Information and Market Power in DeFi Intermediation

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Introduction

- Intermediation is prevalent in financial markets
  - Monitoring, market making, risk sharing, ...
- However, we don't understand much about intermediated markets:
  - Are they efficient?
  - Is there market power?
  - What drives innovation?
- Data is opaque and incomplete

This Paper: DeFi Intermediation

- This paper addresses these challenges by focusing on DeFi Intermediation
- Novel feature: truly riskless arbitrage
- New limit to arbitrage: tension between public blockchain and arbitrageur privacy
- Ethereum ETFs may transform traditional financial institutions into key DeFi intermediaries

This Paper: Three Contributions

- We introduce the DeFi intermediation chain and study the origins of market power
- We causally identify the impact of private information on market power in DeFi.
- We develop a bargaining that illustrates how information asymmetry affects profit sharing between intermediaries.

The Ethereum Blockchain

- Ethereum is the largest blockchain that allows for DeFi protocols
- Two main types of transactions: simple token transfers, and smart contract interactions.
- Smart contracts are blockchain-stored programs which execute pre-defined functions when tokens are sent to them
  - Swapping tokens, Providing Liquidity, Depositing Collateral, Lending Tokens, etc...

Risk-Free Arbitrage

- The large number of competing DeFi protocols creates violations of the law of one price
  - e.g. different prices across exchanges, or fire sales from collateral liquidation
- Ethereum allows for atomic transaction bundles: either all transactions in a bundle execute or none do
- Atomic transaction bundles guarantee risk-free arbitrages

New Limit to Arbitrage: The Need for Privacy

- Even when an arbitrageur identifies a discrepancy, they need to have their transaction executed
- If the arbitrageur does not act quickly, the opportunity will disappear
- However, the arbitrageur cannot broadcast their transaction to the network, or it will be stolen
- Reputable DeFi intermediaries arise due to this need for privacy

Emergence of the DeFi Intermediation Chain

- **Arbitrageurs** find profitable trades
- **Block Builders** aggregate transactions into blocks and bid for a slot on the chain
- **Block Proposers** choose one of the proposed builder blocks and appends it to the blockchain
- **ETH Holders** delegate their ETH stake to proposers

Market Concentration Across the Chain

- **Arbitrageurs** Crypto Hedge Funds such as Wintermute and SCP
- **Block Builders** 3 builders create more than 50% of the blocks
- **Block Proposers** 5 Proposers have over 50% of the stake (Coinbase, Binance, Kraken, Lido, Stakefish)
- **ETH Holders** contribute to concentration by pooling their shares

