

Non-fungible token modeling: the enthusiasm of music fans for the digital-collectible revolution

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ABSTRACT

Blockchain technology has become a major focus in data security and reliability. A foundation for innovations such as non-fungible token (NFT), which opens up new opportunities in managing ownership of digital assets. We investigate NFTs in the form of voice, which is digital audio communication. During the COVID-19 pandemic, podcasts have been rampant, creating new business opportunities in digital media such as NFTs, which have explored and evolved in various markets; voice content has gained significant space in sales, promotion, and dissemination/innovation. This research presents a comprehensive analysis of NFTs from 2019 to 2022, focusing on the variable association consisting of the NFT category, the price of each of those NFT categories, NFT editions, and NFT marketplace. We used structural equation modeling (SEM) to clarify the relationship in partial least squares structural equation modeling (PLS-SEM). This study's findings suggest that music enthusiasts seek NFTs based on the NFT category. Therefore, it is crucial for NFT creators, who are musicians too, to exercise caution when choosing the NFT category that is most popular among music enthusiasts. We suggest that the musicians creating NFTs should consider establishing appealing NFT categories to attract music fans and other collectors.

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1. INTRODUCTION

The impact of the COVID-19 pandemic has been significant in recent years. Such significant changes affect people's behavior in terms of information production and consumption. The rule of staying at home, makes most people turn to more traditional television media to get information. In addition to such phenomena or facts, the emergence of new media elements such as podcasts has become a routine activity at home, when the lockdown rule was enforced, although some also had to travel to work in the office with certain schedules making that time used to listen to information [1]. But the change isn't just about consuming information. The information-making activity also increased as the time spent at home opened up new opportunities for anyone to create information content, with a significant increase in the popularity of new podcasts that were a new trend in the first year of the COVID-19 pandemic era [2]. The challenges in the era of the COVID-19 pandemic in the last few years have also become increasingly intense, especially in the business model. Because face-to-face events are restricted, and most of the dissemination activities are done through streaming.

The very rapid shift to digital content makes reality for consumers and our own perceptions of what we have now, more than ever, that is, virtually [3]. Blockchain also opens a new path to controlling third-party

asset ownership and such transactions can be well monitored [4]. Because of the huge demand for digital artwork, as well as some creation in the music field, non-fungible tokens (NFT) emerged as an opportunity to find alternative income. The time of the COVID-19 pandemic effectively cut musicians off their primary source of income, live shows and merchandise sales [5].

The presence of streaming platforms in music, just begun to move towards a new kind of so-called digital asset. Many famous artists as well as newcomers realize that they can adopt a model business by selling songs on their albums and other unique artworks in token form [6]. With more and more new ways for content creators to market and sell their content that have proven in 2021, NFT has taken new positions regarding new possibilities in terms of consumption and distribution, as well as in the field of vote [7]. Music preferences and items available on the NFT platform, such as songs, albums, and audio clips are also included in the music composition [8]. According to Bradley: “With the absence of a live face-to-face show, artists are increasingly turning to sources that allow fans to pay for exclusive content. Through the use of NFT, blockchain technology can provide a new solution to this problem, a solution that will last longer than the departure of live music” [9].

Blockchain is the basic technology of bitcoin. The stable value and operation of bitcoin makes the blockchain attractive in many areas. Blockchain technology is a special type of data collection distributed on peer-to-peer connected computer networks [10]. Blockchain has a characteristic of decentralization, stability, security, and unmodification. In this technology, each set of data is encrypted and chained to determine the chronological sequence of the pieces of data that determine the one source of the data. Each block is verified with several groups of algorithms [11].

Public interest in cryptocurrencies has increased during the COVID-19 pandemic. Crypto-fans and crypto-collectors are also at odds with global market interest rates, while lockdown enforcement and digital lifestyle transition fans are not only among the general public, but also among academic researchers [12]. NFTs have emerged as potential definers of a centralized global market and are often used as outstanding business opportunities. Most of the NFT technology is still misunderstood and still lacks the presence of major consumers in the global market [13]. Indeed, NFT are appealing at the new entrance, which is also typically supported by celebrities, so greatly increasing the value [14].

