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Blockchain technology for creative industries: Current state and research opportunities

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ABSTRACT

Blockchain based NFTs (non-fungible tokens) and smart contracts provide creative industries with exciting opportunities. While they have created a great deal of frenzy in markets, in the frenzy there emerges real value for the industries. Traditionally, creators in the creative industries often need to rely on powerful intermediaries to distribute and profit from their creations. NFT and smart contracts provide creators much closer access to content consumers/buyers. Along this line of thought, this article provides marketing researchers with an overview of the unfolding adoption of NFTs and smart contracts in creative industries. We start by pointing out the market frictions and consequent "transaction costs" that creators face traditionally when distributing their creative content to consumers/buyers. Then, we present the basic ideas of smart contracts and NFTs, discussing how they can transform the market by reducing these transaction costs. Meanwhile, we point out limitations and challenges that creators, buyers, and marketplaces might face in the adoption of NFTs and smart contracts. Finally, we raise an abundance of unexplored research questions interesting to both marketing researchers and practitioners.

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1. Creative industries and transaction costs

Creative industries commonly refers to economic activities that pertain to the generation of knowledge, content, and information for consumption. Examples of creative products are music, books, artwork, fashion products, TV shows, movies, games, etc. In this editorial, we start by discussing the long journey that creators typically have to go through to distribute their creative works to consumers. This journey adds tremendous transaction costs (in economic terms), which open the doors for the use of blockchain technologies such as NFTs and smart contracts.

Creators tend to only capture a small fraction of the value they create. To be concrete, we use the music industry as an example. In the U.S., music industry artists captured 12% of music revenues in 2017 (CitiGPS 2018). Vast majority of the revenues went to intermediaries: publishers, performing rights organizations, record labels, distributors, retailers and stream-

Abbreviations: NFT, Non Fungible Token; ERC, Ethereum Request for Comment; API, Application Programming Interface; URL, Uniform Resource Locator; AI, Artificial Intelligence.

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ing services (Sherman 2014). Popular creators like Jay-Z (Whitney 2015) and Taylor Swift (Tiffany 2017) have spoken out against streaming services like Spotify to highlight the need for creators to have greater control over pricing. This call has been recently echoed by the Union of Musicians and Allied Workers (Sisario 2021).

To better understand the low share of profits captured by artists, we look at the ecosystem of the music industry. (We use "artist" and "creator" interchangeably.) The journey from song creators to consumers involve multiple players. Fig. 1 illustrates the players. The process typically starts with a composer creating a song. In some instances, the composer only creates melody while a lyricist then contributes words to this melody. The song may then get scouted by record labels, who bring in music producers, singers, and audio engineers to develop a finished product. A record label relies on distributors to sell the song to retailers. The distribution can be in the form of physical CDs, digital downloads, or on-demand streaming. Beside being sold to individual consumers, songs are also licensed to be played at events and concerts or embedded in films, TV, and advertisements.

Different ecosystems exist for other creative products, but the essence is similar to the one presented above. Intermediaries scout high quality contents, fund their development and packaging, and distribute it to the masses. These intermediaries create a "waterfall" (a term frequently used in movie finance) where revenues are split and deducted by multiple players before falling down to artists. In addition, artists require a significant amount of time and expertise in negotiating and handling the contracts with intermediaries. As a result, artists accrue costs, in both time and money, in making sure they are properly paid for their intellectual property. We think of these costs as "transaction costs" in economic terms, and break them down into four aspects below.

1.1. Lack of standardization

Creators license their contents through a range of channels (e.g., CD sales, digital sales, streaming). Different channels of distribution utilize different business models and accordingly report their usage in different ways. Collecting societies spend a large amount of resources to collect/process massive amounts of usage data and use complex formulae to determine the creator's compensation. This data processing task is challenging. For example, International Standard Musical Work Code (ISWC) and International Standard Recording Code (ISRC) are used to identify compositions and recordings respectively. Some compositions may use local coding systems instead of ISWC. Even if an ISWC identification is available, a composition may not be linked with all of its recordings in the ISRC (Rennie et al. 2019). This lack of standardization can prevent royalties from being paid to creators (Levine 2021). Some efforts are currently being made to ensure complete and accurate identification is attached to all compositions and recordings at the point of creation.

1.2. Lack of trust

In creative industries, product usage data are often only known to the end distributors (e.g., Netflix, Apple Music). To other parties, it is hard to verify the product usage information that these distributors provide. In addition, contracts among upstream intermediaries in the "waterfall" often do not specify whether and how payments should be passed on by downstream intermediaries to creators. "A lot of the time, money that is paid outside of the direct usage doesn't end up getting shared [with creators]" (Singleton 2015). The complexity of the administrative and legal aspects of creative product management have opened doors to various forms of scams and fraud (Cornell 2021). The trust problem is faced by not only creators

