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A Methodological Point of View in A Systematic Review of The Documentation of The Effect of Volatility on Cryptocurrency Investment

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Abstract. In this study, we examine the literature that has been published between the years of 2009 and 2022, and we synthesize its contributions to the analysis of volatility during the past ten years, particularly with regard to investments in cryptocurrencies. Papers from journals with a Scopus index are included in our selections. We undertake a literature review and a bibliometric analysis using the VOS-viewer program. Our results are presented in terms of the approaches employed to simulate cryptocurrency volatility as well as in accordance with their key conclusions on the aforementioned assets' volatility and their use in managing portfolios. Our analysis indicates that the Markowitz models appear to be more popular among authors and that continue to be dominated by the GARCH expansion method and hybrid models are thought to be the best machine learning techniques. We also discover that investors can take into account cryptocurrencies because of their capacity to enhance the performance of diversified portfolios.

Keywords: Cryptocurrency; Volatility; Investment; Bibliometric Analysis.

INTRODUCTION

Our research provides a significant contribution to the crucial but fragmented field of cryptocurrency investment by providing bibliometric analysis and a detailed literature assessment with a focus on cryptocurrency volatility. In order to synthesize and gain a deeper understanding of the expanding academic literature on the volatility of cryptocurrencies, we used a systematic literature review in this work. We can more fully understand the body of information on cryptocurrency investment and aid future research by finding literature gaps by doing a systematic review of the literature.

In order to assist investors, we intend to contribute by offering the most thorough and current literature assessment upon this volatility of cryptocurrency investing in this study. In order to not limit the potential contributions of more ancillary studies to the topic, we conducted our research utilizing the Clarivate Scopus database and chose to take more general keywords into consideration. By combining this methodology with the bibliometric coupling of the VOSviewer program, a cluster related to market volatility invariably emerges.

METHOD

We adopted a thorough approach in our inquiry and chose to examine the Scopus database to protect the legitimacy of our sample. Up until 2022, we did a search of the Scopus

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database. January 1st, 2009 (30 September 2022). The fact that Satoshi Nakamoto released the first paper on cryptocurrency in 2008 justifies our start date.

We chose the keywords for our research in a different way than other authors since we do not limit words linked to market volatility in bitcoin like as (Flori, 2019; Haq et al., 2021; Jalal et al., 2021)Flori (2019); (Haq, Maneengam, Chupradit, Suksatan, & Huo, 2021; Jalal, Alon, & Paltrinieri, 2021). Cryptocurrency, Bitcoin, volatility, portfolio, and investment were the keywords chosen. The research equation was then written as "cryptocurrency OR Bitcoin AND volatility AND portfolio AND investment" utilizing the wildcard character and the Boolean operators.

As an additional quality condition, we decided to only consider academic Scopus articles that were open access, published in English, and discussed the topic of cryptocurrencies from the perspective of investors.

We were able to include side studies in addition to the literature that was purely focused on the volatility of the cryptocurrency market because we did not impose any restrictions on the study fields, which improved our comprehension of the subject. Furthermore, we have utilized VOSviewer 1.6.18 for our bibliometric study.

Articles are grouped by clusters that cite numerous articles in the same sentence when bibliometric coupling is selected (Bartolacci, Caputo, & Soverchia, 2020), which uses the references from both papers to show how closely related they are (Rialti, Marzi, Ciappei, & Busso, 2019) (Rialti et al., 2019; Bartolacci et al., 2020)

We use the bibliometric coupling function of VOSviewer in our study to highlight the proximity of publications through their shared references because the number of cited references does not change over time, enabling the reproducibility of our analysis (Bartolacci et al., 2020; Caputo et al., 2018). The normalized citation option was also taken into account, which reduces the bias in favor of recent publications by dividing the number of citations for one item by the average number of citations for all items from the same year in the dataset (Bartolacci et al., 2020; Caputo et al., 2018). As a result, a cluster pertaining to market volatility for bitcoin immediately manifests through VOSviewer bibliometric coupling.

RESULTS AND DISCUSSION

Following are the results of this research. The first part will present the results of the bibliometric analysis and then review the methodology used by the studies included in this literature review.

Bibliometric Analysis

Our initial investigation focuses on the volume of articles mentioning cryptocurrency market volatility. We can conclude that the number of published articles in this field of study has increased from 1 in 2015 to 32 in 2022 based on our criteria for quality and the analysis of Figure 1. It is also evident that fewer papers were published in 2021 than in previous years. In 2022, the subject of researching the volatility of cryptocurrencies produced the most findings.

