Systematic Review

Non-Fungible Token: A Systematic Review and Research Agenda

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Abstract: The popularity of the Non-Fungible Token (NFT) has risen rapidly since 2020, becoming one of the most popular applications in the Fintech field. However, there has so far been no attempt to perform a systematic review in this new area. Considering the items of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), this paper conducts a systematic review of the research work on NFT, published in journals indexed at the Web of Science and ScienceDirect until April 2022. The results reveal that there are 13 published articles in the targeted journals and they are mainly focused on the asset pricing area. The research gaps identified in the literature also can be the opportunity for future study. Thus, we lay down the research agenda for the future in several important but unanswered fields related to asset pricing, tokenomics, and risk and regulation.

1. Introduction

As a special type of cryptocurrency, NFT is widely used in collectibles, artwork, gaming, and other markets. With crypto assets re-entering the bull market in late 2020, NFT has also seen explosive growth, becoming the most popular Fintech application and crypto asset in 2021. According to CryptoSlam[1], one of the NFT market statistics, the market value of NFTs has fallen from its highest point but still remains active. The number of unique purchasers, in particular, has continued to grow, seemingly signaling that the story has not yet stopped (see Figure 1).

Although CryptoKitties, a game based on the Ethereum network, first drew attention to NFT products in late 2017 (Wang et al. 2021), the explosive growth of the entire market is closely related to the emergence of COVID-19. Existing studies have found that cryptocurrency market liquidity increased significantly after the WHO's identification of a worldwide pandemic (Corbet et al. 2022). At the same time, investors were flooding into various cryptocurrency markets, including NFT, due to the significant decrease in global market interest rates (Aharon and Demir 2021; Sarkodie et al. 2022). Significantly, the lockdown measures taken in the pandemic boosted digital engagement and further stimulated the growth of NFT. In addition to gaining widespread attention from investors and enthusiasts, academic research around NFT has also gradually emerged. However, compared to the extensive literature on Bitcoin and other cryptocurrencies, the research on NFT is relatively minor (Maouchi et al. 2021; Bao and Roubaud 2022). On the one hand, NFT is still in the early stages of development, with both great potential and uncertainty; this also means that there is not enough material or data for research to support a large number of studies. On the other hand, it is also because NFT is a cross-cutting area of research. It requires scholars to have broader knowledge accumulation and understanding in multiple areas. Similar to the research on cryptocurrencies, there are three main areas of

research for NFT: computer science; economics and finance; and law and other areas (Yue et al. 2021).
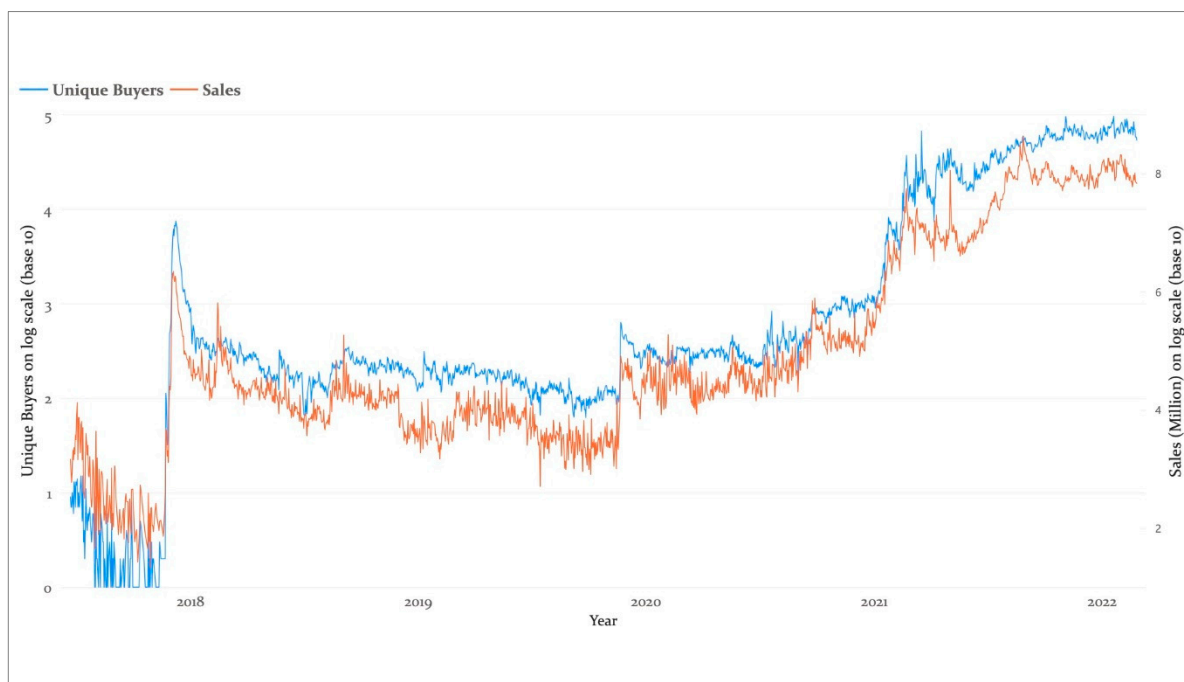