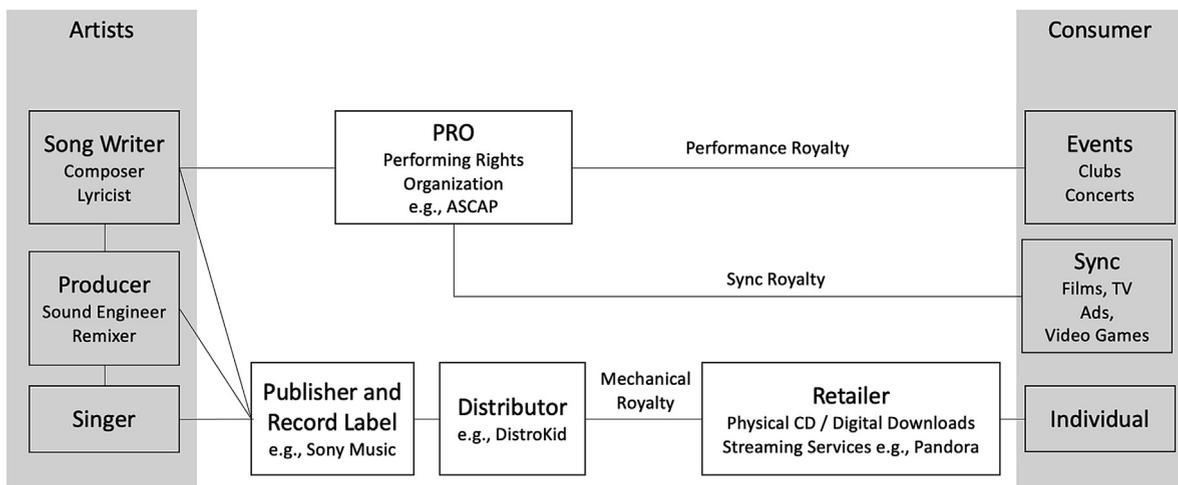


Fig. 1. Current Ecosystem of Music Industry.

but also consumers. In some creative industries, the authenticity of the artwork is vital. But the long journey that an artwork travels makes it difficult for an end consumer to verify its authenticity.

1.3. Long wait to receive payment

It typically takes 9–12 months for a songwriter to see her first royalty payment (Songtrust 2022, Tunecore 2022). With foreign collecting societies it can take upwards of 12–18 months. Creators almost always have to rely on other sources of income in their early years (e.g., side jobs, grants, family; Cascone 2018). Lack of funding or financial support is the major hurdle for creators continuing a successful career (TBR 2016). Long and uncertain time duration to receive payments for creative work forces creators to divert their energy to non-creative occupations.

1.4. Power concentration

A potential solution to reduce transaction costs is large platforms (such as Apple, Google, Spotify) with established contracting practices. However, this solution also comes with the problem of market power concentration, which re-introduces costs to artists. For example, multiple entities have started lawsuits with Apple about its massive 30% cut business model on the App Store (Nicas 2020, Allyn 2021). Similar lawsuits are made against Google with respect to the Google Play app store (McCabe & Wakabayashi 2021). Spotify's dominant market share with 180 million subscribers and 400 million monthly active users allow it to take increasingly large cuts in the revenue waterfall (Chan 2022). Outside of digital platforms, large auction houses take similarly large cuts – up to 30% of the price of the more expensive items (Neuendorf 2016).

The four aspects discussed above all point to significant transaction costs for delivering creative contents from creators to consumers. The costs suggest suitable applications of blockchain. The core of blockchain is to establish a record database that can be trusted without a centralized authority. This basically allows for standardization with high security without power concentration. In addition, automation of royalty collection on blockchain (via smart contracts) allows for fast payments to artists. In the next section, we discuss in detail how blockchain is used in creative industries and examine whether it delivers on the disruptive promise of cutting down the various transaction costs.

2. What can blockchain technology do for creative industries

Blockchain provides a secure ledger stored in a decentralized way. This function has important implications for marketing (Peres et al. 2022, Marthews & Tucker 2022, Zhang 2022, Anatoli 2022, Joo et al. 2022). Building on this function, two pieces of technology emerge with particular relevance for creative industries. These pieces are smart contracts and non-fungible tokens (NFTs). NFTs identify unique artworks and record ownership on the blockchain. Smart contracts are programs stored on a blockchain that automatically execute an agreement when predetermined conditions are met. They can be used to codify the rules of sale, usage, and licensing of NFTs. We start with some background details on how NFTs and smart contracts function for creative content, then discuss their implications for buyers, sellers, and the creative marketplace.

