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Article

NFTS: The evaluation of standards and price volatility

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Abstract: The latest technology Non-Fungible Token (NFT) supports ownership of objects on the internet; everyone wants to reap the maximum of this opportunity. The price of the NFT shot up overnight, creating a market with trading volumes of millions worth, but there seem to be issues related to the legitimacy of this technology. Some countries define the legality of NFTs, cryptocurrencies, and cryptocurrency-based smart contracts, but they are just a handful of them; there requires the assessment of standards in NFT for full-fledged expansion throughout the world. The majority of the problems are related to the security of the users, price volatility of NFTs, and copyright issues. In this research, the evaluation is achieved by applying methods to identify the standards present in the current NFT ecosystem. The methods acquire quantitative and qualitative information to analyze it by designing models based on Correlation and Total Connectedness Index formulas to give the perspective of the inter relation between NFTs and other financial assets and deeply examine the technology's compliance with the regulations like KYC requirements and copyright registrations. The research uses numerical and non-numerical data from various sources, which are familiar with the crypto community. The results manifest the standards of NFTs, stabilization measures to the NFT market, and it guides investors, developers, and entrepreneurs. May be there is a prerequisite for the design change, viewpoint for alternative replacements for establishing smart contracts between the parties engaged in NFT ventures. Contemplating the level of centralization required on NFTs for protection of the stakeholders in the financial market.

Keywords: NFTS; Cryptocurrency; Price volatility; Crypto Community; Blockchain Technology

1. Introduction

A non-fungible token is one of a kind digital object that cannot be interchangeable with another digital object, and each digital object has a unique and irreplaceable identity [1]. NFT is a token assigned to a digital file that consists of a digital form of audio and visual data by signing an Ethereum based smart contract. NFT is operated on blockchain technology for transactions; unlike bitcoin, where each coin is equal and indistinguishable, NFTs are unique and cannot be bought and sold for another NFT [2,3].

The five stages of the NFT protocol as illustrated in **Figure 1**:

1. Digitize: The product's creator should fully digitize it in a format supported by the network. For example, physical forms of art and audio should be captured and converted to png, jpeg, pdf, gif, etc.

2. Store: The data need to be stored in a database outside the blockchain, like cloud storage, website etc.

3. Sign: the creator or owner should sign a contract with the blockchain that

includes the hash of the data and the contract fee, aka gas fee.

4. Mint: When the contract is signed by paying the gas fee minting process begins creating tokens in the blockchain.

5. Confirm: The transaction is confirmed, and NFT is minted in the blockchain with a token address

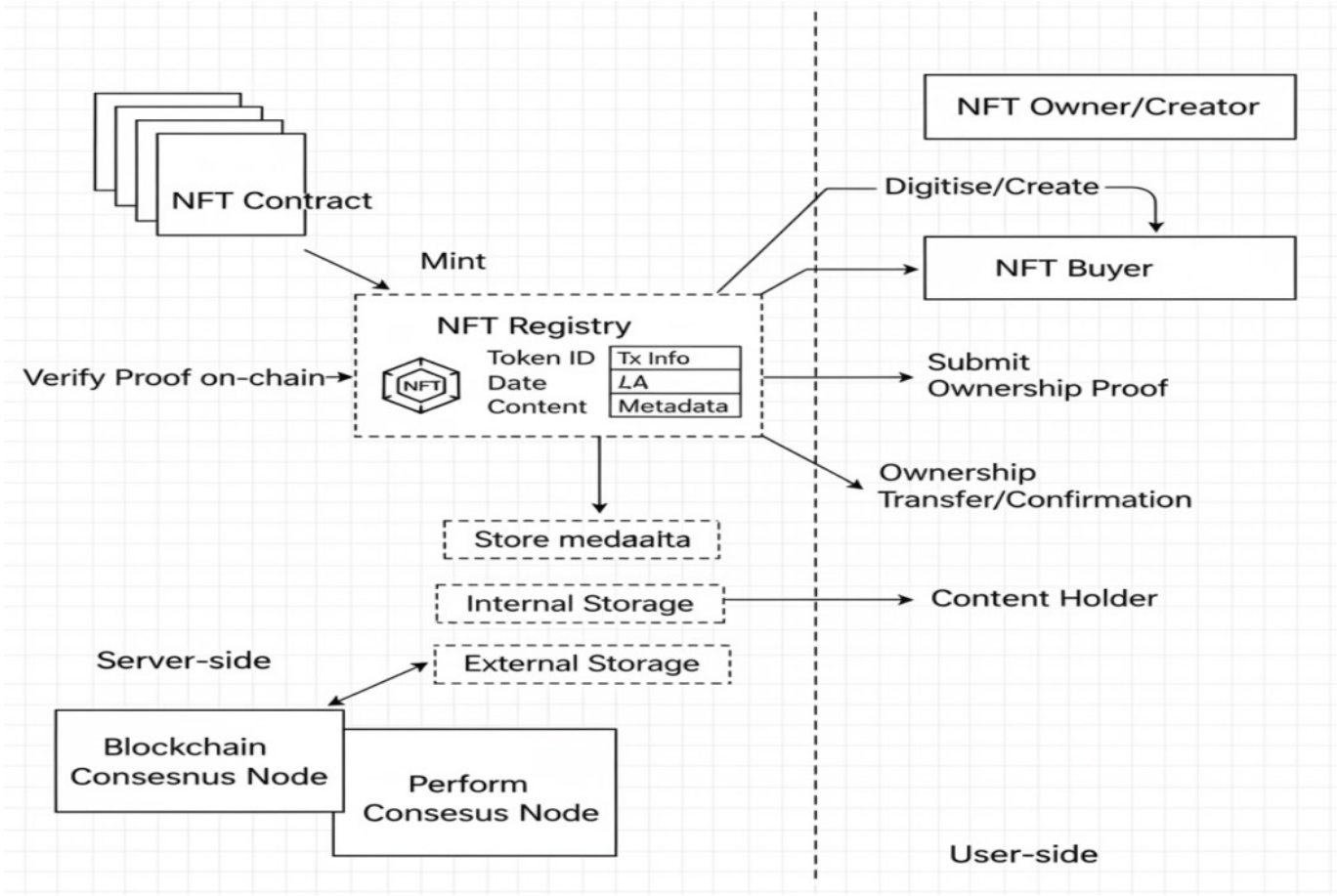

Figure 1. Workflow of NFT systems

In a blockchain system [4], every block has a limited capacity; new transactions enter a new block linked to previous blocks when the capacity is full shown in figure 1. In the end, all blocks create a permanent long-term history. For example, NFT is minted on blockchain and can be sold, and this transaction invokes a smart contract. When the transaction is confirmed, metadata and ownership are added to a block, making a permanent record and ensuring that ownership is preserved. NFTs are intangible [5–6]; the desire for ownership of an NFT depends on the item's scarcity, uniqueness, intangibility and value [7]. NFT are often linked to tangible products or real life services; for example, Sony's "Goosebumps 2" movie offered NFTs, where the consumers could win a ticket to the movie. The buyers of Kings of Leon's NFT album were given access to unreleased music.

