

An Anatomy of (On-Chain) Crypto Trading

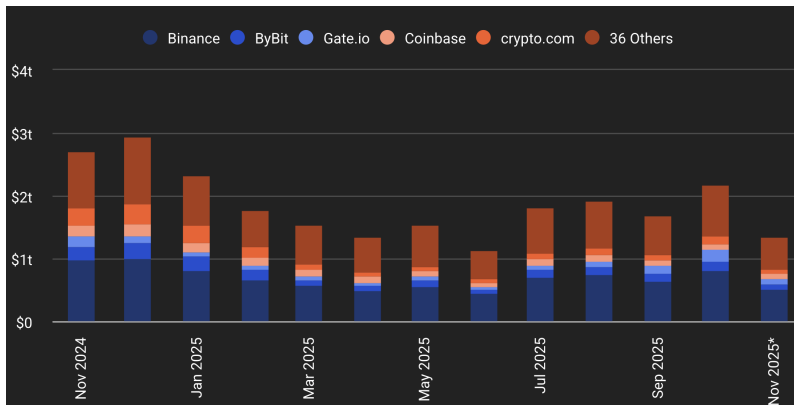
Shihao Yu¹

¹Singapore Management University, Lee Kong Chain School of Business

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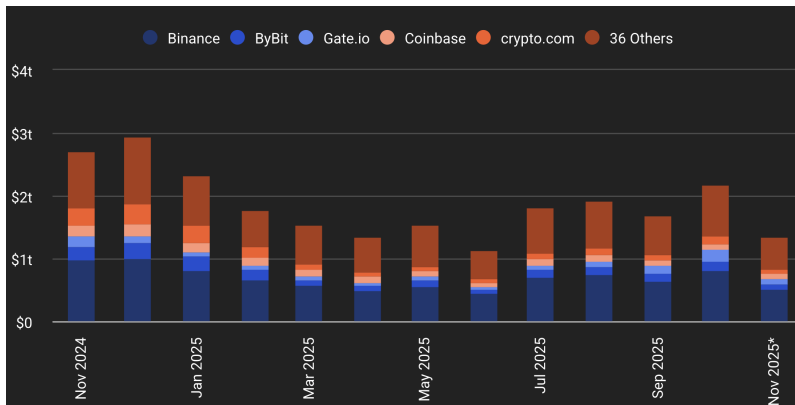
Crypto trading is no longer a niche activity

- ▶ In 2025, crypto spot trading $\approx$ 80 billion USD per day
- ▶ In comparison, US equities spot trading $\approx$ 800 billion USD per day
- ▶ **Crypto $\approx$ 10% of US equities**
- ▶ Increasing institutional participation: crypto ETFs, stablecoins, and more



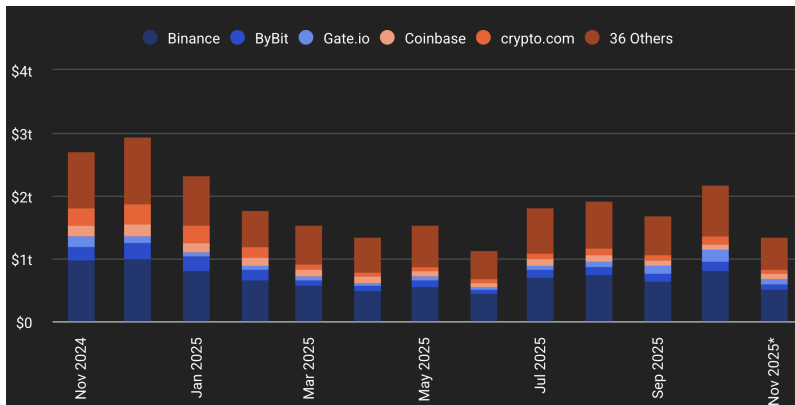
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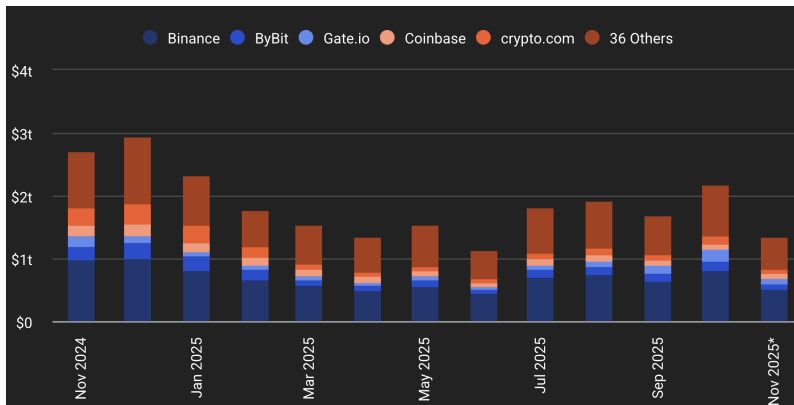
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Two types of exchanges

Centralized exchanges (CEXs)