2.1. NFT and smart contract for creative content

2.1.1. NFT infrastructure

More than 80% of all NFTs are minted and deployed on the Ethereum Blockchain network (Robertson 2022). The Ethereum Blockchain launched in 2015 facilitated creation of a variety of tokens. Examples include value tokens for means of payment (i.e., cryptocurrencies) and utility tokens for rights to use a utility, e.g., file storage space. Most tokens are fungible in nature and they use a smart contract template called ERC20. These smart contracts codify a set of standards in a programming language called Solidity that is executable on Ethereum Blockchain. They provided a basis for NFTs. Among the first NFTs launched on Ethereum in 2017 were the Cryptopunks art collection and the Cryptokitties video game. These NFTs used a template smart contract called ERC721 derived from ERC20. Some of the standards codified in the baseline ERC20 include – total supply of a token, balance of the token held by an owner, and how a token owner would cryptographically approve transfer of some quantity of tokens. The derivative ERC721 template makes a critical refinement by enforcing a unique identifier for every token and making the transfer of tokens based on these identifiers instead of quantities (Sen 2021; Leewayhertz 2022). Such tokens are non-fungible, as a result. This refinement ensures that a piece of creative content, say digital art, has a unique identifier and its ownership is linked to a unique address on the blockchain. Both the rules in smart contracts and executions of those rules are recorded on the blockchain in a decentralized fashion. Unlike the traditional creative marketplace where a small number of intermediaries might exert tremendous market power, blockchain ensures that no single entity has the power to unilaterally change these rules or alter the execution records. For example, the same could not be guaranteed in a centralized database of ownership maintained by a record label. The record label company could choose to edit credits for composition, lyrics, or singing in the absence of oversight.

2.1.2. Content identification

The ERC721 smart contract usually does not store the digital art itself on the blockchain. In fact, storing 1 GB of digital art in its entirety on the Ethereum Blockchain may cost as much as \$4 million (Omaar 2017). Essentially, the security feature crucial to blockchains requires a restriction on data recording rate which makes storage expensive. Therefore, the ERC721 contract only keeps record of either an external URL address where the digital art is stored (Khun 2021) or a unique checksum (e.g., SHA-1) of the digital art's pixel representation. The dependence on external URL links can be a potential source of risk when the link is broken or hijacked (Edwards 2022). The record of digital art's checksum on the ERC721 contract provides greater reliability. One can compare the checksum stored in the NFT to the checksum of a copy of the digital art stored centrally or in any distributed file system like IPFS (IPFS 2022; Hunter 2020). This provides some safeguard against a hijacker who claims the ownership of digital art.

2.1.3. NFT beyond digital art

The same model as above for digital art is valid for broader digital creative content such as text messages, video clips, event tickets, sports cards, and electronic in-game items. For example, Jack Dorsey, twitter's CEO, sold his first ever tweet as NFT for \$2.9 million (Haselton 2021, Handagama 2022). The digital record of ownership for physical creative content such as paintings and sculptures can also be kept using IoT devices (Internet of Things; Wang et al. 2021). An IoT device can be physically tagged to a painting, while keeping a connection to the blockchain (e.g., a miniature computer using a low-power bluetooth connection). The device is designed such that an attempt to detach or tamper with the device would result in a record on the blockchain. One can use such records to digitally track any incidence of tampering as well as the history of ownership back to an authentic creator. However, like how digital arts are prone to broken or hijacked URLs, IoT devices are prone to physical hacking. Further, none of the mechanisms discussed so far stops a creator from originating new NFTs for the same or similar art piece on multiple blockchains.

2.1.4. Blockchain fees

NFTs for creative content are also affected by limitations of the underlying blockchain platform. Blockchains achieve a secure consensus over its decentralized system by asking participating computers (commonly referred to as miners) to solve difficult math problems. The difficulty limits the "throughput" of a blockchain, i.e., how many records it can log per hour. The limited throughput is a necessary blockchain design to provide secure decentralized consensus (Malik et al. 2022). Blockchain users who wish to add records to the chain participate in an auction for the limited throughput (Huberman et al. 2021). In this way, users pay fees to miners. The increasing number of NFTs and other blockchain applications have created congestion on the Ethereum Blockchain, making these auctions increasingly competitive. The fees for minting and selling a NFT have been pushed up to \$100–500 (Geron 2022). This has led to emergence of competing blockchains like Solana (Robertson 2022) as well as secondary chains or off-chain solutions that trade off security for throughput.

2.2. How creators can use NFTs and smart contracts

2.2.1. Minting NFTs

A content creator typically announces an upcoming creative content sale on marketplaces (e.g., OpenSea, Nifty Gateway). These marketplaces allow potential buyers to evaluate and compare a wide range of creative content. Fig. 2 illustrates a top marketplace called OpenSea that connects creators with a crowd of prospective buyers. The content creator may not be associated with large, trusted institutions like art galleries or record labels. This is where blockchains facilitate a trustless (i.e., requiring no prior trust established between parties) mode of payment and corresponding transfer of NFT ownership to the buyer. An intermediary is not needed to mediate the transaction. The smart contract rules and the execution of those rules on the blockchain ensure that neither the buyer can delay the payment nor the creator can hold back on transfer of NFT ownership. Smart contracts also offer more flexibility. For example, ownership of expensive creative content can be split (not duplicated) into a number of smaller NFTs, which further facilitates the participation of smaller buyers.

2.2.2. Secondary NFT sales

Buyers can re-sell their acquired creative content by transferring ownership of their NFTs on the blockchain. Even as the NFT changes ownership multiple times, prospective buyers can always check the historical ownerships on the blockchain to verify that the NFT originated from the authentic creator. In contrast, drawing up legal paperwork for transfer of ownership and verifying content authenticity are not as easy in traditional channels. As a result, traditional secondary markets for creative content are dominated by few established auction houses to facilitate re-sale, e.g., Christie's and Sotheby's in the art market (Schlenker 2015).

