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DISSERTATION

SYSTEMATIC LITERATURE REVIEW ON ASSET TOKENIZATION

BRAHIM KHALIL MAMI

JUNE - 2025

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SUPERVISION:
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CA: Carbon allowances

CCCs-metals: conventional cryptocurrencies and metals

EMH: Efficient Market Hypothesis

GBC: Gold-backed cryptocurrency

ICO: Initial Coin offerings

IFRS: International Financial Reporting Standards

IRS: Internal Revenue Service

IP: intellectual property

IPR: intellectual property right

LB: Luxury Brand

LT: Long Term

MAS: Monetary Authority of Singapore

NFT: Non-fungible Token

NFTC: Non-fungible token collectible

PFP: Picture for proof

ST: Short Term

STO: Security Token Offerings

TAC: Transaction costs

ABSTRACT, KEYWORDS AND JEL CODES

This review aims to analyse and synthesize the literature produced so far on asset tokenization. The software was VOSviewer 1.6.20 to perform a bibliometric analysis and elaborate a systematic literature review on Asset Tokenization on a sample of 121 papers published in journals ranked in the ABS 2024 journal list, considering the different fields of knowledge. The research on the Arts asset class was developed compared to others, which set the path that future researchers should follow. The main findings were that NFT investor have financial and emotional drivers, in addition of being safe hedges against other assets. For luxury, NFTs increase brand awareness. Tokenized securities lower transaction fees. This research will help investors, academics, and regulators by providing an analysis of the literature with relevant information for future studies on Asset Tokenization.

KEYWORDS: Asset Tokenization; Digital Assets; Non-Fungible Token, Digital Finance; Alternative Investments.

JEL CODES: G10; G12; G41.

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I am also happy that I had a good education where I had the chance to attend classes taught by qualified professor that helped me in my learning journey

I am also grateful to my colleagues Antonio and Luca for the support and encouragement through this long road.

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AI DISCLAIMER

This dissertation report was developed with strict adherence to the academic integrity policies and guidelines set forth by ISEG, Universidade de Lisboa. The work presented herein is the result of my own research, analysis, and writing, unless otherwise cited. In the interest of transparency, I provide the following disclosure regarding the use of artificial intelligence (AI) tools in the creation of this thesis.

I disclose that AI tools were employed during the development of this thesis as follows:

- AI-based research tools were used to assist in the literature review and data collection.

- Generative AI tools were consulted for brainstorming and outlining purposes. However, all final writing, synthesis, and critical analysis are my own work. Instances where AI contributions were significant are clearly cited and acknowledged.

Nonetheless, I have ensured that the use of AI tools did not compromise the originality and integrity of my work. All sources of information, whether traditional or AI-assisted, have been appropriately cited in accordance with academic standards. The ethical use of AI in research and writing has been a guiding principle throughout the preparation of this thesis.

I understand the importance of maintaining academic integrity and take full responsibility for the content and originality of this work.

Brahim Khalil Mami, 29th of June 2025.

By Brahim Khalil Mami

This review aims to analyze and synthesize the literature produced so far on asset tokenization. The software was VOSviewer 1.6.20 to perform a bibliometric analysis and elaborate a systematic literature review on Asset Tokenization on a sample of 121 papers published in journals ranked in the ABS 2024 journal list, considering the different fields of knowledge. The research on the Arts asset class was developed compared to others, which set the path that future researchers should follow. The main findings were that NFT investor have financial and emotional drivers, in addition of being safe hedges against other assets. For luxury, NFTs increase brand awareness. Tokenized securities lower transaction fees.. This research will help investors, academics, and regulators by providing an analysis of the literature with relevant information for future studies on Asset Tokenization.

1. INTRODUCTION

Once the ambition of cryptographic idealists seeking alternatives to centralized finance in the aftermath of the 2008 financial crisis, asset tokenization is now emerging as a transformative force within mainstream financial markets. At its core, asset tokenization refers to the process of digitally representing ownership of real-world assets on a blockchain such as equities, bonds, real estate, or art. These blockchain-based tokens confer direct ownership and can be transferred across digital wallets almost instantaneously, bypassing traditional intermediaries and reducing the time, cost, and complexity of settlement (Kharif & Nicholson-Messmer, 2024)

While the technology initially gained traction in the cryptocurrency space, institutional interest has accelerated as tokenization demonstrates its capacity to improve operational efficiency, unlock new use cases, and expand market access. Fractional ownership enables the division of high-value assets into smaller, tradable units, broadening participation among retail and crypto-native investors. Moreover, the programmability of tokens and their ability to trade 24/7 set them apart from legacy financial instruments. Financial giants such as BlackRock, JPMorgan, and Franklin Templeton are no longer merely observing these developments, rather they are actively integrating tokenization into their operations. BlackRock, for instance, has launched a $500 million tokenized mutual fund recorded on the ETH blockchain, while JPMorgan's Tokenized Collateral Network facilitates the use of digital assets in derivatives trading (Kharif et al., 2024)

This trend is not limited to private actors. Regulators and central banks are beginning to take a more proactive role in shaping the infrastructure for tokenized markets. The MAS, through initiatives like Project Guardian and the newly launched SGD Testnet, has introduced frameworks for tokenizing fixed-income securities and investment funds. By collaborating with over 40 institutions across seven jurisdictions, MAS is fostering the kind of interoperability and legal clarity that will be essential for global adoption (Monetary Authority of Singapor, 2024). Yet, even as momentum builds, the integration of asset tokenization into the financial mainstream is not without contention. Regulatory frameworks remain fragmented, particularly in the United States, where concerns over systemic risk, instant settlement, and cybersecurity persist. Critics argue that Wall Street's embrace of tokenization may replicate old patterns of financialization, turning a technology meant to decentralize finance into another mechanism for fee extraction. Moreover, the risks associated with public blockchain infrastructure such as irreversible losses due to theft or misdirected transfers have led many institutions to favor private, permissioned networks, raising questions about openness and interoperability.

Against this backdrop, a pivotal question arises: "Asset tokenization: does it herald the future of the financial industry, or does it risk becoming its next downfall?" This literature review seeks to explore this question by systematically examining the motivations, benefits, risks, regulatory developments, and returns that define the rapidly evolving landscape of tokenized finance. By the conclusion, this research would contribute to this literature by providing information and findings that will help Investors, researchers, and regulators deliver a better outcome in their works.

2. METHODOLOGY

This study employs a Systematic Literature Review (SLR) methodology to ensure a rigorous, unbiased, and transparent research process. The structured nature of the SLR helps minimize subjective interpretations by following a predefined protocol for the identification, selection, analysis, and synthesis of relevant literature. This methodological rigor is particularly valuable for a master's thesis, as it supports the production of a well-founded and academically sound contribution. Consequently, to ensure the integrity of the sample, this search is focused on Web of Science database

(WoS) made on June 11th. More importantly, it allowed us to use a combination of keywords that generated more articles which allowed us to have a better and well diversified collection than other databases like Scopus which generated less articles which most of them were articles.

The primary objective of mapping the various research trajectories within the field of asset tokenization. Rather than focusing on a single problem or sub-topic, the review aims to provide a comprehensive understanding of the breadth and depth of existing literature. By synthesizing the current body of knowledge, this research seeks to identify prevailing challenges, highlight key themes, and uncover gaps in the literature. Ultimately, the goal is to offer a structured and coherent overview that can serve as a foundation for future research and contribute to greater conceptual clarity within the domain of tokenization. Since the topic emerged during the covid pandemic where NFTs became an industry trend, we use that initial landmark as a reference date for this study and searched the WoS database from the 1/1/2020 to 01/05/2025.

In the systematic review process we adopted and adapted the systematic review protocol as shown below. The approach considers a broader keyword scope since we do not consider restrictive words regarding Asset Tokenization and Non Fungible tokens to provide the search query with as many details to maximize the outcome. Therefore, the equation used for this researches composed of keywords mentioned in Protocol below. The search equation focused on the "topic" option that searches within the title, abstract, author keywords and keyword plus. Only French and English-written academic journals that addressed the topic of Asset Tokenization from the investor or investment perspective are considered from the Academic Journal Guide ABS (Association of Business Schools) list of 2024, thus ensuring a better quality on the revised studies.

The flow of information through the different phases of the systematic review process is based on the PRISMA protocol adapted from M. Ali (2021) which is presented in table 1 below. As a start, in the identification stage, 4695 articles were found , from which 4501 were eliminated with the use of automated tools and the application of the quality criteria with the help of VOSviewer and Excel Functions. Next, in the screening stage 194 articles were screened, eliminating through the eligibility criteria 73 articles that did not fit the

purpose. Finally, in the inclusion stage and as a conclusion, the final sample revealed 121 articles. A bibliometric analysis using VOSviewer version 1.6.20 was conducted following the methodological guidance of Almeida & Gonçalves (2023). Rather than employing bibliographic coupling, we opted to cluster the articles by asset class, aligning with the goals of this study and drawing on a thematic analysis approach similar to that of Ibrahim (2012). This decision reflects both the interdisciplinary nature of the topic, given its relevance across various asset classes, and the need for clarity and analytical efficiency in presentation. Accordingly, we categorized the literature into the following asset classes: Arts, Gaming, Luxury, Real Estate, Agriculture, Commodities, Securities, and Regulations.

Systematic Review Protocol

Background motivation

- Institutional Interest in Tokenization led by Larry Fink and Blackrock.
- Projection that this industry will reach trillions of dollars of valuation
- Adoption of Tokenization in the different asset classes like Real Estate, commodities, Luxury (wine, horses...)

Objectives

- Understand the potential of asset tokenization.
- Understand the usage of tokenized assets
- To understand tokenization in each asset class.
- How to invest?
- How to price?
- What is the added value of tokenized assets?

