

Determinants of Sustained Success in NFT Markets

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Inspiration

The motivation for the following thesis takes root in my childhood dream of becoming a successful artist later on in life. Growing up, I often hesitated to sell my art because the price that people were willing to pay never felt enough to offset the thought and effort I put into said works. If we ran the calculations, I would be making less than half of minimum wage, so it intrigued me how certain artists in the fine art industry were able to become so successful, especially ones that sold deceptively simple and technically unimpressive works of “art,” while other artists could slave away an entire lifetime and still barely make a living or a name.

NFTs, or Non-Fungible Tokens, are one of the latest developments in the art space, and overlap with traditional art markets in certain elements. For example, in parallel to the traditional art world, many simplistic, artistically-unimpressive NFT projects also fetch dollar-valuations in the thousands to millions.

However, unlike traditional markets with auctioneers acting as gatekeeping agents, NFTs are fully transparent, with every single transaction logged on the blockchain. This data, combined with publicly available social media data, presents the perfect opportunity for analyzing how and what makes certain creators more successful in generating long-term sales over others. As I dug deeper in my research, it dawned on me that the core value drivers of NFTs, and perhaps to an extent also in the modern fine-art space, is not the technicality of the art at all, but the marketing, network, and consistent innovation that creators link to their pieces.

As an Economics (B.S) major and Visual Arts Minor, the following thesis is the synthesis of my two disciplines. I take great pride in my findings and hope that my insights would help all readers understand the NFT market a little more, but in particular, be helpful to other artists, potential NFT creators, and business leaders who hope to venture into the NFT space.

Acknowledgements

I would like to extend my deepest gratitude to Dr. Michelle Connolly and Dr. Connel Fullenkamp for their continued encouragement and support throughout what I consider to be the single most daunting and mentally-taxing experience of my undergraduate career. This project truly would not have seen itself to completion without their patience and mentorship.

I would also like to extend thanks to Art Professor Beverly McIver for providing me the opportunity to both commission large-scale paintings for Cucciolo Raleigh's private dining room, and the chance to co-curate Craven Allen's Truth & Memory Gallery. These projects gave me an insider view to the life of a successful contemporary artist, sparking the foundational structuring and inspiration of my thesis.

Abstract

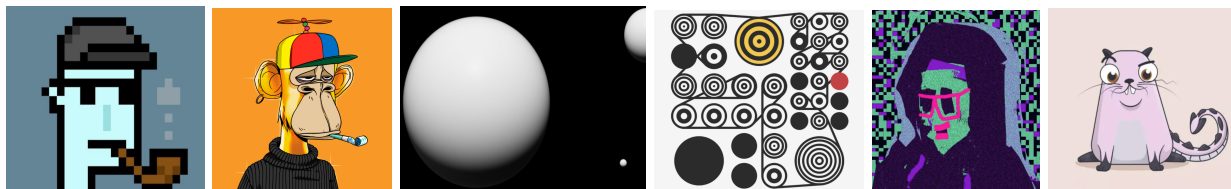
Non-Fungible Tokens (NFTs) took headlines by storm in 2021 and have since established their own marketplace. As public interest in the space wanes in 2022-2023, I characterize this emerging space and investigate factors that distinguish top-performing NFT projects within their respective market segments while controlling for external market and cryptocurrency exposures.

Literature in this emerging space remains sparse and I contribute in the following ways: 1) My cross-sectional time series panel synthesizes the most recent data from February 2022 to March 2023, utilizing information from five platforms (NonFungible.com, Twitter, OpenSea, ArtIndex, YahooFinance). To the best of my knowledge, this is the first holistic dataset that combines time-varying secondary sales data, Twitter, and market data. 2) My analysis categorizes data points by both NFT market segments and secondary sales performance, allowing for finer comparison between top and low performers within their respective categories.

I find that a change in Twitter followers and tweets over time is a statistically significant and positive predictor of secondary sales, indicating that top-performing NFT projects must consistently add value and market to investors in order to generate sustained secondary sales. Additionally, top-performers saturate the space at incredibly high speeds and grand scales. For instance, the median top-performing collectible project has a collection of 10,000 items, attracted at least 60,000 Twitter followers, and achieved over \$42 million in total sales, all within 1-2 years of the “NFT hype.” This concludes that royalties generated from NFTs are not passive, requiring creators to be reactive and consistent in their efforts.

1. Introduction

In 2014, Non-Fungible Tokens (NFTs) made their debut, but it wasn't until 2021 that they gained mainstream recognition as celebrities and auction houses alike began to acknowledge and sell NFTs. To date, some of the most expensive NFT sales include LarvaLab's CryptoPunk #7804 at \$7.6 million, YugaLab's Bored Ape Yacht Club (BAYC) #8817 at \$3.4 million, Pak's 'The Merge' at \$91.8 million¹, Art Blocks' "The Ringers" #109 at \$6.9 million, XCopy's "Right-Click and Save-As Guy" at \$7.1 million, and Dragon CryptoKitty at \$1.1 million (fig. 1) (Hale, 2023).



(Fig. 1) Left to right: Cryptopunks, Bored Ape Yacht Club, Pak, ArtBlocks, XCopy, CryptoKitties

These NFTs are visually simple and intangible – barely incorporating light and shadow, utilizing few shapes, lines, and interacting subjects. Their color palettes are limited and do not command master-use of human or animal anatomy. They pale against old-master works such as Michelangelo's *Sistine Chapel*, Monet's *Water Lilies*, or Leonardo's *Mona Lisa*, and yet they still fetched astronomical prices. This phenomenon prompts a plethora of interesting topics to investigate, from “why are investors willing to pay so much for such visually unimpressive works?” to “Is this space a fad or here to stay?”, or “how does one go about creating a successful royalty-generating NFT project?”

Before we proceed, let us first define NFTs. The term “Non-Fungible” in Non-Fungible Token alludes to an NFT's irreproducible nature. Fungibility is synonymous to “exchangeable on a 1:1 basis” – for example, the dollar is considered fungible because one dollar is completely identical to another dollar and holds the same value; by contrast, NFTs are non-fungible because each token is unique and a second token with the same ID can never be generated (Wade, 2023). This is possible because NFTs are products of computer code on the blockchain (Fig.1.1), a decentralized, fully-transparent and immutable data-ecosystem that records transactions. Within

¹ 'The Merge' was split into 300,000 components and sold to approximately 30 thousand people for a grand sum of \$91.8 million – which rounds out to approximately \$3,000 a piece

this ecosystem, the blockchain code ensures that no NFT token is identical, cross-checking with all other NFT identification codes before generating (or minting) a uniquely new NFT. As products of code, NFTs have established a revolutionary authentication system where 1) the public can see where and in whose digital wallet an NFT resides at all times, 2) when and how much money someone exchanged for an NFT, and 3) the transaction history for any given NFT. Thus, in theory, this extensive system of coded transparency establishes the ultimate authentication system and trust.

```
// SPDX-License-Identifier: MIT
pragma solidity ^0.8.0;

import "@openzeppelin/contracts/token/ERC721/ERC721.sol";
import "@openzeppelin/contracts/utils/Counters.sol";

contract EmotionalShapes is ERC721 {
    using Counters for Counters.Counter;
    Counters.Counter private _tokenIdCounter;

    constructor() ERC721("EmotionalShapes", "ESS") {}
    function _baseURI() internal pure override returns (string memory) {
        return "https://YOUR_API/api/erc721/";
    }

    function mint(address to) public returns (uint256) {
        require(_tokenIdCounter.current() < 3);
        _tokenIdCounter.increment();
        _safeMint(to, _tokenIdCounter.current());

        return _tokenIdCounter.current();
    }
}
```

