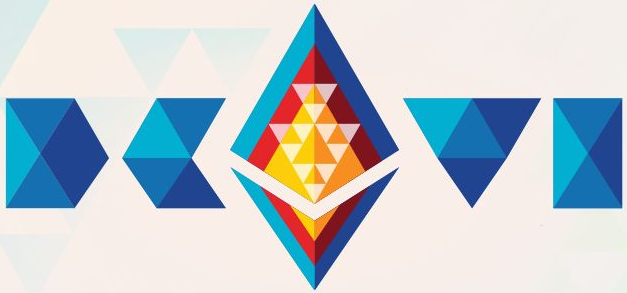


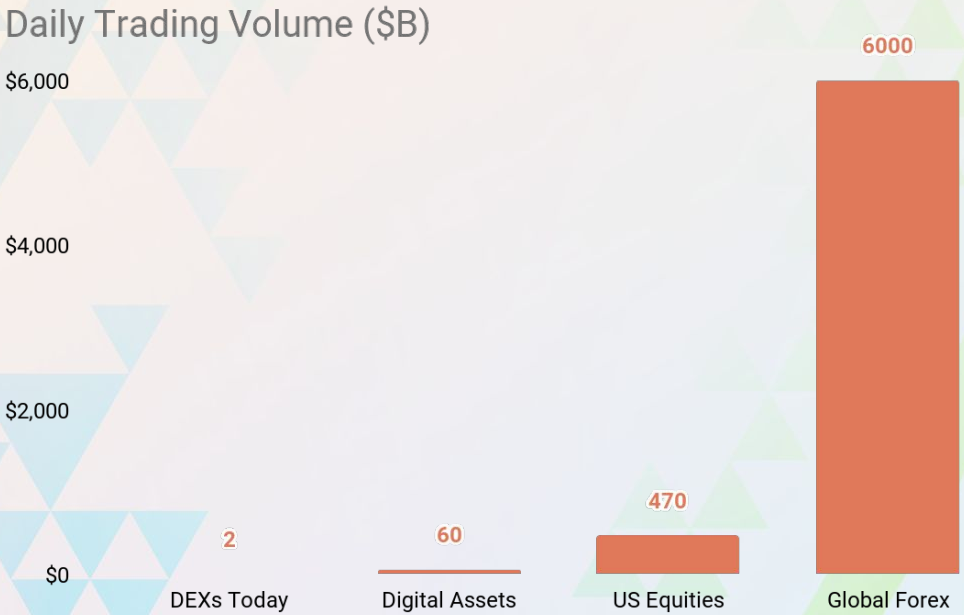
Towards Fairer DEXs on Ethereum

One price per token per block

Felix Leupold

CoW Swap

The DEX journey is 0.03% finished



Section 1

Brief history of DEX markets

The Art of Designing Markets

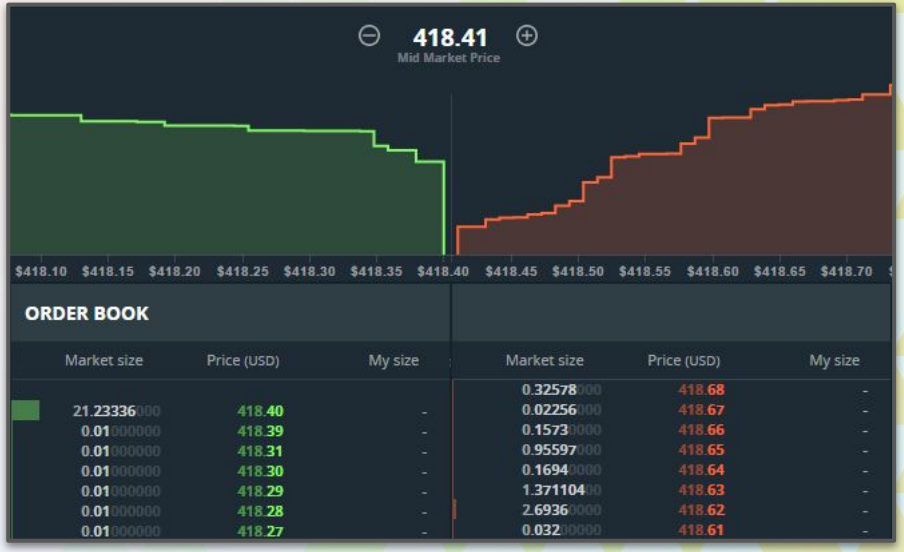
To function properly, markets need at least three things *[Alvin Roth]*:

1. **Thickness -** Bring together a large enough proportion of potential buyers and sellers
2. **Safety -** Incentivize participants to truthfully reveal their preferences
3. **Overcome Congestion -** Give market participants means to make satisfactory choices when faced with a variety of options

On-chain Limit Order Book DEXs

- Etherdelta, Idex, Oasis
- Required **active** market making
- Difficult to bootstrap new pairs
- High cost for managing orders

→ Hard to create **thick** markets

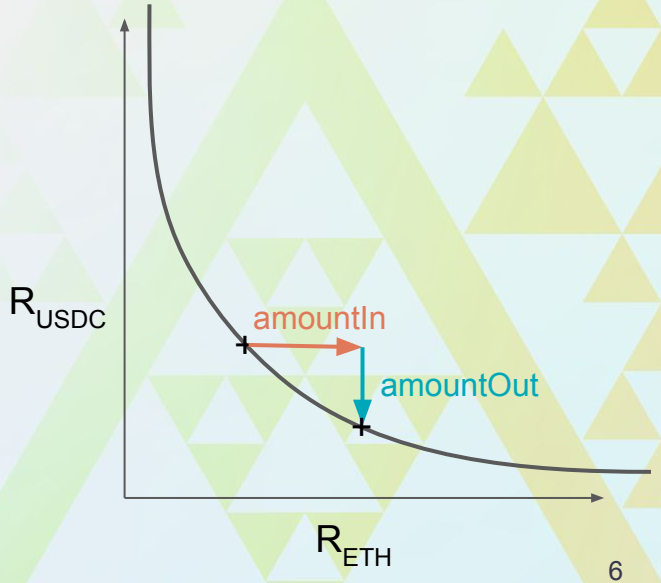


AMMs democratized market making

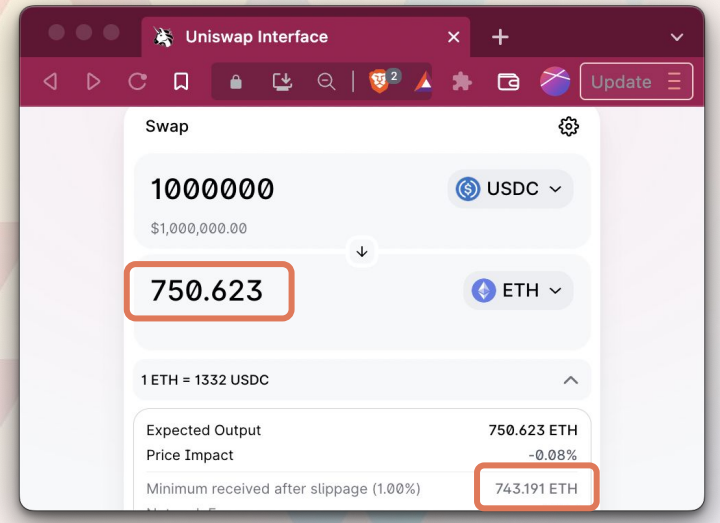
- Based on Logarithmic Market Scoring Rule *[Hanson et al. 2002]*
- Given current inventory, automatically compute exchange rate:
  - $x * y = k$ *[Uniswap, Bancor]*
  - $\prod_{i=1}^{n} R_i^{w_i} = k$ *[Balancer]*
  - $An^n \sum x_i + D = ADn^n + \frac{D^{n+1}}{n^n \prod x_i}$ *[Curve]*
  - ...

