Revolutionizing finance with bitcoin and blockchain: a literature review and research agenda

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Abstract

Purpose – Our analysis is targeted at researchers in the fields of economics and finance, and we place emphasis on the incremental contributions of each paper, key research questions, study methodology, main conclusions and data and identification tactics. By focusing on these critical areas, our review seeks to provide valuable insights and guidance for future research in this rapidly evolving and complex field.

Design/methodology/approach – This paper conducts a structured literature review (SLR) of Bitcoin-related articles published in the leading finance, economics and accounting journals between 2018 and 2023. Following Massaro *et al.* (2016), SLR is a method for examining a corpus of scholarly work to generate new ideas, critical reflections and future research agendas. The goals of SLR are congruent with the three outcomes of critical management research identified by Alvesson and Deetz (2000): insight, critique and transformative redefinition.

Findings – The present state of research on Bitcoin lacks coherence and interconnectedness, leading to a limited understanding of the underlying mechanisms. However, certain areas of research have emerged as significant topics for further exploration. These include the decentralized payment system, equilibrium price, market microstructure, trading patterns and regulation of Bitcoin. In this context, this review serves as a valuable starting point for researchers who are unacquainted with the interdisciplinary field of bitcoin and blockchain research. It is essential to recognize the potential value of research in Bitcoin-related fields in advancing knowledge of the interaction between finance, economics, law and technology. Therefore, future research in this area should focus on adopting innovative and interdisciplinary methods to enhance our comprehension of these intricate and evolving technologies.

Originality/value – Our review encompasses the latest research on Bitcoin, including its market microstructure, trading behavior, price patterns and portfolio analysis. It explores Bitcoin's market microstructure, liquidity, derivative markets, price discovery and market efficiency. Studies have also focused on trading behavior, investors' characteristics, market sentiment and price volatility. Furthermore, empirical studies demonstrate the advantages of including Bitcoin in a portfolio. These findings enhance our understanding of Bitcoin's potential impact on the financial industry.

Keywords Bitcoin, Decentralized payment system, Equilibrium price, Market microstructure, Price discovery, Cryptocurrency, Blockchain

Paper type Literature review

JEL Classification — C53, C58, D47, D82, E31, E42, G11, G12, G13, G14, G15, G40, L17

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1. Introduction

Cryptocurrencies are digital currencies that utilize blockchain, decentralization and cryptography technology, with Bitcoin being the most popular among investors. In the wake of the 2008 financial crisis, the public's trust in banks and centralized financial institutions was significantly compromised. In response to this, Bitcoin emerged as a viable alternative to traditional financial systems, demonstrating the reliability of its underlying blockchain technology. Since then, Bitcoin has gained significant attention from market practitioners, regulators and scholars alike, underscoring its potential to revolutionize the finance industry.

The emergence and development of Bitcoin have garnered significant scholarly attention in recent years. This paper conducts a structured literature review (SLR) of Bitcoin-related articles published in the leading finance, economics and accounting journals between 2018 and 2023. Following Massaro *et al.* (2016), SLR is a method for examining a corpus of scholarly work to generate new ideas, critical reflections and future research agendas. The goals of SLR are congruent with the three outcomes of critical management research identified by Alvesson and Deetz (2000): insight, critique and transformative redefinition. Given the multifaceted and emerging nature of Bitcoin, SLR is an ideal approach for studying this topic. Our literature review aims to achieve three primary objectives: (1) present a taxonomy of the Bitcoin phenomenon; (2) synthesize the current state of knowledge in the fields of Bitcoin from financial and economic perspectives and (3) identify knowledge gaps and research opportunities for future studies. Ultimately, our review seeks to advance the scholarly discourse on Bitcoin and contribute to the development of this rapidly evolving field.

Due to the absence of a regulatory body overseeing the Bitcoin market, users are the primary drivers of price fluctuations. As a result, Bitcoin has been increasingly recognized as an investment asset. At the same time, it continues to function as a medium of exchange or currency. Therefore, scholarly articles investigating Bitcoin can be broadly categorized as either focusing on its currency or asset characteristics. In studies that view Bitcoin as a currency, scholars have primarily explored its role as a decentralized payment system and equilibrium pricing. Meanwhile, studies that view Bitcoin as an asset have examined topics such as market microstructure, trading behavior of investors and its reflection in price patterns and portfolio analysis. Through a comprehensive examination of these diverse research streams, we can deepen our understanding of Bitcoin and its potential implications for the future of finance.

We have undertaken a thorough examination of Bitcoin-related articles that have been published in top-tier finance, economics and accounting journals. To our knowledge, while other relevant articles have covered specific topics such as investor behavior (Almeida & Gonçalves, 2023), the digital economy (Sitthipon *et al.*, 2023), and the environmental impact of cryptocurrencies (Wendl, Doan, & Sassen, 2023), our study stands apart. Specifically, our analysis is targeted at researchers in the fields of economics and finance and we place emphasis on the incremental contributions of each paper, key research questions, study methodology, main conclusions and data and identification tactics. By focusing on these critical areas, our review seeks to provide valuable insights and guidance for future research in this rapidly evolving and complex field.

This paper is structured to provide a comprehensive review of the literature on Bitcoin-related articles. In Section 2, we provide an overview of our survey criteria, scope and summary statistics. Section 3 offers a critical analysis of the literature, focusing on five primary areas: decentralized payment systems, equilibrium pricing, market microstructure, trading behavior/patterns and portfolio analysis. By providing a detailed examination of each of these areas, our review offers valuable insights into the complex nature of the Bitcoin market. Finally, in Section 4, we conclude the paper with a summary of our key findings and recommendations for future research in this field.

2. Survey criteria, scope and result

To ensure a rigorous and comprehensive review, we employed a rigorous methodology that involved a combination of keyword searches and manual confirmation of each paper's title and abstract. We focused our search on top-tier journals in the fields of finance, economics and accounting to ensure that our review is representative of the most current and significant research. Our search is limited to articles published between 2018 and 2023, which we believe is an appropriate timeframe given Bitcoin's initial proposal in 2008 (Nakamoto, 2008) and the lag between practice and publication in top-tier journals due to factors such as data accessibility and the editorial process [1]. By employing this methodological approach, we are confident that our review provides a comprehensive and insightful analysis of the state of the art in Bitcoin research.

