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Original Research Article

Investigating the Impact of Non-Fungible Tokens (NFTs) Using a Mixed Quantitative and Qualitative Approach

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This study examines the impact of Non-Fungible Tokens (NFTs) on the structure and dynamics of the digital art economy through a mixed-methods research design. Market data spanning the period from 2020 to 2024 are analyzed using Ordinary Least Squares (OLS), Autoregressive Distributed Lag (ARDL), and Vector Autoregression (VAR) models to evaluate the relationships between NFT artwork prices, Ether (ETH) prices, trading volume, and sales counts. The achieved results indicate that ETH prices have a strong and statistically significant positive effect on NFT valuations in both the short and long run. Trading volume demonstrates a weaker yet statistically significant causal effect, whereas sales counts do not exhibit a meaningful impact on NFT prices. In addition to the quantitative analysis, a thematic analysis of semi-structured interviews with 52 industry experts is conducted. The qualitative results show that NFTs facilitate decentralization, disintermediation, and expanded market access for artists. However, participants also express concerns regarding inadequate legal frameworks, high price volatility, and the long-term sustainability of NFT markets. Overall, the study concludes that NFTs play a dual role by empowering creators and reshaping digital art market structures, while remaining highly susceptible to speculative behavior and regulatory uncertainty. These findings provide important implications for policymakers, artists, and investors seeking to navigate the evolving digital art ecosystem.

Keywords: Non-Fungible Token (NFT), Digital Art Economy, Mixed-Methods Analysis, Blockchain, ARDL Model, Delphi Method, Artwork Valuation.
JEL Classification*:* C40, Z11, G12

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1 Introduction

Blockchain is a distributed ledger technology that enables secure, transparent, and tamper-resistant recording of transactions across a decentralized network of computers. Within this chain, each block contains a list of transactions, a timestamp, and a cryptographic hash of the previous block, ensuring data integrity and chronological order. By eliminating the need for a central authority and employing consensus mechanisms such as Proof-of-Work and Proof-of-Stake, blockchain enables participants to collectively verify and record transactions. Following the introduction of Bitcoin (Nakamoto, 2008) in early 2008 blockchain emerged as the foundational infrastructure for cryptocurrencies which are known as digital assets. Its capacity for decentralized trust and immutable record-keeping not only made peer-to-peer digital cash possible but also laid the groundwork for subsequent innovations such as smart contracts and tokenization.

After Bitcoin's inception in 2009, cryptocurrencies have expanded into a diverse ecosystem of thousands of digital assets, each serving purposes ranging from decentralized finance (DeFi) to cross-border payments, gaming, and supply chain verification. Economically, cryptocurrencies have disrupted payment systems by removing reliance on third parties, lowering transaction fees, and enabling financial inclusion for unbanked populations. At the same time, they have introduced new investment opportunities, leading to periods of extreme Price volatility and raising concerns about financial stability. Global market capitalization for cryptocurrencies has, at its peak, surpassed $3 trillion, drawing significant attention from institutional investors, regulators, and policymakers. Looking ahead, the path of cryptocurrencies will likely be shaped by a combination of technological advancements (such as scalability solutions and interoperability protocols), regulatory frameworks, and integration with broader Web3 infrastructures.

The appearance of Blockchain technology has created a wave of financial and cultural innovations. Non-Fungible Tokens (NFTs) (NFTs; Hammi et al., 2023), represent one of the most significant innovations enabled by blockchain technology. NFTs have attracted huge attention in the fields of art, economics, and information technology by enabling digital ownership of artistic and cultural assets. In contrast to cryptocurrencies such as Bitcoin, which are interchangeable by nature, each NFT possesses a unique identifier that renders it a distinct digital asset.

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The digital art market has faced critical structural changes. These changes include the redefinition of artistic ownership, reduced dependence on intermediary institutions such as galleries and auction houses, and improved access for independent artists to global markets without requiring physical infrastructure. However, this emerging technology also presents several challenges such as ambiguity in intellectual property rights, extreme price volatility, and a lack of legal oversight.

