

Blockchain-Based Trading and Settlement

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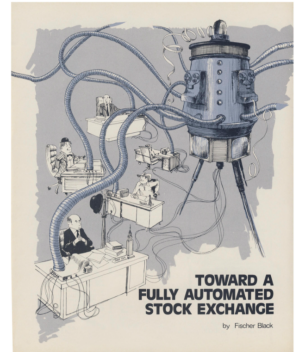
International Blockchain School 2022

Blockchain-based trading is fascinating (not just crypto)!

- My research: HF, Big data, DeFi
- Get in touch! stefan.voigt@econ.ku.dk or voigtstefan.me

Why do I care? What do I care about?

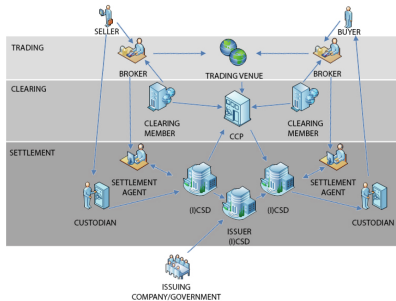
- Trading rules affect transaction costs, price informativeness, volatility
- Consensus protocol is the implicit rulebook (Scale, Speed, Costs, Competition, ...)



Source: Black (1971)

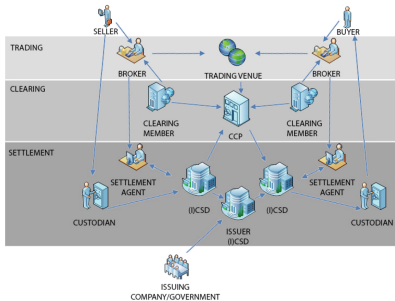
Blockchains as alternatives to “traditional” markets?

“Traditional” market

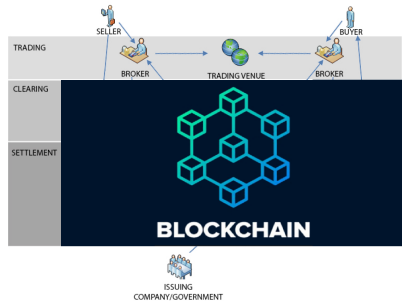


Blockchains as alternatives to “traditional” markets?

“Traditional” market



Blockchain-based market



Source: Pinna (2016)

1. The Finance legacy system and DeFi
2. Where are we today? CEX
3. Where are we headed to? DEX
4. What should be done? And how?

The big picture: The rulebook of the trading game

- Tampering with trading rules can have unintended consequences
- As a blockchain architect: Focus on the equilibrium outcomes!

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Example 1: Speed



- Old-school trading: HFT market-making reduces transaction cost *but* HFT preying on large orders increases transaction cost (Menkveld, 2016)
- How fast can we process transactions? How fast *do we want to* process transactions? (Hinzen et al., 2019)

The big picture: The rulebook of the trading game

- Tampering with trading rules can have unintended consequences
- As a blockchain architect: Focus on the equilibrium outcomes!

Example 2: Transparency

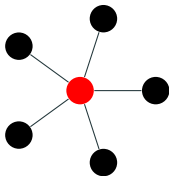


- Settlement on a public ledger is equivalent to post-trade revelation
- Even more: Trading on a public ledger reveals transactions *ex-ante*
- More information can be good - but for whom (Glosten and Milgrom, 1985)?

(Still) the standard crypto trading
venue: CEX

The standard crypto trading protocol as of today: CEX

- CEX function as *trusted intermediaries* and often act as *custodians* by storing funds
- Dec. '21: 89% of digital asset trades are executed through CEX (\approx \$1.04 trillion USD a month) (Source: cryptocompare)



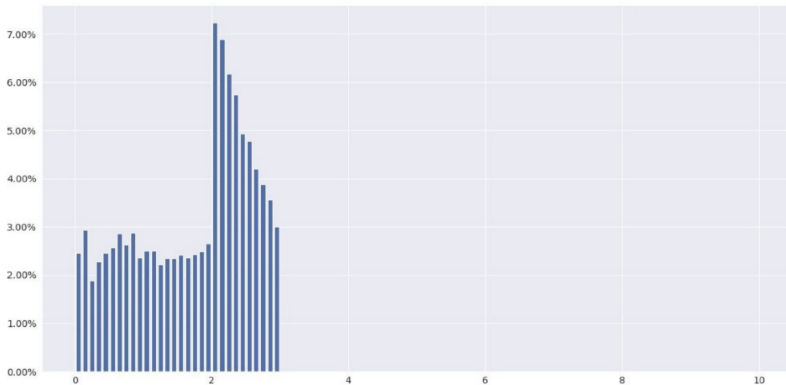
Very valid question: Why do we need intermediaries?



