

Article

Comprehensive Analysis of the Trade of NFTs at Major Auction Houses: From Hype to Reality

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Abstract: On 11 March 2021, amidst the lingering grip of the COVID-19 pandemic, the art world witnessed an extraordinary event. Christie's, the renowned auction house, hosted a groundbreaking auction counting just one lot: a Non-Fungible Token (NFT)—a digital asset that had been generating buzz in recent times. The astounding price fetched by the NFT sent shockwaves through the art world. While the 255-year-old auction house was known for selling unique assets, its auctioning of an NFT was surprising as Christie's online marketplace was not on the blockchain, contrarily to NFT platforms such as Opensea, Nifty Gateway, etc. The resounding success, however, of its historic auction was followed by a surge of NFT off-chain sales at Christie's, Sotheby's, and Phillips. While extensive research has been done on the trade of NFTs on the blockchain, little research exists on the trade of NFTs at public auction houses. Based on more than two years' tracking of NFTs auctioned at major auction houses, our research identifies three phases in the development of the trade and provides valuable insights into the unique factors that contributed to the growth of NFTs at public auctions between the springs of 2021 and 2023.

Keywords: art market; public auction; auction house; NFT; non-fungible token; cryptocurrency; metaverse; W3; live auctions; online-only auctions; COVID-19 crisis; estimates on request; guarantees; irrevocable bids



Citation: Bourron, Christine. 2023. Comprehensive Analysis of the Trade of NFTs at Major Auction Houses: From Hype to Reality. *Arts* 12: 212. <https://doi.org/10.3390/arts12050212>

Academic Editors: Thor J. Mednick and Elena Sidorova

Received: 31 May 2023

Revised: 10 September 2023

Accepted: 26 September 2023

Published: 7 October 2023



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1. Introduction

By the time Christie's launched its first NFT auction, NFTs had been traded on dedicated NFT marketplaces on the blockchain for a few years already. The introduction in 2017 of the NFT standard in Ethereum ERC721 allowed for the standardization of the processes of creation (minting) and transfer of NFTs on the blockchain (Valeonti et al. 2021)¹. This was shortly followed by the emergence of dedicated NFT marketplaces to trade NFTs on various blockchains. In their systematic study on the current NFT ecosystems, Wang et al. (2021)² note that the sales of NFTs on these platforms exploded at the beginning of 2021 from an estimate of USD 12 million in December 2020 to USD 340 million by February 2021. The authors list more than 30 marketplaces on which one can trade NFTs, out of which 6 marketplaces focus on the art market: SuperRare, Rarible, Cargo, Async Art, Nifty Gateway, and KnownOrigin. While there has been extensive research covering NFT trading on blockchains (Taherdoost 2023)³, very little research has been conducted on the volume and value of NFTs auctioned at the three leading auction houses. Multiple reasons come to mind as to why: first, historical data for public auction sales are not easily available. In fact, the auctions of NFTs arranged by the public auction houses were for the most part handled off the blockchain with the final results entered post-sales on an on-chain marketplace (mostly on Nifty Gateway or Opensea). It is only after the fall of 2022 that Christie's and Sotheby's launched their fully on-chain marketplaces for NFTs (Christie's 2022)⁴. Second, while some of the most expensive NFTs were sold at the three leading auction houses, the volume of NFTs auctioned at Christie's, Sotheby's, and Phillips stands ridiculously small compared to the volume of NFTs traded on dedicated NFT marketplaces, making any quantitative analysis challenging. But although sparse and off-chain, sales of NFTs at

public auctions undeniably impacted the NFT landscape as the notoriety and credibility that the venerable auction houses brought to the NFT market participated in increasing the visibility and awareness of NFTs, especially outside of the core crypto community.

In their research, Wang et al. (2022)⁵ identified three specific time periods during which trading of NFTs on blockchain marketplaces shows great volatility and signs of bubble behaviors. Did the same happen to NFTs on the public auction market? The purpose of this research is to present the history of public auctions of NFTs at Christie's, Sotheby's, and Phillips and highlight the critical factors that contributed to their success. Hopefully, this will open the door to further research analyzing in detail the role and influence of public auctions on the performance of NFT trade on other marketplaces on the blockchain. In the absence of easily available public sources, our research is based on a systematic and exhaustive tracking of public auctions of NFTs at Christie's, Sotheby's, and Phillips from 11 March 2021, to April 2023. Via the identification, monitoring, and analysis of multiple public auctions parameters, we address the following Research Questions (RQs):

- RQ1: What was the state of NFT trade at the three leading auction houses?
- RQ2: What critical factors played a key role in the rise of NFTs at public auctions?
- RQ3: How will the trade of NFTs at public auction evolve in the coming years?

This paper is organized as follows: the second section covers in detail the research methodology used to identify and track public auction sales of NFTs at the three leading auction houses, with the purpose to record and categorize sales parameters overtime. The third part includes the key learnings drawn from our research, presented as answers to our research questions. The conclusion is addressed in the last portion of the research.

2. Research Methodology—Exhaustive Tracking of Public Auction Sales of NFTs

2.1. Planning the Research

Our research was prompted by Christie's auctioning of Beeple's "Everydays: the First 5000 Days". On 25 February 2021, as Christie's started its first NFT auction online, there was little to indicate that this would be a remarkable event. However, within the following two weeks, it became clear that something was happening as more than 200 early bids were placed on the NFT, the single lot offered at the auction. Slowly but surely the highest bid increased from USD 100 to USD 13.2 m just before 10 a.m. on 11 March 2021. Then, as the online-only auction started closing, bidders engaged in a fierce online battle, vying to possess this unique digital artwork. The suspense finally came to an end as the virtual gavel fell promptly after 10:03 a.m. (Eastern Time) and set a historic hammer price of USD 60.25 m for an NFT. The USD 69.35 million of revenue (as over USD 9 m of commission was added to the hammer price) that Christie's generated through the sale of a single NFT lot was truly remarkable as it surpassed by far the USD 48 million generated by the auction house during the preceding months of January and February 2021 from the offering of 3048 lots worldwide. It is this realization that prompted the current research. Over the following weeks, we started to plan for the systematic tracking of all upcoming NFT auctions at the three leading auction houses. While there are many more auction houses worldwide, Christie's, Sotheby's, and Phillips were not only the first auction houses to offer NFTs but they alone also generate more than 50% of the public auction trade worldwide according to the 2022 Art Basel & UBS Report (McAndrew 2023). As such, we felt confident that a comprehensive analysis of their sales would provide a valuable barometer for assessing the overall state of the NFT market at public auctions.

2.2. Data Collection Process

The goal of our research was to capture not only the results of the auctions but also multiple parameters potentially contributing to the results of the public auctions of NFTs. While tracking sales of NFTs traded on the blockchain is facilitated by the availability of historical data on the blockchain, tracking sales of NFTs auctioned at Christie's, Sotheby's, and Phillips is challenging as the historical data are not always on the blockchain and the data published on the auction houses' websites are often limited if at all available. To

achieve our goal, we developed the following strategy and process to capture a reliable dataset by identifying sales before they even started (D-n), capturing key parameters one day ahead of the sale (D-1), viewing the sales live (D), and confirming the results the following day (D + 1) (Figure 1).

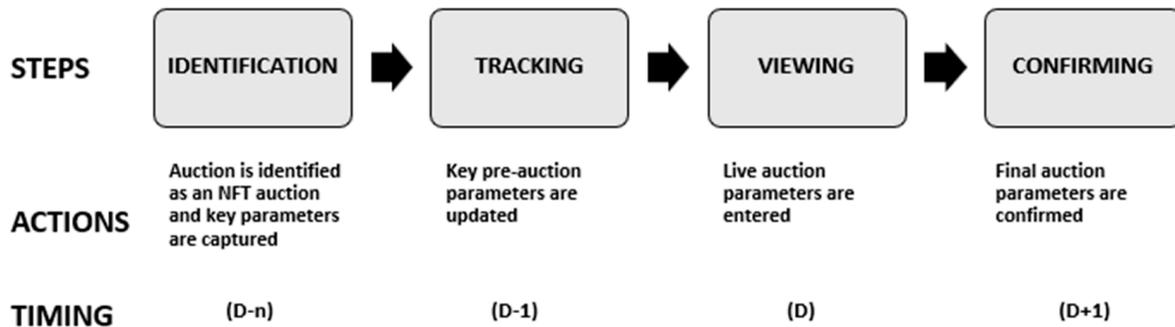


Figure 1. Diagram depicting the process used to track information about each NFT sale at public auctions.

Within a period of more than two years (from February 2021 to April 2023), we collected data from all of the 61 dedicated NFT auctions arranged worldwide at Christie’s, Sotheby’s, and Phillips. We also identified additional NFTs sold in auctions combining both NFT lots and non-NFT lots. These were added to our dataset. Finally, in the absence of a large body of academic research, we used press articles covering the various NFT sales at public auctions to cross-reference our information and confirm details and impact of the auctions.

2.3. Research Criteria

To understand both the context in which the NFTs were sold and the specificities of each NFT, we tracked criteria related to both the auction itself and the NFT lots (Figure 2):

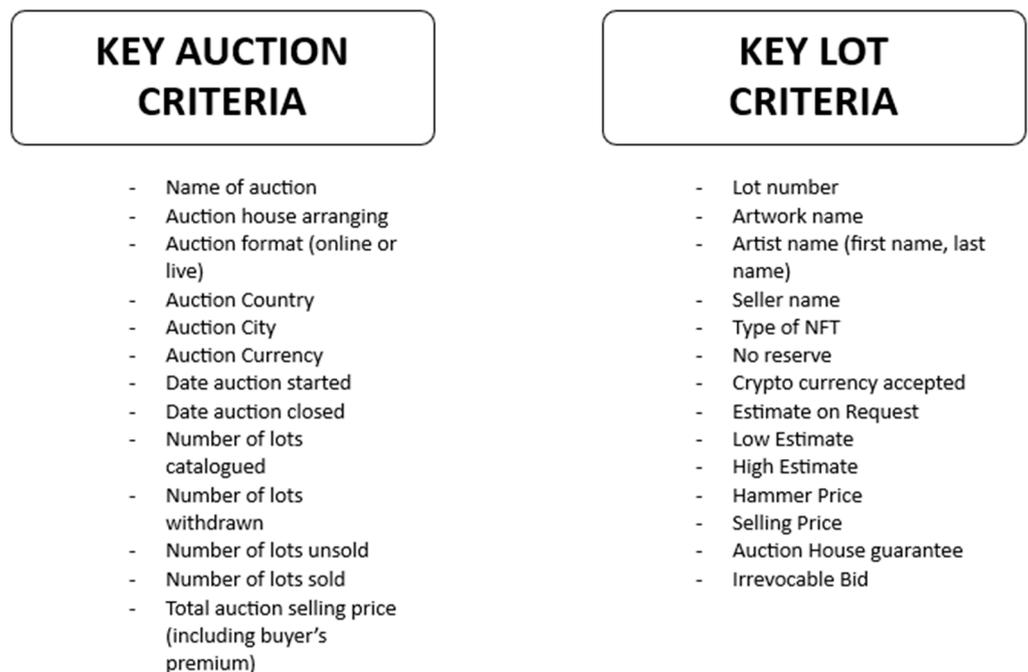


Figure 2. List of criteria tracked for NFTs sold at public auctions.