The main goal of this study is to investigate the effects of NFTs on the structure and behavior of the digital art economy through a mixed quantitative and qualitative analysis. Accordingly, on one hand, statistical data from the NFT market are analyzed, and on the other, the perspectives of market stakeholders are collected using the Delphi method. In other words, this study tries to answer the key question: What causal and structural roles have NFTs played in transforming the digital art market?

The rest of the paper is organized as follows: Section 2 presents the conceptual and theoretical background of the study. Section 3 reviews the relevant literature. Section 4 describes the research methodology in detail. Sections 5 and 6 present the empirical findings and concluding remarks, respectively.

2 Background

2.1 NFT

NFTs are unique, cryptographically verifiable digital assets recorded on a blockchain, that represent ownership and authenticity of a specific digital or physical asset (Dowling, 2022). Unlike fungible assets such as Bitcoin or fiat currencies, which are interchangeable and divisible into units of equal value. In contrast, NFTs are indivisible and distinct, meaning each token has its own unique identifier and associated metadata (Wang et al., 2021). This non-fungibility enables NFTs to function as digital certificates of authenticity, provenance, and scarcity, particularly for creative works, collectibles, and rare digital items.

To show the concept of an NFT in simple terms, consider a signed baseball card. Its value comes from its uniqueness, verifiable provenance, and scarcity. An NFT functions as the digital equivalent of such an asset: it is a cryptographically secured token recorded on a blockchain, containing metadata that guarantees the asset's authenticity and identifies its current owner. While the associated digital content (e.g., an image file) may be freely

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accessible or reproducible by others, the NFT serves as an immutable proof of ownership for the original asset.

NFTs are typically implemented as smart contracts on programmable blockchains such as Ethereum, Solana, or Flow. Each NFT contains at least:

1) A Token ID: a unique numerical string assigned to the asset.
2) Metadata: descriptive information (e.g., title, creator, creation date) stored on-chain or via decentralized storage systems such as the InterPlanetary File System (IPFS).
3) Smart Contract Logic: which defines rules for transfer, royalty payments, and interaction with other digital systems (Entriken et al., 2018).

The first attempts to create non-fungible digital assets emerged, appeared with early projects such as Colored Coins on Bitcoin and Counterparty (Rosenfeld, 2012), Ethereum-based collectibles like CryptoPunks (Schaar & Kampakis, 2022) and the widely popular blockchain game CryptoKitties (Evans, 2019). The ERC-721 standard, introduced by Entriken et al., (2018) became the technical foundation for most NFTs, specifying a global interface for creating and transferring unique tokens. Later, the ERC-1155 standard introduced semi-fungibility for efficient multi-token management while retaining NFT properties. Generally, NFTs are known for three key properties:

1) Uniqueness: each asset is unique like a painting.
2) Immutability: ownership and transaction history are permanently recorded on a blockchain.
3) Interoperability: NFTs can be traded or displayed across multiple decentralized platforms.

These features make NFTs a critical element in the emerging Web3 ecosystem, where users maintain sovereign ownership of their digital assets without relying on centralized intermediaries (Tapscott, 2023). As a result, NFTs are not solely technological constructs but also socio-economic tools reshaping digital ownership, creative economies, and cross-platform asset portability.

2.2 Smart contracts

Smart contracts are self-executing programs deployed on a blockchain that automatically run predefined contractual functions without the need for centralized intermediaries (Christidis & Devetsikiotis, 2016). These contracts consist of code and associated data functioning at a unique blockchain address, and their execution is triggered by transactions that meet

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specific conditions defined in the contract's logic. By utilizing consensus mechanisms inherent to blockchain networks, smart contracts guarantee that predefined rules are applied consistently and transparently across all network nodes.