Criterias for considering studies for this review

- Studies that contribute to the understanding of Asset Tokenization.
- Qualitative and quantitative studies.
- Studies from all research fields
- Studies based on an investment perspective

Search strategies for identification of studies

- Web of Science databases.
- Time period between 2020-2025

- Search terms and keywords – "**asset tokenization** (Topic) or **non-fungible token*** (Topic) or **real estate tokenization** (Topic) or **equit* tokenization** (Topic) or **tokenized securities** (Topic) or **tokenized commodities** (Topic) or **tokenized investment funds** (Topic) or **Art tokenization** (Topic) or **wine tokenization** (Topic) or **luxury tokenization** (Topic) or **debt tokenization** (Topic) or **security token*** (Topic) or **fungible token*** (Topic) or **bond* tokenization** (Topic)"
- Language restriction – only studies in English and French
- No unpublished data will be sought.

Eligibility

- The inclusion criteria
    o All the topics related to tokenization
- Exclusion criteria
    o Machine Learning and big data related themes
    o Cybersecurity related themes
    o Blockchain related themes
    o All articles that do not study Asset Tokenization

Data Collection

- Only Academic journal Articles

Assessment of methodological quality

- Academic Journal Guide ABS (Association of Business Schools) list of 2024

Synthesis

- Literature classification, conduction of critical analysis, synthesization of key insights, and the interpretation of the findings by asset class within a broad conceptual framework.
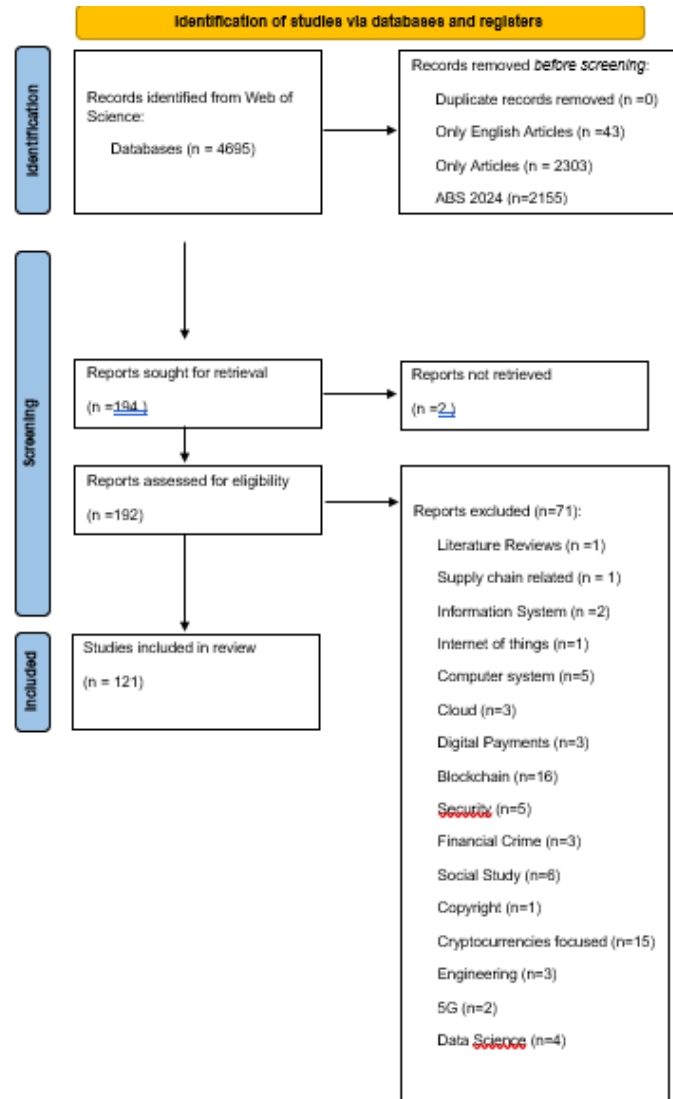
Fig 1. PRISMA Fluxogram

3. BIBLIOMETRIC ANALYSIS

3.1 Countries Analysis:

China is leading the research on asset tokenization with 32 publications followed by the United States with 24 researches as shown in Table 1. Ireland that has the highest citations per publication with 134 as explained. China and the US are constantly conducting research, but we can observe an emergence of African countries led by Tunisia and Ghana, along with New Zealand that are joining this wave of contribution shown in figure 2. Which means that some countries established the ground with strong research that is helping other countries to carry on.
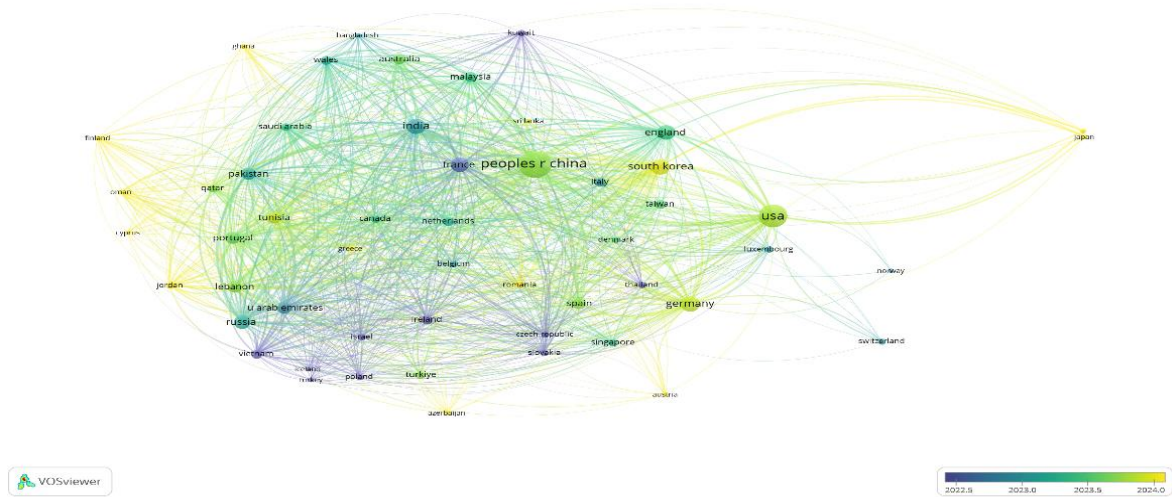
Fig 2. Normalized citation of countries per year.

Table 1. Top 10 cited countries

Rank	Country	Documents	Citations	Average citations per document
1	france	10	659	65.90
2	ireland	4	535	133.75
3	peoples r china	32	513	16.03
4	usa	24	312	13.00
5	england	10	283	28.30
6	india	11	267	24.27
7	australia	5	230	46.00
8	russia	8	209	26.13
9	germany	11	207	18.82
10	portugal	7	197	28.14

3. 2. Organizations:

Dublin university has the highest citations and the average citation per article, however most of these research date back to 2022 as shown in figure 3. The university of Lisbon is leading the in both the number of documents (7) and the most recent articles (2024), followed by the Lebanese American university (6 in 2024) which is why we should follow others such as Paris business School (3 around the second half of 2023).
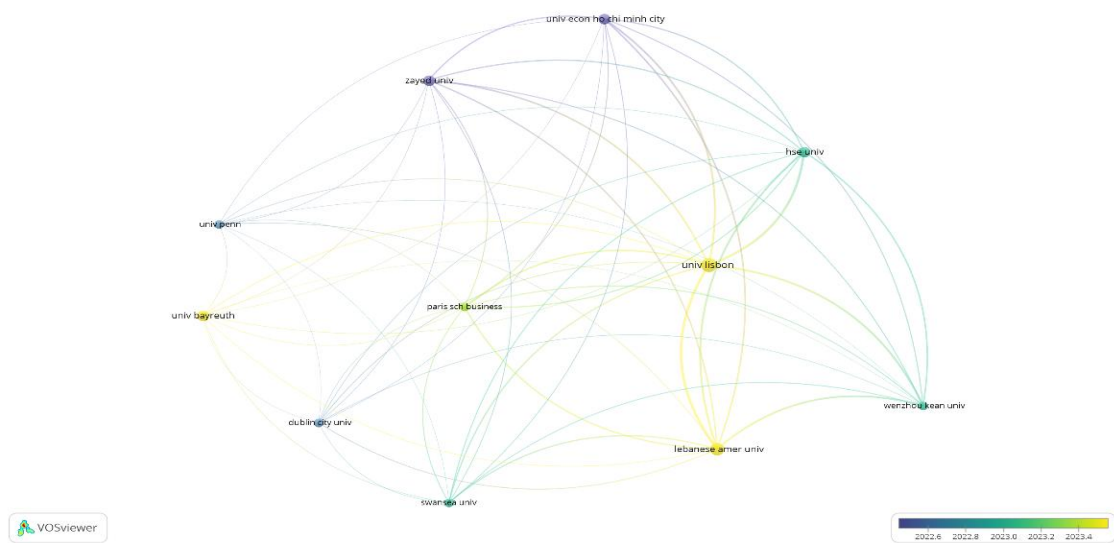
Fig 3. Normalized citations of institutions per year

Table 2. Top 10 cited institutions

Rank	organization	documents	citations	Average citations per research
1	dublin city univ	3	431	143.67
2	univ lisbon	7	197	28.14
3	univ econ ho chi minh city	4	188	47.00
4	zayed univ	4	184	46.00
5	swansea univ	3	157	52.33
6	hse univ	4	145	36.25
7	univ penn	3	117	39.00
8	wenzhou kean univ	3	110	36.67
9	lebanese amer univ	6	94	15.67
10	univ bayreuth	4	54	13.50

3. 3. Journals:

Finance Research Letters is the leading journal with 30 papers and average citation of 43 per article (Table 3), but most of them are between 2022 and 2023 as observed in Figure 4. New journals like applied economic letters, journal of retailing and consumer services, and journal of consumer behaviour along with other that are providing to this literature. The main conclusion is that the topic is earning the interest of many journals that are competing the be the leaders of the sector.
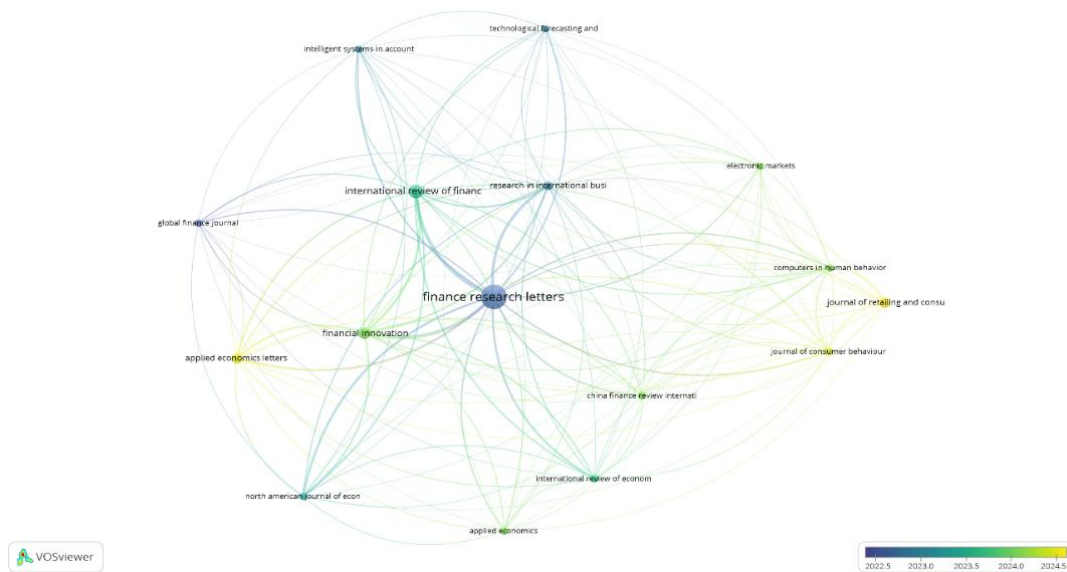
Fig 4. Normalized citations of Journals per year

Table 3. Top 10 cited journals

Rank	Source	documents	citations	average citation
1	finance research letters	30	1296	43.20
2	international review of financial analysis	9	266	29.56
3	technological forecasting and social change	3	97	32.33
4	research in international business and finance	4	66	16.50
5	financial innovation	7	57	8.14
6	north american journal of economics and finance	3	46	15.33

7	computers in human behavior	3	39	13.00
8	global finance journal	3	37	12.33
9	international review of economics & finance	3	33	11.00
1	applied economics letters	5	31	6.20

3. 4. Authors:

As shown in Table 4, Mariya Gubareva emerges as the most prolific contributor to the literature, with six publications and an average of 31 citations as of 2024. Michael Dowling, who, despite having only three publications, holds the highest average citation count at 144 in 2022. The interconnection among the leading articles suggests a cumulative and collaborative development within the field, where each contribution plays a significant role in shaping and advancing the literature.
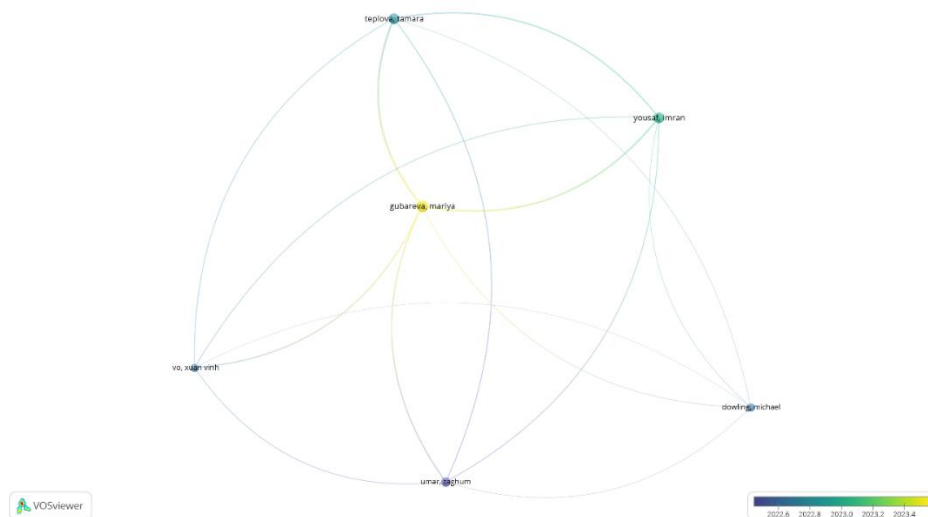
Fig 5. Normalized citations of authors

Table 4. Top 10 cited authors

Rank	author	documents	citations	Avg citation per article
1	dowling, michael	3	431	143.67
2	gubareva, mariya	6	188	31.33
3	umar, zaghum	4	184	46.00
4	teplova, tamara	5	181	36.20
5	yousaf, imran	5	151	30.20
6	yarovaya, larisa	2	113	56.50
7	ko, hyungjin	2	92	46.00

8	lee, jaewook	2	92	46.00
9	ante, lennart	2	89	44.50
10	abedin, mohammad zoynul	2	86	43.00

4. LITERATURE REVIEW

4.1. Arts:

Characteristics of Art NFTs:

NFTs, which is a form of digital document that is used to certify ownership of items such as artwork or collectibles (Fan et al., 2024), present a novel way to establish digital ownership that could potentially challenge traditional IPRs mechanisms (Kraizberg, 2023). This could create new investment opportunities in digitally unique assets that derive value from their verifiable ownership rather than traditional utility or IPRs.

Taxonomy provides a clear, extendible framework for understanding and classifying NFTs based on their reference object, token properties, distribution, and realizable value which is crucial for a nuanced investment analysis (Hartwich et al., 2024). The parties involved with these products are Creators and Holders. After setting business models, creators can realize proceeds from primary sales in addition to generating royalties for a pre-defined percentage of resale price in perpetuity (Hartwich et al., 2024; X. Liu et al., 2024). As a result, they gain popularity and recognition and deepen customer loyalty and engagement. Holders or buyers can realize proceeds from resales or generating fees by lending an NFT and rewards by staking tokens in addition to providing utility and granting associated rights as in participating in votes. For the rare and limited editions holder, they may have social or cultural "prestige". Moving on to the properties, the standard of these tokens may be a Unique Token Standard with one issue, or a MultiToken Standard with multiple issues. For Transferability Unrestricted that can be moved at will or restricted with limited, time-bound, or zero transfers. Transparency is either shielded that conceals attributes using zero-knowledge proof or Unshielded, which discloses all information. For Metadata, it could be Mutable that could be changed after minting, often for delayed reveals, or Immutable that cannot be changed. Finally for Expiration they are either Defined (burn function, if not by attribute counting blocks) or Undefined. The provided information will help creators in structuring NFTs to fit their purpose and buyers

make informed acquisition decisions by understanding their characteristics and potential value.

The adoption of NFTs is driven by a complex interplay of economic, social, and personal factors that differ between new and existing investors (Vega & Camarero, 2024). For repurchase and continued investment, the experience itself becomes more influential, while the impact of general social pressure and perceived risk diminishes.

NFTs and cryptocurrencies share unique characteristics (Ghosh, Bouri, et al., 2023) such as heavy tails, volatility clustering, and long memory. Schwiderowski et al. (2023) approved that NFTs are not an entirely new asset class, but rather a unique combination of existing ones, inheriting characteristics from both blockchain-based crypto tokens and their underlying physical or digital assets.

Investor Behavior:

NFT investors form a distinct subgroup within the broader cryptocurrency investment community, characterized by unique demographic and behavioral traits. According to Balietti et al. (2025), holders tend to be younger with lower average formal education levels compared to the general crypto population, but they demonstrate higher levels of cryptocurrency knowledge particularly in the domain of NFTs. Notably, there are no significant gender differences between NFT and non-NFT investors, suggesting that NFT participation may be less gender-skewed than other areas of crypto. Moreover, individuals employed within the crypto sector are significantly more likely to invest in NFTs, and engagement with advanced DeFi activities such as yield farming and crypto derivatives is also positively associated with NFT ownership. Additionally, individuals who express greater concern about the potential for cryptocurrencies to be misused in illicit activities are less inclined to own NFTs.

 Ho et al (2024) further emphasize the role of age, finding that younger investors are disproportionately represented in the NFT space, though this relationship follows a nonlinear pattern. Early adopters of cryptocurrencies (especially those with existing ETH holdings) are also more likely to own NFTs, likely due to lower perceived entry costs and greater familiarity with ETH-based assets.

Contrary to the popular perception of NFT buyers as purely profit-driven speculators, purchase intentions are primarily shaped by intrinsic motivations such as enjoyment, aesthetic appreciation, personal fulfillment, and exclusivity (Griffiths et al., 2024; Vishnu Prasad et al., 2024). This suggests that, for many consumers, NFTs function more like digital luxury goods, valued for their emotional and symbolic significance (emotional, identity-building, social signaling, and playful aspect) rather than purely for financial gain (Alkhudary et al., 2023). Guan et al. (2024) also directs that investors evaluating NFTs should involve considering both aesthetic incongruity and image quality, as image quality ultimately determines LT value. Furthermore, the lack of motivation or Uncertainties in macroeconomic fundamentals or investor attention can significantly increase the volatility of NFTs as single determinants negatively influences purchase intent which causes volatility (Griffiths et al., 2024; Jiang & Xia, 2024). However, expectations of future value can compensate for this absence of drive, acting as a key psychological anchor in decision-making. Notably, these value expectations do not amplify either intrinsic or extrinsic motivations, indicating that they operate as a separate and independent factor in shaping consumer behavior. While the expectation of future value plays a key role; especially in countering negative motivations; it doesn't consistently enhance financial or emotional drivers. For investors, understanding NFTs as emotionally charged, luxury-like assets are crucial to evaluating their market behavior and long-term value, in addition understanding perceived functionality and price value that are critical for the rational investment motives (Griffiths et al., 2024; Fortagne & Lis, 2024).