2.4. Research Analysis

The challenge with analyzing the performance of NFTs auctioned at Christie's, Sotheby's, and Phillips is that the dataset is very small, especially in comparison to the total number of NFTs traded on the blockchain. While insufficient data may lead to inaccurate conclusions in statistical analysis, this does not apply to our research as our dataset includes every single NFT auction and NFT lot offered at Christie's, Sotheby's, and Phillips from 11 March 2021, to April 2023. Our conclusions may not apply to the entire public auction market, but they fairly represent historic trends at the three leading auction houses since we captured the entire data history.

3. Results and Discussion

Over a period of more than two years, from March 2021 to April 2023, the trade of NFTs at Christie's, Sotheby's, and Phillips has evolved significantly as shown by our research. Specifically, the answers to the three RQs set in the Introduction are as follows:

3.1. RQ1: What Was the State of the NFT Trade at the Three Leading Auction Houses?

Our analysis identified three distinct time periods (Figure 3) based on the review of multiple criteria: revenue generated, volume of lots catalogued, types of estimates provided ahead of the sales, performance of auctions, coverage provided by irrevocable bids, etc. (Figure 2):

- Phase 1: from March 2021 to September 2021: the explosion phase consisting in seven months of incredible success following the Beeple ignition boost;
- Phase 2: from October 2021 to February 2022: the trouble phase: a rollercoaster ride of success and disappointments over a period of 5 months;
- Phase 3: from March 2022 to April 2023: the back to reality phase: the long harsh return to market-anchored valuations.

The first phase saw an explosion of enthusiasm and creativity as the auction houses outdid themselves to offer intriguing auctions featuring NFTs. Ahead of Christie's first NFT sale, combined revenue at Christie's, Sotheby's, and Phillips had fallen to one of its lowest levels in the midst of the COVID-19 pandemic and, despite arranging more auctions than ever, the auction houses found it difficult to convince their core customers to buy art online (Bourron 2021).⁶ At the same time, prices for cryptocurrencies and NFTs traded on the blockchain were exploding as the COVID-19 pandemic was having the reverse effect on digital assets (Maouchi et al. 2022).⁷ In this context, it is hardly surprising that the auction houses saw the offering of NFTs as the perfect solution to boost their sales and target new potential customers who were comfortable trading online only. While none of the following auctions managed to match the Beeple sales results (USD 69 m), revenue from NFT sales reached USD 179 m as an additional USD 110 m (USD 92 m through dedicated NFT auctions plus USD 18 m via NFTs sold in traditional auctions) was generated between April and September 2021. Remarkably, not one NFT offered ended up unsold, as the appetite for NFTs offered at public auctions seemed bottomless. Appendix A retraces month after month the various NFT sales arranged by Christie's, Sotheby's, and Phillips during Phase 1.

The second phase was marked by mixed performances with still some excellent results but also more last-minute withdrawn lots, a notable increase in unsold lots (bought ins), and cancelled sales. By the end of Phase 2—almost a year after the groundbreaking Beeple sale—it appeared that the NFT frenzy at the three leading auction houses had subsided. The same could be observed for NFTs traded on the blockchain. In their research covering bubbles in the NFT markets, Wang et al. (2022)⁸ highlight an increase in volatility in 2021 with a series of bubbles followed by periods of calm. Multiple factors could be seen as contributors to the upcoming downturn: (1) the rapid fall of cryptocurrencies: by February 2022, ether, the leading cryptocurrency for NFTs, was already worth only 60% of what it was at its peak in November 2021. While research by Dowling (2022)⁹ concludes that NFTs are

a distinct new asset class, he does observe some strong evidence of co-movement between the cryptocurrencies and the NFT market; (2) the global economy was also struggling to restart after the pandemic, and the invasion of Ukraine by Russia on the exact day of the “Punk it!” auction at Sotheby’s did not announce great prospects of growth for the coming months. (See Appendix B for the monthly list of public auctions at the three leading auction houses in Phase 2).

Phases	PHASE 1: The Explosion	PHASE 2: The Troubles	PHASE 3: Back to Reality
Timing	March 2021 to September 2021	October 2021 to February 2022	March 2022 to April 2023
Total Revenue (including buyer’s premium) (USD)	\$179m	\$62m	\$20m
Total number of NFT lots catalogued	134	149	480
Average number of NFTs catalogued per month	19	30	34
Number of Estimates on Request (EOR)	122	135	136
Number of Withdrawn Lots	2	8	4
Number of Lots with Hammer Price (HP) < Low Estimate (LE)	2	-	212
Number of Lots unsold	-	10	51
Value covered by IRB	\$36m	\$37m	\$2m

Figure 3. Key parameters for each of the three phases highlighted in the trade of NFTs at Christie’s, Sotheby’s, and Phillips from March 2021 to April 2023.

Despite the downturn, the trading of NFTs did not come to a halt at the leading auction houses. In Phase 3, an average of 34 NFTs were catalogued per month. This figure surpasses the average of 19 and 30 NFTs auctioned per month, respectively, during the first and the second phase. Most striking, however, in Phase 3 is the increase in NFTs offered with estimates ahead of the auction (i.e., without an estimate on request). This is a significant

shift as the auction houses offered most of the lots with estimates on request in Phase 1 and Phase 2. This new transparency, especially as regards pricing, could explain why the value generated by NFTs sold at the leading auction houses between March 2022 and April 2023 plummeted to its lowest level. Over the 14-month period, none of the dedicated NFT auctions yielded more than USD 2.5m. The largest revenue was brought in by the Sotheby's "Natively Digital 1.3: Generative Art" sale arranged on 25 April 2022, which generated USD 2.26m with 15 lots. By 2023, most NFT lots sold at public auction sales achieved prices less than USD 50,000. (See Appendix C for an overview of public auctions in Phase 3).

3.2. RQ2: What Critical Factors Played a Key Role in the Rise of NFTs at Public Auctions?

What were the critical factors, specific to the public auction process, that played a pivotal role in explaining both the rise and fall of NFTs? Exploring the elements that fueled the initial surge and the subsequent challenges provides valuable context for comprehending the trajectory of NFTs at public auctions. Our research identified four key factors that propelled NFTs to prominence and subsequently led to their decline: 1. paying and bidding in cryptocurrency, 2. online-only format of auctions, 3. Estimates on Request (EORs), and 4. irrevocable bids.

3.2.1. Paying and Bidding in Cryptocurrency

An essential factor contributing to the success of Christie's Beeple NFT sale on 11 March 2021, was the introduction of cryptocurrency payment options (Sansom 2021).¹⁰ By enabling bidders to pay in Ether (ETH), Christie's not only facilitated the process for crypto investors, eliminating the need to convert their digital assets into fiat currency, but it also provided them with a potential hedge against the volatility of the crypto market (Reyburn 2021).¹¹

In March 2021, when Christie's auctioned Beeple's NFT, Ether was experiencing a robust rebound following two years of a bear market. In fact, Ether's value had surged from USD 600 per ETH at the beginning of December 2020 to USD 1800 by the start of March 2021. Despite the positive trend, Ether remained highly volatile, leaving few options for cryptocurrency investors to safeguard their newfound wealth from drastic market fluctuations. In this context, purchasing an NFT through a reputable auction house seemed like a convenient and prudent investment strategy, offering stability and potential long-term value appreciation within the volatile crypto landscape.

Recognizing the importance of attracting new wealth from crypto investors, auction houses embraced the acceptance of cryptocurrency payments for most of their NFT offerings. Sotheby's went even further by allowing payment in Ether for a physical artwork by Banksy during its May 2021 Contemporary Evening Auction and even for a 101.38-carat, pear-shaped D color flawless diamond (Kinsella 2021b).¹² Both Christie's and Sotheby's also took the innovative step of conducting live bids in Ether, showcasing their commitment to integrating cryptocurrencies into the auction process. Christie's even claimed the distinction of organizing "the first ever live auction with bidding in Ether" during its 1 October 2021 "Post-War to Present: The NFTs" auction, where the auctioneer successfully placed bids in Ether for the two lots on offer (De Saro 2021).¹³ Sotheby's extended this concept beyond NFTs, enabling bids in Ether for physical artworks by Banksy at its 18 November 2021 "The Now Evening Sale".

While offering the option to pay in Ether proved successful, the introduction of bidding in Ether added complexity to the process and limited the pool of potential bidders to those who held cryptocurrencies. The limitation became evident during Christie's sale on 1 October 2021, as the top lot, Lot 1Y "Full sets 1, 2 and 3–31 Projects" by Art Blocks Curated, ended up being unsold after an unsuccessful bid of ETH 560. Further challenges also became obvious when the value of Ether and other cryptocurrencies started to plummet in November 2021. The trade of NFTs at the auction houses benefited positively from the growth of cryptocurrencies but their ultra-reliance on cryptowealth became a liability when the cryptocurrency markets started to plummet.

3.2.2. Online-Only Format of Auctions

Out of all dedicated NFT auctions conducted by the top three auction houses between March 2021 and April 2023, a staggering 89% were held as online-only auctions, while a mere 11% took place as live evening and day auctions (Figure 4/Table 1). Although a few additional NFTs were included in existing recurring live sales, the majority of NFTs sold by the auction houses were featured in online-only events. Interestingly, the online-only format was seen as a drawback in the traditional art world, but it proved to be a distinct advantage for NFT sales.