Some NFTs grant creators and early buyers a fraction of proceeds from future resale. While this practice encourages participation in the NFT market, it also incentivizes the participants not to focus on the artistic value of a NFT's creative content but to speculate its popularity or virality. Speculative bubbles are readily seen in NFT markets. One example of such bubbles is the aforementioned twitter's CEO tweet that was originally sold for \$2.9 million in March 2021, but could not raise even \$280 in a sale a year later (Handagama 2022). Another example is a collaboration of auction house Sothebys and the English football club Liverpool that minted 171,000 NFTs in a well promoted sale, but was only able to sell 10,000 of those (Salt 2022).

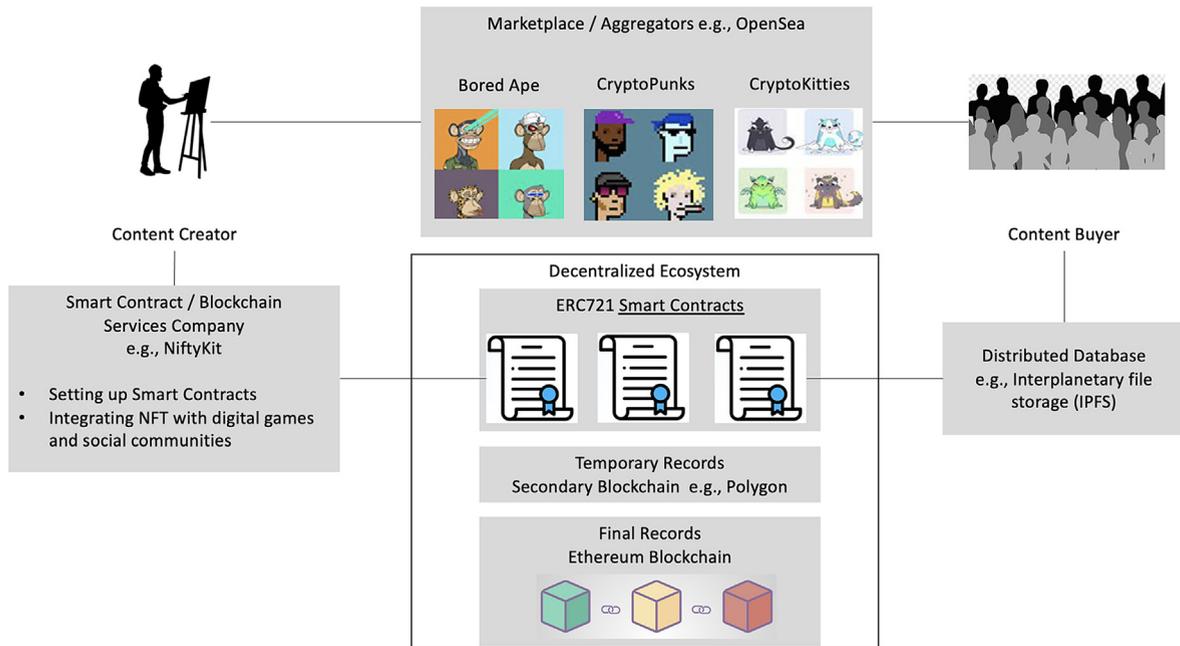


Fig. 2. NFTs for creative content rely on a decentralized ecosystem of smart contracts, sidechains or secondary chains, and primary blockchain. This decentralized ecosystem is also supported by centralized blockchain services companies, content marketplaces, and distributed storage for content.

The NFT market has attracted the participation of curators. Curators bring in much needed quality checks. The inclusion of curators does not necessarily defeat the goal of dis-intermediation. Traditional intermediaries (like auction houses and distributors) extract compensation partly in return for procedural functions like managing payments, royalties, and ownership transfer. NFTs and smart contracts automate and make redundant these procedural functions. They are, however, not purposed to replace intermediary functions that add value to the markets of creative content.

2.2.3. Tracking usage

An emerging application of blockchain is to help creators track the usage (streaming or downloads) of their contents and subsequently collect royalties. Conceptually, usage data (hours of streaming or number of downloads) can be stored on blockchain, which smart contracts take as inputs to automatically initiate payments to content owners. This practice will dramatically shorten the time that creators have to wait to receive their royalty payment. However, this application is still in its infancy and various obstacles have to be overcome (Music Business Worldwide 2022). In the music industry, the first step seems to be building a standardized music database to be used by all streaming platforms to identify compositions and recordings (Gupta 2020, Pastukhov 2019). Overall, the state of usage tracking is similar to ad delivery tracking by blockchains in digital advertising (Ghose 2018).

2.3. Implications for creators and buyers

Blockchain, NFTs, and smart contracts have created alternative routes to content distribution that does not require the complete reliance on traditional intermediaries such as publishers and distributors (see Fig. 1). How will this affect the creators, buyers, and market as a whole?