(Fig.1.1) Code to Create NFT

NFTs are often represented as digital images, but they are fundamentally lines of code. And as code, NFTs have the potential to push technological boundaries and revolutionize business systems. Just as how emails, websites, and the internet have revolutionized the way modern society does business, NFTs have the same potential. In fact, NFTs already did just that. In the art space, traditional artists usually only profit via primary sales, reaping zero benefit from secondary sales. For instance, say a traditional artist sells a painting of flowers today for \$10, becomes famous in 10 years, said painting appreciates, and subsequently sells for \$1000 dollars. In this case, the artist usually reaps 0% of the \$1000. There are three reasons for this: first, traditional art can be transferred without the artist's knowledge; second, subsequent owners are

not obligated to give original artists any percentage of the sale, and third, even with a hypothetical contract in place, artists may find it tedious to enforce such contracts given legal costs. By contrast, NFTs have the capability to seamlessly resolve all these issues with code that automatically triggers royalty-charges upon every secondary transaction (fig 1.2).

```
pragma solidity ^0.6.0;
import "../IERC165.sol";

///
/// @dev Interface for the NFT Royalty Standard
///
interface IERC2981 is IERC165 {
    /// ERC165 bytes to add to interface array - set in parent contract
    /// implementing this standard
    ///
    /// bytes4(keccak256("royaltyInfo(uint256,uint256)")) == 0x2a55205a
    /// bytes4 private constant _INTERFACE_ID_ERC2981 = 0x2a55205a;
    /// _registerInterface(_INTERFACE_ID_ERC2981);

    /// @notice Called with the sale price to determine how much royalty
    ///         is owed and to whom.
    /// @param _tokenId - the NFT asset queried for royalty information
    /// @param _salePrice - the sale price of the NFT asset specified by _tokenId
    /// @return receiver - address of who should be sent the royalty payment
    /// @return royaltyAmount - the royalty payment amount for _salePrice
    function royaltyInfo(
        uint256 _tokenId,
        uint256 _salePrice
    ) external view returns (
        address receiver,
        uint256 royaltyAmount
    );
}
```

(Fig. 1.2) Sample NFT code on royalties. Code includes instructions on payment amount and where payment should go.²

To artists and non-artists alike, this royalty system may seem like the perfect opportunity for easy, “passive” money. However, current case studies do not reveal that to be true. In fact, many celebrities have attempted their luck with NFTs but failed to sustain their projects over time. For example, A\$AP Rocky issued a collection of 118 NFTs on NiftyGateway and initially sold some for \$2,000 a piece in April 2021, but by March 2022, valuation fell by 47%, sustaining only 10 secondary sales since then. Similarly, the collections of Logan Paul and John Terry also saw their valuations plummet over 90% months after issuance. Jack Dorsey, founder of Twitter, also sold his first tweet as an NFT for \$2.9 million in 2021, but in 2022, valuation dropped to a mere \$270 (Jones, 2022).

In a stark contrast to these celebrity failures, certain projects are still going strong. Even after public interest in NFTs waned in 2022, as of writing, the cheapest Bored Ape still sells for

² <https://trufflesuite.com/guides/nft-royalty/>

over \$2,000 – 2 years after the founding of BAYC.³ So what differentiates an NFT project’s long-term success from failure?

With an original dataset of 100 NFT projects and 18,000 time-varying observations, I investigate this research question and characterize the existing market from 2022-2023.

2. Background

As previously established, NFTs authenticate ownership of some underlying asset, but those underlying assets can manifest in various formats, which are then grouped into general classifications. According to Nonfungible.com, NFT market segments constitute the following: Art, Utility, Collectibles, Metaverse, and Gaming.

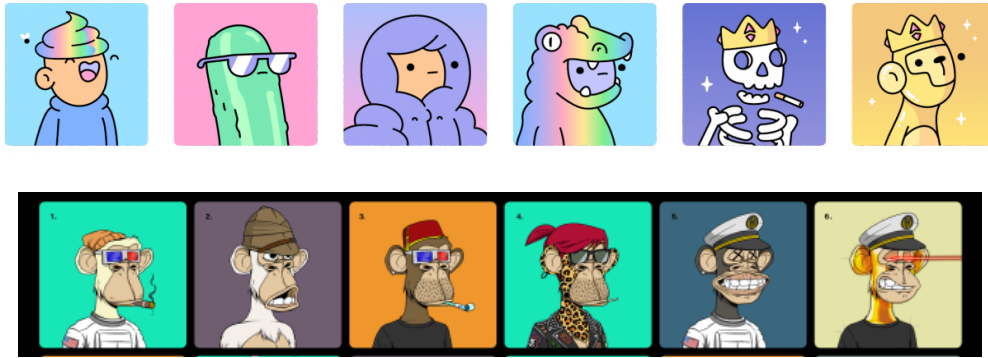
Art NFTs included on NonFungible.com include platforms that enable artists to sell NFT digital art and digital artists themselves. The most notable NFT artist is Beeple, whose NFT artwork “Everydays” sold for \$69.3 million (fig. 2). Art, just like in the traditional sense, can have political meaning, represent the artist’s identity, emotions, or take on life. For example, Beeple rose to fame with his political, controversial, and disturbing artwork (fig. 3).



(Fig. 2) Beeple’s “Everydays” and select zoomed-in images

Collectibles are collections of NFTs in which features are simple and largely stylistically homogeneous (fig. 2.2). Typically, they depict avatars whose traits determine their rarity and value. Many collections belonging to the Collectibles category attempt to add non-artistic value such as pledges to charities (Lewitinn, 2022) or in-person parties (Bein, 2023).

³ <https://opensea.io/collection/boredapeyachtclub>



(Fig. 2.2) Top to bottom: Doodles, Bored Ape Yacht Club Collectibles

Utilities are NFTs that mainly provide value in addition to the token itself – for example, Ethereum Name Service allows users to purchase domain names for the decentralized space, mapping human-readable names to computer code such as Ethereum addresses or website urls. Other utility benefits may include tickets to real-world concert events, physical product claims, skip-the-line access, etc. The range of possibilities in this category is broader than Collectibles but there does exist overlap when Collectible collections attempt to add tangible value. For example, Bored Ape Yacht Club gives its NFT holders exclusive access to parties and concerts.

Games and Metaverse NFTs relate to virtual land and digital gaming systems where players own their avatars, loot, weapons, and virtual property, which creates a gaming experience more interactive than ever. Because these two categories are less related to the art or physical world, I have limited my paper’s scope to discuss Utilities, Art, and Collectibles.

2.1. The Role of Social Media

Twitter and Discord are the platforms of choice for NFT creators and investors. In 2021, I conducted a personal interview with Nicole Sales, Director of Digital Art/NFTs at Christie’s, who oversaw the auctioning of Beeple’s “Everydays.” At Christie’s, Sales observed that successful NFT projects primarily themselves through strong communities. Sales said, “[It’s] very community driven, it’s very Twitter based, it’s all over Discord ... A lot of the artists are very very young, they’re experimenting and they’re friends with all of their collectors ... it’s a lot of organic growth, a lot of their own marketing” Sales, N. (2021, November 7). Personal communication [Personal interview].