NFT itself differs from the fungible token that we previously knew as Bitcoin, where each token has the same value as the other one and can be easily exchanged. The non-fungible aspect of NFT ensures that each Token is unique and gives ownership of the digital asset to its holder [15]. According to Wang: “Bitcoin is a standard coin where all coins are equal and indistinguishable. On the contrary, NFT is a unique thing that cannot be exchanged, so it is suitable to identify something or someone in a unique way. Using NFT on smart contracts (in Ethereum), a creator can easily prove the existence and ownership of digital assets in the form of videos, pictures, artworks, and tickets. In addition, crypto-collectibles are more relevant because of their unique value, according to Chevet: “Like artworks stored on the blockchain, all forms of data (pictures, texts, sounds) are identified in their uniqueness by the blockchain. A brand can also build loyalty by creating ownership with powerful elements like a logo or brand design. NFT itself can be used to persuade consumers to buy physical products from a brand, thus creating cross-selling opportunities. Examples are digital fashion brands like Nike and Adidas that have sold a lot of physical shoes as NFT and or vice versa [16]. Crypto-art is also a new artwork that is silent images or animations distributed through crypto galleries or their own digital channels using blockchain technology [17]. The overlap between technology innovation and music over the past few decades promised a revolutionized music industry with space for all types of artists to prosper and find creative and monetary empowerment [18].

As more music artists are entering the scene with innovative utility value offerings to their fans, the community around music NFTs is rapidly growing, further popularizing the technology. This study investigates the correlation among NFT collectors/owners, NFT category, NFT editions, and NFT marketplace, aimed at assisting musicians in the creation of NFTs. While the ecosystem is still getting built, it is important to have a look at the NFT music artists and creators who have been the most prominent and active in driving the music NFT space forward up to date [19]. Thus, the following hypothesis is formulated:

- Hypothesis 1 (H1): music fans looking for NFT in terms of category
- Hypothesis 2 (H2): music fans looking for NFT by the price
- Hypothesis 3 (H3): music fans looking for NFT based on marketplace
- Hypothesis 4 (H4): pricing for NFT based on the number of NFT edition

2. METHOD

Partial least squares (PLS) is a composite-based method for structural equation modeling (SEM) that allows estimating complex interrelationships between constructs and their indicator variables [20]-[22]. The sample size of this study is 445 NFT from views digital marketplace of NFT that create by 6 creators that

especially from musician/artist. We crawled that digital marketplace (Figure 1) than we analyze the result data with Smart-PLS4.

