

Whom to regulate in Decentralized Finance?

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Introduction

Decentralized Finance (DeFi) is a general term for financial services resting on a blockchain, including lending, trading, and asset management. DeFi disrupts the way agents interact in financial markets, media citations are through the roof and the business is booming: As of October 2021, crypto worth more than USD \$105 billion has been put up for collateral on DeFi applications.¹ DeFi allows peers to interact directly and removes the need for a middleman to act as a central clearing house. As such, the major promise of DeFi is to offer greater efficiencies and opportunities for inclusion.

However, DeFi also raises substantial considerations related to consumer protection, loss of funds, governance complexities and systemic risks (see, e.g., Harvey et al., 2021). Significant incidents involving technical failures and attacks on DeFi applications have already occurred. The chairman of the U.S. Securities and Exchange Commission (SEC) expressed these growing concerns in August 2021 by a call for active regulation of DeFi users and developers.² But doing so is not straightforward: The building block of DeFi comprises innovations based on blockchain technology, digital assets and smart contracts. The major challenge for regulating DeFi is that no particular user can be associated with the execution of a smart contract. Regulators will thus need to assess: “what identifiable institution is responsible”? This study provides clear implications: Instead of asking *whom* to regulate in an established DeFi application, the focus should rather be on *how* to design optimal consensus protocols in the first place.

Regulatory efforts so far have concentrated directly on developers and users of various DeFi applications (see, e.g., World Economic Forum, 2021). Instead, this study sheds light on *validators*, a core group of agents for any blockchain application. Validators are responsible for the verification and processing of any single transaction, and thus serve as gatekeepers in the DeFi universe. Regulation of validators implies a direct focus on the economic mechanism behind the consensus protocol architecture. While often determined by security or anonymity, the early-stage development process of the consensus protocol instead should incorporate regulatory concerns. Therefore, in this study, I ask:

How can we improve upon *validator* incentives to ensure that DeFi adoption is compatible with market efficiency?

¹Data from crypto analyst DeFi Pulse, see <https://defipulse.com/>.

²“At this time, it [DeFi] is more like the Wild West”, Garry Gensler’s remarks before the Aspen Security Forum, August 2021.

Consensus protocols specify how validators reach agreement and how validators are incentivized to collaborate. The design of consensus protocols serves as the regulatory framework and can take different forms to ensure a reliable record of transaction histories (see, e.g., Biais et al., 2019). I show theoretically and empirically that current consensus protocols incentivize validators to extract monopoly rents from major market participants. As a result, severe market inefficiencies occur, which today are of worrisome magnitudes: Daian et al. (2019) argue that validators have been able to extract more than USD \$700 million in excess fees since January 2021 by actively exploiting the trading mechanisms of DeFi. I derive the link from the incentive structure for validators to market efficiency. My aim is then to derive policy recommendations for the design of consensus protocols that enforce compliance of all transactions that are processed by DeFi applications and, as a result, improve market efficiency.

Policy relevance

The noncustodial nature of decentralized exchanges presents a legal gray area and may require fundamental rethinking of regulatory approaches, but little doubt exists that regulation will arrive once the market expands further (Harvey et al., 2021).

The problems associated with unintended consequences for market efficiency due to ill-constructed incentive schemes for validators are especially relevant given that central banks, marketplaces, and corporations actively explore innovative applications for transaction settlement (e.g., NASDAQ (2017)) and government backed digital currencies (e.g., BoC (2020), ECB (2020) and Riksbank (2021)). To provide relevant policy recommendations, I show how regulators can interfere directly with the consensus protocol or, alternatively, directly participate as validators themselves to enforce compliance of all transactions that are processed by DeFi applications. The result of the study is a framework that allows to analyze optimal validator behavior and subsequently to identify the efficiency-maximizing incentive structure.