We now understand that marketing can play a large role in an NFT project’s success, and certain investors would go as far as to use social media metrics as a way to distinguish promising

NFT investments. For example, crypto and NFT enthusiast Pascal Potvin provides the speculative baseline that a promising NFT investment should have 10K+ Twitter and 10K+ Discord followers. But what could this marketing look like?

Via these communication channels, creators can present to their RoadMaps, a long-term vision board that includes goals for the project and incentive events for investors. They may include sales targets, donations to charity, or in-person parties (NFT Roadmap Guide, 2023). They may also set targets with promises to profit-share with investors (e.g the issuing of free additional NFTs to existing holders or free cryptocurrency that they can subsequently sell). Theoretically, these plans incentivize a sticky investor base that doubles as a marketing medium.



(Fig. 5) Bored Ape Yacht Club Roadmap

Roadmaps, however, can run the risk of being empty promises. The decentralized nature of block-chain and lack of regulatory oversight led to multiple high-profile rug-pulls, where creators promised investors benefits via an attractive roadmap, but cashed out immediately after early investors bought-in, leaving the project tanking.

With these cases propagating, investors require transparency from the creating team. This may come in the form of the creators revealing themselves to the public or providing their backstory and motives for creating said project. This transparency and storytelling would also be communicated via Twitter and Discord. Thus, marketing is a rather broad-encompassing term that captures a plethora of quality and consistency factors.

3. Literature Review

Econometric literature in the NFT space is still growing but has already established a couple of key findings. First, NFT items by the same creator tend to be grouped into sets, or “collections” (projects), and within a given collection, items are visually homogeneous (Nadini et al., 2021). Nadini et al. studied 6.1 million transactions involving 4.7 million NFTs grouped in 4624 collections from 2017 - 2021. After controlling for market segments (Games, Utility, Art, Metaverse, Collectibles, and Other), they use machine-learning to analyze the images, and conclude that items within collections are visually homogeneous and share common characteristics. This indicates that universally across the NFT space, regardless of sector, creators see the artistic aspect as a branding tool.

Second, there is ongoing debate on whether NFTs are exposed to cryptocurrency. Vartanian et al. (2022) analyzed daily data from January 2020 to July 2022, controlling for the price of gold, bitcoin, and treasuries. For their variable of interest they used secondary sales data from CryptoPunks and Decentraland, two of the most successful NFT projects in the space. They concluded that Bitcoin and Ethereum were not correlated with the NFTs due to the low correlation coefficient (correlation coefficients 0.01 and -0.01 respectively). Note that there was no mention of p-value or idiosyncratic factors in this study. By contrast, a different research paper by Borri et. al. (2022) concludes the opposite – utilizing the repeat sales model with a 2018 - end of 2021 and controlling for market segments, Borri et al (2022) found that “NFT market excess return is positively and significantly exposed to the coin market excess return at the 1-percent level – a one percent increase in the coin market excess return is associated with a 0.789 percent increase in the NFT market excess return.” While the second study includes more NFT projects in addition to market segments as controls, the R-squared was still only 20%, which leaves much of the excess return to be explained. Neither of the studies included data on social media statistics.

Finally, Kapoor et. al. (2022) established the importance of social media on NFT valuation, analyzing the specific effects of Twitter promotions on the virality and success of NFT projects over a two-month period. They researched the effects of Twitter user activity on secondary sales price on OpenSea from January 2021 to March 2021 and controlled for image features. Using data from over 17,155 users, 245,159 tweets and 62,997 OpenSeaNFT assets, this study concluded that Twitter features such as retweets and likes strongly predicted asset value, while follower count was a weaker, but still positive predictor of asset value. This study

has a large sample size and controls for many factors, but unfortunately neglects market data and is limited by its short time window. More importantly, it missed key industry events, such as the bursting of the NFT bubble later in mid-2022.

NFT speculation and market hype began in 2021, but reached new heights in January 2022, when trading volume spiked to \$17.6 billion, a 21,000% increase from 2021 according to NonFungible's 2021 market report (Becher, 2023). By mid-late 2022, the bubble had burst – general loss of public interest, combined with major shocks in the crypto-space such as the LunaCoin and FTX crash resulted in precipitous drops to NFT valuation and trade volume. On OpenSea, the largest NFT trading platform, overall sales dropped from a peak of \$400 million in May 2022 to \$11 million by February of 2023 (Becher, 2023). Thus, unlike previous years, the time period between 2022-2023 truly tests the quality and grit of an NFT project.

I contribute to this growing field of research by constructing an original dataset covering February 2022 - March 2023, which includes the entirety of the NFT bubble's collapse. This is the first holistic NFT markets dataset that analyzes this time period and includes stock market, cryptomarket, art market, Twitter, and idiosyncratic data such as collection size and royalty percentage. Notably, I attempt to understand how NFT creators construct projects that sustain consistent, long-term sales. Taking the perspective of NFT-creators in an econometric analysis has not been done before.

4. Data Collection and Construction

In the following section I describe and justify my data collection and construction methods. I collect and merge data from 5 different sources: NonFungible.com, Twitter, OpenSea, Art Market Research, and Yahoo Finance.

4.1. NonFungible.com Data

On the NFT-front, I download and manually-enter collection-specific data from NonFungible and OpenSea. NonFungible.com is one of the largest NFT database companies that tracks real-time transactions on the Ethereum blockchain. NonFungible provides the bulk of both my cross-sectional, and my time-varying sales data (cross sectional: *market-segment, collection name, and collection rank within market-segment*, time-varying: *number of transactions, and volume of transactions per date*). To obtain sales data, the user must manually click into each project file, select the corresponding date ranges/moving-windows, and download the csv separately for each project. Each download limits the user to 2 variables at a time. As of late 2022, NonFungible no longer allows users to download “All-Time” data, which begins at project-inception. Currently, Nonfungible only allows users to download data for up to 1 year going back from the date of download. This limitation requires free users to download Nonfungible data quickly, especially as the site is prone to frequent maintenance shutdowns.

4.2. OpenSea Data

OpenSea, on the other hand, is an actual marketplace that allows creators and investors to buy and sell NFTs. As of November 2022, it hosts over 2 million active users and a daily trading volume of \$6 million (Amure, 2023). OpenSea contains non-time varying data such as collection size and royalty-percentage. They also have time-varying data for up to 1-2 months per project, but customer service must first grant user access to their API. For the purposes of my study, I used their non-time-varying data.

4.3. Twitter Data

As previously alluded to, Twitter is one of two main platforms that NFT investors and creators like to communicate with. Among other reasons, I chose Twitter as my only social

media platform of interest due to its transparency and availability of public records. By comparison, Discord channels are often closed off to the public with no historical records of membership fluctuation. The Duke University Economics Department provided a \$500 grant for 500 SocialBlade API credits, which grants scraping access to 1-year of Twitter data (follower count over time, tweets over time) per Twitter account handle. Each scrape costs 3 credits per account and provides 30-days of data access. After 30-days have elapsed, re-scraping the same account incurs another 3 credits. Via SocialBlade, I scraped 150 Twitter handles, some of which did not provide time-varying data due to the recency of account opening and SocialBlade's algorithm that occasionally defaults to a one-day scrape for certain accounts. Similar to the process NonFungible data, all-scraping must be completed within a short time frame to ensure that enough dates match. I scraped and cleaned all data between February 2023 - March 2023 to ensure recency.