Solved the problem of bootstrapping liquidity

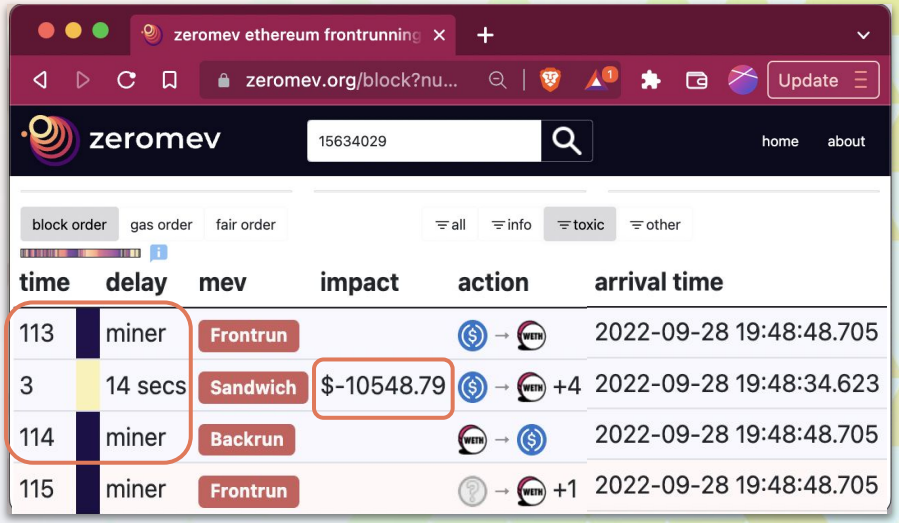
allowing **thick markets** for **long tail tokens**



Problem with AMMs: **Pay as Bid Pricing & MEV**



Volatility & revert risk requires users to incorporate **“slippage tolerance”** into their bids



Block producer **manipulate prices** to match tolerance & extract risk free profit

AMMs are **unsafe** by design

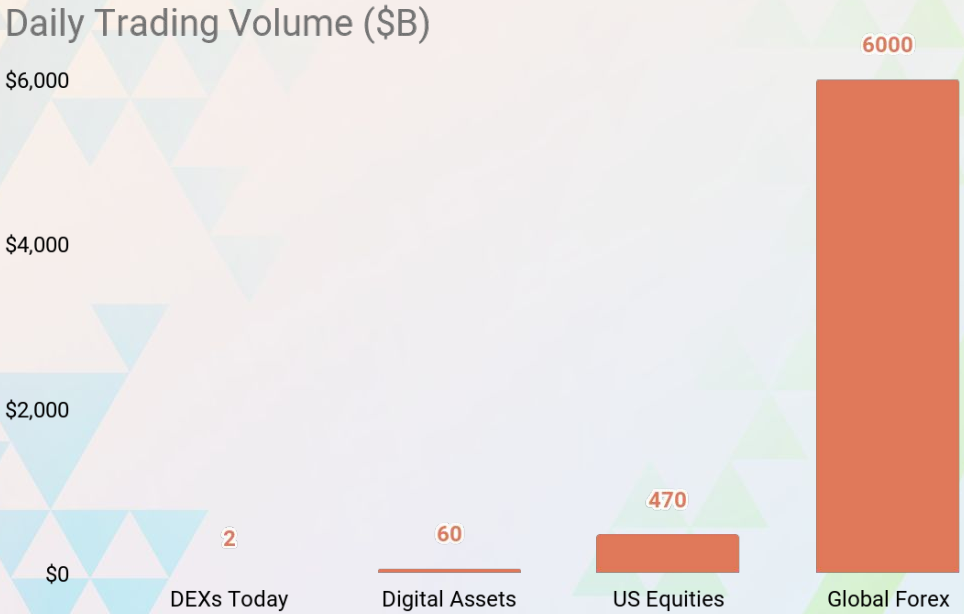
Traders need to **under-report** their **slippage tolerance**

Advantages of “safe” markets

1. **Simplicity:** Optimal strategy & behavior is easier to predict & reason about, makes it easier to find the “right” answer.
2. **Efficiency:** Truthful revelation of preferences leads to more efficient outcomes.
3. **Fairness** to the least sophisticated participants.

