

Almeida, José; Gonçalves, Tiago Cruz

**Article**

## Portfolio diversification, hedge and safe-haven properties in cryptocurrency investments and financial economics: A systematic literature review

Journal of Risk and Financial Management

**Provided in Cooperation with:**

MDPI – Multidisciplinary Digital Publishing Institute, Basel

*Suggested Citation:* Almeida, José; Gonçalves, Tiago Cruz (2023) : Portfolio diversification, hedge and safe-haven properties in cryptocurrency investments and financial economics: A systematic literature review, Journal of Risk and Financial Management, ISSN 1911-8074, MDPI, Basel, Vol. 16, Iss. 1, pp. 1-25, <https://doi.org/10.3390/jrfm16010003>

This Version is available at:

<https://hdl.handle.net/10419/275099>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*



<https://creativecommons.org/licenses/by/4.0/>

Systematic Review

# Portfolio Diversification, Hedge and Safe-Haven Properties in Cryptocurrency Investments and Financial Economics: A Systematic Literature Review

José Almeida  and Tiago Cruz Gonçalves \* 

ISEG—Lisbon School of Economics & Management, Universidade de Lisboa, Advance/CSG,  
1200-781 Lisboa, Portugal

\* Correspondence: tiago@iseg.ulisboa.pt; Tel.: +351-213-925-800

**Abstract:** Our study collected and synthesized the existing knowledge on portfolio diversification, hedge, and safe-haven properties in cryptocurrency investments. We sampled 146 studies published in journals ranked in the Association of Business Schools 2021 journals list, considering all fields of knowledge, and elaborated a systematic literature review along with a bibliometric analysis. Our results indicate a fast-growing literature evidencing cryptocurrencies' ability to hedge against stocks, fiat currencies, geopolitical risks, and Economic Policy Uncertainty (EPU) risk; also, that cryptocurrencies present diversification and safe-haven properties; that stablecoins reveal unstable peg with the US dollar; that uncertainty is a determinant for cryptocurrency returns. Additionally, we show that investors should consider Gold, along with the European carbon market, CBOE Bitcoin futures, and crude oil to hedge against unexpected movements in the cryptocurrency market.

**Keywords:** cryptocurrencies; bitcoin; hedge; safe-haven; portfolio diversification; SLR



**Citation:** Almeida, José, and Tiago Cruz Gonçalves. 2023. Portfolio Diversification, Hedge and Safe-Haven Properties in Cryptocurrency Investments and Financial Economics: A Systematic Literature Review. *Journal of Risk and Financial Management* 16: 3. <https://doi.org/10.3390/jrfm16010003>

Academic Editor: Victor Dragotă

Received: 18 November 2022

Revised: 15 December 2022

Accepted: 16 December 2022

Published: 21 December 2022



**Copyright:** © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

The paper published by Nakamoto (2008) was the precursor of the cryptocurrency market. Today it is well known that cryptocurrencies are decentralized digital currencies, which represent a disruption in the traditional financial system (Almeida 2021).

The cryptocurrency market had rapid development and is still evolving (Białkowski 2020; Fang et al. 2021; Li et al. 2021). It fascinates and draws the attention of individual investors, institutional investors, regulators, and the media, and consequently is also an actual and important topic of research in numerous fields of academia (Angerer et al. 2020).

Investors have the necessity to properly manage their portfolios. Empirical research stresses the importance of cryptocurrencies' relationships with other assets (Bouri et al. 2022) and among themselves (Kumar et al. 2022), as well as their volatility traits (Klinkova and Grabinski 2017; Wang et al. 2022) in portfolio management. Therefore, information on assets' diversification, hedge, and safe-haven properties is of extreme importance. Even more so when we consider investment in the cryptocurrency market since it is a very recent market.

With this in mind, coupled with the fast production of new empirical evidence on cryptocurrencies, it is imperative to aggregate and synthesize all quality knowledge produced so far, as well as to identify literature gaps to facilitate future research lines (Angerer et al. 2020; Corbet et al. 2019). To this end, we conduct a systematic literature review process.

Our motives are twofold: (1) provide a better understanding of the existing academic literature on portfolio diversification, hedge, and safe-haven properties in cryptocurrency investments; (2) present important research findings for investors, policymakers, academics, businesses, and society in general.

We contribute to the literature in several ways. Firstly, we present the most comprehensive and up-to-date systematic literature review along with bibliometric analysis

contributing to knowledge consolidation on portfolio diversification, hedge, and safe-haven properties in cryptocurrency investments.

Secondly, with our literature review, we contribute with the identification and explanation of the current academic knowledge apprehended so far in portfolio diversification, hedge and safe-haven properties in cryptocurrency investments, complementing the broader and more general review of the literature findings of [Almeida \(2021\)](#); ([Almeida and Gonçalves 2022](#); [Angerer et al. 2020](#); [Bariviera and Merediz-Solà 2021](#); [Corbet et al. 2019](#); [Flori 2019b](#); [Hairudin et al. 2020](#); [Haq et al. 2021](#); [Jalal et al. 2021](#); [Kyriazis et al. 2020](#)).

Thirdly, in our research we use more inclusive keywords on our WoS search, thus considering the possible contributions of more peripheral studies on the topic of portfolio diversification, hedge, and safe-haven properties in cryptocurrency investments. The use of VOSviewer along with this methodology enables the emergence of a cluster related to the research topic.

Finally, we extend previous reviews by aggregating both a bibliometric analysis with a critical review of the findings in extant literature. We also contribute to the identification of research gaps and future venues about the use of crypto assets in investment strategies.

Our findings are important for researchers and academics in general, investors and analysts, and regulators. They provide researchers with structured networking for research outlets and literature strands, with time-trended information relevant to future studies on portfolio diversification, hedge, and safe-haven properties of cryptocurrency investments. Concurrently, we provide investors and analysts with a highly important compilation of practical findings that can help them better devise their investment strategies. In addition, our syntheses provide insights for regulators to effectively regulate the cryptocurrency markets.

We explore a growing literature and identify the most cited author in this research field Elie Bouri with 11 publications and 404 citations, as the most cited institution Trinity College Dublin, whereas the most cited journal is the Finance research letters, and the most cited county is China.

Our findings reveal that cryptocurrencies may hedge against stocks, fiat currencies, geopolitical risks, Economic Policy Uncertainty (EPU), however, these properties are time-varying. Extant research also indicates that cryptocurrencies present diversification and safe-haven properties, nonetheless, they vary across time and market conditions. Concurrently, stablecoins may act as a safe-haven and diversifiers and contribute to market efficiency, however, they reveal an unstable peg with the US dollar. Another significant finding in the literature analyzed is that uncertainty is indeed a determinant of cryptocurrency returns. Additionally, we show that investors should consider Gold, along with the European carbon market, CBOE Bitcoin futures, and crude oil to hedge against unexpected movements in the cryptocurrency market.

The remainder of the paper is structured as follows: Section 2, presents the methodology used. Section 3 presents the bibliometric analysis. In Section 4 we present the literature analysis regarding portfolio diversification, hedge and safe-haven properties in cryptocurrency investments, and highlight future research venues. Finally, in Section 5, we present our conclusions.

## 2. Methodology

We decided to adopt a systematic review process for our research. Based on the studies of ([Almeida and Gonçalves 2022](#); [Jiang et al. 2021](#); [Liang et al. 2016](#); [Linnenluecke et al. 2020](#); [Milian et al. 2019](#); [Yue et al. 2021](#)) We research search in the Web of Science database (WoS) to ensure integrity in our sample.

Since our aim is to cover the whole period, from the publication of the first article related to cryptocurrencies until nowadays, we considered the article published by [Nakamoto \(2008\)](#), which introduces cryptocurrencies, as our reference date. Therefore, we searched WoS from 1 January 2009, up until 4 November 2021, to cover all the cryptocurrency literature.

In our approach we consider broader keywords regarding portfolio diversification, hedge and safe-haven properties in cryptocurrency investments, which differentiates our research from other reviews such as [Flori \(2019a\)](#); [Haq et al. \(2021\)](#); [Jalal et al. \(2021\)](#); [Kyriazis et al. \(2020\)](#) We have selected the following keywords: “Cryptocurrency”, “Cryptocurrencies”, “Bitcoin”, “Portfolio diversification”, “Investment”, “Investor”, “investors”, “Alternative investment”; which resulted in the following research equation: “cryptocurrenc\* OR Bitcoin AND diversification AND portfolio AND invest\* AND alternative”.

To confer a higher quality to our research, we have only considered English-written journal articles listed in the Academic Journal Guide ABS (Association of Business Schools) list of 2021. Furthermore, all the articles should address cryptocurrencies through the perspective of investor/investment (not ignoring methodologies).

Moreover, we did not impose any restrictions regarding the areas of knowledge. Therefore, we could also enrich our research in portfolio diversification, hedge, and safe-haven properties in cryptocurrency investments with peripheral studies. Our final sample revealed 146 articles.

Following the studies by [Bartolacci et al. \(2020\)](#); [Ding et al. \(2014\)](#); [Galvao et al. \(2019\)](#); [Rialti et al. \(2019\)](#); [Sadeghi Moghadam et al. \(2021\)](#); [Van Eck and Waltman \(2017\)](#), we conduct our bibliometric analysis using VOSviewer.

We used the bibliographic coupling since it organizes the articles into clusters based on their shared references ([Bartolacci et al. 2020](#); [Rialti et al. 2019](#); [Van Eck and Waltman 2017](#)). Additionally, to reduce the bias related to the fact that older published articles might have higher citations than the new ones, we also use normalized citations ([Bartolacci et al. 2020](#); [Caputo et al. 2019](#); [Van Eck and Waltman 2017](#)).

The VOSviewer analysis provides relationships, between the articles, which appear as closer as their relationship is stronger ([Bartolacci et al. 2020](#); [Rialti et al. 2019](#)). Consequently, through the bibliographic coupling a cluster related to portfolio diversification, hedge and safe-haven properties in cryptocurrency investments arise.

### 3. Literature Mapping and Bibliometric Analysis

In our first analysis, Figure 1, we show the number of publications and citations related to the literature on portfolio diversification, hedge, and safe-haven properties in cryptocurrency investments. We identify as the year with fewer publications 2018 (2) and, on the other hand, as the year with the higher publications 2021 (81). The highest citation year is 2020, with 942 citations. These results suggest an increasing interest of academics in this field of knowledge, as well as its novelty.

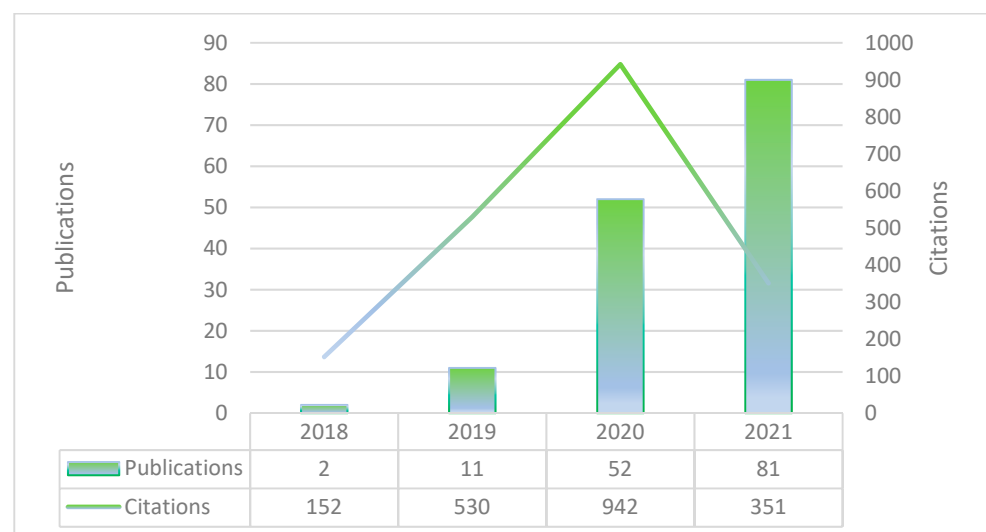


Figure 1. Citations and publications over time.

### 3.1. Top Articles Analysis

In Table 1, we present the top 10 most cited articles in the portfolio diversification, hedge, and safe-haven properties in cryptocurrency investments literature. Corbet et al. (2020c), Ji et al. (2019a), and Yi et al. (2018) are the top three most cited articles, with more than 100 citations each.

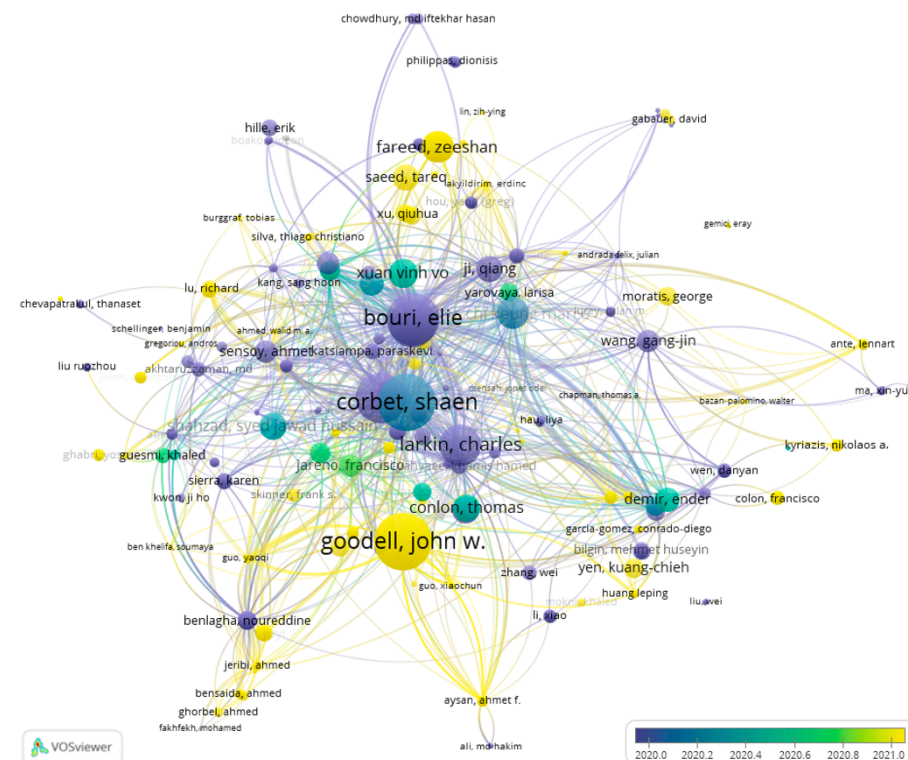
**Table 1.** Top 10 articles by number of citations (1975 Citation and 146 Publications).