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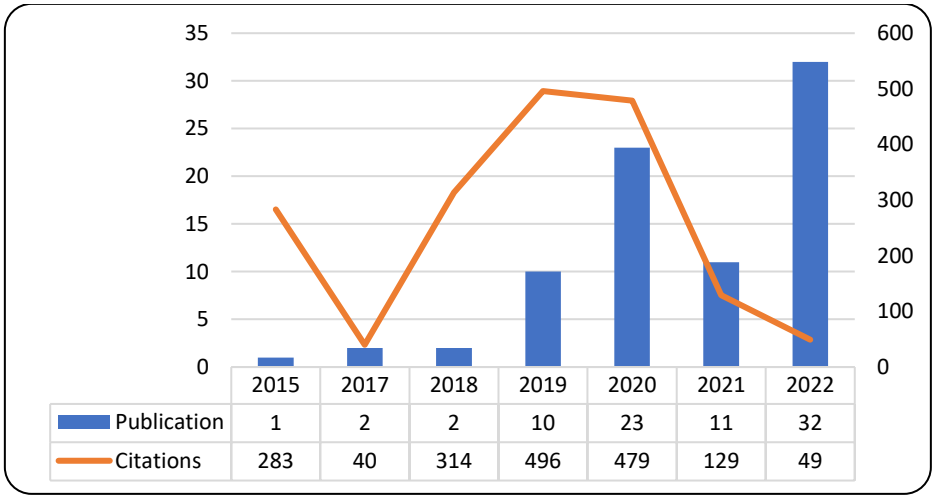

Figure 1. the evolution of citations and publications

Top Articles

The top 10 articles that address a variety of subjects related to investing volatility in cryptocurrencies are listed in Table 1. We may note that Klein et al. (2018) received the most citations, followed by Briere et al. (2015) and Guesmi et al (2019). This shows that the three papers with the highest number of citations in our databases are from the years 2015, 2018, and 2019, which might account for their increased citation rate.

Table 1. Top ten publications with the most citations (1282 citations)

Rank	Author (Year)	Citations
1	Klein et al. (2018)	308
2	Briere et al. (2015)	283
3	Guesmi et al. (2019)	237
4	Su et al. (2020)	122
5	Katsiampa, Paraskevi (2019)	91
6	Al-Yahyaee et al. (2019)	55
7	Watorek et al. (2021)	51
8	Al Mamun et al. (2020)	46
9	Tiwari et al. (2019)	45
10	Adjepong and Alagidede (2019)	44

Countries

The contributions of many nations to our field of study are shown in Table 2. With 594 citations, France stands out as the most referenced nation, followed by the United Kingdom with 474 and China with 208. The nation having the most articles on cryptocurrency volatility is China.

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Table 2. The top 10 nations by publication and citation rates

Rank	Country	Publications	Citations
1	China	11	208
2	United Kingdom	9	474
3	Pakistan	8	123
4	France	7	594
5	India	7	23
6	South Korea	6	126
7	United States	6	38
8	Vietnam	5	114
9	Germany	4	325
10	Greece	4	52

According to normalized citations, Figure 2 shows that France is the most cited nation. But how it contributes changes over the course of 2019–2020. In 2019, there were more citations for the United Kingdom. In 2020, Germany will receive the most citations. In 2021, China will make the most contribution to our field of study.