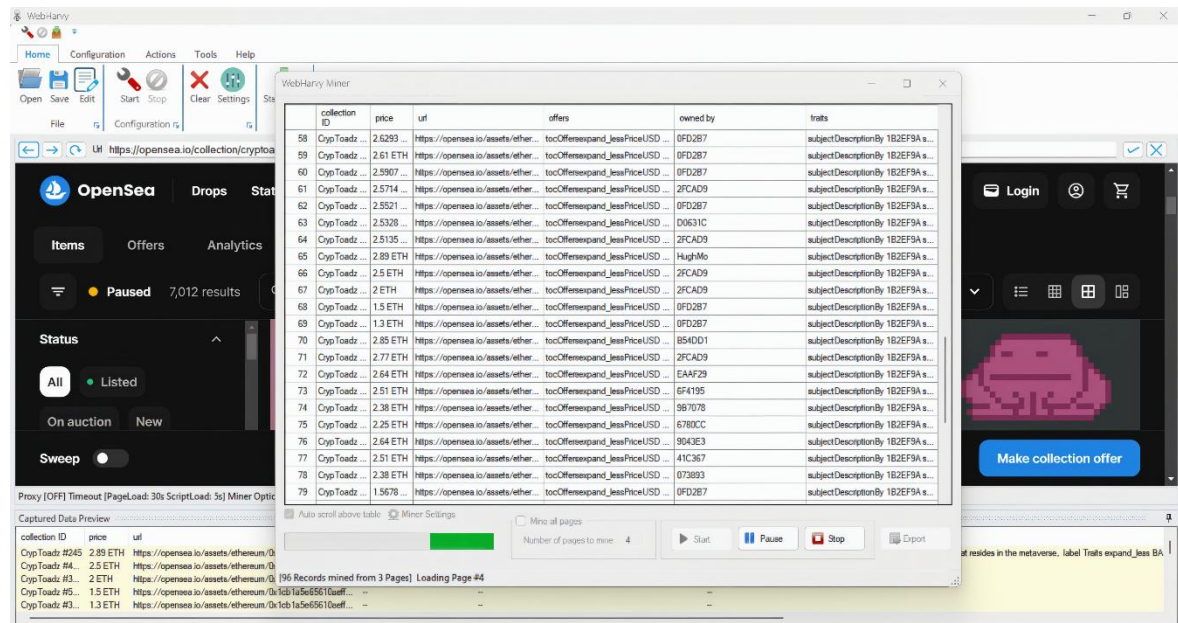


Figure 1. Crawling NFT

Analyzing PLS-SEM data begins with looking at the measurement models. When it comes to formative and reflective constructions, different requirements apply. After determining that the measurement models satisfy all necessary requirements, researchers must evaluate the structural model [23]. PLS-SEM is the preferred approach when formative constructs are include in the structural model [24]. The demographic profile emerged with the result listed in Table 1 indicates that the high percentage of owners in the “Art” and “PFPs” categories may suggest a strong interest in “Audio/mpeg” and “Music” may also reflect different demographic preferences.

Table 1. Demographic profile

NFT category	NFT owners (%)	NFT editions (%)
-	0.22	5.84
3D digital art	0.67	139.55
3D digital art, animation	0.22	137.53
Art	26.29	15510115
Audio/mpeg	28.76	28.76
Audio/wav	1.8	1.8
Domain names	0	0.45
Gaming	0.22	0.22
Image/gif	0.45	921.12
Image/jpeg	1.35	426.74
Memberships	0.22	240.45
Music	13.93	14277.75
PFPs	24.27	236.18

We performed SEM to clarify the relationship between music fans as an owner of NFT, category of NFT, price of NFT, NFT marketplace and the price of each NFT. The measurement of the relationship between these variables was set as the formative measurement model on Figure 2. SEM is a statistical method that uses metrics to examine the structural relations between theoretical causality and correlation among component concepts [25].

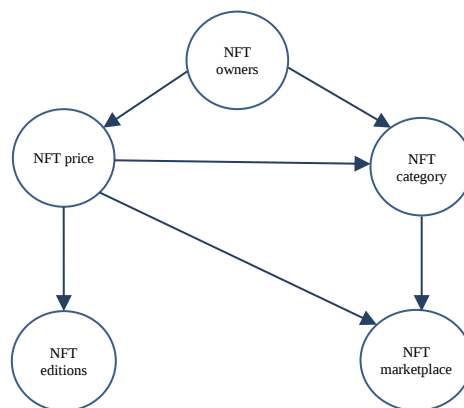


Figure 2. Diagram model

2.1. Structural relationship analysis

2.1.1. Evaluation of measurement models

To validity of the measurement indicators and the model's component elements must be assessed in order to assess a formative measurement model utilizing formative indicators. Within a model of formative assessment, strong correlations are challenging from the perspective of technique and interpretation, therefore both the indicators and constituent elements need to be independent and noncorrelated [20], [26]. Measurement indicators are typically assessed for their validity. The variance inflation factor (VIF) must be 5.0 or less, that the first factor to consider in terms of multicollinearity. At least a few researchers have stated that the VIF must be equal to or less than 10, as with reflective indicators, it is not appropriate to apply the same permissible reference value to formative and reflective indicators [27], [28]. This research relied only on formative measurement methods that employed formative indicators for its analysis, we executed multicollinearity analysis with VIF=5.0. For all the formative indicators (measurement indicators), forming for 5 models and the VIF value is 1.000, proving that the indicators did not have a collinear relationship. This was followed by an evaluation of the formative indicators contributions and relevance using the outer weights or outer loadings data. The outer weight was applied to each of the 5 models in order to confirm the presence of the relative contributions of the formative indicators to the construct, that is, the relative importance levels of the construct.