Rank	Article	Citations
1	Corbet et al. (2020c)	171
2	Ji et al. (2019a)	136
3	Yi et al. (2018)	104
4	Conlon et al. (2020)	83
5	Goodell and Goutte (2021a)	74
6	Ji et al. (2019b)	67
7	Katsiampa et al. (2019)	59
8	Bouri et al. (2019)	57
9	Wang et al. (2019)	56
10	Sun et al. (2020)	54

### 3.2. Author's Analysis

Table 2 shows the top 10 most cited authors regarding portfolio diversification, hedge, and safe-haven properties in cryptocurrency investment literature. Bouri, Roubaud, and Corbet are the most cited authors and are also the ones with the most published articles. Nonetheless, Xu and Yi are the authors with the highest citation per publication ratios (104.00).

Figure 2 showed, regarding normalized citations, that Bouri and Larkin were the most cited authors at the beginning of the year 2020, Corbet and Colon at the end of 2020, and in 2021 Goodell and Fareed are the most cited authors.



**Figure 2.** Normalized citations of authors by year.





**Table 3.** Top 10 institutions by number of citations.

<i>Rank</i>	<i>Institutions</i>	<i>Publications</i>	<i>Citations</i>	<i>Citations per Publications</i>
1	Trinity College Dublin	9	386	42.89
2	Dublin City University	11	379	34.45
3	Montpellier Business School	12	372	31.00
4	Holy Spirit University Kaslik	8	363	45.38
5	University Economics Ho Chi Minh City	15	361	24.07
6	University Waikato	9	293	32.56
7	University Sydney	5	276	55.20
8	Chinese Academy of Science	6	261	43.50
9	University Bath	4	235	58.75
10	University Huddersfield	6	223	37.17

### 3.4. Journal Analysis

Table 4 presents the most productive journals regarding portfolio diversification, hedge, and safe-haven properties in cryptocurrency investments in our dataset. Finance Research Letters is the most cited journal with 716 citations and is also the journal with the most contributions to this field of knowledge (34). The International Review of Financial Analysis with 345 citations and the Research in International Business and Finance with 178 citations are the second and third most cited journals in our dataset. Nevertheless, the journal with the highest ratio of citations per publication is Energy Economics.

**Table 4.** Top 10 journals by number of citations.

<i>Rank</i>	<i>Journals</i>	<i>Publications</i>	<i>Citations</i>	<i>Citations per Publications</i>
1	Finance research letters	34	716	21.06
2	International review of financial analysis	16	345	21.56
3	Research in international business and finance	17	178	10.47
4	Energy economics	2	100	50.00
5	Journal of international financial markets institutions and money	6	93	15.50
6	North American journal of economics and finance	10	92	9.20
7	Economic modeling	4	79	19.75
8	Technological forecasting and social change	5	73	14.60
9	Quarterly review of economics and finance	7	65	9.29
10	Economics letters	6	53	8.83

Figure 4 presents the analysis of the most productive research areas, and as expected finance and economy are the most contributing with 89 and 48 contributions, respectively. With this analysis, we also reveal how other areas of knowledge contributed to better understanding of portfolio diversification, hedge, and safe-haven properties in cryptocurrency investments.

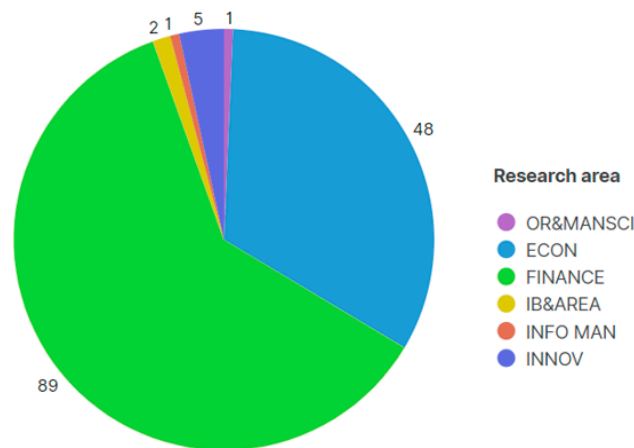


Figure 4. Most productive research areas.

Figure 5 shows evidence that regarding normalized citations Energy Economics is the most cited journal at the beginning of 2020, and Finance Research Letters is the most cited journal at the end of 2020. In 2021, Studies in Economics and Finance is the most cited journal.

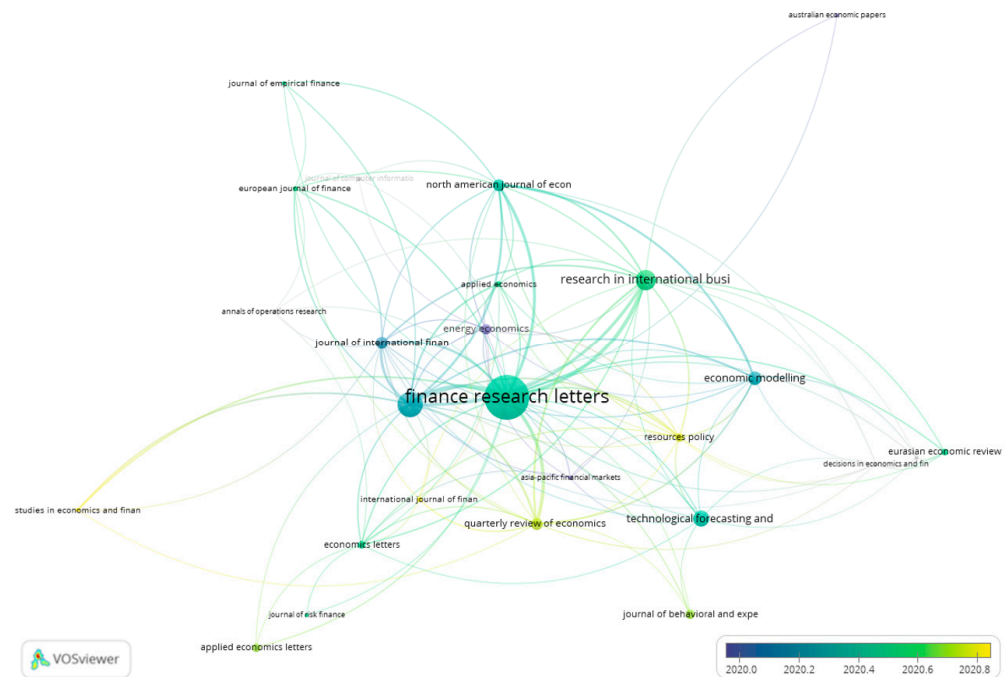


Figure 5. Normalized citations of journals by year.

### 3.5. Country Analysis

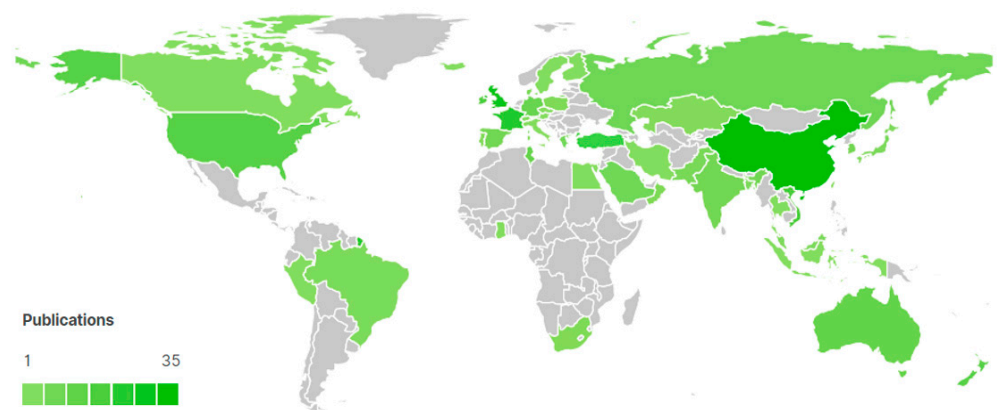
Through Table 5 and Figure 6, we evidence the most productive countries in our research field. China is the most cited country with 686 citations, followed by England and France with 614 and 567, respectively. On the other hand, the country that has the highest citation per publication ration in our top 10 countries is Lebanon (36.73).

Figure 7 evidence that regarding normalized citations, Lebanon and Australia are the most cited countries at the beginning of 2020, and France, England, and the USA at the end of the same year. In 2021, Indonesia and Greece appear as the most cited counties.

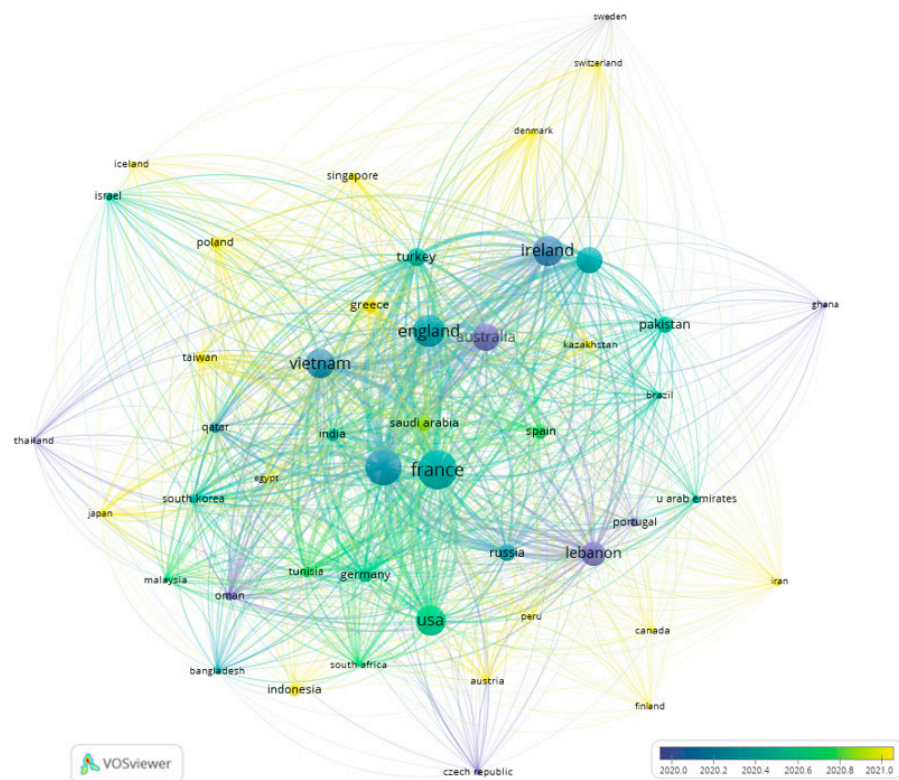


**Table 5.** Top 10 countries by number of citations.

Rank	Country	Publications	Citations	Citations per Publications
1	Peoples R. China	35	686	19.60
2	England	27	614	22.74
3	France	23	567	24.65
4	Ireland	16	505	31.56
5	Vietnam	18	415	23.06
6	Lebanon	11	404	36.73
7	Australia	11	363	33.00
8	New Zealand	14	316	22.57
9	USA	14	180	12.86
10	Turkey	17	163	9.59



**Figure 6.** Publications by country world map.



**Figure 7.** Normalized citations of countries by year.

#### 4. Literature Findings on Portfolio Diversification, Hedge and Safe-Haven Properties of Cryptocurrency Investments

##### 4.1. Do Cryptocurrencies Bear Hedging Properties?

This literature review addresses the hedging properties of cryptocurrencies. In this strand of literature, we found evidence that supports the hedging ability of cryptocurrencies against stocks (Fang et al. 2020; Kumah and Odei-Mensah 2021), fiat currencies (Hsu et al. 2021; Kinkyo 2020), Gold (González et al. 2021; Hsu et al. 2021; Kumah and Mensah 2020), geopolitical risks (Colon et al. 2021), Economic Policy Uncertainty (EPU) risk (Yen and Cheng 2021) as well as against the uncertainty caused by the COVID-19 pandemic (Demir et al. 2020a; Iqbal et al. 2021).