Figure 1. NFT Index from CryptoSlam (As of 25 February 2022).

In the light of the experience of cryptocurrency development, it is imperative to maintain research on NFT. Some scholars believe that NFT will grow at a rate and to a degree similar to cryptocurrencies and will constitute a more important approach to blockchain technology, further exploiting the potential of decentralized, distributed ledgers (Chohan 2021). Especially in the field of economics and finance, NFT is deemed the most likely to be an innovation with disruptive impact, in view of the existing research and development trend. First, by introducing digital scarcity, NFT further expands the application scenarios of blockchain technology (Franceschet 2021), especially by providing a new form of ownership that gives value to digital assets (Chalmers et al. 2022). Second, NFT helps create a new economic ecosystem that energizes content creators. Not only does it allow content creators to enter new markets with previously high barriers, in which they can sell material such as artwork, music, or images, but it also enables them to adjust mart contracts or reduce third-party players, increasing efficiency and cutting costs (Wilson et al. 2021). Finally, for regulatory policy makers, NFT has exacerbated new challenges such as speculation, fraud, and high volatility (Maouchi et al. 2021). This implies that balancing potential and risk becomes critical.

The purpose of this paper is to analyze the state of the literature on NFT, with a focus on the economic and finance domains, which can provide both a direct contribution to newcomer researchers to help them quickly understand the progress in this field, as well as suggestions to improve the validity and reliability of future research. Specifically, we present a systematic review of the published literature about NFT. The fundamental characteristic that differentiates systematic reviews from other types of reviews concerns the methodical procedures involved in the synthesis of findings, which provide unbiased searches with a higher degree of efficiency and quality (Pahlevan-Sharif et al. 2019). More specifically, our study is based on PRISMA (Liberati et al. 2009), which is a protocol to conduct systematic reviews consisting of a 27-item checklist and a four-phase flow diagram (see Figure 2). The reason behind the choice of PRISMA (Liberati et al. 2009) over other existing protocols lies in the recognition of its comprehensiveness, its ability to improve

the transparency and accuracy of literature reviews, as well its use in several disciplines worldwide (Pahlevan-Sharif et al. 2019).
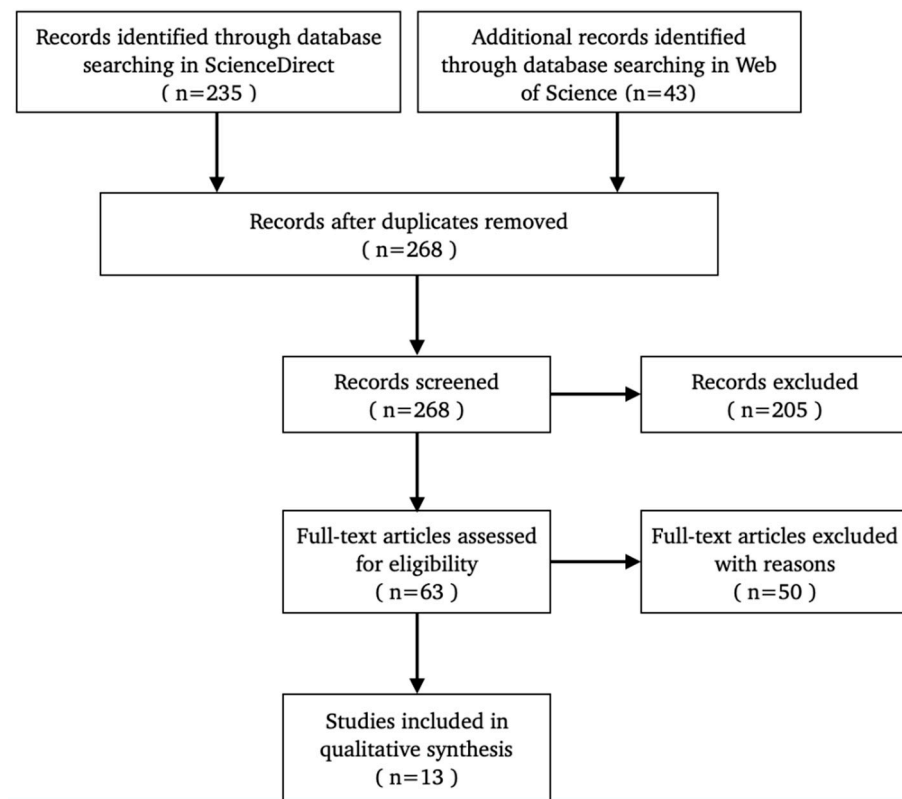
Figure 2. Flow chart of study selection process.