2.3.1. Creator's perspective

In creative industries, blockchain can change how creators receive value for their work. Artists gain additional control of as well as more stake in the revenue generated from their creative products. Artists rely less on or even bypass the intermediaries that increasingly insert themselves into the value chain between the creative products and their audience. As such, artists may receive a greater share of the revenue generated, and have more say on how their intellectual properties are priced, shared, or advertised. This directly addresses the concerns voiced by creators such as Jay-Z, Taylor Swift, Union of Musicians, and Allied Workers we brought up in Section 1. Furthermore, the trustless feature of blockchains encourages creators to work with a wider range of collaborators (e.g., composers, lyricists, and musicians). For example, with automated revenue sharing via smart contracts, creators should see less risks from contract breaches by their collaborators, even the ones with whom they did not work with before or are unfamiliar with.

Traditionally, intermediaries have had the power to select content. They try to filter content that they think is of low quality or low potential. In the movie industry, studios green light proposals based on their predictions of box office revenues. In the music industry, record labels predict the popularity of a song. In the art industry, curators and galleries appraise paintings. Naturally these intermediaries extract compensation for their expertise in evaluating quality of creative content. As NFTs make it possible for content creators to directly reach consumers, the power to select content rests more with the crowd. Decentralizing the selection power is likely going to encourage more diverse content that suits consumers' heterogeneous preferences (e.g., niche segments).

However, the reduction of intermediaries raises the question of how to discover and select content. In this aspect, it is important to distinguish selection based on price vs. consumption. One may identify high-quality contents by the prices they were sold at. However, as discussed before, the price of an NFT can be volatile, heavily driven by speculative investors. Research on cryptocurrency suggests bubbles are easier to form for a new, diffusing technology such as cryptocurrency (Wei and Dukes 2021); the same should apply to NFTs. Speculation can have real consequences. One consequence is adverse incentives for creators to focus on short run virality instead of quality (e.g., creating a large quantity of low-quality NFTs). As an ocean of creators try to take advantage of the noisy selection process, high quality creators may be crowded out.

Compared to prices, relying on consumption data (e.g., downloads or streaming of a song) to identify high-quality creative products can be more reliable. Still, a caveat is that consumers in a NFT market may not be best positioned to evaluate creative contents. Minting an NFT is relatively easy; tens of thousands of NFTs are being sold daily (Barber 2022). Consumers thus find themselves faced with a cluttered market difficult to navigate. Average consumers have limited capacity to evaluate large numbers of NFTs, and may resort to chasing word of mouth about a smaller number of NFTs going viral among the crowd, i.e., herding. For this reason, in the near future we will likely see curators trying to establish themselves in the NFT market. One recent example is that Sotheby's, one of the largest fine arts brokers in the world, entered the NFT world (Escalante-De Mattei 2021).

Another benefit for creators is having a tighter control over payments. In contrast to the typical 9–12 month lag before a songwriter sees the first royalty payment, artists can leverage smart contracts to obtain immediate royalty payments from tracked usage. One example is PeerTracks, which attaches a smart contract to every song an artist uploads and distributes the revenue according to the terms indicated in the contract (Redman 2019).

Finally, it is important to note that not all creators have the tech skills to go through the process to create, mint, and promote their NFTs (Plau 2021), and a creator's lack of tech skill might leave them open to hacks or phishing attempts (Spichak 2022). This is where new intermediaries may step in. Overall, while blockchain technology can definitely reduce transaction costs in creative industries, it is not an all-in-one solution. The adoption of NFTs and smart contracts creates room for new types of intermediaries.

2.3.2. Buyer's perspective

Blockchain helps buyers verify the authenticity of creative products. Counterfeits have been a long standing challenge for buyers in art markets. With blockchain-based smart contracts, every single transaction is verified and approved by consensus among participants in the network. The full chronology of events (e.g., transitions) is being tracked, allowing anyone on the network to trace or audit prior transactions. As such, the use of blockchain makes counterfeits considerably more difficult to sell.

As blockchain technology lowers transaction costs along the journey from creators to buyers, the expectation is that buyers will enjoy some of the reduction in costs in the form of lower prices. Blockchain does incur its own cost in the form of fees that users pay in the auction for the limited throughput of major blockchains. However, the fees depend on the size of the transaction record (in bytes) instead of the value of the transaction. As a result, for large-value creative artworks, these fees are incredibly low relative to the charges by auction houses that are pegged to the values of artworks. Further, some tradeoff between security and throughput (e.g., secondary chains and off-chain solutions) can greatly reduce the fees. The tradeoff could also enable micro payments (Morris, 2022). Small payments (e.g., for a single-instant usage of a creative content, or an accessory in online games) are typically drowned in the fees that traditional payment systems (e.g., Visa) charge. Blockchain provides new potential solutions for such small payments without involving financial intermediaries.

Not all potential buyers feel comfortable with the technology involved in trading NFTs. Educating the potential buyers on how to do so is one of the current challenges (Canales 2022). Account hacks and phishing attempts add to this challenging market (Hu 2022). Price volatility discourages the participation of buyers who are interested in fair trading based on quality, too.

