i>et al.</i> , [101]; Podhorsky [5]; Boubaker <i>et al.</i> , [110]	17
Prescriptive	Gorman and Huguen [119]; Hoque <i>et al.</i> , [135]; Leong <i>et al.</i> , [16]; Xiao <i>et al.</i> , [106]; Yu <i>et al.</i> , [17]; Patel <i>et al.</i> , [151]; Echaust <i>et al.</i> , [117]; Umar <i>et al.</i> , [122]; Kliber and Będowska-Sójka [10]	9
Descriptive	Anas <i>et al.</i> , [179]; Atree and Tripathy [176]; Behl <i>et al.</i> , [136]; Hägele [128]; Kräussl and Tugnetti [138]; Sharma <i>et al.</i> , [105]; Walker [123]; BenMabrouk <i>et al.</i> , [137]; Wang <i>et al.</i> , [115]; Kräussl and Tugnetti [138]; Li <i>et al.</i> , [169]; Zhao <i>et al.</i> , [107]; Mercik <i>et al.</i> , [145]; Roche <i>et al.</i> , [148]; Zięba [152]; Apostolakis [97]; Assamoi <i>et al.</i> , [109]; Felföldi-Szűcs and Králik [112]; Özer <i>et al.</i> , [143]; Drăgan <i>et al.</i> , [163]; Lee <i>et al.</i> , [165]	21

Table A6

Continued

Analytical Framework	Related Studies	Frequency
Diagnostic	Abakah <i>et al.</i> , [1]; Agnese and Rios [170]; Ali <i>et al.</i> , [130]; Ali <i>et al.</i> , [131]; Almeida <i>et al.</i> , [126]; Asl <i>et al.</i> , [127]; Asl <i>et al.</i> , [153]; Assaf <i>et al.</i> , [13]; Bajra <i>et al.</i> , [133]; Batra <i>et al.</i> , [116]; Chen <i>et al.</i> , [154]; Cheng <i>et al.</i> , [155]; Conlon <i>et al.</i> , [100]; Huang [102]; Jiang <i>et al.</i> , [134]; Kayani <i>et al.</i> , [2]; Kyriazis and Corbet [113]; Lei <i>et al.</i> , [156]; Liu <i>et al.</i> , [149]; Narayan and Kumar [3]; Yang <i>et al.</i> , [158]; Yousaf <i>et al.</i> , [124]; Yousaf <i>et al.</i> , [159]; Naeem <i>et al.</i> , [120]; Liu and Yuan [103]; Kreuzer <i>et al.</i> , [19]; Sakariyahu <i>et al.</i> , [160]; Osman <i>et al.</i> , [161]; Wang <i>et al.</i> , [11]; Yousaf <i>et al.</i> , [12]; Sila <i>et al.</i> , [121]; Abdullah <i>et al.</i> , [96]; Aliu [108]; Anaza <i>et al.</i> , [8]; Bai <i>et al.</i> , [14]; Beckmann <i>et al.</i> , [167]; Cai and Zhao [99]; Chen and Nguyen [6]; Divakaruni and Zimmerman [139]; Dobrynskaya [4]; Echaust <i>et al.</i> , [117]; Feng <i>et al.</i> , [118]; Gerritsen and de Regt [142];	31
Others	Gill-de-Albornoz <i>et al.</i> , [164]; Jagolinzer [140]; Kogan <i>et al.</i> , [15]; Luo <i>et al.</i> , [166]; Mathmann <i>et al.</i> , [141]; Meyer <i>et al.</i> , [104]; Osman <i>et al.</i> , [161]; Proelss <i>et al.</i> , [114]; Ryu [9]; Subramanian <i>et al.</i> , [129]; Zhao <i>et al.</i> , [107]; Mercik <i>et al.</i> , [145]; Patel <i>et al.</i> , [151]; Podhorsky [5]	26
Total		104

Table A7

Research types (TCCMR Framework)

Research Type	Related Studies	Frequency
Quantitative	Abakah <i>et al.</i> , [1]; Abdullah <i>et al.</i> , [96]; Agnese and Rios [170]; Ali <i>et al.</i> , [130]; Ali <i>et al.</i> , [131]; Aliu [108]; Apostolakis [97]; Assamoi <i>et al.</i> , [109]; Bai <i>et al.</i> , [14]; Bajra <i>et al.</i> , [133]; Batra <i>et al.</i> , [116]; Beckmann <i>et al.</i> , [167]; BenMabrouk <i>et al.</i> , [137]; Boubaker <i>et al.</i> , [110]; Bouri and Jalkh [98]; Bouri <i>et al.</i> , [147]; Bouteska <i>et al.</i> , [111]; Bouteska <i>et al.</i> , [171]; Buse <i>et al.</i> , [172]; Cai and Zhao [99]; Chen and Nguyen [6]; Chen <i>et al.</i> , [154]; Chen <i>et al.</i> , [150]; Cheng <i>et al.</i> , [173]; Cheng <i>et al.</i> , [155]; Conlon <i>et al.</i> , [100]; Divakaruni and Zimmerman [139]; Dobrynskaya [4]; Echaust <i>et al.</i> , [117]; Feng <i>et al.</i> , [118]; Feng <i>et al.</i> , [178]; Gorman and Hughen [119]; Guo <i>et al.</i> , [101]; Harris <i>et al.</i> , [174]; Hoque <i>et al.</i> , [135]; Horváth and Výrost [144]; Huang [102]; Jabbour and Mansour-Ichrahieh [18]; Jabeur <i>et al.</i> , [180]; Jiang <i>et al.</i> , [134]; Karim <i>et al.</i> , [146]; Kayani <i>et al.</i> , [2]; Kliber and Będowska-Sójka [10]; Kreuzer <i>et al.</i> , [19]; Kyriazis and Corbet [113]; Leong <i>et al.</i> , [16]; Lei <i>et al.</i> , [156]; Liu and Yuan [103]; Liu <i>et al.</i> , [149]; Lu <i>et al.</i> , [157]; Mercik <i>et al.</i> , [145]; Mizdrakovic <i>et al.</i> , [175]; Naeem <i>et al.</i> , [120]; Narayan and Kumar [3]; Osman <i>et al.</i> , [161]; Özer <i>et al.</i> , [143]; Patel <i>et al.</i> , [151]; Podhorsky [5]; Proelss <i>et al.</i> , [114]; Roche <i>et al.</i> , [148]; Sakariyahu <i>et al.</i> , [160]; Sila <i>et al.</i> , [121]; Subramanian <i>et al.</i> , [129]; Umar <i>et al.</i> , [122]; Wang <i>et al.</i> , [11]; Wang <i>et al.</i> , [115]; Yang <i>et al.</i> , [158]; Yousaf <i>et al.</i> , [124]; Yousaf <i>et al.</i> , [159]; Yousaf <i>et al.</i> , [12]; Yu <i>et al.</i> , [17]; Zhao <i>et al.</i> , [107]; Zięba [152]	82
Qualitative	Arora <i>et al.</i> , [132]; Hägele [128]; Jagolinzer [140]; Kräussl and Tugnetti [138]; Sharma <i>et al.</i> , [105]; Walker [123]; Podhorsky [5]; Mercik <i>et al.</i> , [145]; Lee <i>et al.</i> , [165]; Gerritsen and de Regt [142]; Mathmann <i>et al.</i> , [141]	11
Mixed (Quantitative + Qualitative)	Anas <i>et al.</i> , [179]; Anaza <i>et al.</i> , [8]; Atree and Tripathy [176]; Behl <i>et al.</i> , [136]; Drăgan <i>et al.</i> , [163]; Gemayel and Preda [7]; Gill-de-Albornoz <i>et al.</i> , [164]; Kogan <i>et al.</i> , [15]; Luo <i>et al.</i> , [166]; Ryu [9]; Meyer <i>et al.</i> , [104]	11
Total		104

Table A8

Various antecedents in past studies (ADO Framework)

Variables / Antecedents	Related Studies	Frequency
Market uncertainty / macroeconomic shocks	Abakah <i>et al.</i> , [1]; Abdullah <i>et al.</i> , [96]; Aliu [108]; Bai <i>et al.</i> , [14]; Cheng <i>et al.</i> , [155]; Conlon <i>et al.</i> , [100]; Divakaruni and Zimmerman [139]; Feng <i>et al.</i> , [118]; Feng <i>et al.</i> , [178]; Hodula [168]; Jabbour and Mansour-Ichraikieh [18]; Kreuzer <i>et al.</i> , [19]; Liu and Yuan [103]; Osman <i>et al.</i> , [161]; Sakariyahu <i>et al.</i> , [160]; Yang <i>et al.</i> , [158]; Chen <i>et al.</i> , [154]; Chen <i>et al.</i> , [150]; Narayan and Kumar [3]; Kyriazis and Corbet [113]; Kayani <i>et al.</i> , [2]; Batra <i>et al.</i> , [116]; Bajra <i>et al.</i> , [133]; Jiang <i>et al.</i> , [134]; Anaza <i>et al.</i> , [8]; Cai and Zhao [99]; Chen and Nguyen [6]; de Almeida Junior <i>et al.</i> , [162]; Drăgan <i>et al.</i> , [163]; Gemayel and Preda [7]; Gerritsen and de Regt [142]; Gill-de-Albornoz <i>et al.</i> , [164]; Jagolinzer [140]; Kogan <i>et al.</i> , [15]; Lee <i>et al.</i> , [165]; Luo <i>et al.</i> , [166]; Mathmann <i>et al.</i> , [141]; Ryu [9]; Walker [123]; Zhao <i>et al.</i> , [107]; Beckmann <i>et al.</i> , [167]; Meyer <i>et al.</i> , [104]; Osman <i>et al.</i> , [161]; Mercik <i>et al.</i> , [145]; Divakaruni and Zimmerman [139]; Huang [102]	24
Investor sentiment/ behavior/psychology	Agnes and Rios [170]; Alharbi <i>et al.</i> , [125]; Arora <i>et al.</i> , [132]; Asl <i>et al.</i> , [153]; Jiang <i>et al.</i> , [134]; Kliber and Będowska-Sójka [10]; Lei <i>et al.</i> , [156]; Lu <i>et al.</i> , [157]; Umar <i>et al.</i> , [122]; Wang <i>et al.</i> , [11]; Yousaf <i>et al.</i> , [12]; Yu <i>et al.</i> , [17]; Zięba [152]; Yousaf <i>et al.</i> , [124]; Yousaf <i>et al.</i> , [159]; Patel <i>et al.</i> , [151]; Hoque <i>et al.</i> , [135]; Wang <i>et al.</i> , [115]	22
Energy, climate, and sustainability factors	Assaf <i>et al.</i> , [13]; Behl <i>et al.</i> , [136]; BenMabrouk <i>et al.</i> , [137]; Boubaker <i>et al.</i> , [110]; Bouteska <i>et al.</i> , [111]; Bouteska <i>et al.</i> , [171]; Cheng <i>et al.</i> , [173]; Harris <i>et al.</i> , [174]; Mizdrakovic <i>et al.</i> , [175]; Naeem <i>et al.</i> , [120]; Subramanian <i>et al.</i> , [129]; Li <i>et al.</i> , [169]; Xiao <i>et al.</i> , [106]; Yu <i>et al.</i> , [17]	18
Technological/digital innovation factors	Apostolakis [97]; Assamoi <i>et al.</i> , [109]; Bouri and Jalkh [98]; Echaust <i>et al.</i> , [117]; Felföldi-Szűcs and Králik [112]; Gorman and Hughen [119]; Hoque <i>et al.</i> , [135]; Huang [102]; Jabeur <i>et al.</i> , [180]; Leong <i>et al.</i> , [16]; Liu <i>et al.</i> , [149]; Narayan and Kumar [3]; Özer <i>et al.</i> , [143]; Podhorsky [5]; Roche <i>et al.</i> , [148]; Zięba [152]	14
Financial market structure & liquidity factors	Bai <i>et al.</i> , [14]; Chen <i>et al.</i> , [154]; Jagolinzer [140]; Jabbour and Mansour-Ichraikieh [18]; Kreuzer <i>et al.</i> , [19]; Yang <i>et al.</i> , [158]; Sakariyahu <i>et al.</i> , [160]; Osman <i>et al.</i> , [161]; Hodula [168]; Xiao <i>et al.</i> , [106]	16
Regulatory/institutional / policy factors		10
Total		104