The relevance of smart contracts to NFTs is both foundational and functional. NFTs are typically implemented as smart contracts adhering to standardized specifications such as ERC-721 or ERC-1155 on the Ethereum blockchain (Entriken et al., 2018). These standards determine the required functions for minting unique tokens, transferring ownership, and retrieving corresponding metadata. In this context, the smart contract acts as the governing framework for:

1) Token Creation (Minting): generating new NFTs with unique identifiers and metadata.
2) Ownership Records: storing an immutable ledger of token transfers and current holders.
3) Programmable Royalties: enabling creators to receive a fixed percentage of resale prices automatically upon each secondary market transaction.
4) Access Control: restricting certain actions (e.g., transfer, burn) to authorized addresses.

By adding the logic of ownership, authenticity verification, and transferability directly into blockchain code, smart contracts remove the need for traditional intermediaries such as auction houses or record-keeping agencies. This direct execution capability has expanded market access for creators and collectors, allowing peer-to-peer exchanges of digital assets under trustless environments. Moreover, the Interoperability of smart contracts facilitates cross-platform NFT utilization, enabling a token minted on one marketplace to be traded or displayed in another, provided both are compatible with the same standard.

However, the immutability that ensures trust in smart contracts also introduces challenges: coding errors can become permanent vulnerabilities, security audits are critical but not always comprehensive, and contract upgrades often require complex design patterns such as proxy contracts. The interplay between technical precision and decentralized governance in smart contracts therefore remains a key area of research in ensuring the robustness of NFT ecosystems.

From an economic perspective, NFTs establish verifiable digital property rights, reduce transaction costs associated with ownership verification, and create new markets for digital assets. Consequently, NFTs can be analyzed as

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institutional innovations that alter incentives, market structures, and value-creation mechanisms within digital economies.

3 Literature Review

Research on NFTs has quickly expanded as the technology has moved from niche blockchain circles into mainstream markets. Recent studies examine how NFTs are priced, how they function in real-world applications, and how they fit within larger trends like the growth of the metaverse. Researchers from different fields have explored topics such as the factors influencing NFT value, the use of smart contracts to manage ownership and transactions, and the efficiency of NFT markets. Together, these works provide both empirical evidence and conceptual frameworks that demonstrate how NFTs are reshaping digital ownership, challenging established market structures, and fostering new areas for innovation in Web3 environments.

Cong et al. (2021) examined the evolution of the NFT market with a focus on the important factors influencing price formation, current use cases, and new opportunities. Drawing upon a synthesis of financial and econometric models from existing literature, they analyze how variables such as verifiable scarcity, provenance, ownership rights, market liquidity, and interoperability influence NFT valuation, while also considering the role of investor sentiment and broader cryptocurrency trends. The study reports significant market growth from 2019 to 2022 and attributes this to NFTs' disruptive potential in redefining digital ownership within the Web3 ecosystem. The authors developed a conceptual framework to better understand value creation and investor behavior, emphasizing parallels with traditional asset pricing theory by comparing predictive performances of pricing models. Their results indicate the nascent but complex interplay between technical architecture, behavioral finance, and market infrastructure, offering both theoretical contributions and practical insights for stakeholders navigating NFT markets.

Regner, et al., (2019) presented one of the earliest comprehensive explorations of NFTs in a functional, real-world scenario by designing and evaluating a blockchain-based event ticketing prototype. They address structural problems in ticketing markets such as fraud, lack of trust, uncontrolled secondary market pricing, opacity etc, through the integration of NFTs and smart contracts on the Ethereum blockchain. In fact, they implemented ERC-721-compliant tokens to represent unique, tamper-proof digital tickets with programmable features such as automated royalty

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distribution and transfer restrictions. Their test shows that NFTs can decrease fraudulent resale, enable organizers to regulate secondary transactions, and improve transparency without any dependence on central intermediaries. Beyond the technical aspect, the study offers generalizable design principles and managerial recommendations for NFT-based applications, positioning the work as both a conceptual and practical contribution to blockchain implementation research.