Wu et al. (2024) uncover a counterintuitive relationship between risk perception and NFT adoption, finding that higher concerns about privacy and security can enhance trust, attitude, and purchase intention. These key mediators, link risk perception to adoption, with gender differences showing stronger risk-driven effects in males and attitude-driven effects in females.

For creators, customer satisfaction plays the most crucial role in increasing the effectiveness of NFT investments (Dinçer et al., 2024). This satisfaction is attained through transparent communication, accessible communication channels, and timely feedback mechanisms. In Malaysia, among various drivers for NFT investors (Ramly & Md Zabri, 2024) . Financial motivation is the first, especially for creative industry

entrepreneurs who benefit from direct engagement and profit realization. Next, community support plays a pivotal role in investor decision-making within the NFT space, fostering trust and engagement. As for experienced investors, basic technology acceptance factors like ease of use and trust in the technology itself may be assumed, with focus shifting to financial returns and community dynamics.

Looking at secondary market, their introduction can leave investors worse off overall (Zou et al., 2024) particularly if a majority miss the primary market and are forced to buy pre-owned NFTs, resulting in a lower consumer surplus compared to a primary-marketonly scenario.

Platform affordances are crucial for fostering psychological contracts, which in turn drive customer loyalty in NFT platforms (C. T. Lee et al., 2024) . Understanding the distinct needs and priorities of both creators and buyers is essential for designing effective NFT platforms. Transaction, aesthetics, status, and UI affordances all positively influence the creation of psychological contracts which positively influence both attitudinal and behavioral customer loyalty.

Twitter sentiment and activity are crucial early indicators for the development and dynamics of nascent NFT markets (Horky et al., 2023) , offering potential information advantages for investors and aiding policymakers in identifying policy-relevant trends or bubbles. To detect early market developments, potential misinformation, manipulation, and speculative activities in new digital markets, Policymakers and regulators should actively monitor social media.

While profit expectations often spark initial NFT purchases, LT engagement is driven more by social factors (Brahmstaedt, 2025), particularly the formation of community bonds and a shared sense of identity. Within NFT ecosystems, active participation and strong community leadership play a pivotal role in reinforcing engagement, creating a feedback loop where user involvement directly boosts perceived and actual asset value. However, this bond is broken when profit expectations. This sense of community abandonment often results in loss of interest and declining asset value, underscoring that the sustainability of NFT projects depends not only on financial performance but on the strength and integrity of their social infrastructure.

Consumer decisions to purchase NFTs are shaped by a blend of technological perceptions (W. jun Lee & Cha, 2024), financial motivations, and social dynamics, with the bandwagon effect emerging as a particularly strong influence. Positive attitudes toward the underlying technology which are driven by perceived ease of use, usefulness, and tolerance for uncertainty, play a key role in shaping intent. Similarly, seeing NFTs as viable financial assets, based on expectations of profitability, transaction efficiency, and manageable volatility, further encourages purchase decisions. The perception that others are buying amplifies desire through social conformity and status signalling. This suggests that NFTs function not only as technological or financial instruments, but also as cultural markers, acquired as much for what they represent socially as for what they deliver functionally or financially.

In Dutch auctions, NFT investors exhibit risk-seeking behaviors driven by time pressures and value propositions which is affecting the seller's revenue negatively (Shannon et al., 2024). Investors' cognitive biases and heuristics can be exploited in NFT marketplaces, highlighting the need for financial education and regulatory attention.

The development of a robust and comprehensive NFT ecosystem is essential for addressing public concerns (Xing et al., 2025) and guiding key stakeholders in a rapidly evolving digital asset landscape. A nuanced understanding of public opinion; including dominant concerns and cross-cultural differences; is critical for policymakers aiming to craft effective regulations and for NFT developers and managers seeking to enhance user value, drive innovation, and mitigate emerging risks. For investors, the study emphasizes the growing financialization of NFTs, underscoring the need to monitor social media signals for market trends, potential scams, and legal uncertainties Meanwhile, developers and businesses are encouraged to track public sentiment not only to refine sales and transaction strategies, but also to explore new use-cases, such as smart contract features that enable artists to earn royalties on resale. As such, they should focus on enhancing the user journey, fostering authentic community ties, and possibly empowering users through participatory roles. Collectively, these insights underscore the importance of aligning NFT infrastructure, regulation, and innovation with the evolving expectations of a diverse and global user base.

NFTs is a distinct asset class (Yilmaz et al., 2023) shaped by a multifaceted mix of monetary, functional, emotional, and social values throughout the ownership cycle. For investors, financial considerations dominate during the buy, hold, and especially the sell phases, highlighting the importance of clear investment potential.

Risk perception (privacy/security concerns) positively influences trust, attitude, and purchase intention in NFTs (Yousaf & Yarovaya, 2022a). The conceptual framework highlights trust and attitude as critical mediators, with gender differences emerging: males show stronger risk-to-intention pathways, while females exhibit stronger attitude-tointention effects.

Investor sentiment plays a statistically significant role in influencing NFT sales volume, offering crucial insights for investment strategies (Teplova et al., 2023) . In addition, Social media sentiment is particularly influential in predicting NFT market activity, highlighting the importance of monitoring these platforms for investors. The dominance of past sales in predicting current volume suggests that investors exhibit herd behavior, which is a key characteristic of the NFT market..

The NFT market exhibits clear evidence of herding behavior, particularly during periods of high returns and increased media exposure (T. Bao et al., 2023; De Silva et al., 2024), often driven by an influx of inexperienced investors influenced by hype and lacking market insight. This Herding behavior contributed to both upward and downward market movements. Moreover, it arises from information cascades via media statements. In addition market trends and social factors influence this behaviour, implying investors should be cautious and not solely follow word-of-mouth (De Silva et al., 2024; Mamidala & Kumari, 2023) .

Pricing:

Pricing is an important factor in NFT investment as it influences decision makers by helping them to determine entry and exit points, growth and value assessment, portfolio allocation and diversification, and identifying market trends. NFT pricing is quite distinct from cryptocurrency pricing in terms of volatility transmission, as they can potentially be considered a low-correlation asset class distinct from cryptocurrencies, with interesting

implications for investment portfolios (Dowling, 2022b). This is why Cryptocurrency pricing behaviors might help in understanding NFT pricing patterns.

In his research, Vidal-Tomás (2023) described the current Web3 meta-economy as an "illusion" where hype has outpaces reality. Its native tokens function as speculative assets rather than stable currencies, and this speculation bleeds into NFT pricing, creating significant risk. Although NFT prices are speculative, the genuine user interest in metaverse activities is a positive sign for the future, but this interest is also declining.

Investment-related design features (initial price and royalty) have diverse impacts on ST and LT NFT project performance (Y. Wang et al., 2024). Creators can use the study's results to set appropriate initial prices and royalties to achieve their financial goals. The market's dynamic nature and uncertainty are crucial factors for creators to consider when making design decisions. As a result, effective pricing strategies that align with perceived quality will be crucial for NFTCs given their subjective value (Fortagne & Lis, 2024) . Furthermore, ensuring perceived blockchain security and privacy is fundamental for establishing consumer trust, especially given the transparency of transaction records.

A social value-based framework is more useful than a traditional scarcity-based perspective for analyzing NFT prices that are not solely driven by traditional economic principles of supply and demand, as the implications of scarcity fundamentally shift when social value becomes paramount (Hofstetter et al., 2024) .

For Secondary markets, their introduction compels the creator to set a lower initial selling price regardless of royalties' collection. Lower prices are needed to attract price-sensitive consumers who are motivated by the new resale opportunity (Zou et al., 2024).

Return:

NFTs have emerged as a novel asset class characterized by both high return potential and pronounced volatility. Projects with IPRs and low image similarity tend to generate the highest LT returns, while uniqueness alone also predicts strong performance (Tian et al., 2023). In contrast, profile picture PFPs without IP rights often exhibit high first-day and 30-day returns but underperform over a longer horizon, some even display patterns of pump-and-dump behavior. These return patterns reflect the speculative nature of the

market, further emphasized by bubbles during Covid (Sadorsky & Henriques, 2024; Tian et al., 2023) .

The NFT market's relationship with broader financial systems has evolved. Initially acting as a volatility spillover receiver and showing minimal correlation with traditional financial assets, NFTs offered promising diversification benefits (Y. Wang, 2022). However, as the market matures, its role has begun shifting toward that of a volatility transmitter, indicating a deeper integration with broader financial cycles.

This dynamic is further illustrated by the interaction between different NFT categories. Collectible NFTs primarily absorb spillovers, while Utility NFTs act as key transmitters of both return and volatility shocks (Umar, Abrar, et al., 2022). Additionally, trading volume emerges as a strong predictor of NFT returns and volatility, especially under extreme bullish conditions. This asymmetric and time-varying connectedness underscores market inefficiencies, compelling investors to closely monitor volume and price patterns to adapt their strategies accordingly.

Despite initial hopes, NFTs may not serve as reliable safe-haven assets. The absence of an inverse asymmetry effect suggests that they behave more like high-risk assets during downturns (Ghosh, Bouri, et al., 2023). Moreover, the long memory observed in NFT return data challenges assumptions of market efficiency and signals potential concern for regulators and policymakers.