4.4. Market Data

For market data, I used Art Market Research's "All-Art Index" to extract traditional art-market data and Yahoo! Finance to extract Sp500 and Ethereum data.

Art Market Research is a professional source for art market data, powering research reports for firms such as Christies, Sotheby's, Wall Street Journal, and Financial Times (Art Market Research). I use their "All-Art Index," a live index that documents 'Artist Price' performance, the "the weighted moving average of 24 months' worth of sales at 130 auction salerooms worldwide (buyer's premium removed) where weights attached to observations decrease arithmetically, with older observations having the smallest weights. To be eligible for inclusion in the All-Art Index, artists must have sold at least one work in a 24-month period" (Art Market Research). Note that the All-Art Index includes one data-point per month, so all dates within the same month contain the same art-index number.

Yahoo! Finance⁴ is a media company a part of the Yahoo! network that provides financial data, stock quotes, news, and reports. It provides historical data for both Ethereum-USD and SP500 (adjusted-close) over the past year. Note that while Ethereum trades daily including weekends, Sp500 does not due to market close. To preserve observations, I duplicate Friday adjusted-close numbers for the missing weekend values.

⁴ <https://finance.yahoo.com/quote/SPY/history?p=SPY>

4.5. Data Construction Process

From these data sources, I construct 2 panel datasets. The first is made up of purely cross-sectional, non-time-varying data.⁵ It includes a project's rank within a collection (sorted by All-Time Sales Volume in USD), total number of items in a collection, social media age, year of Twitter account creation, and the NFT category that the project belongs to (Collectible, Art, Utility, MetaVerse, and Games). The second dataset is pooled time-series cross sectional dataset, and includes all data from the previous dataset but additionally integrates time-dimensional data such as SP500 market data, Ethereum price fluctuations,⁶ and 30-day moving windows of each project's Secondary Sales Volume, Twitter followers, tweet counts, and average price sold.

I collected data in a sequential and iterative manner. First, I import all the projects available on NonFungible.com, ranking them by all-time sales volume in each category. With a rough quality mapping of each project, I then section off each category (Collectibles: 1-150, 200-300, 350-434, Art: 1-35, 35-70, Utility 1-10, 10-20)⁷ and begin to collect Twitter handles, alternating different segments for every 20-50 Twitter handles I collected (circling back to each as I finished sampling for the entire market). On NonFungible, each project page links to the project's supposed Twitter account; however, as Twitter handles often change, I cross-checked by searching the project name in the Twitter search engine to verify that the handle is accurate, replacing outdated handles⁸. Some projects still had no Twitter handle to be found, which would then lead to a dropping of the project.

Among projects with valid Twitter handles, I ran them through a manual search on OpenSea, logging in each project's total product count, floor price, among other constant variables. Subsequently, I input each Twitter handle into SocialBlade's API system, which is integrated as an extension of Google Sheets. Each handle must be inputted and run separately.

⁵ Data were manually scraped between January 22nd and March 22nd

⁶ Ethereum is the main cryptocurrency used to purchase NFTs. Thus, as the value of Ethereum appreciates, so does the value of an NFT.

⁷ The top, mid, and bottom-bucket Collectible divisions were based upon a rough division of thirds, with the bottom-bucket sectioned off where projects consistently showed "0 past-7 day sales."

⁸ Occasionally, the old Twitter handle would put a link in their bio which indicates the new Twitter handle, other times I would have to manually search Google and Twitter for the new handle, often relying on the verified Twitter check mark and follower count for guidance (e.g if the follower count seems abnormally low, such as in the low thousands when its peers boast hundreds of thousands of followers, I would double check).

After scraping Twitter, I went into NonFungible to obtain the matching sales data for each project once more.

Finally, I imported the SP500 and Ethereum market data from Yahoo Finance and merged all data sets in my final pooled panel. The resulting pooled dataset yielded 18,000 time-varying observations ($\Delta = 1$), and 150 groups (50 of which dropped in my main regression due to data mismatches). The cross-sectional yielded 400 observations, each observation representing a project.

5. Descriptive Data

To provide data context before the regression, I provide analysis on various descriptive aspects to compare and contrast high vs. low-performing projects (ranked by all-time sales volume)⁹ within each market segment.

Table 1: All-Time Sales Volume Ranking Within Market-Segments

NonFungible Data	Category Rank	Category Obs. #	Total All-Time Sales Volume (Median)	Total All-Time Sales Volume (Max)	Total All-Time Sales Volume (Min)
Top Collectibles	1-150	148	43,176,538	5,091,682,379	15,293,903
Mid Collectibles	200-300	101	5,759,941	9,490,038	3,344,823
Bottom Collectibles	350-434	134	933,667	3,317,997	3,564
Top Art	1-30	30	26,714,746	1,693,925,834	4,865,646
Bottom Art	40-72	33	144,830	1,233,025	4,082
Top Utility	1-13	13	12,919,365	269,178,481	1,291,606
Bottom Utility	14-24	10	180,179	1,149,717	6,623

This table contains the entire cross-section downloaded from NonFungible and illustrates the all-time sales volume range that each category performance group operates in. First, it seems that even at the low-performing ranges across all market segments, absolute sales volume remains high, with medians of 933K, 144K, and 180K for Collectibles, Art, and Utility respectively. This may be due to a survivorship bias, where projects that fail prior or shortly after launch, and were not included in the database.

⁹ I rank collections by all-time-volume simply as a rough estimate. The cross-sectional dataset that NonFungible provides does not include secondary sales.

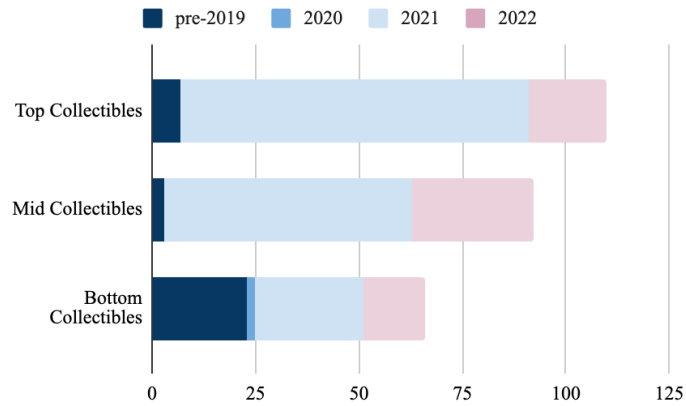
Despite this, performance groups across all market-segments are distinct in market-cap, leaving ample room for comparison analysis. Top projects in Art and Utility net 71% more in median all time sales relative to bottom projects within the same segment. For Collectibles, the spread is slightly tighter at 46% but still sizable. The \$933K median at the lower-performing category for Collectibles may indicate greater market interest and speculation.