Through our rigorous keyword search and human confirmation process, we have compiled a total of 47 Bitcoin-related papers for review. To provide a clear overview of the distribution of these papers, Table 1 presents the number of Bitcoin-related articles published in various leading journals. Notably, the *Journal of Futures Markets* has taken the lead with 12 publications in the past five years. These articles focus primarily on market microstructure, Bitcoin derivatives and price discovery. Following closely behind are *Management Science* and the *Review of Quantitative Finance and Accounting*, which has published four papers on Bitcoin-related topics. This comprehensive analysis allows for a deeper understanding of the current state of research on Bitcoin in top-tier journals.

Figure 1 presents a breakdown of the number of Bitcoin-related articles published each year. The data reveals that scholarly interest in Bitcoin has steadily increased over time, with a sharp uptick in the number of publications since 2019. In 2018, only one paper was published on Bitcoin, but by 2021, the number had peaked at 13. This trend underscores the growing recognition of the significance of Bitcoin as a financial instrument and its potential

Journal	Total articles
Journal of Futures Markets	12
Management Science	4
Review of Quantitative Finance and Accounting	4
Journal of Empirical Finance	3
Journal of Finance	2
Review of Financial Studies	2
Pacific-Basin Finance Journal	2
Financial Management	2
Journal of Monetary Economics	2
Journal of Financial Stability	1
Journal of Financial Economics	1
Review of Finance	1
Journal of Corporate Finance	1
Journal of Money, Credit and Banking	1
Journal of International Money and Finance	1
Journal of Financial Research	1
Journal of Financial Markets	1
Financial Review	1
Financial Analysts Journal	1
Review of Economic Studies	1
Journal of Political Economy	1
American Economic Review: Insights	1
British Accounting Review	1

Source(s): Table by authors

Table 1. Bitcoin-related articles by journal

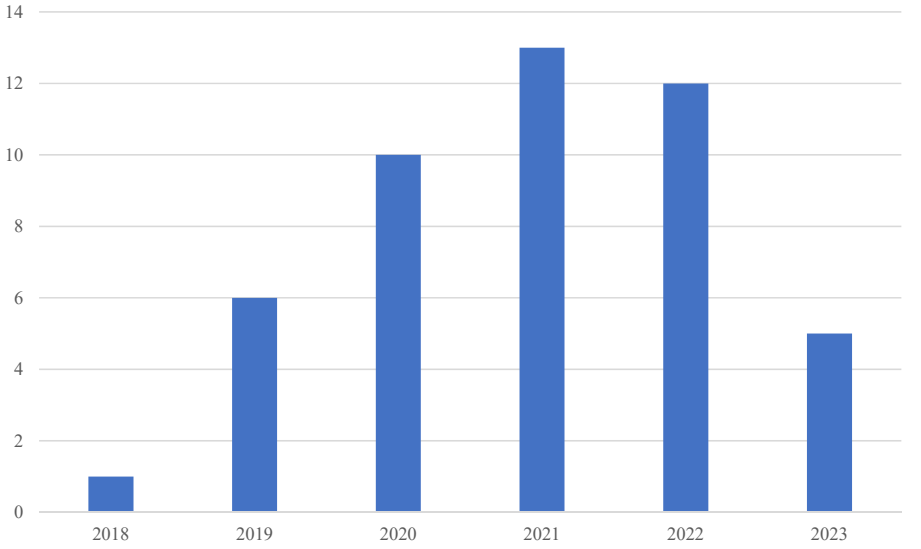

Figure 1.
Bitcoin-related articles by year

Source(s): Figure by authors

impact on the broader economy. The surge in scholarly attention may be attributed to various factors, including the notable price fluctuations of Bitcoin in 2017 and 2018, as well as the launch of Bitcoin futures by the Chicago Board Options Exchange (CBOE) and Chicago Mercantile Exchange (CME) in December 2017.

Figure 2 provides a useful categorization of the Bitcoin-related papers according to their respective topics. Among these, "trading behavior/patterns" is the most popular, with 16 papers

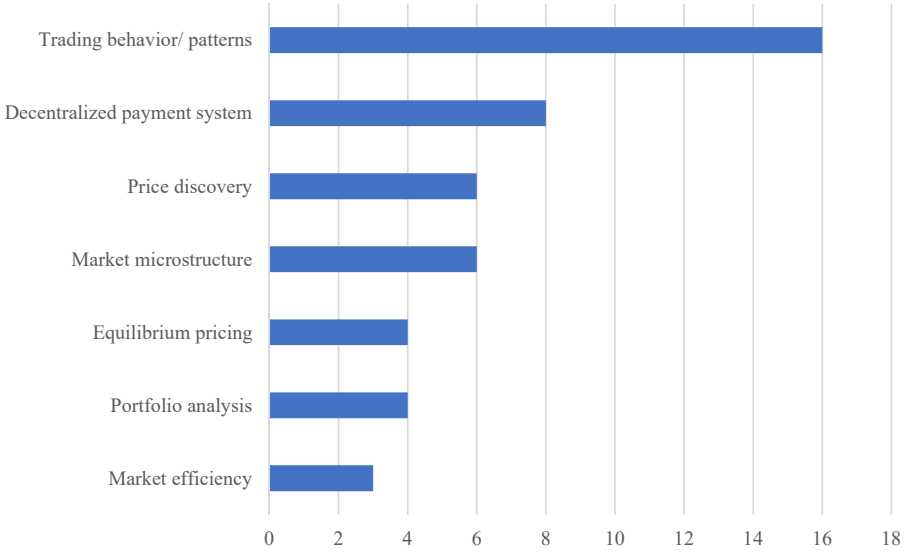

Figure 2.
Bitcoin-related articles by topics of interest

Source(s): Figure by authors

dedicated to analyzing the trading behavior of Bitcoin investors and its impact on the cryptocurrency's price characteristics. Following closely are "decentralized payment system" and "price discovery," with eight and six papers each. Researchers have also shown keen interest in market microstructure, with six papers dedicated to this topic, while four papers are focused on equilibrium pricing and portfolio analysis, respectively. Finally, three papers explore the topic of Bitcoin market efficiency, highlighting the various aspects that contribute to its performance.

