‘What Have We Learned from Market Design?’ Blockchain and The Conditions for a Well-Functioning Market

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Abstract

Blockchain technologies, specifically those related to cryptocurrencies and NFTs, have recently been garnering a significant amount of public interest. Blockchain has been lauded as being potentially transformative across a wide variety of industries, including decentralized finance, supply chain management, healthcare, file storage, and more. However, it has also been the source of much investor angst, evidenced by numerous media headlines replete with instances of fraud and catastrophic asset losses. In this paper, we examine whether the current incarnations of blockchain technologies provide a well-functioning market to its participants. We apply Roth’s market design framework to evaluate whether blockchain marketplaces provide safety, thickness, low congestion and low repugnance. We find that blockchain markets in their current state do not represent a well-functioning market. We conclude by suggesting additional avenues of research and explore whether even in their suboptimal market-state, they can still provide value to organizations

Introduction

The popularization of blockchain technology and their related applications, in particular cryptocurrencies and non-fungible tokens (NFTs), has generated increasing interest from technologists, investment brokers, hedge funds, individual investors, and managers who wish to explore their relevance to their organizations. Transaction volumes between buyers and sellers of cryptocurrencies such as Bitcoin and Ethereum, and NFTs such as the Bored Ape Yacht Club and Cryptopunks have been increasing at a rapid pace in the past several years. Blockchain enthusiasts have also asserted that the core technology can be applied to a multitude of other industries, including supply chain management, academic research, healthcare management and more, potentially upending the traditional operational flow of these sectors, and reconfiguring the dynamics of the key stakeholders that reside within them.

However, there currently exists a dichotomous phenomenon where within a single news cycle, blockchain enthusiasts laud high-profile transactions such as the sale of Beeple’s digital art NFT at Christie’s for $69 million USD (asserting that these high dollar value transactions that occur within premier auction houses are validation that blockchain has hit the mainstream) and blockchain critics excoriate such transactions as immoral, without functional value and are fed solely by investor greed, or even nefarious intent. Thus, it is unclear whether the current state of the blockchain market is structured in a way that will enable and facilitate the growth of cryptocurrencies, NFTs and other blockchain-backed financial assets, or if it is fundamentally flawed and its widespread adoption might face intractable headwinds in the future.

This paper applies the principles of a seminal paper by Novelist Alvin Roth (2008) titled, “What have we learned from market design?”. In this paper, Roth argued that a well-designed, efficient market must exhibit three key characteristics: *safety*, *thickness*, and *low congestion*. He also suggested that *repugnance* may play a role in constraining or preventing the development of good markets. To our knowledge, there has not been a research-based analysis of the emerging blockchain market using this economics-oriented approach. We apply Roth’s framework to determine whether cryptocurrency and NFTs markets in their current incarnation represent a well-functioning market. We find that because of blockchain technologies failing to meet the preconditions of an efficient market, they do not represent a well-functioning marketplace in their current form. We conclude by suggesting future avenues for research, to better predict the specific manifestations of future blockchain markets, given its increasing uptake by a wide spectrum of consumers, from casual hobbyists to luminary investment portfolio managers.

Roth’s Market Design Framework

In this section, we briefly review Roth’s framework for well-functioning markets and discuss how we use his methodology to evaluate the blockchain market. He argues that a good market needs to exhibit three key characteristics:

Thickness – there needs to exist an adequate number of market participants who can freely transact with each other. In other words, there must be a sufficient number of sellers for every buyer, and vice versa.
Safety – participants must be confident they are not being defrauded, and there must be low incentive for participants to engage in strategy behavior to game the market
Congestion – market participants must be reasonably assured that their transaction will be completed quickly, so that they can move onto the next transaction with confidence that the available set of products to buy or sell is not stuck in other transactions

Roth notes that a fourth factor, *repugnance*, can also constrain good market design, that is, if the nature of the product or service being sold is distasteful to potential market participants, or can be perceived as being objectionable to other market participants, it may hinder the development of an efficient market, even if the preceding three conditions are met.
Roth utilizes case studies, many of which were examples from his own consultations of municipalities and other public entities that wanted to improve dysfunctional local markets, to argue for the importance of this framework. For example, he notes that the kidney transplant ecosystem suffered from a lack of available donors due to the low likelihood that a volunteer donor’s kidney would be biologically compatible with the recipient. Thus, the system suffered from a lack of thickness. The solution was to develop a centralized kidney exchange, where donors could offer their healthy kidney, not to a specified individual, but to the exchange, and the exchange would make a determination on who the recipient would be. In most cases, the recipient and donor would not know each other, but the mechanism of this centralized exchange allowed for a rapid increase in market thickness.
Rather than using this inductive approach to develop a new model to evaluate the efficiency of the blockchain market, we apply Roth’s framework to notable developments in the cryptocurrency and NFT markets. Roth notes that each market has its own idiosyncrasies but that his framework was designed to be applied across sectors and is generalizable. Thus, in the following sections, we evaluate each of thickness, safety, congestion and repugnance in the context of blockchain markets to argue that in its current form, the blockchain ecosystem is *not* a well-functioning marketplace.