Regarding the specific case of Bitcoin, it is found that it reveals hedging effectiveness (Bhuiyan et al. 2021; Ghabri et al. 2020; Huynh et al. 2020a, 2020b). Similar to Gold, Bitcoin can be considered a hedge against developed markets (Jeribi and Ghorbel 2021; Zeng et al. 2020), showing the ability to hedge in normal, and also in stressed market conditions (Chemkha et al. 2021). Bitcoin has matured from a speculative trading asset to an investment tool that responds to the underlying macroeconomic factors (Vo et al. 2021). According to the reviewed literature, Bitcoin may be used as a hedge against increased asset volatility due to high uncertainty levels in countries such as the USA, Germany, France, China, Canada, Russia, the UK, and Japan (Mokni 2021). Bitcoin also has the ability to hedge against industry portfolios and bonds (Akhtaruzzaman et al. 2020). It is also able to act as a hedging tool for the crude oil market, and for the Finnish, Dutch, and American stock markets (Ghorbel and Jeribi 2021a; Urom et al. 2020). Moreover, Bitcoin seems to present hedging properties for investors who consider sustainable, Islamic, and traditional investments (Dow Jones Sustainability, Dow Jones Islamic Index, Index Dow Jones Global Index) at different time horizons (Disli et al. 2021), as well as to investors who consider commodities from agricultural and metal groups (Fakhfekh et al. 2021; Naeem et al. 2021a). Furthermore, Bitcoin can be seen as a hedge against Asian fiat currencies in periods of 8 to 32 days, and 32 to 64 days, presenting better results in risk reduction for Asian fiat currencies than Gold or oil, especially over medium- and long-term horizons (Kinkyo 2020). Further evidence indicates that Bitcoin may even act as a hedge against Gold, as well as against other assets highly correlated to Gold since it developed short- and long-term asymmetric responses to Gold returns, especially during the COVID-19 pandemic (González et al. 2021).

Additional evidence reveals that Bitcoin hedging properties during times of instability and market shocks seem to be undermined (Guo et al. 2021). It also reveals that the ability of Bitcoin to be an effective hedge instrument against the Partisan Conflict Index (PCI) and the Economic Policy Uncertainty (EPU) varies across time (Hsu et al. 2021; Jiang et al. 2021b; Wu et al. 2021), meaning that when there is high political and economic uncertainty; those abilities are present; but when the impact of the PCI and EPU is negative, those abilities no longer appear.

This should be a warning sign to investors who consider Bitcoin as an effective hedge against uncertainties (Jiang et al. 2021b; Umar et al. 2021; Wu et al. 2021). Moreover, the ability of Bitcoin to hedge against fiat currencies (Majdoub et al. 2021), and against the Asian Pacific and Japanese equity markets (Bouri et al. 2020a) vary across time and market conditions (Hsu et al. 2021; Umar and Gubareva 2020; Wang et al. 2021). In addition, cryptocurrency portfolios seem not to be able to hedge against global economic policy uncertainty (GEPU), World Uncertainty Index (WUI) (Nguyen et al. 2020), as well as against increased forward inflation expectations (Conlon et al. 2021).

Nonetheless, there is also evidence that contradicts the previously mentioned literature, indicating that cryptocurrencies do not reveal a good hedging ability for the stock market (Jiang et al. 2021b) since the correlation between stock/cryptocurrency pairs reveals to be positive in most cases (Thampanya et al. 2020). In addition, Bitcoin seems not to be a proper hedging tool for stocks due to its high volatility (Wang et al. 2021). Moreover,

most cryptocurrencies have poor hedging capacity, especially Bitcoin and Ethereum, which revealed low levels of hedging effectiveness (Charfeddine et al. 2020).

There is also evidence that indicates that the European carbon market, contrary to the Chinese one, may provide a hedge against the cryptocurrency market (Yang and Hamori 2021). Evidence also points to the fact that the CBOE Bitcoin futures can effectively hedge against Bitcoin itself but also against other cryptocurrencies such as Ethereum, Litecoin, and Ripple (Sebastião and Godinho 2020). Additionally, evidence shows that in the short-term period crude oil assets can hedge against Ethereum. Regarding a long time period, crude oil can hedge against Solve, Elastos, and Bit Capital Vendor. Thus, crude oil can be used to hedge the risk in the cryptocurrency market (Okorie and Lin 2020). On the other hand, evidence indicates that Gold can also be a good hedge for cryptocurrencies due to its independence (Huynh et al. 2020b). Therefore, investors should consider Gold, along with the European carbon market, CBOE Bitcoin futures, and crude oil to hedge against unexpected movements in the cryptocurrency market (Huynh et al. 2020b).

#### 4.2. Do Cryptocurrencies Bear Diversification Properties?

The diversification ability of cryptocurrencies is also addressed in this strand of cryptocurrency literature. We found evidence that adding cryptocurrencies into traditional portfolios (stocks, currencies, and commodities) increases the benefits of diversification and returns, reducing portfolio volatility (Ma et al. 2020). It can also help to better diversify away the liquidity risk (Ghabri et al. 2020). For instance, adding cryptocurrencies such as Bitcoin, Ethereum, and Litecoin to an equity portfolio present diversification benefit for investors compared to a solo equity portfolio (Bouri et al. 2020a; Kumah and Mensah 2020). The cross-correlation of cryptocurrencies with traditional assets is time-changing and weak. This fact supports the hypothesis of cryptocurrencies' ability to be good financial diversifiers, especially Bitcoin and Ethereum (Charfeddine et al. 2020). Nonetheless, an optimal weight combination of digital and traditional assets must be used (Charfeddine et al. 2020).

Adding cryptocurrencies into small-cap stocks portfolios also result in the improvement of their risk diversification, and returns (Matkovskyy et al. 2021). These diversification benefits seem to be present in the global, developed, emerging, and US markets stock indexes (Jiang et al. 2021a; Kumah and Odei-Mensah 2021).

Considering investments in Gold, cryptocurrencies, such as Cardano, Tether, and Tezos, seem to provide diversification benefits (González et al. 2021; Hsu et al. 2021). Investors in emerging markets may also benefit from holding cryptocurrencies such as Bitcoin or Ripple during times of market turmoil since they can act as diversifiers and also reduce the risk in emerging equities and foreign currency rates during bad market conditions (Omane-Adjepong and Alagidede 2020). Nonetheless, the benefits from the use of these cryptocurrencies vary across regional and country-specific assets, as well as across emerging asset classes such as forex and equities (Omane-Adjepong and Alagidede 2020).

Considering developed stock markets, Monero and Dash can also be considered good diversifiers (Jeribi and Ghorbel 2021). However, the most effective diversifier in the short-term appears to be Ethereum. On the other hand, in the long-term this feature seems to be present in cryptocurrencies such as Bitcoin, Ripple, Litecoin, Stellar, and also in Monero and Dash (Bouri et al. 2020b; Jiang et al. 2021a).

According to the reviewed literature, the specific case of Bitcoin presents diversification benefits for investors (Corbet et al. 2020a; Mensi et al. 2019; Scharnowski 2021). Evidence shows benefits in high-frequency trading on BTC-XRP and BTC-LTC, and benefits in crypto-portfolio diversification with BTC-ETH, BTC-ETC, or BTC-EOR (Wang and Ngene 2020). Furthermore, Bitcoin can offer diversification benefits for conventional equity indices, especially for the Dow Jones Islamic, but also to sustainable indices such as FTSE 4 Good index (Uddin et al. 2020). These diversification benefits hold for short and for long-term periods (Uddin et al. 2020). Bitcoin evidence also reveals that the inclusion of Bitcoin in portfolios denominated in Chinese Yuan, Japanese Yen, and US Dollar improved their

risk-adjusted returns, thus highlighting the diversification ability of Bitcoin (Bedi and Nashier 2020). However, for Chinese portfolios, Gold can be seen as a better diversifier than Bitcoin. Nevertheless, Bitcoin can provide higher returns than Gold, but increases the risk. Thus, for risk-seeking Chinese investors, Bitcoin is a better portfolio diversifier (Pho et al. 2021).

The reviewed literature on the diversification properties of Bitcoin also highlights that Bitcoin is relatively isolated from most financial assets, making it able to provide investors with diversification benefits (Bhuiyan et al. 2021). There is limited and time-varying connectedness between Bitcoin and traditional assets, therefore evidencing its diversification ability (Mensi et al. 2020b; Zeng et al. 2020). Additionally, Bitcoin can also be considered a good diversifier for BRICS economies (Jeribi and Ghorbel 2021), as well as for the FTSE and Nikkei indices, since they present a negative dynamic dependence (Fakhfekh et al. 2021). Additionally, the inexistence risk spillover effect from the EPU to Bitcoin, implies that Bitcoin may be used as a diversifier in extreme EPU shocks (Wang et al. 2019).

During times of instability and market shocks, diversification seemed to be undermined (Guo et al. 2021). Before China banned ICOs in 2017, the inclusion of cryptocurrencies in a portfolio could deliver diversification benefits. However, after the news announcement, evidence reveals that the benefits of portfolio diversification with cryptocurrencies disappear (Zhang and Gregoriou 2021). Additional evidence reveals that the co-movements between cryptocurrencies and stock indices are mostly positive and have increased during the COVID-19 pandemic. Hence, cryptocurrencies in general fail to provide diversification benefits (Goodell and Goutte 2021b). During the COVID-19 period, the diversification benefits in crypto portfolios also deteriorated (Demiralay and Golitsis 2021). Moreover, it is indicated that the possibilities of diversification are undermined due to a close integration across major cryptocurrencies (Naeem et al. 2021b). It is also evidenced that the jumps in one cryptocurrency increase the probability of jumps in other cryptocurrencies, and this also reduces diversification benefits (Bouri et al. 2020c).

Furthermore, evidence reveals that better crypto portfolio management can be achieved with the implementation of a Hierarchical Risk Parity approach since it delivers better portfolio diversification properties, and also compared to traditional risk-based strategies, it better deals with volatility and tail risk (Burggraf 2021).

#### 4.3. Are Cryptocurrencies Safe-Havens?

The safe-haven properties of cryptocurrencies are also addressed in this literature review. Evidence reveals that Bitcoin, Stellar, and Ripple seem to be good safe-havens for US stock indexes, similar to Litecoin and Monero. On the other hand, Ethereum, Dash, and Nem seem to be good safe-havens for the financial sector, telecom services sector, utility sector, and information technology sector (Bouri et al. 2020d). Furthermore, Bitcoin, Ethereum, Ripple, and Litecoin can be seen as safe-havens for commodities of metal and agricultural groups. However, they are less effective as a safe-haven for energy commodities (Naeem et al. 2021a). Even though Ethereum is the least connected cryptocurrency to oil price returns, which allows it to be used as a safe-haven against oil (Jareño et al. 2021), it seems to be a weak safe-haven against the S&P500, STOXX600, DAX, and the FTSE250 (Będowska-Sójka and Kliber 2021). Cardano, Tether, and Tezos may also be used as safe-havens when considering investments in gold (González et al. 2021).

In the specific case of Bitcoin, evidence indicates that it can be considered a strong safe-haven for crude oil. However, it is a weak safe-haven for the S&P500 index (Corbet et al. 2020b), the FTSE250, and the DAX index (Będowska-Sójka and Kliber 2021). Additionally, Bitcoin may be used as a safe-haven in extreme EPU shocks (Jareño et al. 2020; Wang et al. 2019).

On the other hand, there is also evidence that reveals that Bitcoin does not present any safe-haven properties during the COVID-19 pandemic (Disli et al. 2021), especially for investments in energy assets such as crude oil and gas (Ghorbel and Jeribi 2021b). Further



evidence reveals that in general cryptocurrencies cannot be considered as safe-havens against stock markets (Conlon et al. 2020; Goodell and Goutte 2021b; Jiang et al. 2021a; Thampanya et al. 2020), and Gold (Corbet et al. 2020b).

Nonetheless, evidence reveals that the safe-haven ability of cryptocurrencies varies across time and market conditions (Będowska-Sójka and Kliber 2021; Conlon et al. 2020; Guo et al. 2021; Hsu et al. 2021; Jareño et al. 2020; Raheem 2021; Umar et al. 2021; Wang et al. 2020). However, in periods of high uncertainty cryptocurrencies are highly suitable as safe-haven instruments (Hsu et al. 2021; Jareño et al. 2020). For instance, in times of high volatility and uncertainty, as was the case of the COVID-19 period, Bitcoin and Ethereum can be used as short-term safe-havens against the stock market (Corbet et al. 2020a; López-Cabarcos et al. 2021; Mariana et al. 2021).

When uncertainty is present in the cryptocurrency market, investors may consider Gold since it shows stable and reliable safe-haven properties against cryptocurrency uncertainty (Hassan et al. 2021). The European carbon market may also be considered as safe-haven for the cryptocurrency market (Yang and Hamori 2021).

#### 4.4. The Impact of Uncertainty on Cryptocurrency Investments

This literature review also contributes to understanding the role of uncertainty in crypto investments. Evidence reveals a strong causal relationship between the uncertainty of social media (Twitter-Based Economic Uncertainty (TEU) and Twitter-Based Market Uncertainty (TMU)), and the cryptocurrency returns (Bitcoin, Ethereum, Bitcoin Cash, and Ripple) (Aharon et al. 2022). When analyzing the reaction of Bitcoin prices to the uncertainty of fiat currencies, evidence reveals that the fiat currency uncertainty creates additional demand for Bitcoin, even though this demand cannot be seen as a determinant of Bitcoin prices (Jin et al. 2021). However, uncertainty effects are found to be determinants of net directional spillovers among cryptocurrency returns (Ji et al. 2019a). Furthermore, uncertainty and trading volume are key determinants for cryptomarket integration (Bouri et al. 2021c). Thus, uncertainty reveals to be indeed a determinant of cryptocurrency returns (Colon et al. 2021).

Additionally, it can be seen, a positive correlation between Bitcoin and trade policy uncertainty in the USA, revealing that Bitcoin returns can significantly be affected by trade policy uncertainty in the USA (Gozgor et al. 2019). Furthermore, during periods of extreme events, Bitcoin returns seem to be negatively related to changes in trade policy uncertainty (Gozgor et al. 2019).