5.1 Twitter Join Date Distribution

In this section I analyze the years that each collection's account joined Twitter and the distribution of those join dates between market-segment performance groups. This statistic effectively proxies for when the collection launched, including the period before launch in which creator teams may hype up the project. By assessing these dates, we learn about: 1) the approximate age of projects in each market-segment performance group, 2) how much new interest is a market-segment garnering, and 3) the speed in which newly minted projects can rise to the top from 0 followers.

Starting with Collectibles, the upper echelons of the Collectible NFT market seem to be saturated with newcomers, which again points to the observation that collectibles are more speculative. Most top-collectible projects joined Twitter in 2021, but 2022 still saw decent numbers. This idea that prominence and social media fame can be achieved in under 1-2 years is incredible and emphasizes the importance of jumping on trends fast as 2021 was *the* year of NFTs. Of 110 sampled "top" collectibles, 76% created their Twitter accounts in 2021, and by contrast only 17% created their Twitter accounts in 2022. This also suggests that the segment has saturated quickly and is beginning to slow in growth. Nevertheless, it seems that relative to mid or high-ranking collectibles, a disproportionately higher percentage of low-performing collectible projects joined Twitter 2019 or before. This again signifies the importance of adaptability - the formula for a model successful collectible-collections (e.g Bored Ape Yacht Club, CryptoKitties, etc.) emerged and garnered media attention in 2021, and so creators in 2021 had a template to follow and an industry spotlight to leverage pre-launch. Projects dating before 2019 may not have been able to adapt as quickly and have missed the launch-phase, which tends to be important in garnering excitement. Alternatively, these projects may have once enjoyed success but could not keep up with the speed of the sector, failing to sustain themselves over the past the 3 year mark.

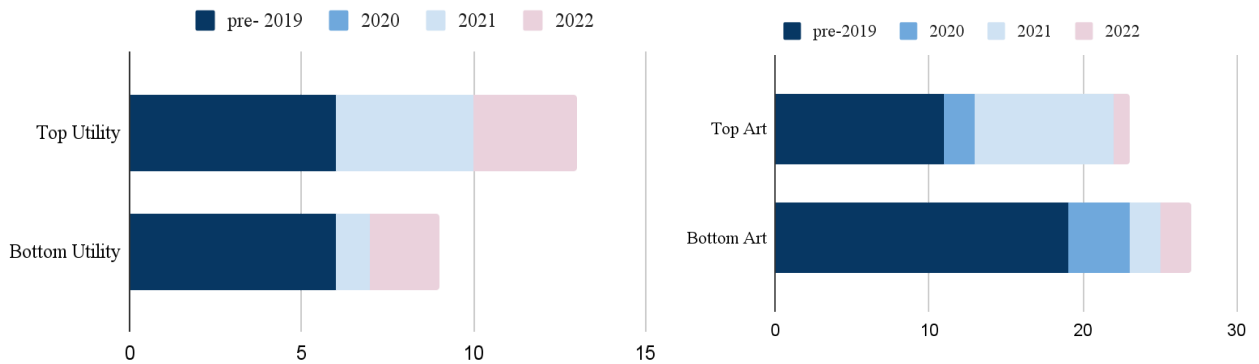
Collectibles: Year of Joining Twitter by Performance Group



(Fig. 5.1)

Expanding to other segments for comparison, the Art and Utility segments tend to be less skewed in Twitter-handle founding years relative to Collectibles. In my sample, approximately half of the top Art projects in my sample joined in 2019, while the other half joined in 2021. For Utility projects, 50% of top projects joined Twitter in 2019 or before, 33% in 2021, and 25% in 2022.

Utility and Art: Year of Joining Twitter by Performance Group (Left to Right)



(Fig. 5.2)

Newcomers (projects that start 2021 or later) saturate top Art and Utility markets at speeds slower relative to Collectibles likely due to differences in technological and labor constraints. For example, lone-artists may find themselves limited in manpower, production capacity, and creativity. Collectible projects, on the other hand, often have teams running them

before launch. They have collections that are visually homogeneous by definition and no other definite coding requirements. Characters are often simple with minor alterations; hence, creators can utilize AI¹⁰ or templates to mass generate thousands of NFTs simultaneously. Despite using art as a key branding tool, Collectible creators do not direct focus in creating awe-inspiring art masterpieces. Instead they may direct the bulk of their focus to marketing and raising capital, effectively running as a startup from day 0. By contrast, Utility NFTs require higher time-investment because their underlying asset must be tangible, functional, and ideally innovative. For example, the utility project Dancing Seahorse (ranked 9 in all-time sales volume within category), provides holders with access to VIP music experiences, a network of music professionals, and “equity in a new music-based NFT marketplace.” Parsing through logistical setups, such as hosting music shows/grand networking events, or creating another marketplace entity, takes more time.

5.2. Total Items

In this section I describe the relationship between total number of items in a collection in relation to its overall all-time sales-volume rank. One would believe that scarcity would create higher prices. However, in observing the top collections across the collectible, art, and utility segments, we see that relationship as positively correlated. That is to say, the higher ranked NFT projects also happen to have more items in their collection. The sweet spots for Collectibles and Utility NFTs seem to be 10K (the median in top-collectibles). This could be due to a couple of factors. First, the sizing allows for artificial scarcity within the collection (e.g one Bored Ape has rarer traits than another), and second, it allows for a sizable community that can bond internally while marketing externally. The median number of artworks in the Art category is significantly smaller, so there may be room for growth in the segment. 10K works is also a concrete number that emerging artists can target as a guidance. Due to the royalty-system, creators may very well underprice NFTs during primary sales to maximize reach, and then attempt to profit off secondary sales.

¹⁰ Photoshop released new AI-powered updates in October 2022, allowing for quicker digital workflows <https://www.theverge.com/2022/10/18/23408954/adobe-photoshop-new-ai-collaboration-features-announcement>

Table 2: Total Items in Collection Within Market Segment

OpenSea Data	Nonfungible Category Rank	Category Obs #	Total Items in Collection (Median)	Total Items in Collection (Max)	Total Items in Collection (Min)
Top Collectibles	1-150	65	10,000	3,362,000	616
Mid Collectibles	200-300	64	7,983	33,800	512
Bottom Collectibles	350-434	61	3,332	43,800	97
Top Art	1-30	25	1,000	212,500	82
Bottom Art	40-72	23	178	8	8
Top Utility	1-13	8	10,000	35,300,000	1,000
Bottom Utility	14-24	5	108	5,113	6