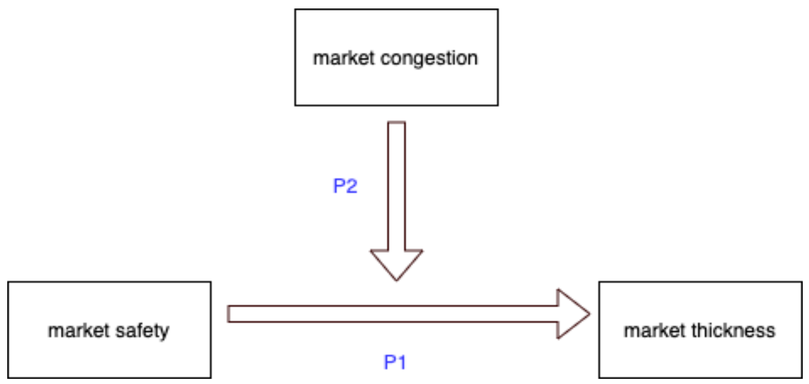

Figure 1. Figure 1. A conceptual model of the relationship between market safety on market thickness, adapted from Park et al. (2022)

The authors also explore the impact of congestion on this relationship (P2, Figure 1). Their data specification therefore becomes:
$ln(MT) = \beta_0 + \beta_1 * ln(MS) + \beta_2 * MC + \beta_3 * ln(MS) * MC$
Where:
MS = market safety (*ln* is natural log transformed)
MC = market congestion
MT = market thickness (*ln* is natural log transformed)

While we do not separately empirically test this moderating effect in this paper, we discuss market congestion in the design of efficient markets in the next section.

Discussion and Conclusion

Using evidence from the cryptocurrency and NFT markets, we argue that they fail to sufficiently provide market safety, thickness, and low congestion to existing and potential users. Thus, blockchain technologies currently fail to satisfy Roth’s requirements for a well - functioning marketplace. One interesting point to note that in Roth’s exploration of the conditions for an efficient market, he examined cases where an inefficient market was improved to become an efficient one, and in most cases, the solution was the establishment of a centralized intermediary that could act as a clearing house to better match buyers and sellers.
The problem was using such a strategy to solve issues related to safety, thickness and low congestion in blockchain markets is that it is fundamentally incompatible with the core philosophy of the blockchain – to remove the need for an intermediary or a third party to government the trust mechanisms between network participants. In other words, the configuration of the network itself, and the rational economic behavior of the participants should obviate the need for any centralization. Any attempt to incorporate a clearinghouse, or third party to which disgruntled participants can appeal transactions would disrupt the natural laws governing blockchain development.
Roth does use an example of how decentralization was preserved in a previously poorly functioning market, that eventually became well-functioning. In the case of new economists who were seeking professorships upon completing of their doctoral studies, there was a disconnect between applicants and hiring departments, where hiring departments would spend an extended period of time sourcing, interviewing and making offers to candidates, only to have their offers rejected. If the departments had prior knowledge of their chances of recruiting the candidate, they may prefer to give offers to their second choice candidates instead. From the perspective of the candidates, they suffered from extreme market congestion as they waited to hear about hiring decisions from departments that were going through their extended hiring process. The solution was to create a “scramble” web page where departments and candidates could be matched at the end of the initial hiring cycle. This matched unsuccessful candidates with unsuccessful departments, leading to an improved outcome for both.
This may represent an appropriate solution for blockchain markets as well. Ardent blockchain purists would argue that any type of intermediary such as a “scramble” web page would still sacrifice decentralization, as the governing body of that web page would still be prone to temptations and vagaries of the human condition. However, it is likely that some concessions with respect to decentralization must be made in order for the blockchain ecosystem to attract a sufficient number of users and create market thickness.
It may be that several versions of blockchain networks emerge, if current trends persist and blockchain applications fail to get meaningful, widespread adoption. The current, and original version of the blockchain, namely Bitcoin and similar early-version cryptocurrencies such as Ethereum, may maintain its niche status (we are fully cognizant of the fact that some investment portfolio managers may argue that it’s already evolved out of its niche status) which some asymptotic limit of the number of users. That is, while user adoption for Bitcoin may continue to increase, there will likely be some point at which diminishing returns are encountered.
In order to benefit from the advantages blockchain offers with respect to decentralization and immutability, some organizations may embrace the tradeoffs related (scalability, security and decentralization) and create a version of the blockchain that fits the operational needs of their firms. Several supply chain initiatives already exist that use permissioned blockchains to improve their operational workflows. In permissioned blockchain, nodes or maintainers are invited to participate, and these nodes are the stewards of the blockchain. Once they are invited, they wield significant power to mutate the previous chain of transactions. However, because there are few participants, the chain can easily scale, and congestion is a virtual non-issue.
We suggest that perhaps the goal of blockchain technologies isn’t to enable the proliferation of many different types of well-functioning marketplaces. While the creation of novel marketplaces is where the technology is headed today, as seen in the swath of cryptocurrency and NFT marketplaces such as Binance, KuCoin, OpenSea and more, it may be a more fruitful exercise for ecosystem participants to view blockchain technologies as a tool to enable current operational workflows than to become good markets in and of themselves.
Before any such determination can be made, it is likely that a rich suite of empirical research must be conducted to determine a) if the conclusions drawn from this paper remain consistent across a deep nomological net of independent and dependent variables representing market outcomes and the pre-conditions of safety, thickness, congestion and repugnance, b) if there are micro- and large-scale modifications that can be made to the core protocol itself that may lend decentralized ledger technologies to be more consistent with the development of good markets, and c) if the aspirations for a well-functioning market should be abandoned altogether and organizations that realize this and instead embrace the technology as a utility to improve its own productivity may be a better approach to evaluate the usefulness of the blockchain. What is clear to us today, is that we are in agreement with Roth’s remark that, “transactions and institutions matter at a level of detail that economists have not often had to deal with, and in this, respect, all markets are different. But there are also general lessons.” The general lessons suggest that blockchains in their current form do not represent well-functioning markets. Whether examining blockchain markets further, expanding the “level of detail” will force an adjustment to these conclusions, is yet to be seen

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