- CEX settle off-chain: CEX is in charge of private keys and transactions do not show up in the public ledger
- Simple answer: *It is cheaper and simpler*
- Example: In 2017, Lykke switched to off-chain settlement ("*we've seen Bitcoin transaction fees increase by more than 24,000%*")

What can go wrong?

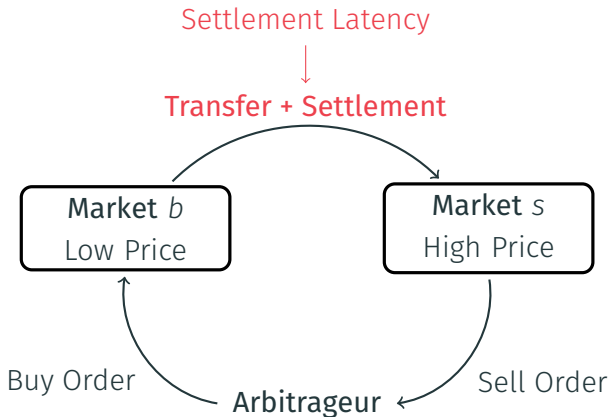
- Settlement is cheap and fast, liquidity + trading volumes are big, but ...



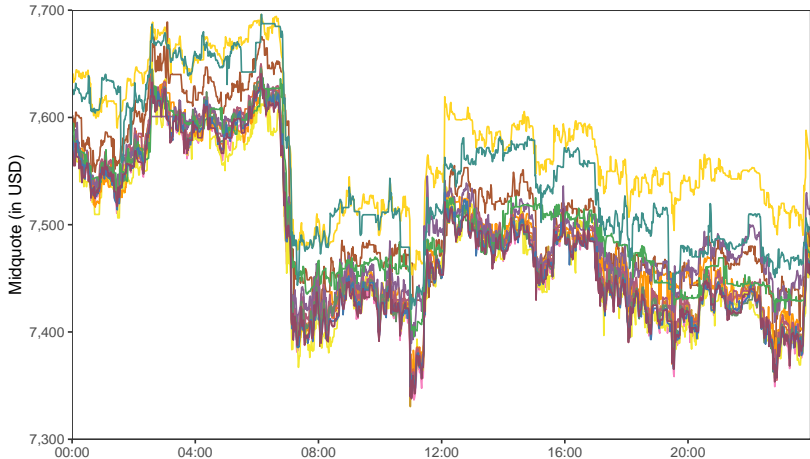
Source: Bitwise, 2018

- Hacks (Biais et al., 2019), Wash Trading Cong et al. (2021), Regulation

The CEX Dilema (Hautsch et al., 2018)



Arbitrage opportunities in Bitcoin vs. Dollar trading?



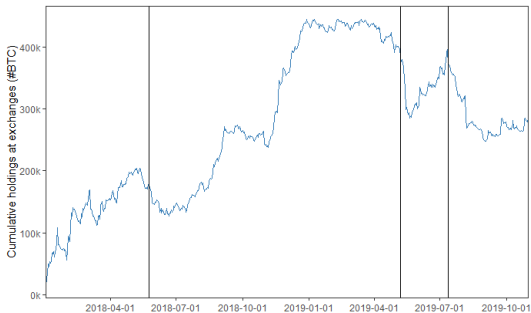
- Capital regulation? (Makarov and Schoar, 2020; Choi et al, 2018)
- Settlement latency?

Settlement latency increases price differences

<i>Dependent Variable:</i>				
	(2)	(3)	(4)	(5)
Arbitrage Bound (in %)		0.440*** (18.62)	0.442*** (12.84)	0.333*** (17.61)
Spot Volatility (in %)	5.416*** (16.99)			
Latency Median (in Min)	0.003*** (3.92)			
Latency Variance	0.078*** (3.53)			
Spread (in %)	0.075* (1.95)	0.093** (2.42)	0.101*** (2.65)	0.099*** (2.59)
Arbitrage Bound × Margin		-0.258*** (-7.07)		
Arbitrage Bound × Business			-0.220*** (-5.38)	
Inventory				-1.349*** (-60.42)
Exchange Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R ²	0.163	0.162	0.162	0.212
Exchange-Hour Observations	213,984	213,984	213,984	213,622

Building trust takes time

- "[...]centralized exchanges essentially live or die based on their ability to “create trust” among their users.” (*C Zhao, Binance CEO*)
- Substantial increase of funds under exchange custody (12.4 Billion USD as of October 2019)

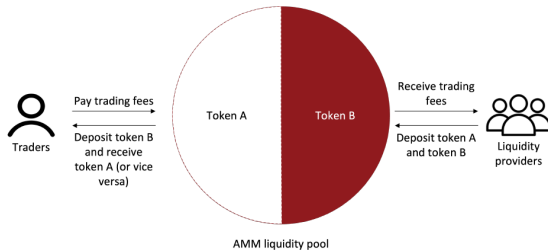


- *How?* Regulation compliance (BitLicense), transparency on funds under custody, insurance schemes

Up and coming: DEX

Up and coming: DEX

- matching of buy and sell-side orders *without* taking custody of user fund
- System of *smart contracts* which deterministically make the market according to an algorithm rather than relying on a traditional order book (Lehar and Parlour, 2021; Capponi and Jia, 2021)










Source: Münster et al, 2022

Do DEXes solve the problem?