Price volatility is particularly problematic for small buyers. The ease of participation in the NFT market encourages and attracts retail investors (private individuals investing for their own profit; Shumba 2021). One can argue that they are more exposed to the short-term risk of volatility. Institutional investors can mitigate the volatility risk by managing a quantitatively diversified portfolio of NFTs. Retail investors, with less time, expertise, and capital, can not manage a well diversified portfolio of NFTs to diversify away the short-term volatility risk. As a result, they have to pay more attention to short-term volatility as opposed to longer-term trends based on fundamental value. This may end up reinforcing the volatility in the market.

2.3.3. Market's perspective

Some benefits of blockchain apply to both sellers and buyers. Smart contracts allow for transparent dynamic pricing. The demand for creative products (paintings, photos, songs) fluctuates over time. Under the traditional marketplace, the creator, the buyer, and the intermediaries may need to renegotiate to change prices as the demand fluctuates. The menu cost of modifying prices and terms can be quite high (Levy et al. 1997). Under smart contracts, the owners of the creative products can readily set rules to adjust prices to market demand. A correctly executed dynamic pricing mechanism benefits not just sellers but also buyers, allowing more low-willing-to-pay buyers to access the product. Importantly, the pricing mechanism is transparent for buyers to see. Transparency is a quality that consumers seek from a company (Wharton@Work 2018, Ghose 2018).

More generally, an automated smart contract (such as dynamic pricing) can be offered by a centralized platform too. One can imagine Youtube or Tiktok establishes an implicit contract between short video creators, advertisers, and consumers. The contract ensures that creators are paid for views and advertisers pay for consumer attention. However, such centralized intermediaries will likely extract greater compensation compared to fees that sustain a decentralized blockchain. Further, the centralized intermediary may exercise control on contract terms as well as disputes stemming from the contracts.

Even more broadly, when we compare a NFT marketplace (e.g., OpenSea) and traditional online content platforms (like Etsy, Youtube, and Tiktok), there is not much difference from a functional perspective. Buyers have a large catalog of content to choose from; the entry barriers for creators are relatively low; creators often succeed by developing social communities around their content. However, the key innovation brought by blockchain technology is to allow creators to prove ownership and enforce custom contracts programmatically without having to rely on legal systems or profit-maximizing intermediary platforms. This changes the market structure beneath the market functions.

Blockchain technology can also help establish a reputation system. For example, creators who do not fulfill creative contracts on time will have actions recorded and stored on the blockchain, forever. Buyers/resellers who fail to pay on time will also be recorded for their bad behaviors too. One caveat is that blockchain is pseudo-anonymous: participants can create new accounts to hide their past records. However, in this case the length of someone's record becomes a signal too. The reputational benefits of a long, good track record can incentivize participants to maintain their identities.

Here, a special note should be made regarding the metaverse. The metaverse is a network of 3D virtual worlds focused on social connection. Each virtual world in the metaverse provides a unique immersive experience using augmented and virtual reality. Users design their own appearances in these worlds. In an effort to adapt to the metaverse, real-world fashion brands have started to offer consumers NFTs alongside the purchase of a physical product (McDowell 2022). Burberry has offered NFTs to accessorize avatars in the metaverse with Burberry branded jetpack, armbands and pool shoes (Manley & Yang 2021). With the help of NFTs to prove product authenticity, conspicuous consumption can become more popular in the metaverse than in the physical world. In addition, the use of NFTs allows the consumer to keep a seamless identity across different virtual worlds. Each virtual world's developers can simply look up a consumer's NFT ownership on a blockchain to know his or her expensive belongings. More broadly, as e-commerce, marketing, and social interactions become increasingly virtual (not just online), digitally verifiable ownership will become more important (Gadekallu et al. 2022).

3. Research opportunities

In this section, we point out future research opportunities in three directions: 1) measuring performance of the NFT market; 2) examining the strategic behaviors of the market participants, and 3) designing of the NFT market. We list potential research questions for each direction. The list is meant to be exemplary rather than exhaustive.

Before we detail each research direction, it is useful for researchers to have an idea of the data available on blockchains. First, the creative content itself can be collected from APIs offered by marketplaces such as OpenSea and Nifty Gateway. Creative content such as digital art is typically publicly available to view and download for non-commercial purposes without having to purchase ownership or pay royalty. Researchers can freely download and study such creative content at scale. Second, for each creative content one can access underlying smart contracts on the public blockchains like Ethereum. Given the high degree of standardization, it should be relatively easy to compare smart contracts at scale. Third, researchers can track the content ownership history as well as the price history. While the identities of owners are anonymous, all the activities of an owner (e.g., portfolios of content bought or sold) are publicly available. For example, etherscan.io is one avenue to access Ethereum smart contracts and ownership trading records.