Table A9

Different types of decisions made by past studies (ADO Framework)

Types of decisions	Related Studies	Frequency
Investment / portfolio allocation decisions	Ali <i>et al.</i> , [130]; Ali <i>et al.</i> , [131]; Bouri and Jalkh [98]; Echaust <i>et al.</i> , [117]; Feng <i>et al.</i> , [118]; Gorman and Hughen [119]; Hoque <i>et al.</i> , [135]; Liu and Yuan [103]; Patel <i>et al.</i> , [151]; Umar <i>et al.</i> , [122]; Yu <i>et al.</i> , [17]; Xiao <i>et al.</i> , [106]; Leong <i>et al.</i> , [16]; Assamoi <i>et al.</i> , [109]; Mercik <i>et al.</i> , [145]; Podhorsky [5]; Özer <i>et al.</i> , [143]; Zhao <i>et al.</i> , [107]; Guo <i>et al.</i> , [101]; Bouteska <i>et al.</i> , [171]; Roche <i>et al.</i> , [148]; Narayan and Kumar [3]; Bajra <i>et al.</i> , [133]; Batra <i>et al.</i> , [116]; Kyriazis and Corbet [113]; Kayani <i>et al.</i> , [2]; Jiang <i>et al.</i> , [134]; Wang <i>et al.</i> , [115]; Zięba [152]; Yousaf <i>et al.</i> , [124]; Yousaf <i>et al.</i> , [159]; Naeem <i>et al.</i> , [120]; Jabeur <i>et al.</i> , [180]; Bouri <i>et al.</i> , [147]	34

Table A9

Continued

Types of decisions	Related Studies	Frequency
Risk management / hedging decisions	Alharbi <i>et al.</i> , [125]; Bouri and Jalkh [98]; Echaust <i>et al.</i> , [117]; Feng <i>et al.</i> , [118]; Hoque <i>et al.</i> , [135]; Liu and Yuan [103]; Patel <i>et al.</i> , [151]; Umar <i>et al.</i> , [122]; Kliber and Będowska-Sójka [10]; Yu <i>et al.</i> , [17]; Xiao <i>et al.</i> , [106]; Gorman and Hughen [119]; Hoque <i>et al.</i> , [135]; Wang <i>et al.</i> , [11]; Yousaf <i>et al.</i> , [12] ; Sila <i>et al.</i> , [121]; Sakariyahu <i>et al.</i> , [160]; Osman <i>et al.</i> , [161]; Horváth and Výrost [144]; Proelss <i>et al.</i> , [114]; Karim <i>et al.</i> , [146]; Dobrynskaya [4]; Cai and Zhao [99]; Podhorsky [5]; Mercik <i>et al.</i> , [145]; Roche <i>et al.</i> , [148]; Zięba [152]; Echaust <i>et al.</i> , [117]; Bajra <i>et al.</i> , [133]; Divakaruni and Zimmerman [139]; Aliu [108]; Beckmann <i>et al.</i> , [167]; Cai and Zhao [99]; Chen and Nguyen [6]; Chen <i>et al.</i> , [150] ; Karim <i>et al.</i> , [146]; Proelss <i>et al.</i> , [114]; Zhao <i>et al.</i> , [107]; Kogan <i>et al.</i> , [15]; Gemayel and Preda [7]; Luo <i>et al.</i> , [166]; Mathmann <i>et al.</i> , [141]; Ryu [9]; Meyer <i>et al.</i> , [104]; Gerritsen and de Regt [142]; Subramanian <i>et al.</i> , [129] ; Mizdrakovic <i>et al.</i> , [175]; Guo <i>et al.</i> , [101]; Bouteska <i>et al.</i> , [111]; Cheng <i>et al.</i> , [173]	29
Trading / timing / speculative decisions	Bai <i>et al.</i> , [14]; Jabbour and Mansour-Ichraikieh [18]; Kreuzer <i>et al.</i> , [19]; Yang <i>et al.</i> , [158] ; Jagolinzer [140]; Hodula [168]; Osman <i>et al.</i> , [161]; Chen <i>et al.</i> , [154]; Sakariyahu <i>et al.</i> , [160]; Narayan and Kumar [3]; Walker [123]	21
Policy / regulatory / institutional decisions	Arora <i>et al.</i> , [132]; Behl <i>et al.</i> , [136]; BenMabrouk <i>et al.</i> , [137]; Li <i>et al.</i> , [169]; Assaf <i>et al.</i> , [13]; Boubaker <i>et al.</i> , [110]; Naeem <i>et al.</i> , [120]; Sharma <i>et al.</i> , [105]; Kräussl and Tugnetti [138]	11
Strategic / managerial / technological decisions		9
Total		104

Table A10

Outcomes of past studies (ADO Framework)

Outcome Category	Related Studies	Frequency
Market efficiency/pricing / valuation	Apostolakis [97]; Assamoi <i>et al.</i> , [109]; Bouteska <i>et al.</i> , [171]; Cai and Zhao [99]; Chen <i>et al.</i> , [150] ; Dobrynskaya [4]; Felföldi-Szűcs and Králik [112]; Guo <i>et al.</i> , [101]; Karim <i>et al.</i> , [146]; Kogan <i>et al.</i> , [15]; Mercik <i>et al.</i> , [145]; Özer <i>et al.</i> , [143]; Podhorsky [5]; Roche <i>et al.</i> , [148]; Sila <i>et al.</i> , [121]; Wang <i>et al.</i> , [115]; Zhao <i>et al.</i> , [107]; Zięba [152]; Huang [102]; Chen and Nguyen [6]; Horváth and Výrost [144]; Proelss <i>et al.</i> , [114]; Bouri <i>et al.</i> , [147] ; Guo <i>et al.</i> , [101]; Liu <i>et al.</i> , [149]; Narayan and Kumar [3]	26
Risk optimization/ diversification / hedging	Alharbi <i>et al.</i> , [125]; Bouri and Jalkh [98]; Echaust <i>et al.</i> , [117]; Feng <i>et al.</i> , [118]; Gorman and Hughen [119]; Hoque <i>et al.</i> , [135]; Liu and Yuan [103]; Patel <i>et al.</i> , [151]; Umar <i>et al.</i> , [122]; Yu <i>et al.</i> , [17]; Xiao <i>et al.</i> , [106]; Kliber and Będowska-Sójka [10]; Wang <i>et al.</i> , [11]; Yousaf <i>et al.</i> , [12] ; Sila <i>et al.</i> , [121]; Sakariyahu <i>et al.</i> , [160]; Osman <i>et al.</i> , [161]; Karim <i>et al.</i> , [146]; Dobrynskaya [4]; Proelss <i>et al.</i> , [114]; Mercik <i>et al.</i> , [145]; Roche <i>et al.</i> , [148]; Zięba [152]; Bajra <i>et al.</i> , [133]	24
Volatility / spillover intensity	Abakah <i>et al.</i> , [1]; Almeida <i>et al.</i> , [126]; Asl <i>et al.</i> , [127]; Asl <i>et al.</i> , [153]; Assaf <i>et al.</i> , [13]; Bajra <i>et al.</i> , [133]; Batra <i>et al.</i> , [116]; Chen <i>et al.</i> , [154]; Cheng <i>et al.</i> , [155] ; Conlon <i>et al.</i> , [100] ; Huang [102]; Jiang <i>et al.</i> , [134]; Kayani <i>et al.</i> , [2]; Kyriazis and Corbet [113]; Lei <i>et al.</i> , [156]; Liu <i>et al.</i> , [149]; Yang <i>et al.</i> , [158] ; Yousaf <i>et al.</i> , [124]; Yousaf <i>et al.</i> , [159]; Naeem <i>et al.</i> , [120]; Lu <i>et al.</i> , [157]; Anaza <i>et al.</i> , [8] ; Chen and Nguyen [6]; de Almeida Junior <i>et al.</i> , [162]; Divakaruni and Zimmerman [139]; Drăgan <i>et al.</i> , [163]; Gemayel and Preda [7]; Gerritsen and de Regt [142]; Gill-de-Albornoz <i>et al.</i> , [164]; Jagolinzer [140]; Kogan <i>et al.</i> , [15]; Lee <i>et al.</i> , [165]; Luo <i>et al.</i> , [166]; Mathmann <i>et al.</i> , [141]; Ryu [9]; Walker [123]; Zhao <i>et al.</i> , [107]; Beckmann <i>et al.</i> , [167]; Meyer <i>et al.</i> , [104]	21
Investor behavior / investment decision-making		18