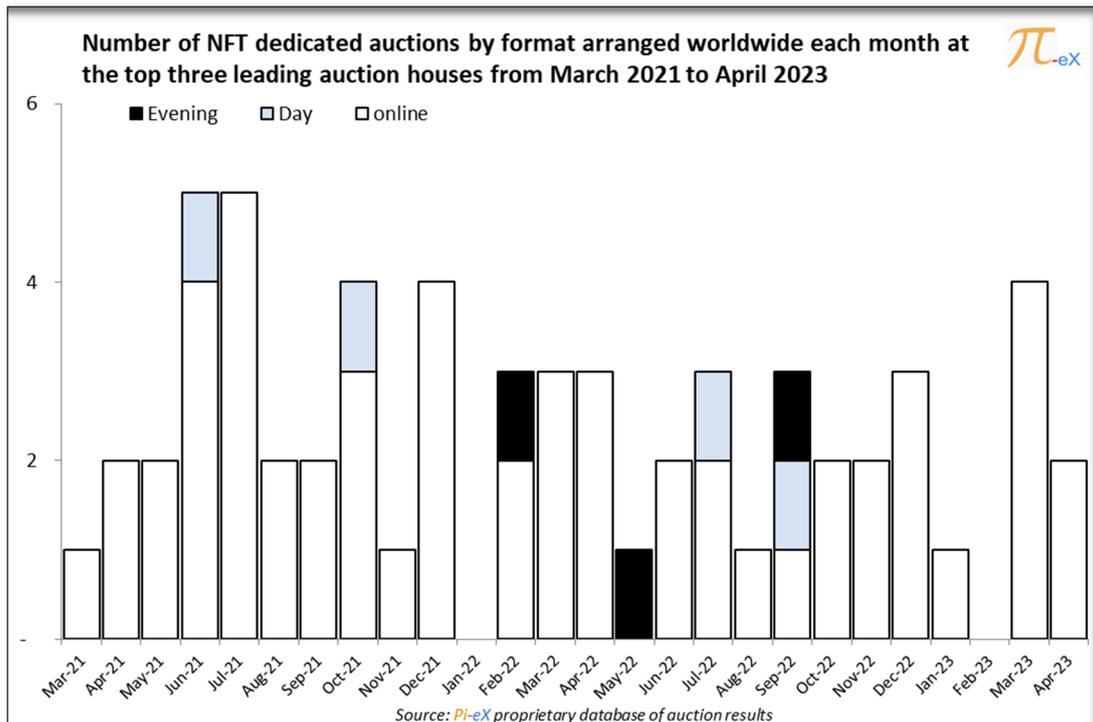


Figure 4. Number of dedicated NFT auctions by format arranged worldwide each month at the top three leading auction houses from March 2021 to April 2023.

Table 1. Number of dedicated NFT auctions by format arranged worldwide each month at the top three leading auction houses from March 2021 to April 2023.

Month	Day	Evening	Online
Mar-21			1
Apr-21			2
May-21			2
Jun-21	1		4
Jul-21			5
Aug-21			2
Sep-21			2
Oct-21	1		3
Nov-21			1
Dec-21			4
Jan-22			0
Feb-22		1	2
Mar-22			3
Apr-22			3
May-22		1	0

Table 1. *Cont.*

<u>Month</u>	<u>Day</u>	<u>Evening</u>	<u>Online</u>
Jun-22			2
Jul-22	1		2
Aug-22			1
Sep-22	1	1	1
Oct-22			2
Nov-22			2
Dec-22			3
Jan-23			1
Feb-23			
Mar-23			4
Apr-23			2

Source: Pi-eX Ltd proprietary database of auction results

Given that most NFTs are best experienced and appreciated through digital platforms, there was no requirement for potential buyers to physically visit an auction house. Instead, the entire auction process could be conveniently, and cost-efficiently, conducted online. Furthermore, the promotion and marketing of these sales were easily executed through social media channels and discussion groups on platforms like Discord and Twitter, thus reaching a wide audience of potential buyers and easily linking them to the online-only auction. The shift to online-only auctions not only catered to the unique nature of NFTs but also embraced the digital realm's potential for broader exposure and accessibility, providing a convenient and efficient platform for public auctions of NFTs.

3.2.3. Estimates on Request (EORs)

An overwhelming majority of NFTs sold in Phases 1 and 2 (90%) were offered with an Estimate on Request (EOR) (Figure 5/Table 2). Traditionally, auction houses utilize EORs when dealing with exceptionally high-value lots. For instance, in 2020, lots featuring EORs achieved an average hammer price of USD 22 million. Noteworthy examples of lots sold with EORs include Leonardo da Vinci's "Salvator Mundi", which fetched over USD 450 million in New York in 2017, and more recently, Pablo Picasso's "Femme assise près d'une fenêtre (Marie-Thérèse)", which sold for USD 103 million in May 2021.

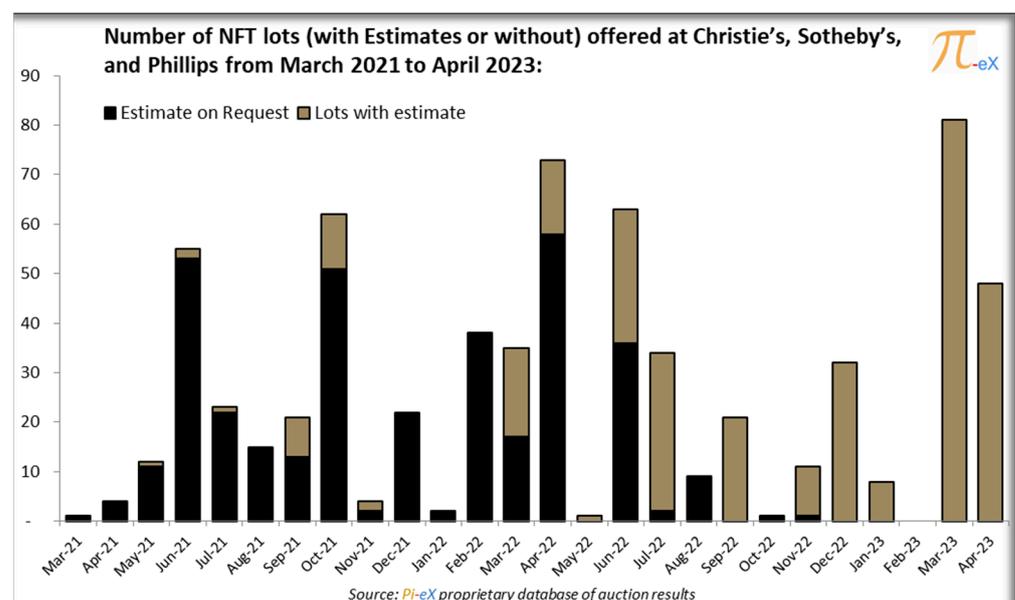


Figure 5. Number of NFT lots (with estimates or without) offered at Christie's, Sotheby's, and Phillips from March 2021 to April 2023.

Table 2. Number of NFT lots (with estimates or without) offered at Christie’s, Sotheby’s, and Phillips from March 2021 to April 2023.

<u>Month</u>	<u>Lots with Estimate</u>	<u>Estimate on Request</u>
Mar-21		1
Apr-21		4
May-21	1	11
Jun-21	2	53
Jul-21	1	22
Aug-21		15
Sep-21	8	13
Oct-21	11	51
Nov-21	2	2
Dec-21		22
Jan-22		2
Feb-22		38
Mar-22	18	17
Apr-22	15	58
May-22	1	
Jun-22	27	36
Jul-22	32	2
Aug-22		9
Sep-22	21	
Oct-22		1
Nov-22	10	1
Dec-22	32	
Jan-23	8	
Feb-23		
Mar-23	81	
Apr-23	48	

Source: Pi-eX Ltd proprietary database of auction results

As the first NFT was presented by Christie’s on 11 March 2021, the auction house opted to offer it with an EOR, or—as they wrote—an “Estimate Unknown”. This decision was likely due to the challenge of determining a precise valuation for the NFT, given the lack of historical data at the time regarding NFTs’ performance in major public auctions. The strategy worked well since Beeple’s NFT achieved an impressive price of USD 69 million, including the auction house’s commission. Interestingly, this approach persisted for several months, as all listed NFTs at Sotheby’s were auctioned with an “Estimate Upon Request”, while Christie’s continued to employ the “Estimate Unknown” designation.

The immense interest in NFTs and the prevalent Fear of Missing Out (FOMO) combined with the online-only bidding format which extended over several days allowed prices to soar to new heights. Without the presence of estimates, particularly the high estimate, bidding at public auctions remained uninhibited, leading to exceptionally high prices. The lack of pricing clarity in the public auction setting is surprising as trade of NFTs on the blockchain featured continuous transparent bidding and pricing. The prestige associated with being offered in top public auction settings—as opposed to “just” on the blockchain—allowed, however, for enough interest and hype to boost prices, at least for some time. It is worth noting that the first lot offered with an estimate at an NFT online-only auction, “PROOF OF SOVEREIGNTY: A Curated NFT Sale by Lady PheOnix”, held by Christie’s on 3 June 2021, achieved a hammer price of USD 45,000, falling far below its estimated range of USD 100,000 to USD 200,000. Consequently, it is not surprising that auction houses and sellers were hesitant to provide estimates and continued to list the majority of NFTs with EORs or “Estimates Unknown” labels.

Eventually, in Phase 3, auctioning lots with estimates became the norm, which most likely participated in the pricing correction of the NFT trade at public auctions.

3.2.4. Irrevocable Bids (IBs)

Irrevocable bids, also known as third-party guarantees, are special arrangements made between an auction house and a third party prior to the auction of a specific lot. Under this agreement, the third party commits to purchasing the lot at a predetermined price. In essence, the lot is pre-sold to the third-party guarantor, and potential bidders can only acquire it if they surpass the bid offered by the guarantor. In return for their early commitment, the third-party guarantor receives a fee from the auction house.

This practice has become increasingly prevalent at significant recurring live public auctions, particularly those featuring top lots, but was relatively uncommon in online-only auctions before the emergence of NFTs.