2. LITERATURE SURVEY

Non-fungible Tokens have gathered much attention recently for their sky-rocketing prices. In December 2020, the sales were at $12 million but quickly rose to $340 million in just two months [7]. On March 11, 2021, an Art by the artist Beeple

was sold for the equivalent of $69 Million [4]. Millennials are primarily motivated to invest in new projects like NFTs; Some have gone far as to invest their life savings in NFTs. Ultimately, there is an element of risk associated with new technologies as they are not secured and are not backed by any authorized institution. As a result, NFTs introduced financial [8–10] instability and increased volatility in market prices. But most believe that regulation can boost exponential growth in the world economy [11,12]. Further, there has been increased fraud related to money laundering, terror funding and theft by link disappearance [13]. The threshold for copyright protection is considered to be low in NFTs. Most countries have not announced the legality of NFTs. El Salvador is more favorable to making most crypto projects legal. Recently, India has declared a tax on crypto assets, raising profit from minting and mining crypto assets.

Currently, NFTs are developed on the blockchain, which is reputed for its security assurance, but most cryptocurrencies based on blockchain are highly volatile. NFTs have attracted the market because of their decentralized nature. In contrast, copyright protection implies sharing information with centralized institutes. Therefore, the problems of NFTs are interlinked to each other. The risks associated with NFTs are fraud, legitimacy, volatility, copyright infringement, and security threats. For NFTs to sustain themselves in the market, they need to address some of their risks. The research dissects the risks associated with NFTs and analyzes the problems to standardize and stabilize the NFTs, which benefits the stakeholders. More particularly, NFTs must overcome a trilemma of price instability, copyrights, and security issues shown in **Table 1**.

Table 1. Literature Review and its Relevant Research Outcomes

Reference	Parameter	Description	Relevance to Your Research
[14]	Market Dynamics and Price Volatility	Studies on the price fluctuations of NFTs, examining the factors influencing volatility.	The research will explore quantitative models for price stability and volatility, analyzing correlations between NFTs and other financial assets like Bitcoin, Gold, and S&P 500.
[15]	Blockchain Technology and NFTs	Literature on the role of blockchain in ensuring the security, immutability, and decentralization of NFTs.	Focus on the transparency of the technology and how blockchain's decentralized nature leads to anonymity and security issues. Your work will look at the standards for smart contracts in NFTs.
[16]	NFTs and Cryptocurrency Correlation	Research on the correlation between NFTs and cryptocurrencies like Bitcoin and Ethereum, and their impact on pricing.	The aims to model and analyze the relationship between NFTs and cryptocurrencies, contributing new insights into price volatility in the NFT market.
[17]	Security Concerns	Exploration of security risks associated with NFTs, such as fraud, hacking, and lack of transparency in transactions.	Assess Security enhancement mechanisms for NFTs, focusing on KYC/AML compliance and mitigating risks such as money laundering and terror financing.

Continuation Table:

Reference	Parameter	Description	Relevance to Your Research
[18]	Copyright Issues in NFTs	Discuss the role of intellectual property laws in the creation, sale, and ownership of NFTs.	Research will focus on the lack of copyright protection for NFTs and propose models for compliance with legal frameworks to protect creators' rights and prevent infringement.
[14]	NFTs as Financial Assets	Research on how NFTs are viewed as investments and the challenges they pose in financial markets.	You will evaluate how NFTs can be standardized as viable financial assets and the effects of price stability and volatility on their long-term investment potential.
[18]	Standardization of NFTs	Literature that focuses on the standardization of NFTs and the need for uniform regulatory frameworks.	Research addresses the gap in NFT standards by proposing a model to regulate smart contracts and ensure compliance with global standards.
[12]	Regulatory and Legal Frameworks	Studies that examine the role of regulation in the NFT ecosystem, focusing on policies for anti-money laundering (AML) and know your customer (KYC).	Plan to assess NFT market regulations, exploring the implementation of KYC/AML standards and how this can help mitigate the current legal and security challenges.

Problem Statements

Carefully evaluate the problem regarding stakeholders' security in NFTs, the pricing volatility of NFTs, and Copyright issues on minting NFTs.

• Security

Stakeholders' security depends on the technology's transparency; the tech's anonymity can make it more difficult for the investigation to have regulatory standards [19]. Therefore, analysis of the security of NFTs, transparency entanglement to security, and implication of centralised institutes is required.

• Price

Most NFTs are sold as art pieces; taste changes when the art horizon gets longer and the value of the art gets volatile. The price of bitcoin and Ethereum is positively correlated to NFTs [4]. Bitcoin is a volatile asset like NFTs, and there needs to be an investigation of the price correlation between NFTs and other assets.

• Copyrights

NFTs provide ownership of digital assets, which must be governed under property law. Records of NFT transfers should be registered in the copyright office [20]. When converting the digitized file to an NFT on the exchange through minting, there could be an infringement of Copyrights [21]. There seems to be no law to control the minting of NFTs; several copies of original work are produced as NFTs. Most exchanges are unregulated, and There are thefts of millions worth of NFTs. Personal information, Metadata, and intellectual properties are at risk.

Scope of the Study

The boundaries of the research can be defined as reviewing and analyzing scientific papers related to the study of blockchain projects and blockchain-based applications. NFT related security threats, security enhancement, copyright infringement, copyright security, and correlation of blockchain-based assets like

bitcoin NFTs with other traditional financial assets. A survey on key terms like NFTs, Bitcoin, blockchain, standards associated with a financial asset, Stocks, S&P 500, Gold, etc. Data extracted from popular, trusted sources like coin market cap, coin gecko, and Google finance for real-time and recorded information.

The research aims to assess the standards in the NFT ecosystem, develop a standardized NFT prototype model and provide guidance for the stakeholders. The research time plan is restrictive and is limited to 30 weeks. The time constraints could reflect the complexity and quality of the research; however, the method is simplified not to have a substantial impact on the quality of the research. Another major limitation is that the technology is constantly evolving, which requires a change of opinions, and the opinions are limited to the data reviewed by the scientific community; a massive amount of data is under review. Unlike Bitcoin or blockchain, there are very few journals published on NFTs as of 2022, and there is a gap between academic research and practice [22]. The source for data is mainly obtained from online platforms like IEEE, ScienceDirect Etc. There is no requirement for a specific location as a target because blockchain and NFT are global phenomena.

However, some jurisdictions are proactive, and some have banned the use of blockchain and Block-chain based applications.

Standards in Blockchain

Blockchain is a digital ledger instead of a traditional paper-based ledger. Blockchain belongs to the family of DLT. Blockchain is a synchronized sharing and distribution of ledger to all the nodes in the database where transactions are verified by a consensus mechanism, creating blocks interlinked by cryptographic hash. Blockchain creates immutable, irrevocable blocks of transactions, solving the problems of double spending, trust lessness, transaction costs and security. Blockchain has huge potential to replace the existing monetary system and facilitate smart contracts on the internet. Smart contracts are computer codes on DLT like blockchain or Hyperledger, encrypted with conditions agreed between the parties [23]. However, the government has reasons to support blockchain, the expectations from the public need to be carried out by better policy implementation and gain the public's trust. Government is centralized, and Blockchain is an opportunity to propose decentralization to the citizens. Blockchain is permissionless, and blockchain standardization is significant for implementing blockchain in government applications. Standards in industry impact the various actors like consumers, regulators and creators or manufacturers of the industry. Standards eliminate deliberations and discussions which can influence the operation and implementation of the technology. Standards are guidelines.