For portfoilio managers,NFTs demonstrate strong diversification potential. The inclusion of high-value NFT collections has been shown to improve key performance metrics (including mean returns, Sharpe ratios, skewness, and kurtosis) though it also introduces higher volatility (Menvouta et al., 2023).

Metaverse-related NFTs play a particularly dynamic role: they significantly drive upside risk in the ST but tend to reverse this influence over the long run (Qiao et al., 2023). This highlights the importance of time horizon in evaluating NFT performance.

Liquidity, however, remains a critical and non-diversifiable risk in NFT markets. Benedek & Nagy (2025)suggest that NFTs with cash flow potential are treated as LT holdings, like dividend-paying equities. Moreover,Wilkoff & Yildiz (2023) argue that NFT liquidity is not random but driven by identifiable factors such as trading activity,

asset characteristics, and information flow. Better dissemination of information reduces frictions and improves market depth, offering valuable tools for traders and platforms to manage NFT liquidity more effectively.

Crucially, NFTs tend to remain decoupled from both traditional and alternative assets under normal market conditions. However, they act as net receivers of return shocks in most scenarios, shifting to net transmitters only during bullish phases. In contrast, they consistently serve as net receivers of volatility shocks, regardless of broader market movements (Urom et al., 2024). These patterns reinforce the complexity of NFTs as an asset class and highlight the need for adaptive, data-informed investment approaches.

In markets like China, NFTs not only offer downside protection but also demonstrate superior LT, risk-adjusted returns (Hemrit et al., 2023). The connectedness between NFTs and developed stock markets is dynamic and varies across investment horizons that are strong in the ST but weaker in the long run making time horizon a critical factor in portfolio strategy (Hemrit et al., 2023) . Diversification benefits are especially notable when pairing NFTs with less correlated markets such as Japan and China.

NFTs demonstrate a weak linkage with traditional financial markets, indicating a high degree of independence in their price formation (Panagiotidis & Papapanagiotou, 2024). Attention indices typically have a negative or statistically insignificant effect on NFT returns, reinforcing the notion that NFTs are driven by internal dynamics rather than external financial market sentiment. This decoupling suggests that NFTs are not simply derivatives of cryptocurrencies but instead offer unique diversification opportunities for investors (Aharon & Demir, 2022).

This structural independence makes NFTs a compelling addition to traditional investment portfolios. Their low correlation with conventional asset classes, coupled with minimal contagion effects, enhances portfolio resilience particularly during periods of financial stress such as the COVID-19 pandemic (Umar et al., 2023). NFTs are characterized by a distinctive risk-return profile: high and positively skewed returns with low tail dependence. These attributes make them attractive for optimizing performance, especially in equally weighted and tangency portfolio strategies (Ko et al., 2022). The inclusion of

NFTs significantly improves risk-adjusted returns, with measurable benefits across metrics such as correlation, co-movement, and volatility transmission.

While NFTs largely operate independently, they are not entirely insulated from broader financial systems. During episodes of market turbulence, such as those induced by news shocks or global uncertainty, NFTs can both transmit and absorb volatility (Chowdhury et al., 2023). The presence of asymmetric multifractality further suggests that NFTs behave differently in bullish versus bearish markets, requiring risk management strategies that account for such non-linear dynamics.

Despite these complexities, NFTs maintain weak return spillovers with U.S. equities, which reinforces their role as diversification instruments (BenMabrouk et al., 2024). Moreover, they have demonstrated hedge and safe-haven properties in relation to traditional asset classes (particularly bonds and USD indices) during crisis periods like the COVID-19 pandemic (Ko & Lee, 2024). Their low hedge ratios also imply that incorporating NFTs into portfolios such as those based on the S&P 500 or BTC can deliver diversification at a relatively low hedging cost (Bas et al., 2024).

However, NFTs' role as a safe haven is not consistent across all market conditions. While they provide risk absorption and exhibit strong connectedness with cryptocurrencies under normal circumstances (Xia et al., 2022), their behavior shifts dramatically during extreme market events. High volatility spillovers and clustering patterns emerge, diminishing their distinctiveness as an asset class during periods of systemic stress.

Further, the connectedness between NFTs and U.S. equity sectors is both asymmetric and heterogeneous, particularly under extreme market conditions (S. Ali et al., 2024). NFTs alternate between being net transmitters and receivers of return and volatility shocks, depending on the market quantile. This dynamic adaptability offers nuanced portfolio management opportunities. However, investors should note that hedging costs tend to rise significantly during periods of global uncertainty, such as the COVID-19 pandemic and the Russia–Ukraine conflict.

The next step would be to study the relationship between NFTs and fiat currencies which was found to be heterogeneous and time-varying. While NFTs generally exhibit low overall correlation with traditional fiat currencies, a notable exception is the BRICS

group, where a consistent positive relationship has been observed (Abakah et al., 2024). Furthermore, NFTs have demonstrated a stable capacity to function as both a hedge and a safe haven for the U.S. dollar, particularly during periods of market stress (Z. Zhang et al., 2022).

This weak but dynamic correlation with fiat markets positions NFTs as valuable instruments in multicurrency portfolios. Their limited connectedness with conventional currencies enhances diversification potential, while their role as net transmitters of both return and volatility shocks suggests they can serve as effective hedging tools against downside risks in the foreign exchange space (Yousaf et al., 2024). However, these relationships intensify during turbulent periods, underscoring the need for adaptive and frequent portfolio rebalancing.

The stabilizing role of fiat currencies during digital asset turbulence has also been emphasized in recent research. (Dimitriadis et al., 2024) highlight that fiat currencies can act as effective shock absorbers when volatility surges in digital markets. In contrast, NFTs are increasingly being viewed as high-risk, high-reward assets, mirroring the early behavior of cryptocurrencies. While NFTs may offer partial hedging against fiat exposure under specific market conditions, their inherent volatility necessitates cautious and active management. Amid rising inflationary pressures and shifting liquidity preferences, NFTs may be entering a new "BTC-like" phase, one that could significantly reshape investor strategies, market infrastructure, and the broader positioning of NFTs within the global financial landscape.

NFTs and carbon allowance (CA) markets exhibit meaningful interconnections, with their roles as shock transmitters or receivers varying dynamically based on broader market conditions. During periods of extreme volatility, CA instruments may act as shock absorbers for digital asset markets, highlighting the importance of monitoring systemic risks in cross-asset portfolios (Ghosh, Gubareva, et al., 2023). This dynamic nature underscores the need for portfolio managers to closely track shifts in inter-market relationships when constructing risk-aware strategies.

Similarly, NFTs maintain a close and influential relationship with metal markets. NFTs have been found to transmit significant levels of volatility to metals, particularly during

stressed market periods (Shao et al., 2024). Empirical findings indicate that both return and volatility connectedness indices are lower in NFT–metal relationships compared to crypto–metal (CCCs–metals) frameworks, reinforcing NFTs' potential as an alternative asset class with superior hedging and diversification properties (Yousaf et al., 2023). This distinction offers actionable insights for optimal portfolio weights and hedge ratios, especially in times of elevated uncertainty. Major global crises further intensify market connectedness and alter volatility spillover mechanisms. Precious metals, in particular, serve as effective hedging tools against NFT-related risks. Investors are advised to rebalance their portfolios by increasing metal allocations relative to NFTs during turbulent periods. Meanwhile, regulators should monitor evolving net spillover roles and consider implementing early-warning systems to manage cross-market contagion risks effectively.

In the oil market, NFTs exhibit nonlinear interactions, especially in relation to BTC. In stable oil price environments, NFTs and BTC act as largely independent assets influenced by distinct variables, supporting their use in diversified portfolios. However, during sharp oil price shocks, the relationship between the two assets becomes highly interdependent, diminishing their diversification benefits (Bani-Khalaf & Taspinar, 2023). Notably, NFTs demonstrate stronger hedging potential against oil price uncertainty than BTC (Aharon & Demir, 2022; Bani-Khalaf & Taspinar, 2023). Nevertheless, due to their volatility and structural immaturity, both assets remain unsuitable as safe havens during extreme macroeconomic disruptions such as hyperinflation.

Fakhfekh et al. (2024) conclude that For investors, understanding the nonlinear dependencies between NFTs, DeFi assets, and gold-backed cryptocurrencies is critical to optimizing portfolio resilience. Given NFTs' unique price dynamics, often influenced by speculative bubbles, selected gold-backed tokens can serve as effective stabilizing agents within digital asset portfolios.

Policymakers and regulators must remain vigilant about the evolving interconnectedness between crypto assets, clean energy markets, and commodities. As Kayani et al. (2024) argue, these assets demonstrate heightened sensitivity to external shocks, requiring

adaptive regulatory frameworks that can respond to shifting risk transmission dynamics across asset classes.

For crypto, NFT trading activity and particularly sales volume has been shown to significantly influence NFT returns. (Urom et al., 2022) find that NFT volume is a key predictor of returns, especially in bullish market phases, though this relationship is weaker in specific segments such as the CryptoPunks market. Various macroeconomic and geopolitical factors which include equity market uncertainty, gold and oil prices, business conditions, and term spread, also impact NFT submarket returns. Notably, increases in BTC prices consistently correlate with a reduction in NFT market returns, underscoring a competitive dynamic between these asset classes.

During the COVID-19 pandemic, NFTs exhibited increased pairwise return coherence with major asset classes, particularly over longer investment horizons, suggesting enhanced hedging and diversification potential (Umar, Gubareva, et al., 2022). However, this coherence was significantly lower over shorter horizons, indicating that NFTs only absorbed risk effectively in the short run. NFTs also displayed superior mean and median returns compared to most traditional assets, though their standard deviation of 0.55 was over ten times greater than that of BTC or oil, reinforcing their high-risk, high-reward profile.