Regarding the research methodologies used in academic Bitcoin-related research, our review includes both empirical and theoretical articles. Figure 3 provides an overview of the research methodologies used in the 43 Bitcoin-related articles, revealing that 34 articles use empirical methods, ten articles are pure theoretical studies and three articles combine empirical and theoretical approaches. Despite the majority of articles utilizing empirical methods, our examination indicates that theoretical articles are more common in top finance and economic journals.

Figure 4 analyzes the data sources utilized in the empirical studies. A variety of data providers were observed, with Bitcoincharts (https://bitcoincharts.com) being the most popular data source. This provider provides researchers with comprehensive Bitcoin trading data across different exchanges. More detailed transaction data can be obtained from Blockchain.com, which is the second-most popular data source. Other cryptocurrency data providers include CoinDesk, CoinMarketCap and CoinAPI. Well-known financial data providers such as Refinitiv, Bloomberg, Yahoo Finance and Wharton Research Data Services (WRDS) have also been evident in Bitcoin-related research.

Our investigation includes an examination of the exchanges referenced in Bitcoin-related research. Figure 5 provides a breakdown of the exchanges from which trading data are sourced. Bitstamp is identified as the most widely used cryptocurrency exchange, followed by Coinbase, Bitfinex, Mt. Gox and Kraken. In addition to these exchanges, research on Bitcoin incorporates data from regulated derivative markets, such as the CBOE and the CME, where Bitcoin futures and options are traded (see Figure 6).

3. Review of bitcoin-related research by topic

This section provides an overview of the literature on Bitcoin, which is presented by topic and outlined in detail in Table 2. In order to augment our analysis, we will refer to published

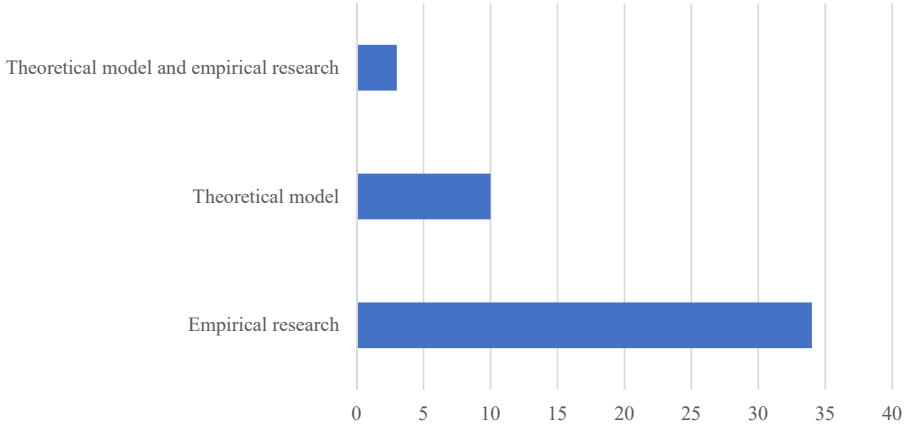

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Figure 3.
Bitcoin-related articles by research methodologies

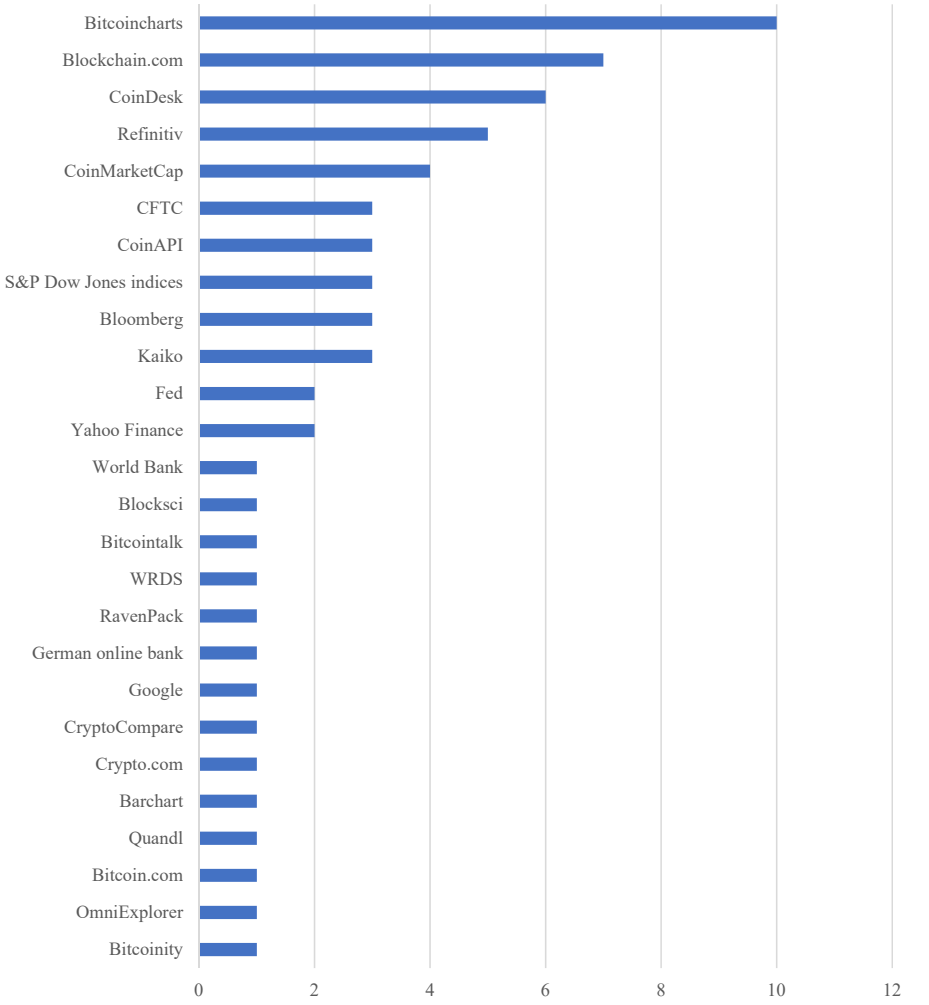

Figure 4.
Bitcoin-related articles by data sources

Source(s): Figure by authors

papers from other journals or working papers as necessary. Our review will commence by examining the literature that views Bitcoin as a currency, focusing on topics such as medium of exchange, decentralized payment system, equilibrium pricing and initial coin offerings (ICOs). We will then proceed to investigate the literature that regards Bitcoin as an asset, which encompasses topics such as market efficiency, price discovery, trading behavior/patterns, portfolio analysis and market microstructure.