2.1.2. Structural model validation

There are three steps to evaluating a structural model. The first is checking for a multicollinear relationship between the variables and the VIF's inner size. Then, comparing variables through the use of statistical t-values and p-values for hypothesis testing. There is a substantial effect between the variables if either the t-statistics of the calculation result (t-table) is larger than 1.96 or the p-value of the test findings is lower than 0.05. The third metric is the f-square value, which represents the variable's impact on the structural level and may be defined as follows: f square 0.02 for low, 0.15 for moderate, and 0.35 for high [29]. When evaluating a structural model, it is necessary to examine the hypothesis of influence between the study variable. Examination of the absence of multicollinearity between variables with a size of the inner VIF is less than 5, testing the hypotheses, and determining the confidence interval of 95% for the path coefficient parameters, as well as the direct influence of the variable on the structural level, also known as direct impact with a size of f square, are all components of the evaluation examination of the structural model [24]. The upsilon v statistical measure, which is obtained by squaring the [30] mediation coefficient, is interpreted in [31] with a moderate mediation effect of 0.075, a high mediation impact of 0.175, and a low mediation influence of 0.02. The model's overall evaluation is comprised of the following: R square values for endogenous latent variables are assessed as follows 0.26 are substantial, 0.13 is moderate, 0.02 is weak [32], for Q square as determined by [20], vulnerable SRMR value 0.8–0.10 is acceptable fit [33]. The PLS Predict shown by RMSE and MAE is same as linear regression model (LM) [24], as well as the robustness check, which is comprised of linearity and heterogeneity of structural models with finite mixture partial least squares (FIMIX PLS) [34].

3. RESULTS AND DISCUSSION

The structural model's evaluation result indicate that it is satisfactory, as the parameter assessment yields a robust result and the inner VIF does not indicate any multicollinearity between the variables. Based on the R square value of the aforementioned processing findings, it can be concluded that the price of NFT has the least impact on NFT ownership.

The NFT price hypothesis against the NFT marketplace is accepted due to the significant influence with $p\text{-value } 0.000 < 0.05$, which is consistent with the outcome of the NFT price hypothesis in comparison to the NFT category. With the $p\text{-value } 0.283$ generate a non-significant result of the NFT pricing determination in comparison to the NFT edition. Though each NFT pricing is listed in every NFT marketplace and NFT category, the prices of each edition of NFT are not necessarily identical. This has been substantiated by the research undertaken by Westland [35] “The research found that while linear models are not useful in modeling NFT price series, models that extract periodic behavior can provide explanations and predictions of price behavior”.

The NFT marketplace and NFT price exhibit a significant disparity in confidence levels. The confidence intervals provide a significant amount of room for interpretation. The 95% confidence interval value, is influenced by the diverse NFT variations. Also, the confidence interval value for NFT editions is an important factor in pricing of NFT. Nevertheless, the prices of NFTs in most NFT marketplaces have minimal impact on the overall structure. Similarly, the presence of NFT prices across various editions has a negligible effect on the structure, unlike NFTs within a specific category, which moderately influence the structure. NFT prices can be influenced by social value and scarcity, as demonstrated in the research by Hofstetter *et al.* [36] in study 1 and study 2.

According to the data, the hypothesis that emerged has no substantial impact on the owners of NFT, who are music enthusiasts with an interest in the NFT marketplace [35]. In the same vein, the owner’s assessments of NFT editions do not suggest a statistically significant correlation of variable. There are certain NFT marketplace that do not have a considerable number of NFT owners that are actively engaged, and it is not typical for every NFT holder it means as music enthusiast to looking for NFTs depending on the edition they have. The coefficient of the owner hypothesis of NFT when faced with the NFT category’s existence has a substantial impact. While the coefficient value of the NFT owner hypothesis over the existence of NFT category has a significant influence of variable. Similarly, the hypotheses of the owners of NFT against the NFT price also have a significant impact. Detailed statistics are provided in Table 2.