5.3. Twitter Following

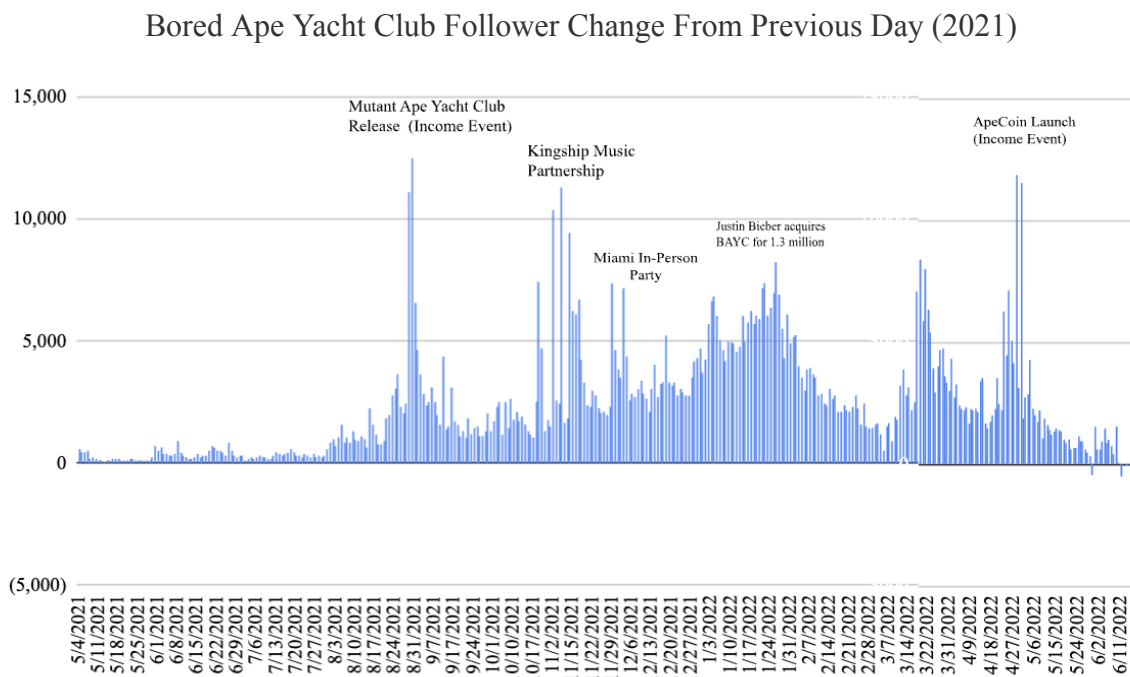
Finally, we examine Twitter Follower data, in which we see an obvious positive correlation between total followers and total-sales-volume. Despite this trendline, however, the range in followers between performance is large, with the highest follower count in bottom-performing projects hitting 131K, 35K, and 43K for Collectibles, Art, and Utility respectively. This indicates that simply having followers (e.g. bots, or perhaps followers for an unrelated niche) may not be enough. Twitter followers are indicative of an audience, but perhaps not a sales-converting audience.¹¹

Table 3: Total Twitter Follower Distribution Market Segments

Cross-Section Data	Category Rank	Category Obs. #	Followers (Median)	Followers (High)	Followers (Min)
Top Collectibles	1-150	110	63,150	1,000,000	3,596
Mid Collectibles	200-300	92	14,200	267,400	300
Bottom Collectibles	350-434	66	2,603	131,800	50
Top Art	1-30	24	36,550	339,200	3,076
Bottom Art	40-72	27	3,872	35,600	143
Top Utility	1-13	13	35,200	557,100	1,598
Bottom Utility	14-24	9	2,723	43,800	195

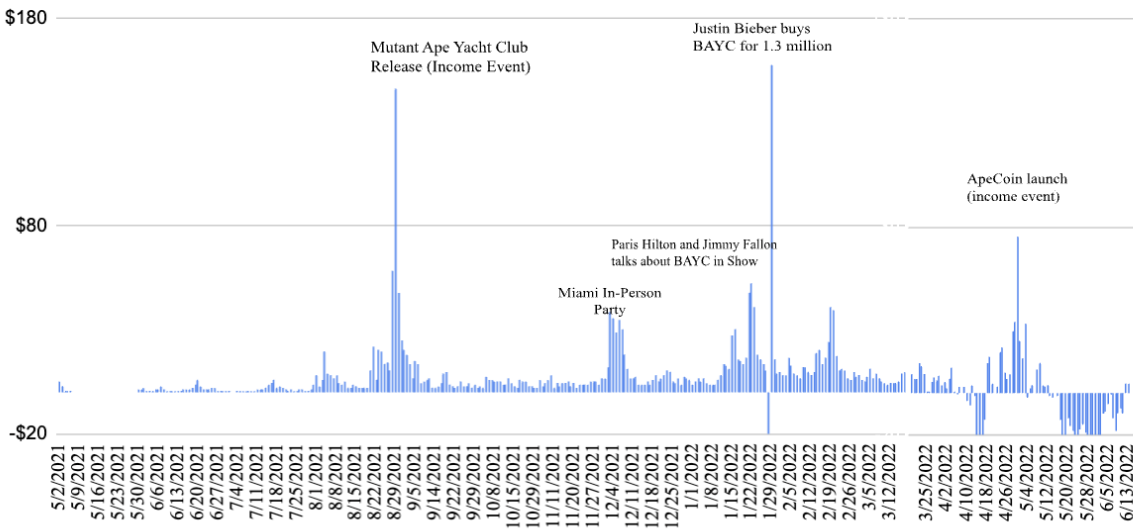
¹¹ <https://codedesign.org/why-instagram-followers-are-not-converting/>

I further investigate these suspicions with Bored Ape Yacht Club (BAYC) time-varying Twitter follower data from 2021,¹² I notice that certain marketing actions can drive secondary sales within the same timeframe. For example, when BAYC launched new profit-sharing products, both followers and secondary sales skyrocketed. The same thing happened with Ape Coin. Thus I hypothesize that Twitter followers over time capture a variety of active marketing tactics, but are ultimately outputs to creator efforts and creativity. In other words it indicates marketing effectiveness.



¹² This data subset is from the data I collected in 2022, before Nonfungible removed its “All-Time” feature from sales downloads. It is not a part of my regression dataset.

Bored Ape Yacht Club Secondary Sales Change From Previous Day (2021)



(Fig.5.3) Bored Ape Yacht Club Twitter Follower Change vs Secondary Sales Change (\$mm)

6. Empirical Specification

Consistent with previous NFT researchers, I use the repeat-sales method and ordinary least squares (OLS) to predict two variables of interest, secondary sales volume (USD) and secondary sales average price sold (USD). Typically used in real-estate analysis, the repeat-sales method looks at the sales price movement of the same asset on a secondary sales market in order to control for asset-specific characteristics, such as size, color, and material of a house. Previous researchers control at the item level to study general NFT valuation; however, because I am interested in the construction of long-term NFT projects from the creator’s perspective, I control at the collection level. By definition, items within a “collection” should share common traits that distinguish them from other collections, the most common of which is the underlying artwork. And as alluded to prior, Nadini et al. (2021) already established that items within collections, regardless of market segment, are visually homogeneous.

To elaborate on my variables of interest, I selected secondary sales volume because it proxies for both public adoption of the project and creator revenue from the royalty system. Secondary sales average price on the other hand, does not account for the number of transactions, but conveys investor valuation at a per-item basis. For an NFT creator, both are important considerations for longevity.