This literature review further highlights that the EPU does not influence higher levels of volatility in the cryptomarket, meaning that high-risk crypto-investors are not influenced by the economic environment (Papadamou et al. 2021). On the other hand, however, it is shown that an increase in the EPU, leads to an increase in cryptocurrencies attractiveness (Balli et al. 2020), and consequently also to higher Bitcoin returns (Wang et al. 2020). Moreover, evidence reveals that after a spike in United States EPU, the trading volume and volatility of Bitcoin increased. Nonetheless, the same cannot be said for the United Kingdom EPU (Wang et al. 2020), as well as for the global economic policy uncertainty GEPU (Nguyen Quang et al. 2020). Consequently, the effect of the United Kingdom EPU on the BTC/GBP pair is of a lesser magnitude than the effect of the United States EPU on the BTC/USD pair (Wang et al. 2020). China's EPU has a significant impact on cryptocurrencies, such as Litecoin and Bitcoin (Yen and Cheng 2021).

#### 4.5. Sentiment and News Impact on Cryptocurrency Investment

Sentiment and news' impacts on cryptocurrency investment are also addressed in this literature review. It is revealed that investor attention is influenced by the performances of cryptocurrencies such as Bitcoin, Ethereum, and Litecoin (Lin 2021). Similarly, Bitcoin's return volatility and trading volume are influenced by emotions (Ahn and Kim 2021). The information transmissions flow from the returns of cryptocurrencies toward sentiment (Akyildirim et al. 2021a). Nevertheless, regarding sentiment connectedness, Bitcoin is



dominant, probably due to its popularity. Evidence also indicates that the volatility of the sentiment connectedness is higher when compared to the return's connectedness, which indicates that in specific periods, investors have a renewed interest in the cryptocurrency market. (Akyildirim et al. 2021a).

Negative sentiment can be a predictor of Bitcoin returns, realized volatility, jumps, and trading volumes. In fact, evidence reveals that Trump's Twitter sentiment can indeed influence Bitcoin's price (Huynh 2021). Further evidence reveals that tweets related to Bitcoin, as well as Google searches, cause herding amplification in these markets. On the other hand, EPU patterns, and the connectedness of foreign exchange markets and equity cause herding dampening (Philippas et al. 2020).

Regarding news sentiment in the cryptocurrency market, evidence reports that very good news leads to high returns and trading volume in the cryptocurrency market (Naeem et al. 2020). Furthermore, whereas the returns of traditional currencies tend to increase after positive news and decrease after negative news, Bitcoin reacts positively in both cases, evidencing that the enthusiasm towards Bitcoin is irrespective of the news sentiment. During periods of bubbles, this is even more exacerbated. Nonetheless, in the presence of news related to crypto cyber-attacks and frauds, Bitcoins' returns and volatility fall (Rognone et al. 2020). On the other hand, Bitcoin returns decrease when there is an increase in positive news after unemployment and durable goods announcements (Corbet et al. 2020c). When there is an increase in the number of negative news encompassing these statements Bitcoin returns seem to increase (Corbet et al. 2020c). GBP and Consumer Price Index (CPI) seem not to have any significant relationship with Bitcoin returns (Corbet et al. 2020c).

There is a presence of informed trading in the Bitcoin market, more specifically ahead of crypto-negative market events, and ahead of large positive events. Thus, regarding positive news, informed traders build their positions two days before the event. On the other hand, regarding negative news, they place their orders one day before the event (Feng et al. 2018).

#### 4.6. Stablecoins Role in Cryptocurrency Investment

In the crypto market stablecoins also seem to play an important role (Hoang and Baur 2021). Stablecoins issuances seem to contribute to the market efficiency of cryptocurrencies as well as to price discovery. Stablecoins can also act as safe-havens (Wang et al. 2020). USD-pegged stablecoins perform better than gold-pegged stablecoins (Wang et al. 2020). However, this property changes across market conditions. In normal market conditions, stablecoins mostly act as diversifiers (Wang et al. 2020). For instance, Tether may be used as a diversifier or even as a safe-haven when considering investments in gold (González et al. 2021). Furthermore, since Tether co-moves negatively with stock indices, it is seen as an important safe-haven during times of bad market conditions (Goodell and Goutte 2021b). However, even though Tether might act as a safe-haven, these properties are also not consistent over time, mostly due to the short-term historical losses in Tether related to an unstable peg with the US dollar (Conlon et al. 2020).

Further evidence reveals that stablecoins are not perfect substitutes among themselves (Ante et al. 2021). They also reveal excessive price variation (Hoang and Baur 2021). Additionally, it is highlighted that Bitcoin influences the volatility in stablecoins due to the high correlation of their returns, volumes, and volatility (Hoang and Baur 2021). Consequently, when past Bitcoin volatility declines, the volatility of the stablecoins tends to raise (Groby et al. 2021).

#### 4.7. Cryptocurrency Market

Evidence highlights that during periods of crisis, investors should consider reducing their exposure to Bitcoin compared to Litecoin, Ethereum, and Ripple, to minimize their risk and maintain their returns (Mensi et al. 2020a). Nonetheless, during the COVID-19 pandemic Bitcoin evolved significantly (Corbet et al. 2020c), since its prices grew with the number of high levels of COVID-19 fatalities (Goodell and Goutte 2021a). Additionally,

there is evidence that COVID-19 had no impact on the interaction between cryptocurrency hedge funds and Bitcoin and Ethereum (Khelifa et al. 2021). Bitcoin and Ethereum represented the main cryptocurrencies used by cryptocurrency fund managers (Khelifa et al. 2021). Furthermore, during times of stressed markets, crypto assets can be grouped into speculative assets, which are mainly tail contagion transmitters (where Bitcoin belongs). They can also be grouped into technical assets, which are mainly tail contagion revivers (where Ethereum belongs) (Ahelegbey et al. 2021). Moreover, during bull market periods, Bitcoin seems to be one of the major risk-driving cryptocurrencies (Nguyen et al. 2020). However, during low volatility periods the correlation of Bitcoin with Bitcoin forks is highly positive, yet, during high volatility periods, it reveals to be negative (Bazán-Palomino 2020).

Considering policy restrictions, it is seen that cryptocurrency returns (Bitcoin, Ethereum, Litecoin, and Ripple) seem to increase during Chinese monetary policy tightening. The same cannot be said for the U.S. monetary policies since they do not significantly affect cryptocurrency returns (Nguyen et al. 2019).

Further evidence reveals that the introduction of Bitcoin futures had no relation to the crash of the Bitcoin spot market in 2017 (Hattori and Ishida 2021). The Bitcoin 2017 bubble's impact on the P2P market depended on the currency and country. However, the US dollar is an exception since it is widely traded all over the world (Holub and Johnson 2019). Even though there is no relation between Bitcoin futures and the 2017 bubble burst, there is a negative relationship between Bitcoin returns and the introduction of Bitcoin futures (Liu et al. 2020). Furthermore, the introduction of Bitcoin futures reshaped the mean and tail dependence between the stock and cryptocurrency markets (Lahiani et al. 2021). It is also evidenced that the introduction of futures markets may cause convergence shifts between cryptocurrencies (Apergis et al. 2020).

The specific case of Ethereum on the BitMEX swap, reveals that after the introduction of the BitMEX swap, the price volatility of Ether has decreased, the spot trading volume has increased, and market efficiency has improved. Moreover, the day-of-week effect has weakened, and the hour-of-the-day effect has strengthened, which reveals an increased participation of informed institutional traders in the Ether spot markets (Alexander et al. 2020). Additionally, it is identified the existence of extreme positive and negative returns caused by the trading volume of cryptocurrencies. More specifically, a granger causality from the trading volume to the returns of Bitcoin, Ripple, Ethereum, Litecoin, Nem, Dash, and Stellar at both left and right tails (Bouri et al. 2019).

However, other studies highlight that if structural breaks are accounted for there is no causal relationship between COVID-19 growth and cryptocurrency returns. (Sahoo 2021). There is also evidence of asymmetry between the behavior of return spillovers in lower quantiles and upper quantiles. Therefore, during times of market turmoil, investors should consider adopting trading strategies based on the magnitude and flow of the return spillovers within the cryptocurrency market (Bouri et al. 2021b).

When Bitcoin energy consumption is analyzed, evidence shows that there is a relationship between the energy consumption of Bitcoin and its returns and volumes (Huynh et al. 2021). However, contrary to the belief that energy as an important role in cryptocurrencies, evidence reveals a weak connection between energy commodities and cryptocurrencies (Ji et al. 2019b).

Several other studies, make more methodological contributions, and indicate that to better forecast Bitcoin futures prices and volatility, machine learning algorithms (MLAs) should be considered since they outperform benchmark models such as the ARIMA and the random walk in the forecasting of Bitcoin futures prices (Akyildirim et al. 2021b). Additionally, the non-homogeneous hidden Markov (NHHM) model with four states should be considered, highlighting the existence of a predictor with a state-dependent, time-varying predicting power (Koki et al. 2022).

Finally, to forecast the Value-at-Risk (VaR) of Bitcoin, Litecoin, and Ethereum, the Laplace GAS specification which considers the volatility and the asymmetric responses to positive and negative volatility, presents the best performance at most levels (Liu et al. 2020).

## Volatility

Volatility is one of the main characteristics of the cryptocurrency market, thus also being addressed in this literature review. In this regard, we found that the introduction of Bitcoins futures led to upward volatility, liquidity, and kurtosis on the Bitcoin spot market. On the other hand, it led to a downward impact on Bitcoin returns and skewness (Jalan et al. 2021). Additionally, investors that consider investments in cryptocurrencies with higher idiosyncratic volatility will receive more profits, since the idiosyncratic volatility is positively related to cryptocurrency returns (Zhang and Li 2020).

It is also revealed through this literature review that the volatility connectedness in the cryptocurrency market, as well as between cryptocurrencies and other assets, varies across time and market conditions (Ahmed 2021; Bouri et al. 2021a; Gemici and Polat 2020; Xu et al. 2021). For instance, Bitcoin positively influences developed markets under different market conditions. On the other hand, emerging markets show an asymmetric response to Bitcoin's volatility (Ahmed 2021). Furthermore, the volatility connectedness between cryptocurrencies and traditional currencies is time-varying and arises in periods of economic and financial instability (Andrada-Félix et al. 2020). Consequently, during the COVID-19 period, Bitcoin, Ethereum, and Ripple were net transmitters of returns and volatility, whereas the fiat currencies such as Euro, Yuan, and GBP were net receivers. Nonetheless, the dynamic total return and volatility connectedness vary over time (Umar et al. 2021).

Additionally, evidence reports that Bitcoin's past realized volatilities (RV) and jumps are important in explaining its future realized volatility (Qiu et al. 2021). Furthermore, Bitcoin volatility can explain most of the volatility in the cryptocurrency market (Dimpfl and Elshiaty 2021). In the cryptocurrency market, volatility seems to have different spillover patterns since the structures of the returns and volatility clusters are different among cryptocurrencies (Sensoy et al. 2021). Nonetheless, large cryptocurrencies such as Bitcoin, Ethereum, and Litecoin receive and transmit volatility spillovers in the cryptocurrency market (Polat and Günay 2021). However, evidence indicates that low-capitalized cryptocurrencies may also be transmitters of volatility connectedness, which is the case for Madsafe Coin (Yi et al. 2018).

### 4.8. Cryptocurrency Portfolios

Regarding the construction of portfolios with cryptocurrencies, it is revealed that portfolios that only consider cryptocurrencies in their composition benefit from the use of portfolio selection when compared to naive portfolios; revealing gains of Sharpe ratio and average return (Tavares et al. 2020). Nonetheless, considering the highly speculative nature of the cryptocurrency market, all investors (professional and individual investors) should consider the optimization of their cryptocurrency portfolios enhancing their performance by minimizing their variance (Schellinger 2020). For instance, professional portfolio managers may consider the construction of a global minimum variance portfolio, whereas individual investors (who have less sophisticated resources) may consider investment in coins' market cap portfolios instead of tokens, due to their higher Omega ratio (Schellinger 2020).

Additionally, there is also evidence that indicates that a strategy that regards the construction of a portfolio comprised only of cryptocurrencies may present high risks since Bitcoin and altcoins prices are highly correlated (Demir et al. 2020b; Yang et al. 2020).

Further evidence shows that the use of a two-sided Weibull distribution for portfolio Value-at-Risk (VaR) estimation outperforms other benchmarked methods, when applied to a cryptocurrency portfolio composed of Bitcoin, Ripple, Dash, and Litecoin, since it can capture the stylized facts of cryptocurrencies' time series, such as volatility clustering, heavy tails, skewness, and extreme volatility (Silahli et al. 2021). Additionally, the use of an algorithm based on vine copulas to estimate the Value-at-Risk (VaR) and Expected Shortfall (ES) in a cryptocurrency portfolio proved to display good performance (Trucíos et al. 2020). Furthermore, the Black-Litterman model with variance-based constraints (VBCs) reveals a superior performance compared to the traditional benchmarks in overcoming the

difficulties that portfolio theory has when applied to a portfolio of cryptocurrencies given the higher estimation error in the parameters (Platanakis and Urquhart 2019).

#### 4.9. Future Venues of Research

In this strand of cryptocurrency literature that investigates cryptocurrencies as diversifiers, hedgers, and safe-havens, we find literature gaps that indicate the need to further investigate the potential role of stablecoins as diversifiers, hedges, or safe-haven (Wang et al. 2020), as well as to further analyze stablecoins volatility (Grobys et al. 2021). Further investigation is also needed to assess if the stability of stablecoins is time-varying, and whether new-generation stablecoins are more stable than the older ones (Hoang and Baur 2021).

There are also indications that future research is essential in the investigation of the relationships between cryptocurrencies and other assets classes such as equities, bonds, currencies, and commodities (Bouri et al. 2021a; Cao and Xie 2021; Demiralay and Bayraci 2020; González et al. 2021; Hsu et al. 2021). More specifically to explore these relationships in less studied stock markets such as the African (Kumah and Odei-Mensah 2021) and Islamic stock markets (Aloui et al. 2021), and to consider broader commodity (Kumah and Mensah 2020) and currencies markets (López-Cabarcos et al. 2021). Future research should also consider larger samples of cryptocurrencies in these analyses (Charfeddine et al. 2020; Jiang et al. 2021a). Additionally, it is also imperative to further analyze the environmental sustainability of cryptocurrencies (not just Bitcoin), since they bear different characteristics (different carbon footprints and levels of energy consumption), therefore having different relationships with energy and utility companies (Corbet et al. 2021). This will also help clarify to green investors whether they should allow cryptocurrencies into their portfolios.