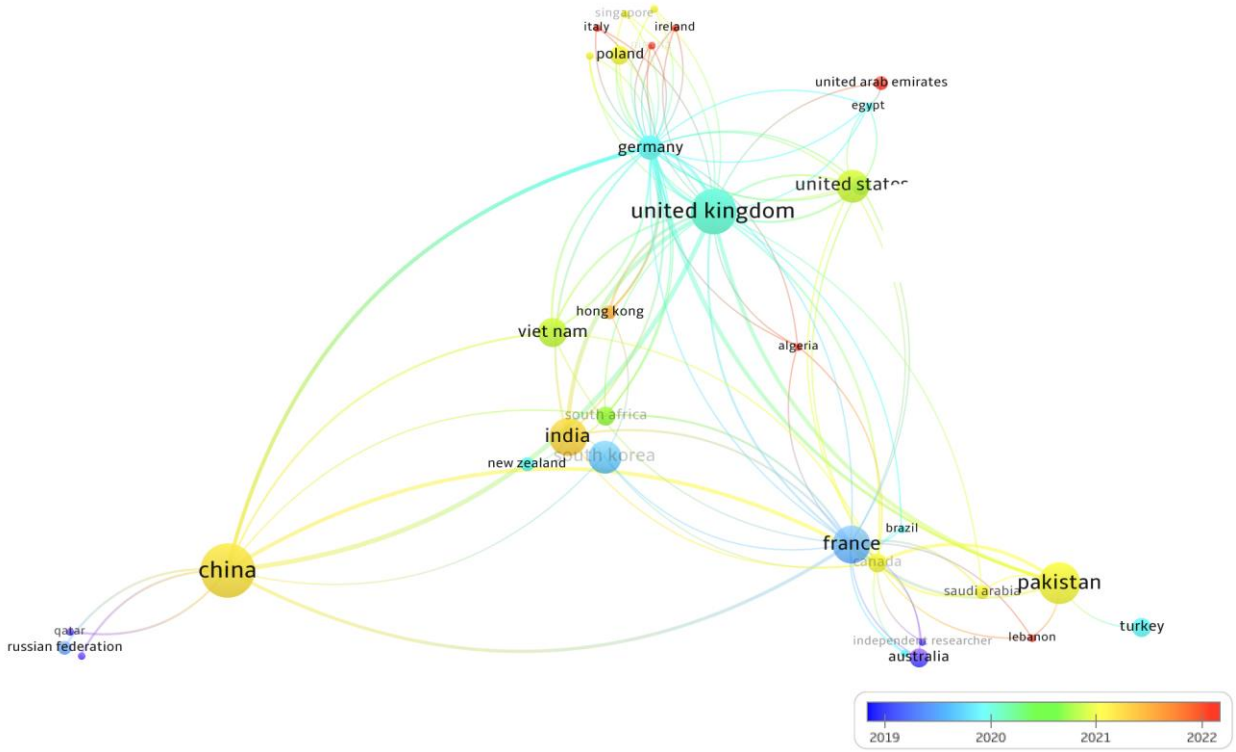

Figure 2. Country citations normalized by year

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Journals

Table 3 provides an analysis of the journals that contributed the most to the volatility field. The International Review of Financial Analysis is the most frequently cited journal in our dataset with 577 citations. The journal with the most published papers is Finance Research Letters, which has four issues. With 116 citations, Physical a Statistical Mechanics and Its Applications is rated second, and technological forecasting and social change is ranked third with 133 citations.

Table 3. The ten best journals according to citations

Rank	Journal	Publications	Citations	Publications with Citations
1	International Review of Financial Analysis	3	577	192.3
2	Technological Forecasting and Social Change	3	133	44.3
3	Physica A Statistical Mechanics and Its Applications	3	116	38.7
4	Finance Research Letters	4	101	25.3
5	North American Journal of Economics and Finance	2	56	28.0
6	Research In International Business and Finance	2	53	26.5
7	Financial Innovation	2	41	20.5
8	Economics Letters	2	30	15.0
9	Applied Economics	2	18	9.0
10	Journal Of Risk and Financial Management	2	1	0.5

When we examine the research fields that affect cryptocurrency volatility (Figure 3), we find that, as we may have predicted, economics, econometrics, and finance account for the majority of the variance, each contributing 34%.

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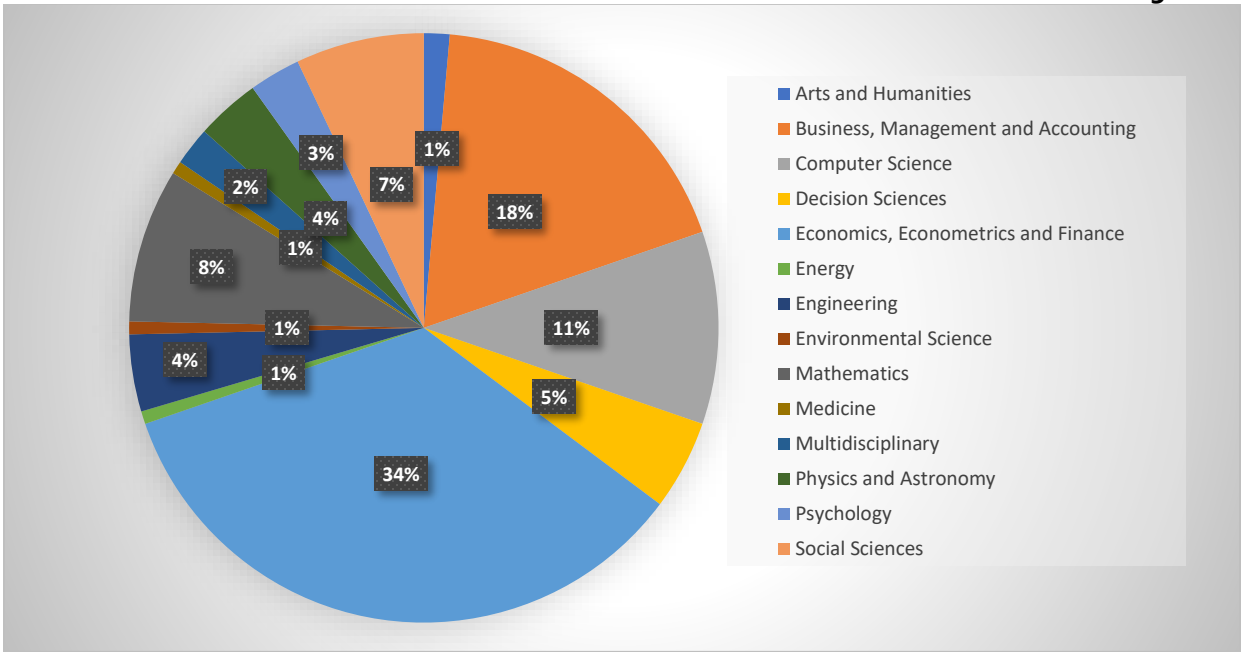