An extensive foresight study was conducted by Anderson and Rainie (2022) regarding the future development of the metaverse by 2040. Gathering responses from more than 600 technologists, researchers, business leaders, and policymakers, they synthesized numerous visions for immersive digital environments, spanning fully realized 3D virtual worlds to more modest advancements in augmented and mixed-reality applications. The study identifies both drivers and barriers, including commercial monopolization, privacy concerns, regulatory gaps, and persistent technological limitations. While proponents expect transformative applications in education, healthcare, entertainment, and remote work, skeptics forecast that the metaverse will remain a niche or fragmented toolset rather than an all-encompassing medium. For NFT research, this report situates tokenized digital assets within a broader socio-technical context, framing them as potential enablers of scarcity, identity, and economic exchange in immersive environments, yet also subject to the same governance, adoption, and equity challenges projected for the metaverse itself.

Dowling et al., (2022) investigated the efficiency of NFT market by analyzing the pricing of "LAND" parcels in Decentraland, making use a dataset of 4,936 secondary-market LAND transactions between March 2019 and March 2021. The study utilizes multiple statistical tests such as the Automatic Variance Ratio (Kim, 2009), Automatic Portmanteau (Escanciano & Lobato, 2009), Consistent Test (Domínguez & Lobato, 2004), and Corrected Empirical Hurst Exponent (Weron, 2002), to evaluate the efficiency. Results show that the LAND market indicates persistent price inefficiencies alongside a steady upward trend in value, challenging traditional assumptions about rational pricing in nascent digital asset markets. They attribute these inefficiencies to the novelty of NFTs, speculative behavior, and the evolving nature of blockchain-based metaverses. Their main contribution is extending financial econometrics into the NFT domain and providing a methodological framework for future price-dynamics studies of uniform NFT asset classes.

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In their comprehensive investigations on NFT markets, Ante (2021) investigate the determinants of NFT pricing, and outline emergent opportunities for investors and developers. Synthesizing findings from financial economics and blockchain research, the authors developed a conceptual framework linking fundamental factors, such as verifiable scarcity, provenance, ownership rights, interoperability, liquidity, and investor sentiment, to price formation in NFT markets. Using market data, they demonstrated NFTs' disruptive potential for reshaping digital ownership and secondary markets. The review evaluates econometric models applied to NFT price prediction, highlighting both methodological advances and persistent gaps in explaining volatility and long-term value retention. By situating NFT valuation within established asset pricing theory, the paper contributes a structured foundation for future research while offering practical guidance for market participants navigating this rapidly evolving asset class.

The review clearly presents that, so far, research literature within Iran has mostly focused on the technical or descriptive parts of NFTs, and few studies have scientifically and analytically examined the economic effects of NFTs on the digital art market. Also, at the international level, combined quantitative-qualitative modeling has received relatively little attention. This study aims to fill this gap by offering a precise and multilayered model for analyzing the dynamic market behavior of NFTs.

4 Methodology

This study is conducted using a mixed-methods approach, which includes the quantitative analysis of NFT market data and qualitative analysis from expert viewpoints. The main goal is to model and explain the impact of economic variables (such as ETH price, trading volume, and number of sales) on the price of NFT artworks, and to comprehend the structural changes resulting from this new phenomenon. In the following subsections, the flow of conducting the analysis is explained comprehensively.

4.1 Data Collection

4.1.1 Quantitative Data

Daily observations for four key variables were collected from NFT platforms such as OpenSea and SuperRare, covering the period from January 2020 to December 2024. These key variables are:

- NFT_Avg_Price_USD: Average selling price of NFT artworks (in USD)

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- ETH_Price_USD: Price of Ether cryptocurrency (in USD)
- NFT_Trade_Volume_Million_USD: NFT trading volume (in millions of USD)
- NFT_Sales_Count: Number of NFT sales

4.1.2 Qualitative Data

For the qualitative analysis, the Delphi method was applied. Insights from 52 experts and professionals in the field of digital art and NFTs, including artists, collectors, gallery owners, investors, and researchers, were gathered through interviews and questionnaires. This process generated detailed evidence regarding the social, cultural, and economic implications of NFTs for the digital art market.