3.1 Bitcoin's decentralized payment system

Leshno and Strack (2020) contend that while Bitcoin's decentralized payment system has the potential to revolutionize traditional banking, it faces numerous challenges and risks. Through the use of an axiomatic approach, the authors explore the general properties of

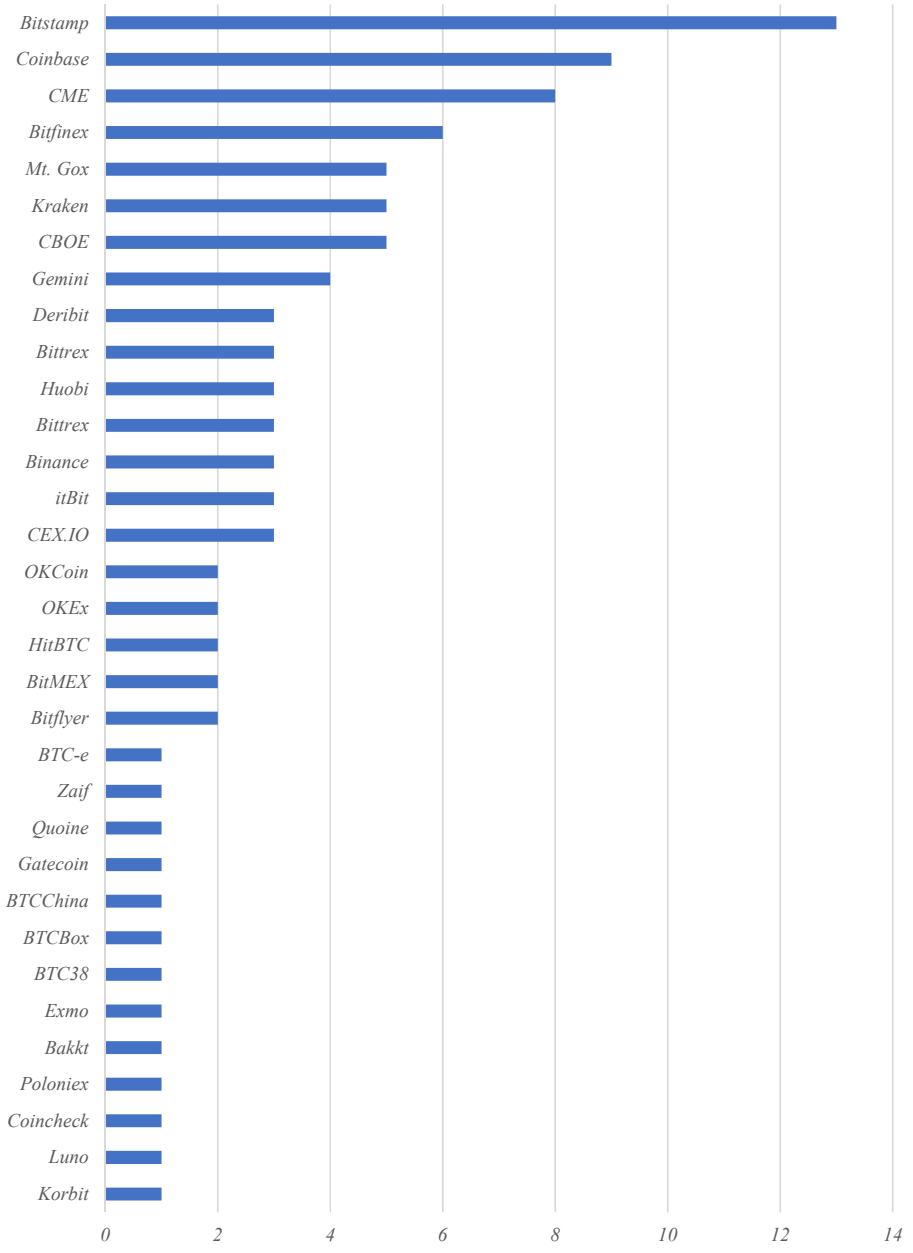

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Figure 5.
Bitcoin-related articles by exchanges

protocols and the necessary economic trade-offs. According to their research, Bitcoin's decentralized system relies on three critical axioms: the anonymity of miners, no incentives for miners to consolidate and no incentive to assume multiple fake identities. The authors

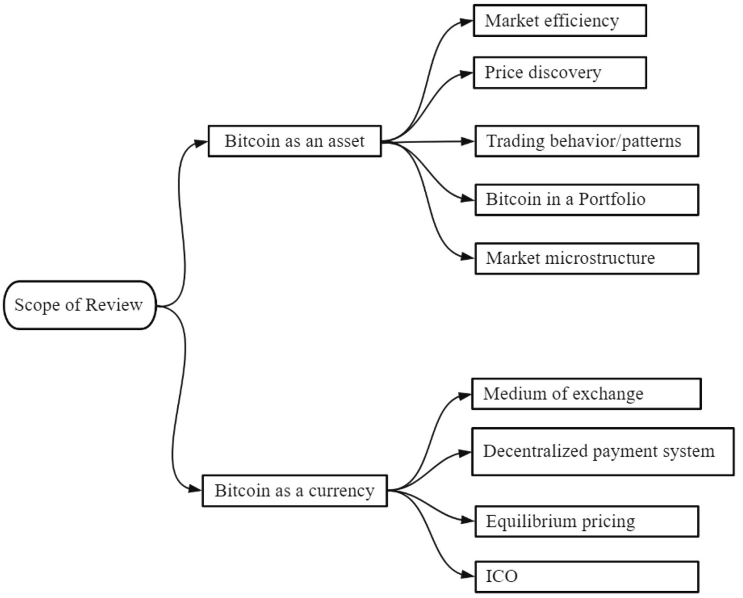

Figure 6.
Scope of review mind map

Source(s): Figure by authors

assert that any protocol with these properties must have the same reward scheme as Bitcoin, thereby revealing an impossibility result for risk-averse miners.