The study

This study focuses on decentralized exchanges, the cornerstone application of DeFi. Decentralized exchanges enable matching of buy and sell-side orders without taking custody of user funds. My arguments that the incentive structure for validators determines market efficiency of assets traded on decentralized exchanges unfolds in three steps:

1. Theoretical Framework. To map the risks and benefits associated with DeFi applications, I propose a theoretical microstructure framework, which represents an extension of the work on decentralized exchanges by Capponi and Jia (2021). The agents in the baseline model are competitive liquidity providers, arbitrageurs, investors or validators. Two identifying features of blockchain technologies determine the main friction of the model: DeFi implies pre-trade transparency, in the sense that

transactions waiting for verification are observable by all market participants. Also, verification capacities by validators are scarce, which requires incentivizing fees that determine the order of the verified transactions. Taken together, the result can be devastating for market efficiency: Upon observing transactions waiting for verification, validators can infer and extract the associated rents associated with each transaction in their entirety. As a result, for instance, arbitrage transactions are not going to be validated unless the arbitrageur is willing to give up all associated profits. Similarly, their unique role allows validators to actively conduct front-running or quote snooping. Thus, non-regulated consensus protocols result in excessive costs for market participants. It becomes costlier to participate and less attractive to provide liquidity or to act as arbitrageur. Ultimately, the market can break down in spirit of Milgrom and Stokey (1982).

2. Empirical Analysis. These theoretical predictions may sound overly pessimistic. However, each of the features described above can be observed from actual data. I plan to exploit unique transaction-level data from the leading decentralized exchange Uniswap together with data from the publicly available Ethereum blockchain to provide evidence for and quantify the extent of active front-running and rent extraction by validators. I use the data to test the main prediction of the theoretical model: excessive rent extraction by validators implies excessive costs for market participants and harms market efficiency.

3. Optimal Mechanism Design. The final step of the study is to interfere with the consensus protocol. The aim is to create an optimal mechanism design that ensures incentive-compatibility of all market participants but results in large-scale adoption at lowest possible costs (in terms of liquidity or informational efficiency). Such an intervention represents an effective way of regulating validator choices and emphasizes the relevance of regulatory input at the early stage of designing consensus protocols. To cast market efficiency in a framework of mechanism design, I closely follow Bergemann and Morris (2019). I first define the design problem (the consensus protocol) and relevant participation constraints for potential mechanisms, and then characterize the profit-maximizing behavior of the model agents. The study thus sheds new light on the actual target of regulation: restricting the monetary benefit from processing non-compliant transactions or methods such as front-running, which harm market efficiency.

Theoretical background

While the study naturally relates to the rapid growth of the unregulated market for cryptocurrencies which creates challenges with respect to money laundering (e.g., Foley et al. (2019)), I focus on the more general backbone of any form of digital asset: blockchain-technology and the incentive structure for validators.

My work rests on the theoretical framework of Capponi and Jia (2021) who show that liquidity providers on decentralized exchanges suffer from excess fees as a result of competitive demand for validator services. Their model, however, does not contain a validator itself such that they do not discuss potential regulatory implications. Lehar and Parlour (2021) investigate the circumstances under which decentralized exchanges dominate markets which rely on trusted middlemen, but they take the underlying consensus protocol as given. Another important strand of related literature identifies the optimal behavior of validators: Cong et al. (2021) find that common consensus protocols foster bundling of validation resources(so-called mining pools). Such strategic behavior intensifies the problem of excessive rent extraction by validators even further.

Expected output and publication potential

The project aims to generate 1-2 academic papers, targeting top field journals in financial economics. The few relevant existing papers on issues of related blockchain matters have been published in similar best field journals. I plan to present my work at international conferences and invited talks to increase the visibility. It would be an honor to present the work at the EPRN Conference 2022 in order to foster the exchange of knowledge with the Economic Policy Research Network. As common for my research projects, I ensure that a broader audience gets informed about my results by my LinkedIn and Twitter activity and by reaching out to journalists. I plan to have first results ready during early 2022, and at least one paper ready for journal submission at the end of 2022.

Budget

The proposed budget contains the following elements for the complete project duration (18 months until June 2023): 4 months of my research time fully dedicated to the project. In the process, I plan to dedicate January 2022 entirely to pushing the project during a research stay with Albert J. Menkveld, a leading researcher in the field of market microstructure and blockchain economics. Albert, currently Associate Editor at the Journal of Financial Economics, invited me to visit VU Amsterdam to exchange knowledge on the concepts underlying this project description.

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