Table A10

Continued

Outcome Category	Related Studies	Frequency
Forecasting accuracy / predictive modelling	Bouri <i>et al.</i> , [147] ; Bouteska <i>et al.</i> , [111]; Cheng <i>et al.</i> , [173]; Guo <i>et al.</i> , [101]; Harris <i>et al.</i> , [174]; Mizdrakovic <i>et al.</i> , [175]; Subramanian <i>et al.</i> , [129] ; Feng <i>et al.</i> , [178]; Boubaker <i>et al.</i> , [110]	9
Policy, regulatory, or sustainability effects	Bai <i>et al.</i> , [14]; Arora <i>et al.</i> , [132]; Jabbour and Mansour-Ichraikieh [18]; Kreuzer <i>et al.</i> , [19]; Yang <i>et al.</i> , [158] ; Hodula [168]	6
Total		104

Table A11

Populations studied in the past literature (PICO Framework)

Population Category	Related Studies	Frequency
Cryptocurrency markets / assets (Bitcoin, altcoins, stablecoins)	Abdullah <i>et al.</i> , [96]; Ali <i>et al.</i> , [130]; Ali <i>et al.</i> , [131]; Aliu [108]; Apostolakis [97]; Assamoi <i>et al.</i> , [109]; Bai <i>et al.</i> , [14]; Boubaker <i>et al.</i> , [110]; Bouri and Jalkh [98]; Bouri <i>et al.</i> , [147] ; Bouteska <i>et al.</i> , [111]; Bouteska <i>et al.</i> , [171]; Cai and Zhao [99]; Chen <i>et al.</i> , [154]; Chen <i>et al.</i> , [150] ; Chen and Nguyen [6]; Cheng <i>et al.</i> , [173]; Cheng <i>et al.</i> , [155] ; Conlon <i>et al.</i> , [100] ; Dobrynskaya [4]; Felföldi-Szűcs and Králik [112]; Guo <i>et al.</i> , [101]; Harris <i>et al.</i> , [174]; Karim <i>et al.</i> , [146]; Liu <i>et al.</i> , [149]; Mercik <i>et al.</i> , [145]; Mizdrakovic <i>et al.</i> , [175]; Narayan and Kumar [3]; Özer <i>et al.</i> , [143]; Podhorsky [5]; Proelss <i>et al.</i> , [114]; Roche <i>et al.</i> , [148]; Sila <i>et al.</i> , [121]; Wang <i>et al.</i> , [115]; Yousaf <i>et al.</i> , [124]; Yousaf <i>et al.</i> , [159]; Yousaf <i>et al.</i> , [12] ; Zhao <i>et al.</i> , [107]; Zięba [152]; Horváth and Výrost [144]; Sakariyahu <i>et al.</i> , [160]	41
Financial markets (equities, bonds, commodities, FX)	Abakah <i>et al.</i> , [1]; Almeida <i>et al.</i> , [126]; Asl <i>et al.</i> , [127]; Asl <i>et al.</i> , [153]; Bajra <i>et al.</i> , [133]; Batra <i>et al.</i> , [116]; Echaust <i>et al.</i> , [117]; Feng <i>et al.</i> , [118]; Gorman and Hughen [119]; Hoque <i>et al.</i> , [135]; Huang [102]; Jabeur <i>et al.</i> , [180]; Kyriazis and Corbet [113]; Leong <i>et al.</i> , [16]; Liu and Yuan [103]; Patel <i>et al.</i> , [151]; Umar <i>et al.</i> , [122]; Yu <i>et al.</i> , [17]	18
Investors / traders / households	Anaza <i>et al.</i> , [8] ; Beckmann <i>et al.</i> , [167]; Cai and Zhao [99]; Chen and Nguyen [6]; de Almeida Junior <i>et al.</i> , [162]; Divakaruni and Zimmerman [139]; Drăgan <i>et al.</i> , [163]; Gemayel and Preda [7]; Gerritsen and de Regt [142]; Gill-de-Albornoz <i>et al.</i> , [164]; Jagolinzer [140]; Kogan <i>et al.</i> , [15]; Lee <i>et al.</i> , [165]; Luo <i>et al.</i> , [166]; Mathmann <i>et al.</i> , [141]; Ryu [9]; Zhao <i>et al.</i> , [107]	17
Energy / climate / sustainability-linked markets	Agnese and Rios [170]; Alharbi <i>et al.</i> , [125]; Arora <i>et al.</i> , [132]; Jiang <i>et al.</i> , [134]; Kliber and Będowska-Sójka [10]; Lei <i>et al.</i> , [156]; Lu <i>et al.</i> , [157] ; Umar <i>et al.</i> , [122]; Wang <i>et al.</i> , [11]; Yousaf <i>et al.</i> , [12] ; Yu <i>et al.</i> , [17]; Zięba [152]; Bajra <i>et al.</i> , [133]; Patel <i>et al.</i> , [151]	14
Digital platforms / technologies (blockchain, NFTs, exchanges)	Behl <i>et al.</i> , [136]; BenMabrouk <i>et al.</i> , [137]; Hägele [128]; Kräussl and Tugnetti [138]; Li <i>et al.</i> , [169]; Meyer <i>et al.</i> , [104]; Subramanian <i>et al.</i> , [129] ; Xiao <i>et al.</i> , [106]; Buse <i>et al.</i> , [172]	9
Institutions / regulators / firms	Arora <i>et al.</i> , [132]; Bai <i>et al.</i> , [14]; Jabbour and Mansour-Ichraikieh [18]; Kreuzer <i>et al.</i> , [19]; Yang <i>et al.</i> , [158]	5
Total		104

Table A12

Exposures of the past studies (PICO Framework)

Exposure	Related Studies	Frequency
Market risk/uncertainty (macro, geopolitical, pandemic)	Abakah <i>et al.</i> , [1]; Abdullah <i>et al.</i> , [96]; Aliu [108]; Bai <i>et al.</i> , [14]; Cheng <i>et al.</i> , [155]; Conlon <i>et al.</i> , [100]; Divakaruni and Zimmerman [139]; Feng <i>et al.</i> , [118]; Feng <i>et al.</i> , [178]; Hodula [168]; Jabbour and Mansour-Ichraikie [18]; Kreuzer <i>et al.</i> , [19]; Liu and Yuan [103]; Osman <i>et al.</i> , [161]; Sakariyahu <i>et al.</i> , [160]; Yang <i>et al.</i> , [158]; Chen <i>et al.</i> , [154]; Chen <i>et al.</i> , [150]; Narayan and Kumar [3]; Kyriazis and Corbet [113]; Kayani <i>et al.</i> , [2]; Batra <i>et al.</i> , [116]; Bajra <i>et al.</i> , [133]; Jiang <i>et al.</i> , [134]; Lu <i>et al.</i> , [157]; Gill-de-Albornoz <i>et al.</i> , [164]; Anaza <i>et al.</i> , [8]; Cai and Zhao [99]; Chen and Nguyen [6]; de Almeida Junior <i>et al.</i> , [162]; Drăgan <i>et al.</i> , [163]; Gemayel and Preda [7]; Gerritsen and de Regt [142]; Gill-de-Albornoz <i>et al.</i> , [164]; Jagolinzer [140]; Kogan <i>et al.</i> , [15]; Lee <i>et al.</i> , [165]; Luo <i>et al.</i> , [166]; Mathmann <i>et al.</i> , [141]; Ryu [9]; Walker [123]; Zhao <i>et al.</i> , [107]; Beckmann <i>et al.</i> , [167]; Meyer <i>et al.</i> , [104]; Divakaruni and Zimmerman [139]; Mercik <i>et al.</i> , [145]; Huang [102]	26
Investor sentiment, behavior, or psychology	Apostolakis [97]; Assamoi <i>et al.</i> , [109]; Bouri and Jalkh [98]; Dobrynska [4]; Felföldi-Szűcs and Králik [112]; Guo <i>et al.</i> , [101]; Karim <i>et al.</i> , [146]; Liu <i>et al.</i> , [149]; Mercik <i>et al.</i> , [145]; Narayan and Kumar [3]; Özer <i>et al.</i> , [143]; Podhorsky [5]; Roche <i>et al.</i> , [148]; Sila <i>et al.</i> , [121]; Wang <i>et al.</i> , [115]; Zhao <i>et al.</i> , [107]; Zięba [152]; Horváth and Výrost [144]; Proelss <i>et al.</i> , [114]	21
Asset characteristics (volatility, liquidity, returns, pricing)	Agnese and Rios [170]; Alharbi <i>et al.</i> , [125]; Arora <i>et al.</i> , [132]; Jiang <i>et al.</i> , [134]; Kliber and Będowska-Sójka [10]; Lei <i>et al.</i> , [156]; Lu <i>et al.</i> , [157]; Umar <i>et al.</i> , [122]; Wang <i>et al.</i> , [11]; Yousaf <i>et al.</i> , [12]; Yu <i>et al.</i> , [17]; Zięba [152]; Bajra <i>et al.</i> , [133]; Patel <i>et al.</i> , [151]	19
Energy / ESG / sustainability	Assaf <i>et al.</i> , [13]; Behl <i>et al.</i> , [136]; BenMabrouk <i>et al.</i> , [137]; Boubaker <i>et al.</i> , [110]; Bouteska <i>et al.</i> , [111]; Bouteska <i>et al.</i> , [171]; Cheng <i>et al.</i> , [173]; Harris <i>et al.</i> , [174]; Mizdrakovic <i>et al.</i> , [175]; Naeem <i>et al.</i> , [120]; Subramanian <i>et al.</i> , [129]; Li <i>et al.</i> , [169]; Xiao <i>et al.</i> , [106]	14
Technology/ innovation	Bai <i>et al.</i> , [14]; Chen <i>et al.</i> , [154]; Jagolinzer [140]; Jabbour and Mansour-Ichraikie [18]; Kreuzer <i>et al.</i> , [19]; Yang <i>et al.</i> , [158]; Sakariyahu <i>et al.</i> , [160]; Osman <i>et al.</i> , [161]; Hodula [168]; Xiao <i>et al.</i> , [106]; Walker [123]	13
Regulation/governance/policy measures		11
Total		104

Table A13

Comparative analysis made in past studies (PICO Framework)