The results show that only 13 papers on NFT have been published in influential economics and finance journals, indicating a gap between academic research and practice. In addition, the lack of theoretical research on NFT is quite apparent. Through further analysis of published articles, such as the research methods, the scope of studies, and research trends in general, we propose a future research agenda focused on three major areas: asset pricing, tokenomics, and risk and regulation.

The remainder of this paper is organized as follows: Section 2 presents the methodology and Section 3 describes the results of the review; Section 4 discusses the future direction for NFT research; finally, conclusions and limitations are provided in Section 5.

2. Method

2.1. Inclusion and Exclusion Criteria

Based on the requirements of PRISMA and the purpose of this study, our inclusion and exclusion criteria are (1) literature published in Australian Business Deans Council (ABDC) journals was selected for the reason that this is more comprehensive than other journal ranking lists, such as Social Science Citation Index (SSCI), Association of Business Schools (ABS) and Scopus (Pahlevan-Sharif et al. 2019); (2) the field to which the study belongs is mainly economics and finance; (3) the main content of the study is NFT, excluding studies that are briefly mentioned or analyzed; and (4) the type of article is not restricted, including all empirical and descriptive articles; (5) since the last search was run on April 4, 2022, articles published after that date will not be covered in this article.

2.2. Search Strategy and Selection Process

We utilized Web of Science and ScienceDirect to search for articles published in the selected journals containing the term "non-fungible token" in their titles, abstracts, and/or

keywords, while no date and language restrictions were imposed. The reason for not selecting "NFT" as a research keyword is that it is not a generic term and can be easily confused with "Neurofibrillary tangle", "Neurofeedback training", "Nitrofurantoin", etc., which affects the efficiency and accuracy of the work, and most of the articles that focus on NFT will have the complete name in the text. In addition, the basis search results using "non fungible token" in the two databases mentioned above are the same.

The literature search against the databases and search engines resulted in 278 records. To obtain a refined sample for the literature review, we first excluded duplicate articles by title, and then excluded articles that were disqualified for inclusion by reading the abstracts. Finally, we removed the studies that did not satisfy the criteria by carefully screening the full texts of the remaining papers.

3. Results

In the end, a total of 13 studies from five journals (11 papers from A, and 2 from B journals in the ABDC master journal list) remained in the final sample. The steps implemented during the sample construction are shown in Figure 2.

According to the purpose of our study and the suggestion in PRISMA's checklist (Item #17 the study characteristics), we report the characteristics of reviewed papers in Table 1.

Table 1. Summary of the identified literature.