NFTs also show strong positive co-explosivity with most cryptocurrencies, reflecting shared bubble dynamics. Market sentiment indicators significantly influence these explosive behaviors, providing crucial insights for regulators and investors seeking to understand NFT bubbles and cryptocurrency pricing trends (Guo et al., 2023).

Importantly, NFT-based cryptocurrencies (NFTCs) exhibit lower volatility compared to BTC, largely due to their valuation being anchored in underlying NFT assets rather than speculative momentum (Kumar & Rao, 2023). This asset-backed structure lends NFTCs greater price stability and distinguishes them from traditional cryptocurrencies. Given NFTs' limited correlation with conventional financial markets, NFTCs offer strong potential as hedging tools against stock market volatility and broader financial shocks.

Additional studies underscore the non-linear relationship between NFTs and BTC, particularly during periods of oil price shocks (Bani-Khalaf & Taspinar, 2023; Mensi et

al., 2024; Panagiotidis & Papapanagiotou, 2024) further reveal a strong interconnectedness between NFTs and major cryptocurrencies especially under stressed conditions. NFTs often absorb risk from leading digital assets like BTC and ETH, making them valuable diversification instruments in crypto-dense portfolios. While BTC is difficult to hedge directly, it has proven to reduce risk across NFT portfolios. The consistent risk-transmitting behavior of BTC, ETH, BTC Cash, and Litecoin points to persistent inefficiencies in crypto markets, which can be leveraged for forecasting and portfolio optimization. Moreover, Crypto art prices are mostly determined by gains in the cryptocurrency of denomination (ETH) and other crypto-world related assets, such as BTC and Crypto Index, and are severely driven by the rise in their volume(Anselmi & Petrella, 2023).

While some NFT segments like digital art display dynamics relatively independent of broader crypto trends or media coverage(Boido & Aliano, 2023), other NFT markets remain highly influenced by major coins and market sentiment. Notably, (Deng et al., 2023) find that NFTs have the lowest liquidity spillovers among crypto assets, indicating strong risk-bearing capacity and potential as effective hedging instruments. Understanding the time-frequency and quantile-specific characteristics of this liquidity is critical for investors managing DeFi-heavy portfolios.

Return and volatility spillovers between NFTs and their affiliated tokens are relatively limited, indicating market independence (Ho et al., 2024). Additionally, NFT submarket are distinct, suggesting that constructing diversified NFT portfolios across different submarkets can enhance risk-adjusted returns. However, media coverage still acts as a net transmitter of both return and volatility spillovers, particularly through utility NFTs (Umar, Abrar, et al., 2022).

While NFTs do not yet function as a fully distinct asset class due to price movements that often mirror those of BTC and ETH (Gunay & Kaskaloglu, 2022), they do demonstrate unique volatility dynamics. For instance, during the COVID-19 pandemic, NFTs experienced the strongest positive return shift among major crypto assets, even as ETH transitioned from a risk receiver to a risk transmitter (Aharon & Demir, 2022). Including NFTs in BTC-heavy portfolios is generally advised. Kumar & Padakandla (2023) find

that NFTs can act as short-, medium-, and LT hedges or safe havens against BTC volatility. However, they are less effective in hedging ETH price movements, providing at best short- to medium-term diversification.

Pricing inefficiencies persist across the NFT ecosystem. Although these gaps may present arbitrage opportunities(Ante, 2023), they also introduce significant valuation risk and undermine NFTs' potential to serve as stable investment or transactional tools. Moreover, in the DeFi ecosystem, BTC remains the largest shock transmitter, while Chainlink is the largest shock receiver. NFTs, by contrast, transmit and receive the fewest shocks, reinforcing their usefulness for diversification (Goodell et al., 2023).

NFT coin prices exhibit a level of predictability that contradicts the EMH, revealing underlying market inefficiencies. This presents an opportunity for investors to enhance risk-adjusted returns by employing machine learning models to forecast price direction which exhibit persistent trends and are generally predictable, making them lucrative(Henriques & Sadorsky, 2023) . Integrating macroeconomic indicators and technical analysis signals significantly improves prediction accuracy as they are highly successful. The Extra Trees algorithm stands out for being effective for generating actionable NFT coin trading signals. Moreover volume has predictive power for returns and volatility in extreme market conditions, indicating inefficiency in the NFT market, that's why investors should monitor it to their trading strategies(J. N. Wang et al., 2023; Yousaf & Yarovaya, 2022b).

Wash trading exists in NFT markets and can entirely distort the apparent fair value of tokens (Serneels, 2023) in a collection by artificially boosting asset prices and volumes. The strategies implemented to detect suspicious activities are: closed loop token trades, closed loop value trades, and high transaction volumes. Closed loop value trades detected Most suspect wash trades following LooksRare's launch, in addition to identifying most visibly suspect trades and the ability to detect wash trades involving different tokens. High transaction volume detection flags suspicious activity even in the period right after collection launch, attributed to "conventional" wash traders. Some extremely high-valued transactions might not be spotted by the volume-based algorithm if they involve only a few swaps. The authors concluded that wash trading is comparably easy to accomplish in

NFT markets due to the permissionless nature of blockchains and the ability to spawn new wallet addresses freely, and that the LooksRare protocol's reward program incentivized wash trading.

Challenges

While NFTs hold considerable promise as emerging digital assets, they face a range of systemic and human-centered challenges (O. Ali et al., 2023) including usability, privacy, governance, security, extensibility, environmental sustainability, and IP rights. Such obstacles pose significant barriers to mainstream adoption and LT market stability. For investors, acknowledging and understanding these risks is essential for informed decision-making. Proactive engagement with these issues enables better risk prediction and mitigation, especially in an environment where formal research and regulatory frameworks are still developing. As such, due diligence around these structural challenges is critical to managing exposure in NFT investments. While the ecosystem is still evolving with associated risks (from volatility to security), ongoing technical advancements and strategic managerial approaches are addressing these challenges as NFTs move towards widespread exploitation and potential disruption of existing markets (Wilson et al., 2022).

4.2. Gaming (GameFi):

GameFi, a revolutionary concept blending "gaming" and "decentralized finance" (DeFi), is an emerging sector within the cryptocurrency ecosystem. Unlike traditional gaming which is known for its "pay-to-play" and "free-to-play" models where assets lack realworld value and are controlled by developers, GameFi allows players to earn real-world value through Play-to-Earn (P2E) mechanics. This innovative approach engages gamers in enjoyable experiences where they typically earn cryptocurrencies and NFTs, all possessing real-world value.

In their research, Shi et al. (2024) highlighted GameFi as a disruptive innovation. It seamlessly blends gaming, DeFi, and NFTs to forge new economic opportunities for both players and developers. This shift empowers users by enabling true ownership and monetization of in-game assets through NFTs and token-based economies.

Early collections like CryptoPunks and CryptoKitties established the utility of NFTs in digital art and gaming (Proelss et al., 2023). This confirmed that in GameFi, NFTs

tokenize in-game items, enabling true player ownership and facilitating robust secondary markets. Furthermore, NFTs bridge games with DeFi services like staking and lending, creating new revenue streams for developers through royalties and capital raising. This also incentivizes players with actual ownership and monetization opportunities through various platforms and gaming guilds.

Gaming guilds like Yield Guild Games (YGG) exemplify this model. They allow players (Managers) to rent out their NFTs (e.g., Axies) to new members (scholars) in exchange for a percentage of earned tokens. This not only monetizes idle Axies and generates yield on NFT portfolios but also allows guilds to diversify NFT investments across different games and gain early access to new releases. However, despite GameFi's transformative potential, the LT sustainability of many P2E games faces significant challenges. These include economic sustainability issues, an overreliance on a continuous influx of new players, and the inherent risk of in-game currency inflation (Proelss et al., 2023; Shi et al., 2024). Many projects also struggle with credibility due to overpromising and underdelivering on game quality, leading to user backlash and hindering mainstream adoption. Numerous projects lack depth in gameplay and fail to deliver promised quality, ultimately undermining trust. Moreover, there are evolving dependencies between GameFi, crypto markets, and NFTs over different market cycles.

4.3.Luxury:

LBs, which incorporate elements of traditional organizations can effectively use the unique attributes of NFTs (representativity, collectability, and exchangeability) to develop innovative solutions for fundamental organizational issues(M. Kim et al., 2025). In addition, NFTs reshape business models by enabling digital property rights and new value creation avenues by generating new revenue streams, particularly through direct NFT sales and automated resale royalties, are significant for creators(Hofstetter et al., 2022; S. Li & Chen, 2023). Nevertheless, the successful implementation of NFT-enabled organization design is subject to considerable organizational and technological challenges that must be carefully managed These brands can significantly enhance consumer trust and willingness to pay by strategically integrating visually appealing and intuitive NFTs into their product strategies (J. Kim et al., 2025) . These unforgeable digital certificates of authenticity are crucial in safeguarding luxury items from counterfeits, directly

addressing consumer concerns and boosting purchasing intentions. The main conclusion is that Creators should tailor their NFT strategies, prioritizing integration and investment in products where authenticity and counterfeiting are paramount, such as high-end goods, items with active second-hand markets, or automobiles.

Implementing NFT authentication can directly translate into increased sale (Jang & Kang, 2025) by mitigating authenticity risks and providing transparent, verifiable product histories that enhance perceived future value.

There are two aspects LBs should emphasize: Perceived investment potential and uniqueness that are key drivers for young consumers' purchase intention and engagement with Virtual Luxury NFTs (H. Lee et al., 2024a) . Furthermore, Consumer engagement plays a crucial mediating role, converting perceived value into actual purchase intention for VL-NFTs. Brands need to foster engagement to convey value and reduce uncertainty. The motivations for purchasing VL-NFTs differ from traditional luxury, with less emphasis on status signaling and more on personal pleasure and digital uniqueness.