Transaction fees are a critical component of the stability of Bitcoin's decentralized payment system. In a game-theoretic model, Easley *et al.* (2019) provide insights into the evolution of transaction fees and their future outlook. They argue that transaction fees in the Bitcoin network have emerged due to strategic behavior from both miners and users, with factors such as the Bitcoin price, waiting times and block rewards all playing a role. Huberman *et al.* (2021) posit that the decentralized design of Bitcoin's payment system protects users from monopoly pricing in transaction fees. This is because miners, who are responsible for processing transactions and maintaining the system's integrity, compete to earn rewards in the form of newly minted bitcoins. This competition ensures that transaction fees remain low and users are not subject to monopolistic pricing. These findings align with the equilibrium model of Bitcoin mining markets proposed by Prat and Walter (2021), which highlights that miners' transaction fees or seigniorage income is limited due to the free entry of the mining market. Therefore, the decentralized design of Bitcoin has significant implications for competition and pricing in digital currencies and payment systems.

In their recent study, Kang and Lee (2022) highlight the challenges that Bitcoin currently faces as it seeks to establish itself as a viable alternative to traditional currencies. They note that the system's limitations, such as delayed settlements and congestion issues, must be taken into account when evaluating the role of Bitcoin in monetary policy. The authors also find that an economy with both money and Bitcoin has lower welfare than a money-only economy due to the congestion that occurs in the confirmation of Bitcoin transactions. In addition, they demonstrate that the welfare gap between the two economies expands as inflation rises, suggesting that Bitcoin can only compete with money as a medium of exchange in high-inflation environments. Research by Malik *et al.* (2022) also shows concern about Bitcoin's payment capabilities, which are significantly inferior to those offered by

Decentralized payment system	Easley, O'Hara, and Basu (2019)
	Foley, Karlsen, and Putniņš (2019)
	Leshno and Strack (2020)
	Huberman, Leshno, and Moallemi (2021)
	Prat and Walter (2021)
	Arnosti and Weinberg (2022)
	Kang and Lee (2022)
	Malik, Aseri, Singh, and Srinivasan (2022)
Equilibrium pricing	Schilling and Uhlig (2019)
	Cao and Celik (2021)
	Biais, Bisiere, Bouvard, Casamatta, and Menkveld (2023)
	Pagnotta (2022)
Market microstructure	Hattori and Ishida (2021)
	Brauneis, Mestel, Riordan, and Theissen (2022)
	De Blasis and Webb (2022)
	Shi (2022)
	Alexander, Choi, Park, and Sohn (2020)
	Augustin, Rubtsov, and Shin (2023)
Market efficiency	Krückeberg and Scholz (2020)
	Detzel, Liu, Strauss, Zhou, and Zhu (2021)
	Shynkevich (2021)
Price discovery	Baur and Dimpfl (2019)
	Alexander and Heck (2020)
	Alexander *et al.* (2020)
	Entrop, Frijns, and Seruset (2020)
	Hung, Liu, and Yang (2021)
	Wu, Xu, Zheng, and Chen (2021)
Trading behavior/patterns	Gandal, Hamrick, Moore, and Oberman (2018)
	Gronwald (2019)
	Jain, McInish, and Miller (2019)
	Griffin and Shams (2020)
	Hoang and Baur (2020)
	Jo, Park, and Shefrin (2020)
	Cahill and Liu (2021)
	Hachicha and Hachicha (2021)
	Koutmos and Payne (2021)
	Baur and Smales (2022)
	Hackethal, Hanspal, Lammer, and Rink (2022)
	Shen, Urquhart, and Wang (2022)
	Tsang and Yang (2022)
	Theodossiou, Ellina, and Savva (2022)
	Divakaruni and Zimmerman (2023)
	Koutmos (2023)
Portfolio analysis	Platanakis and Urquhart (2020)
	Rehman, Asghar, and Kang (2020)
	Ahmed (2021)
	Koutmos, King, and Zopounidis (2021)

Source(s): Table by authors

Table 2. Surveyed articles by category

banks. Using a game-theoretic model, they reveal that this scaling issue cannot be resolved by simply increasing the block size. Finally, the concentration of mining hardware ownership among a limited number of dominant entities, along with the centralization of mining hardware production within a single prominent entity, poses a substantial challenge to the realization of a genuinely decentralized digital currency (Arnosti and Weinberg, 2022).

These findings have important implications for policymakers and investors who are interested in the potential of digital currencies as a new form of money.

As a dark side of Bitcoin's decentralized system, Foley *et al.* (2019) found that Bitcoin has been working as a medium of exchange for illegal activities such as illegal sex and drug trade. They estimate that approximately one-quarter of bitcoin users are involved in illegal activity, and around $76 bn illegal activity per year involves bitcoin. The authors argue that cryptocurrencies are among the largest unregulated markets in the world and that they are transforming theblack markets by enabling "black e-commerce." Their techniques might be used in cryptocurrency surveillance to monitor illegal activity and its trends, responses to regulatory interventions and how its characteristics change through time. Despite this, more techniques are still needed to reduce the regulatory uncertainty about the negative consequences and risks of cryptocurrencies, thereby allowing more informed policy decisions that weigh up the benefits and costs.