Besides the growing contributions in this strand of cryptocurrency literature, further investigation is still required to explore the possibility to hedge Bitcoin as well as other cryptocurrencies with various assets (Majdoub et al. 2021), and also to further analyze cryptocurrency hedging abilities against other markets (Kinkyo 2020), especially during periods of economic turmoil (Jareño et al. 2021). Cryptocurrencies' diversification and safe-haven properties also demand further investigation (González et al. 2021). For instance, to analyze the potential time-variant safe-haven properties of cryptocurrencies (Jareño et al. 2020); what might drive the heterogeneity in the safe-haven and hedge properties of cryptocurrencies for some stock indices such as the US (Bouri et al. 2020d); as well as investigate the diversification benefits in emerging and advanced economies in the context of cryptocurrency regulation (Akhtaruzzaman et al. 2020).

Additionally, since a large number of cryptocurrencies are on the market, it is important to investigate the overall causal relationships among them (Kim et al. 2021), as well as to further investigate cryptocurrency futures and options (Qiao et al. 2020). It is also revealed the need to investigate the relationship between spillover risk and market capitalization (Moratis 2021), as well as the interlinkages between changes in liquidity and price volatility, to better understand the dynamics of cryptocurrency price volatility behavior (Katsiampa et al. 2019).

Future research is also needed to analyze the effects of liquidity and transaction costs on the optimal rebalancing of portfolios and their diversification with cryptocurrencies (Ma et al. 2020). It is also important to investigate the asymmetric effect in bull and bear market periods and their impact on portfolio management (Demir et al. 2020b). Furthermore, the literature also highlights the need to understand the influence of size, frequency, and time off jumps and co-jumps on the correlations in the cryptocurrency market (Mensi et al. 2020a).

Other studies show the need for more research on why and how cryptocurrencies react in a heterogeneous manner to different types of uncertainty (Colon et al. 2021). For instance, future research should consider monetary policy or fiscal policy uncertainty, to examine the effects of uncertainty measures on the returns and volatility of cryptocurrencies (Bedi and Nashier 2020; Bhuiyan et al. 2021; Gozgor et al. 2019); it should also analyze how high and low capitalized cryptocurrencies are affected by changes in Twitter-Based



Economic Uncertainty (TEU) and Twitter-Based Market Uncertainty (TMU) (Aharon et al. 2022), as well as to changes in the Economic Policy Uncertainty Index (EPU), and other uncertainty indices (Al-Yahyaee et al. 2019; Jareño et al. 2020; Wang et al. 2021); and it also ought to access if uncertainty is priced in the cross-section of cryptocurrency markets (Aharon et al. 2022).

Studies also indicate the need to further investigate the non-linear reaction of Bitcoin to high-frequency news sentiment (Rognone et al. 2020), as well as the possible existence of a bidirectional relationship between investor sentiment and cryptocurrencies, especially Bitcoin (López-Cabarcos et al. 2021). There are also indications to further investigate investor sentiment considering several proxies such as Google Search, VIX, Tweets, surveys, and the dynamics of cryptocurrency prices (Pho et al. 2021).

The growing use of machine learning methods and techniques in this literature is evident; however, indications of future research point out the need for more promising, powerful deep learning algorithms and machine learning approaches such as the xgboost (Huynh 2021; Huynh et al. 2020a; Sun et al. 2020)

There are also indications to further employ approaches such as inverse volatility (IV), l2-norm constrained minimum variance (NMV), minimum variance (MV), l2-norm constrained maximum decorrelation (NMC), risk parity (RP), and maximum diversification (MD), to evaluate the construction of portfolios with some weights to cryptocurrency (Huynh et al. 2020b). Additionally, it is also important to evaluate the change of efficient frontier in three-dimensional space (mean–variance-skewness), with Bitcoin as an element of the investment opportunity set (Kwon 2020).

Other methodologies, such as the Value-at-Risk (VaR) analysis in a time rolling-window manner (Chemkha et al. 2021), and the multivariate factor stochastic volatility model (MFSVM) (Shi et al. 2020) are also recommended to investigate portfolio profit and loss dynamics (Chemkha et al. 2021), and to examine the relationship between cryptocurrencies and traditional assets (Shi et al. 2020).

## 5. Conclusions

To improve our understanding of portfolio diversification, hedge, and safe-haven properties in cryptocurrency investments, we apply for a systematic literature review along with a bibliometric analysis of extant literature. To this end, we used VOSviewer, with data retrieved from the WoS database (2009 to 2021) to conduct our bibliometric analysis.

Our bibliometric analysis highlights that Finance Research Letters is the most cited journal similar to the findings of Aysan et al. (2021), however different from the conclusions made by Almeida and Gonçalves (2022). We indicate Asia as the continent that has contributed the most to portfolio diversification, hedge, and safe-haven properties in cryptocurrency investments literature, with China being its most cited country and major contributor, this contradicts the findings by Almeida and Gonçalves (2022); García-Corral et al. (2022); Jiang et al. (2021b); Yue et al. (2021) where Europe is the continent with more contributions and citations. Trinity College Dublin is the institution with more citations on the research topic.

Our results show that (1) cryptocurrencies may hedge against stocks, fiat currencies, geopolitical risks, Economic Policy Uncertainty (EPU) risk, however, these properties are time-varying; (2) cryptocurrencies present diversification and safe-haven properties, nonetheless, they vary across time and market conditions; (3) investors should consider Gold, along with the European carbon market, CBOE Bitcoin futures and crude oil to hedge against unexpected movements in the cryptocurrency market; (4) uncertainty is indeed a determinant for cryptocurrency returns; (5) stablecoins may act as a safe-haven and diversifiers and contribute to market efficiency, however, they reveal an unstable peg with the US dollar; (6) individual investors may consider investment in coins' market cap portfolios instead of tokens, due to their higher Omega ratio.

A study with these contributions is important for researchers, investors, analysts, regulators, and academics in general. Our findings provide researchers and academics



in general with structured networking for research outlets and literature strands, with time-trended information relevant for future studies on portfolio diversification, hedge, and safe-haven properties of cryptocurrency investments. It also provides investors and analysts with a highly important compilation of practical findings that can help them better devise their investment strategies. In addition, it provides insights for regulators to effectively regulate the cryptocurrency markets.

As a limitation of our research, we point out the use of only one database (WoS). However, due to our quality criterion (ABS journal guide list), there were no significant contributions from other databases (Scopus). Further updates should follow to ensure timeliness in identifying research trends and unsolved research inquiries and debate current and future research streams. Clustering our research literature allowed us to note more clearly the extant findings and future venues, further (sub)clustering could provide new highlights with potential for scientific contribution.

As future research venues, and in reaction to the recent event related to the UST stablecoin meltdown, and the Russia-Ukraine War, we highlight the importance of exploring and accessing if the stability of stablecoins is time-varying and their potential role as diversifiers, hedges, or safe-havens. Furthermore, a critical discussion of underlying events and their roots ought to be carried out in light of the 2022 Bitcoin and other cryptocurrencies' crash. Value (conservation) and returns might be significantly at odds in crypto markets, which influences volatility (Appel and Grabinski 2011). As argued by Klinkova and Grabinski (2017), the resulting market instability may lead to chaotic behavior, which is mathematically challenging and significantly different from randomness in investment modeling (Grabinski and Klinkova 2019, 2020). Finally, research analyzing rising connectedness between several cryptocurrencies, and their implication for investing, has emerged (Kumar et al. 2022; Bouri et al. 2022; Wang et al. 2022) and further investigation should be pursued to shed light on the role of these inter-assets dynamics on portfolio management.

**Author Contributions:** Conceptualization, J.A.; methodology, J.A. and T.C.G.; software, J.A.; validation, J.A. and T.C.G.; formal analysis, J.A.; investigation, J.A.; resources, J.A. and T.C.G.; data curation, J.A.; writing—original draft preparation, J.A.; writing—review and editing, J.A. and T.C.G.; visualization, J.A. and T.C.G.; supervision, T.C.G.; project administration, J.A. and T.C.G. All authors have read and agreed to the published version of the manuscript.

**Funding:** The authors acknowledge financial support from Fundação para a Ciência e a Tecnologia (grant UI/BD/151446/2021 and grant UID/SOC/04521/2020, respectively).

**Data Availability Statement:** The data to conduct our review was sourced from Clarivate Web of Science.

**Conflicts of Interest:** The authors declare that there are no conflicts of interest regarding the publication of this paper.

## References

- Aharon, David Y., Ender Demir, Chi Keung Marco Lau, and Adam Zaremba. 2022. Twitter-Based Uncertainty and Cryptocurrency Returns. *Research in International Business and Finance* 59: 101546. [CrossRef]
- Ahelegbey, Daniel Felix, Paolo Giudici, and Fatemeh Mojtahedi. 2021. Tail Risk Measurement in Crypto-Asset Markets. *International Review of Financial Analysis* 73: 101604. [CrossRef]
- Ahmed, Walid M. A. 2021. Stock Market Reactions to Upside and Downside Volatility of Bitcoin: A Quantile Analysis. *North American Journal of Economics and Finance* 57: 101379. [CrossRef]
- Ahn, Yongkil, and Dongyeon Kim. 2021. Emotional Trading in the Cryptocurrency Market. *Finance Research Letters* 42: 101912. [CrossRef]
- Akhtaruzzaman, Md, Ahmet Sensoy, and Shaen Corbet. 2020. The Influence of Bitcoin on Portfolio Diversification and Design. *Finance Research Letters* 37: 101344. [CrossRef]
- Akyildirim, Erdinc, Ahmet Faruk Aysan, Oguzhan Cepni, and S. Pinar Ceyhan Darendeli. 2021a. Do Investor Sentiments Drive Cryptocurrency Prices? *Economics Letters* 206: 109980. [CrossRef]
- Akyildirim, Erdinc, Oguzhan Cepni, Shaen Corbet, and Gazi Salah Uddin. 2021b. Forecasting Mid-Price Movement of Bitcoin Futures Using Machine Learning. *Annals of Operations Research*, 1–32. [CrossRef]