Figure 3. Most contributive research fields

According to normalized citations, the International Review of Financial Analysis is the most cited journal in 2019, as depicted in Figure 4. In the period between 2019 and 2020, Physica A Statistical Mechanics and Its Applications received the most citations. In our research field between 2020 and 2021, The Finance Research Letter received the most citations.

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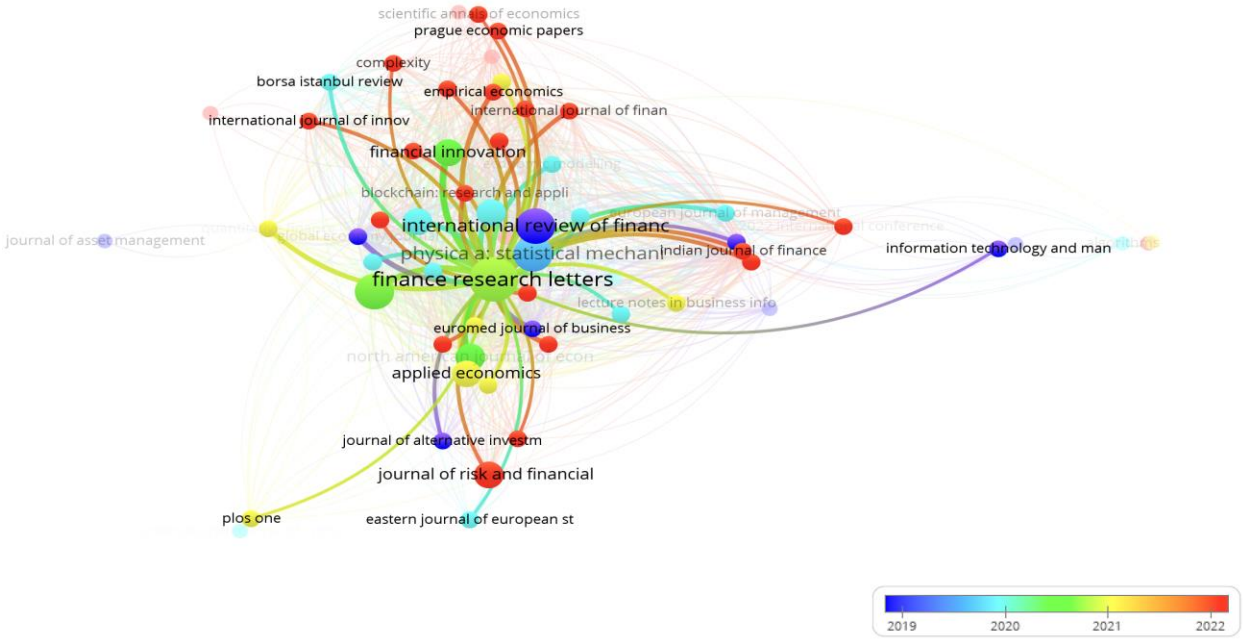

Figure 4. Journal citations normalized by year

Authors

The most frequently cited writers in the subject of cryptocurrency volatility research are shown in Table 4. The top two authors in the dataset in terms of citations are Klein and Briere. Guesme, who has 2 published articles and a citation to publication ratio of 133, is in third place.

Table 4. The top ten authors on citations based

Rank	Author	Publications	Citations	Average Citations
1	Klein et al.	1	308	308.0
2	Briere et al.	1	283	283.0
3	Guesme et al.	2	266	133.0
4	Su et al.	1	122	122.0
5	Katsiampa, Paraskevi	1	91	91.0
6	Al-Yahyaee et al.	1	55	55.0
7	Watorek et al.	1	51	51.0
8	Tiwari et al.	2	61	30.5
9	Al Mamun et al.	1	46	46.0
10	Omane-Adjepong et al.	1	44	44.0

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According to normalized citations, Figure 5 shows that Klein, Guesme, and Katsiampa were the most referenced authors in 2019, Yousaf, Urom, and Su were the most cited authors in 2020, and in 2021, Qami, Petukhina, and Wang were the most cited authors.