Table 2. Hypothesis and path coefficients significance testing result

Hypothesis	Path coefficients	P values	2.5%	97.5%	sig?	VIF	f-square
PRICE -> category	-0.308	0.000	-0.386	-0.234	yes	1.014	0.106
PRICE -> editions	-0.023	0.283	-0.080	0.013	no	1.014	0.001
PRICE -> marketplace	-0.327	0.000	-0.455	-0.212	yes	1.014	0.118
owners -> PRICE	-0.118	0.002	-0.190	-0.042	yes	1.000	0.014
owners -> category	0.125	0.000	0.068	0.184	yes	1.014	0.018
owners -> editions	0.160	0.525	0.118	0.866	no	1.014	0.026
owners -> marketplace	0.003	0.950	-0.099	0.060	no	1.014	0.000

From Table 3, the NFT editions and NFT marketplace have low-impact of NFT ownership with R square values is more than 0.02 and less than 0.13 [32]. Its different value of NFT category, the ownership NFT R square value have a somewhat higher numerical value than all the latent ones, despite their modest influence. The Q square value is a validation measurement that is employed PLS to evaluate the predictive relevance, or compatibility, of model predictions. The Q square value of the aforementioned model, as shown in Table 3, indicate that three models with positive value (NFT price, NFT editions and NFT category) have predictive significance, as stated by [24]. The model’s SRMR value is 0.021, which is data considered an acceptable model fit [29]. In accordance with the recent recommendations of [37], we conducted a comprehensive analysis that included the testing of all hypothesized effects. In order to enhance the methodological integrity of our analysis, we implemented robustness check for PLS SEM [34] to evaluate the non-linear effects. It is important to note that, although linear relationships are frequently able to accurately approximate non-linear relationships [38], this is not always the case [39]. The linear effect’s robustness was evaluated by analyzing the quadratic effects between the linked constructs [38]. This was accomplished through the implementation of the default parameters in a two-step process [34]. PLS is a predictive version of SEM analysis. Consequently, it is imperative to create a model validation from that is universally applicable in order to demonstrate the predictive capabilities of the model. The prediction test PLS is validated through the use of PLS predict. In order to demonstrate that the PLS results are a reliable indicator of prediction strength, they must be compared to the fundamental LM. In accordance with Table 3, the same number of indicators in the PLS-SEM analysis prediction error root mean square error (RMSE) or mean absolute error (MAE) compared to the naïve LM benchmark indicates a medium predictive power of the structure model [40]. This provides information to musicians and NFT creators to decide on NFT categories and expand the digital marketplace for NFT sales.

Table 3. R-square, Q-square and PLS predict

Path	R-square	Q-square	PLS-SEM RMSE	PLS-SEM MAE	LM RMSE	LM MAE
Price	0.014	0.008	43.489	36.698	43.489	36.698
Category	0.119	0.019	3.951	3.752	3.951	3.752
Editions	0.027	0.000	3366004.080	327720.932	3366004.080	327720.932
Marketplace	0.107	-0.001	0.640	0.575	0.640	0.575

The consideration of endogeneity on Table 4 shows most of the indicators have p-value are over 0.05, indicating there is no issue of endogeneity. It can be concluded that in addition to the influence of NFT price on the NFT category, NFT price on the NFT marketplace are linear, or the effect of the linearity model is fulfilled (robust).