- Alexander, Carol, Jaehyuk Choi, Hamish R. A. Massie, and Sungbin Sohn. 2020. Price Discovery and Microstructure in Ether Spot and Derivative Markets. *International Review of Financial Analysis* 71: 101506. [\[CrossRef\]](#)
- Almeida, José. 2021. Cryptocurrencies and Financial Markets—Extant Literature and Future Venues. *European Journal of Economics Finance and Administrative Sciences* 109: 29–40.
- Almeida, José, and Tiago Cruz Gonçalves. 2022. A Systematic Literature Review of Volatility and Risk Management on Cryptocurrency Investment: A Methodological Point of View. *Risks* 10: 107. [\[CrossRef\]](#)
- Aloui, Chaker, Hela ben Hamida, and Larisa Yarovaya. 2021. Are Islamic Gold-Backed Cryptocurrencies Different? *Finance Research Letters* 39: 101615. [\[CrossRef\]](#)
- Al-Yahyaee, Khamis Hamed, Mobeen Ur Rehman, Walid Mensi, and Idries Mohammad Wanas Al-Jarrah. 2019. Can Uncertainty Indices Predict Bitcoin Prices? A Revisited Analysis Using Partial and Multivariate Wavelet Approaches. *North American Journal of Economics and Finance* 49: 47–56. [\[CrossRef\]](#)
- Andrada-Félix, Julián, Adrian Fernandez-Perez, and Simón Sosvilla-Rivero. 2020. Distant or Close Cousins: Connectedness between Cryptocurrencies and Traditional Currencies Volatilities. *Journal of International Financial Markets, Institutions and Money* 67: 101219. [\[CrossRef\]](#)
- Angerer, Martin, Christian Hugo Hoffmann, Florian Neitzert, and Sascha Kraus. 2020. Objective and Subjective Risks of Investing into Cryptocurrencies. *Finance Research Letters* 40: 101737. [\[CrossRef\]](#)
- Ante, Lennart, Ingo Fiedler, and Elias Strehle. 2021. The Influence of Stablecoin Issuances on Cryptocurrency Markets. *Finance Research Letters* 41: 101867. [\[CrossRef\]](#)
- Apergis, Nicholas, Dimitrios Koutmos, and James E. Payne. 2020. Convergence in Cryptocurrency Prices? The Role of Market Microstructure. *Finance Research Letters* 40: 101685. [\[CrossRef\]](#)
- Appel, Dominik, and Michael Grabinski. 2011. The origin of financial crisis: A wrong definition of value. *Portuguese Journal of Quantitative Methods* 2: 33–51.
- Aysan, Ahmet Faruk, Hüseyin Bedir Demirtaş, and Mustafa Saraç. 2021. The Ascent of Bitcoin: Bibliometric Analysis of Bitcoin Research. *Journal of Risk and Financial Management* 14: 427. [\[CrossRef\]](#)
- Balli, Faruk, Anne de Bruin, Md Iftakhar Hasan Chowdhury, and Muhammad Abubakr Naeem. 2020. Connectedness of Cryptocurrencies and Prevailing Uncertainties. *Applied Economics Letters* 27: 1316–22. [\[CrossRef\]](#)
- Bariviera, Aurelio F., and Ignasi Merediz-Solà. 2021. Where Do We Stand in Cryptocurrencies Economic Research? A Survey Based on Hybrid Analysis. *Journal of Economic Surveys* 35: 377–407. [\[CrossRef\]](#)
- Bartolacci, Francesca, Andrea Caputo, and Michela Soverchia. 2020. Sustainability and Financial Performance of Small and Medium Sized Enterprises: A Bibliometric and Systematic Literature Review. *Business Strategy and the Environment* 29: 1297–1309. [\[CrossRef\]](#)
- Bazán-Palomino, Walter. 2020. How Are Bitcoin Forks Related to Bitcoin? *Finance Research Letters* 40: 101723. [\[CrossRef\]](#)
- Bedi, Prateek, and Tripti Nashier. 2020. On the Investment Credentials of Bitcoin: A Cross-Currency Perspective. *Research in International Business and Finance* 51: 101087. [\[CrossRef\]](#)
- Będowska-Sójka, Barbara, and Agata Kliber. 2021. Is There One Safe-Haven for Various Turbulences? The Evidence from Gold, Bitcoin and Ether. *North American Journal of Economics and Finance* 56: 101390. [\[CrossRef\]](#)
- Bhuiyan, Rubaiyat Ahsan, Afzol Husain, and Changyong Zhang. 2021. A Wavelet Approach for Causal Relationship between Bitcoin and Conventional Asset Classes. *Resources Policy* 71: 101971. [\[CrossRef\]](#)
- Białkowski, Jędrzej. 2020. Cryptocurrencies in Institutional Investors' Portfolios: Evidence from Industry Stop-Loss Rules. *Economics Letters* 191: 108834. [\[CrossRef\]](#)
- Bouri, Elie, Chi Keung Marco Lau, Brian Lucey, and David Roubaud. 2019. Trading Volume and the Predictability of Return and Volatility in the Cryptocurrency Market. *Finance Research Letters* 29: 340–46. [\[CrossRef\]](#)
- Bouri, Elie, Brian Lucey, and David Roubaud. 2020a. Cryptocurrencies and the Downside Risk in Equity Investments. *Finance Research Letters* 33: 101211. [\[CrossRef\]](#)
- Bouri, Elie, Brian Lucey, and David Roubaud. 2020b. The Volatility Surprise of Leading Cryptocurrencies: Transitory and Permanent Linkages. *Finance Research Letters* 33: 101188. [\[CrossRef\]](#)
- Bouri, Elie, David Roubaud, and Syed Jawad Hussain Shahzad. 2020c. Do Bitcoin and Other Cryptocurrencies Jump Together? *Quarterly Review of Economics and Finance* 76: 396–409. [\[CrossRef\]](#)
- Bouri, Elie, Syed Jawad Hussain Shahzad, and David Roubaud. 2020d. Cryptocurrencies as Hedges and Safe-Havens for US Equity Sectors. *Quarterly Review of Economics and Finance* 75: 294–307. [\[CrossRef\]](#)
- Bouri, Elie, David Gabauer, Rangan Gupta, and Aviral Kumar Tiwari. 2021a. Volatility Connectedness of Major Cryptocurrencies: The Role of Investor Happiness. *Journal of Behavioral and Experimental Finance* 30: 100463. [\[CrossRef\]](#)
- Bouri, Elie, Tareq Saeed, Xuan Vinh Vo, and David Roubaud. 2021b. Quantile Connectedness in the Cryptocurrency Market. *Journal of International Financial Markets Institutions and Money* 71: 101302. [\[CrossRef\]](#)
- Bouri, Elie, Xuan Vinh Vo, and Tareq Saeed. 2021c. Return Equicorrelation in the Cryptocurrency Market: Analysis and Determinants. *Finance Research Letters* 38: 101497. [\[CrossRef\]](#)
- Bouri, Elie, Ladislav Kristoufek, and Nehme Azoury. 2022. Bitcoin and S&P500: Co-Movements of High-Order Moments in the Time-Frequency Domain. *PLoS ONE* 17: e0277924. [\[CrossRef\]](#)

- Burggraf, Tobias. 2021. Beyond Risk Parity—A Machine Learning-Based Hierarchical Risk Parity Approach on Cryptocurrencies. *Finance Research Letters* 38: 101523. [\[CrossRef\]](#)
- Cao, Guangxi, and Wenhao Xie. 2021. The Impact of the Shutdown Policy on the Asymmetric Interdependence Structure and Risk Transmission of Cryptocurrency and China's Financial Market. *North American Journal of Economics and Finance* 58: 101514. [\[CrossRef\]](#)
- Caputo, Andrea, Giacomo Marzi, Jane Maley, and Mario Silic. 2019. Ten Years of Conflict Management Research 2007-2017: An Update on Themes, Concepts and Relationships. *International Journal of Conflict Management* 30: 87–110. [\[CrossRef\]](#)
- Charfeddine, Lanouar, Noureddine Benlagha, and Youcef Maouchi. 2020. Investigating the Dynamic Relationship between Cryptocurrencies and Conventional Assets: Implications for Financial Investors. *Economic Modelling* 85: 198–217. [\[CrossRef\]](#)
- Chemkha, Rahma, Ahmed BenSaïda, Ahmed Ghorbel, and Tahar Tayachi. 2021. Hedge and Safe Haven Properties during COVID-19: Evidence from Bitcoin and Gold. *Quarterly Review of Economics and Finance* 82: 71–85. [\[CrossRef\]](#)
- Colon, Francisco, Chaehyun Kim, Hana Kim, and Wonjoon Kim. 2021. The Effect of Political and Economic Uncertainty on the Cryptocurrency Market. *Finance Research Letters* 39: 101621. [\[CrossRef\]](#)
- Conlon, Thomas, Shaen Corbet, and Richard J. McGee. 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. [\[CrossRef\]](#) [\[PubMed\]](#)
- Conlon, Thomas, Shaen Corbet, and Richard J. McGee. 2021. Inflation and Cryptocurrencies Revisited: A Time-Scale Analysis. *Economics Letters* 206: 109996. [\[CrossRef\]](#)
- Corbet, Shaen, Brian Lucey, Andrew Urquhart, and Larisa Yarovaya. 2019. Cryptocurrencies as a Financial Asset: A Systematic Analysis. *International Review of Financial Analysis* 62: 182–99. [\[CrossRef\]](#)
- Corbet, Shaen, Yang (Greg) Hou, Yang Hu, Charles Larkin, and Les Oxley. 2020a. Any Port in a Storm: Cryptocurrency Safe-Havens during the COVID-19 Pandemic. *Economics Letters* 194: 109377. [\[CrossRef\]](#) [\[PubMed\]](#)
- Corbet, Shaen, Paraskevi Katsiampa, and Chi Keung Marco Lau. 2020b. Measuring Quantile Dependence and Testing Directional Predictability between Bitcoin, Altcoins and Traditional Financial Assets. *International Review of Financial Analysis* 71: 101571. [\[CrossRef\]](#)
- Corbet, Shaen, Charles Larkin, and Brian Lucey. 2020c. The Contagion Effects of the COVID-19 Pandemic: Evidence from Gold and Cryptocurrencies. *Finance Research Letters* 35: 101554. [\[CrossRef\]](#)
- Corbet, Shaen, Brian Lucey, and Larisa Yarovaya. 2021. Bitcoin-Energy Markets Interrelationships—New Evidence. *Resources Policy* 70: 101916. [\[CrossRef\]](#)
- Demir, Ender, Mehmet Huseyin Bilgin, Gokhan Karabulut, and Asli Cansin Doker. 2020a. The Relationship between Cryptocurrencies and COVID-19 Pandemic. *Eurasian Economic Review* 10: 349–60. [\[CrossRef\]](#)
- Demir, Ender, Serdar Simonyan, Conrado Diego García-Gómez, and Chi Keung Marco Lau. 2020b. The Asymmetric Effect of Bitcoin on Altcoins: Evidence from the Nonlinear Autoregressive Distributed Lag (NARDL) Model. *Finance Research Letters* 40: 101754. [\[CrossRef\]](#)
- Demiralay, Sercan, and Selçuk Bayracı. 2020. Should Stock Investors Include Cryptocurrencies in Their Portfolios after All? Evidence from a Conditional Diversification Benefits Measure. *International Journal of Finance and Economics* 26: 6188–204. [\[CrossRef\]](#)
- Demiralay, Sercan, and Petros Golitsis. 2021. On the Dynamic Equicorrelations in Cryptocurrency Market. *Quarterly Review of Economics and Finance* 80: 524–33. [\[CrossRef\]](#)
- Dimpfl, Thomas, and Dalia Elshiaty. 2021. Volatility Discovery in Cryptocurrency Markets. *Journal of Risk Finance*. ahead-of-print. [\[CrossRef\]](#)
- Ding, Ying, Ronald Rousseau, and Dietmar Wolfram. 2014. *Measuring Scholarly Impact*. Cham: Springer. [\[CrossRef\]](#)
- Disli, Mustafa, Ruslan Nagayev, Kinan Salim, Siti K. Rizkiah, and Ahmet F. Aysan. 2021. In Search of Safe Haven Assets during COVID-19 Pandemic: An Empirical Analysis of Different Investor Types. *Research in International Business and Finance* 58: 101461. [\[CrossRef\]](#)
- Fakhfekh, Mohamed, Ahmed Jeribi, Ahmed Ghorbel, and Nejib Hachicha. 2021. Hedging Stock Market Prices with WTI, Gold, VIX and Cryptocurrencies: A Comparison between DCC, ADCC and GO-GARCH Models. *International Journal of Emerging Markets*. [\[CrossRef\]](#)
- Fang, Tong, Zhi Su, and Libo Yin. 2020. Economic Fundamentals or Investor Perceptions? The Role of Uncertainty in Predicting Long-Term Cryptocurrency Volatility. *International Review of Financial Analysis* 71: 101566. [\[CrossRef\]](#)
- Fang, Fan, Waichung Chung, Carmine Ventre, Michail Basios, Leslie Kanthan, Lingbo Li, and Fan Wu. 2021. Ascertaining Price Formation in Cryptocurrency Markets with Machine Learning. *European Journal of Finance*, 1–23. [\[CrossRef\]](#)
- Feng, Wenjun, Yiming Wang, and Zhengjun Zhang. 2018. Informed Trading in the Bitcoin Market. *Finance Research Letters* 26: 63–70. [\[CrossRef\]](#)
- Flori, Andrea. 2019a. Cryptocurrencies in Finance: Review and Applications. *International Journal of Theoretical and Applied Finance* 22. [\[CrossRef\]](#)
- Flori, Andrea. 2019b. News and Subjective Beliefs: A Bayesian Approach to Bitcoin Investments. *Research in International Business and Finance* 50: 336–56. [\[CrossRef\]](#)
- Galvao, Anderson, Carla Mascarenhas, Carla Marques, João Ferreira, and Vanessa Ratten. 2019. Triple Helix and Its Evolution: A Systematic Literature Review. *Journal of Science and Technology Policy Management* 10: 812–33. [\[CrossRef\]](#)