The first instance of an irrevocable bid on an NFT took place at Sotheby’s during its 10 June 2021, auction titled “Natively Digital: CryptoPunk 7523” (Kinsella 2021d).¹⁴ The auction consisted of a single lot, CryptoPunk 7523 by Larva Labs, which was listed with an estimate upon request. The auction format combined online pre-bidding with live bidding. Tracking the online and live bids reveals how the presence of an irrevocable bid led to the price inflating to USD 10 million in the final bid, despite the previous bid being under USD 2 million (Figure 6). It is more than likely that the lot was ultimately sold to the third-party guarantor involved in the irrevocable bid agreement, making this case a good example of how irrevocable bids can inflate prices.

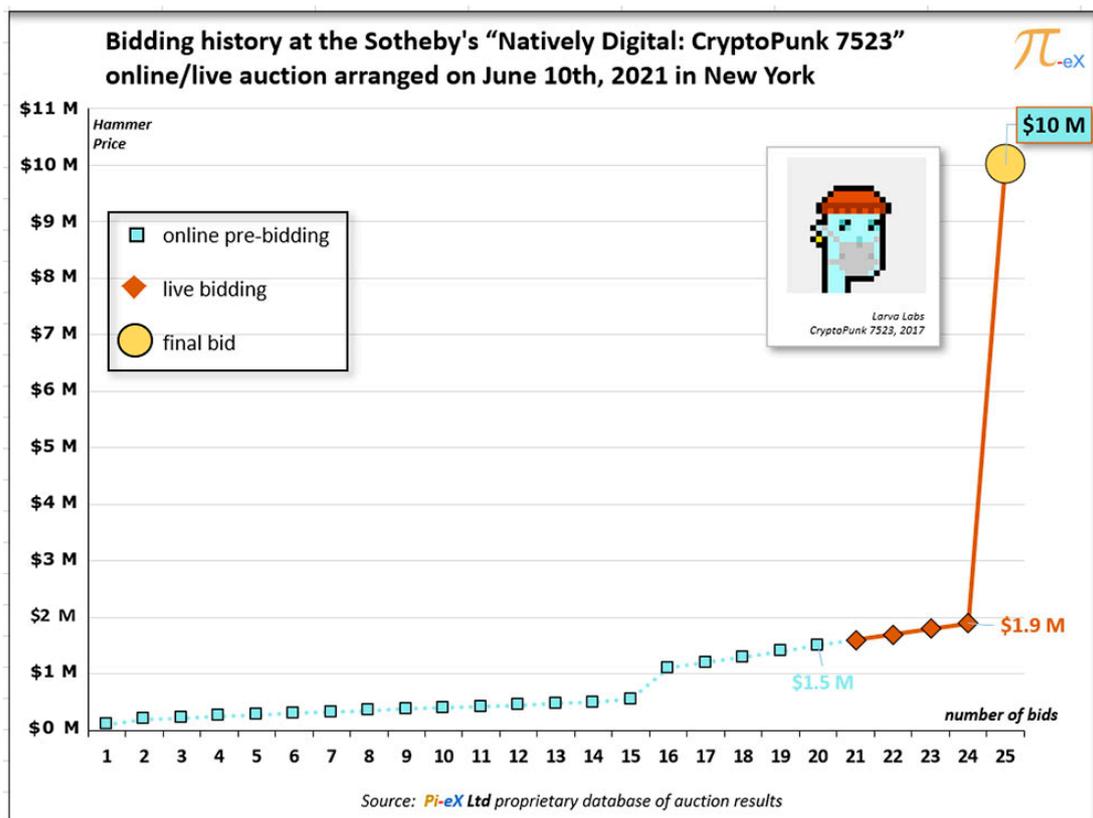


Figure 6. Online and live bids at the June 10 dedicated NFT auction “Natively Digital: CryptoPunk 7523” at Sotheby’s New York.

During the autumn of 2021, the utilization of irrevocable bids gained momentum, after Christie’s witnessed its first-ever bought-in (unsold) NFT lot at auction. Five more irrevocable bids were introduced into significant NFT sales during this period. In total, these bids, secured by third-party guarantors, contributed to a substantial portion of the hammer price value. Specifically, USD 52 million, representing 65% of the total hammer

price value achieved between September and November 2021, was underwritten by these third-party arrangements (Figure 7/Table 3).

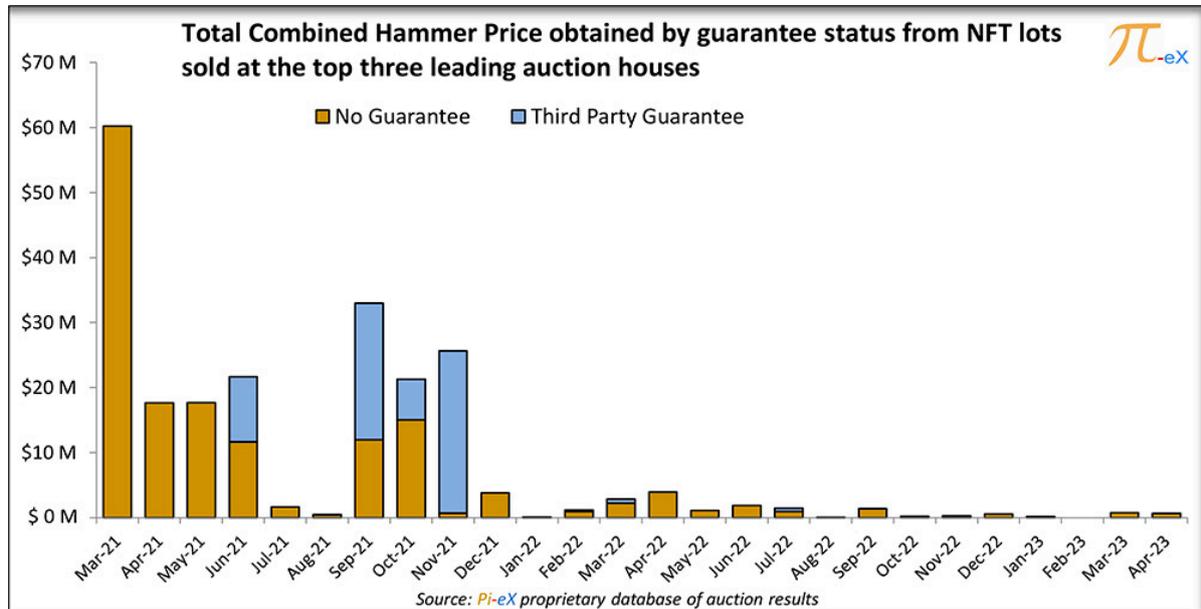


Figure 7. Total combined hammer price obtained by guarantee status from NFT lots sold at the top three leading auction houses from March 2021 to April 2023.

Table 3. Total combined hammer price obtained by guarantee status from NFT lots sold at the top three leading auction houses from March 2021 to April 2023.

Month	No Guarantee	Third Party Guarantee
Mar-21	\$60,250,000	
Apr-21	\$17,658,363	
May-21	\$17,675,000	
Jun-21	\$11,662,000	\$10,000,000
Jul-21	\$1,626,302	
Aug-21	\$438,496	
Sep-21	\$11,986,458	\$21,000,000
Oct-21	\$15,047,608	\$6,250,000
Nov-21	\$687,588	\$25,000,000
Dec-21	\$3,796,936	
Jan-22	\$60,372	
Feb-22	\$936,619	\$220,000
Mar-22	\$2,213,884	\$665,750
Apr-22	\$3,938,052	
May-22	\$1,100,000	
Jun-22	\$1,896,190	
Jul-22	\$912,794	\$550,000
Aug-22	\$10,607	
Sep-22	\$1,420,400	
Oct-22	\$246,137	
Nov-22	\$272,300	
Dec-22	\$541,276	
Jan-23	\$192,000	
Feb-23	\$-	
Mar-23	\$761,922	
Apr-23	\$626,576	

Source: Pi-eX Ltd proprietary database of auction results

3.3. RQ3: How Will the Trade of NFTs at Public Auction Evolve in the Coming Years?

As shown in RQ1, the most recent Phase 3 has seen a correction of the NFT market at the three leading auction houses. Although there has been an increase in the number of NFTs auctioned, public auctions of NFTs have significantly evolved compared to the initial year of trading, especially as regards pricing. The increased price transparency observed in Phase 3 and discussed in RQ2 enables a clearer evaluation of NFTs’ performance at the top three auction houses. Of particular interest is the analysis of how many lots obtain a Hammer Price (HP) above or below the initial Low Estimates (LEs) offered by the auction house.

In fact, the lukewarm performance of lots with estimates in Phase 3 provides some hints about the future of trading at public auctions. Almost 50% of lots offered at public auctions in Phase 3 were sold with an HP at or below their LE when they were not bought-in (unsold) or withdrawn (Figure 8/Table 4).