(Cho et al., 2024a) conducted a research that uses only Supergucci in their dataset, where they found that NFTs can serve as effective promotional devices for LBs, creating customer equity that translates into increased purchase intention and projected customer lifetime value. Since the main driver of this research is to look at papers from an investment perspective, the resaleability attribute of NFTs is a significant driver, indicating that these consumers perceive NFTs as potential future economic gains, which is crucial for building their authentic value perception. For brands, this resaleabity was found to positively influence brand respect but no signficant effect on brand love (C. T. Lee et al., 2023; W. Li et al., 2025; Xie & Muralidharan, 2024) which is positively influenced by the attributes of scarcity and authenticity along withrespect (Cho et al., 2024b).

Moreover, another research on Supergucci (Chen et al., 2025) classified investors to three categories: Speculators driven by the investment value of the NFTs, captivated by the historical performance, future growth potential, and offering exclusive early access. For Casual Collectors, interested in the aesthetic, unique, and collectible aspects of the NFTs, developing an emotional connection rather driven by purely financial gain. Finally, for

Cryptocurrency is allured by blockchain integration, security, transparency, and potential for tokenomics or enhanced functionalities.

In China, it was found that all NFT characteristics (NFT scarcity, NFT exclusivity, NFT design aesthetics, and NFT novelty) have a positive influence on consumers' perceived hedonic value, which contributes to their emotional attachment with luxury fashion brands (L. Zhang & Phang, 2024) .

Branded NFTs is a presentation of the brand's identity, and they align with the goals of LBs (Xie et al., 2024) , as their unique value is particularly significant for financially constrained consumers, as it appears to be a compensatory mechanism for perceived resource disparity where uniqueness should be emphasized. To complement the research of H. Lee et al. (2024b); W. Li et al. (2025); Xie & Muralidharan (2024), three more profiles of investors that NFT strategies should be tailored to were identified: Statusseeking consumers, attracted by prestige, exclusivity, and self-expression. Innovative consumers, driven by the novelty, fun, and unique aspects of NFTs. As for financially constrained consumers, they are interested in the exclusivity and unique collectible nature of NFTs rather than solely investment value. This was confirmed by the research of (C. T. Lee et al., 2023); W. Li et al. (2025); Xie & Muralidharan (2024) as Branded NFTs can generate both social value (exclusivity, status signaling) and economic value (financial benefits and investment potential) for consumers.

Going further, and in research where the objective is to explore whether the metaverse can enhance sustainability in fashion or worsen environmental issues, particularly those linked to NFTs it was found that investing in emission reduction capabilities leads to competitive advantages and increased profitability for platforms and brands (Xin et al., 2025) .

4.4 Real Estate:

The tokenization of real estate leads to dispersed ownership of properties, enabling substantial risk sharing across households (Swinkels, 2023). Moreover, Investors with more than USD 5,000 invested generally hold well-diversified portfolios, reflecting sophistication in this new market. These tokens exhibit liquidity in the secondary market, especially on decentralized exchanges, though legal impediments (whitelisting) limit

liquidity which is affected by high transaction fees of ETH (Manahov & Li, 2025; Swinkels, 2023). Token trading on this chain adapts to US dollar fluctuations within a few days, and in the longer term, token prices reflect housing prices, suggesting they behave like real estate investments on a smaller scale. However, Real estate tokenization are accompanied by a risk of cybersecurity enhanced from liquidity to fractional ownership and reduced TAC. As an effect, there is an urge Robust security measures to mitigate direct and indirect impacts of cyber threats and boost investor confidence in real estate token projects, including AI-driven tracking tools and a dedicated cybersecurity fund, are urgently needed. The type of real estate token (investment vs. transactional) and its market capitalization are crucial determinants of its sensitivity to these hacker attacks.

When looking at Decentraland; a metaverse where LAND NFTs are sold; it was found that there is an inefficiency in pricing for LAND NFTs, but despite this, there is a rapid rise in value (Dowling, 2022a). In addition, LAND prices attenuate with distance to roads and attractions, despite access to near-instant and costless travel (Yencha, 2023). For Sandbox LAND transactions, the willingness to pay varies significantly with the token used (Nakavachara & Saengchote, 2022). Specifically, users pay a premium when transacting in SAND compared to ETH. Collectively, these findings reveal that crypto asset pricing is not only sensitive to macroeconomic signals but is also shaped by internal ecosystem mechanics and behavioral perceptions of token quality.

The market has shown periods of both switching behavior from negative to positive autocorrelation (Dowling, 2022a) which led to the conclusion that traders of cryptocurrencies are expected to be leading traders in these NFTs due to their familiarity with cryptocurrencies. Retail investors specifically are motivated to acquire digital real estate for speculative and investment purposes (Ante et al., 2023), seeking financial gains through ST and LT sales, as well as considering saving and staking opportunities. Indeed, the motivations for investing in metaverse land via NFTs are multifaceted, extending beyond pure financial speculation to include interests in technological innovation and the disruptive potential of digital realms. The attraction of this type of investors is achieved by designing engaging virtual experiences that cater to these diverse motivations, including providing clear pathways for financial returns and opportunities for community participation and staking.

4.5. Agriculture and Farming:

Technological innovation has increasingly permeated the agricultural sector, giving rise to concepts such as Smart Farming or Agriculture 4.0, which leverage digital tools, IoT, big data, and automation to optimize agricultural processes. In this evolving landscape, NFTs represent a potentially transformative development

NFT technology could be adapted for certified products to enhance local development (Colamartino et al., 2024), increase knowledge about the blockchain system behind certified products, and protect them from fraud and counterfeiting. These NFTS represent a significant strategic innovation for agri-food firms and consortia where direct implications include the potential for reinvestment in agri-food companies and consortia by positioning themselves in the virtual space. Asset tokenization via NFTs presents a novel Fintech approach to address investment needs for firms.

4.6. Commodities:

GBCs are superior hedging instruments compared to traditional cryptocurrencies, offering effective portfolio diversification and risk reduction benefits, especially during turbulent economic conditions with their generally low positive correlation with other digital assets (Fakhfekh et al., 2024; Maouchi et al., 2024). However, their utility as a consistent hedging tool is somewhat limited by the absence of short selling mechanisms. This means that a hedging strategy might not be feasible for investors who are constrained by a lack of access to short selling opportunities (Maouchi et al., 2024). The behavior of GBCs as safe havens is also not uniform; they exhibit an oscillating capacity between weak and strong safe-haven properties during crisis (Maouchi et al., 2024). GBCs also act as a hedge against NFTs and DeFi which are influenced by market bubbles (Griffiths et al., 2024; Vishnu Prasad et al., 2024).

4.7. Securitties:

After the absence of abnormal returns in the stock prices of four major public ETF issuers on the day of a key court decision concerning spot BTC ETFs which led to the implication that capital markets do not interpret the approval of spot BTC ETFs as a signal for the imminent tokenization of other financial assets (S. Liu & Yang, 2024). These findings are particularly relevant given the widespread belief voiced notably by BlackRock's CEO,

Larry Fink that spot cryptocurrency ETFs represent the first step toward the tokenization of all financial assets. However, empirical evidence does not support this narrative in the ST.

Disclosure quality, benchmarked against more regulated STOs, is a critical determinant of ICO fundraising success, as investors perceive STO-like content as more credible (Chou et al., 2023). High-quality ICOs can differentiate themselves by voluntarily disclosing more information, like STOs, despite potential proprietary costs. White papers serve as crucial information sources for investors in the inherently asymmetric and unregulated ICO market. Effective disclosure content, particularly concerning energy use, green issues, and technology in healthcare, is vital for attracting STO funding. Issuers should prioritize concise, "lightweight" documents and consider providing summaries to enhance comprehension and signal quality.

Investors in STOs are particularly swayed by disclosures on environmental impact and healthcare technology, viewing these as credible signals of quality and attracting interest in high-potential businesses with social and environmental value (Bongini et al., 2022). Voluntary disclosure of such high-quality, specific information reduces asymmetry between entrepreneurs and investors. Therefore, entrepreneurs should prioritize these topics in their white papers, alongside "lightweight" main documents and concise summaries.

The comparative value of STOs and loan guarantees depends heavily on the information environment and project risk level. When information is symmetric, STOs are generally superior due to their ability to diversify risk across investors (X. Liu & Yang, 2023), otherwise high-type entrepreneurs are willing to reduce the loss of information asymmetry by holding a share of equity rather than selling all of it. However, when project risk is relatively low, the need for risk diversification diminishes, making loan guarantees potentially more favourable. This dynamic supports the pecking order hypothesis, where firms prefer debt financing over equity financing under certain conditions. Ultimately, while STOs excel in risk diversification, loan guarantees are more effective in addressing information asymmetry, highlighting the contextual trade-offs between these financing mechanisms.

The burgeoning field of asset tokenization holds significant promise for modernizing traditional financial markets, particularly in addressing the pervasive issue of high TAC and broadening market access (Cisar et al., 2025). Research on blockchain-based bond prototypes demonstrates a clear capacity to reduce TAC across transaction frequency, asset specificity, and uncertainty by streamlining processes and reducing complex intermediation. This mirrors the findings in the Islamic finance sector, where sukuk tokenization, by leveraging blockchain, similarly promises increased operational efficiency, cost reduction, and enhanced transparency essential for Shariah adherence (Khan et al., 2022). Both areas highlight blockchain's ability to replace institutional intermediaries with a trust infrastructure, facilitating nearly instantaneous settlement and reducing reliance on central depositories, thereby opening markets to smaller investors and SMEs.

