SoK: Blockchain Decentralization

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Blockchain empowers a decentralized economy by enabling distributed trust in a peer-to-peer network. However, surprisingly, a widely accepted definition or measurement of decentralization is still lacking. We explore a systematization of knowledge (SoK) on blockchain decentralization by comprehensively analyzing existing studies in various aspects. First, we establish a taxonomy for analyzing blockchain decentralization in the five facets of consensus, network, governance, wealth, and transaction. We find a lack of research on the transaction aspects that closely characterize user behavior. Second, we apply Shannon entropy in information theory to propose a decentralization index for blockchain transactions. We show that our index intuitively measures levels of decentralization in peer-to-peer transactions by simulating blockchain token transfers. Third, we apply our index to empirically analyze the dynamics of DeFi token transfers by three methods of description, prediction, and causal inference. In the descriptive analysis, we observe that levels of decentralization converge inter-temporally, regardless of the initial levels. A comparative study across DeFi applications shows that exchange and lending are more decentralized than payment and derivatives across DeFi applications. Second, in the predictive analysis, we also discover that a greater return of Ether, the native coin of the Ethereum blockchain, predicts a greater transaction decentralization in stablecoin that include Ether as collateral. Third, in an event study of causal inference, we find the change of Ethereum Transaction Fee Mechanism to EIP-1559 significantly changes the decentralization level of DeFi transactions. Finally, we identify future research directions: 1) to explore the interactions between different facets of blockchain decentralization, 2) to design blockchain mechanisms that achieve sustainable decentralization, and 3) to study the interplay of decentralization levels and economic factors. We also raise challenges in addressing the controversies in blockchain decentralization.

Biography

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