- No! On-chain is a blessing but also the central friction
- What matters for the execution priority is the gas fee
- *"Like high-frequency traders on Wall Street, bots exploit inefficiencies in DEXes, paying high transaction fees"* (Daian et al., 2019)
- Even worse: Arbitrage capital is not limited (flash swaps allow instantenous, risk-less borrowing without collateral)

Transaction Action:

- ▶ Swap 16.290806524344807055 Ether For 19,106.558477  USDC On  Balancer
- ▶ Swap 19,106.558477  USDC For 6,178.07283593  sil On  Sushiswap
- ▶ Swap 6,165.71669026  sil For 32.98093614065103254 Ether On  Sushiswap

Value:

0 Ether (\$0.00)

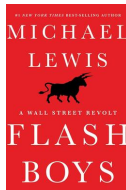
Transaction Fee:

12.006066915817169675 Ether  (\$38,161.04)

What can (or should) be done?

What should be done?

- Good news is: *"traditional finance"* has seen a lot of these issues in the past
- Parts of the DeFi world restore *"traditional intermediation"* (CEX, private side-chains, regulation)



Source: Lewis (2014)

- Search for the equilibrium: Nobody should be worse off
- *The challenge is: keep everybody on board*
- Liquidity providers on CEX benefit from "speed bump"
- Liquidity providers on DEX benefit from sandwich attacks (HF-trader equivalent)

What should be done?

- Open question: Finance has a lot of answers but often these rely on some contractual basis: Regulation, liability

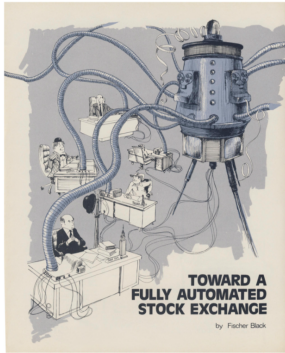
Whom to regulate in DeFi?

1. Relatively easy for CEXes
2. What about DEXes?

What can be done?

- Everything relies on financial incentives which come from the microstructure
- Potential ideas: Random execution order (IEX), Batch Auctions (Budish et al, 2015), Price feed from Oracles, Order Slippage

Wrap-up: Blockchains as alternatives to “traditional” markets?



Source: Black (1971)

- DeFi is growing extremely fast
 - Decentralization is partly an illusion
 - DEX adoption limited by consensus protocol structure
- ⇒ Open up the consensus protocol rulebook!

References i

- Biais, B., C. Bisiere, M. Bouvard, C. Casamatta, and A. J. Menkveld (2019). Equilibrium Bitcoin Pricing. Working paper, University of Toulouse.
- Black, F. (1971). Toward a fully automated stock exchange, part ii. *Financial Analysts Journal* 27(6), 24–28.
- Capponi, A. and R. Jia (2021). The adoption of blockchain-based decentralized exchanges. *arXiv preprint arXiv:2103.08842*.
- Cong, L. W., X. Li, K. Tang, and Y. Yang (2021). Crypto wash trading. *arXiv preprint arXiv:2108.10984*.
- Daian, P., S. Goldfeder, T. Kell, Y. Li, X. Zhao, I. Bentov, L. Breidenbach, and A. Juels (2019). Flash boys 2.0: Frontrunning, transaction reordering, and consensus instability in decentralized exchanges. *arXiv preprint arXiv:1904.05234*.
- Glosten, L. R. and P. R. Milgrom (1985). Bid, Ask and Transaction Prices in a Specialist Market with Heterogeneously Informed Traders. *Journal of Financial Economics* 14(1), 71 – 100.
- Hautsch, N., C. Scheuch, and S. Voigt (2018). Limits to arbitrage in markets with stochastic settlement latency. Technical report, CFS Working Paper Series.

References ii

- Hinzen, F. J., K. John, and F. Saleh (2019). Bitcoin's Fatal Flaw: The Limited Adoption Problem. Working Paper, NYU Stern School of Business.
- Lehar, A. and C. A. Parlour (2021). Decentralized exchanges. Technical report, working paper, University of Calgary and University of California, Berkeley.
- Lewis, M. (2014). *Flash boys: a Wall Street revolt*. WW Norton & Company.
- Menkveld, A. J. (2016). The economics of high-frequency trading: Taking stock. *Annual Review of Financial Economics* 8, 1–24.