- Examples: Binance, Coinbase, Crypto.com



Decentralized exchanges (DEXs)

- Examples: Uniswap, PancakeSwap, and many others



Centralized vs. decentralized exchanges

	CEX	DEX
Operator	Centralized entity	Smart contracts
Access	Regulated; KYC/AML	Permissionless
Execution Venue	Off-chain internal ledger	On-chain settlement
Custody	Custodial (exchange holds assets)	Non-custodial (user holds assets)
Trading Model	Continuous & CLOB	Batched & AMM

Trading on CEXs

- ▶ Like equities exchanges in TradFi, trading on CEXs uses a **continuous limit order book (LOB)**
- ▶ Orders are sequenced at a **first-come-first-serve (FCFS)** basis
- ▶ **Speed** is crucial, leading to an arms race between high-frequency traders (HFTs):

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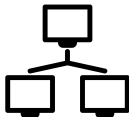
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(a) Low-latency market data



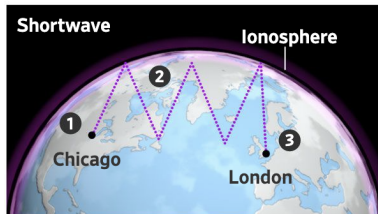
(b) Colocation



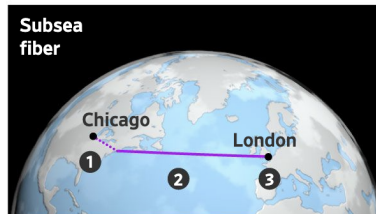
(c) High-speed transmission

Fibers and microwaves are in the past...

Current technology



1. Data is encoded, which can take several milliseconds, and transmitted by shortwave radio from Chicago.
2. The data signal bounces off the ionosphere, an upper layer of the atmosphere.
3. The signal is received in London. The speed of the process varies depending on the setup, but one provider says it delivers the data in 29.6 milliseconds.



1. Microwave antennas send data from Chicago to New York.
2. The data travels under the Atlantic by fiber-optic cable. Fiber transmits data at about two-thirds the speed of light, slower than lasers or radio waves moving through air or space.
3. The data is received in London after 33.5 milliseconds.

Now satellite

Masters of the Universe

Satellite networks could speed up data transmission for high-frequency trading firms.

Potential technology



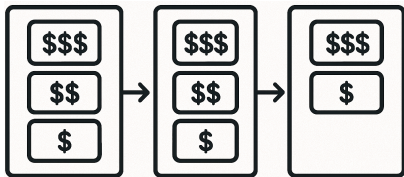
1. A radio antenna in Chicago sends data up to a satellite.

2. The satellite receives the data and relays it via laser to another satellite, which then transmits it towards London.

3. The data arrives in London. It is not yet known how long this will take, but one satellite operator has touted speeds of less than 29 milliseconds.

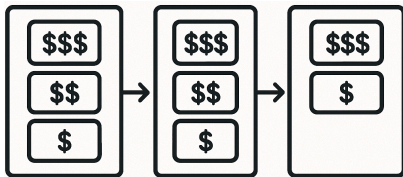
Trading on DEXs

- ▶ Operating on blockchains, DEXs inherit the infrastructure of the underlying blockchain
- ▶ On Ethereum, transactions are executed **in blocks every 12 seconds**
- ▶ Within a block, execution priority is based on the **gas fees traders bid**
- ▶ **Traders no longer compete on speed, but on fees**



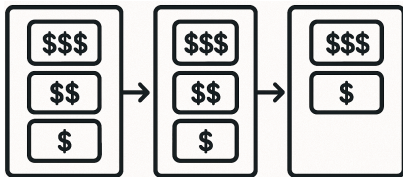
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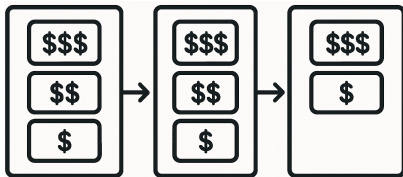
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Research paper #1: Price discovery on DEXs

- ▶ In Capponi, Jia, and Yu (2025, forthcoming in RFS), we study the impact of the **fee bidding mechanism** on the **price discovery process** on DEXs
- ▶ The fee bidding mechanism allows us to quantify the **willingness to pay** for their information order by order
- ▶ We **identify informed traders** based on their past price impacts...
- ▶ ...and then analyze their bidding behavior out of sample
- ▶ We focus on Uniswap v2 on Ethereum. Sample between Nov 2020 and Aug 2021 for ETH-USDT, WBTC-ETH, and a few others

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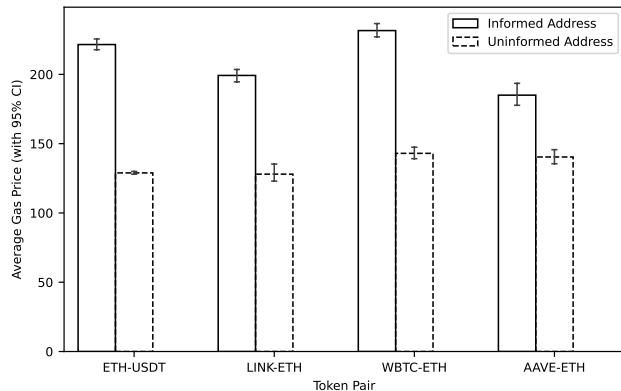
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Research paper #1: Price discovery on DEXs (continued)

- **Key takeaway:** informed traders on DEXs bid higher fees using a jump bidding strategy, revealing their private information, and contributing to price discovery.