In previous sections of the paper, we have established multiple possible variables that could significantly influence secondary sales transactions, but can overall be subdivided into three categories: market factors, marketing factors (creator efforts), and collection properties. I use the following equation in my OLS:

$$\begin{aligned}
Y_{ct} = & \alpha + \beta_1 \ln(30\text{DayMovingWindowofTwitterFollowers})_{ct} + \beta_2 30\text{DayMovingWindowofTweets}_{ct} \\
& + \beta_3 SP500_t + \beta_4 ETH_t + \beta_5 ArtIndex_t + \beta_6 RoyaltyPercentage_c \\
& + \beta_7 TotalItemsInProj + \beta_8 AgeOfTwitterAccInDays_c + \beta_9 JoinTwitter2021_c \\
& + \beta_{10} JoinTwitter2022_c + \beta_{11} Art_c + \beta_{12} Utility_c + \beta_{13} ArtXETH_{ct} + \beta_{14} UtilityXETH_{ct} \\
& + \beta_{15} ArtXSP500_{ct} + \beta_{16} UtilityXSP500_{ct} + \beta_{17} ArtXTotalItemsInProj_{ct} \\
& + \beta_{18} UtilityXTotalItemsInProj_{ct} + \beta_{19} UtilityXArtIndex_{ct} + \beta_{20} ArtXArtIndex_{ct} + \epsilon \quad (1)
\end{aligned}$$

Where Y_{ct} is the variable of interest, the natural log of secondary sales volume (USD) or the natural log of secondary sales average price sold (USD) per collection c at time t ($\text{delta} = 1 \text{ day}$). For both these measures I use the 30-day moving window, which is the cumulated number of sales for the past 30-days (a level-change) and as well as their corresponding average sales price. I calculate the average secondary sales price sold by dividing a collection's total sales volume by the number of transactions (both 30-day changes), replacing division by 0 errors with 0. Similar to traditional art, NFTs are unique and illiquid assets that are subject to severe fluctuations and thus require a degree of smoothing. This practice is standard in the traditional art industry. The Art Index for example, does a 12-month smoothing effect. In a further transformation, I also take the natural log because the top-performing collections skews the data and we would like to standardize it.

6.1. Marketing Variables and Creator Efforts

I expect both tweets and Twitter followers to be statistically significant predictors of both secondary sales volume and secondary sales price. Whereas tweets directly proxies for creator effort in online investor engagement, Twitter followers is an indirect measure that captures the effectiveness of singular marketing events, the brand image, the believability of a creator's

roadmap, and other sales-generating campaigns. Consistent increases in Twitter followers translates to consistent value-add that attracts new audiences while retaining old ones.

To accurately represent creator-efforts, I transform our cumulative historical Twitter data into 30-day-moving-window level changes, consistent with the format of our secondary sales data variables. This makes intuitive sense because after a marketing event, followers may increase over the span of a couple days or even weeks. Twitter follower change also exponentially increases as collections heighten in fame, therefore I take the natural log of this variable. I left the Tweets variable as a simple 30-day change because it is not a variable that should exponentially increase or decrease as an account increases in fame. There are limited hours in the day, limited announcements to make, and an upper-threshold to which followers may become annoyed if an account posts too much.

6.2. Market & Related Interaction Variables

I would also like to confirm the correlation between the NFT markets and the three markets (traditional art, SP500, and Ethereum) as existing literature conflicts on the relationship between NFTs, Ethereum, and the SP500. However, I hypothesize that there is a significant relationship between these markets, especially as the macroeconomy sours and we saw multiple crypto-shocks in the past year. In 2021, it seemed likely that the speculation bubble on NFTs wiped out correlations between this emerging market and the much more mature SP500, and even Ethereum market. But now that general public interest has simmered, it would be odd to see macroeconomic shocks not affecting the NFT market.

Regarding the interaction terms, I expect to see some degree of additional correlation between the Art NFTs and the art-index simply because they are in the same category. However, it is also known that art auctions “burn” paintings, where they take a painting off the market, selling it privately or at a different location in a different auction, should the painting fail to meet a pre-set reserve price (Assil, 2021). This keeps art market prices inflated. Nevertheless, it would be an interesting relationship to observe as NFT markets are completely transparent and art cannot be hidden away and “burned.”

6.3. Collection-Specific Variables

Art and Utility Indicator variables control for category specific traits, such as how Collectibles tend to have artwork that is on the simpler side, Utilities bias towards tangible use, and Artists tend to operate as individuals. Moreover, as shown by the descriptive statistics, it seems that Collectibles should be the most speculative category, generating more sales and at higher prices. Therefore, coefficients should be negative on the Utility and Art interaction terms. All other collection variables are also expected to be significant. Royalties make intuitive sense to have an effect on secondary sales. A higher royalty percentage means that every transaction would cost the buyer more or the seller less in profit. A longer social-media age should theoretically be correlated with higher sales due to these creators having more expertise, time to set up operations, and time to market. And finally, joining Twitter in 2021 and 2022 should also be significant because public recognition of NFTs began in these years.

7. Results & Discussion

I regressed the OLS equation specified in the previous section and achieved results largely significant and consistent with expectations. With an overall R-square of 0.32 for my regression on secondary sales average price sold and 0.52 on secondary sales volume, these variables explain 32% and 52% of the variation in secondary sales average price sold and secondary sales volume respectively.

Table 2: Results

	Ln (Secondary Sales Avg Price Sold 30-Day Moving Window)	Ln (Secondary Sales 30-Day Moving Window)
ln_TwitterFollowers (30-day window)	0.0322*** (.0093)	0.1844*** (.0090)
DailyTweets	0.0000 (.0001)	0.0006*** (.0001)
SP500	0.0003 (.0011)	-0.0082*** (.0011)
Ethereum	0.0055** (.0000)	0.0009*** (.0000)
Art Index	-0.0000*** (0.000)	0.0000* (0.0000)
RoyaltyPercentage	-9.8744 (8.669)	-2.1262 (10.8150)
TotalItems	0.0009*** (.0001)	0.0002*** (.0001)
SocialMediaAge in Days	0.0052 (.0003)	0.0008** (.0004)
JoinTwitter2021 (Indicator)	4.3946*** (0.8489)	7.1782*** (1.066)
JoinTwitter2022 (Indicator)	4.3730*** (1.091)	7.9577*** (1.271)
Art (Indicator)	0.0890 (1.0856)	-2.987** (1.271)
Utility (Indicator)	-6.5472*** (1.3328)	-5.8007*** (1.543)
ArtxETH	-0.00013* (.0001)	-0.0004*** (.0001)
UtilityXETH	-0.0006*** (.0001)	-0.0010*** (.0001)
ArtxSP500	0.0008 (.0018)	0.0056*** (.0018)
UtilityxSP500	0.0129*** (.0025)	0.0207*** (.0024)
ArtxArtIndex	0.0000* (0.0000)	0.0000*** (0.0000)
UtilityXArtIndex	0.0000*** (0.0000)	0.0000** (0.0000)
ArtXTotalItems	0.0000 (.0001)	0.0006* (.0001)
UtilityXTotalItems	-0.0001* (.0001)	-0.0016** (.0001)
Cons	1.0376	4.032
Observations	18599	18066
Groups	103	102
R-Squared (Overall)	0.32	0.52
Within	0.12	0.56
Between	0.36	0.13

P<0.01*** P<0.05** P<0.1*

7.1. Social Media Factor Results

As expected, change in Twitter followers positively correlates with both change in secondary sales and average price sold in secondary sales at the 1% level of significance. A 1% increase in Twitter followers predicts an increase in secondary sales volume by 0.18% and price by .03%. This means that continuous Twitter growth positively correlates to continuous secondary sales. As previously mentioned, Twitter follower growth is often the byproduct of successful organic marketing, a holistic proxy for factors such as an identifiable brand, a strong roadmap, celebrity collaborations, product-launch announcements, giveaway announcements, in-person parties, and other hard-to-measure qualitative factors. Referencing back to the Bored Ape 2021 timeline of Twitter day-by-day follower change vs Secondary Sales Volume day-by-day change (fig, these two variables largely move in tandem and in real time, particularly after a major marketing event or product launch. Thus, while some may tout NFTs as a way to generate passive income via royalties, the marketing requirements may make the ordeal not be so passive after all. This means that at larger scales, creators may need to outsource project management if they would like to create new or spin-off projects.