The DeFi Intermediation Chain

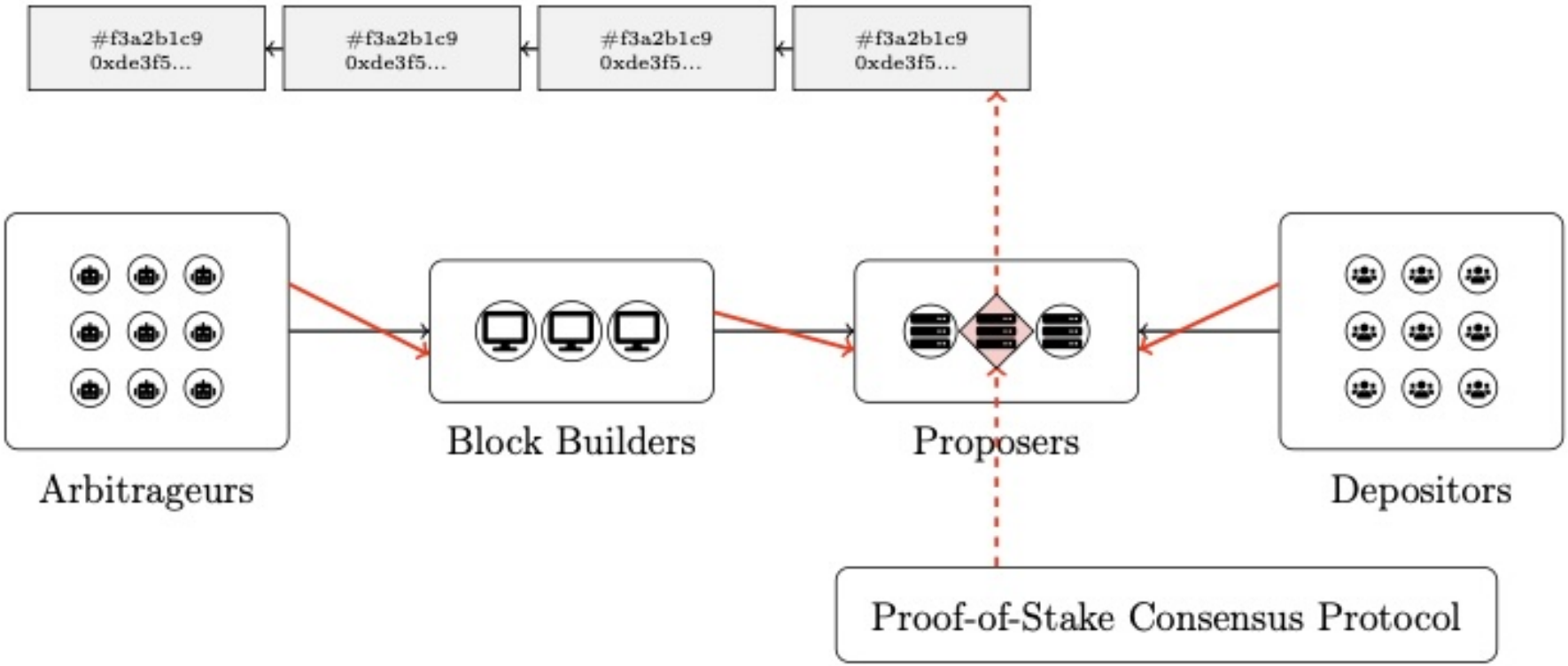


Figure 2: Market structure of the DeFi intermediation chain, Ethereum blockchain's production network.

Data

- September 15, 2022 (switch to proof-of-stake) - January 31, 2024
- MEV blocks in Ethereum: 2,723,653 blocks (75.9%) ▸ MEV
  - Builder different from proposer and use MEV-boost
- Dune Analytics
  - Block-level data
  - Identity of the builder and proposer
  - Total revenue and split between the builder and the proposer
- **Mempool** Guru project (Secure Decentralized Systems Lab)
  - Keep track of whether transactions were broadcast or not to the network before being appended to the blockchain

  $\Rightarrow$ *Public vs private transaction* ▸ Alternative

Variables

- B_t: block appended to blockchain at time t

Rev_t	Total revenue of block builder and proposer from block t
$\Pi_{B,t}$	Revenue of block builder
$\Pi_{P,t}$	Revenue of block proposer
$\theta_{B,t}$	$\frac{\Pi_{B,t}}{Rev_t}$, Revenue share of block builder
$\theta_{P,t}$	$\frac{\Pi_{P,t}}{Rev_t}$, Revenue share of proposer
$\log Private_t$	Total value of private transactions in block t

Block-Level Summary Statistics

	Mean	Std. Dev.	Min	5th	Median	95th	Max	Skewness	Kurtosis
Rev_t	0.14	1.52	0.00	0.02	0.06	0.37	691.96	225.07	76506.49
$\Pi_{B,t}$	0.01	0.40	-0.30	-0.00	0.00	0.02	386.27	474.65	366718.03
$\Pi_{P,t}$	0.14	1.39	0.00	0.02	0.05	0.35	691.96	254.00	95968.37
$\theta_{B,t}$	0.03	0.08	-0.10	-0.02	0.01	0.16	1.00	4.66	32.36
$\theta_{P,t}$	0.97	0.08	0.00	0.84	0.99	1.02	1.10	-4.66	32.36
log $Private_t$	0.07	0.17	0.00	0.00	0.03	0.27	6.54	8.44	119.52
log $Public_t$	0.03	0.05	0.00	0.01	0.02	0.07	5.20	24.48	1115.99
Hack Dummy	0.07	0.26	0.00	0.00	0.00	1.00	1.00	3.23	11.46
Crisis Dummy	0.02	0.14	0.00	0.00	0.00	0.00	1.00	6.95	49.32
Observations	2627618								

- Total revenue, profits, and profit shares very skewed
- Builder profit and profit share even more skewed