Blockchain Trilemma

To demonstrating blockchain to be a disruptive technology, technical challenges need to be addressed, and Blockchain trade-offs like security, decentralization and scalability need to be considered. Blockchain "Scalability Trilemma" was proposed by the founder of Ethereum, Vitalik Buterin. According to Vatalik, achieving trilemma is possible by building a blockchain that offers security, decentralization and scalability without compromising any of them. Presently, blockchains provide only two of the proposed variables. For example, Bitcoin provides security and decentralisation, but scalability is compromised [24].

The scalability of blockchain can resolve by layer one and layer two technologies. One of the Layer 1 solutions is to fork the existing blockchain, which can be a hard or soft fork. A hard fork is updating the software, which runs separately from existing software. In contrast, a soft fork is updating the software, which is

compatibility with the previous version of the blockchain. For instance, Bitcoin has a block size of 1 MB, and it can process 4000 transactions in a block every 10 minutes, resulting in a speed of 7 transactions per second. For this reason, Bitcoin was hard forked to bitcoin cash with a block size of 32 MB. Further, bitcoin was soft forked to have 20 transactions per second in an update called Segregated Witness, AKA Segwit. Another Layer 1 solution is to change the consensus mechanism from Proof of Work to Proof of Stake. Proof of work requires higher computational resources to validate the blocks and slows down the blockchain, Whereas the Proof of stake is lighter and requires considerably lesser computational resources. Proof of stake increases transactional speed [1], which was a major trade-off of blockchain trilemma; Ethereum has successfully implemented Proof of Stake called Casper. Blockchain Sharding is considered to have solved blockchain trilemma [2], but only theoretically. Sharding is handling separate functionalities in multiple chains to support parallel computations. However, Sharding has a drawback of security attacks when working on the Proof of Work consensus mechanism. Layer-2 solutions are off-chain upgradations.

The two prominent layer-2 technologies integrated into the blockchain are State channels and side chains [3]. A State channel is a private connection to record transactions and report the end status when they are complete to the blockchain. A lightning network is developed for bitcoin to establish a state channel to record transactions between the parties approved by providing their signatures. The security is ensured by having the parties' signatures, notwithstanding that side channels are vulnerable to malleable attacks. In fact, in march 2018, DDOS attack affected 20% of the lightning network. A Sidechain is creating a child chain from the main blockchain. A Sidechain need not broadcast all the transactions to the main chain. However, they eventually update the end state to the main chain. A side chain called plasma was developed to solve the problems of Ethereum; it is prone to 51% attack; it is far from actual deployment.

NFT concerns: NFT standards require more accountability, transparency, and usability for the stakeholders. NFTs seemed promising for their immutability [5], but this feature could bring new issues. The design of the NFT cannot be altered once deployed on the blockchain. There is a concern for the contract to comply with copyrights, transparency, transfer of ownership, regulations, etc.

The immutability quality of the NFTs does not provide the flexibility that a contract requires, and the design of the NFTs needs to be oriented to meet the constant improvements [9]. Standardization is considered standard practice when two or more parties come into a contract by drafting the terms. Otherwise, there is a tremendous advantage for the influential players in the market over the others. The anonymity of NFTs using blockchain [6] with the immutability of contract can advocate the powerful to win against the vulnerable part of the traders who deserves more protection. Regulators have outlined accounting and bookkeeping requirements for companies and transparency of transactions from companies and individuals to eliminate money laundering, tax evasion, and other fraud.

UETA laws are meant to streamline commercial activity online across various jurisdictions. The law permits digital signatures to be accepted, giving the same weight as handwritten signatures. This law lowers the information that needs to be shared by NFTs and cryptocurrencies for compliance with the regulations. The effectiveness of the accountability measures to the extent that enables investigation

and provides evidence for the prosecution, blockchain hinders this facility. From the regulator's perspective, there is a concern for protection, evidence, and transparency. The users must deal with their asset ownership, Copyright Issues, and stolen intellectual property. Investors [25] must assess the risk involved in trading, privacy, and tax compliance.

Coherence of NFTs: They were determining the asymmetric correlation between price and volatility for cryptocurrencies like bitcoin, Ethereum, Ripple, and Litecoin from June 1, 2016, to December 28, 2020. Cross-correlation is stronger in a downtrend of BTC and ETH, and cross-relation is more robust in an uptrend of XRP and LTC [15]. The investigations show that there is higher persistence in uptrend compared to downtrend. Financial regulators and investors can assess the volatility behaviors of cryptocurrency markets on different time scales.

NFTs [14] have a higher return than any other traditional financial assets; a more elevated risk is associated with high volatility. Average monthly returns are from 6.10% to 44.11%, and the standard deviation fluctuates between 44.35% and 74.57% [17]. The movement of the NFT index is correlated to cryptocurrencies and stocks. When investors' wealth aggregates, they look for new opportunities like NFTs.

There is an influence of bitcoin on NFTs, as there is a co-movement of prices during the covid period. Documenting the coherence between NFTs and five other major financial assets is predominantly high during the pre-covid and pandemic. In the pre-covid period, NFTs lagged behind bitcoin and led Gold. The coherence with the major assets increased during the first half of the pandemic [18]. After a successful vaccination campaign, stronger coherence exists between NFTs and BTC with technology-driven growth in the 2nd year of the covid-19 pandemic. However, further research is required in this domain, market sentiment interrelations and coherence with other major cryptocurrencies like Ethereum¸ ripple, etc., and Defi coins.

Security Concerns on NFTs: Security challenges of NFTs cover investors risking controversies, criticism, and cybersecurity. NFT criticism concerning digital art being used as an instrument to launder money across international borders. Minting NFTs from pseudonym profiles facilitates money laundering and terror financing risk. NFT marketplaces haven't imposed KYC regulations;

KYC-free transactions can impact the technology's credibility. Financial Action Task Force (FATF) develops policies for anti-money laundering, terror financing, and financing proliferation of weapons of mass destruction. The FAFT recommends global anti-money laundering (AML) and counter-terrorist financing (CFT) standards and released crypto guidance [19]. FATF suggested that standards be implemented on NFTs as financial assets though it is excluded from virtual assets. Nifty Gateway, users unregister with 2FA had been hacked, and their NFTs [20], credit card information and NFTs bought with their credit cards were stolen. An anonymous individual with the pseudonym Monsieur Personne ran an " NFTheft" project to expose the vulnerabilities of the NFT ecosystem. He used "sleep minting" to duplicate Beeple's "Everyday" artwork. He listed the art artwork on Opensea and rarible. Eventually, the listing was taken down; this incident raised many questions about the NFT ecosystem.

The platforms delist the artwork can centralize the NFT marketplace, impacting the value proposition and economic model. Private keys stored in a centralized location by the exchanges are at risk of being prey for hackers.

Most fintech apps have made the 2FA authentication mechanism compulsory to strengthen security. However, experts believe that users' data ownership should be decentralized.

Environmental Challenges:

There are several controversies on NFTs related to higher gas fees and environmental concerns. For example, ETH transactions reached 1.5 trillion in a quarter of 2021, breaking all-time highs yearly; the adverse reports on higher gas fees and electric consumption for processing the transaction worry the investors.