Author(s) (Year)	Journal Names (ABDC Rating)	Research Field	Methodology	Types of NFTs Analyzed
Chohan and Paschen (2021)	Business Horizons (B)	Business	Descriptive Research	General type
Wilson et al. (2021)	Business Horizons (B)	Business	Concept/Model Building	General type
Dowling (2022a)	Finance Research Letters (A)	Asset Pricing	Empirical Testing	Decentraland
Dowling (2022b)	Finance Research Letters (A)	Asset Pricing	Empirical Testing	CryptoPunk, Decentraland, and Axie Infinity
Vidal-Tomás (2022)	Finance Research Letters (A)	Asset Pricing	Empirical Testing	General type
Umar et al. (2022)	Finance Research Letters (A)	Asset Pricing	Empirical Testing	General type
Aharon and Demir (2021)	Finance Research Letters (A)	Asset Pricing	Empirical Testing	General type
Karim et al. (2022)	Finance Research Letters (A)	Financial Risks	Empirical Testing	Theta, Tezos, Enjin Coin, Decentraland and Digibyte
Maouchi et al. (2021)	Finance Research Letters (A)	Asset Pricing/Financial Risks	Empirical Testing	Theta, Enjin Coin, and Decentraland
Ko et al. (2022)	Finance Research Letters (A)	Asset Pricing	Empirical Testing	Sandbox, Decentraland, and Cryptopunks
Chalmers et al. (2022)	Journal of Business Venturing Insights (A)	Business	Descriptive Research	General type
Yousaf and Yarovaya (2022)	Global Finance Journal (A)	Asset Pricing	Empirical Testing	Theta, Tezos, Enjin Coin, DigiByte, and Decentraland
Haaften-Schick and Whitaker (2022)	Journal of Cultural Economics (A)	Business	Descriptive Research	General type

3.1. Literature Distribution

The results show that all published papers are from 2021, with the majority (about 77%) arising in 2022, which is in line with the NFT development trend, which is also the same as the research in the cryptocurrency field (Yue et al. 2021). In addition, according to the ABDC ranking system, higher-rated journals published more papers and eight papers came from the journal of Finance Research Letters, which published 97 papers on cryptocurrencies from 2013–2020 (Yue et al. 2021). Finally, regarding the research methods and areas of the articles, there are nine empirical studies (about 70%) among the reviewed paper, most of which can be classified as studies on asset pricing, including the pricing efficiency of the market, the connection with other crypto assets and traditional assets, etc. In contrast, the rest of the articles explore a broader range of content, including, but not limited to, the functions and potential of NFT, which we will cover in detail in the subsequent analysis.

3.2. Types of NFTs

"Non-fungible" literally and technically indicates that each NFT is a unique and indivisible token, hence theoretically there should be an infinite number of NFT types. The researchers usually classify NFTs into six major categories according to the scenarios in which they are most widely used: art, collectibles, games, metaverse, other, and utility (Dowling 2022b; Bao and Roubaud 2022).

For the descriptive researches reviewed in this paper, all NFTs are discussed as a whole and refer generally to digital assets whose ownership is recorded on the blockchain and are tradable. In addition, empirical studies are more focused, usually selecting one or a few NFTs with higher liquidity and reputation to investigate (Dowling 2022b; Ko et al. 2022). As one of the most popular blockchain-based virtual game platforms, Decentraland most frequently appeared in the papers reviewed. In brief, Decentraland is a virtual world in which people can create and trade virtual lands tokenized by NFT. Based on the properties of NFT, each piece of land is guaranteed to be unique and the transactions can be traced. At the same time, Decentraland issues its own fungible token, MANA, as an intermediary for the exchange market and the governance coin for the ecosystem. Accordingly, existing research around Decentraland has explored both the NFT trading market (Dowling 2022a, 2022b) and the relationship with other assets based on MANA prices (Maouchi et al. 2021; Karim et al. 2022).

3.3. Content Analysis of Empirical Studies

Table 2 reports the title, method and sample interval of included empirical studies. Overall, these papers focus on the NFT market, examining the market efficiency, spillover effects with mainstream cryptocurrencies, and pricing models through transaction data of representative NFT products. Specifically, the main conclusions drawn include that (1) NFT markets may have different price dynamics from pure cryptocurrencies (Maouchi et al. 2021), and scholars have different views on the volatility correlation between the two; for example, Karim et al. (2022) find a strong volatility correlation between NFT markets and cryptocurrency markets, and Bitcoin is an important determinant in predicting the volatility of NFT assets (Yousaf and Yarovaya 2022), but Dowling (2022b) demonstrates that the volatility transmission between the pair is low, although there is co-movement. (2) The empirical analysis of gold, bonds, stocks, oil, and the US dollar index reveals only weak interactions between NFT and traditional financial assets (Aharon and Demir 2021; Umar et al. 2022), and which can be used to construct portfolios with higher risk-adjusted capacity (Ko et al. 2022). (3) There is little spillover across NFT markets (Dowling 2022b). NFT markets are inefficiently priced and even subject to bubbles, manipulation, or other fraudulent practices (Maouchi et al. 2021; Dowling 2022a; Vidal-Tomás 2022).

Table 2. Content analysis of empirical literature reviewed.