4.2 Analytical Methods

To analyze the quantitative data different regression models are used. At the first step, Granger causality tests were applied to analyze causal relationships and responses to shocks among variables. Then Ordinary Least Squares (OLS) regression was applied to check the relationship between NFT prices and the different variables. The following equation shows the regression model used for analysis:

$$NFT\_price = \beta\_0 + \beta\_1\ (ETHprice) + \beta\_2\ (volume) + \beta\_3\ (Sales\_count) + \varepsilon \quad (1)$$

Where:

NFT_Price = Price of NFT artworks

•ETH_Price = Price of Ether cryptocurrency

•Volume = NFT trading volume

•Sales_Count = Number of NFT sales

•β_0 = Intercept

•β_1, β_2, β_3 = Regression coefficients

•ε = Error term

Next, to analyze more complex relationships, the ARDL (Autoregressive Distributed Lag) model was tested to study both short-term and long-term relationships among variables. The ARDL model is structured as shown in equation (2):

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$$NFT\_price_t = \alpha + \sum\left(\beta_i NFT_{price_{t-i}}\right) + \sum(\gamma_i ETH\_price_{t-j}) + \sum(\delta_k volume_{t-k}) + \sum(\theta_l sales\_count_{t-1}) + \varepsilon_t \quad (2)$$

Furthermore, the ECM (Error Correction Model) was used to determine the speed of adjustment toward long-run equilibrium. Which is shown in equation (3):

$$NFT\_price_t = \alpha + \sum(\beta_i \Delta NFT\_price_{t-i}) + \sum(\gamma_i \Delta\, ETH\_price_{t-j}) + \sum(\delta_k \Delta volume_{t-k}) + \sum(\theta_l \Delta Sales\_count_{t-l}) + ECT_{t-l}\, \varepsilon_t \quad (3)$$

Where ECT_{t-l} represents the Error Correction Term from the previous period.

Also to check the stationarity and stability of variables, ADF (Augmented Dickey-Fuller) and PP (PhillipsPerron) tests were applied to avoid spurious regression**.** Besides, VAR models (Vector Autoregression)**,** variance decomposition.

The qualitative data was analyzed using the Thematic Analysis approach. In this approach, data are first encoded, then themes and core concepts are extracted by analyzing expert responses. These viewpoints are categorized based on the conceptual framework of the digital art economy. This analysis helps identify and classify different perspectives on the impact of NFTs on the art market.

Although a comprehensive analysis on both types of data is conducted some inevitable limitations affected the research. Which are:

- The available quantitative data spans only from 2020 to 2024, which may not capture historical changes prior to this period.
- The NFT market is evolving very fast, and the findings may require future revision. Moreover, the specific characteristics of different NFT markets may not have been fully addressed in this study.
- The statistical data were extracted only from specific platforms, and may not be generalizable to the entire market.
- The qualitative interviews were conducted based on purposive sampling and do not represent all market participants**.**

Despite these limitations, the use of a mixed-methods approach enhanced the depth and accuracy of the findings.

5 Data Analysis and Research Findings

In this section, the results obtained from the quantitative and qualitative analyses of the study are presented. Quantitative data were collected on NFT

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artwork prices**,** Ether (ETH) prices, trading volume, and number of sales over the 2020-2024 period. In addition, qualitative evidence was collected through questionnaires and semi-structured interviews with NFT market participants.

One of the primary reasons underlying the relationship between Ethereum prices and NFT valuations is that most NFT market transactions take place on the Ethereum blockchain, and most transactions are settled using ETH token. Ethereum is the world's second-largest cryptocurrency and provides the core infrastructure for smart contracts and NFTs. Therefore, changes in the price of ETH are directly reflected in NFT prices. In other words, if the price of Ethereum increases, the dollar cost of purchasing an NFT will also increase, and consequently, the dollar value of digital artworks increases. In contrast, a decrease in Ethereum's price may result in a decline in the dollar value of NFTs, even if the demand for the artworks themselves remains unchanged.