3.1. Measuring market performance

3.1.1. How well do artists retain income from their work in the NFT market?

There are two main types of income for artists. The first type comes from the initial sale and re-sales of their works on blockchains. The second type comes from royalties and licensing. The first-order task is to measure the percentage of value that artists retain from their works distributed via the blockchain channel. This percentage is to be compared to the percentage via the traditional distribution channel (i.e., publishers, collecting societies, etc.) An equally important but more difficult task is to examine whether the same artwork generates more or less value when distributed via the blockchain channel. The difficulty lies in a selection issue where artists may self-select into different channels. Consequently, it is difficult to have the

ideal experimental condition where two identical artworks are distributed through different channels. The same artist may also strategically allocate his or her works to different channels (more on this point later in [Section 3.2](#)).

3.1.2. Can we separate fundamental value from speculative value?

[Wei and Dukes \(2021\)](#) make the distinction between speculative and fundamental value for cryptocurrencies; the same distinction can be made for NFTs. People generally believe that speculative bubbles exist in the NFT market. But can we get an idea of the magnitude and extent of the bubbles? Assessing the degree of speculation in a market is a difficult task, but nevertheless a very important one in understanding the performance of the NFT market. We can break this task down to more approachable, smaller questions. For example, to what extent does the initial sale of a NFT retain its value in subsequent sales? Does the initial sale price really reflect subsequent demand from consumers (e.g., hours of streaming, number of downloads/views)? Does the initial sale heavily influence subsequent sales even when the initial sale detaches far from the later demand data (also see herding in [Section 3.2](#)). It is also important to see how the answers to these questions change over time, which would tell us whether the NFT market has been stabilizing (i.e., prices are less driven by speculation but based more on fundamental value).

3.1.3. Pricing individual NFTs

While a fraction of all NFTs are sold at very high prices, the vast majority of NFTs are never sold ([Nadini et al. 2021](#)). Are there significant predictors for NFT prices, or are NFT prices more or less random and unpredictable? This pricing question is related to the last question on fundamental vs. speculative values. However, the key difference is that it takes a predictive rather than retrospective perspective. In general, the value of an NFT backed creative content can arise from - (i) artistic value of the content as perceived by art experts, (ii) willingness to pay by the crowd for consumption of the NFT, (iii) the mathematical rarity or finiteness of a content feature (e.g., less than 0.1% of cryptopunk NFTs have alien instead of human skins), and (iv) exclusive access to a social community granted by some NFTs ([Kastrenakes 2021](#), [George 2022](#)). Under these four general aspects, one can ask a series of interesting questions. For example, does the novelty of the artwork underlying the NFT lead to a higher or lower expected sale price? What about the track record of the artist? What about the exclusive accesses added into the NFT? Can we use the prices or consumption data of past similar NFTs to predict the price of a new NFT (more on NFT similarity in [Section 3.2](#))? The answers to these questions will be very useful for artists, helping them develop pieces of artwork that are more likely to succeed in the NFT market.

3.1.4. To what extent does blockchain protect authenticity and prevent counterfeits?

Although NFT technology is designed to prove authenticity, it is an empirical question whether this new technology has effectively protected the authenticity of creative contents in practice. For example, it is relatively easy to marginally alter the original artwork (e.g., pictures, manuscripts, lyrics) and mint a NFT for the nearly identical artwork, i.e., a counterfeit. "Double minting" refers to the extreme case where the creator mints multiple NFTs for the exactly same content in multiple marketplaces ([Smith 2021](#)). How prevalent are counterfeits in NFTs? Do counterfeits significantly harm the popularity and value of the original? It is also interesting to know whether successful sales (or even price bubbles) make a NFT more likely to become a victim of counterfeits. Less infringing than counterfeits are copycats with similar but not nearly identical contents. The effect of copycats on the original content can go either way ([Wang et al. 2018](#)). It will be useful to understand what moderates this effect in the NFT market. To track counterfeits and copycats, one may measure the degrees of similarity between NFTs (more on this point in [Section 3.2](#)). From a technical perspective, it will be useful to quantify which degree of similarity should be deemed as counterfeits. However, this problem may also require a marketing perspective. For example, one may define the cutoff for counterfeits as the degree of similarity below which the popularity of the original NFT is no longer substantially harmed by the subsequent NFT.

3.2. Strategic behaviors

3.2.1. Do artists use traditional and NFT channels differently?

For example, do they market their best works mostly via the traditional channel but the rest (many) works via NFTs? This is an extension of the aforementioned research questions on measuring the NFT market performance. For example, if success happens more at random and is thus less predictive in the NFT market, then it incentivizes artists to pursue quantity over quality when participating in this market. One related question is whether an artist prefers the traditional channel when developing content for acknowledgement by experts but prefers the NFT channel when developing content for consumption by the crowd?