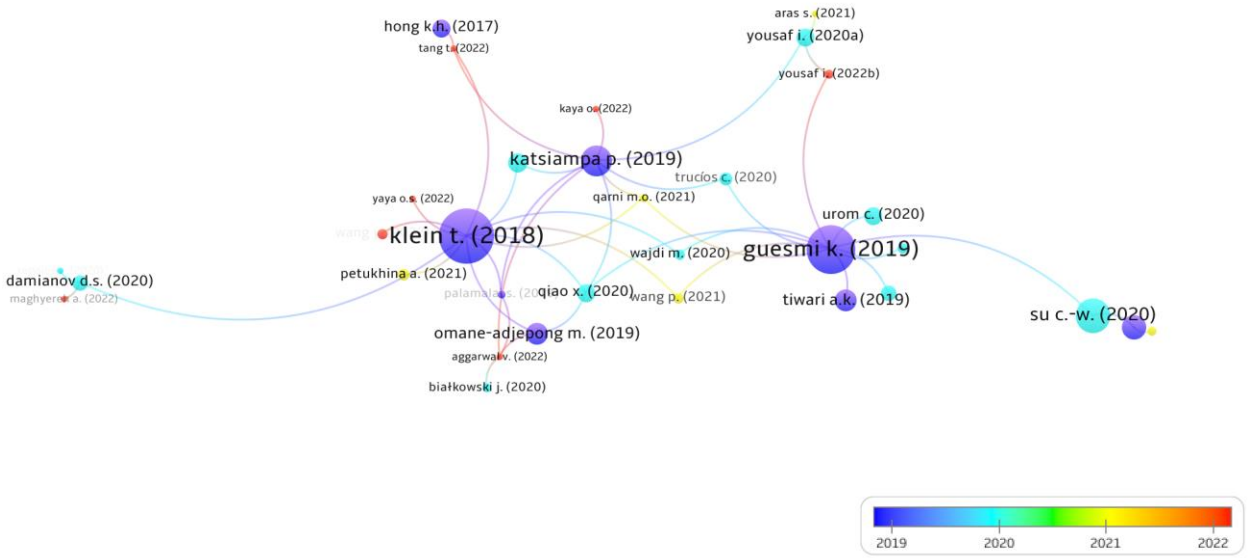

Figure 5. Author citations normalized by year

In this chapter of our research, we focus the methodological findings and the most important lessons learned from the literature about volatility in cryptocurrencies.

Methodological Results

While numerous models seem to perform well in terms of measuring and forecasting the volatility of cryptocurrencies, Table 5 highlights the models that have been presented to do so. The GARCH approach and its improvements continue to be widely used in studies on volatility. The Markowitz model is still the preferred way for research that shows portfolio diversification and performance by integrating bitcoin assets.

Table 5. Techniques for modeling the volatility of cryptocurrency

Author	Period	Methodology	Best Model
(Yousaf, 2020b)	2018 – 2020	VAR-AGARCH / VAR-BEKK-GARCH	VAR-AGARCH
(Zhu, 2021)	2013 – 2020	Granger Causality Model / VAR Model	Granger Causality Model / VAR Model
(Y. Wang, 2022)	2013 – 2021	VAR Model / VECM	VECM
(Bruhn, 2022)	2008 – 2022	GARCH-EVT / t-Student Copula	GARCH-EVT/t-Student Copula
(Živanović, 2022)	2020 – 2021	GARCH-DCC / MPT & GRG	GARCH-DCC
(Maghyereh, 2022)	2019–2020	Cross-Wavelet Coherency / DCC GARCH	Cross-Wavelet Coherency / DCC GARCH