Information-Driven Market Power

- **Do builders with superior information compared to other builders get a higher share of profit from the proposers?**
- Plain-vanilla reduced-form evidence

$$\theta_{B,t} = \alpha + \beta \log \mathit{Private}_t + \epsilon_t$$

Potential Endogeneity Concerns

1. **Omitted variable bias:**
   1. Relationships between builders and proposers may lead builders to treat some proposers more or less favorably:

      Include fixed effects
   2. other block characteristics can affect $\theta_{B,t}$:

      Include revenue Rev_t

$$\theta_{B,t} = \beta \log Private_t + \gamma \log Rev_t + \psi_{i(t)} + \eta_{j(t)} + \phi_{i(t),j(t)} + \epsilon_t$$

2. **Simultaneity:**
   - Builders simultaneously decide the transactions that they want to insert into the block and the payment to the proposer ($\Rightarrow \theta_{B,t}$)

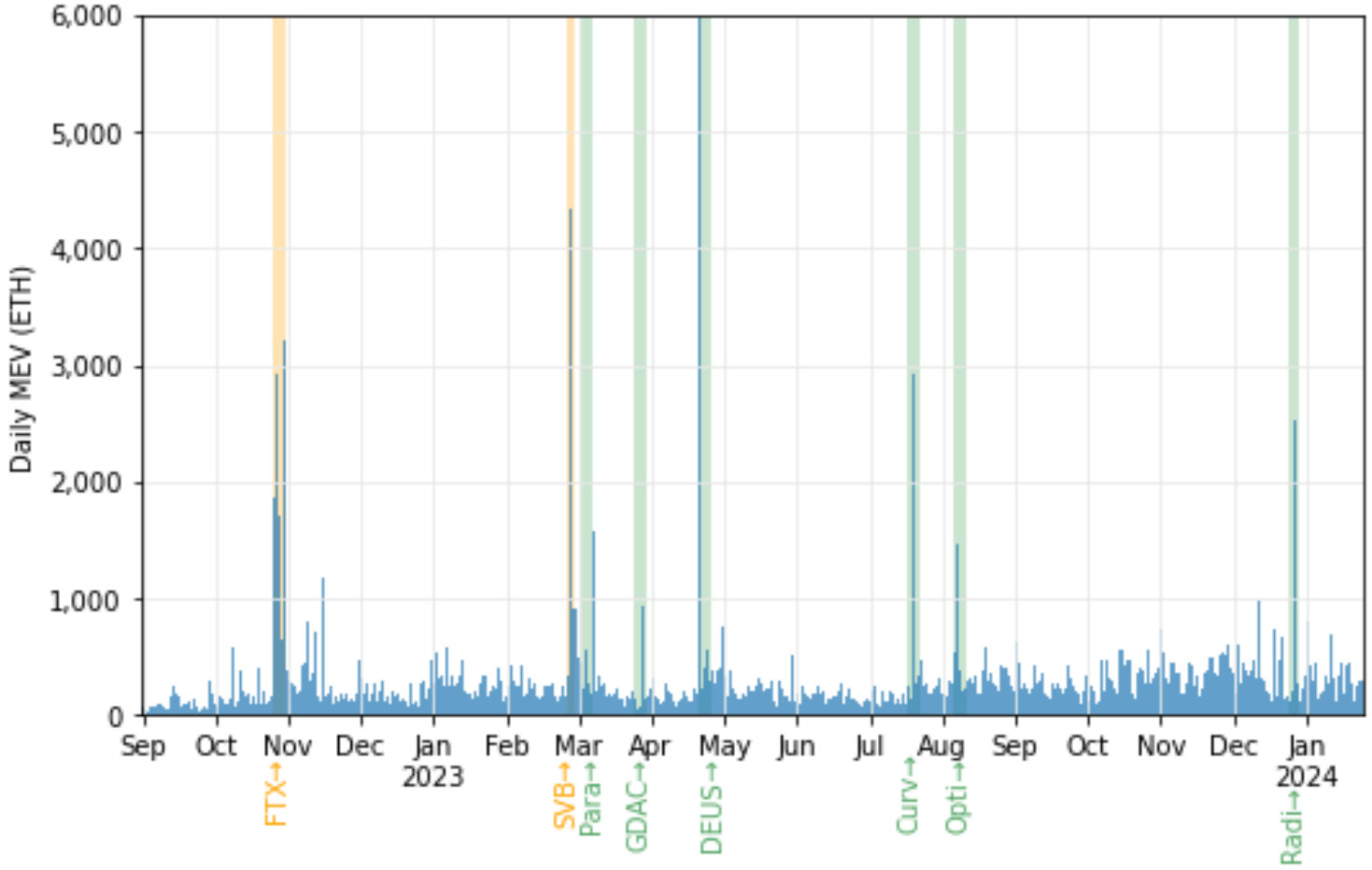
   $\equiv$ Builders decide how much of their private information to capitalize in this block, and how much of that value to share with the proposer