3.2 Equilibrium pricing

A substantial body of literature has focused on the equilibrium pricing of Bitcoin as a currency. Biais *et al.* (2023) posit that the fundamental value of cryptocurrencies lies in their net transactional benefits, which are contingent on their computing power and network. Schilling and Uhlig (2019) derive a fundamental pricing equation, demonstrating that the price of Bitcoin in dollars follows a martingale where the expected future price of Bitcoin equals its current price. Meanwhile, Pagnotta (2022) suggests that Bitcoin's design enables the existence of multiple equilibria, where the same blockchain technology is consistent with sharply different price and security levels. The author argues that the degree of Bitcoin's acceptability imposes further constraints on its value, and a lower bound for fiat currency inflation must be met for bitcoins to command a positive price. These insights offer a nuanced understanding of the pricing dynamics of Bitcoin, shedding light on the factors that contribute to its market value and potential future trajectory.

In the realm of Bitcoin options, Cao and Celik (2021) present a comprehensive framework for valuing these options that accounts for the distinct attributes of Bitcoin as a foreign currency in a small, open economy. They demonstrate that the equilibrium prices of Bitcoin are influenced by both diffusive and jump risks of exogenous factors and provide analytical option pricing formulas utilizing Merton's model. Notably, their findings indicate that all risks contribute to increased option premiums when compared with the traditional Black–Scholes model. This study highlights the need for a nuanced approach to valuing Bitcoin options and provides insight into the unique risk factors involved in this process.

3.3 Market microstructure

Scholars have taken an interest in the market microstructure of Bitcoin, not only in its spot market but also in its futures and options markets. While the established microstructure theory applies to cryptocurrency markets, differences still exist between traditional markets and these markets. Bitcoin exchanges are highly liquid, with bid-ask spreads that are lower than those of large-cap stocks on equity exchanges. According to Brauneis *et al.* (2022), Bitcoin liquidity is driven by blockchain-specific and exchange-specific (local) factors that are unique in cryptocurrency markets. As a result, liquidity in cryptocurrency markets is decoupled from the liquidity of other asset classes, such as equities and foreign exchange. This suggests that the market microstructure of Bitcoin warrants further examination to fully understand its unique characteristics and implications for investors.

In recent years, there has been a growing interest in the Bitcoin futures market among researchers, with studies focusing on identifying and exploiting arbitrage opportunities. Hattori and Ishida (2021) observe that Bitcoin market crashes provide a profitable

opportunity for arbitrage, which dissipates over time after the launch of Bitcoin futures, thereby increasing market efficiency. Similarly, De Blasis and Webb (2022) identify cash-and-carry arbitrage opportunities during market dislocations and suggestive evidence of spillover effects between quarterly and perpetual futures. These findings highlight the potential for profitable trading strategies in Bitcoin futures markets while also emphasizing the importance of market efficiency in ensuring that arbitrage opportunities are short-lived. In addition, Shi (2022) demonstrates that the trading activity and sentiment of speculators and retailers, as well as macroeconomic variables, can significantly predict the subsequent changes in Bitcoin futures prices across different time horizons. Overall, these studies shed light on the dynamics of the Bitcoin futures market and provide insights for investors seeking to capitalize on profitable trading opportunities.

3.3.1 Price discovery. Efficient price discovery and market efficiency are crucial for the functioning of financial markets, including Bitcoin. Studies have investigated the role of futures, swaps and spot exchanges in Bitcoin price discovery and market efficiency. Alexander and Heck (2020) and Alexander *et al.* (2020) find that Bitcoin futures and swaps traded on unregulated exchanges, such as Huobi, OKEx and BitMEX, lead prices on major Bitcoin spot exchanges. Conversely, Baur and Dimpfl (2019) and Alexander and Heck (2020) suggest that major spot exchanges play a more important role in price discovery than regulated CME futures. Wu *et al.* (2021) employ the fractional cointegrated vector autoregressive (FCVAR) method and provide evidence that the CME futures market dominates the Bitcoin price discovery process. Furthermore, the COVID-19 pandemic has led to the spot market taking over the price discovery leadership role, according to Wu *et al.* (2021). Augustin *et al.* (2023) demonstrated that the introduction of futures makes spot prices more informative. contributes to the price efficiency, market quality and liquidity of Bitcoin. These findings provide insights into the complex interplay between Bitcoin spot and futures markets and the impact of exogenous events on Bitcoin market efficiency.

Scholars have shown a keen interest in understanding the factors that determine Bitcoin's price discovery. A positive causal effect has been established between market quality and price discovery, which is attributed to a decrease in trading costs and an increase in trading activity (Entrop *et al.*, 2020). On the other hand, different trading activities also impact the price discovery of futures markets. Hedgers' trading activity has a positive correlation with the price discovery of futures markets, while retailers' trading activity negatively correlates with it (Hung *et al.*, 2021).

3.3.2 Market efficiency. The efficiency of Bitcoin markets remains a topic of interest among scholars, despite their high trading volume and liquidity. Shynkevich (2021) finds evidence of significant return predictability through technical analysis in Bitcoin spot markets, indicating that the markets are not weak-form efficient. However, the introduction of Bitcoin futures leads to a dramatic decline in the forecasting ability of technical analysis, suggesting an increase in market efficiency.

Detzel *et al.* (2021) further demonstrated that the ratio of Bitcoin prices to their moving averages can predict daily Bitcoin returns. Krückeberg and Scholz (2020) identified potential arbitrage opportunities, indicating that Bitcoin markets are not fully efficient. Their long-term analyses suggest that Bitcoin market inefficiency has increased over time, highlighting the need for further research on market efficiency and the factors that may affect it.

3.4 Trading behavior/patterns

Our review of the literature on trading behavior and patterns in the Bitcoin market has yielded 16 articles that investigate either the behavior of investors or its impact on the price of Bitcoin. Empirical evidence reveals that Bitcoin exhibits unique patterns in its pricing dynamics. For instance, Jain *et al.* (2019) show that there is a significant level of synchronous

trading volume across Bitcoin-fiat currency pairs on exchanges worldwide, with a single common factor accounting for 68% of the variance in hourly volume.