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Author	Period	Methodology	Best Model
(Madhavan, 2022)	2020–2022	DCC-GARCH	DCC-GARCH
(Paule-Vianez, 2020)	2019	Quantile Regression Models / Simple Linear Regression	Quantile Regression Models / Simple Linear Regression
(Livieris, 2020)	2018–2019	Adaptive Moment Estimation (ADAM) algorithm / Deep learning models CNN-LSTM and CNN-BiLSTM	Adaptive Moment Estimation (ADAM) algorithm / Deep learning models CNN-LSTM and CNN-BiLSTM
(Zahid, 2022)	2013–2020	HARQ-L-GARCH-Type models / HAR-GARCH	HARQ-L-GARCH-Type models
(Yousaf, 2022a)	2019–2020	VAR / DCC-GARCH / VAR-GARCH / BEKK-GARCH	DCC-GARCH
(Sui, 2022)	2019-2021	The ARCH-Lagrange Multiplier Statistic / GARCH Model	GARCH Model
(Bowala, 2022)	2020 – 2022	MVP / MRP-VEV / MRP VES / MRP-VESV / MRP-MAD / MMRP-VEV / MMRP VES / MMRP-VESV / MMRP-MAD	MVP / MRP-VEV / MRP VES / MRP-VESV / MRP-MAD / MMRP-VEV / MMRP VES / MMRP-VESV / MMRP-MAD
(Qarni, 2021)	2014–2018	VAR / Barunik and Křehlík's Method	VAR / Barunik and Křehlík's Method
(Livieris, 2020)	2017 – 2020	Deep neural network model (MICDL)	Deep neural network model (MICDL)
(Haffar, 2022)	2010 – 2021	The student copula / DCC-GARCH model	DCC-GARCH
(Omane-Adjepong, 2019)	2014 – 2018	Wavelet / VAR	Wavelet / VAR
(A.H.A. Othman, 2019)	2010 – 2017	GARCH / News Impact Curve (NIS) analysis	GARCH / News Impact Curve (NIS) analysis
(Trucíos, 2020)	2015 – 2019	Vine copulas combine with GARCH / robust univariate volatility models	Vine copulas combine with GARCH
(Kinkyo, 2022)	2013 – 2019	SV model with a multivariate factor and wavelet transform	SV model with a multivariate factor and wavelet transform
(Zhai, 2020)	2015 – 2018	Python, Excel, Linier regression model	R – Phyton
(Koutsouri, 2020)	2016 – 2019	Weighted Risk Contribution (WRC) strategy	Weighted Risk Contribution (WRC) strategy
(Subramanian, 2022)	2013 – 2019	E-GARCH / DCC-GARCH	E-GARCH / DCC-GARCH
(Kim, 2022)	2018 – 2022	Factor Analysis / GMV / RP / MD	Factor Analysis / GMV / RP / MD
(Gopane, 2021)	2011 – 2019	EGARCH	EGARCH
(P. Wang, 2021)	2016 – 2021	The time frequency domain spillover frameworks / DCC-GARCH model with wavelet-based	The time frequency domain spillover frameworks / DCC-GARCH model with wavelet-based
(Ehlers, 2019)	2015 - 2017	Correlation and autocorrelation / Gaussian random walk analysis / Variance ratio test (VRT) with heteroscedasticity adjustment / Variance-reduction	Correlation and autocorrelation /Gaussian random walk analysis / Variance ratio test (VRT) with heteroscedasticity

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Author	Period	Methodology	Best Model
			adjustment /Variance-reduction
(Yousaf, 2020a)	2019 – 2020	VAR-DCC-GARCH	VAR-DCC-GARCH
(Guesmi, 2019)	2012 – 2018	VARMA (1,1)-DCC-GARCH, VARMA (1,1)-DCC-EGARCH, VARMA (1,1)-DCC-GARCH, VARMA (1,1)-cDCC-FIAPARCH VARMA (1,1)-DCC-GJR-GARCH	VARMA(1,1)-DCC-GJR-GARCH
(Meynkhard, 2020)	2018 – 2019	The Linear Pearson Correlation Coefficient	The Linear Pearson Correlation Coefficient
(Vo, 2017)	2013 – 2016	Autoregressive Moving Average (ARMA) / GARCH models under GHYP (Generalized Hyperbolic) distribution	ARMA(1,2)-fGARCH(2,2)/TGARCH
(Koutmos, 2020)	2013 – 2017	Markov regime-switching regression approach	Markov Regime
(Brière, 2015)	2010 – 2013	OLS Regression / the annualized mean return, Sharpe, semi-variance, and Sortino ratios	OLS Regression / the annualized mean return, Sharpe, semi-variance, and Sortino ratios
(Hong, 2017)	2013 – 2015	Regression / generalized least squares (GLS) estimation	Regression / generalized least squares (GLS) estimation
(Bu, 2018)	2016	Deep Boltzmann Machine (DBM) and Double Q-network	Deep Boltzmann Machine (DBM) and Double Q-network
(Klein, 2018)	2011 – 2017	GARCH / BEKK-GARCH / APARCH / FIAPARCH	FIAPARCH
(Al-Yahyaee, 2019)	2013 – 2018	Wavelet Coherence (WC), Cross Wavelet Transform (CWT), Power Wavelet Coherence (PWC), and Multiple Wavelet Coherence (MWC) approaches.	Wavelet Coherence (WC), Cross Wavelet Transform (CWT), Power Wavelet Coherence (PWC), and Multiple Wavelet Coherence (MWC) approaches.
(Guesmi, 2019)	2012 – 2018	VARMA(1,1)-DCC-GJR-GARCH / VARMA(1,1)-DCC-EARCH / VARMA(1,1)-DCC-GJR-GARCH / VARMA(1,1)-cDCC-FIAPARCH	VARMA(1,1)-DCC-GJR-GARCH
(Katsiampa, 2019)	2015 – 2018	bivariate Diagonal BEKK model	bivariate Diagonal BEKK model
(A.H. Abdullah Othman, 2019)	2010 – 2017	GARCH(1,1) / EGARCH(1,1) / APGARCH(1,1) / TGARCH(1,1)	GARCH (1,1), EGARCH (1,1) APGARCH (1,1), TGARCH (1,1)
(Palamalai, 2019)	2013 – 2019	Diagonal BEKK Multivariate GARCH model and Vector Error Correction approach	Diagonal BEKK Multivariate GARCH model and Vector Error Correction approach
(Vardar, 2019)	2010 – 2018	VAR–GARCH with mean framework and the BEKK representation	VAR–GARCH with mean framework and the BEKK representation
(Białkowski, 2020)	2013 – 2019	VAR	VAR