Copyright issues

Further, there are accessibility challenges for crypto-illiterate users, and the technology is changing so rapidly that it is extremely troublesome to be updated. Many investors in the financial market are not tech-savvy like the younger generation with meagre savings; losses can be made with just a click of a button, and convincing investors to the NFT marketplace will be strenuous.

Establishing legal ownership of assets on NFTs can still challenge the creators. Transferring and owning the NFT assets internationally across borders and working with laws related to Intellectual property in various geographies can be a monumental problem [21]. Ownership of NFT does not guarantee the recognition of the transaction; in a particular jurisdiction, it all depends on the smart contract made on the blockchain. NFTs are highly dependent on the legality of the cryptocurrency it is minted [22]. Experts urge that the copyright of the artwork should remain with the artist but not the technology. Therefore, it is essential to know that the creator of the NFTs should have the copyrights and ownership of the original artwork. Even when the copyright is transferred, the author of the artwork remains unchanged.

Most brands like NIKE, GUCCI, and Rolex sell their NFTs while claiming ownership titles over physical products; consumer fraud can be eliminated in this. Nevertheless, most NFT sales on the platforms do not hold any license for minting, transferring, and reselling, making these tokens just an informal agreement between buyers and sellers.

Comparing Traditional Art and NFT Art

Artists like Beeple have tied their art to NFT; they retain the rights to reproduce the jpeg image and acquire automated royalty when it is resold. At the same time, [19] Traditional art can be tough to reproduce and get royalties on counterfeits. According to [26]. NFT should be considered as an ownership document that comes along with the original Picasso.

An art expert verifies the ownership document and the originality of Picasso, and the world accepts the ownership of the original Picasso. NFT makes it possible to verify the ownership of digital art. Many counterfeit Picassos exist over the limited supply of valuable art from the artist, [27]and the experts can identify the owner of the legitimate Picasso. It used to be impossible to trace the owner of the digit art before the invention of NFTs; Multiple copies are reproduced and shared with a click of a button. Since copies were made indefinitely, there was no way to bring originality to digital art; NFT has changed all this. NFT has changed the life of Art and Art creators; NFT has brought the tremendous potential to Blockchain other than investments in Ethereum and bitcoin. The artwork has become the main purpose of NFT after the greatest sale of Beeple [27]. Some of the artwork has sold for millions of dollars, and many successful art projects like CryptoKitties, CryptoPunks, Bored Ape, Meebits, Cool Cat, ZED RUN, Hashmask, and NBA Top Shots shown in the **Figure 2**.

Figure 2. Popular NFTs: CryptoKitties, CryptoPunks, Bored Ape, Meebits, and others

However, the price of art is determined by the cost, size, type of art, and buyers' income and aesthetic quality [13]. The quality relies on the artist who has been chosen by the representative from the art community based on his background (career, school, achievements). The price of the art is correlated to the wealth of the buyers [14]. Therefore, the investment in art is highly riskier than financial assets [22] and real estate. Smart contracts and royalties are the greatest prepositions of NFTs. Royalties of 10% to the artists have become the market standard for the NFTs [21]. NFTs markets are more appealing than traditional art markets because they are faster and more democratic. The success ladder in the traditional art market is highly strenuous, and it takes years to get noticed as an artist. Often gallery directors charge hefty commissions of up to 50% on the art sale. NFTs are the most suitable alternative, and they are immensely automated; they are not complicated though they charge a certain fee for minting the NFT, and royalties can be coded into the smart contract. Depending on the superior technology, the prices of the NFTs have sky-rocketed; NFTs do not provide the physical experience like the traditional art. The author demonstrates that millions of art appreciators travel to see the painting of the Mona Lisa. This explains that physical and original art has greater value when compared to the original digital art and copies of digital art as they are identical. It is hard to determine the value of original artwork without or combining NFT technology; however, it was impossible to assign value to any digital art before NFTs and blockchain technology. NFTs accelerated the growth of creators, artists, collectors, and developers who bring novel ideas to the world.

Collectibles: Collectables are unique items with low intrinsic value with their selling price, and the price is driven by scarcity and emotional factors; collectables are also known as emotional assets; the assets provide the owner higher utility in terms of aesthetic value [28].

NFT collectables were introduced in 2012 as bitcoin's "colored coins," representing physical assets like real estate properties, bonds, and cars. NFT collectables were implemented in 2017 as a digital collectable game CryptoKitties [29].

CryptoPunks: CryptoPunks is a collection of 10,000 uniquely computer-generated characters with ownership stored on the Ethereum blockchain [30]. CryptoPunks is a 24X24 pixel image launched by Larva Labs inspired by the style

of the 70s London Punk scene, 90s cyberpunk, and 80s video games [12]. Of these 10,000 characters, there are 11 different types, more than 6000 male and 3840 female in 4 skin tones, 88 are zombies, 24 are apes, and 9 are Alien CryptoPunks [21]. There are seven attributes, like traits or additional features, to these characters, including a beanie, a mohawk, and 3D glasses. CryptoPunks are computer-generated images using an algorithm for making 10,000 combinations by assigning skin tone, type, and attributes. These images are launched as NFTs by Larva Labs.

Initially released for free, all the CryptoPunks were claimed and traded on Larva Labs or OpenSea. A year later, a CryptoPunk was sold for 3500$. As of February 2022, the lowest price of a CryptoPunk is 200,000$. Crypunks have attracted imitators like CryptoPhunks, created by Not Larva Labs. Cryptophunks copied the entire 10,000 collections and flipped them facing left from right, and were sold as NFTs with a selling price of 2000$. This was a major copyright issue faced by Larva Labs, and they were distressed by this. Larva Labs filed a DMCA notice to delist Cryptophunks from Opensea [22]. Nevertheless, Not larva labs CryptoPhunks were relisted, and Larva Labs could not do anything about it. CryptoPunks faces copyright issues for infringement by CryptoPhunks, as the NFT technology by itself does not protect against copyright infringement.

CryptoKitties: Cryptokitties is the first popular game which brought collectables minted as NFTs to gaming at the end of the year 2017. Crykitties is a web browser game where cute looking digital kitties are minted and sold as NFTs; players purchase these kitties to breed them to reap new, rare and beautiful kitties and trade them online [31]. There were many similar games in 2017 which did not manoeuvre blockchain technology like DragonVale, Neopets, and Ovipets. Although some games used in-game currency, CryptoKitties brought in-game value to the real world using Cryptocurrencies. Cryptokitties run on an expensive gene mixing logarithm to create a new cat; this complex logarithm has clogged the Ethereum network [22].

Bored Ape Yatch Club: Yuga labs produce the Bored Ape Yacht Club (BAYC). Gargamel, Gordon Goner, Emperor Tomato Ketchup, and No Sass are the Pseudonyms of the developers who developed BAYC.