Instrument

- Instrument for total block revenue and total value of private transactions
- Two instruments, both dummies
  1. $\mathbf{Hacked_t = 1}$ if the block is appended on a day where there is a crypto protocol hack: 40 hacks
  2. $\mathbf{Crisis_t = 1}$ if the block is appended during either the FTX or SVB crises: 7 days

$$\log Private_t = \hat{\beta}_1 Hacked_t + \hat{\gamma}_1 Crisis_t + \hat{\psi_{1,i(t)}} + \hat{\eta_{1,j(t)}} + \hat{\phi_{1,i(t),j(t)}} + \hat{\epsilon_{1,t}};$$
$$\log Revenue_t = \hat{\beta}_2 Hacked_t + \hat{\gamma}_2 Crisis_t + \hat{\psi_{2,i(t)}} + \hat{\eta_{2,j(t)}} + \hat{\phi_{2,i(t),j(t)}} + \hat{\epsilon_{2,t}};$$

Instruments and Decentralized Institutions



- Crises and hacks first order institutional features of DeFi
- Decentralization makes rolling backs bugs/thefts highly unlikely

First Stage

	(1) log $Private_t$	(2) log Rev_t	(3) log $Private_t$	(4) log Rev_t
Hack Dummy	0.0072^{***}	0.0039^{***}	0.0059^{***}	0.0043^{***}
	(0.0007)	(0.0007)	(0.0006)	(0.0007)
Crisis Dummy	0.1208^{***}	0.1300^{***}	0.1236^{***}	0.1289^{***}
	(0.0092)	(0.0093)	(0.0099)	(0.0100)
Constant	0.0715^{***}	0.0985^{***}		
	(0.0022)	(0.0020)		
Observations	2607730	2607730 2277574		2277574

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Second Stage

	Builder Profit Share $\theta_{B,t}$			
	(1) OLS No FE	(2) IV No FE	(3) OLS FE	(4) IV FE
log $Private_t$	0.143***	1.367***	0.111***	1.484***
	(0.0138)	(0.177)	(0.0149)	(0.235)
log Rev_t	-0.0713***	-1.240***	-0.0511***	-1.360***
	(0.00906)	(0.175)	(0.00950)	(0.223)
Constant	0.0237***	0.0511***		
	(0.00244)	(0.00535)		
N	2607730	2607730	2277574	2277574
F Statistic		583.25		127.22
Robust F Statistic		220.937		26.100

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Empirical Finding

1. Higher value of private transactions in a given block
   - Causally increases the profit share of the block builder
2. Higher total block revenue, controlling for the value of private transactions
   - Causally decreases the profit share of the block builder

Wrapping Up

- Private information is a powerful driver of market power in DeFi
- Despite decentralization, significant concentration occurs due to information asymmetry
- Traditional financial institutions may become key intermediaries

Thank you! Questions?

MEV: Maximum Extractable Value

- revenue from the ordering of transactions in a block, in excess of revenue from the value of transactions alone
- arbitrageur profits + transaction fees paid to the block builders + direct payments sent by arbitrageurs to builders (to include transaction in the block)
- how to recognize an MEV block
  - last transaction of the block is issued from builder to proposer

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Alternative Definition of Public and Private Transactions

- private $\equiv$ non-atomic
  - not on Mempool
  - involve a direct transfer
  - appear to be a one-way swap (public leg of an arbitrage)
  - involve a CEX traded token
- public $\equiv$ atomic
  - the rest!

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