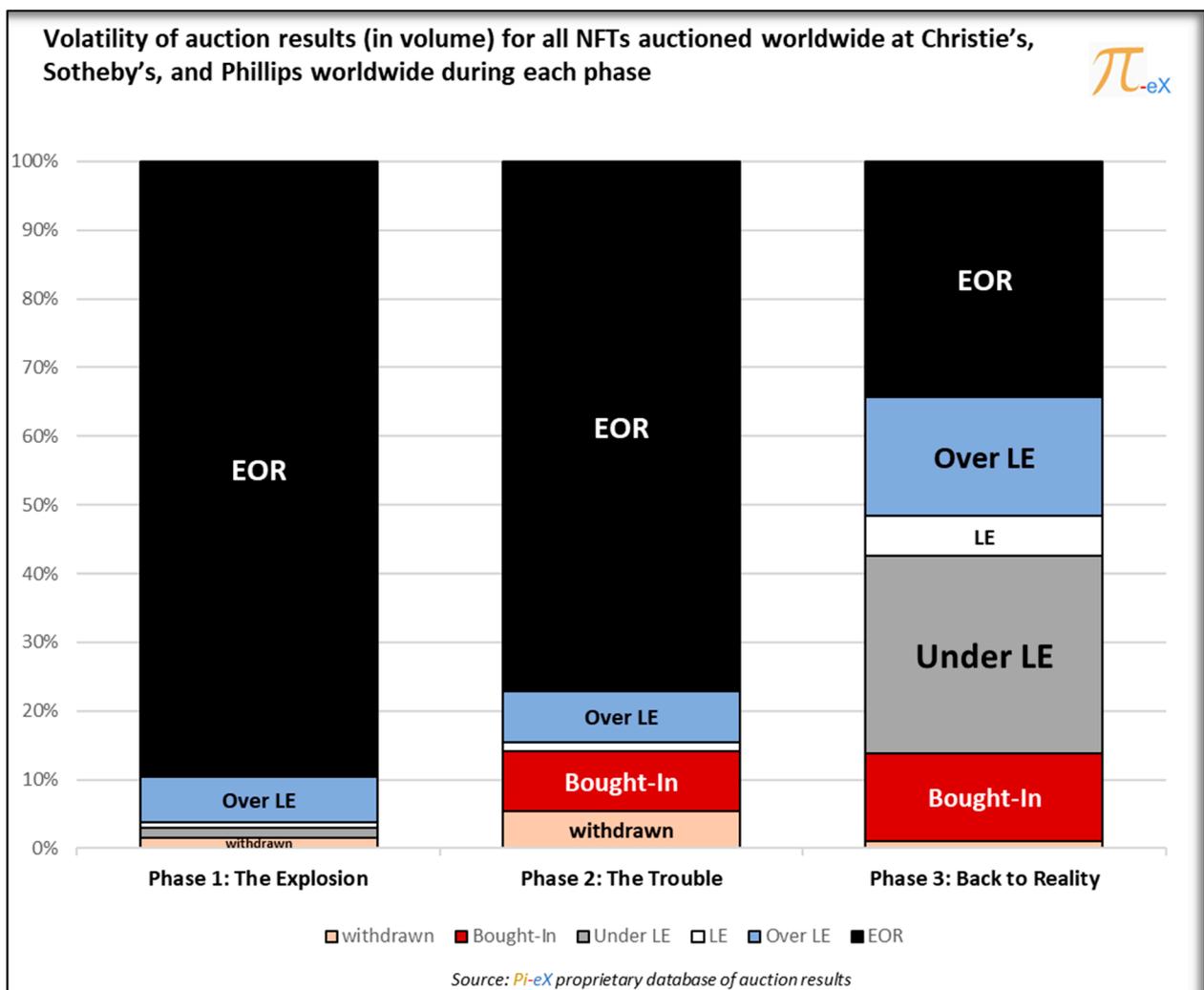


Figure 8. Estimates and volatility of auction results (in volume) for all NFTs auctioned worldwide at Christie’s, Sotheby’s, and Phillips worldwide during each phase.

Table 4. Estimates and volatility of auction results (in volume) for all NFTs auctioned worldwide at Christie’s, Sotheby’s, and Phillips during each phase.

	Phase 1	Phase 2	Phase 3
<i>Number of NFTs auctioned</i>	The Explosion	The Trouble	Back to Reality
Estimates On Request	120	115	124
Hammer Price above Low Estimate (Over LE)	9	11	63
Hammer Price at Low Estimate (LE)	1	2	21
Hammer Price below Low Estimate (Under LE)	2		104
Unsold Lots		13	46
Withdrawn Lots	2	8	4

Source: Pi-eX Ltd proprietary database of auction results

This suggests that sellers now possess a better understanding of pricing and are more willing to sell their NFTs at lower prices rather than hold onto illiquid assets. The consequence is a sharp price correction, as shown by the plummeting of the average HP obtained for NFTs at public auctions (Figure 9/Table 5).

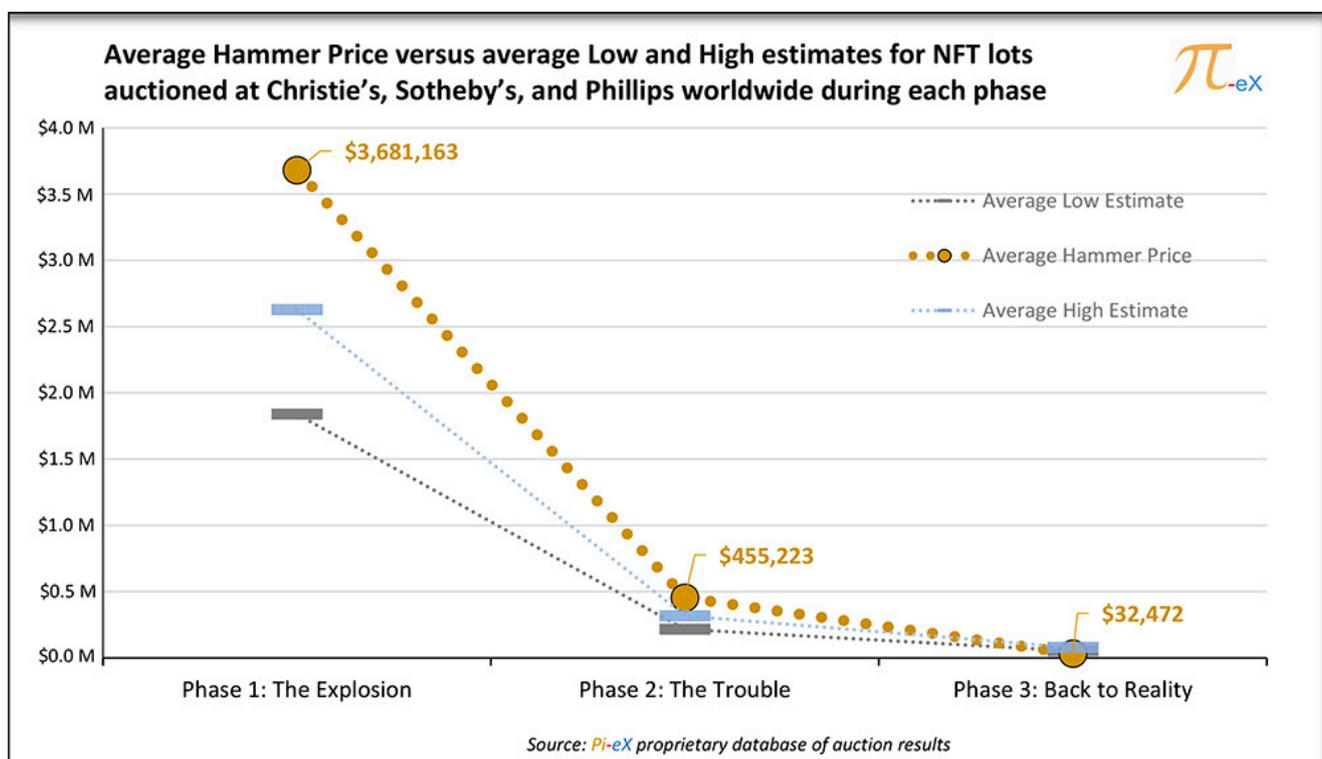


Figure 9. Average hammer price obtained by NFTs sold with estimates at Christie’s, Sotheby’s, and Phillips worldwide compared to initial average low and high estimates during each phase.

The recent correction, driven by less hype and more price transparency, is likely to continue as Christie’s and Sotheby’s have both launched full on-chain trading platforms, respectively, in September 2022 (Christie’s 2022)¹⁵ and May 2023.¹⁶ Both platforms (Christie’s 3.0 and Sotheby’s Metaverse) are separate from the auction houses’ traditional websites.¹⁷ Interested bidders can connect via their cryptocurrency’s wallets and their trade is recorded directly on the blockchain. A full bidding history for each lot is available, not only during the sale, but also after the sale, which is an important step for public auctions. While additional transparency is welcome news for the public, the trading on both platforms has been limited. The number of auctions arranged by both auction houses remains small while interest by potential buyers seems lukewarm. This could explain why the auction

houses continue to arrange NFT auctions off the blockchain on their traditional websites, to target not only cryptocurrency holders but also traditional art collectors.

With NFT trading at the top three auction houses having adjusted to the realities of the market, it is difficult to imagine how this segment could recover. As observed with other categories of items traded at public auctions, it is very possible that the trade of NFTs will slowly but surely dwindle as buyers and sellers gradually abandon the market. If this were to happen, NFTs at public auctions could experience a further decline until they quietly disappear.

Table 5. Average hammer price obtained by NFTs sold with estimates at Christie’s, Sotheby’s, and Phillips worldwide compared to initial average low and high estimates during each phase.

NFT lots with estimates (in USD)	Phase 1	Phase 2	Phase 3
	The Explosion	The Trouble	Back to Reality
Average Low Estimate	\$1,839,574	\$216,043	\$53,235
Average High Estimate	\$2,627,905	\$317,832	\$78,490
Average Hammer Price	\$3,681,163	\$455,223	\$32,472

Source: Pi-eX Ltd proprietary database of auction results

4. Conclusions

While the trade of NFTs on the blockchain has been extensively researched in academic papers, there has been very little research of the auctioning of NFTs at public auctions, especially at Christie’s, Sotheby’s, and Phillips. The three leading auction houses, however, have arranged multiple sales of NFTs since March 2021. Compared to the volume of NFTs sold on the blockchain, the number of NFTs sold at public auction sales is relatively small, but the impact of the sales has been huge given the pristine reputation of the auction houses and the extraordinarily high prices obtained by the lots. Based on more than two years of observation, this research presents a detailed and exhaustive timeline of the various NFT sales arranged at Christie’s, Sotheby’s, and Phillips and identifies three distinct phases that have marked the trading of NFTs at the three leading auction houses: (1) Phase 1—the explosion: launched by the inaugural sale of Beeple’s NFT at Christie’s in March 2021 and followed by a series of highly creative auctions. (2) Phase 2—the trouble: a 5-month period from September 2021 when successes followed disappointments as multiple signs started to indicate that the crypto bubble may soon burst. (3) Phase 3—back to reality: the maturation of the NFT market at public auctions, which brought about a more realistic valuation framework. Our research also shows how four critical factors, specific to the trade at public auction, contributed to the rollercoaster ride observed at Christie’s, Sotheby’s, and Phillips: (1) the acceptance of cryptocurrency payments, (2) the convenience of online-only auctions, (3) the absence of estimates, and (4) the inclusion of irrevocable bids. Each of these factors played a significant role in shaping the NFT market at public auctions in its early days. More than two years after the incredible sale of Beeple’s NFT at Christie’s, the future of NFT trading at public auctions does not look bright. While both Christie’s and Sotheby’s have invested in their own on-chain trading platforms, one can wonder whether the high level of transparency on the blockchain is at all sustainable within the business model of a public auction house.

Funding: This research received no external funding.

Data Availability Statement: Data were obtained from Pi-eX Ltd. All data were collected independently by Pi-eX Ltd. over the past 2 years from public information published by Christie’s, Sotheby’s, and Phillips and by attending live or viewing online auctions. The data presented in this article are available with the permission of Pi-eX Ltd. Restrictions apply to the availability of any further data related to the subject.