Gronwald (2019) observes that Bitcoin shares some characteristics with exhaustible resource commodities and can be considered a commodity due to its fixed total number and known circulation, which is consistent with the findings of Divakaruni and Zimmerman (2023) that the increase in household wealth will lead to more buying and holding of Bitcoin. Established pricing theories for exhaustible resource commodities can be applied to Bitcoin, according to the author. Moreover, the market is susceptible to price manipulation, as evidenced by the suspicious trading activity that likely caused the unprecedented spike in the USD-BTC exchange rate in late 2013, which led to the fraudulent acquisition of 600,000 bitcoins worth $188 m on the Mt. Gox exchange (Gandal *et al.*, 2018). ICO cases reveal that while imitation may yield some benefits in the short term, it is not a sustainable strategy for long-term success, as Bitcoin copycats earn higher returns initially but have a lower survival rate in the long run (Cahill & Liu, 2021). Finally, Griffin and Shams (2020) find that purchases with Tether were timed following market downturns and resulted in significant increases in Bitcoin prices, indicating a strong relationship between the two cryptocurrencies.

In the literature on Bitcoin markets, it is widely acknowledged that the participants in these markets differ significantly from those in traditional asset markets. Studies have explored the trading behaviors of these investors and their impact on Bitcoin price dynamics. Hackethal *et al.* (2022) have found that cryptocurrency investors tend to hold risky portfolios and exhibit investment biases, while also being more likely to employ heuristics from technical analysis. Koutmos and Payne (2021) have developed an intertemporal regime-switching asset pricing model that demonstrates the existence of different types of traders in Bitcoin markets, including mean-variance optimizers, speculators and fundamentalists. This paper suggests that behavioral heterogeneity is a significant driver of Bitcoin price behavior.

Tsang and Yang (2022) have examined the network structure of Bitcoin investors and found that highly connected addresses tend to have higher returns than less connected addresses, implying that investors who are well-connected may have access to valuable information or coordinate their trading strategies more effectively. These findings illustrate the importance of understanding the unique characteristics of Bitcoin market participants and their impact on price dynamics.

The identification and exploitation of patterns in Bitcoin markets represent a promising avenue for generating considerable profits. In support of this view, Baur and Smales (2022) argue that leveraged money traders, who are typically the largest traders and hold net short positions, possess market timing ability in the Bitcoin futures market. Specifically, they adjust their short positions and other trader types subsequently follow this "smart money" in adjusting their own positions in subsequent periods. The findings suggest that it is possible to trade profitably based on such strategies.

Additionally, Shen *et al.* (2022) provide evidence that the first half-hour return positively predicts the last half-hour return in Bitcoin and that intraday momentum-based trading generates substantial economic gains in terms of market timing and asset allocation. The authors further demonstrate that this is particularly true during periods of market downturn in Bitcoin. Taken together, these findings highlight the potential for skilled traders to generate profits by exploiting patterns in Bitcoin markets.

3.4.1 Bitcoin & sentiment. The interplay between investor sentiment and bitcoin prices has emerged as a crucial topic of interest for market participants and scholars alike. Understanding this relationship can inform investors' decisions about buying and selling bitcoin. In a sentiment-dependent factor model, Jo *et al.* (2020) note that Bitcoin shares characteristics with high sentiment beta stocks, particularly small startup firms with high growth potential. The study reveals that Bitcoin's expected returns are low when sentiment, as measured by the Volatility Index, is high, while expected returns are high when sentiment is low.

Meanwhile, Koutmos (2023) leverages a unique dataset of intraday buy and sell orders from 2015 to 2020 to construct a proxy for daily investor sentiment and quantify the sentiment-return relationship across the conditional distribution of bitcoin price changes. This paper provides evidence that rising investor sentiment is positively linked to price increases in bitcoin, while declining sentiment is linked to price decreases. These findings have important implications for investors seeking to capitalize on opportunities in the volatile world of bitcoin trading.

3.4.2 Volatility, skewness and kurtosis. In addition to its level, the high-order moment characteristics of the Bitcoin price, such as volatility, skewness, and kurtosis, are crucial in understanding the behavior of this digital asset. Hachicha and Hachicha (2021) utilize stochastic volatility models to demonstrate that the volatility pattern of Bitcoin is similar to that of traditional stock market indices. Similarly, Hoang and Baur (2020) examined the effectiveness of implied volatility (IV) calculated from Bitcoin option data in predicting short-term and long-term Bitcoin volatility. The study finds that IV is less accurate in predicting short-term volatility (1 day ahead) than other forecasting models but is superior in predicting long-term volatility (7, 10 and 15 days ahead).

However, combining IV and model-based forecasts leads to the highest accuracy for all forecasting horizons, suggesting that the Bitcoin options market provides unique information for predicting Bitcoin volatility. Theodossiou *et al.* (2022) note that the distribution of Bitcoin is leptokurtic, and the true price of risk can be obtained by considering the effect of skewness–kurtosis. These findings underscore the importance of incorporating high-order moment characteristics in modeling and forecasting Bitcoin price movements.

3.5 Bitcoin in a portfolio

Previous research has provided substantial evidence for the inclusion of Bitcoin in traditional portfolios of stocks and bonds. Platanakis and Urquhart (2020) demonstrate that adding Bitcoin to a traditional portfolio results in significantly higher risk-adjusted returns. Additionally, during periods of economic uncertainty, cryptocurrencies, particularly Bitcoin, can serve as effective minimum-variance hedging instruments, as shown by Koutmos *et al.* (2021). The study suggests that the inclusion of Bitcoin in a well-diversified portfolio may offer risk reduction benefits and improve the overall performance of the portfolio.

The relationship between Bitcoin and traditional stock markets has been the subject of numerous studies. Rehman *et al.* (2020) provide evidence that certain Islamic indices exhibit time-varying risk dependence with Bitcoin, leading to potential diversification benefits from adding these indices to a portfolio along with Bitcoin. The study finds that such benefits are more pronounced during bearish market conditions. Additionally, Ahmed (2021) investigates the reaction of Sharia-compliant stocks to Bitcoin's realized volatility in various market states. The study reveals that these stocks exhibit different reactions to positive and negative intraday returns of bitcoin in bear, normal and bull market conditions. Understanding the relationship between Bitcoin and stock markets is essential for investors seeking to diversify their portfolios and mitigate risk.