7.2. Collection-Specific Results

Surprisingly, the percentage of sales price that a creator receives as royalties is not significant given current levels (range is approximately (0%-10%). This indicates that creators can viably increase royalty rates within the 2-10% range for new mints.

All other collection-specific variables resulted in expected outcomes, with total items in collections being positively correlated with both secondary sales average price sold and secondary sales volume at the 1% significance-level. For every additional item in a collection, this model predicts secondary sales volume to increase by 0.01% and secondary sales average price sold to increase by 0.02% in a 30-day period.¹³ Translating these percentages to dollar terms, one additional collection item could increase secondary sales volume by \$0.63 - \$509.82 per month and the average price of a secondary transaction by \$0.01-\$0.57. These ranges represent the differences between the median and mean statistics on secondary sales volume and secondary sales average price sold for all collections across all time periods in 2022 - 2023.

¹³ Given that the secondary sales variables are log-transformed, I used the formula $(\exp(\text{coefficient})-1)*100\%$ to obtain the percentage that I could interpret the results with.

While I did expect for 2021 and 2022 project-start dates to be significant, I did not expect the magnitude.¹⁴ At a 1%-level of significance, projects that start in 2021 expect to increase secondary sales price by over 8000% and secondary sales volume by 130,000% relative to projects that started before 2020. 2022 Twitter-join dates yielded similar numbers. This result is consistent with findings in the descriptive statistics.

7.3. Market-Specific Results

The regression found Ethereum, Sp500, and the Art Index to be statistically significant predictors of secondary sales volume. However, the coefficient for the Art Index and related interaction terms was abysmally small. This may be due to the limitation of having access to only one data point per month for the Art Index and the fact that Art Market Research constructed their index using a 12-month window as opposed to 30-days, the moving-window I used for my Twitter and secondary sales variables. Another simple explanation may be that the NFT markets are simply different from the traditional art markets.

Finally, the interaction terms between the market data and collection category dummies were all significant. Most of the marginal coefficients, except for the Utility x Sp500 interaction term, were small and not particularly notable. Relative to other market segments, Utility collections are more affected by the SP500 – when the SP500 increases by \$1, the average secondary sale price of Utility NFTs will go up 1.30% higher than other sectors' price and secondary sale volume will go up 2.09% higher than other sectors' prices. This makes sense as Utilities NFTs are based on real-world services.

¹⁴ Given that the secondary sales variables are log-transformed, I used the formula $(\exp(\text{coefficient}) - 1) * 100\%$ to obtain the percentage that I could interpret the results with.

8. Conclusion

Despite NFTs' initial association with the art space in 2021, it seems as though successful NFT projects have little to do with art at all. In fact, by definition, NFTs are not art – they are code that establish ownership over something ... anything! Successful NFT creators use art for branding as opposed to creating aesthetic masterpieces. We saw that Collectibles tend to be simple in aesthetic style and easily mass producible. Our regression verifies that at least up to 10,000 items, having more products allows a brand to increase both sales volume and price. Thus, with such motivations, it is no wonder that many of these items look ... artistically unimpressive.

From the beginning, successful NFT creators treat their projects like a startup business as opposed to an artistic process, drilling focus into marketing, networking and creating strategy. In this paper we also established that simply having a massive following, i.e being a celebrity, is not enough to achieve long-term success in the NFT space. Creators must create a brand around their project and consistently add value. Our regression only goes to reveal that the change in an NFT collection's Twitter followers is positively correlated to the change in the collection's secondary sales, but based on our examination of BAYC's sales and 2021 follower growth records, it seems that monster exponential growth can only be achieved with back-to-back engaging socials, collaborations, and product-launches that provide real value to the investor. Thus, the royalty system is far from passive.

We also established that the NFT ecosystem is a rapidly evolving space that saturates at incredible speeds. With the majority of top-earning NFT projects achieving their multi-million-dollar success in less than 2 years, the space is competitive and cutthroat. Fortunately or unfortunately, it seems that with the democratization of AI, competition in the space may only become fiercer and faster as repeatable tasks are increasingly automated. Bubbles will inflate quickly and perhaps crash even faster.

In 2022, the NFT market saw an intense market correction as public interest waned. Fortunately, however, it seems that NFT technology is not just a fad. As shown by the higher Utility x Sp500 correlation coefficients, NFTs are making their way into the tangible world with real uses. Perhaps sooner than we think, another revolutionary business system like the NFT royalties will emerge very soon.

Appendix

Construction of the Dataset Documentation

- 1) Go to Non-Fungible.com, navigate to market-tracker, select “all-time” and market segment of your choice. Rank projects by all-time-sales volume and copy-paste to Google Sheets. Repeat until pages run out and all segments completed.
- 2) Add market-segment into spreadsheet and section off Collectibles into top, middle, and bottom-performers by all-time sales volume rank. Section off top and bottom Utility and Art performers.
- 3) Manually search each project in Non-Fungible, click on the Twitter icon, and enter Twitter handle, date account joined Twitter, and log number of followers. Cross-check by searching project name in Twitter search-engine if follower count seems abnormally low and there is no blue-checkmark. Log in 20-30 users per section and then cycle to the next section. Add more if time-allows.
- 4) Label those observations with valid Twitter handles 1-150 for time-series dataset, Observations should be spread across performance level and market - segment level.
- 5) For those observations, manually search OpenSea for Total Items, Floor Price, and Creator Earnings for entries with Twitter usernames. Change performance sections after every 20-30 projects.
- 6) Copy Cross-Sectional Data into 2 new tabs, label one SalesData and one Aggregate data. Add columns in SalesData spreadsheet for variables. Create a filter for all variables.
- 7) Use the filter for your observation number – first deselect all, then select 1, going up from there. Go back to NonFungible.com, search for the corresponding project name, download Secondary Sales and Secondary Sales USD (Volume) in addition to Primary Sales and Primary Sales USD (Volume). The file will come up as separate downloads with no title, so immediately paste the data into the SalesData tab. Make sure to copy down the rest of the time-non varying data so the filter and vlookup works later on.
- 8) Go to the “Aggregate” tab and filter by observation again. This time, use API and follow SocialBlade instructions to download Twitter followers over time. Make sure to save the API and edit the columns to the ones that you need. Google Sheets API Connector integrates with SocialBlade and allows you to import data straight from Twitter.

Copy-Paste all non time-varying data for each time-data point to ensure that filter will work.

- 9) Download Ethereum and SP500 data from YahooFinance, enter them in Google Sheets in a “Markets” tab.
- 10) Use the V-lookup function to merge two datasets in the Aggregate tab.
- 11) Make sure there are no commas in the spreadsheet or else Stata will not recognize the variable as numerical
- 12) Use the “Date” formatting option in Google Sheets to standardize metadata format and ensure Vlookup works properly.
- 13) Double-check that all formulas are extending to the right range and that the column/row locks are accurate
- 14) Import Google Sheets as CSV files

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