Comparison Category	Related Studies	Frequency
Asset classes (crypto vs stocks, commodities, FX, bonds)	Abakah <i>et al.</i> , [1]; Agnese and Rios [170]; Ali <i>et al.</i> , [130]; Ali <i>et al.</i> , [131]; Almeida <i>et al.</i> , [126]; Bajra <i>et al.</i> , [133]; Batra <i>et al.</i> , [116]; Echaust <i>et al.</i> , [117]; Feng <i>et al.</i> , [118]; Gorman and Hughen [119]; Hoque <i>et al.</i> , [135]; Huang [102]; Jabeur <i>et al.</i> , [180]; Kayani <i>et al.</i> , [2]; Kyriazis and Corbet [113]; Lei <i>et al.</i> , [156]; Liu and Yuan [103]; Patel <i>et al.</i> , [151]; Umar <i>et al.</i> , [122]; Wang <i>et al.</i> , [11]; Yousaf <i>et al.</i> , [124]; Yousaf <i>et al.</i> , [159]; Yousaf <i>et al.</i> , [12]; Yu <i>et al.</i> , [17]; Bajra <i>et al.</i> , [133]; Sakariyahu <i>et al.</i> , [160]; Narayan and Kumar [3]; Alharbi <i>et al.</i> , [125]; Jiang <i>et al.</i> , [134]	29

Table A13
Continued

Comparison Category	Related Studies	Frequency
Various cryptocurrencies (Bitcoin vs altcoins/stablecoins/tokens)	Apostolakis [97]; Assamoi <i>et al.</i> , [109]; Bouri and Jalkh [98]; Cai and Zhao [99]; Chen <i>et al.</i> , [150]; Dobrynskaya [4]; Felföldi-Szűcs and Králik [112]; Guo <i>et al.</i> , [101]; Karim <i>et al.</i> , [146]; Mercik <i>et al.</i> , [145]; Özer <i>et al.</i> , [143]; Podhorsky [5]; Roche <i>et al.</i> , [148]; Sila <i>et al.</i> , [121]; Wang <i>et al.</i> , [115]; Zhao <i>et al.</i> , [107]; Zięba [152]; Horváth and Výrost [144]; Proelss <i>et al.</i> , [114]; Bouri <i>et al.</i> , [147]; Liu <i>et al.</i> , [149]; Naeem <i>et al.</i> , [120]; BenMabrouk <i>et al.</i> , [137]; Kräussl and Tugnetti [138]	24
market performance under various periods (crisis vs normal periods)	Aliu [108]; Bai <i>et al.</i> , [14]; Cheng <i>et al.</i> , [155]; Conlon <i>et al.</i> , [100]; Divakaruni and Zimmerman [139]; Feng <i>et al.</i> , [178]; Gill-de-Albornoz <i>et al.</i> , [164]; Hodula [168]; Kreuzer <i>et al.</i> , [19]; Lu <i>et al.</i> , [157]; Osman <i>et al.</i> , [161]; Sakariyahu <i>et al.</i> , [160]; Yang <i>et al.</i> , [158]; Chen <i>et al.</i> , [154]; Kayani <i>et al.</i> , [2]; Kyriazis and Corbet [113]; Batra <i>et al.</i> , [116]; Jiang <i>et al.</i> , [134]	18
Investor groups / behavioral segments	Anaza <i>et al.</i> , [8]; Beckmann <i>et al.</i> , [167]; Cai and Zhao [99]; Chen and Nguyen [6]; de Almeida Junior <i>et al.</i> , [162]; Drăgan <i>et al.</i> , [163]; Gemayel and Preda [7]; Gerritsen and de Regt [142]; Gill-de-Albornoz <i>et al.</i> , [164]; Jagolinzer [140]; Kogan <i>et al.</i> , [15]; Lee <i>et al.</i> , [165]; Luo <i>et al.</i> , [166]; Ryu [9]	14
Performances of models/methods/strategies	Bouteska <i>et al.</i> , [111]; Bouteska <i>et al.</i> , [171]; Buse <i>et al.</i> , [172]; Cheng <i>et al.</i> , [173]; Harris <i>et al.</i> , [174]; Mizdrakovic <i>et al.</i> , [175]; Subramanian <i>et al.</i> , [129]; Xiao <i>et al.</i> , [106]; Yu <i>et al.</i> , [17]; Guo <i>et al.</i> , [101]; Boubaker <i>et al.</i> , [110]	11
Others	Arora <i>et al.</i> , [132]; Behl <i>et al.</i> , [136]; Hägele [128]; Sharma <i>et al.</i> , [105]; Walker [123]; Li <i>et al.</i> , [169]; Meyer <i>et al.</i> , [104]; Atree and Tripathy [176]	8
TOTAL		104

Note: Research outcomes (PICO Framework) have already been covered in Table A10.

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Conflicts of Interest

The authors declare no conflicts of interest.

References

- [1] Abakah, E. J. A., Hossain, S., Abdullah, M., & Goodell, J. W. (2024). Global uncertainty factors and price connectedness between US electricity and blockchain markets: Findings from an R-square connectedness approach. *Finance Research Letters*, 59, 104693. <https://doi.org/10.1016/j.frl.2023.104693>
- [2] Kayani, U., Ullah, M., Aysan, A. F., Nazir, S., & Frempong, J. (2024). Quantile connectedness among digital assets, traditional assets, and renewable energy prices during extreme economic crisis. *Technological Forecasting and Social Change*, 208, 123635. <https://doi.org/10.1016/j.techfore.2024.123635>
- [3] Narayan, S., & Kumar, D. (2024). Unveiling interconnectedness and risk spillover among cryptocurrencies and other asset classes. *Global Finance Journal*, 62, 101018. <https://doi.org/10.1016/j.gfi.2024.101018>
- [4] Dobrynskaya, V. (2024). Is downside risk priced in cryptocurrency market?. *International Review of Financial Analysis*, 91, 102947. <https://doi.org/10.1016/j.irfa.2023.102947>
- [5] Podhorsky, A. (2024). Bursting the bitcoin bubble: Do market prices reflect fundamental bitcoin value?. *International Review of Financial Analysis*, 93, 103158. <https://doi.org/10.1016/j.irfa.2024.103158>
- [6] Chen, A. S., & Nguyen, H. T. (2024). A new perspective on how investor sentiment affects herding behavior in the cryptocurrency market. *Finance Research Letters*, 67, 105737. <https://doi.org/10.1016/j.frl.2024.105737>

- [7] Gemayel, R., & Preda, A. (2024). Herding in the cryptocurrency market: A transaction-level analysis. *Journal of International Financial Markets, Institutions and Money*, 91, 101907. <https://doi.org/10.1016/j.intfin.2023.101907>
- [8] Anaza, N. A., Upadhyaya, B., Bennett, D., & Ruvalcaba, C. (2024). Is it FOMO or is it ME? The influence of personality traits on cryptocurrency consumption. *Psychology & Marketing*, 41(1), 184-202. <https://doi.org/10.1002/mar.21919>
- [9] Ryu, H. S. (2024). What drives problematic Bitcoin investment behavior?: The role of financial literacy. *International Journal of Bank Marketing*, 42(7), 1437-1471. <https://doi.org/10.1108/IJBM-01-2024-0018>
- [10] Kliber, A., & Będowska-Sójka, B. (2024). Proof-of-work versus proof-of-stake coins as possible hedges against green and dirty energy. *Energy Economics*, 138, 107820. <https://doi.org/10.1016/j.eneco.2024.107820>
- [11] Wang, J. N., Vigne, S. A., Liu, H. C., & Hsu, Y. T. (2024). Divergent jump characteristics in brown and green cryptocurrencies: The role of energy-related uncertainty. *Energy Economics*, 138, 107847. <https://doi.org/10.1016/j.eneco.2024.107847>
- [12] Yousaf, I., Mohammed, K. S., Yousaf, U. B., & Serret, V. (2025). The effect of crypto price fluctuations on crypto mining, and CO2 emissions amid geopolitical risk. *Finance Research Letters*, 72, 106551. <https://doi.org/10.1016/j.frl.2024.106551>
- [13] Assaf, A., Demir, E., & Mokni, K. (2024). Exploring connectedness among cryptocurrency, technology communication, and FinTech through dynamic and fractal analysis. *Finance Research Letters*, 63, 105260. <https://doi.org/10.1016/j.frl.2024.105260>
- [14] Bai, Z., Wang, P., & Zhang, H. (2024). When uncertainties matter: the causal effect of cryptocurrency investment on retirement hardship withdrawals. *Finance Research Letters*, 67, 105952. <https://doi.org/10.1016/j.frl.2024.105952>
- [15] Kogan, S., Makarov, I., Niessner, M., & Schoar, A. (2024). Are cryptos different? evidence from retail trading. *Journal of Financial Economics*, 159, 103897. <https://doi.org/10.1016/j.jfineco.2024.103897>
- [16] Leong, M., Alexeev, V., & Kwok, S. (2025). Managing cryptocurrency risk exposures in equity portfolios: Evidence from high-frequency data. *Journal of International Financial Markets, Institutions and Money*, 99, 102123. <https://doi.org/10.1016/j.intfin.2025.102123>
- [17] Yu, M., Xu, K., & Zheng, X. (2025). Reprint of: Mimicking crypto portfolios in sustainable investment. *The British Accounting Review*, 57(1), 101565. <https://doi.org/10.1016/j.bar.2025.101565>
- [18] Jabbour, G. M., & Mansour-Ichraikieh, L. (2025). Dollarization vs. bitcoinization in Türkiye: Which is more dangerous for the financial market?. *Journal of International Financial Markets, Institutions and Money*, 100, 102116. <https://doi.org/10.1016/j.intfin.2025.102116>
- [19] Kreuzer, C., Laschinger, R., Priberny, C., & Benninghoff, S. (2024). Cryptocurrencies as a vehicle for capital exodus: Evidence from the Russian–Ukrainian crisis. *Finance Research Letters*, 69, 106191. <https://doi.org/10.1016/j.frl.2024.106191>
- [20] Yadav, S. P., Agrawal, K. K., Bhati, B. S., Al-Turjman, F., & Mostarda, L. (2022). Blockchain-based cryptocurrency regulation: An overview. *Computational Economics*, 59(4), 1659-1675. <https://doi.org/10.1007/s10614-020-10050-0>
- [21] OECD. (2022). *Lessons from the Crypto Winter: DeFi versus CeFi* (OECD Business and Finance Policy Papers, No. 18). OECD Publishing.
- [22] Inci, A. C., & Lagasse, R. (2019). Cryptocurrencies: applications and investment opportunities. *Journal of Capital Markets Studies*, 3(2), 98-112. <https://doi.org/10.1108/JCMS-05-2019-0032>
- [23] Drożdż, S., Kwapien, J., & Wątopek, M. (2023). What is mature and what is still emerging in the cryptocurrency market?. *Entropy*, 25(5), 772. <https://doi.org/10.3390/e25050772>
- [24] Hanl, A. (2018). Some insights into the development of cryptocurrencies (No. 04-2018). *MAGKS Joint Discussion Paper Series in Economics*. <https://hdl.handle.net/10419/175855>
- [25] Vasudeva, S. (2023). Cryptocurrency as an investment or speculation: a bibliometric review study. *Business Analyst Journal*, 44(1), 34-50. <https://doi.org/10.1108/BAJ-07-2022-0008>
- [26] Arriola, J., & Barredo-Zuriarrain, J. (2023). From “Crypto-Alternatives” to a Regional Unit of Account: Monetary Proposals in Latin America for a Greater Shared Autonomy. In *Value, Money, Profit, and Capital Today* (pp. 95-114). Emerald Publishing Limited. <https://doi.org/10.1108/S0161-723020230000039007>
- [27] Alonso, S. L. N., Fernández, M. Á. E., Bas, D. S., & Rico, C. P. (2023). El Salvador: an analysis of the monetary integration law and the bitcoin law. *Brazilian Journal of Political Economy*, 44(1), 189-209. <https://doi.org/10.1590/0101-31572024-3459>
- [28] Mikhailov, A. (2021). Cryptocurrency market development: Hurst method. <https://doi.org/10.26794/2587-5671-2020-24-3-81-91>