To achieve a deeper understanding of market behavior, the model also uses transaction volume and sales count in addition to the price of Ethereum. Transaction volume reflects the level of market turnover and liquidity, thereby providing additional insight into price dynamics. Sales count is an indicator of user activity and participation. While it did not show a statistically significant effect in the empirical results, it remains important as a control variable in market analysis.

In summary, Ethereum performs as the "primary underlying economic driver" for NFTs, and its fluctuations are the most important factor identified in the statistical models. At the same time, NFTs, as one of the critical innovations of the Ethereum blockchain, maintain a fundamental connection with this cryptocurrency. Below, the regression analysis results are first presented, followed by the qualitative findings and then the analysis of stationarity and convergence.

5.1 Granger causality

Granger causality test is another test model used to interpret the results. The results of this test provide insights into the directional predictive relationships between key market variables and NFT prices. This method examines whether past values of one variable contain information that helps forecast another, beyond the information already contained in the latter's history. The results indicate a strong unidirectional causality from ETH price to NFT price ($P < 0.001$), meaning that cryptocurrency market movements have significant predictive power over subsequent NFT price changes. Trading volume also shows a statistically significant causal effect on NFT

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prices (P = 0.0001), demonstrating that higher trading activity can help anticipate price shifts in the NFT market. In contrast, no causal relationship was identified between sales count and NFT prices (P > 0.5), implying that transaction frequency alone does not reliably predict price dynamics.

5.2 Regression Analysis Results (OLS)

In the first step, to examine the relationship between average NFT price and key economic variables, including ETH price, trading volume, and number of sales, the OLS regression model was used which is shown in equation (1). Using this model the R^2 and adjusted R^2 values were 0.77 and 0.76 respectively. Also, Table 1 shows the estimated OLS coefficients.

Table 1
Initial results achieved by OLS

Variable	Coefficient	Standard Error	t-Statistic	P-value
Constant (C)	232.52	104.87	2.22	0.0308
ETH_Price_USD	0.152	0.025	6.09	0.0000
Volume	2.41	4.46	0.54	0.5908
Sales_Count	-0.0196	0.032	-0.61	0.5425

Source: Research Findings

The results show that the Ethereum price has a positive and statistically significant effect on the average price of NFT artworks. Specifically, the coefficient for ETH price ($\beta_1 = 0.152$, $P < 0.01$) indicates that, on average, a one-unit increase in ETH price is associated with a 0.152-unit increase in NFT artwork prices, holding other variables constant. The coefficient for trading volume ($\beta_2 = 2.41$) is also positive, indicating a direct relationship between trading activity and NFT prices; however, this effect is not statistically significant ($P > 0.05$), implying limited reliability of this relationship in the current model. Conversely, the coefficient for the number of sales ($\beta_3 = -0.0196$) is negative and also statistically insignificant ($P > 0.05$), indicating that higher sales volumes have only a minimal, non-significant impact on NFT prices. The model's explanatory power is relatively strong, with an R^2 value of 0.77, showing that approximately 77% of the variation in NFT prices can be explained by the included variables. Furthermore, the Ramsey RESET test yields a *P*-value of 0.1262, confirming that there is no evidence of functional form misspecification without evidence of misspecification. To deeply analyze the temporal dynamics of the relationships, the ARDL model with the structure ARDL (2,4,0,0) was selected. The ARDL estimation results

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indicate that ETH price has a strong and statistically significant influence on NFT prices, with a long-term coefficient of 0.1747 ($P < 0.001$). This finding reveals the critical role of cryptocurrency market conditions in shaping NFT valuations. In contrast, the variables for trading volume and sales count do not show statistically significant effects ($P > 0.5$), aligning with the outcomes observed in the OLS model and suggesting that market activity levels alone are not reliable predictors of long-term price movements. The Bounds Test supports the presence of a statistically significant long-run relationship between the variables, with an F-statistic of 8.63 exceeding the I(1) critical value at the 1% significance level. Additionally, the ECM reveals a fast adjustment toward long-run equilibrium, with the CointEq term indicating a speed of adjustment of 118% in each period. Although this rate is unusually high, its negative and statistically significant coefficient confirms meaningful error correction dynamics in the NFT pricing process. Table 2 briefly shows these findings

Table 2
Long-Run results of ARDL model.