Conflicts of Interest: The author declares no conflict of interest. Pi-eX Ltd. is an independent third-party data and research provider whose mission is to independently highlight trends in the global art market.

Appendix A Phase 1

From March 2021 to September 2021: the explosion phase consisting in seven months of incredible success following the Beeple ignition boost (Figure A1):

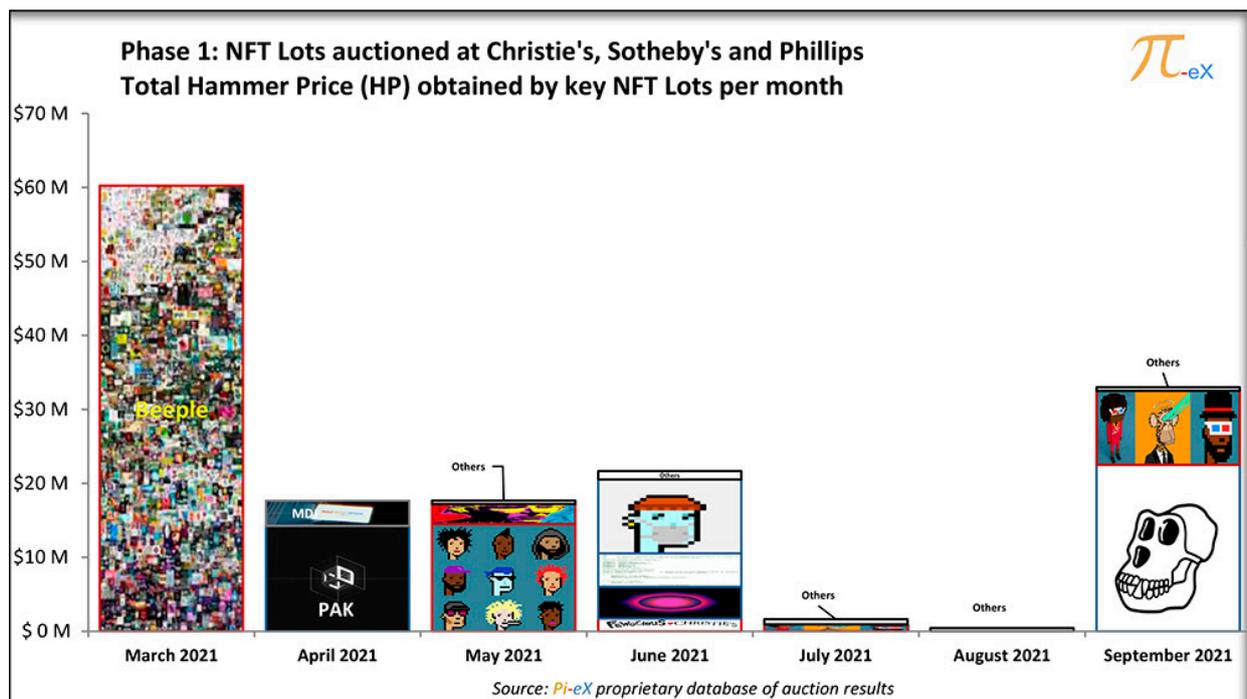


Figure A1. Phase 1: Total Hammer Price (HP) obtained by NFTs sold at Christie's, Sotheby's, and Phillips from April 2021 to September 2021.

March 2021:

On 11 March 2021, amidst the lingering grip of the COVID-19 pandemic, the art world witnessed an extraordinary event that etched its name in history. Christie's, the renowned auction house, hosted a small yet groundbreaking online auction that would captivate the imagination of art enthusiasts worldwide. The curated auction titled "Beeple | The First 5000 Days" counted just one lot: a Non-Fungible Token (NFT)—a digital asset that had been generating buzz in recent times. The astounding price fetched by the NFT on offer sent shockwaves through the art world (Kinsella 2021a),¹⁸ instantly sparking an unprecedented fervor surrounding NFTs.

April 2021:

Just a month after the astonishing success of the Christie's Beeple sale, both Sotheby's and Phillips joined the trend by organizing their own NFT sales. On 16 April 2021, Sotheby's conducted a highly anticipated auction of "The Fungible Collection by PAK", fetching an impressive USD 16.83 million (including the auction house commission) (Villa 2021b).¹⁹ Not to be outdone, Phillips joined the NFT frenzy on 23 April 2021, presenting "MDJ × Phillips: A Multi-Generational NFT", which achieved a notable sale price of USD 4.14 million (with fees) (Villa 2021a).²⁰

May 2021:

In May 2021, Christie's continued its exploration of the NFT market by introducing an NFT lot in its highly anticipated 21st Century May Marquee live evening sale held

in New York. Lot 11A, which consisted of nine CryptoPunks by Larva Labs (including CryptoPunks 2, 532, 58, 30, 635, 602, 768, 603, and 757), exceeded all expectations with a USD 14.5 million hammer price, surpassing the estimated range of USD 7 million to USD 9 million and reaching the remarkable sale price of nearly USD 17 million (including commission). In addition to the CryptoPunks, Christie's also presented a collection of five unique NFTs featuring digital artworks created by the iconic artist Andy Warhol in the mid-1980s. These digital works had been recovered from obsolete floppy disks in 2014. The auction of these rare NFTs generated an additional USD 3.38 million in revenue for Christie's in May 2021, further solidifying the market's growing interest in digital art and collectibles (Block 2021).²¹

June 2021:

In June 2021, Sotheby's stepped again into the realm of NFT sales and made significant strides in the market. Across three distinct auctions, Sotheby's successfully sold NFTs with a combined value of nearly USD 23 million with fees. These auctions were as follows:

- "Natively Digital: CryptoPunk 7523": this live day auction, held on 10 June 2021, featured a single lot and achieved an impressive result of USD 11.8 million, inclusive of commission.
- "Natively Digital: A Curated NFT Sale": taking place on the same day, this online auction added to the success by generating an additional USD 5.4 million in sales.
- "This Changed Everything: Source Code for WWW x Tim Berners-Lee, an NFT": this creative auction revolved around a unique NFT that included a historical artifact related to the invention of the World Wide Web by the renowned British computer scientist Sir Tim Berners-Lee in 1989 (Hern 2021).²² The lot garnered considerable attention and ultimately sold for USD 5.4 million, commission included.

July–August 2021:

Following a period of relative calm in the summer of 2021, both Christie's and Sotheby's set their sights on additional NFT sales in the upcoming fall.

September 2021:

Sotheby's made a significant splash with its online auction titled "Ape in!" closing on 9 September 2021. The auction featured two highly sought-after Apes created by Yuga Labs. The results were outstanding, as the two Apes fetched a remarkable sum of over USD 26 million, including commission (Escalante-de Mattei 2021a).²³

During the same month, Christie's made its debut in the Asian NFT market by organizing its first NFT sale in Hong Kong. The online-only sale, titled "No Time Like Present", was arranged from 17–28 September 2021, and featured a remarkable single-owner private collection offered by Mr. Shawn Yue, a prominent actor and collector in Asia. The auction garnered significant attention, resulting in the successful sale of all 14 NFTs from Mr. Yue's collection. The total value achieved for these digital assets amounted to an impressive USD 9.5 million, including the auction house's commission.

From March to September 2021, 134 NFTs were offered at auctions at Christie's, Sotheby's, or Phillips and almost every single one of them found a buyer. Only one online-only sale "PROOF OF SOVEREIGNTY: A Curated NFT Sale by Lady PheOnix" arranged by Christie's on 3 June 2021 saw two lots withdrawn (Lot 17 and 21), most likely because they had not received any bid ahead of the closing of the sale.

Out of the 134 lots, only 12 (9%) had estimates provided by the auction houses while 91% of NFT lots were offered without estimates. This was highly unusual as lots without estimates are usually reserved for extremely valuable lots and this is often interpreted at public auction as a sign of extreme rarity.

Appendix B Phase 2

From October 2021 to February 2022: the trouble: a rollercoaster ride of success and disappointments within 5 months (Figure A2).

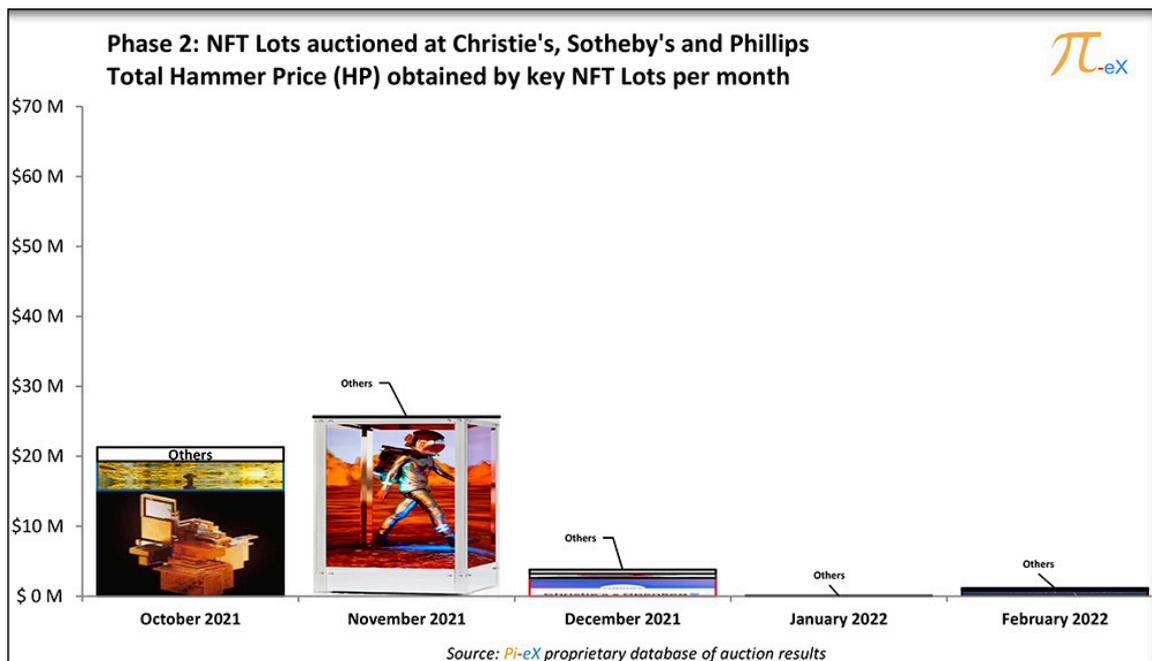


Figure A2. Phase 2: Total Hammer Price (HP) obtained by NFTs sold at Christie's, Sotheby's, and Phillips from October 2021 to February 2022.