- [29] Conti, M., Kumar, E. S., Lal, C., & Ruj, S. (2018). A survey on security and privacy issues of bitcoin. *IEEE Communications surveys & tutorials*, 20(4), 3416–3452. <https://doi.org/10.1109/COMST.2018.2842460>
- [30] Fletcher, E., Larkin, C., & Corbet, S. (2021). Countering money laundering and terrorist financing: A case for bitcoin regulation. *Research in International Business and Finance*, 56, 101387. <https://doi.org/10.1016/j.ribaf.2021.101387>
- [31] Almeida, J., & Gonçalves, T. C. (2023). A systematic literature review of investor behavior in the cryptocurrency markets. *Journal of Behavioral and Experimental Finance*, 37, 100785. <https://doi.org/10.1016/j.jbef.2022.100785>
- [32] Bartoletti, M., Lande, S., Loddò, A., Pompianu, L., & Serusi, S. (2021). Cryptocurrency scams: analysis and perspectives. *IEEE Access*, 9, 148353-148373. <https://doi.org/10.1109/ACCESS.2021.3123894>
- [33] Fang, F., Ventre, C., Basios, M., Kanthan, L., Martinez-Rego, D., Wu, F., & Li, L. (2022). Cryptocurrency trading: a comprehensive survey. *Financial Innovation*, 8(1), 13. <https://doi.org/10.1186/s40854-021-00321-6>
- [34] Kyriazis, N., Papadamou, S., & Corbet, S. (2020). A systematic review of the bubble dynamics of cryptocurrency prices. *Research in International Business and Finance*, 54, 101254. <https://doi.org/10.1016/j.ribaf.2020.101254>
- [35] Wu, J., Liu, J., Zhao, Y., & Zheng, Z. (2021). Analysis of cryptocurrency transactions from a network perspective: An overview. *Journal of Network and Computer Applications*, 190, 103139. <https://doi.org/10.1016/j.jnca.2021.103139>
- [36] Fauzi, M. A., Paiman, N., & Othman, Z. (2020). Bitcoin and cryptocurrency: Challenges, opportunities and future works. *The Journal of Asian Finance, Economics and Business*, 7(8), 695-704. <https://doi.org/10.13106/jafeb.2020.vol7.no8.695>
- [37] Suratkar, S., Shirole, M., & Bhirud, S. (2020). Cryptocurrency wallet: A review. In 2020 4th international conference on computer, communication and signal processing (ICCCSP) (pp. 1-7). IEEE. <https://doi.org/10.1109/ICCCSP49186.2020.9315193>
- [38] Amsyar, I., Christopher, E., Dithi, A., Khan, A. N., & Maulana, S. (2020). The challenge of cryptocurrency in the era of the digital revolution: A review of systematic literature. *Aptisi Transactions on Technopreneurship (ATT)*, 2(2), 153-159. <https://doi.org/10.34306/att.v2i2.96>
- [39] Zohuri, B., Nguyen, H. T., & Moghaddam, M. (2022). What is the Cryptocurrency. Is it a threat to our national security, Domestically and Globally, 1-14.
- [40] Alzahrani, S., & Daim, T. U. (2019). Analysis of the cryptocurrency adoption decision: Literature review. In 2019 Portland International Conference on Management of Engineering and Technology (PICMET) (pp. 1-11). IEEE. <https://doi.org/10.23919/PICMET.2019.8893819>
- [41] Donthu, N., Kumar, S., & Pattnaik, D. (2020). Forty-five years of Journal of Business Research: A bibliometric analysis. *Journal of business research*, 109, 1-14. <https://doi.org/10.1016/j.jbusres.2019.10.039>
- [42] Singh, S., Dhir, S., Das, V. M., & Sharma, A. (2020). Bibliometric overview of the Technological Forecasting and Social Change journal: Analysis from 1970 to 2018. *Technological Forecasting and Social Change*, 154, 119963. <https://doi.org/10.1016/j.techfore.2020.119963>
- [43] Khanra, S., Dhir, A., Kaur, P., & Mäntymäki, M. (2021). Bibliometric analysis and literature review of ecotourism: Toward sustainable development. *Tourism Management Perspectives*, 37, 100777. <https://doi.org/10.1016/j.tmp.2020.100777>
- [44] 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>
- [45] Jain, V., Wirtz, J., Salunke, P., Nunkoo, R., & Sharma, A. (2023). Luxury hospitality: A systematic literature review and research agenda. *International Journal of Hospitality Management*, 115, 103597. <https://doi.org/10.1016/j.ijhm.2023.103597>
- [46] Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & Prisma Group. (2010). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *International journal of surgery*, 8(5), 336-341. <https://doi.org/10.1016/j.ijsu.2010.02.007>
- [47] Rethlefsen, M. L., Kirtley, S., Waffenschmidt, S., Ayala, A. P., Moher, D., Page, M. J., & Koffel, J. B. (2021). PRISMA-S: an extension to the PRISMA statement for reporting literature searches in systematic reviews. *Systematic reviews*, 10, 1-19. <https://doi.org/10.1186/s13643-020-01542-z>
- [48] Salunke, P., Jain, V., Eastman, J., Mishra, T., & Chakraborty, A. (2025). Decoding the effectiveness of social media influencers' endorsement on consumer behavior: an evidence-based approach. *Electronic Commerce Research*, 1-37. <https://doi.org/10.1007/s10660-025-09975-1>
- [49] Mathiyazhagan, K., Rajak, S., Sampurna Panigrahi, S., Agarwal, V., & Manani, D. (2021). Reverse supply chain management in manufacturing industry: a systematic review. *International Journal of Productivity and Performance Management*, 70(4), 859-892. <https://doi.org/10.1108/IJPPM-06-2019-0293>

- [50] Small, H. (1973). Co-citation in the scientific literature: A new measure of the relationship between two documents. *Journal of the American Society for Information Science*, 24(4), 265–269. <https://doi.org/10.1002/asi.4630240406>
- [51] Van Eck, N., & Waltman, L. (2009). Software survey: VOSviewer, a computer program for bibliometric mapping. *scientometrics*, 84(2), 523-538. <https://doi.org/10.1007/s11192-009-0146-3>
- [52] Phan Tan, L. (2022). Bibliometrics of social entrepreneurship research: Cocitation and bibliographic coupling analyses. *Cogent Business & Management*, 9(1), 2124594. <https://doi.org/10.1080/23311975.2022.2124594>
- [53] Martyn, J. (1964). Bibliographic coupling. *Journal of Documentation*, 20(4), 236–236. <https://doi.org/10.1108/eb026352>
- [54] Cobo, M.J., López-Herrera, A.G., Herrera-Viedma, E., & Herrera, F. (2011). An approach for detecting, quantifying, and visualizing the evolution of a research field: A practical application to the fuzzy sets theory field. *Journal of Informetrics*, 5(1), 146–166. <https://doi.org/10.1016/j.joi.2010.10.002>
- [55] Chang, Y.-W., Huang, M.-H., & Lin, C.-W. (2015). Evolution of research subjects in library and information science based on keyword, bibliographical coupling, and co-citation analyses. *Scientometrics*, 105(3), 2071–2087. <https://doi.org/10.1007/s11192-015-1762>
- [56] Moed, H. F. (2006). *Citation analysis in research evaluation* (Vol. 9). Springer Science & Business Media. <https://doi.org/10.1007/1-4020-3714-7>
- [57] Xu, S., Zhang, X., Feng, L., & Yang, W. (2020). Disruption risks in supply chain management: a literature review based on bibliometric analysis. *International Journal of Production Research*, 58(11), 3508-3526. <https://doi.org/10.1080/00207543.2020.1717011>
- [58] Brin, S., & Page, L. (1998). The anatomy of a large-scale hypertextual web search engine. *Computer networks and ISDN systems*, 30(1-7), 107-117. [https://doi.org/10.1016/S0169-7552\(98\)00110-X](https://doi.org/10.1016/S0169-7552(98)00110-X)
- [59] Fahimnia, B., Sarkis, J., & Davarzani, H. (2015). Green supply chain management: A review and bibliometric analysis. *International journal of production economics*, 162, 101-114. <https://doi.org/10.1016/j.ijpe.2015.01.003>
- [60] Ullah, M., Shahid, A., Din, I. U., Roman, M., Assam, M., Fayaz, M., ... & Aljuaid, H. (2022). Analyzing interdisciplinary research using Co-authorship networks. *Complexity*, 2022(1), 2524491. <https://doi.org/10.1155/2022/2524491>
- [61] Aldieri, L., Kotsemir, M., & Vinci, C. P. (2018). The impact of research collaboration on academic performance: An empirical analysis for some European countries. *Socio-Economic Planning Sciences*, 62, 13-30. <https://doi.org/10.1016/j.seps.2017.05.003>
- [62] Bariviera, A. F., & Merediz-Solà, I. (2021). Where do we stand in cryptocurrencies economic research? A survey based on hybrid analysis. *Journal of Economic Surveys*, 35(2), 377-407. <https://doi.org/10.1111/joes.12412>
- [63] Flori, A. (2019a). Cryptocurrencies in finance: Review and applications. *International Journal of Theoretical and Applied Finance*, 22(05), 1950020. <https://doi.org/10.1142/S0219024919500201>
- [64] Flori, A. (2019b). News and subjective beliefs: A Bayesian approach to Bitcoin investments. *Research in International Business and Finance*, 50, 336-356. <https://doi.org/10.1016/j.ribaf.2019.05.007>
- [65] Bedi, P., & Nashier, T. (2020). On the investment credentials of Bitcoin: A cross-currency perspective. *Research in International Business and Finance*, 51, 101087. <https://doi.org/10.1016/j.ribaf.2019.101087>
- [66] Ahmed, W. M. (2022). Robust drivers of Bitcoin price movements: An extreme bounds analysis. *The North American Journal of Economics and Finance*, 62, 101728. <https://doi.org/10.1016/j.najef.2022.101728>
- [67] Ghorbel, A., Frikha, W., & Manzli, Y. S. (2022). Testing for asymmetric non-linear short-and long-run relationships between crypto-currencies and stock markets. *Eurasian Economic Review*, 12(3), 387-425. <https://doi.org/10.1007/s40822-022-00206-8>
- [68] Schellinger, B. (2020). Optimization of special cryptocurrency portfolios. *The Journal of Risk Finance*, 21(2), 127-157. <https://doi.org/10.1108/JRF-11-2019-0221>
- [69] Bhuiyan, R. A., Husain, A., & Zhang, C. (2023). Diversification evidence of bitcoin and gold from wavelet analysis: RA Bhuiyan et al., *Financial Innovation*, 9(1), 100. <https://doi.org/10.1186/s40854-023-00495-1>
- [70] Qarni, M. O., & Gulzar, S. (2021). Portfolio diversification benefits of alternative currency investment in Bitcoin and foreign exchange markets. *Financial Innovation*, 7(1), 17. <https://doi.org/10.1186/s40854-021-00233-5>
- [71] Corbet, S., Lucey, B., Urquhart, A., & Yarovaya, L. (2019). Cryptocurrencies as a financial asset: A systematic analysis. *International Review of Financial Analysis*, 62, 182-199. <https://doi.org/10.1016/j.irfa.2018.09.003>
- [72] Urquhart, A. (2016). The inefficiency of Bitcoin. *Economics Letters*, 148, 80-82. <https://doi.org/10.1016/j.econlet.2016.09.019>
- [73] Dyhrberg, A. H. (2016). Hedging capabilities of bitcoin. Is it the virtual gold?. *Finance research letters*, 16, 139-144. <https://doi.org/10.1016/j.frl.2015.10.025>
- [74] Thakor, A. V. (2020). Fintech and banking: What do we know?. *Journal of financial intermediation*, 41, 100833. <https://doi.org/10.1016/j.jfi.2019.100833>