Variable	Coefficient	P-Value	Interpretation
ETH	0.1747	0.000	Positive and significant relationship with NFT price
Volume	-2.83	0.5171	Statistically insignificant
Sales	-0.0014	0.9590	Statistically insignificant and very weak

Source: Research Findings

The VAR model was tested with two lags. The variance decomposition analysis shows that, by the 10th forecast period, almost 35% of the fluctuations in NFT prices can be related to changes in ETH price, indicating the effective influence of cryptocurrency market movements on the NFT sector. Trading volume has a more modest share, accounting for about 7-8% of the variation, while sales count shows less than 2%, which indicates a minimal role in driving price dynamics. The largest share of forecast error variance is explained by NFT prices' own shocks (approximately 55%), indicating substantial price persistence and the importance of historical price dynamics in predicting future NFT valuations.

5.3 Qualitative Data Analysis

The qualitative data obtained from open-ended questionnaires and semi-structured interviews provide a good understanding of how key stakeholders in the digital art and NFT ecosystem perceive this emerging

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technology. Applying thematic analysis allowed complex, individual viewpoints to be distilled into a set of overarching themes that capture the central opportunities, tensions, and uncertainties in the field. The data indicate that while NFTs have generated considerable enthusiasm among certain stakeholders, they have also sparked skepticism and doubts in others, particularly regarding the market's long-term path and the regulatory environment. Four primary themes emerged from the analysis:

- **Impact on Art Pricing:** Many participants, especially those actively engaged in the NFT space, believe that NFTs have the capacity to push digital art prices upward. In bullish market conditions, scarcity mechanisms embedded in blockchain technology can increase an artwork's market value. However, some caution was voiced about the volatility of such pricing and its dependence on broader cryptocurrency trends.
- **Opportunities for Emerging Artists:** Some participants emphasized the role of NFTs in democratizing art markets. By removing traditional intermediaries such as galleries and auction houses, artists will have direct access to a global pool of collectors. This direct-to-consumer model not only increases revenue capture for creators but also allows them to retain greater control over their work, including through programmable royalties.
- **Legal Risks and Threats:** A substantial subset of respondents expressed apprehension about the absence of robust legal and regulatory frameworks. Issues such as intellectual property enforcement, the potential for fraudulent sales, and disputes over provenance were mentioned as risks that could deteriorate trust in the NFT art market. These concerns point to a broader need for standardized governance mechanisms in digital asset transactions.
- **Market Sustainability:** Several interviewees questioned whether NFTs represent a durable market innovation or a speculative bubble. Fears of overvaluation and "hype-driven" buying behavior were common, with some predicting that a sharp correction could significantly reduce NFT trading volumes and prices. This skepticism was often grounded in comparisons to previous speculative episodes in both technology and art markets.

In addition to these thematic insights, the results reveal clear contrasts between stakeholder groups. Artists tended to adopt an optimistic point of view, framing NFTs as a transformative tool for empowerment, economic

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Table 3
Summary of statistical test results.

Model	Key Findings
Granger	ETH and VOLUME are causal; SALES_COUNT is not.
OLS	ETH significantly affects NFT prices; other variables are not statistically significant
ARDL	Long-term relationship between ETH and NFT is confirmed; model exhibits fast convergence
ECM	High speed of return to long-term equilibrium; ETH has the dominant effect.
VAR	ETH and VOLUME account for the largest share in variance decomposition.