- García-Corral, Francisco Javier, José Antonio Cordero-García, Jaime de Pablo-Valenciano, and Juan Uribe-Toril. 2022. A Bibliometric Review of Cryptocurrencies: How Have They Grown? *Financial Innovation* 8: 1–31. [\[CrossRef\]](#) [\[PubMed\]](#)
- Gemici, Eray, and Müslüm Polat. 2020. Causality-in-Mean and Causality-in-Variance among Bitcoin, Litecoin, and Ethereum. *Studies in Economics and Finance* 38: 861–72. [\[CrossRef\]](#)
- Ghabri, Yosra, Khaled Guesmi, and Ahlem Zantour. 2020. Bitcoin and Liquidity Risk Diversification. *Finance Research Letters* 40: 101679. [\[CrossRef\]](#)
- Ghorbel, Achraf, and Ahmed Jeribi. 2021a. Investigating the Relationship between Volatilities of Cryptocurrencies and Other Financial Assets. *Decisions in Economics and Finance* 44: 817–843. [\[CrossRef\]](#)
- Ghorbel, Achraf, and Ahmed Jeribi. 2021b. Volatility Spillovers and Contagion between Energy Sector and Financial Assets during COVID-19 Crisis Period. *Eurasian Economic Review* 11: 449–67. [\[CrossRef\]](#)
- González, María de la O., Francisco Jareño, and Frank S. Skinner. 2021. Asymmetric Interdependencies between Large Capital Cryptocurrency and Gold Returns during the COVID-19 Pandemic Crisis. *International Review of Financial Analysis* 76: 101773. [\[CrossRef\]](#)
- Goodell, John W., and Stephane Goutte. 2021a. Co-Movement of COVID-19 and Bitcoin: Evidence from Wavelet Coherence Analysis. *Finance Research Letters* 38: 101625. [\[CrossRef\]](#)
- Goodell, John W., and Stephane Goutte. 2021b. Diversifying Equity with Cryptocurrencies during COVID-19. *International Review of Financial Analysis* 76: 101781. [\[CrossRef\]](#)
- Gozgor, Giray, Aviral Kumar Tiwari, Ender Demir, and Sagi Akron. 2019. The Relationship between Bitcoin Returns and Trade Policy Uncertainty. *Finance Research Letters* 29: 75–82. [\[CrossRef\]](#)
- Grabinski, Michael, and Galiya Klinkova. 2019. Wrong use of averages implies wrong results from many heuristic models. *Applied Mathematics* 10: 605. [\[CrossRef\]](#)
- Grabinski, Michael, and Galiya Klinkova. 2020. Scrutinizing distributions proves that IQ is inherited and explains the fat tail. *Applied Mathematics* 11: 957–84. [\[CrossRef\]](#)
- Grobys, Klaus, Juha Junntila, James W. Kolari, and Niranjana Sapkota. 2021. On the Stability of Stablecoins. *Journal of Empirical Finance* 64: 207–23. [\[CrossRef\]](#)
- Guo, Xiaochun, Fengbin Lu, and Yunjie Wei. 2021. Capture the Contagion Network of Bitcoin—Evidence from Pre and Mid COVID-19. *Research in International Business and Finance* 58: 101484. [\[CrossRef\]](#) [\[PubMed\]](#)
- Hairudin, Aiman, Imtiaz Mohammad Sifat, Azhar Mohamad, and Yusnilyana Yusof. 2020. Cryptocurrencies: A Survey on Acceptance, Governance and Market Dynamics. *International Journal of Finance and Economics* 27: 4633–59. [\[CrossRef\]](#)
- Haq, Inzamam Ul, Apichit Maneengam, Supat Chupradit, Wanich Suksatan, and Chunhui Huo. 2021. Economic Policy Uncertainty and Cryptocurrency Market as a Risk Management Avenue: A Systematic Review. *Risks* 9: 163. [\[CrossRef\]](#)
- Hassan, M. Kabir, Md Bokhtiar Hasan, and Md Mamunur Rashid. 2021. Using Precious Metals to Hedge Cryptocurrency Policy and Price Uncertainty. *Economics Letters* 206: 109977. [\[CrossRef\]](#)
- Hattori, Takahiro, and Ryo Ishida. 2021. Did the Introduction of Bitcoin Futures Crash the Bitcoin Market at the End of 2017? *North American Journal of Economics and Finance* 56: 101322. [\[CrossRef\]](#)
- Hoang, Lai T., and Dirk G. Baur. 2021. How Stable Are Stablecoins? *European Journal of Finance*, 1–17. [\[CrossRef\]](#)
- Holub, Mark, and Jackie Johnson. 2019. The Impact of the Bitcoin Bubble of 2017 on Bitcoin's P2P Market. *Finance Research Letters* 29: 357–62. [\[CrossRef\]](#)
- Hsu, Shu Han, Chwen Sheu, and Jiho Yoon. 2021. Risk Spillovers between Cryptocurrencies and Traditional Currencies and Gold under Different Global Economic Conditions. *North American Journal of Economics and Finance* 57: 101443. [\[CrossRef\]](#)
- Huynh, Toan Luu Duc. 2021. Does Bitcoin React to Trump's Tweets? *Journal of Behavioral and Experimental Finance* 31: 100546. [\[CrossRef\]](#)
- Huynh, Toan Luu Duc, Erik Hille, and Muhammad Ali Nasir. 2020a. Diversification in the Age of the 4th Industrial Revolution: The Role of Artificial Intelligence, Green Bonds and Cryptocurrencies. *Technological Forecasting and Social Change* 159: 120188. [\[CrossRef\]](#)
- Huynh, Toan Luu Duc, Muhammad Ali Nasir, Xuan Vinh Vo, and Thong Trung Nguyen. 2020b. 'Small Things Matter Most': The Spillover Effects in the Cryptocurrency Market and Gold as a Silver Bullet. *North American Journal of Economics and Finance* 54: 101277. [\[CrossRef\]](#)
- Huynh, Anh Ngoc Quang, Duy Duong, Tobias Burggraf, Hien Thi Thu Luong, and Nam Huu Bui. 2021. Energy Consumption and Bitcoin Market. *Asia-Pacific Financial Markets* 29: 79–93. [\[CrossRef\]](#)
- Iqbal, Najaf, Zeeshan Fareed, Guangcai Wan, and Farrukh Shahzad. 2021. Asymmetric Nexus between COVID-19 Outbreak in the World and Cryptocurrency Market. *International Review of Financial Analysis* 73: 101613. [\[CrossRef\]](#)
- Jalal, Raja Nabeel Ud Din, Ilan Alon, and Andrea Paltrinieri. 2021. A Bibliometric Review of Cryptocurrencies as a Financial Asset. *Technology Analysis and Strategic Management*, 1–16. [\[CrossRef\]](#)
- Jalan, Akanksha, Roman Matkovskyy, and Andrew Urquhart. 2021. What Effect Did the Introduction of Bitcoin Futures Have on the Bitcoin Spot Market? *European Journal of Finance* 27: 1251–81. [\[CrossRef\]](#)
- Jareño, Francisco, María de la O. González, Marta Tolentino, and Karen Sierra. 2020. Bitcoin and Gold Price Returns: A Quantile Regression and NARDL Analysis. *Resources Policy* 67: 101666. [\[CrossRef\]](#)
- Jareño, Francisco, María de la O. González, Raquel López, and Ana Rosa Ramos. 2021. Cryptocurrencies and Oil Price Shocks: A NARDL Analysis in the COVID-19 Pandemic. *Resources Policy* 74: 102281. [\[CrossRef\]](#)



- Jeribi, Ahmed, and Achraf Ghorbel. 2021. Forecasting Developed and BRICS Stock Markets with Cryptocurrencies and Gold: Generalized Orthogonal Generalized Autoregressive Conditional Heteroskedasticity and Generalized Autoregressive Score Analysis. *International Journal of Emerging Markets*. [CrossRef]
- Ji, Qiang, Elie Bouri, Chi Keung Marco Lau, and David Roubaud. 2019a. Dynamic Connectedness and Integration in Cryptocurrency Markets. *International Review of Financial Analysis* 63: 257–72. [CrossRef]
- Ji, Qiang, Elie Bouri, David Roubaud, and Ladislav Kristoufek. 2019b. Information Interdependence among Energy, Cryptocurrency and Major Commodity Markets. *Energy Economics* 81: 1042–55. [CrossRef]
- Jiang, Shangrong, Xuerong Li, and Shouyang Wang. 2021. Exploring Evolution Trends in Cryptocurrency Study: From Underlying Technology to Economic Applications. *Finance Research Letters* 38: 101532. [CrossRef]
- Jiang, Yonghong, Jiayi Lie, Jieru Wang, and Jinqi Mu. 2021a. Revisiting the Roles of Cryptocurrencies in Stock Markets: A Quantile Coherency Perspective. *Economic Modelling* 95: 21–34. [CrossRef]
- Jiang, Yonghong, Lanxin Wu, Gengyu Tian, and He Nie. 2021b. Do Cryptocurrencies Hedge against EPU and the Equity Market Volatility during COVID-19?—New Evidence from Quantile Coherency Analysis. *Journal of International Financial Markets Institutions and Money* 72: 101324. [CrossRef]
- Jin, Xuejun, Keer Zhu, Xiaolan Yang, and Shouyang Wang. 2021. Estimating the Reaction of Bitcoin Prices to the Uncertainty of Fiat Currency. *Research in International Business and Finance* 58: 101451. [CrossRef]
- Katsiampa, Paraskevi, Shaen Corbet, and Brian Lucey. 2019. High Frequency Volatility Co-Movements in Cryptocurrency Markets. *Journal of International Financial Markets, Institutions and Money* 62: 35–52. [CrossRef]
- Khelifa, Soumaya Ben, Khaled Guesmi, and Christian Urom. 2021. Exploring the relationship between cryptocurrencies and hedge funds during COVID-19 crisis. *International Review of Financial Analysis* 76: 101777. [CrossRef]
- Kim, Myeong Jun, Nguyen Phuc Canh, and Sung Y. Park. 2021. Causal Relationship among Cryptocurrencies: A Conditional Quantile Approach. *Finance Research Letters* 42: 1–8. [CrossRef]
- Kinkyo, Takuji. 2020. Hedging Capabilities of Bitcoin for Asian Currencies. *International Journal of Finance and Economics* 27: 1769–84. [CrossRef]
- Klinkova, G., and M. Grabinski. 2017. Due to Instability Gambling is the best Model for most Financial Products. *Archives of Business Research* 5: 255–61. [CrossRef]
- Koki, Constandina, Stefanos Leonardos, and Georgios Piliouras. 2022. Exploring the predictability of cryptocurrencies via Bayesian hidden Markov models. *Research in International Business and Finance* 59: 101554. [CrossRef]
- Kumah, Seyram Pearl, and Jones Odei Mensah. 2020. Are cryptocurrencies connected to gold? A wavelet-based quantile-in-quantile approach. *International Journal of Finance and Economics* 27: 3640–59. [CrossRef]
- Kumah, Seyram Pearl, and Jones Odei-Mensah. 2021. Are Cryptocurrencies and African stock markets integrated? *Quarterly Review of Economics and Finance* 81: 330–41. [CrossRef]
- Kumar, Ashish, Najaf Iqbal, Subrata Kumar Mitra, Ladislav Kristoufek, and Elie Bouri. 2022. Connectedness among major cryptocurrencies in standard times and during the COVID-19 outbreak. *Journal of International Financial Markets, Institutions and Money* 77: 101523. [CrossRef]
- Kwon, Ji Ho. 2020. Tail behavior of Bitcoin, the dollar, gold and the stock market index. *Journal of International Financial Markets, Institutions and Money* 67: 101202. [CrossRef]
- Kyriazis, Nikolaos, Stephanos Papadamou, and Shaen Corbet. 2020. A Systematic Review of the Bubble Dynamics of Cryptocurrency Prices. *Research in International Business and Finance* 54: 101254. [CrossRef]
- Lahiani, Amine, Ahmed Jeribi, and Nabila Boukef Jlassi. 2021. Nonlinear Tail Dependence in Cryptocurrency-Stock Market Returns: The Role of Bitcoin Futures. *Research in International Business and Finance* 56: 101351. [CrossRef]
- Li, Rong, Sufang Li, Di Yuan, and Huiming Zhu. 2021. Investor Attention and Cryptocurrency: Evidence from Wavelet-Based Quantile Granger Causality Analysis. *Research in International Business and Finance* 56: 101389. [CrossRef]
- Liang, Xiaobei, Yibo Yang, and Jiani Wang. 2016. Internet Finance: A Systematic Literature Review and Bibliometric Analysis. *Proceedings of the International Conference on Electronic Business (ICEB)* 38. Available online: <https://aisel.aisnet.org/iceb2016/38> (accessed on 14 November 2022).
- Lin, Zih Ying. 2021. Investor Attention and Cryptocurrency Performance. *Finance Research Letters* 40: 101702. [CrossRef]
- Linnenluecke, Martina K., Mauricio Marrone, and Abhay K. Singh. 2020. Conducting Systematic Literature Reviews and Bibliometric Analyses. *Australian Journal of Management* 45: 175–94. [CrossRef]
- Liu, Ruozhou, Shanfeng Wan, Zili Zhang, and Xuejun Zhao. 2020. Is the Introduction of Futures Responsible for the Crash of Bitcoin? *Finance Research Letters* 34: 101259. [CrossRef]
- Liu, Wei, Artur Semeyutin, Chi Keung Marco Lau, and Giray Gozgor. 2020. Forecasting Value-at-Risk of Cryptocurrencies with RiskMetrics Type Models. *Research in International Business and Finance* 54: 101259. [CrossRef]
- López-Cabarcos, M. Ángeles, Ada M. Pérez-Pico, Juan Piñeiro-Chousa, and Aleksandar Šević. 2021. Bitcoin Volatility, Stock Market and Investor Sentiment. Are They Connected? *Finance Research Letters* 38: 101399. [CrossRef]
- Ma, Yechi, Ferhana Ahmad, Miao Liu, and Zilong Wang. 2020. Portfolio Optimization in the Era of Digital Financialization Using Cryptocurrencies. *Technological Forecasting and Social Change* 161: 120265. [CrossRef]
- Majdoub, Jihed, Salim Ben Sassi, and Azza Bejaoui. 2021. Can Fiat Currencies Really Hedge Bitcoin? Evidence from Dynamic Short-Term Perspective. *Decisions in Economics and Finance* 44: 789–816. [CrossRef]



