Written evidence submitted by
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Non-fungible tokens (NFTs) and the blockchain

RELEVANT AUTHOR EXPERTISE

Prof. Perry's research lies in understanding the use of digital money to support the design of relevant, useful, and intelligible future financial systems that work for their users. His work is oriented towards human interactions with digital systems examining issues around the privacy, trust, acceptability, usability, and usefulness of emerging financial technologies. He has held funding to look at digital currencies and payment systems, peer-to-peer 'fintech' operations, and programmable 'smart money' systems using blockchain and cryptocurrencies.

Dr Destefanis' research focuses on Empirical Software Engineering, focusing on improving software quality and the software developer experience. His research in the Blockchain and Cryptocurrencies sector bridges the gap between Blockchain application development and Software Engineering, and he advocates the need for Blockchain Oriented Software Engineering (BOSE). He has authored an award-winning book on blockchain and is a senior lecturer at Brunel University London.

Dr Neykova's research focuses on the design, development, and evaluation of large-scale distributed systems, including emerging technologies such as blockchain. She has created tools and techniques to detect and prevent software security vulnerabilities in large-scale distributed systems that have applications in programming smart contracts on the blockchain. She is a senior lecturer at Brunel University and a recipient of VMWare PhD scholarship and EPSRC Doctoral Prize Fellowship.

All written evidence is submitted in a personal capacity by the authors. We hope to offer informed comments that the committee will be able to use in examining opportunities and problems within this space, and to shape appropriate legislation.

EXECUTIVE SUMMARY

- The NFT market has been associated with high levels of speculative activity and losses to investors.
- Determining the fundamental value of NFTs is a hard problem, and while it poses some problems, market-based price setting (via speculative trading) is a useful tool to identify this.
- NFTs take different forms. Some types of NFT may be suitable for speculative activities, while others are not. Regulation that assumes speculative activity may negatively impact on other innovative uses that could benefit the UK economy.
- Market price manipulations are possible and appear to have been commonplace in the recent (2022) past, and the fundamental properties of NFTs make them susceptible to manipulation.
- UK legislation on trading or banning NFTs is likely to be difficult given the international market, and the decentralised nature of blockchain infrastructures.
- While blockchain technology and NFT platforms have been developed to prioritise secure 'trustless' interactions, the technology is not fully mature, and vulnerabilities exist that may expose NFT users to fraud or potential loss of their investment. There is space here for investment into research to protect users.

SUBMISSION

Introduction

1. This written evidence addresses the following questions in the call for evidence: 2) *What are the potential harms to vulnerable people of NFT speculation?*, 3) *Do blockchains offer security to British investors?*, and 4) *What are the potential benefits to individuals and society of NFT speculation?* The authors do not have legal expertise and are less qualified to address the first question posed by the committee other than where NFT regulation maps directly to technological aspects of design and use or where its technical reach is factually incorrect: 1) *Is the UK's light-touch NFT regulation sufficient?*

2. This evidence is prepared in the understanding that there are many variations of:
   a) the technical implementation of an NFT (eg. they may be hosted on different blockchains, and may have different standards or protocols),
   b) how an NFT maps the world of code to physical reality (eg. they may attest a variety of aspects of authenticity, ownership, and access rights), and
   c) what an NFT represents (eg. spanning whole or partial ownership of digital art, real-estate ownership, software, and access to digital, physical or hybrid services).

3. For the purposes of this evidence, we take the widely held position that an NFT is a digital claim on an asset, held on a blockchain (or digital ledger) and created via 'minting' on a 'smart contract', that may be held, displayed, sold on, or copied. Proprietary rights to an NFT asset are currently unclear and contested, as ownership is demonstrated by nothing more than a cryptographic digital signature on a blockchain record. This is therefore a

socially and culturally–as well as a technically–mediated system because there is *no legal basis* for ownership or other forms of usage rights. Commonly, the product or service that the NFT represents is not itself hosted on the blockchain, with the NFT acting like a digital certificate, an IOU, or a key to use what it represents, and which can be accessed elsewhere online or in the real world.

What are the potential harms to vulnerable people of NFT speculation?

4. NFTs have recently been implicated in highly speculative trading and market manipulation, with some buyers losing most, or all their investment. This is linked to the implementation of NFTs on blockchains and their purchase with cryptocurrencies, which themselves have been involved in several speculative bubbles and a deep crash in 2022.

5. As it is usually impossible to assess the 'real' commercial value or even the real utility of an NFT, or the ownership of the asset that the NFT represents, reasons for purchasing can currently often at best be *described* as a hobby, at worst, as gambling, often for large sums of money[1]. There are clear and well-known potential harms around gambling and financial speculation that have been legislated in the UK, but it is not clear whether owning and trading NFTs are directly comparable to these.

6. NFT purchasers may describe themselves as investors, and this may be a valid reason for financial speculation in the same way as buying a painting as an investment. As the speculative trade in artworks is not regulated as a form of gambling, clear differentiation would need to be made as to why NFTs require special consideration. We can see no reason why this should be done given the current NFT marketplaces and infrastructures, as functionally (if not technically), they operate in a similar way to the traditional art market.