There are 10,000 different Bored Apes minted on the Ethereum blockchain as ERC-721 tokens. Bored Apes have 170 qualities with various expressions, hats, attire and more; qualities define the rarity of an Ape. Bored Apes were sold out in 12 hours at a price of 0.08 ether [31], or 190$ [23]. Bored Ape adopted the De-Collab business model; unlike a typical NFT license, the BAYC license grants rights for the buyers to commercially use the bored ape characters; the license is unlimited to use, copy and display. This unusual NFT model made the BAYC exceptionally successful, and the sales have reached beyond $1 billion. The Bore Ape holders get excess to BAYC membership, which provides exclusive members only benefits. BAYC community organized exclusive parties for the members in the NewYork. The BAYC is active on Twitter, discord, YouTube and Instagram. BAYC established the Bored Ape Kennel Club (BAKC) to adopt NFT dogs. Another interesting launch is that Bored Ape owners can mix mutant serum to produce Mutant Ape NFT and be a part of the Mutant Ape Yacht club (MAYC). Many celebrities like Snoop Dogg, Justin Bieber, Jimmy Fallon, Serena Williams and Neymar are all owners of Bored Ape. Most of the owners had changed their Twitter handle profile pictures to Bored Ape NFTs. Jimmy McNelis Owned four Bored Apes and signed a music deal with Universal Music group in a Kingship music band featuring four Bored Apes. Music

Producer Timbaland collaborated with Bored Ape under Ape-In productions to form a music band in Metaverse exclusively for Bored Ape owners [24]. Yuga Labs signed a contract with Guy Oseary to develop media projects for Bored Apes [25]. The Bored Ape has become a status symbol for the ultra rich with its popularity. Adidas has associated with BAYC to enter Metaverse.

CBDC: CBDC could be an alternative to blockchain contracts, and it could provide partial anonymity, set transaction limits, make anonymity conditional and can be removed by a court's order [32]. Central banks of Canada, China, Norway and Sweden are working to conduct an experiment to determine the degree of anonymity required for households on payments and to explore the potential of CBDCs [33]. CBDC can be designed to provide anonymity and not compromise on security, for example, the anonymity can be preserved by the third parties, and the data can be stored with the central banks, but the data can be accessed only at the time of transaction limit is breached, or there is a suspicion of fraud.

Furthermore, the interest rate on CBDC becomes optimal when it is used to ensure that cash remains in use. However, the interest rate can be brought down to zero. There are recommendations for blockchain in the design of CBDC; a major limitation of blockchain is transaction speed [34]. Countries like the Bahamas, Russia, Turkey, Canada, Eastern Caribbean, and Kenya recognise the vast potential for public utility. The Central Bank of Bahamas has launched Sand Dollar as CBDC to the public [23]; it is a substitute for cash payments.

To deepen the theoretical foundation of the study, it is crucial to integrate financial market theories that explain the relationship between systematic risk and trade tariffs. Modern Portfolio Theory (MPT) and the Capital Asset Pricing Model (CAPM) are particularly useful in understanding how trade tariffs may impact asset prices and overall market risk [35]. MPT suggests that tariffs, as an external economic factor, could disrupt the risk-return trade-off in investment portfolios, leading to heightened uncertainty and volatility. Similarly, CAPM highlights how the imposition of tariffs may increase the systematic risk (beta) of financial assets, including NFTs, as market participants adjust their expectations. Behavioral Finance also offers insight into how investor sentiment could drive increased volatility in the NFT market, especially during periods of heightened economic uncertainty caused by trade policies. Thus, the relationship between trade tariffs and systematic risk may not only be a direct economic consequence but also a psychological response from investors, which can magnify volatility. In examining the results of this research, it is essential to consider these theoretical frameworks to interpret the economic implications of observed correlations and causalities between NFT prices and other financial assets, such as Bitcoin and gold. The influence of tariffs on systematic risk and the subsequent impact on digital asset markets like NFTs warrants further investigation within these established financial models.

3. RESEARCH METHODOLOGY

For rapid expanding technology like NFTs, there is a strong demand for standardization of digital technologies and their usefulness of it. Standardization of targets includes credentials protection, Security, compliance with intellectual property laws, etc.; The target of this research is implied to solve the problems of the NFT trilemma, i.e. price stabilization, Copyright protection and Security.

The flow of the methodology is discussed in detail below.

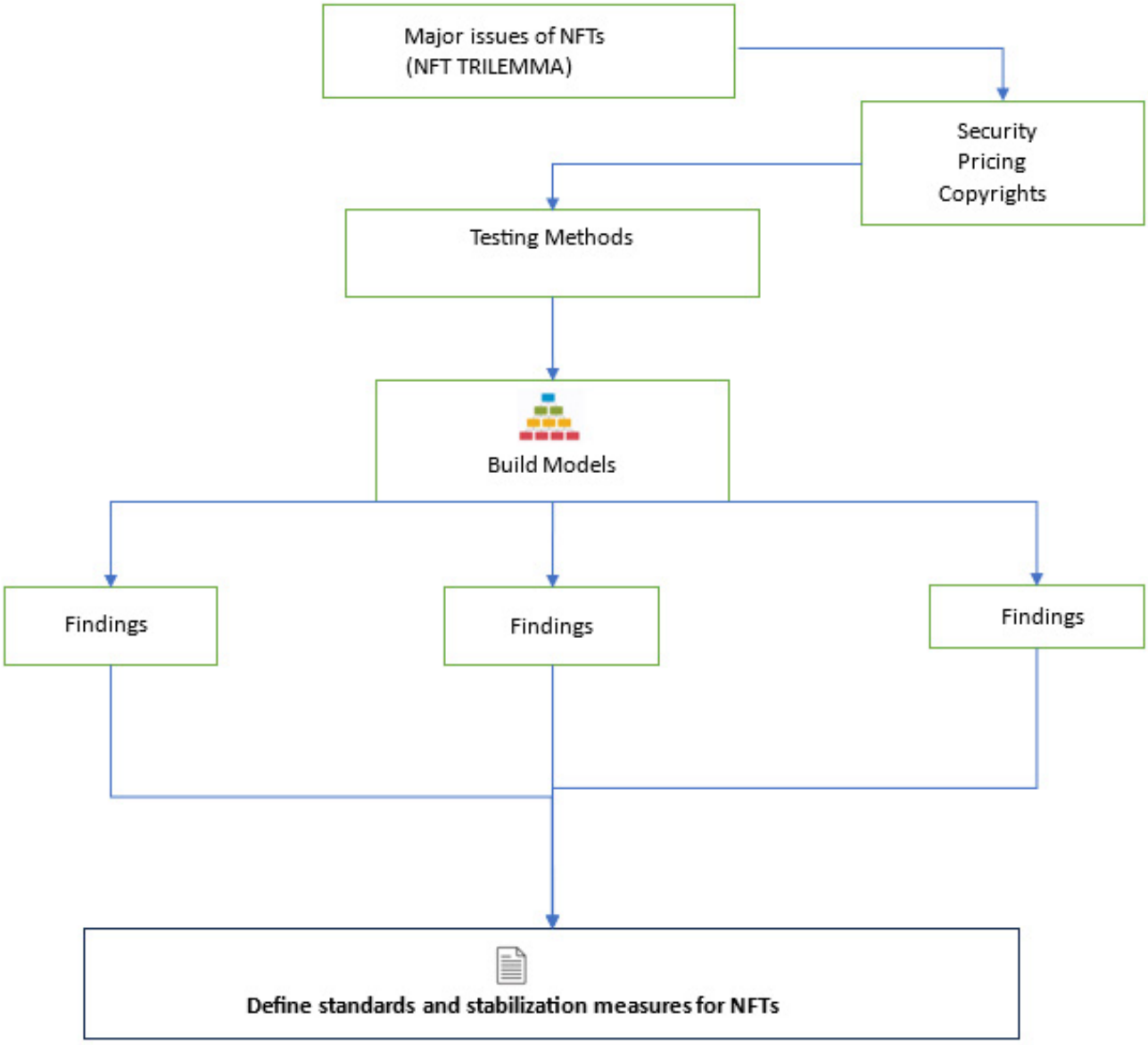

Figure 3. Flowchart- Research Methodology of the NFT Stabilization

The flowchart (**Figure 3**) demonstrates the identification and evaluation of standards related to these targets. Further, the evaluation proceeds with methods for the targets; the methods can have equations and formulas applied to the datasets available to build models. Finally, studying these models can establish connections, unravel the confusion, and provide answers.