Author	Title	Method	Sample Interval
Dowling (2022a)	Fertile LAND: Pricing non-fungible tokens	AVR, AP and DL consistent test[2]	March 2019 to March 2021
Dowling (2022b)	Is non-fungible token pricing driven by cryptocurrencies?	Volatility spillover methodology, Wavelet coherence	March 2019 to March 2021
Vidal-Tomás (2022)	The new crypto niche: NFTs, play-to-earn, and metaverse tokens	Pearson and Kendall correlations, BSADF[3], Wavelet coherence	October 2017 to October 2021
Umar et al. (2022)	COVID-19 impact on NFTs and major asset classes interrelations: Insights from the wavelet coherence analysis	Wavelet coherence	June 2017 to October 2021
Aharon and Demir (2021)	NFTs and asset class spillovers: Lessons from the period around the COVID-19 pandemic	TVP-VAR[4]	January 2018 to June 2021
Karim et al. (2022)	Examining the interrelatedness of NFTs, DeFi tokens and cryptocurrencies	Quantile var, Volatility spillover methodology	March 2018 to October 2021
Maouchi et al. (2021)	Understanding digital bubbles amidst the COVID-19 pandemic: Evidence from DeFi and NFTs	Logit, Probit, Tobit, and Linear regression	From the first trading day for each cryptoasset to March 2021
Ko et al. (2022)	The economic value of NFT: Evidence from a portfolio analysis using mean–variance framework	Pearson correlations, Gerber Statistic, Volatility spillover methodology, TVP-VAR	December 2019 to June 2021
Yousaf and Yarovaya (2022)	Static and dynamic connectedness between NFTs, Defi and other assets: Portfolio implication	TVP-VAR, BEKK-GARCH	May 2018 to July 2021

3.4. Content Analysis of Descriptive Research

Relative to empirical studies, the rest of the literature also discusses the commercial potential, impact, and risks of NFT, including (1) NFT will change the way businesses operate and is already having a disruptive impact in industries such as art, sports, law, escrow, ticketing, digital collectibles, gaming, and crypto, and could extend to real estate, vehicles, financial markets, and the entire digital world in the future (Chohan and Paschen 2021; Wilson et al. 2021). (2) Chalmers et al. (2022) argue that while NFT has the potential to support various new forms of digital ownership and creative sponsorship, market activity has so far been dominated by speculative transactions. If it cannot be further optimized and improved, it faces the risk of failure. (3) In the art sector, the entry of NFT has transformed the resale market, creating a dramatic change in how individual artists and groups are funded (Haaften-Schick and Whitaker 2022).

4. Suggestions for Further Research

An essential reason for using a systematic review in this paper is that it can provide unbiased searches with a higher degree of efficiency and quality by establishing the focus of the study, the research strategy and the inclusion/exclusion criteria (Liberati et al. 2009; Pahlevan-Sharif et al. 2019). The search results based on the PRISMA protocol objectively capture the large gap between the current research on NFT with its hot market atmosphere and the extensive studies in the cryptocurrency field. According to Yue et al. (2021), between 2013 and 2020, scholars published nearly 2000 articles on cryptocurrencies, including more than 1000 in the field of Finance and Economics. In future research, we will further accommodate NFT literature that was excluded from this review but is of

great importance, especially theoretical articles, as well as common knowledge from the cryptocurrency field, suggesting several broad topics for future NFT research.

4.1. Asset Pricing

Although research in this area is already very active, there is still room for greater output and clearer paths. The first is about whether there is a basic model that drives NFT price determination. There are more NFT markets than just a single market to explore and analyze in depth (Dowling 2022a). Additional factors could be considered for inclusion in the analysis, such as market sentiment, economic and financial policy uncertainty, and pure volatility indicators, etc. (Umar et al. 2022). The second is to clarify the correlation between NFT and other cryptocurrencies and further uncover the common factors driving both markets (Dowling 2022b), including the Volatility Index (VIX), economic policy uncertainty (EPU), Consumer Confidence Index (CCI), and Consumer Sentiment Index (CSI) (Aharon and Demir 2021). Finally, as an increasing number of investors are likely to include NFT in their portfolios, its relationships with a broader range of assets, and the resulting impacts, can be further examined