“No market succeeds if it’s not viewed as fair. It’s as simple as that.”
[Maureen O'Hara]

Leading to wider market adoption



Section 2

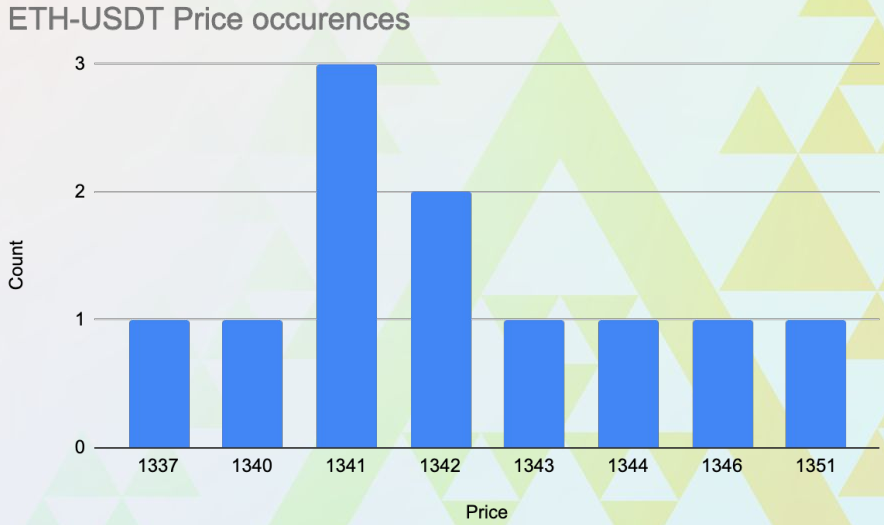
Building Safety on top of AMMs

Root Cause

One asset,
many prices

E.g. Block 15673043:

>**1.05%** price range for ETH/USD trades



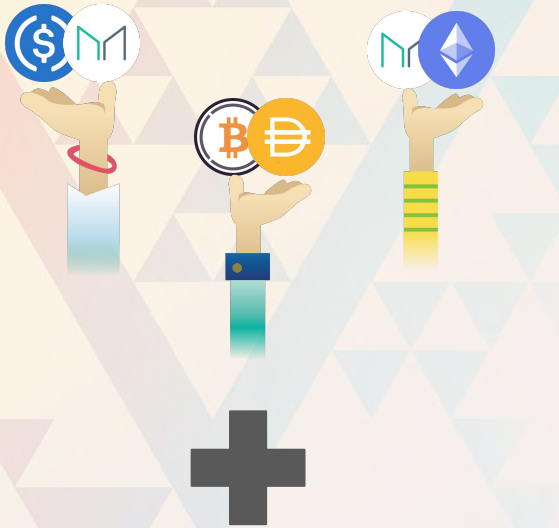
Prices that depend on (arbitrary) intra-block ordering make the market unsafe

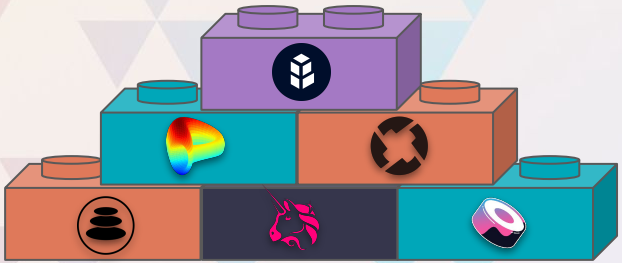
Asset	Price	Trades
ETH	$1300	0x2473… **0xb61b...**
WBTC	$19000	0x9caa… 0xf437... 0x8a84…
MATIC	$0.7	**0xb61b...**

Solution:

One price per token per block

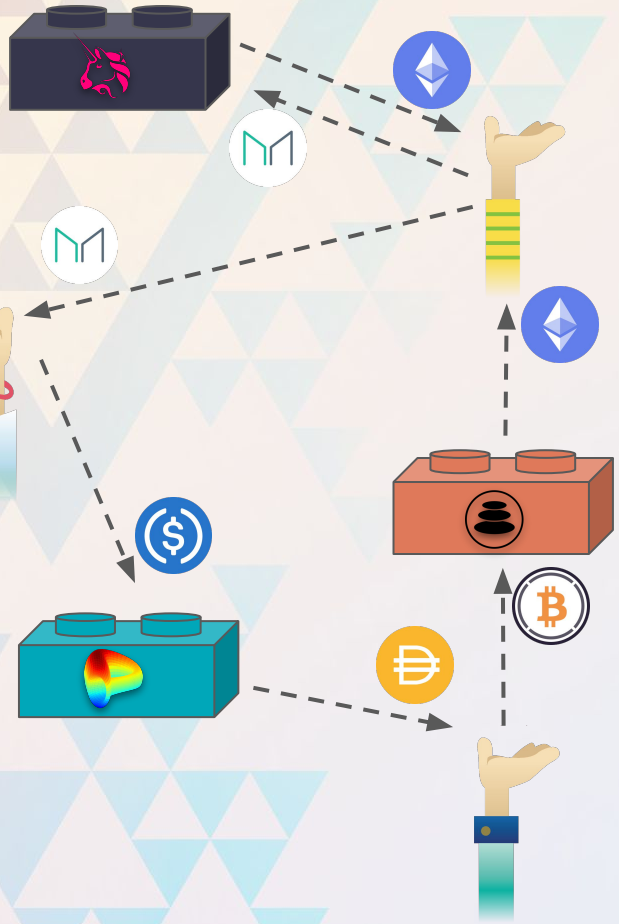
How to build a batch auction on Ethereum in 6 “simple” steps…





Multi-Dimensional trade intents

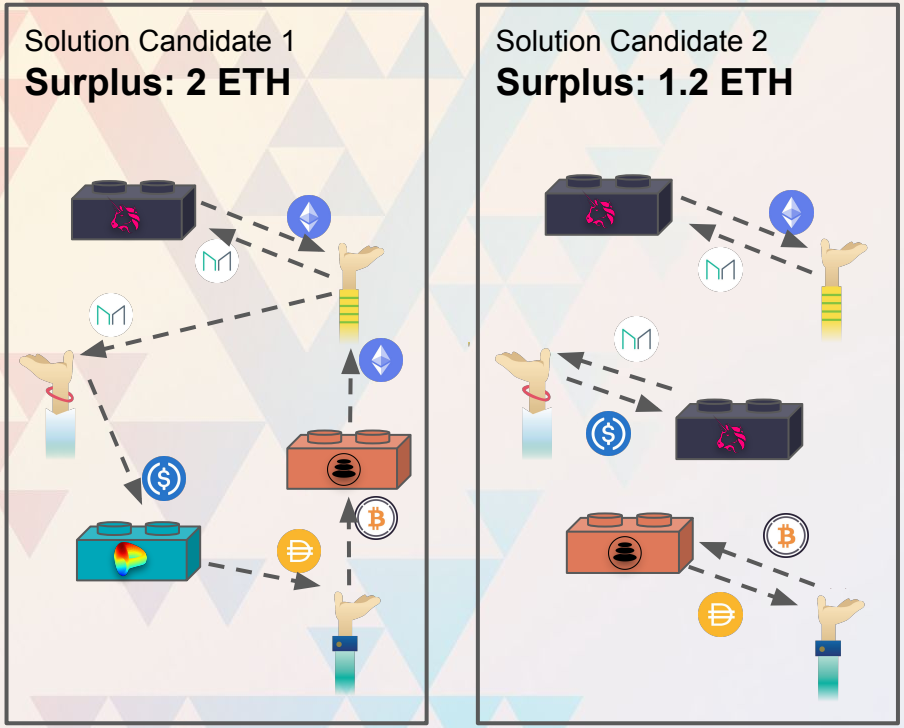
1. Users express their **trades intents** (approval + signed message) across all token pairs
2. Intents combined with on-chain liquidity (AMMs, RFQ, etc) create a **thick market**