7. Not all NFTs take the form of visual artworks or 'collectables' that can be used as investments, and practical applications have been developed for event ticketing, purchase of computer game elements, music sales, as a means of authenticating the provenance of physical products, in identity verification, and for documentation of personal records (amongst others), and there may be cross-integrations and interdependencies between these forms of use. For many of these forms, the role of NFTs is not one primarily or wholly one of financial speculation, and they may hold no financial value for speculative investors. The potential harms in these cases would seem to be low with respect to risky financial speculation.

8. Critics have argued that rapid increases in NFTs prices are usually due to 'greater fool' herd mentality (Bogan, n.d.) in a speculative financial 'bubble' and are not the result of any connection to their fundamental value. In these cases, buyers ('fools') are aware that their investments are overvalued but hope to exit the market and sell (to 'greater fools') before the market bubble bursts. We do not attempt to place a moral judgment on the commercial value of an NFT, but there may be good reasons why the market sale value of NFTs may have been manipulated in addition to their being caught up in a rising price bubble.

[1] Note that NFTs are typically not purchased in fiat money, but in a cryptocurrency, itself a highly speculative asset.

9. Market manipulation is the act of artificially influencing the price of a market, commodity, or asset through deceptive or fraudulent practices. It can occur in the NFT market, with serious consequences for individual investors, as well as the market as a whole.

10. Market manipulation can affect NFT prices in numerous ways. The most common tactic is the use of social media channels to artificially inflate demand for an NFT, by generating huge amounts of unjustified positive social media content about it to create a false sense of demand, or one agent using multiple accounts to bid up the price of an NFT. Such manipulation is not easy to detect as it involves the use of fake accounts (possible as the owners of crypto wallets are not easily identifiable) or individuals paid to promote an NFT sale. A group of people can also work together to artificially inflate the price of an NFT or other asset, then sell off their own holdings once the price has been driven up (eg. the GameStop short squeeze (Wikipedia, n.d.) triggered by users of a social news website).

11. Several properties of the NFT ecosystem make it susceptible to manipulations (see an extensive review by Das et al., 2022): i) Wallet addresses on the most used NFT payment platform, Ethereum, are anonymous, so traders can swap the same token multiple times, inflating the price of the asset (colloquially known as 'shill bidding' or 'wash trading'). Indeed, a recent analysis (White et al., 2022) shows that a small subset of cryptocurrency wallets is driving massive growth in one of the major NFT marketplaces, OpenSea. ii) NFT marketplaces do not currently run similarity checks to see if an asset is already owned or verify the authenticity of the assets claimed by the NFT. Hence, a purchaser can easily be fooled into buying a "plagiarised" NFT. iii) The NFT markets remain non-liquid. Analysis of the most traded NFTs on OpenSea shows that 39% have never been sold and 92% have only been sold three times or less (Lommers et al., 2022). It is hard to assess fundamental prices in illiquid markets because of their potential for much wider price variations than in more actively traded assets, making price distortions hard to identify.

12. National legislation over purchasing and ownership of NFTs is likely to be extremely problematic. Policing or restricting access to NFTs, cryptocurrencies, and blockchains in general has proven hard to achieve where it has been attempted; most notably, even in China this has not been entirely successful, despite having levels of network surveillance and control that are far more intrusive than in the UK.

13. Even if, in the UK, we were to make the case for banning NFT ownership because of their potential for harm, the international reach of the internet and the cryptocurrency infrastructure is likely to bypass any restrictions, offering an online market to UK users. The only practical regulatory option to manage prices or to restrict purchasing would be an international agreement to place controls on NFT marketplaces. However, in a free economy, most assets are worth what their purchasers are prepared to pay for them. Should we place a minimum or maximum value on an artwork, a concert ticket, or a property? These are political questions with political solutions, and their technical implementation or representational format–in this case as an NFT–seems to be less relevant than the societal values that we hold about capital and ownership.

14. Recommendations: Although regulation is likely to be problematic, some steps can be taken to mitigate the harm posed by fraudulent actors in NFT markets, and the potential market manipulations. Investment in research and development of malpractice detection and blockchain security prevention techniques can be used to identify markets with predominant malpractices and faulty NFTs; creating guidelines and recommendations for NFT marketplaces on identity and NFT verification can create a more secure space for users. Finally, it is of paramount importance to educate the public and bring awareness to cybersecurity threats (including social media vulnerabilities) which impact not just on the NFT ecosystem but extend to broader digital and online activities.

Do blockchains offer security to British investors?

15. A blockchain is a decentralized, distributed ledger that stores a continuously growing list of records, called blocks. These blocks are linked and secured using cryptographic techniques and each block typically contains a cryptographic hash of the previous block, a timestamp, and transaction data. By design, a blockchain is resistant to modification of the data. The security of a blockchain is achieved through a combination of factors, including the use of cryptographic techniques to secure the data within the blocks, the use of decentralized networks to ensure that no single point of failure can compromise the integrity of the data, and the use of economic incentives to encourage participants to act in the best interests of the network.