Data Requirements Analysis

This research considers NFT prices traded on NFT exchanges like Rarible.com, and OpeanSea. Cryptocurrency prices can be obtained from prices traded on binance.com or from coingecko.com for real-time prices, S&P500, and gold prices from google.com/finance. Data collection from every quarter (Q1, Q2, Q3, Q4) from the beginning of 2019 to 2021 is analyzed using the formulas proposed in the method. NFT sales data from popular crypto information providers like coingecko.com and coinmarketcap.com.

Method

• There are several advanced methods to identify the efficiency of NFT prices;

depending on the available time, the Pearson correlation coefficient (PCC) has been used to analyze the relationship between the explosive behaviour of cryptocurrencies [26].

Cross-correlation methods were used to determine the asymmetrical price volatility in cryptocurrency markets [33]. The below method is a simple method applied to produce price relation and price efficiency results. Keeping in mind the time available for the research, we have chosen a simplified formula for finding the correlation between NFT and cryptocurrency or traditional financial assets. Below equation 3.1

$$\rho_{XY} = \frac{\sum_{t=1}^{T}(x_t - \bar{x})(y_t - \bar{y})}{\sqrt{\sum_{t=1}^{T}(x_t - \bar{x})^2 \sum_{t=1}^{T}(y_t - \bar{y})^2}}$$

ρXY = Correlation coefficient between X and Y

x_t and y_t = Prices of assets X and Y at time t

$\overline{x}$ and $\overline{y}$ = Mean prices of assets X and Y over the time period

T = Total number of data points

Eq.(3.1) is simplified to derive values directly from the datasets, which don't require extensive calculations. In Eq.(2) $\hat{\rho}$ =Correlation coefficient, xt and yt are the values of XY at time t, the mean of X and Y are $\overline{x}$ and $\overline{y}$ respectively.

$$\bar{x} = \frac{1}{T}\sum_{t=1}^{T} x_t$$

$$\bar{y} = \frac{1}{T}\sum_{t=1}^{T} y_t \tag{3.2}$$

$\overline{x}$ = The **mean price** of asset **X** over all the years being analyzed.

$\overline{y}$ = The **mean price** of asset **Y** over all the years being analyzed.

Here in Eq (3.2), x_t is the price of an asset at a quarter (Q) of a particular year, y_t is the price of another asset at a time, $\overline{x}$ and $\overline{y}$ are the mean of prices of all the years.

• The result of the Correlation formula is expected to be between 1 and -1. If the result is positive, there is a direct positive influence of the price of an asset on the price of NFT.

When the coefficient value is -1, then there is opposite relation to the price on NFTs. 0 is neutral relation and does not follow any market trend. The formula is applied to find empirical results in NFT markets. To investigate if there is a relation between the NFT market and real-life incidences like financial crises or elections like other financial markets [23] The test involves an examination of quarterly prices [27] for the last 3years of bitcoin, Ethereum, NFTs, S&P500, and gold. Having the values represented on a graph to deeply analyse the price fluctuations.

High volatility does not comply with the efficient pricing of NFTs; therefore, it requires policies that will maintain the consistency of NFTs. Consistency is an essential factor in standardizing the NFT ecosystem.

This section presents the interconnectedness of various variables as measured by above equation, the total connected index (TCI). To measure systemic risk transmission, interdependence, and connectivity of the assets under analysis. TCI evaluates NFTs as transmitters or receivers of shocks to other assets like BTC, ETH, bonds, and gold during market crashes and regular times [27]. This provides ample

information for diversification and hedging benefits, weak or strong interactions of NFTs with other financial assets for NFT investors.

The cyber security method will analyses illicit activities and fraud that occurred in recent times. Analyze the performance of NFTs produced on the most secure blockchains. The security depends on the transaction volume the cryptocurrency can establish in the market. With the anonymity of Ethereum, can the NFT have contracts with other existing technologies that are more secure in terms of fraud and investigation of a case related to obscure transactions? Deploying the NFT ecosystem on Ripple is not entirely anonymous; when the transaction is distributed among various routes, some of the information can be tracked from the path the transaction is processed [26]. CBDC is a concept proposed by many governments to control crypto developments over anonymity issues. The higher the anonymity, high is the risk [6]. The method here is to analyses the level of security provided by different crypto technologies minting NFTs.

• Copyrights can be sorted with a design to make them transparent enough to the institutes of the govt authorities. Various algorithm composition methods were proposed to analyses copyright protection provided by different technologies. Researchers found that blockchain and deep learning+ blockchains provide maximum protection [30]. Nevertheless, here, we need to analyse the NFTs that are licensed by copyright law.

The method involves searching, selecting, and analysing the volume of NFTs that comply with the law.

4. EXPERIMENTS AND RESULTS

This sub-section describes the Data preparation for model testing. The time considered here is for the last three years, 2019, 2020, and 2021. The Assets are Gold, Bitcoin, S&P 500 and NFT – CryptoPunks.

Table 2: Dataset of quarterly prices of Gold, Bitcoin, S&P 500 And CryptoPunks in the year 2019, 2020 and 2021.

Assets	2019 Q1	2019Q2	2019 Q3	2019 Q4	2020 Q1	2020 Q2	2020 Q3	2020 Q4	2021Q1	2021 Q2	2021 Q3	2021 Q4
Gold	41.43	44.54	48.20	48.60	50.90	57.20	60.60	60.80	54.14	57.15	56.00	58.75
Bitcoin	4103	11972	8250	7240	6403	9185	10700	28837	57634	34600	41587	47191
S&P 500	2834	2941	3000	3235	2500	3100	3300	3756	4000	4297	4307	4766
NFT	1	93	22	49	233	754	2497	6780	9136	35	365	225
CryptoPunks	141	270.93	110.22	124.49	233.49	754.08	2497.06	6780.47	91369.97	35000	365025	225751

The prices are recorded from the last month of each quarter, i.e. 1st–31st March, 1st–30th June, 1st–30th September, and 1st–31st December. Most of the Data is acquired on the last day of the last month of each quarter for Gold, Bitcoin and S&P 500. Crypunks were known to few Crypto stakeholders, and it was an underdog technology in its initial stage. As a result, the extraction of information is hugely onerous. Though information is available from 2018, full-fledge tracking of the Crytopunks tracking began in the 3rd quarter of 2021.

The model-testing the price volatility and connectedness of the price of CryptoPunks (NFT) to the assets like Gold, Bitcoin, and S&P500 involves accumulating the data and the methods.

The Price volatility, the price correlation coefficient, and the TCI revealed huge

deviations from the price of cryptoPunks to the price of Gold, Bitcoin and S&P500.