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Author	Period	Methodology	Best Model
(Bondar, 2020)	2016 – 2019	Markowitz / Sharpe Ratio	Markowitz / Sharpe Ratio
(Chowdhury, 2020)	2019	Machine learning approaches / neural network / ensemble learning method / K-NN model	Ensemble learning method
(Damianov, 2020)	2010 – 2018	GARCH models / AR(1)-ADCC-GARCH	AR(1)-ADCC-GARCH
(Karahanoglu, 2020)	2014 – 2020	VAR / EWMA / EVT VaR	EWMA filtered VaR
(Ma, 2020)	2015 – 2019	Markowitz Mean-Variance optimization / Sharpe ratio	Markowitz Mean-Variance optimization / Sharpe ratio
(Mamun, 2020)	2010 – 2016	DCC-GJR-GARCH	DCC-GJR-GARCH
(Qiao, 2020)	2014 – 2019	The wavelet-coherence and the correlation network	The wavelet-coherence and the correlation network
(Regaieg, 2020)	2010 – 2017	Markov-switching autoregressive (MS-AR)	Markov-switching autoregressive (MS-AR)
(Su, 2020)	2010 – 2020	VAR	VAR
(Urom, 2020)	2013 – 2018	Bayesian with Time Varying Parameter Vector Autoregressive (TVP-VAR)	Bayesian with Time Varying Parameter Vector Autoregressive (TVP-VAR)
(Wajdi, 2020)	2015 – 2018	VAR / GJR-GARCH / DCC-GJR-GARCH	VAR / DCC-GJR-GARCH
(Weisskopf, 2020)	2014 – 2018	CAPM / OLS Regression	CAPM / OLS Regression
(Aras, 2021)	2014 – 2021	GARCH / EGARCH / GJRGARCH / APARCH / IGARCH / CGARCH / AVGARCH / TGARCH / NGARCH / NAGARCH / FGARCH	CGARCH
(Chancharat, 2021)	2010 – 2021	Diagonal BEKK-GARCH	Diagonal BEKK-GARCH
(Gopane, 2021)	2011 – 2019	EGARCH	EGARCH
(Petukhina, 2021)	2015 – 2019	EW / MinVar / MinCVaR / ERC / MD / RR-MaxRet / MV-S / CombNaive / Comb	MD
(Wątorek, 2021)	2012 – 2018	Multifractal cross correlation analysis / the Q dependent detrended cross correlation coefficient / the non linear correlations / multiscale characteristics	Multifractal cross correlation analysis / the Q dependent detrended cross correlation coefficient / the non linear correlations / multiscale characteristics
(Yousaf, 2021)	2020	VAR–BEKK–AGARCH	VAR–BEKK–AGARCH
(Aggarwal, 2022)	2015 – 2020	BEKK-GARCH(1,1)	BEKK-GARCH(1,1)
(Arwatchanakarn, 2022)	2017 – 2021	ARDL / VAR	ARDL / VAR
(Będowska-Sójka, 2022)	2020 – 2022	Asymmetric causality / Vector-autoregressive model / DCC	Asymmetric causality / Vector-autoregressive model / DCC
(Chopra, 2022)	2019	TGARCH	TGARCH
(Dempsey, 2022)	2020	Markowitz Diversification	Markowitz Diversification
(Foroutan, 2022)	2019 – 2020	EGARCH-M / VAR	EGARCH-M / VAR
(Gopane, 2022)	2011 – 2019	EGARCH / VCC-MGARCH	EGARCH / VCC-MGARCH