4. Discussion and conclusion

The emergence of Bitcoin and blockchain, first proposed by Nakamoto (2008), has resulted in unparalleled and rapid growth in cryptocurrency markets, generating significant interest both in the industry and academia. Despite the lack of a comprehensive agreement on the true nature of Bitcoin, there has been a considerable surge in research pertaining to Bitcoin and blockchain, reflecting the increasing importance of these technologies.

Our literature review is centered on a selection of top-tier finance, economic and accounting journals, in which we identified and examined Bitcoin-related papers published over the past five years. Specifically, we have focused on papers that recognize Bitcoin as a currency, and our analysis highlights two main areas of inquiry. Firstly, these papers investigate the decentralized payment system underpinning Bitcoin, examining topics such as system design, welfare analysis, transaction fees and the medium of exchange function. Secondly, these papers explore the pricing of Bitcoin in equilibrium, which involves developing mathematical models that establish the equilibrium price of Bitcoin and its associated options.

Our review encompasses the latest research on Bitcoin as an asset, which investigates its market microstructure, the trading behavior of investors, price patterns and portfolio analysis. The literature review explores the extensive research on Bitcoin's market microstructure, which includes the analysis of its liquidity, derivative markets, price discovery and market efficiency. Furthermore, several studies have focused on the trading behavior and patterns of Bitcoin, considering factors such as investors' characteristics, market sentiment and price volatility. Additionally, the review examines the advantages of including Bitcoin in a portfolio, which have been demonstrated by several empirical studies. Overall, these papers contribute significantly to our understanding of Bitcoin as a financial asset and its potential impact on the financial industry.

Despite the fact that the current state of research on Bitcoin lacks a cohesive framework and suffers from a lack of connectivity, there are several research areas that have emerged as important topics for further exploration. The first area concerns the decentralized payment system and the equilibrium price of Bitcoin. Much of the existing research on decentralized payment systems is based on the Bitcoin payment system and thus, future studies should explore the optimization of decentralized payment systems, their relationship with centralized payment systems and the regulatory challenges they face. While some pricing models are moderately accurate, they still rely on overly stylized assumptions. Future research should focus on relaxing these assumptions to determine the long-term equilibrium price of Bitcoin. As Bitcoin continues to gain popularity and usage, scalability remains a critical concern. Future research may focus on exploring and developing solutions to improve transaction throughput, reduce fees, and enhance the overall scalability of the Bitcoin network. Investigating user experience, usability and user-centric design to enhance the accessibility and user-friendliness of Bitcoin for a broader audience should be a significant direction for future research as well.

The second research agenda in the Bitcoin literature is centered on the market microstructure and trading patterns of Bitcoin. Our literature review highlights a growing interest in investigating the characteristics of Bitcoin price and retail investors, Bitcoin derivative markets, price discovery and market efficiency. Nonetheless, recent studies suggest that the statistical relationships between Bitcoin prices and other factors are unstable over time (Koutmos & Payne, 2021). Given that cryptocurrencies were initially popularized among retail investors before becoming well-known on Wall Street, examining the persistence of behavioral or market anomaly effects may be important. For instance, future studies may use data sources on direct cryptocurrency investments and have a longer time horizon to examine whether households perpetuate investment biases in Bitcoin. Additionally, once a basic understanding of what risk factors can be hedged with cryptocurrencies has been established, the next step would be to investigate whether the technological underpinnings of cryptocurrencies, such as their individual mining protocols or rules that control their money supplies, also play a role in determining the effectiveness of hedging. To advance new theoretical or empirical research, studies that develop analytical frameworks or empirical data to comprehend these problems are crucial.

The regulation of Bitcoin is a research agenda that presents numerous prospects but has not been extensively studied in finance and economics. From a legal perspective, the regulation of Bitcoin is necessary to prevent market failure, technology misuse that leads to rights violations and an uneven distribution of benefits. Welfare concerns must be considered to evaluate the impact of Bitcoin. While Bitcoin and blockchain technology present opportunities, they could also pose risks to investors, consumers, financial stability and integrity and therefore, require regulation. The category of Bitcoin regulation encompasses a broad range of topics, such as consumer financial protection, financial risk associated with fraud involving cryptocurrencies, participation in ICOs and the relationship between cryptocurrencies and criminal activity. As Foley *et al.* (2019) demonstrate, Bitcoin has been utilized for criminal purposes, such as trading in illegal sex and drugs, made possible by Bitcoin's decentralized structure. Policymakers need to strike a balance between exploiting the benefits of blockchain and Bitcoin and mitigating their potential threats to the financial system. Researchers may explore techniques such as zero-knowledge proofs, secure multi-party computation and improved encryption methods to strengthen the privacy and security of Bitcoin transactions. Moreover, future research may delve into designing effective governance models for decentralized cryptocurrencies and analyzing the impact of regulatory frameworks on Bitcoin's adoption and ecosystem.

In conclusion, it is important to acknowledge the limitations of this study. Our literature review, while extensive, was limited to leading journals in finance, economics and accounting, which may reflect the editors' perspectives on the fundamental issues surrounding Bitcoin and blockchain. Additionally, the articles under consideration primarily focus on the United States of America, while Bitcoin and blockchain have become an international phenomenon that affects other significant markets such as Europe, India and other developing nations. Despite these limitations, this review provides an essential starting point for researchers who are unfamiliar with the interdisciplinary field of Bitcoin and blockchain research. It is vital to recognize the potential value of Bitcoin-related research in furthering knowledge on the interaction among the disciplines of finance, economics, law and technology. Therefore, future researchers should approach this field using innovative and interdisciplinary methods to expand our understanding of these complex and evolving technologies.

Note

1. To explain it further, we selected 2018 as the initial point for our literature search due to the following reasons: Firstly, Bitcoin witnessed a notable upsurge in growth during 2017, generating considerable interest from both the academic and industrial sectors. Secondly, the period subsequent to 2017 witnessed increased institutionalization and regulation of Bitcoin transactions, coupled with the introduction of Bitcoin derivatives, leading to enhanced market quality and efficiency. Lastly, the analysis of annual publications in Figure 1 indicates a substantial growth in research dedicated to Bitcoin within the economic and management category journals since 2018.

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