- [75] Conlon, T., & McGee, R. (2020). Safe haven or risky hazard? Bitcoin during the COVID-19 bear market. *Finance Research Letters*, 35, 101607. <https://doi.org/10.1016/j.frl.2020.101607>
- [76] Klein, T., Thu, H. P., & Walther, T. (2018). Bitcoin is not the New Gold—A comparison of volatility, correlation, and portfolio performance. *International Review of Financial Analysis*, 59, 105-116. <https://doi.org/10.1016/j.irfa.2018.07.010>
- [77] Shahzad, S. J. H., Bouri, E., Roubaud, D., Kristoufek, L., & Lucey, B. (2019). Is Bitcoin a better safe-haven investment than gold and commodities?. *International Review of Financial Analysis*, 63, 322-330. <https://doi.org/10.1016/j.irfa.2019.01.002>
- [78] Tiwari, A. K., Jana, R. K., Das, D., & Roubaud, D. (2018). Informational efficiency of Bitcoin—An extension. *Economics Letters*, 163, 106-109. <https://doi.org/10.1016/j.econlet.2017.12.006>
- [79] Conlon, T., Corbet, S., & McGee, R. J. (2020). Are cryptocurrencies a safe haven for equity markets? An international perspective from the COVID-19 pandemic. *Research in International Business and Finance*, 54, 101248. <https://doi.org/10.1016/j.ribaf.2020.101248>
- [80] Selmi, R., Mensi, W., Hammoudeh, S., & Bouoiyour, J. (2018). Is Bitcoin a hedge, a safe haven or a diversifier for oil price movements? A comparison with gold. *Energy Economics*, 74, 787-801. <https://doi.org/10.1016/j.eneco.2018.07.007>
- [81] Urquhart, A., & Zhang, H. (2019). Is Bitcoin a hedge or safe haven for currencies? An intraday analysis. *International Review of Financial Analysis*, 63, 49-57. <https://doi.org/10.1016/j.irfa.2019.02.009>
- [82] Shahzad, S. J. H., Bouri, E., Roubaud, D., & Kristoufek, L. (2020). Safe haven, hedge and diversification for G7 stock markets: Gold versus bitcoin. *Economic Modelling*, 87, 212-224. <https://doi.org/10.1016/j.econmod.2019.07.023>
- [83] Li, X., & Wang, C. A. (2017). The technology and economic determinants of cryptocurrency exchange rates: The case of Bitcoin. *Decision support systems*, 95, 49-60. <https://doi.org/10.1016/j.dss.2016.12.001>
- [84] Bouri, E., Shahzad, S. J. H., Roubaud, D., Kristoufek, L., & Lucey, B. (2020). Bitcoin, gold, and commodities as safe havens for stocks: New insight through wavelet analysis. *The Quarterly Review of Economics and Finance*, 77, 156-164. <https://doi.org/10.1016/j.qref.2020.03.004>
- [85] Bouri, E., Gupta, R., & Roubaud, D. (2019). Herding behaviour in cryptocurrencies. *Finance Research Letters*, 29, 216-221. <https://doi.org/10.1016/j.frl.2018.07.008>
- [86] Yi, S., Xu, Z., & Wang, G. J. (2018). Volatility connectedness in the cryptocurrency market: Is Bitcoin a dominant cryptocurrency?. *International Review of Financial Analysis*, 60, 98-114. <https://doi.org/10.1016/j.irfa.2018.08.012>
- [87] Le, T. L., Abakah, E. J. A., & Tiwari, A. K. (2021). Time and frequency domain connectedness and spill-over among fintech, green bonds and cryptocurrencies in the age of the fourth industrial revolution. *Technological Forecasting and Social Change*, 162, 120382. <https://doi.org/10.1016/j.techfore.2020.120382>
- [88] Polasik, M., Piotrowska, A. I., Wisniewski, T. P., Kotkowski, R., & Lightfoot, G. (2015). Price fluctuations and the use of bitcoin: An empirical inquiry. *International journal of electronic commerce*, 20(1), 9-49. <https://doi.org/10.1080/10864415.2016.1061413>
- [89] Fang, L., Bouri, E., Gupta, R., & Roubaud, D. (2019). Does global economic uncertainty matter for the volatility and hedging effectiveness of Bitcoin?. *International Review of Financial Analysis*, 61, 29-36. <https://doi.org/10.1016/j.irfa.2018.12.010>
- [90] Borri, N. (2019). Conditional tail-risk in cryptocurrency markets. *Journal of Empirical Finance*, 50, 1-19. <https://doi.org/10.1016/j.jempfin.2018.11.002>
- [91] Isaac, A. T., Mafimisebi, O., Wakunuma, K., & Mwila, N. (2024). Knowledge exchange mechanisms: a bibliometric analysis of knowledge exchange literature. *Knowledge Management Research & Practice*, 1-16. <https://doi.org/10.1080/14778238.2024.2355914>
- [92] Johri, A., Joshi, P., Kumar, S., & Joshi, G. (2024). Metaverse for Sustainable Development in a bibliometric analysis and systematic literature review. *Journal of cleaner production*, 435, 140610. <https://doi.org/10.1016/j.jclepro.2024.140610>
- [93] Paul, J., & Rosado-Serrano, A. (2019). Gradual internationalization vs born-global/international new venture models: A review and research agenda. *International marketing review*, 36(6), 830-858. <https://doi.org/10.1108/IMR-10-2018-0280>
- [94] Sahoo, S. K., Sahu, S., Choudhury, B. B., Dhal, P. R., & Dhar, I. (2026). Transforming Decision-Making in Generation Z Education: A Systematic and Bibliometric Review of Artificial Intelligence. *Journal of Contemporary Decision Science*, 2(1), 114-130.
- [95] Ullah, K., Rehman, N., & Ali, A. (2026). Business-oriented stock market decision analysis using circular complex picture fuzzy sets and advanced MCDM based on the CRITIC–WASPAS method. *Journal of Contemporary Decision Science*, 2(1), 1-54.