Source: Research Findings

independence, and expanded audience reach. In contrast, gallery owners and art critics were more guarded, often framing NFTs as a disruptive threat to established market structures. Concerns in this group included the eliminating of traditional gatekeeping roles, challenges to curatorial authority, and the risk that the emphasis on blockchain-verified scarcity could overshadow artistic merit and authenticity. Taken together, these findings portray a digital art ecosystem in which enthusiasm for innovation coexists with legitimate apprehensions. They also suggest that the trajectory of NFTs in the art market will be shaped not only by technological capabilities but also by how effectively stakeholders address issues of trust, regulation, and market stability.

6 Conclusion and Future works

This study examined the impact of Non-Fungible Tokens (NFTs) on the digital art economy using a mixed-methods approach that combined quantitative and qualitative analyses that uses quantitative and qualitative analyses. The quantitative results, obtained from regression analysis, dynamic time-series models (ARDL and VAR), and causality tests, show the price of Ether (ETH) has a positive and statistically significant effect on NFT prices, whereas trading volume does not exhibit a statistically significant effect in the estimated models. In contrast, the number of NFT sales does not play an important role, as its effect on prices is not statistically significant.

The qualitative component of the study was based on Delphi interviews with 52 industry experts. The findings reveal that NFT technology has transformed value creation mechanisms in the art market by promoting disintermediation, enhancing relative transparency, and enabling the emergence of new markets for artists. At the same time, experts emphasize

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several persistent challenges, including inadequate intellectual property protection, high price volatility, and ongoing concerns regarding authenticity.

The findings from both methodological approaches confirm that NFTs play a dual and paradoxical role in the digital art economy. On the one hand, they suggest opportunities for decentralizing the art market and empowering independent artists. On the other hand, they introduce legal and economic issues that pose risks to established market structures.

From a market dynamics point of view, the ARDL results indicate that the NFT market converges toward a long-term equilibrium with its key determinants. The associated error correction model (ECM) shows a rapid adjustment process, with an error correction coefficient of approximately 118% per period, suggesting an overshooting adjustment mechanism in response to market shocks, particularly changes in ETH prices.

Finally, based on these findings, a set of policy and strategic recommendations is proposed for key stakeholders, including artists, investors, platform operators, and policymakers.

A) For Policymakers:

- It is essential to develop clear legal frameworks to prevent fraud and enhance public trust in the NFT market, particularly regarding digital ownership**,** smart contracts, and artist protections within NFT ecosystems.
- The creation of a national Blockchain-based registry for artworks is recommended, in collaboration with the Ministry of Culture, the Central Bank, and cultural institutions, to preserve authenticity and prevent plagiarism.

B) For Artists and Content Creators:

- Gaining digital, economic**,** and legal literacy in the field of NFTs is of critical importance.
- It is strongly recommended to use NFTs as a complementary tool, not a replacement, for traditional sales models.

C) For Investors:

- Given the dependence of NFTs on ETH price and their high volatility, investors are advised to engage in portfolio diversification and employ risk-hedging instruments.
- Identifying well-known platforms and conducting a comprehensive analysis of NFT projects before entering the market is absolutely essential.

This study also faced several limitations that can be addressed in future research:

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- The data were limited to specific marketplaces such as OpenSea and SuperRare. Future studies can improve accuracy by using a more complete dataset that includes diverse platforms and artwork categories.
- This study did not account for the effects of global economic volatility and financial crises on the NFT market and pricing. Future research could consider these macroeconomic factors.
- Future studies investigating the effects of NFTs across different countries may provide insights into cultural and economic heterogeneity in NFT adoption and valuation and help policymakers gain a deeper understanding of the global NFT landscape.
- Future analyses could examine heterogeneous NFT effects across categories such as digital art, music, gaming, and virtual assets to determine the unique dynamics of each sector.
- Qualitative factors such as "artistic authenticity" or "artist credibility" could not be quantified in this study.
- External shocks, such as the FTX collapse or major crypto market disruptions, were not incorporated into the models.

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