4.8. Legal compliance:

For investors and asset managers, it is extremely important to stay updated on regulations and fiscality to avoid potential legal problems with regulating entities and understand how it affects their potential income. NFTs are identified as new crypto assets that create new grey areas for tax regulation. The IRS had not released specific tax guidance (it likely views them as collectibles) for NFT trading during the sample period of the study, making the NFT market a challenging area for taxation .(Cong et al., 2023) which explains why there is no impact on the ownership (Balietti et al., 2025) . Some features of NFT transactions are anticipated as taxable events, such as purchasing NFTs with cryptocurrencies, trading NFTs for other NFTs, and disposing of NFTs for other fungible cryptocurrencies. If held longer than a year, collectibles are subject to a special capital gains tax rate of 28%, which is higher than typical capital assets   (Cong et al., 2023) .

While year-end peaks in NFT trading are consistent with tax motivations, the study also notes that this activity could reflect non-tax-related "wash trade" activities which might stimulate demand and pressure the price of these assets upwards. However, it is unclear why such activities would specifically peak toward year-ends if they were purely for demand stimulation holistic approach to crypto tax regulation may push tax-loss

harvesting from one sub-market, like traditional cryptocurrencies, to another, such as NFTs.

Accounting and the classification of tokenized assets is as important as their taxation. However, no studies were conducted on this topic, except for only one (Parrondo, 2023; Umar, Alwahedi, et al., 2022) which explicitly states that NFTs fall outside its scope but it is going to be helpful in paving the way for the first research in the future.

The research of proposes new token definitions for accounting purposes based on legal, economic, and financial criteria, providing initial guidance for IFRS cryptoasset accounting that aligns with established IFRS without requiring new standards. The research concluded that the IAS 32 definition of financial asset should be updated to include security tokens functionally equivalent to securities. classification of tokenized assets should be classified in a step considered to be a big change since digital assets is a decentralized market that follows no regulation. Regulators may differentiate policies by empowering professional creators to make royalty decisions (especially with low royalties to encourage quality) and restricting nonprofessional creators from collecting excessively high royalties to optimize social welfare (X. Liu et al., 2024).

5. CONCLUSION:

With this literature review, we help better understand the topic of Asset Tokenization. We explore and examine the existent literature through bibliometric analysis and literature review on different tokenized asset classes. The articles were retrieved from WoS database from 2020 to 2025. Articles were filtered to correspond to the ABS 2024 journal list, to go through a blibliometric analysis on VOSviewer.

The bibliometric analysis highlights that China and the US are the countries with most contributions to this study trend, with England being the country with more citations and contributions. Additionally, the most cited and contributive journals in the dataset were Finance research letters analogous to (Alshater et al., 2024; Nobanee & Ellili, 2023) findings. For the most cited authors, Dowling is the most cited, where Moreover, University of Lisbon is an institution with more citations regarding Asset Tokenization.

In this literature review, we collected evidence to identify and explain what is currently known about investor behavior in the cryptocurrency market. In summary, we clarify

that(1) NFTs act as Diversifiers and Hedges, (2) Investment decisions are driven by financial and emotional value, (3) NFTs Exhibit High Volatility and Speculative Behavior, (4) it has community with strong social bonds that could be broken when no personal goals are met, (5) NFTs act as promotional tools and brand equity builders as they increase purchase intent and customer lifetime value, (6) Tokenization of real estate enables fractional ownership and broad risk-sharing, especially across households, transforming traditional property markets into more accessible and liquid investment vehicles and they are characterized by lower TAC (7) NFTs for certified products represent a significant strategic innovation for agri-food firms and consortia, (8) GBCs act as a hedge in crisis, (9) In GameFi Strong tokenomics and ecosystem design attract investment (10) Asset tokenization significantly modernizes traditional financial markets by reducing high TAC and expanding market access which was observed in bond prototypes and sukuk tokenization, minimizing intermediation, and enabling nearly instantaneous settlement, (11) STOs and loan guarantees have different advantages depending on the project's risk level , (12) Lack of regulation in most asset classes. These result align with other literature reviews (Al et al., 2024.; H. Bao & Roubaud, 2022; Nobanee & Ellili, 2023).

The main limitations of this research are the lack of data across all asset classes except for the arts class, same for research as tokenization is lacking research in notable assed classes that may land investments in Trillions. The absence of regulations for asset tokenization.

This research holds significant relevance for scholars, investors, and regulatory bodies. It begins by offering a comprehensive bibliometric analysis, highlighting the geographic and thematic distribution of existing research on asset tokenization. This foundational overview enables academics to identify research trends and gaps. Subsequently, the study outlines key factors influencing asset tokenization, providing valuable insights for investors seeking to inform their decision-making processes. Finally, the research addresses policymakers by examining the regulatory implications of asset tokenization, particularly considering concerns that it may contribute to the increasing centralization of digital assets.

Future research should place greater emphasis on examining the distinct characteristics, investor behaviour, pricing dynamics, marketplace structures, and return profiles of various asset classes, particularly those, such as Art, that are anticipated to experience significant growth. Moreover, as the digital asset ecosystem evolves toward increased centralization, this shift represents a substantial transformation with wide-reaching implications. Consequently, further studies focused on regulatory frameworks will be essential to understand and guide this transition.

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Asset Class	Conclusions	Limitations	Future direction
Art	-NFTs are more than just financial instruments; they are deeply rooted in social, emotional, and cultural contexts. -The success of NFTs depends not only on economic fundamentals but also on: Community engagement, Design quality, Public sentiment. -Understanding the complex interplay of these factors is essential for: Investors, Developers, Policymakers -NFTs can serve as Diversifiers in investment portfolios and Hedges against different asset classes	The Lack of Data, some researches rely on customer data which may be biased	Future research should continue to monitor the temporal development of NFT markets, and more importantly study the regulations
Gaming	Strong tokenomics and ecosystem design attract investment. Revolutionizing the gaming industry	The success of P2E games is overly dependent on attracting new users, making them vulnerable to slowdowns in user influx. -Moreover, this type of NFTs is subject to volatility and market fluctions. -Hwavy dependance on the cyptocurrency business.	-Prioritize developing sustainable economic models that Reduce reliance on continuous influx of new users, Support long-term viability of projects -Gain deeper understanding of Regulatory impacts on the NFT and gaming ecosystems and The stabilizing influence of gaming guilds, and Key factors driving sustained success beyond speculative interest -For investors, effective risk mitigation requires thorough assessment Strategic diversification of investments, and Consideration of

			investments in gaming guilds as part of a balanced approach
Luxury	-NFT scarcity, exclusivity, and design positively affect emotional attachment to luxury brands. -NFTs act as promotional tools and brand equity builders as they increase purchase intent and customer lifetime value. -Perceived investment potential and uniqueness are key drivers for young consumers.	Lack of data as some papers relied only on a single brand. -Limited to only Luxury Brands.	Moreover, as discussed in the arts section, we expect studies about return, liquidity, characterestics, and volatility features. We need more studies about investor behaivours, pricing, marketplaces, and comparison to other asset classes.
Real Estate	-Tokenization fractional ownership and broad risk-sharing, especially across households, transforming traditional property markets into more accessible and liquid investment vehicles. -Token prices are responsive to short-term currency fluctuations and long-term real estate trends, reflecting their hybrid nature both as digital tokens and real-world proxies. -there is a cyber-security risk	Lack of data and lack of studies about the returns and the relationship to physical real estate.	Analyze how different regulatory frameworks across jurisdictions affect the adoption and attractiveness of tokenized assets and which approaches lead to more participations of investors. -Examine how traditional financial institutions adapt or respond to tokenized asset frameworks under various regulations.

Agriculture	-Agriculture 4.0 can adapt NFT technology for certified products to enhance local development, increase knowledge about the blockchain system behind certified products, and protect them from fraud and counterfeiting. -NFTs for certified products represent a significant strategic innovation for agri-food firms and consortia. -Direct implications include the potential for reinvestment in agri-food companies and consortia by positioning themselves in the virtual space. -NFTs presents a novel Fintech approach to address investment needs for firms.	-The sample breadth is a limitation, being limited to Italian residents. -The absence NFTs in the market limits consumptive analysis. High HTMT value between Attitude and Behavioural Intention suggests potential discriminant validity problems,	-Testing pilot projects for NFTs on specific certified products to verify the results of this preliminary study and gauge audience reception. Custom surveys by consortia could address sample limitations. Delving into individual product explorations where consortia inquire about the potential appreciation of NFTs for their certified products to guide funding and innovation investments.
Commodities	GBCs serve as a hedge during crisis time.	Research is Limited only to gold. Hedging strategy might not be feasible for constrained investors without access to short selling.	- Extensive empirical investigations to fully ascertain the safe-haven capabilities of GBCs and to explore alternative methodologies for evaluating these digital assets. -Delve into derivative products related to GBCs along with studies on the return of these assets. - Broader research into the tokenization of other commodities, (silver, oil..) prompting investigations into the diverse aspects and implications of tokenizing these various asset classes.

Securities	Asset tokenization reduces high TAC and expanding market access as observed in bond prototypes and sukuk tokenization, minimizing intermediation, and enabling nearly instantaneous settlement STOs and loan guarantees have different advantages depending on the project's risk level	Lack of data for the conducted studies and the limitation of research to only STOs and Bonds	Further research should monitor the development of this category especially since it is receiving the interest of finance giants. Studies should be conducted on markets, regulations, returns and different aspects of all Traditional finance products.
Regulation	Taxable events include purchasing NFTs with cryptocurrencies, trading NFTs for other NFTs, and disposing of NFTs for other fungible cryptocurrencies.	There is a Lack of research. NFTs are still not classified as securities.	- The classification of the fungible and NFTs in collaboration with regulating entities like the IRS, FASB, IASB and others to ensure credibility. Conduct studies of taxation about every asset class.