- Mariana, Christy Dwita, Irwan Adi Ekaputra, and Zaäfri Ananto Husodo. 2021. Are Bitcoin and Ethereum Safe-Havens for Stocks during the COVID-19 Pandemic? *Finance Research Letters* 38: 101798. [CrossRef]
- Matkovskyy, Roman, Akanksha Jalan, Michael Dowling, and Taoufik Bouraoui. 2021. From Bottom Ten to Top Ten: The Role of Cryptocurrencies in Enhancing Portfolio Return of Poorly Performing Stocks. *Finance Research Letters* 38: 101405. [CrossRef]
- Mensi, Walid, Ahmet Sensoy, Aylin Aslan, and Sang Hoon Kang. 2019. High-Frequency Asymmetric Volatility Connectedness between Bitcoin and Major Precious Metals Markets. *North American Journal of Economics and Finance* 50: 101031. [CrossRef]
- Mensi, Walid, Khamis Hamed Al-Yahyaee, Idries Mohammad Wanas Al-Jarrah, Xuan Vinh Vo, and Sang Hoon Kang. 2020a. Dynamic Volatility Transmission and Portfolio Management across Major Cryptocurrencies: Evidence from Hourly Data. *North American Journal of Economics and Finance* 54: 101285. [CrossRef]
- Mensi, Walid, Mobeen Ur Rehman, Debasish Maitra, Khamis Hamed Al-Yahyaee, and Ahmet Sensoy. 2020b. Does Bitcoin Co-Move and Share Risk with Sukuk and World and Regional Islamic Stock Markets? Evidence Using a Time-Frequency Approach. *Research in International Business and Finance* 53: 101230. [CrossRef]
- Milian, Eduardo Z., Mauro de M. Spinola, and Marly M. de Carvalho. 2019. Fintechs: A Literature Review and Research Agenda. *Electronic Commerce Research and Applications* 34: 100833. [CrossRef]
- Mokni, Khaled. 2021. When, Where, and How Economic Policy Uncertainty Predicts Bitcoin Returns and Volatility? A Quantiles-Based Analysis. *Quarterly Review of Economics and Finance* 80: 65–73. [CrossRef]
- Moratis, George. 2021. Quantifying the Spillover Effect in the Cryptocurrency Market. *Finance Research Letters* 38: 101534. [CrossRef]
- Naeem, Muhammad, Elie Bouri, Gideon Boako, and David Roubaud. 2020. Tail Dependence in the Return-Volume of Leading Cryptocurrencies. *Finance Research Letters* 36: 101326. [CrossRef]
- Naeem, Muhammad Abubakr, Saqib Farid, Faruk Balli, and Syed Jawad Hussain Shahzad. 2021a. Hedging the Downside Risk of Commodities through Cryptocurrencies. *Applied Economics Letters* 28: 153–60. [CrossRef]
- Naeem, Muhammad Abubakr, Saba Qureshi, Mobeen Ur Rehman, and Faruk Balli. 2021b. COVID-19 and Cryptocurrency Market: Evidence from Quantile Connectedness. *Applied Economics* 54: 280–306. [CrossRef]
- Nakamoto, Satoshi. 2008. Bitcoin: A Peer-to-Peer Electronic Cash System. Available online: <https://bitcoin.org/en/bitcoin-paper> (accessed on 10 October 2022).
- Nguyen, Thai Vu Hong, Binh Thanh Nguyen, Kien Son Nguyen, and Huy Pham. 2019. Asymmetric Monetary Policy Effects on Cryptocurrency Markets. *Research in International Business and Finance* 48: 335–39. [CrossRef]
- Nguyen, Linh Hoang, Thanaset Chevapatrakul, and Kai Yao. 2020. Investigating Tail-Risk Dependence in the Cryptocurrency Markets: A LASSO Quantile Regression Approach. *Journal of Empirical Finance* 58: 333–55. [CrossRef]
- Nguyen Quang, Binh, Thai Ha Le, and Canh Nguyen Phuc. 2020. Influences of Uncertainty on the Returns and Liquidity of Cryptocurrencies: Evidence from a Portfolio Approach. *International Journal of Finance and Economics* 27: 2497–513. [CrossRef]
- Okorie, David Iheke, and Boqiang Lin. 2020. Crude Oil Price and Cryptocurrencies: Evidence of Volatility Connectedness and Hedging Strategy. *Energy Economics* 87: 104703. [CrossRef]
- Omane-Adjepong, Maurice, and Imhotep Paul Alagidede. 2020. Dynamic Linkages and Economic Role of Leading Cryptocurrencies in an Emerging Market. In *Asia-Pacific Financial Markets*. Tokyo: Springer, vol. 27. [CrossRef]
- Papadamou, Stephanos, Nikolaos A. Kyriazis, and Panayiotis G. Tzeremes. 2021. Non-Linear Causal Linkages of EPU and Gold with Major Cryptocurrencies during Bull and Bear Markets. *North American Journal of Economics and Finance* 56: 101343. [CrossRef]
- Philippas, Dionisis, Nikolaos Philippas, Panagiotis Tziogkidis, and Hatem Rjiba. 2020. Signal-Herding in Cryptocurrencies. *Journal of International Financial Markets, Institutions and Money* 65: 101191. [CrossRef]
- Pho, Kim Hung, Sel Ly, Richard Lu, Thi Hong Van Hoang, and Wing Keung Wong. 2021. Is Bitcoin a Better Portfolio Diversifier than Gold? A Copula and Sectoral Analysis for China. *International Review of Financial Analysis* 74: 101674. [CrossRef]
- Platanakis, Emmanouil, and Andrew Urquhart. 2019. Portfolio Management with Cryptocurrencies: The Role of Estimation Risk. *Economics Letters* 177: 76–80. [CrossRef]
- Polat, Onur, and Eylül Kabakçı Günay. 2021. Cryptocurrency Connectedness Nexus the COVID-19 Pandemic: Evidence from Time-Frequency Domains. *Studies in Economics and Finance* 38: 946–63. [CrossRef]
- Qiao, Xingzhi, Huiming Zhu, and Liya Hau. 2020. Time-Frequency Co-Movement of Cryptocurrency Return and Volatility: Evidence from Wavelet Coherence Analysis. *International Review of Financial Analysis* 71: 101541. [CrossRef]
- Qiu, Yue, Yifan Wang, and Tian Xie. 2021. Forecasting Bitcoin Realized Volatility by Measuring the Spillover Effect among Cryptocurrencies. *Economics Letters* 208: 110092. [CrossRef]
- Raheem, Ibrahim D. 2021. COVID-19 Pandemic and the Safe Haven Property of Bitcoin. *Quarterly Review of Economics and Finance* 81: 370–75. [CrossRef]
- Rialti, Riccardo, Giacomo Marzi, Cristiano Ciappei, and Donatella Busso. 2019. Big Data and Dynamic Capabilities: A Bibliometric Analysis and Systematic Literature Review. *Management Decision* 57: 2052–68. [CrossRef]
- Rognone, Lavinia, Stuart Hyde, and S. Sarah Zhang. 2020. News Sentiment in the Cryptocurrency Market: An Empirical Comparison with Forex. *International Review of Financial Analysis* 69: 101462. [CrossRef]
- Sadeghi Moghadam, Mohammad Reza, Hossein Safari, and Narjes Yousefi. 2021. Clustering Quality Management Models and Methods: Systematic Literature Review and Text-Mining Analysis Approach. *Total Quality Management and Business Excellence* 32: 241–64. [CrossRef]

- Sahoo, Pradipta Kumar. 2021. COVID-19 Pandemic and Cryptocurrency Markets: An Empirical Analysis from a Linear and Nonlinear Causal Relationship. *Studies in Economics and Finance* 38: 454–68. [[CrossRef](#)]
- Scharnowski, Stefan. 2021. Understanding Bitcoin Liquidity. *Finance Research Letters* 38: 101477. [[CrossRef](#)]
- Schellinger, Benjamin. 2020. Optimization of Special Cryptocurrency Portfolios. *Journal of Risk Finance* 21: 127–57. [[CrossRef](#)]
- Sebastião, Helder, and Pedro Godinho. 2020. Bitcoin Futures: An Effective Tool for Hedging Cryptocurrencies. *Finance Research Letters* 33: 101230. [[CrossRef](#)]
- Sensoy, Ahmet, Thiago Christiano Silva, Shaen Corbet, and Benjamin Miranda Tabak. 2021. High-Frequency Return and Volatility Spillovers among Cryptocurrencies. *Applied Economics* 53: 4310–28. [[CrossRef](#)]
- Shi, Yongjing, Aviral Kumar Tiwari, Giray Gozgor, and Zhou Lu. 2020. Correlations among Cryptocurrencies: Evidence from Multivariate Factor Stochastic Volatility Model. *Research in International Business and Finance* 53: 101231. [[CrossRef](#)]
- Silahli, Baykar, Kemal Dincer Dingec, Atilla Cifter, and Nezir Aydin. 2021. Portfolio Value-at-Risk with Two-Sided Weibull Distribution: Evidence from Cryptocurrency Markets. *Finance Research Letters* 38: 101425. [[CrossRef](#)]
- Sun, Xiaolei, Mingxi Liu, and Zeqian Sima. 2020. A Novel Cryptocurrency Price Trend Forecasting Model Based on LightGBM. *Finance Research Letters* 32: 101084. [[CrossRef](#)]
- Tavares, Ricardo de Souza, João Frois Caldeira, and Gerson de Souza Raimundo Júnior. 2020. It's All in the Timing Again: Simple Active Portfolio Strategies That Outperform Naïve Diversification in the Cryptocurrency Market. *Applied Economics Letters* 29: 118–22. [[CrossRef](#)]
- Thampanya, Natthinee, Muhammad Ali Nasir, and Toan Luu Duc Huynh. 2020. Asymmetric Correlation and Hedging Effectiveness of Gold & Cryptocurrencies: From Pre-Industrial to the 4th Industrial Revolution. *Technological Forecasting and Social Change* 159: 120195.
- Trucíos, Carlos, Aviral K. Tiwari, and Faisal Alqahtani. 2020. Value-at-Risk and Expected Shortfall in Cryptocurrencies' Portfolio: A Vine Copula-Based Approach. *Applied Economics* 52: 2580–93. [[CrossRef](#)]
- Uddin, Md Akther, Md Hakim Ali, and Mansur Masih. 2020. Bitcoin—A Hype or Digital Gold? Global Evidence. *Australian Economic Papers* 59: 215–31. [[CrossRef](#)]
- Umar, Zaghun, and Mariya Gubareva. 2020. A Time-Frequency Analysis of the Impact of the Covid-19 Induced Panic on the Volatility of Currency and Cryptocurrency Markets. *Journal of Behavioral and Experimental Finance* 28: 100404. [[CrossRef](#)]
- Umar, Muhammad, Chi Wei Su, Syed Kumail Abbas Rizvi, and Xue Feng Shao. 2021. Bitcoin: A Safe Haven Asset and a Winner amid Political and Economic Uncertainties in the US? *Technological Forecasting and Social Change* 167: 120680. [[CrossRef](#)]
- Umar, Zaghun, Francisco Jareño, and María de la O. González. 2021. The Impact of COVID-19-Related Media Coverage on the Return and Volatility Connectedness of Cryptocurrencies and Fiat Currencies. *Technological Forecasting and Social Change* 172: 121025. [[CrossRef](#)]
- Urom, Christian, Ilyes Abid, Khaled Guesmi, and Julien Chevallier. 2020. Quantile Spillovers and Dependence between Bitcoin, Equities and Strategic Commodities. *Economic Modelling* 93: 230–58. [[CrossRef](#)]
- Van Eck, Nees Jan, and Ludo Waltman. 2017. Citation-based clustering of publications using CitNetExplorer and VOSviewer. *Scientometrics* 111: 1053–1070. [[CrossRef](#)] [[PubMed](#)]
- Vo, Au, Thomas A. Chapman, and Yen Sheng Lee. 2021. Examining Bitcoin and Economic Determinants: An Evolutionary Perspective. *Journal of Computer Information Systems* 62: 572–86. [[CrossRef](#)]
- Wang, Jinghua, and Geoffrey M. Ngene. 2020. Does Bitcoin Still Own the Dominant Power? An Intraday Analysis. *International Review of Financial Analysis* 71: 101551. [[CrossRef](#)]
- Wang, Gang Jin, Chi Xie, Danyan Wen, and Longfeng Zhao. 2019. When Bitcoin Meets Economic Policy Uncertainty (EPU): Measuring Risk Spillover Effect from EPU to Bitcoin. *Finance Research Letters* 31: 489–97. [[CrossRef](#)]
- Wang, Gang Jin, Xin yu Ma, and Hao yu Wu. 2020. Are Stablecoins Truly Diversifiers, Hedges, or Safe Havens against Traditional Cryptocurrencies as Their Name Suggests? *Research in International Business and Finance* 54: 101225. [[CrossRef](#)]
- Wang, Pengfei, Xiao Li, Dehua Shen, and Wei Zhang. 2020. How Does Economic Policy Uncertainty Affect the Bitcoin Market? *Research in International Business and Finance* 53: 101234. [[CrossRef](#)]
- Wang, Peijin, Hongwei Zhang, Cai Yang, and Yaoqi Guo. 2021. Time and Frequency Dynamics of Connectedness and Hedging Performance in Global Stock Markets: Bitcoin versus Conventional Hedges. *Research in International Business and Finance* 58: 101479. [[CrossRef](#)]
- Wang, Jiqian, Feng Ma, Elie Bouri, and Yangli Guo. 2022. Which Factors Drive Bitcoin Volatility: Macroeconomic, Technical, or Both? *Journal of Forecasting* 1–19. [[CrossRef](#)]
- Wu, Wanshan, Aviral Kumar Tiwari, Giray Gozgor, and Huang Leping. 2021. Does Economic Policy Uncertainty Affect Cryptocurrency Markets? Evidence from Twitter-Based Uncertainty Measures. *Research in International Business and Finance* 58: 101478. [[CrossRef](#)]
- Xu, Qiuhua, Yixuan Zhang, and Ziyang Zhang. 2021. Tail-Risk Spillovers in Cryptocurrency Markets. *Finance Research Letters* 38: 101453. [[CrossRef](#)]
- Yang, Lu, and Shigeyuki Hamori. 2021. The Role of the Carbon Market in Relation to the Cryptocurrency Market: Only Diversification or More? *International Review of Financial Analysis* 77: 101864. [[CrossRef](#)]
- Yang, Boyu, Yuying Sun, and Shouyang Wang. 2020. A Novel Two-Stage Approach for Cryptocurrency Analysis. *International Review of Financial Analysis* 72: 101567. [[CrossRef](#)]

- Yen, Kuang Chieh, and Hui Pei Cheng. 2021. Economic Policy Uncertainty and Cryptocurrency Volatility. *Finance Research Letters* 38: 101428. [[CrossRef](#)]
- Yi, Shuyue, Zishuang Xu, and Gang Jin Wang. 2018. Volatility Connectedness in the Cryptocurrency Market: Is Bitcoin a Dominant Cryptocurrency? *International Review of Financial Analysis* 60: 98–114. [[CrossRef](#)]
- Yue, Yao, Xuerong Li, Dingxuan Zhang, and Shouyang Wang. 2021. How Cryptocurrency Affects Economy? A Network Analysis Using Bibliometric Methods. *International Review of Financial Analysis* 77: 101869. [[CrossRef](#)]
- Zeng, Ting, Mengying Yang, and Yifan Shen. 2020. Fancy Bitcoin and Conventional Financial Assets: Measuring Market Integration Based on Connectedness Networks. *Economic Modelling* 90: 209–20. [[CrossRef](#)]
- Zhang, Sijia, and Andros Gregoriou. 2021. Cryptocurrencies in Portfolios: Return–Liquidity Trade-off around China Forbidding Initial Coin Offerings. *Applied Economics Letters* 28: 1–5. [[CrossRef](#)]
- Zhang, Wei, and Yi Li. 2020. Is Idiosyncratic Volatility Priced in Cryptocurrency Markets? *Research in International Business and Finance* 54: 101252. [[CrossRef](#)]

**Disclaimer/Publisher’s Note:** The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.