- [96] Abdullah, M., Chowdhury, M. A. F., & Ullah, G. W. (2025). Asymmetric tail risk dynamics, efficiency and risk spillover among FinTech stocks, cryptocurrencies and traditional assets. *Global Finance Journal*, 64, 101082. <https://doi.org/10.1016/j.gfi.2025.101082>
- [97] Apostolakis, G. N. (2024). Bitcoin price volatility transmission between spot and futures markets. *International Review of Financial Analysis*, 94, 103251. <https://doi.org/10.1016/j.irfa.2024.103251>
- [98] Bouri, E., & Jalkh, N. (2024). Flight-to-safety across time and market conditions. *International Review of Economics & Finance*, 94, 103363. <https://doi.org/10.1016/j.iref.2024.05.042>
- [99] Cai, C. X., & Zhao, R. (2024). Salience theory and cryptocurrency returns. *Journal of Banking & Finance*, 159, 107052. <https://doi.org/10.1016/j.jbankfin.2023.107052>
- [100] Conlon, T., Corbet, S., & Hou, Y. G. (2024). Contagion effects of permissionless, worthless cryptocurrency tokens: Evidence from the collapse of FTX. *Journal of International Financial Markets, Institutions and Money*, 91, 101940. <https://doi.org/10.1016/j.intfin.2024.101940>
- [101] Guo, L., Sang, B., Tu, J., & Wang, Y. (2024). Cross-cryptocurrency return predictability. *Journal of Economic Dynamics and Control*, 163, 104863. <https://doi.org/10.1016/j.jedc.2024.104863>
- [102] Huang, L. (2024). The relationship between cryptocurrencies and convention financial market: Dynamic causality test and time-varying influence. *International Review of Economics & Finance*, 91, 811-826. <https://doi.org/10.1016/j.iref.2024.01.032>
- [103] Liu, P., & Yuan, Y. (2024). Is Bitcoin a hedge or safe-haven asset during the period of turmoil? Evidence from the currency, bond and stock markets. *International Review of Financial Analysis*, 96, 103663. <https://doi.org/10.1016/j.irfa.2024.103663>
- [104] Meyer, E. A., Welpel, I. M., & Sandner, P. (2024). Testing the credibility of crypto influencers: An event study on Bitcoin. *Finance Research Letters*, 60, 104864. <https://doi.org/10.1016/j.frl.2023.104864>
- [105] Sharma, G. D., Tiwari, A. K., Chopra, R., & Dev, D. (2024). Past, present, and future of block-chain in finance. *Journal of Business Research*, 177, 114640. <https://doi.org/10.1016/j.jbusres.2024.114640>
- [106] Xiao, B., Lin, S., Wu, C., & Sun, B. (2025). Leveraging traditional financial asset protection methods for digital asset security. *International Review of Economics & Finance*, 99, 104010. <https://doi.org/10.1016/j.iref.2025.104010>
- [107] Zhao, X., Wang, Y., & Liu, W. (2024). Someone like you: Lottery-like preference and the cross-section of expected returns in the cryptocurrency market. *Journal of International Financial Markets, Institutions and Money*, 91, 101957. <https://doi.org/10.1016/j.intfin.2024.101957>
- [108] Aliu, F. (2024). Do infectious diseases explain bitcoin price fluctuations?. *Journal of International Financial Markets, Institutions and Money*, 93, 102011. <https://doi.org/10.1016/j.intfin.2024.102011>
- [109] Assamoi, V. K., Ekponon, A., & Guo, Z. (2025). Are cryptocurrencies priced in the cross-section? A portfolio approach. *Finance Research Letters*, 71, 106437. <https://doi.org/10.1016/j.frl.2024.106437>
- [110] Boubaker, S., Karim, S., Naeem, M. A., & Rahman, M. R. (2024). On the prediction of systemic risk tolerance of cryptocurrencies. *Technological Forecasting and Social Change*, 198, 122963. <https://doi.org/10.1016/j.techfore.2023.122963>
- [111] Bouteska, A., Abedin, M. Z., Hajek, P., & Yuan, K. (2024). Cryptocurrency price forecasting—a comparative analysis of ensemble learning and deep learning methods. *International Review of Financial Analysis*, 92, 103055. <https://doi.org/10.1016/j.irfa.2023.103055>
- [112] Felföldi-Szűcs, N., & Králik, B. (2024). Put–call parity in a crypto option market—Evidence from Binance. *Finance Research Letters*, 61, 104874. <https://doi.org/10.1016/j.frl.2023.104874>
- [113] Kyriazis, N., & Corbet, S. (2024). Evaluating the dynamic connectedness of financial assets and bank indices during black-swan events: A Quantile-VAR approach. *Energy Economics*, 131, 107329. <https://doi.org/10.1016/j.eneco.2024.107329>
- [114] Proelss, J., Schweizer, D., & Buchwalter, B. (2025). Do risk preferences drive momentum in cryptocurrencies?. *Finance Research Letters*, 73, 106531. <https://doi.org/10.1016/j.frl.2024.106531>
- [115] Wang, Y., An, J., Zhao, X., & Lu, X. (2024). Competency or investment? The impact of NFT design features on product performance. *Decision Support Systems*, 187, 114341. <https://doi.org/10.1016/j.dss.2024.114341>
- [116] Batra, S., Tiwari, A. K., Yadav, M., & Danso, A. (2025). Connectedness among diverse financial assets: Evidence from cryptocurrency uncertainty indices. *Technological Forecasting and Social Change*, 210, 123874. <https://doi.org/10.1016/j.techfore.2024.123874>
- [117] Echaust, K., Just, M., & Kliber, A. (2024). To hedge or not to hedge? Cryptocurrencies, gold and oil against stock market risk. *International Review of Financial Analysis*, 94, 103292. <https://doi.org/10.1016/j.irfa.2024.103292>
- [118] Feng, J., Yuan, Y., & Jiang, M. (2024). Are stablecoins better safe havens or hedges against global stock markets than other assets? Comparative analysis during the COVID-19 pandemic. *International Review of Economics & Finance*, 92, 275-301. <https://doi.org/10.1016/j.iref.2024.01.032>

- [119] Gorman, M., & Huguen, W. K. (2024). Does bitcoin still enhance an investment portfolio in a post Covid-19 world?. *Finance Research Letters*, 62, 105170. <https://doi.org/10.1016/j.frl.2024.105170>
- [120] Naeem, M. A., Arfaoui, N., & Yarovaya, L. (2025). The contagion effect of artificial intelligence across innovative industries: From blockchain and metaverse to cleantech and beyond. *Technological Forecasting and Social Change*, 210, 103822. <https://doi.org/10.1016/j.techfore.2024.103822>
- [121] Sila, J., Kocenda, E., Kristoufek, L., & Kukacka, J. (2024). Good vs. bad volatility in major cryptocurrencies: The dichotomy and drivers of connectedness. *Journal of International Financial Markets, Institutions and Money*, 96, 102062. <https://doi.org/10.1016/j.intfin.2024.102062>
- [122] Umar, Z., Usman, M., Umar, M., & Ktaish, F. (2024). Interdependencies and risk management strategies between green cryptocurrencies and traditional energy sources. *Energy Economics*, 136, 107742. <https://doi.org/10.1016/j.eneco.2024.107742>
- [123] Walker, C. B. (2024). Going mainstream: Cryptocurrency narratives in newspapers. *International Review of Financial Analysis*, 94, 103305. <https://doi.org/10.1016/j.irfa.2024.103305>
- [124] Yousaf, I., Ijaz, M. S., Umar, M., & Li, Y. (2024). Exploring volatility interconnections between AI tokens, AI stocks, and fossil fuel markets: evidence from time and frequency-based connectedness analysis. *Energy Economics*, 133, 107490. <https://doi.org/10.1016/j.eneco.2024.107490>
- [125] Alharbi, S. S., Naveed, M., Ali, S., & Moussa, F. (2025). Sailing towards sustainability: Connectedness between ESG stocks and green cryptocurrencies. *International Review of Economics & Finance*, 98, 103848. <https://doi.org/10.1016/j.iref.2025.103848>
- [126] Almeida, J., Gaio, C., & Gonçalves, T. C. (2024). Crypto market relationships with bric countries' uncertainty—A wavelet-based approach. *Technological Forecasting and Social Change*, 200, 123078. <https://doi.org/10.1016/j.techfore.2023.123078>
- [127] Asl, M. G., Jabeur, S. B., & Zaied, Y. B. (2024a). Analyzing the interplay between eco-friendly and Islamic digital currencies and green investments. *Technological Forecasting and Social Change*, 208, 123715. <https://doi.org/10.1016/j.techfore.2024.123715>
- [128] Hägele, S. (2024). Centralized exchanges vs. decentralized exchanges in cryptocurrency markets: A systematic literature review. *Electronic Markets*, 34(1), 33. <https://doi.org/10.1007/s12525-024-00714-2>
- [129] Subramanian, H., Angle, P., Rouxelin, F., & Zhang, Z. (2024). A decision support system using signals from social media and news to predict cryptocurrency prices. *Decision Support Systems*, 178, 114129. <https://doi.org/10.1016/j.dss.2023.114129>
- [130] Ali, S., Al-Nassar, N. S., & Naveed, M. (2024a). Bridging the gap: Uncovering static and dynamic relationships between digital assets and BRICS equity markets. *Global Finance Journal*, 60, 100955. <https://doi.org/10.1016/j.gfj.2024.100955>
- [131] Ali, S., Naveed, M., Yousaf, I., & Khattak, M. S. (2024b). From cryptos to consciousness: Dynamics of return and volatility spillover between green cryptocurrencies and G7 markets. *Finance Research Letters*, 60, 104899. <https://doi.org/10.1016/j.frl.2023.104899>
- [132] Arora, R., Kapoor, M., Singh, N., & Yaqub, M. Z. (2025). Green cryptocurrency and business strategies: Framework and insights from a stewardship literature review. *Business Strategy and the Environment*, 34(1), 804-829. <https://doi.org/10.1002/bse.3996>
- [133] Bajra, U. Q., Aliu, F., & Prenaj, V. (2025). Connectivity of green financial assets under geopolitical risks and market-implied volatility. *Finance Research Letters*, 76, 107037. <https://doi.org/10.1016/j.frl.2025.107037>
- [134] Jiang, D., Jia, F., & Han, X. (2025). Quantile return and volatility spillovers and drivers among energy, electricity, and cryptocurrency markets. *Energy Economics*, 144, 108307. <https://doi.org/10.1016/j.eneco.2025.108307>
- [135] Hoque, M. E., Billah, M., Alam, M. R., & Tiwari, A. K. (2024). Gold-backed cryptocurrencies: A hedging tool against categorical and regional financial stress. *Global Finance Journal*, 60, 100964. <https://doi.org/10.1016/j.gfj.2024.100964>
- [136] Behl, A., Pereira, V., Nigam, A., Wamba, S., & Sindhwani, R. (2024). Knowledge development in non-fungible tokens (NFT): a scoping review. *Journal of Knowledge Management*, 28(1), 232-267. <https://doi.org/10.1108/JKM-12-2022-0937>
- [137] BenMabrouk, H., Sassi, S., Soltane, F., & Abid, I. (2024). Connectedness and portfolio hedging between NFTs segments, American stocks and cryptocurrencies Nexus. *International Review of Financial Analysis*, 91, 102959. <https://doi.org/10.1016/j.irfa.2023.102959>
- [138] Kräussl, R., & Tugnetti, A. (2024). Non-fungible tokens (NFTs): A review of pricing determinants, applications and opportunities. *Journal of Economic Surveys*, 38(2), 555-574. <https://doi.org/10.1111/joes.12597>
- [139] Divakaruni, A., & Zimmerman, P. (2024). Uncovering retail trading in bitcoin: The impact of COVID-19 stimulus checks. *Management Science*, 70(4), 2066-2085. <https://doi.org/10.1287/mnsc.2023.4790>