Table 4. Assessment of nonlinear effects

	Path coefficients	P values	f-square
QE (PRICE) -> category	0.020	0.000	0.009
QE (PRICE) -> editions	-0.020	0.399	0.011
QE (PRICE) -> marketplace	-0.040	0.000	0.036
QE (owners) -> PRICE	0.010	0.650	0.003
QE (owners) -> category	-0.260	0.451	0.081
QE (owners) -> editions	-0.026	0.508	0.001
QE (owners) -> marketplace	-0.404	0.837	0.217

In order to identify, if necessary, address unobserved heterogeneity in PLS path models, we initially implemented the FIMIX PLS procedure on the data [41]. The selection of the number of segments in FIMIX PLS is based on a number of sizes, for example AIC3, AIC4, CAIC, BIC, dan EN entropy [42]. In the estimated value of the index fit model FIMIX PLS at the Table 5, the estimated value of the index fit model FIMIX PLS above shows the EN criterion value (0.999>0.50). The results of the PLS model estimate, using non-standardized latent variable input score (raw data input), demonstrate the effectiveness of PLS models [43]. There is a potential that heterogeneity occurs in the structural model (2 segment). The 2 segments have lower AIC3, AIC4, and BIC values than the PLS 1 segments, indicating potential heterogeneities in structural models.

Table 5. Heterogeneity (FIMIX PLS)

Index fit	1 segment	2 segments
Akaike's information criterion (AIC)	4947.847	2159.939
Modified AIC with factor 3 (AIC3)	4958.847	2182.939
Modified AIC with factor 4 (AIC4)	4969.847	2205.939
Bayesian information criterion (BIC)	4992.926	2254.195
Consistent AIC (CAIC)	5003.926	2277.195
Hannan-Quinn criterion (HQ)	4965.623	2197.106
Minimum description length with factor 5 (MDL5)	5261.241	2815.218
LogLikelihood (LnL)	-2462.924	-1056.970
Normed entropy statistic (EN)		0.999
Non-fuzzy index (NFI)		1.000
Normalized entropy criterion (NEC)		0.240

4. CONCLUSION

This study investigates the popularity of voice NFTs, which are new to digital audio communication. The basic technology of NFTs is blockchain technology, which has become attractive due to its decentralization, stability, security, and unmodification. The need for better understanding and regulation of NFTs' use drives their popularity in the music industry. This research significantly enhances understanding of the relationship between music fans, NFT category, NFT price, NFT marketplace, and NFT editions. We utilized the formative measurement model in our PLS-SEM evaluation to gauge the correlation between these variables. Despite the fact that this model's structure has a medium predictive power result, the VIF values demonstrated that the indicators did not have a collinear relationship, which means there is a high correlation between two or more variables. The analysis revealed that the NFT price and NFT category had an impact on the interests of music enthusiasts in their NFT exploration at the NFT marketplace. Conversely, the music fans or NFT owners were not interested in exploring NFT by NFT edition because very low values from the majority of indicator characteristics and NFT price created from NFT category based on the result of indicators.

This study suggests that NFT creators who are musicians should contemplate developing a captivating NFT category to engage music enthusiasts and other collectors. This highlights the need of understanding the characteristics of the NFT industry to develop more effective marketing tactics. Moreover, suggestions for the industry will have the potential for future growth as a result of improved regulation and a more comprehensive understanding of NFT usage. This could profoundly influence the interaction between fans and musicians. I propose more research to examine the social and economic ramifications of NFT in the music industry, as well as to understand fan opinions of the value and uniqueness of NFT relative to traditional music formats.

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C : **C**onceptualization

M : **M**ethodology

So : **S**oftware

Va : **V**alidation

Fo : **F**ormal analysis

I : **I**nterpretation

R : **R**esources

D : **D**ata Curation

O : **O**riginal Draft

E : **E**diting

Vi : **V**isualization

Su : **S**upervision

P : **P**roject administration

Fu : **F**unding acquisition

CONFLICT OF INTEREST STATEMENT

In this research, there is no conflict of interest.

DATA AVAILABILITY

The data that support the findings of this study are available from [third party]. Data are available from the following url:

- <https://opensea.io/collection/windchime>
- <https://www.mikeshinoda.com/ziggurats/collection>
- <https://opensea.io/YellowHeartFactories>
- <https://objkt.com/@mikeshinoda>
- <https://www.niftygateway.com/grimes/>
- <https://www.niftygateway.com/steveaoki/>
- <https://www.niftygateway.com/@deadmau5/>
- <https://opensea.io/collection/deathbats-club>

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