4.2. Tokenomics

Tokenomics is an economic system based on the tokenization process, which includes the token features, the monetary policy, and users' incentive systems (Freni et al. 2022). In tokenomics, each participant is rewarded with tokens for their contributions and continues to use tokens to pay for the consumption of goods or services. Compared with the resource allocation method of the traditional market economy, tokenomics is actually the economic behavior of the token allocation method. Depending on the actual function, tokens are categorized into three main groups (Savelyev 2018; Howell et al. 2020): the first type are Payment tokens, commonly referred to as coins, with Bitcoin and Ethereum being typical examples. Moreover, they are all indivisible and non-unique, contrary to the concept of NFT, denoted as fungible tokens (FTs). The second type are Utility tokens, which are widely used and intended to provide digital access to an application or service. The last type are Asset tokens, and the emergence of NFT has greatly expanded the scope of these tokens. Existing studies on tokenomics have focused on the design, issuance, and ecosystem functioning of tokens. Of these, the representative published results are all targeted at FTs. Howell et al. (2020) suggest that a well-designed token offering could provide more security, liquidity, and transparency than conventional financing instruments. Cong et al. (2021) provide a tractable dynamic equilibrium model of token pricing and platform adoption and show that introducing tokens lowers the effective carry cost of conducting platform transactions and hence accelerates the adoption of productive platforms. Gryglewicz et al. (2021) show that token financing is preferred to equity financing unless the platform expects strong cash flows, has large financing needs, or faces severe agency conflicts. Future research around NFT can follow the existing framework by comparison with FT. At the same time, a broader research space lies in exploring the application and impact of NFT, especially at the theoretical level. For example, NFT has led to unprecedented growth in the digital marketplace and incentives for individual creators, but questions about how to design a more efficient marketplace remain unanswered (Nadini et al. 2021). In addition, NFTs are thought to be a key element of the metaverse and Web3.0 (Borri et al. 2022), and there is a lack of cutting-edge theoretical research on how to design NFT-based ecosystems.

4.3. Risk and Regulation

On the one hand, fraud is an important consideration when dealing with cryptocurrencies, and there may be market manipulation or other fraudulent practices in the pricing of NFT (Dowling 2022a). Therefore, in the current or future NFT market, more research is requested to reveal or warn about the risks involved. On the other hand, NFT trading and mining practices may generate unsustainably high returns and distort investors' expectations, thereby pushing up the market bubble due to the massive inflow of new capital

([Maouchi et al. 2021](#)). The potential spillover effect of NFT on other cryptocurrencies and financial markets also raises concerns.

For policymakers and regulators, the NFT market is still small enough that regulation will hinder its growth and potential benefits, but its expansion should be closely watched ([Maouchi et al. 2021](#)). The emphasis of NFT and cryptocurrencies on decentralization, self-management, and collective maintenance has impacted the centralized traditional regulatory approach. How to establish a synergistic and mutually beneficial model between the two still requires researchers to study and analyze NFTs in terms of rule establishment and mechanism improvement.

5. Conclusions and limitations

This paper reviews the existing research papers of NFT. As an emerging and rapidly growing interdisciplinary field of research, there is a gap between cryptocurrency-related research and the amount of attention NFT receives. All studies published in economics and finance journals were formed after 2021 and are mainly empirical, focusing on the field of asset pricing. Considering that NFT, cryptocurrency and blockchain technologies are still developing at a high rate, we have outlined promising areas for future research in the areas of asset pricing, tokenomics, and risk and regulation.

It is important to highlight the main limitations of our study. Firstly, only 13 articles were reviewed in this paper, and most of them are empirical literature. This may raise concerns, as a good review in other areas usually focuses on both theoretical and empirical literature. The selection of articles is based on a higher standard in order to maintain consistency in review quality. We believe that there is an urgent need for scholars in the field to develop more theoretical studies. Secondly, due to the limitation of our research field, the articles reviewed in this paper are restricted to the field of Economics and Finance, which has an impact on the comprehensive reflection of the worldwide research trend of NFT. The study has scope to be further extended by including more literature from other areas as well.

Notes

[1] CryptoSlam is one of the leading NFT aggregators, collecting data from Ethereum, WAX, and FLOW blockchains. The official website is https://cryptoslam.io/ (accessed on 28 Febuary 2022).

[2] AVR = Automatic Variance Ratio, AP = Automatic Portmanteau, DL = Domínguez and Lobato.

[3] BSADF = Backward Sup Augmented Dickey–Fuller test.

[4] TVP-VAR = Time-Varying Parameter Vector Autoregressive model.

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