3.2.2. How do artists learn in the NFT market?

Do creators try to mimic the contents of successful NFTs? To what extent do they put effort into imitation vs. creating original contents? Are there many original contents in the NFT market, or are most NFTs just imitations of a small pool of original contents or the imitations of these imitations? Do creators self-select into niche segments? The NFT market provides a great opportunity to study these questions about artistic creations, as tracking and collecting data about the artworks can be difficult in the traditional marketplace. The digital arts behind NFTs are readily available. Machine learning techniques can be used to compare two pieces of art for similarity. One way to systematically track and analyze the similarity pattern

between millions of NFTs is through a network (Wei 2020, Wei et al. 2021). Aside from the artworks, questions can be asked about smart contracts. Do artists learn from each other's smart contracts (e.g., the terms on how much the artist can collect from secondary sales)? Do the terms in smart contracts converge, i.e., become more and more similar to each other? How fast do innovations in contract design diffuse in the market? In both convergence and innovation, what are the roles of service providers that code smart contracts on behalf of the artists (e.g., NiftyKit)?

3.2.3. How do buyers decide when and which NFTs to purchase?

This question can be asked at both the individual and aggregate level. At the individual level, an interesting question is how buyers differ in their buying strategies. For example, some buyers may pursue NFTs that are currently gaining values, whereas others may try to "buy the dip." Both examples signify speculative strategies. In contrast, successful fundamental-value trading manifests as trading at a relatively low frequency and yet achieving profits on average. What is the percentage of such fundamental-value buyers in the market? Data in the NFT market provides unique opportunities to study these financial behaviors. At the aggregate level, an interesting question is whether exposure in media about NFTs and related topics (e.g., cryptocurrency, blockchain) precedes and drives NFT purchases?

3.2.4. Is a fanbase more engaged if they co-own the NFT creative content?

NFTs enable and make more accessible fractionalized ownership. For example, through smart contracts, songwriters can offer their fans joint ownership of their songs. Co-owners share revenues based on the number of times the song is streamed or downloaded later. This should encourage the use of word-of-mouth (WOM) by these co-owners to promote the song, so they can profit from its popularity. This is a new marketing approach, and it will be interesting to examine its effectiveness. Do co-owning fans engage more in the WOM of the creative product than other fans; does a fan significantly increase his or her WOM of the creative product after becoming a co-owner? Or is freeriding too much of a problem for co-ownership to have an effect?

3.3. Design

3.3.1. How to design smart contracts to elicit truthful content preferences?

An NFT owner can derive payoff from three sources: (i) private consumption of the creative content, (ii) royalties from usage of the content by others, and (iii) re-sale of the NFT. When buyers select and bid on NFTs, they may ignore the first two sources and focus entirely on the third. In this case, the prices of NFTs become very much speculative and do not reflect underlying quality of the content (a point also discussed in Section 2.3). In this regard, research can investigate the design of smart contracts to incentivize buyers to truthfully reveal their private utility from consumption or at least their evaluation of the future demand for usage (Cong et al. 2021). One potential approach could be to impose a sales tax. Note that recording an NFT resale transaction on blockchain already incurs a fee. But this fee depends on the transaction size (in bytes) and not on the NFT value. As such, it fails to discourage bubbles. Researchers can investigate whether a sales tax can effectively reduce speculations. If so, what is the optimal tax, who should collect it, and how to re-distribute it.

3.3.2. How to design smart contracts to incentivize creators to develop original content?

This is an issue related to the last question. Content creators may collect fees from every resale of NFT as specified in smart contracts. Marketplaces (e.g., OpenSea) also collect fees from every resale of NFT. These resale fees have important implications for the dynamics of the NFT market. Low fees induce buyers to engage in frequent and/or speculative trading. However, high fees induce creators and marketplaces to focus on increasing trading volume instead of offering original content. Researchers need to recommend optimal resale fees. Some follow-up questions naturally arise. For example, should the optimal fees vary depending on characteristics of creative content or the reputation of the creator?

4. Concluding remarks

The primary goal of our editorial is to inspire future research to better understand how blockchain technology may introduce longer-term changes in creative industries. It should be noted that blockchain technology is not the only disruption to the creative industries in recent years. For example, the advent of streaming platforms in film and television (e.g., Netflix, Hulu) has shaken up the traditional market structure in these industries. Another example is the generation of novel, edited, or at times copied creative content using artificial intelligence (AI), which poses challenges to human creators. We skip discussing these disruptions in detail due to the scope of this article. Yet they may interact with blockchain technology in significant ways. For example, generative AI (e.g., DALL-E 2, Google Imagen) can create realistic images. It is becoming the latest way to create art and mint NFTs, even by those who might lack the artistic skills (Wolfson 2022). With an audience attentive to digital art, the NFT market may quite possibly serve as a training ground for generative AI. Machines can learn by reinforcement from the reception of the arts they have created and minted NFTs for.

Creative industries have many unique characteristics. Specifically, we have highlighted in this editorial the hefty and complex "transaction costs" of delivering creative products from content creators to consumers in this industry. We discuss how functions of blockchain may provide remedies for the transaction costs. Then, we describe the data that the NFT market

provides with empirical researchers and discuss a variety of exciting research questions, from measuring the NFT market performance, to examining the strategic behaviors of participants, to designing the NFT market. It is our hope that our editorial can be both informative and inspirational to our readers. We look forward to a stream of exciting research endeavors at the intersection of blockchain technology and creative industries.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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