Beyond Ethereum

- ▶ DEXs are not only on Ethereum. They are deployed on a wide spectrum of blockchains, including layer-1 (L1) blockchains, layer-2 (L2) blockchains, and side chains.
- ▶ On L2s, DEXs employ a diverse set of order sequencing rules and block speeds:

Chain	Rule	Block time
Arbitrum	FCFS + Timeboost	250ms
Base	Fee bidding	2s → 200ms
Optimism	Fee bidding	2s → 100ms

- ▶ As block speed increases, fee bidding converges to FCFS

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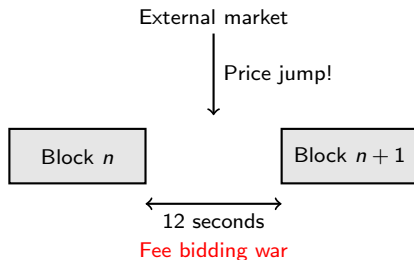
- ▶ In a new paper with Jia (2025), we analyze the impact of block speed on DEX trading
- ▶ On Ethereum or slow blockchains:



- ▶ What if blocks are faster?
 - ▶ Can liquidity providers (LPs) withdraw their liquidity quicker?
 - ▶ How about arbitrageurs?
 - ▶ Overall market liquidity?

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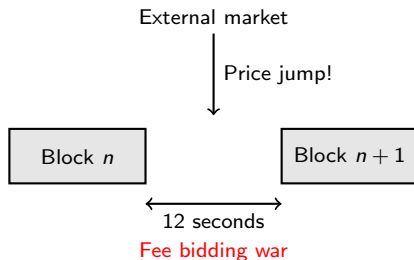
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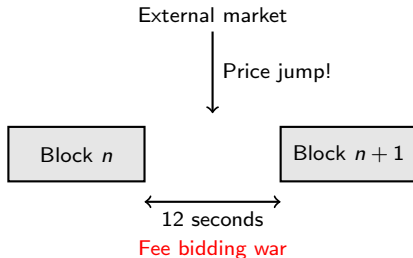
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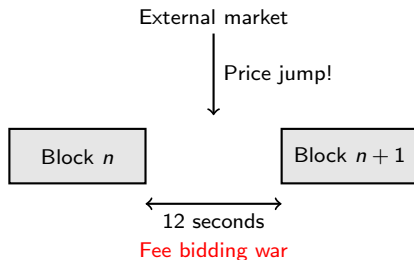
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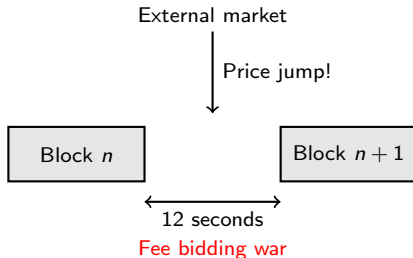
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- ▶ We derived **closed-form solutions** for the following
 - ▶ Arbitrageur fee bidding
 - ▶ LP withdrawal threshold
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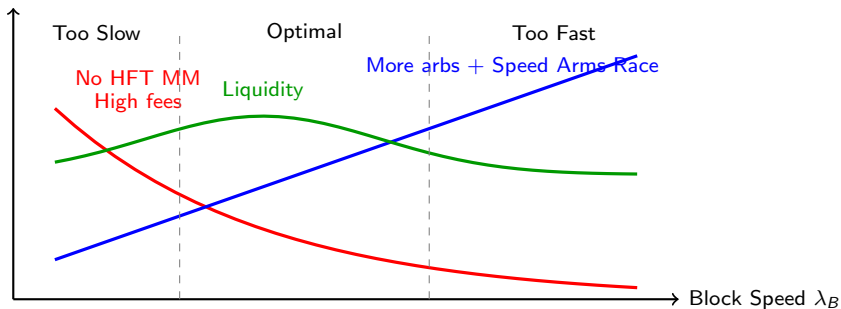
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The block speed trade-off

- **Takeaway: Optimal block speed may exist in between!**



Conclusion

- ▶ Crypto trading is becoming more mainstream with more institutional participation
- ▶ DEXs are an important part of the crypto trading ecosystem
- ▶ DEXs are unique in their market designs
- ▶ It provides a **great laboratory** to study **the optimal design of trading mechanisms**
- ▶ The implications can go beyond DeFi
- ▶ More research is needed!

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