October 2021:

October 2021 marked a significant turning point in the history of NFT auctions at Christie's, Sotheby's, and Phillips. It was the first month where success was no longer a guaranteed outcome for NFT sales. Indeed, two out of the four NFT sales organized by the auction houses included lots that did not find buyers, an unprecedented occurrence in the world of NFT auctions.

The first auction, titled "Post-War to Present: The NFTs", was conducted by Christie's and garnered extensive pre-sale coverage due to the auction house's announcement that it would accept bids in cryptocurrencies for the first time ever (Larkin 2021).²⁴ This auction consisted of two unique lots:

- Lot 1X featured a complete set of 30 curio cards, known as 17b, which were the initial artworks created on the Ethereum blockchain. The lot was offered with estimated values of ETH 250 to ETH 350 (approximately USD 750,000 to USD 1,050,000 based on an exchange rate of 1 ETH = USD 3,000 on 1 October 2021).
- Lot 1Y comprised a set of 31 artworks from the Art Blocks Curated project. Although the estimates were provided upon request, the anticipated minimum price for the lot was ETH 600.

During the live auction, as bids were announced in Ether (Figure A3), Lot 1X achieved a hammer price of ETH 320, thanks to 12 successive bids surpassing the starting bid of ETH 190. However, Lot 1Y did not enjoy the same level of success, as it was declared unsold after the maximum bid received (ETH 540) fell short of the reserve price set by the seller, likely around ETH 600. Although the auctioneer swiftly moved on and declared the sale a success, those who witnessed the auction in person or virtually were taken aback, as it marked the first time an NFT went unsold at one of the top three auction houses.

A few days later in Hong Kong, it seemed that the earlier setback in New York had little impact, as Sotheby's NFT sale titled "Machine Hallucinations—Space: Metaverse", featuring works by artist Refik Anadol, appeared unaffected. The auction generated over USD 5 million with eight lots, demonstrating an ongoing strong demand in Asia. Additionally, Sotheby's successfully sold two more NFTs as part of the October Hong Kong series sales, further highlighting the continued interest in this market.

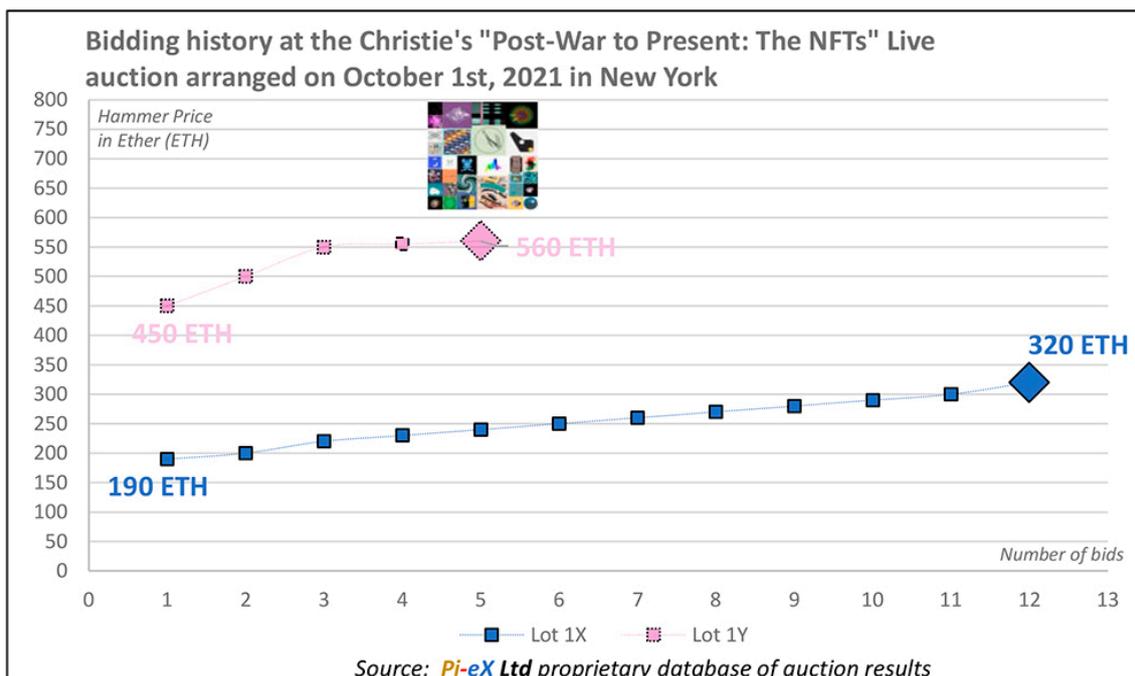


Figure A3. Total Hammer Price (HP) obtained by 2 NFT lots sold at Christie's "Post-War to Present: The NFTs" live auction on 1 October 2021.

Back in New York, however, it was more difficult to ignore what happened at Christie's. Indeed, the Phillips sale titled "CASCADE: An NFT Project by Jen Stark" held on 8 October 2021, just a week after the unsold Lot 1Y seemed to mirror the shifting sentiment in the market. Despite the absence of estimated values, the three lots on offer garnered a meager total of only USD 52,000, a stark departure from the previously robust results achieved by Phillips.

A few weeks later, on 26 October 2021, Sotheby's made a significant move by launching its new Metaverse platform and hosting its inaugural on-chain auction titled "Natively Digital 1.2: The Collectors" (Kinsella 2021c).²⁵ This auction showcased 53 lots from esteemed NFT collectors' vaults and was generally regarded as a success, amassing a total of USD 18.7 million in sales. However, a closer analysis reveals a bought-in rate of 9.4%, with five lots remaining unsold out of the 53 offered. While this may seem relatively small compared to public auctions, it is noteworthy considering the bought-in rate had been close to zero from March to September 2021.

As the month of October 2021 ended, the sales from the NFT realm painted an overall impressive picture, with a grand total of over USD 25 million generated from the auctioning of 66 lots. However, the presence of six unsold lots amid this otherwise remarkable performance started to stir doubts that would linger in the following months, particularly in the context of the New York NFT market.

November 2021:

In November 2021, Sotheby's planned a significant NFT charity auction titled "Gifted: The 140 Collection". Marketed as the largest of its kind, the auction featured seven NFTs originally gifted by Twitter to random followers (Hernandez 2021).²⁶ However, despite initial anticipation, the auction failed to gain traction. By the morning of November 30, none of the lots had surpassed USD 4500, and one lot did not even reach USD 2000. Consequently, Sotheby's made a short sudden announcement on Twitter, stating that the auction would be postponed, ultimately leading to its cancellation.

In November, while there were no other dedicated NFT sales at Christie's, Sotheby's, and Phillips, a few NFTs found their place in the traditional November Marquee sales

in New York. Following the success of the “21st Century Evening” auction in May 2021, where nine CryptoPunks by Larva Labs were sold, Christie’s continued to include NFTs in its traditional live evening auctions. The November “21st Century Evening” auction featured three NFTs. Urs Fischer’s “Chaos #73 Consumer, Chaos #74 Bliss, and Chaos #75 Denominator” achieved a hammer price of USD 180 K (estimated at USD 80 K to USD 120 K), while “Arcadia” by Arch Hades, Andrés Reisinger, and RAC, with undisclosed estimates, sold for USD 420 K. However, the highlight of the auction was lot 7A, “HUMAN ONE” by Beeple, a physical artwork accompanied by a non-fungible token, which became the second most expensive NFT ever sold, second only to “Everydays: the First 5000 Days”. Although Christie’s presented the work as a “triumphant follow-up” to Beeple’s renowned piece, they mitigated risk by arranging a third-party guarantee prior to the sale. This meant that the artwork had already been pre-sold to a third-party guarantor at an undisclosed price, and the guarantor would receive a share of the profits if the lot sold above the agreed-upon amount. After intense bidding both in the auction room and online, the work was ultimately sold to an online bidder for a hammer price of USD 25 million, resulting in a final selling price of nearly USD 29 million, inclusive of the auction house commission (Escalante-de Mattei 2021c).²⁷

December 2021:

In December 2021, after the second success of Beeple’s sale at Christie’s, the NFT market experienced a new surge with multiple sales. Christie’s, Sotheby’s, and Phillips all joined in again, offering a variety of NFTs.

Christie’s collaborated with Opensea for their largest and most successful December sale, titled “CHRISTIE’S x OpenSea”. The auction featured 25 lots and concluded on 7 December 2021, after a week of bidding. The sale generated revenue of ETH 827. However, not all lots found buyers, with six lots remaining unsold. The highest-priced lot achieved a value of ETH 185, equivalent to over USD 800,000 according to the conversion rate at the time. While still a substantial amount, it fell short of previous records set in the NFT market.

The second most successful sale was also a Christie’s sale entitled “The Birth of Wikipedia”, offering two lots connected to the early days of the online encyclopedia. The first lot was a physical artifact: Jimmy Wales’s home computer—a strawberry iMac—which was purportedly used during the launch and development of Wikipedia. The second lot was an NFT representing the first edit made by Jimmy Wales on 15 January 2001, deemed a significant moment in Wikipedia’s history. Interestingly, the NFT garnered more attention and fetched a higher price than the computer. The NFT sold for USD 750 K (including commission), while the computer achieved a price of USD 187.5 K. This outcome exemplifies the continued appeal and value placed on NFTs in the market, especially at lower price points. There were also two notable single-lot sales conducted by Sotheby’s and Phillips:

- Sotheby’s featured the artwork “Chromie Squiggle: MINT IT!” by Snowfro on their Metaverse platform on 13 December 2021. The sale, with undisclosed estimates, concluded at a price of USD 478.8 K, including fees.
- Phillips presented “Will Your Heart Pass the Test” by Drue Kataoka on their regular website on 15 December 2021. The artwork achieved a selling price of USD 252 K.