- [140] Jagolinzer, A. D. (2024). Market and regulatory implications of social identity cohorts: a discussion of crypto influencers. *Review of Accounting Studies*, 29(3), 2298-2317. <https://doi.org/10.1007/s11142-024-09837-5>
- [141] Mathmann, F., Chrysochou, P., Tiganis, A., & Martin, B. A. (2025). What motivates crypto likes? How assessment regulatory mode increases social media engagement with crypto assets. *Psychology & Marketing*, 42(1), 80-96. <https://doi.org/10.1002/mar.22114>
- [142] Gerritsen, D., & de Regt, A. (2025). Influencers and Consumer Financial Decision-Making. *International Journal of Consumer Studies*, 49(2), e70037. <https://doi.org/10.1111/ijcs.70037>
- [143] Özer, M., Frömmel, M., Kamaşlı, M., & Vuković, D. B. (2024). Do bitcoin shocks truly Cointegrate with financial and commodity markets?. *International Review of Financial Analysis*, 95, 103354. <https://doi.org/10.1016/j.irfa.2024.103354>
- [144] Horváth, M., & Výrost, T. (2025). No shortfall of ES estimators: Insights from cryptocurrency portfolios. *Finance Research Letters*, 73, 106685. <https://doi.org/10.1016/j.frl.2024.106685>
- [145] Mercik, A., Słowski, T., & Karaś, M. (2024). Understanding crypto-asset exposure: An investigation of its impact on performance and stock sensitivity among listed companies. *International Review of Financial Analysis*, 92, 103070. <https://doi.org/10.1016/j.irfa.2024.103070>
- [146] Karim, M. M., Shah, M. E., Noman, A. H. M., & Yarovaya, L. (2024). Exploring asymmetries in cryptocurrency intraday returns and implied volatility: New evidence for high-frequency traders. *International Review of Financial Analysis*, 96, 103617. <https://doi.org/10.1016/j.irfa.2024.103617>
- [147] Bouri, E., Sokhanvar, A., Kinatder, H., & Çiftçioğlu, S. (2025). Tech titans and crypto giants: Mutual returns predictability and trading strategy implications. *Journal of International Financial Markets, Institutions and Money*, 99, 102109. <https://doi.org/10.1016/j.intfin.2024.102109>
- [148] Roche, G. A. G., Noël, A., & Sauce, L. (2025). Bitcoin trade volume in decentralized markets: International evidence. *Technological Forecasting and Social Change*, 214, 124054. <https://doi.org/10.1016/j.techfore.2025.124054>
- [149] Liu, J., Julaiti, J., & Gou, S. (2024). Decomposing interconnectedness: A study of cryptocurrency spillover effects in global financial markets. *Finance Research Letters*, 61, 104950. <https://doi.org/10.1016/j.frl.2023.104950>
- [150] Chen, Y., Liu, Y., & Zhang, F. (2024). Coskewness and the short-term predictability for Bitcoin return. *Technological Forecasting and Social Change*, 200, 123196. <https://doi.org/10.1016/j.techfore.2023.123196>
- [151] Patel, R., Gubareva, M., Chishti, M. Z., & Teplova, T. (2024). Connectedness between healthcare cryptocurrencies and major asset classes: Implications for hedging and investments strategies. *International Review of Financial Analysis*, 93, 103181. <https://doi.org/10.1016/j.irfa.2024.103181>
- [152] Zięba, D. (2024). If GPU (time) == money: Sustainable crypto-asset market? Analysis of similarity among crypto-asset financial time series. *International Review of Economics & Finance*, 89, 863-912. <https://doi.org/10.1016/j.iref.2023.10.036>
- [153] Asl, M. G., Jabeur, S. B., Hosseini, S. S., & Riahi, H. T. (2024b). Fintech's impact on conventional and Islamic sustainable equities: Short-and long-term contributions of the digital financial ecosystem. *Global Finance Journal*, 62, 101022. <https://doi.org/10.1016/j.gfj.2024.101022>
- [154] Chen, Y., Chiu, J., Chung, H., & Lien, D. (2024). Bitcoin market connectedness across political uncertainty. *International Review of Economics & Finance*, 96, 103623. <https://doi.org/10.1016/j.iref.2024.103623>
- [155] Cheng, Z., Li, M., Cui, R., Wei, Y., Wang, S., & Hong, Y. (2024b). The impact of COVID-19 on global financial markets: A multiscale volatility spillover analysis. *International Review of Financial Analysis*, 95, 103454. <https://doi.org/10.1016/j.irfa.2024.103454>
- [156] Lei, H., Xue, M., & Ye, J. (2024). The nexus between ReFi, carbon, fossil energy, and clean energy assets: Quantile time–frequency connectedness and portfolio implications. *Energy Economics*, 132, 107456. <https://doi.org/10.1016/j.eneco.2024.107456>
- [157] Lu, X., Huang, N., & Mo, J. (2024). Time-varying causalities from the COVID-19 media coverage to the dynamic spillovers among the cryptocurrency, the clean energy, and the crude oil. *Energy Economics*, 132, 107442. <https://doi.org/10.1016/j.eneco.2024.107442>
- [158] Yang, M. Y., Chen, Z. K., Hu, J., Chen, Y., & Wu, X. (2025). Multidimensional information spillover between cryptocurrencies and China's financial markets under shocks from stringent government regulations. *Journal of International Financial Markets, Institutions and Money*, 100, 102134. <https://doi.org/10.1016/j.intfin.2025.102134>
- [159] Yousaf, I., Youssef, M., & Goodell, J. W. (2024). Tail connectedness between artificial intelligence tokens, artificial intelligence ETFs, and traditional asset classes. *Journal of International Financial Markets, Institutions and Money*, 91, 101929. <https://doi.org/10.1016/j.intfin.2023.101929>
- [160] Sakariyahu, R., Lawal, R., Adigun, R., Paterson, A., & Johan, S. (2024). One crash, too many: Global uncertainty, sentiment factors and cryptocurrency market. *Journal of International Financial Markets, Institutions and Money*, 94, 102028. <https://doi.org/10.1016/j.intfin.2024.102028>

- [161] Osman, M. B., Urom, C., Guesmi, K., & Benkraiem, R. (2024). Economic sentiment and the cryptocurrency market in the post-COVID-19 era. *International Review of Financial Analysis*, 91, 102962. <https://doi.org/10.1016/j.irfa.2023.102962>
- [162] de Almeida Junior, I. N., Palazzi, R. B., Klotzle, M. C., Pinto, A. C. F., & Gomes, L. L. (2024). Beyond hype: Unveiling the herd effect in ESG and non-ESG cryptocurrency portfolios. *Finance Research Letters*, 65, 105500. <https://doi.org/10.1016/j.frl.2024.105500>
- [163] Drăgan, G. B., Arfi, W. B., Tiberius, V., Ammari, A., & Khvatova, T. (2025). Navigating the green wave: Understanding behavioral antecedents of sustainable cryptocurrency investment. *Technological Forecasting and Social Change*, 210, 123909. <https://doi.org/10.1016/j.techfore.2024.123909>
- [164] Gill-de-Albornoz, B., Lafuente, J. A., Monfort, M., & Ordonez, J. (2024). Bitcoin attention and economic policy uncertainty. *Finance Research Letters*, 60, 104839. <https://doi.org/10.1016/j.frl.2023.104839>
- [165] Lee, H. C., De Vries, E. L., & Hosseini, R. (2025). Balancing generosity with profitability: The role of relative market price and value perceptions in crypto philanthropy. *International Journal of Research in Marketing*. <https://doi.org/10.1016/j.ijresmar.2025.02.001>
- [166] Luo, J., Zhang, S., & Zhang, C. (2025). Drivers of investment intentions across diverse cryptocurrency categories. *Finance Research Letters*, 77, 107024. <https://doi.org/10.1016/j.frl.2025.107024>
- [167] Beckmann, J., Geldner, T., & Wüstenfeld, J. (2024). The relevance of media sentiment for small and large scale bitcoin investors. *Journal of International Financial Markets, Institutions and Money*, 92, 101963. <https://doi.org/10.1016/j.intfin.2024.101963>
- [168] Hodula, M. (2025). Retail crypto investors when facing financial constraints: Evidence from energy shocks and the use and downloads of crypto trading apps. *Energy Economics*, 144, 108338. <https://doi.org/10.1016/j.eneco.2025.108338>
- [169] Li, J., Wan, X., Cheng, H. K., & Zhao, X. (2024). Operation dumbo drop: To airdrop or not to airdrop for initial coin offering success?. *Information Systems Research*, 35(4), 1928-1947. <https://doi.org/10.1287/isre.2021.0450>
- [170] Agnese, P., & Rios, F. (2024). Spillover effects of energy transition metals in Chile. *Energy Economics*, 134, 107589. <https://doi.org/10.1016/j.eneco.2024.107589>
- [171] Bouteska, A., Sharif, T., Isskandarani, L., & Abedin, M. Z. (2025). Market efficiency and its determinants: Macro-level dynamics and micro-level characteristics of cryptocurrencies. *International Review of Economics & Finance*, 98, 103938. <https://doi.org/10.1016/j.iref.2025.103938>
- [172] Buse, R., Görgen, K., & Schienle, M. (2025). Predicting value at risk for cryptocurrencies with generalized random forests. *International Journal of Forecasting*. <https://doi.org/10.1016/j.ijforecast.2024.12.002>
- [173] Cheng, J., Tiwari, S., Khaled, D., Mahendru, M., & Shahzad, U. (2024a). Forecasting Bitcoin prices using artificial intelligence: Combination of ML, SARIMA, and Facebook Prophet models. *Technological Forecasting and Social Change*, 198, 122938. <https://doi.org/10.1016/j.techfore.2023.122938>
- [174] Harris, R. D., Mazibas, M., & Rambaccussing, D. (2024). Bitcoin replication using machine learning. *International Review of Financial Analysis*, 93, 103207. <https://doi.org/10.1016/j.irfa.2024.103207>
- [175] Mizdrakovic, V., Kljajic, M., Zivkovic, M., Bacanin, N., Jovanovic, L., Devoci, M., & Pedrycz, W. (2024). Forecasting bitcoin: Decomposition aided long short-term memory based time series modeling and its explanation with Shapley values. *Knowledge-Based Systems*, 299, 112026. <https://doi.org/10.1016/j.knosys.2024.112026>
- [176] Atree, M. K., & Tripathy, N. (2025). Cryptocurrency research: Bibliometric review and content analysis. *International Review of Economics & Finance*, 98, 103940. <https://doi.org/10.1016/j.iref.2025.103940>
- [177] Conlon, T., De Mingo-López, D. V., & Urquhart, A. (2025). Persistence and Market Timing Ability of Cryptocurrency Funds. *Financial Management*. <https://doi.org/10.1111/fima.12498>
- [178] Feng, L., Qi, J., Liu, Y., & Wang, W. (2025). The spillover effects of the "Binance Incident" on financial markets: A study based on machine learning approach. *Finance Research Letters*, 71, 106383. <https://doi.org/10.1016/j.frl.2024.106383>
- [179] Anas, M., Bouri, E., & Shahzad, S. J. H. (2024). A Bibliometric analysis of literature on hedge and safe haven assets. *Journal of Economic Surveys*. <https://doi.org/10.1111/joes.12677>
- [180] Jabeur, S. B., Gozgor, G., Rezgui, H., & Mohammed, K. S. (2024). Dynamic dependence between quantum computing stocks and Bitcoin: Portfolio strategies for a new era of asset classes. *International Review of Financial Analysis*, 95, 103478. <https://doi.org/10.1016/j.irfa.2024.103478>