

From Mining to Markets: The Evolution of
Bitcoin Transaction Fees
Forthcoming, *Journal of Financial
Economics*

David Easley* Maureen O'Hara[†] Soumya Basu[‡]

Abstract

We investigate the role that transaction fees play in the bitcoin blockchains evolution from a mining-based structure to a market-based ecology. We develop a game-theoretic model to explain the factors leading to the emergence of transactions fees, as well as to explain the strategic behavior of miners and users. Our model highlights the role played by mining rewards, transaction fees, price, and waiting time, discusses welfare issues, and examines how microstructure features such as exogenous structural constraints influence the dynamics of user participation on the blockchain. We provide empirical evidence on the models predictions and discuss implications for bitcoins evolution.

*Departments of Information Science and Economics, Cornell University

[†]Johnson College of Business, Cornell University

[‡]Department of Computer Science, Cornell University

Main Points

- The transaction fees that Bitcoin miners earn are voluntarily appended to bitcoin transactions by buyers and sellers wanting to ensure that their transactions are included in the block of transactions the miner attaches to the blockchain. These fees do not affect the equilibrium profitability of miners and they do not affect the overall rate at which transactions are written to the blockchain. What they do is to affect the order in which transactions are written to the blockchain.
- We show that, even with transaction fees, there are limits on the size of the blockchain imposed by waiting times confronting users. We show how these waiting times arise in equilibrium, and how they are influenced both by endogenous transactions fees and by exogenous dynamic constraints imposed by the bitcoin protocol. More intriguing, we show that waiting times (or for that matter, transaction fees) are not influenced by the block reward, provided mining is viable.
- We show that higher transactions fees are being driven by queuing problems facing users, rather than by reductions in bitcoin-denominated block rewards. As predicted, in at least most empirical specifications, we find no statistically significant effects for the block reward level. As users battle to get transactions posted on the blockchain, transaction fees rise to levels that discourage bitcoin usage, highlighting an important structural issue confronting the blockchain. While bitcoin may continue to develop as a financial asset, longer waiting times and higher transactions fees may impede its development as a transactional medium.