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Author	Period	Methodology	Best Model
(Kaya, 2022)	2017 – 2021	Logarithmic test	Logarithmic test
(Livieris, 2022)	2017 – 2019	Dropout weight- constrained recurrent neural networks	Dropout weight- constrained recurrent neural networks
(Som, 2022)	2014 – 2020	The viz historical simulation, Monte-Carlo simulation, and parametric approximation	The viz historical simulation, Monte-Carlo simulation, and parametric approximation
(Tang, 2022)	2014 – 2020	The cyclical volatility model	The cyclical volatility model
(Wenhao, 2022)	2013 – 2019	MFDCCA / MF-ADDCA	MFDCCA / MF-ADDCA
(Yaya, 2022)	2018 – 2020	CCC- VARMA-GARCH	CCC- VARMA-GARCH
(E. Yi, 2022)	2010 – 2018	HE / PLE / EMH	HE / PLE / EMH
(Y. Yi, 2022)	2017 – 2021	HAR-KS	HAR-KS
(Yousaf, 2022b)	2018 – 2021	VAR-BEKK-GARCH	VAR-BEKK-GARCH

Discussion of Main Findings

There is evidence of spillovers both within the bitcoin market and between cryptocurrencies and other markets. The Bitcoin market and stock markets have returns and shock spillovers. This suggests that in order to prevent shocks to the value of their portfolios from "crystallizing," rational investors move across markets as part of their portfolio management strategy (Gopane, 2021; Vardar, 2019; Zhai, 2020). According to evidence (Brière, 2015; Haffar, 2022; Hong, 2017; Wang, 2021) investors who are seeking a hedge in the equity market move uncertainty and volatility to the cryptocurrency market.

On the other hand, there is evidence that the financial markets experience a ripple effect of an initial shock in the cryptocurrency market when taking into consideration both Bitcoin and other cryptocurrencies. However, the high-yield hedged bond and equity markets continue to experience volatility spillovers from the bitcoin market (Subramanian, 2022). They are nevertheless susceptible to trading scales in terms of their degrees of connectivity and volatility correlations. Furthermore, there is evidence that there are cross-chain effects, more specifically, that there are effects of bidirectional volatility between Bitcoin and Ethereum, Bitcoin and Litecoin, and Ethereum and Litecoin, thereby endorsing the concept of a combined crypto market (Meynkhard, 2020; Yousaf, 2020a).

There is evidence that extraneous factors, such as the global real economic activity, the global financial stress index, and the Chinese policy uncertainty index, can help anticipate market volatility. The importance of a network of elements interacting with one another as opposed to a single factor is thus emphasized (Al-Yahyaee, 2019; Guesmi, 2019).

Options may be a vital tool for Bitcoin investors, providing important information, according to the available research (Bruhn, 2022). Results show that with a change of one percentage point in implied volatility, the premium appears to become more sensitive, whereas for a change of one percentage point in the risk-free rate across different expiration dates, the premium often stays the same. Finally, trend-trending techniques can make use of the volatility of Bitcoin, Ethereum, and Ripple. For instance, buying a put and call option on bitcoins with the same expiration and strike price would replicate the volatility of a long position in bitcoins (Petukhina, 2021).

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Evidence suggests that speedier transactions of cryptocurrencies are desirable as a medium of exchange due to their lower liquidity risk (A.H. Abdullah Othman, 2019). Additionally, it demonstrated a link between volatility and the quantity of new businesses adopting cryptocurrency. In this way, the volatility of cryptocurrencies rises as new crypto payment options are added and falls as old crypto payment methods are eliminated by firms. Consequently, it is possible to forecast bitcoin volatility by counting the number of new businesses that take cryptocurrencies as payment (Ehlers, 2019).

CONCLUSION

We conduct bibliometric analysis of the existing literature and an examination of the literature on cryptocurrency volatility is necessary to comprehend the intricacy of the industry. We looked for that in the Scopus database between 2009 and 2022.

In our dataset, The International Review of Financial Study is the journal that receives the most citations, as seen in our bibliometric analysis. The journal that has made the most contributions to our field of study, though, is Finance Research Letters. China has made the largest contribution, as well.

Our review of the literature, however, found evidence that: (1) Bitcoin can be a potent hedge against stock indices at low frequencies; (2) the number of new companies accepting cryptocurrencies as payment can forecast cryptocurrency volatility; (3) Bitcoin's price volatility exhibits a "anti-leverage effect" because good news has a greater impact on volatility than bad news; and (4) bidirectional volatility spillovers in the cryptocurrency market, indicating market volatility in both directions. Our results are consistent with previous cryptocurrency reviews and add to them (Bowala, 2022; Bruhn, 2022; Guesmi, 2019; Klein, 2018; Wang, 2022; Yousaf, 2022a)

To the best of our knowledge, there isn't a lot of research that addresses the volatility of cryptocurrencies, particularly using bibliometric analysis, as in our work, and compiling the numerous methods used to predict cryptocurrency volatility in a systematic way.

We highlight that, despite the fact that using Scopus-indexed journals may be seen as a disadvantage because it limits the amount of data that can be evaluated, it nonetheless improves the caliber of our study.

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