The correlation of CryptoPunks, S&P 500 and Bitcoin has mostly been positive than Gold from (**Table 3**).

Table 3: PCC of CryptoPunks to Gold, S&P500 and Bitcoin

Assets	2019 Q1	2019 Q2	2019 Q3	2019 Q4	2020 Q1	2020 Q2	2020 Q3	2020 Q4	2021 Q1	2021 Q2	2021 Q3	2021 Q4
Gold	1	1	1	1	1	-1	-1	-1	1	-1	1	1
S&P 500	1	1	1	1	1	1	-1	-1	1	-1	1	1
Bitcoin	1	1	1	1	1	1	-1	-1	1	-1	1	1

The movement of the gold is disconnected dramatically from the movement of CryptoPunks; most of the results of gold are negative than S&P500 and Bitcoin (**Table 4**).

Table 4: TCI of CryptoPunks to Gold, S&P500 and Bitcoin

Assets	Gold	S&P 500	Bitcoin
2019 Q1	-310.95	2004.03	2906.47
2019 Q2	-591.85	1076.31	4416.59
2019 Q3	-184.94	2718.15	7483.69
2019 Q4	-217.12	2594.76	5814.01
2020 Q1	-436.41	1062.53	2741.56
2020 Q2	-1310.74	386.77	1209.84
2020 Q3	-4112.05	56.495	405.17
2020 Q4	-11136.54	-125.13	401.78
2021 Q1	-168766.04	-2279.863	-95.453
2021 Q2	-61242.18	-802.25	-2.3
2021 Q3	-658130.34	-8473.98-866.34	-866.34
2021 Q4	-384256.99	-4734.58	-457.47

Model testing on Security and copyrights of NFTs: The security of NFTs built on the Ethereum blockchain is secure and immutable to the extent of transactions between the parties involved, lacking protection against transparency and anonymity from **Table 5**.

Table 5: Security examination of NFT and Blockchain

Aspect	Blockchain	NFT Exchange
Anonymity	YES	YES
KYC record	NO	YES
Pseudonymity	YES	YES
Transparency	NO	NO

Continuation Table:

Aspect	Blockchain	NFT Exchange
Evidence	HIGHLY DIFFICULT	HIGHLY DIFFICULT
Loss of data	NOT POSSIBLE	POSSIBLE
Correction	NOT POSSIBLE	POSSIBLE

NFT is minted on the digital copy of original artwork of tangible or intangible type of possession. However, NFT provides identification of the digital object and the original owner of the object. Interpretation of Visualizations shown here.

Observations from the Dataset reflect a 41.80% growth in the Gold prices, Whereas the CryptoPunks have a growth rate of 160,007.09%. Extreme deviation in the price curve from **figure 4** and **figure 5** is confirmed.

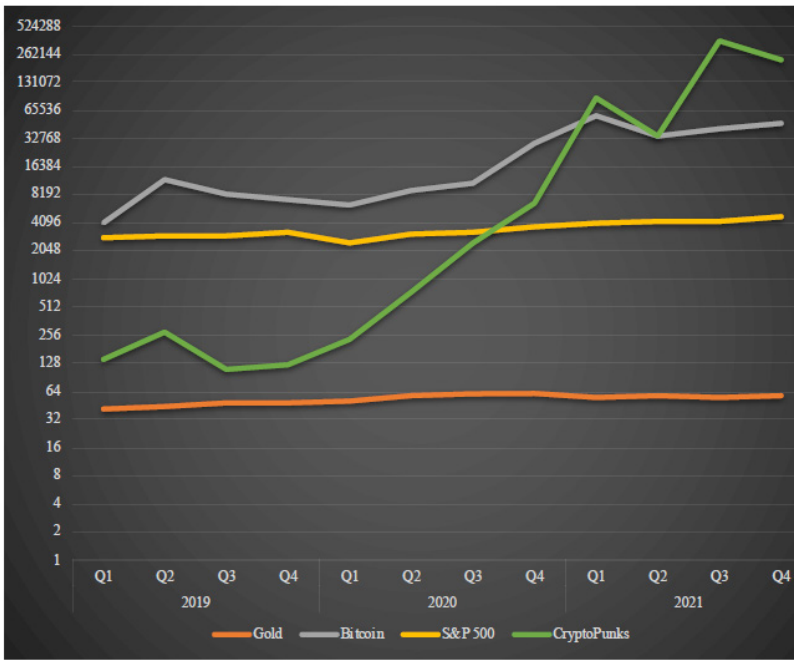

Figure 4. Price Volatility relationship between CryptoPunks and other Financial assets.

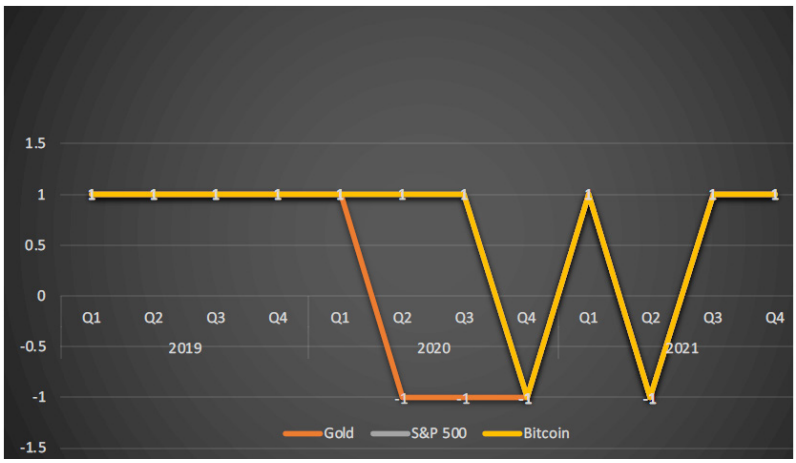

Figure 5. PCC of CryptoPunks to Gold, S&P500 and Bitcoin

The movement is of S&P500 and Bitcoin similarly correlated to CrypoPunks'

price movement. On the other hand, gold is not well interconnected to Crypunks as Bitcoin and S&P500 from the PCC method (**figure 6**).

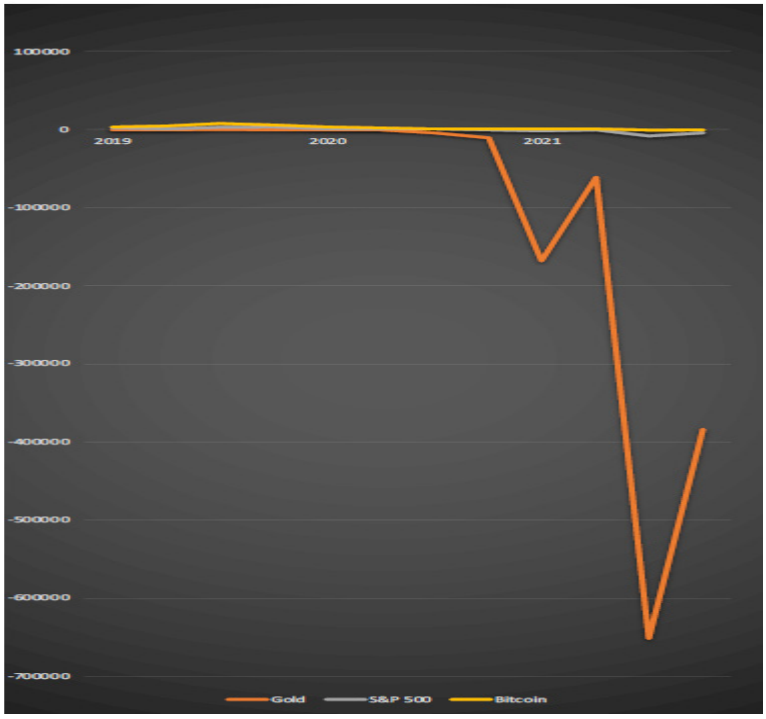

Figure 6. TCI of CryptoPunks to Gold, S&P500 and Bitcoin

The Total connectedness methods unravel that Gold begins to disconnect with Cryptopunks from the first quarter of 2019. In the 3rd quarter of 2021, the Gold was entirely away from the S&P 500 and Bitcoin in connection to Cryptopunks **figure 7**.