As 2021 drew to a close, Christie’s, Sotheby’s, and Phillips had reason to celebrate their NFT sales, totaling nearly USD 240 million over a span of 10 months, from March to December. While the revenue from NFTs did not constitute a significant portion of their overall annual revenue, the vibrant energy and enthusiastic bidding witnessed at each sale injected new life into the public auction market at a much-needed time (Gerlis 2021).²⁸

However, there were more and more signs that the initial excitement had begun to wane, in line with a decline in cryptocurrency prices, particularly of Ether, which gradually but surely was returning to lower levels after reaching a peak of over USD 4600 by mid-November 2021.

January 2022:

As 2022 kicked off, Sotheby’s shifted its focus to Hong Kong for its initial NFT sales.

Throughout January and February, the auction house managed to sell eight NFTs, fetching an average price of HKD 171,000 (USD 22,000). These prices reflected a significant decline compared to the previous year’s figures.

February 2022:

Soon, all attention turned to New York as Sotheby’s unveiled its highly anticipated evening sale dedicated exclusively to NFTs, titled “Punk it!” and scheduled on 24 February 2022. The centerpiece of the sale was a single lot featuring 104 “CryptoPunks”, a renowned and historically significant PFP NFT collection created by Larva Labs in 2017. The lot carried an undisclosed estimate, speculated to be in the range of USD 20 to USD 30 million. The event was set to be a grand affair, held at Sotheby’s headquarters in New York, complete with pre-auction cocktails and a panel discussion. An after-party was even planned, featuring a performance by DJ Seedphrase.

However, as the auction’s start time arrived, Sotheby’s stunned the audience by announcing the withdrawal of the lot and the cancellation of the entire auction. The decision sparked a wave of speculation and conspiracy theories among the prominent members of the NFT community in attendance, questioning the motives behind the seller’s sudden change of heart. Notably, the lot did not have an irrevocable bid in place, leaving various possibilities open, including a bought-in scenario or a potential sale at a lower price point. Such outcomes would have had far-reaching implications for the entire NFT market (Escalante-de Mattei 2021b).²⁹

Disappointed guests left Sotheby’s with a sense that the party had come to an abrupt end.

Appendix C Phase 3

From March 2022 to April 2023: back to reality: the long harsh return to normal valuation (Figure A4).

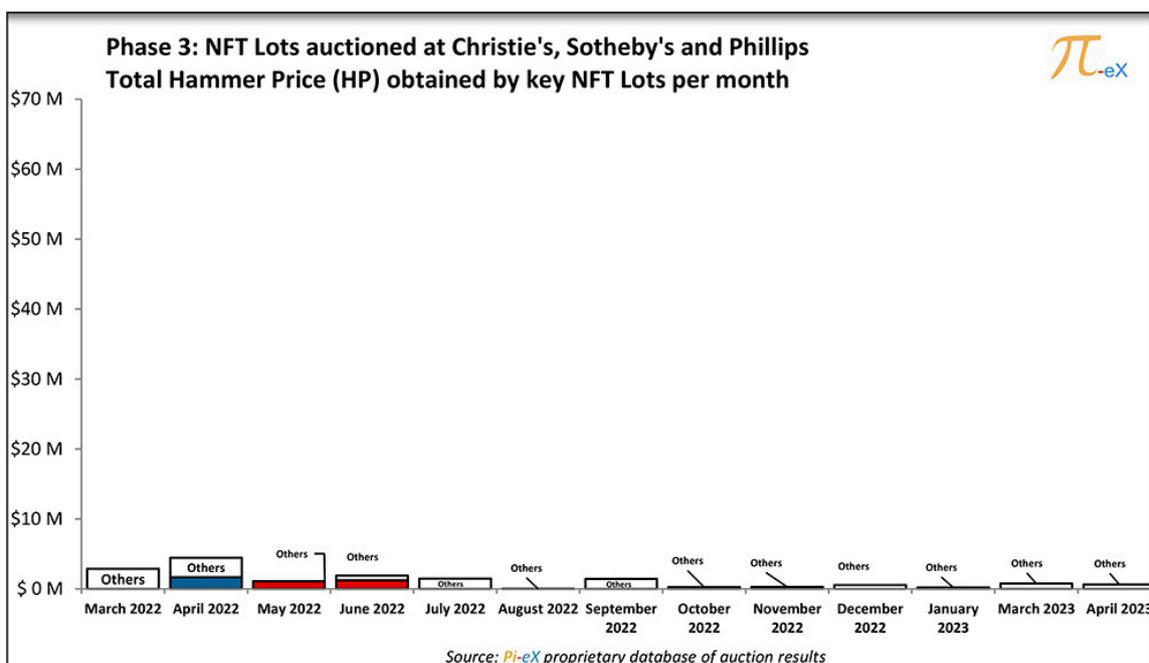


Figure A4. Phase 3: Total Hammer Price (HP) obtained by NFTs sold at Christie’s, Sotheby’s, and Phillips from March 2022 to April 2023.

After the very public failure of Sotheby's inaugural dedicated NFT evening sale, the trading of NFTs did not come to a halt at the leading auction houses but the characteristic of Phase 3 is that there are no high-profile NFT auctions nor notable NFT lots being auctioned. This resulted in the value generated by the NFTs sold at the leading auction houses since March 2022 to plummet to its lowest level. Over the 13-month period, none of the dedicated NFT auctions yielded more than USD 2.5 m. The largest revenue was brought in by the Sotheby's "Natively Digital 1.3: Generative Art" sale arranged on 25 April 2022 (Escalante-de Mattei 2022),³⁰ which generated USD 2.26 m with 15 lots. By 2023, most NFT lots sold for less than USD 50,000, except for a couple of exceptions which for one reason or another managed to reach prices above USD 100,000. The majority of NFT auctions, however, achieve prices at much lower levels:

- Christie's, for example, raised USD 242,000 from its auction "The Next Wave: The New York Edit" arranged on 19 April 2023 and counting 16 NFTs.
- Sotheby's raised almost USD 480,000 from its auction "Glitch: Beyond Binary" arranged on 26 April 2023, and counting 34 NFTs.

As of end of April 2023, it seemed clear that the magic was gone and NFT lots, like most other lots at public auction, were affected by the simple rules of offer and demand.

Notes

- 1 See Valeonti et al. for a detailed explanation of the definition and emergence of NFTs.
- 2 See Wang, Q. et al. for a detailed evaluation of the state of NFT trading on the blockchain in 2021.
- 3 See Taherdoost, H.'s systematic review of publications about NFTs in scientific reviews.
- 4 See Christie's press release: Christie's 3.0: Revolutionary Platform Established Christie's as First Global Auction House to Host Fully On-Chain Sales.
- 5 See Wang, Y. et al.'s analysis of multiple bubble behaviors in the NFT and DeFi markets.
- 6 Review Bourron, C. for more information on how COVID-19 affected the public auction market.
- 7 See Maouchi, Y. et al.'s investigation of digital financial bubbles amidst the COVID-19 pandemic.
- 8 Wang et al. use the time-series NFT Index (NFTI) as a composite indice to represent the wider NFT market.
- 9 Dowling, M. reflects on whether the pricing of NFTs is driven by cryptocurrencies.
- 10 See The Art Newspaper article "Christie's to accept cryptocurrency for first time" (Sansom 2021).
- 11 See The Art Newspaper article "The cost of a single tulip bulb surged to the same price as a mansion 400 years ago: are NFTs the 'tulipmania' of the 21st century?" (Reyburn 2021).
- 12 See Artnet article "Christie's and Sotheby's Are Now Accepting Cryptocurrency for Big-Ticket Items, Including for a \$5.4 Million Keith Haring" (Kinsella 2021b).
- 13 See the Be(in)crypto article "Christie's Auctioning Rare NFTs with Live ETH Bidding" (De Saro 2021).
- 14 See Artnet article "Sotheby's 'Natively Digital' NFT Sale Lands at \$17.1 Million, With More Than Half the Total Racked Up in the Final Minutes" (Kinsella 2021d).
- 15 See Christie's press release: Christie's 3.0: Revolutionary Platform Established Christie's as First Global Auction House to Host Fully On-Chain Sales.
- 16 While Sotheby's launched its separate Metaverse platform in October 2021, it only started to offer a fully on-chain peer-to-peer marketplace in May 2023, allowing not only primary sales but also secondary sales.
- 17 Christie's 3.0 is accessible via the web address <https://nft.christies.com/> (accessed on 30 September 2023) while Sotheby's Metaverse can be reached at <https://metaverse.sothebys.com/> (accessed on 30 September 2023).
- 18 See Artnet: "An NFT Artwork by Beeple Just Sold for an Unbelievable \$69 Million at Christie's—Making Him the Third Most Expensive Living Artist at Auction" (Kinsella 2021a).
- 19 See ARTnews: "In a First, Sotheby's Collaborates with Major NFT Player for Pak Sale" (Villa 2021b).
- 20 See ARTnews: "Amid Crypto Craze, Phillips to Auction Self-Generating NFT 'Experience' by Mad Dog Jones" (Villa 2021a).
- 21 See Barron's: "Five Andy Warhol Works Are Minted and Auctioned as NFTs" (Block 2021).
- 22 See the Guardian article "NFT representing Tim Berners-Lee's source code for the web to go on sale" (Hern 2021).
- 23 See ARTnews article "Sotheby's Brings in \$26 Million with Bored Ape NFT Bundle" (Escalante-de Mattei 2021a).
- 24 See ONE37pm article "Christie's Post-War to Present Auction: Blurring the NFT and Art Worlds" (Larkin 2021).

- ²⁵ See Artnet article “Sotheby’s Launches Metaverse, a Dedicated Digital Art Platform, With a Little Help From Pak, Paris Hilton, and Time Magazine” (Kinsella 2021c).
- ²⁶ See Cointelegraph article “Sotheby’s Metaverse announces latest and largest NFT charity auction” (Hernandez 2021).
- ²⁷ See ARTnews article “Swiss Venture Capitalist Revealed as Buyer of \$29 M. Beeple Sculpture” (Escalante-de Mattei 2021c).
- ²⁸ See Financial Times article “No NFT, no comment—how digital art dominated 2021” (Gerlis 2021).
- ²⁹ See ARTnews article “Sotheby’s Withdraws CryptoPunks Sale, Leading to Widespread Speculation in Crypto Space” (Escalante-de Mattei 2021b).
- ³⁰ See ARTnews article “Sotheby’s Is Launching Another Digital Art Auction, This Time on the Art Before NFTs” (Escalante-de Mattei 2022).

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