16. One of the key security features of a blockchain is its use of consensus algorithms which allow the network to reach an agreement on the state of the blockchain without the need for a central authority. This decentralized structure makes it difficult for a single entity to manipulate the data on the blockchain. An additional aspect of blockchain security is the use of private keys, which are used to sign transactions and provide proof of ownership of assets on the blockchain. Proper management of private keys is essential to the security of a blockchain system. Social engineering (ie. fraudsters exploiting psychological manipulation techniques) to access users' private keys to their NFTs is likely to be the most common form of NFT theft, much as it is with other forms of standard online banking fraud or cybersecurity breaches.

17. Blockchains must not be considered in isolation when evaluating the security of blockchain-related products (including NFTs). The level of security inherent within an NFT is primarily set by the security of the smart contract (ie. software code) that it is held on, the integrity of the blockchain that this contract is hosted on, and the blockchain-based marketplaces used for token trading. Although the blockchain cryptographic mechanism ('hashing') makes it hard for tampering attacks (via manipulating the data on the blockchain), data stored outside of the blockchain *can* be manipulated. Most blockchain-based marketplace platforms use hybrid (both on- and off-chain) technologies for data storage; hence, they are exposed to standard computer security attacks. Finally, smart contracts are written in new and immature languages (most notably Solidity), and loopholes in the smart contracts have been exploited to steal funds and damage the integrity and authenticity of the tokens (Nikolic et al., 2018).

18. While some problems exist in the blockchain and NFT security, there is no indication that blockchains offer more, or less security to British investors (including those of NFTs) than to any other set of international investors. No part of the NFT ecosystem is nationally controlled. Despite their potential, blockchain products are exposed to a plethora of security challenges. British investors may benefit from their easy access to multidisciplinary research on security detection and risk analysis conducted across UK universities.

19. Recommendations: Blockchain-related technologies are still in their infancy. While some security issues they pose can be mitigated with existing techniques, others require novel approaches. Collaboration between industry and academia will ensure that UK investors are well positioned to influence, control and benefit from the development of safe and secure blockchain ecosystems, including the deployment of new and existing blockchains, smart contract languages and marketplaces.

What are the potential benefits to individuals and society of NFT speculation?

20. Societies that have free and open markets for goods and services (whether this is seen to be a good thing or not) are likely to struggle to find political consensus over price controls, even when this is considered societally valuable. Where there is an international market, control of these markets is likely to be much harder, especially when both the medium of sale and asset transfer is over the internet, and when the established banking system is not involved.

21. Economic theory suggests that speculation ideally should lead to realistic market valuations (at least in the long term), where there is reliable information on supply and demand. This is because markets can synthesise diverse information on value into an objective form: price. The open market is a useful mechanism to determine the real value of an NFT to its users; the challenge will be to ensure that traders are operating in a field in which there is symmetrical price information between seller and buyer, and that this operates in a macroscopic environment in which large financial players (eg. FTX, Celcius) or insiders working on parts of the NFT infrastructure (for eg. allegations of insider trading at OpenSea) are not manipulating asset prices. Unfortunately, the evidence to date would suggest that such price manipulations are not uncommon.

22. One final benefit of NFT speculation lies in its utility as collateral when taking out peer-to-peer cryptocurrency loans. This process is similar to borrowing money and using an artwork as collateral to back the loan. The nature of holding NFTs via smart contracts in which ownership can be transferred via code makes holding these potentially valuable as an asset. This process may be cheaper to run than securing a loan with a physical asset that needs to be authenticated and physically transferred; in addition, NFTs may be easier to value as a security because their (and comparable items') prior trades are visible on the blockchain. In this respect, the visible process of NFT price speculation allows borrowers and lenders to determine a reasonable valuation for the asset, so that the terms of the loan can be managed. Commercial systems to do this are currently operating, although the extremely volatile current market conditions for NFTs have made this a very risky activity.

23. Recommendations: In its most primitive form, speculation involves the purchase of an asset in the hope that its price will rise. While this activity may not be based on the underlying fundamental utility of that asset, it is a proxy of this (even if a weak one), and speculative trading of NFTs therefore is a useful means of price discovery. In this sense, speculative trading of NFTs has a potential benefit to both content creators in the UK, and asset holders. Ensuring that fraudulent price manipulations within UK jurisdictions are actively policed seems a useful action, as does developing UK legislation to cover the technical aspects of NFT-related fraud when it occurs within the UK. Similarly, developing policies for regulation (pulling on existing cryptoasset expertise from the FCA, HM Treasury, and Bank of England) within UK-based NFT marketplaces would allow UK investors to act within an environment where the risks are more managed. International co-operation on cryptocurrencies, blockchain and NFTs will be required if this level of control and oversight is to be extended to the majority of current NFT marketplaces.

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