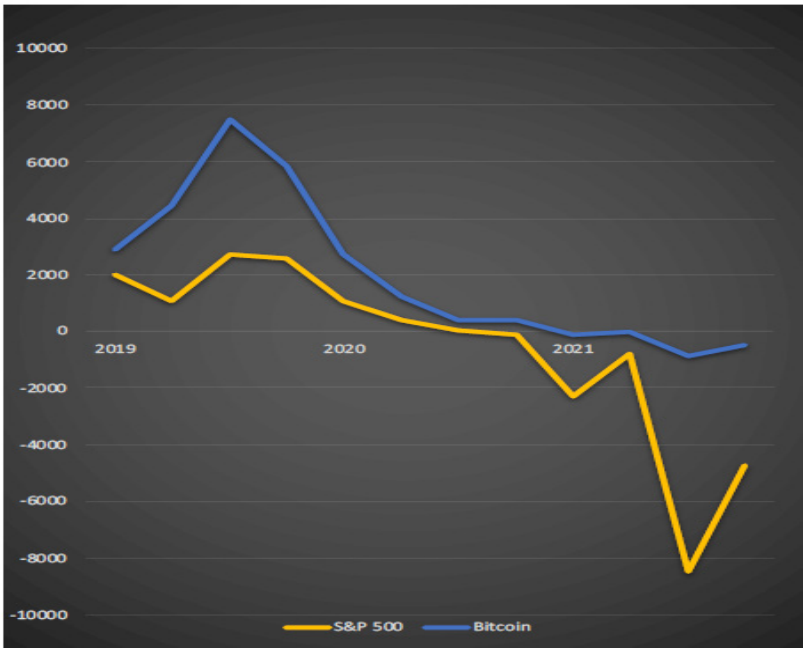

Figure 7. TCI of CryptoPunks to S&P500 and Bitcoin

From **figure 7**, the price of the S&P500 and Bitcoin dominated CryptoPunks in 2019 and till the 3rd quarter of 2020. Later, the TCI significantly dropped down till the last quarter of 2021.

Evaluation of Methods and Results

Testing methods on price stability of CryptoPunks applying Price volatility test, PCC And TCI, reveal that the price is highly uncertain in the year 2021 and volatile all the three years, but extreme volatility can be observed from 2020 to 2021. There is some influence of bitcoin on CryptoPunks from figure 7; Bitcoin price is interconnected to S&P500; the market movement of these assets has positively related to NFTs. Considering NFT is a new technology, the movement is exceptionally volatile.

Table 6 shows that blockchain requires more progress in improving transparency. Design restructuring is necessary for changes in existing policies and new policies, which can be impossible because the data stored in the blockchain is permanent. This involves replacing old information with new, which can be achieved only by the authorized entity; any involvement by an unauthorized entity will harm the technology users. In reality, every case is unique; the relationship between the entities needs to be recorded in the contract; the NFT [36] contracts take basic information like name, collection, and artist. The investor needs to risk the criticism associated with the NFTs and risk management by diversifying their portfolio to NFTs established on other technologies using different consensus mechanisms or built on different ledgers. It will be secure to have funded over different financial assets to recover losses made on NFTs [37]. The creator's Intellectual Property remains with the property owner, and the technology cannot assure their protection. Although NFTs provide accessibility to many digital creators across different boundaries, the transfer of rights must be registered with the local jurisdiction. When the transfer is processed in a different jurisdiction, the transaction is unprotected; this complicates the process with the involvement of multiple jurisdictions.

Table 6. Description of the results.

Stakeholders	Concerns	Applicable standards	Examples
Creators	- Copyrights - Ownership	Contracts UETA changes, Intellectual Property	CryptoPunks vs CryptoPhunks. Both the NFT developers have not copyrighted their art.
Investors	- Criticism - Risk management	Bookkeeping requirements	Diversification of funds over NFTs based on different blockchains with distinctive consensus mechanism and other classes of financial assets.
Regulators	- Security - Transparency - Evidence	KYC regulations, AML, CFT standards	Using NFTs to trade illicit drugs and weapons.

Thus, NFT exchanges must adhere to foreign exchange regulations and facilitate NFTs [38] minted on legitimate technology with a highly elaborated and flexible smart contract acceptable in their jurisdiction.

5. CONCLUSION AND FUTURE WORK

The proposed NFT trilemma—comprising price volatility, copyright issues, and security concerns—can be addressed by stabilizing NFT prices, which is intrinsically tied to the stability of cryptocurrencies. Evidence suggests that Bitcoin and the S&P 500 index influence the price movements of NFTs. As a nascent technology, NFTs

are prone to volatility, making them a high-risk and uncertain investment. Just like traditional art, NFT art's value fluctuates according to the wealth of its buyers. While NFTs are still in their early stages, their future remains uncertain due to numerous factors influencing their behavior. However, NFTs hold long-term potential, particularly as a solution for authenticating digital assets, preventing intellectual property theft, and addressing the proliferation of counterfeit digital items. Although NFTs do not inherently offer copyright protection, they can significantly enhance the security of copyrighted material online. Currently, NFTs are built on blockchain smart contracts, which still face challenges such as transparency issues and the potential for pseudonymous users to exploit the system for illicit activities. This can be mitigated by incorporating Know Your Customer (KYC) protocols. NFT exchanges must adhere to Anti-Money Laundering (AML) regulations, set clear transaction limits, and take proactive measures to prevent financing of terrorism.

Transparency can be addressed by implementing NFT on CBDC; CBDC can be criticized for its centralized and discretionary policies. However, CBDC can ensure complete transparency by maintaining a record of the dealings with the government. In addition, building an NFT ecosystem on CBDC can improve price stabilization, thereby reducing its risks and criticism. There is no requirement for running heavy computational power like mining cryptocurrencies, CBDC are free from environmental harm. CBDC based NFTs should be able to compete with blockchain NFTs; designing a decentralized monetary system with adequate transparency and facilitating the authorities to intervene at the time of fraud is extremely important. A broader exploration of different NFT types, including virtual assets and collectibles, is needed to capture the full market spectrum. Additionally, the evolving legal and regulatory landscape surrounding NFTs warrants further investigation. Lastly, the potential integration of NFTs with central bank digital currencies (CBDCs) could provide new avenues for improving market transparency and security.

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