Asset	Price
ETH	1300
WBTC	19000
MKR	770
USDC	1
DAI	1

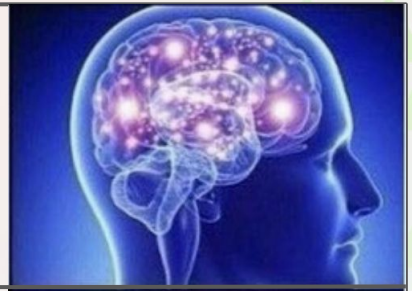
Settlement without ordering priority

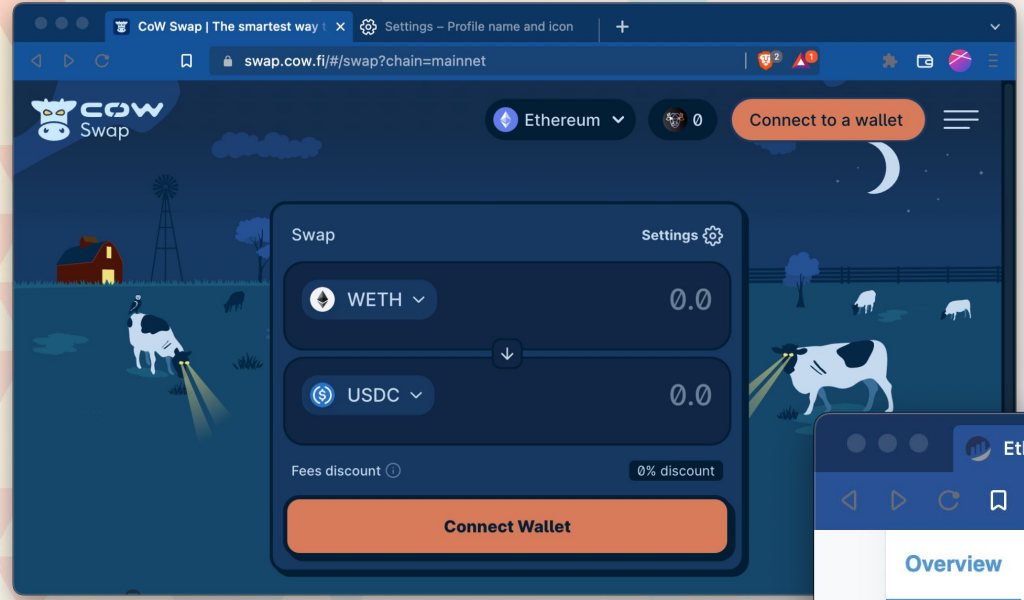
3. Goal is to find **uniform price clearing** and execution path such that *demand equals supply*
4. This poses an NP-hard problem which can be approximated by **maximizing user surplus**

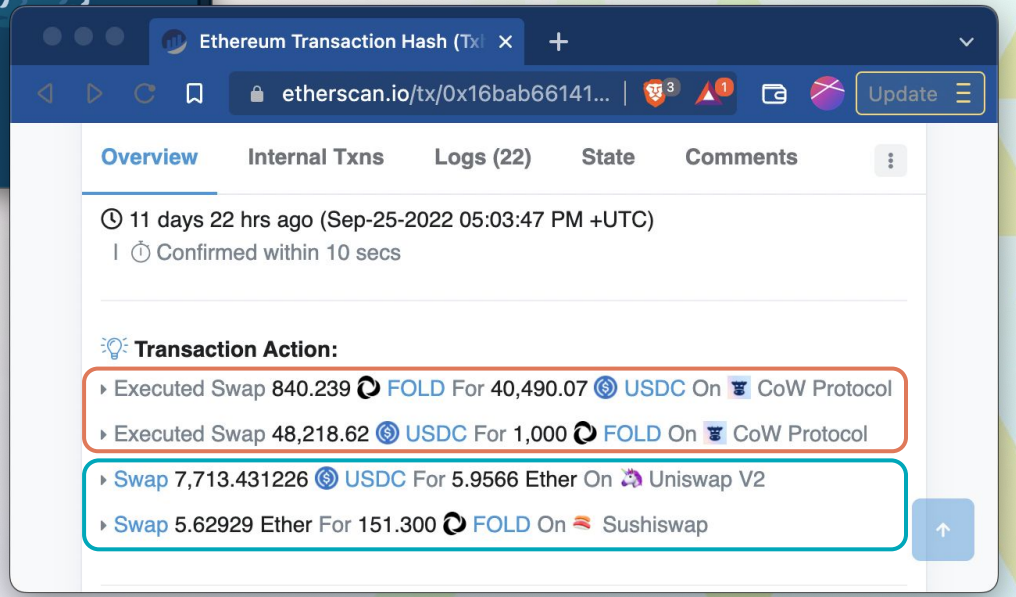


Solver competition to ensure best pricing

5. A **permissionless competition** allows for distributed solving based on different heuristics & algorithms
6. Best solution **receives a reward**

Proof of Work	
Proof of Stake	
Proof of Optimality	

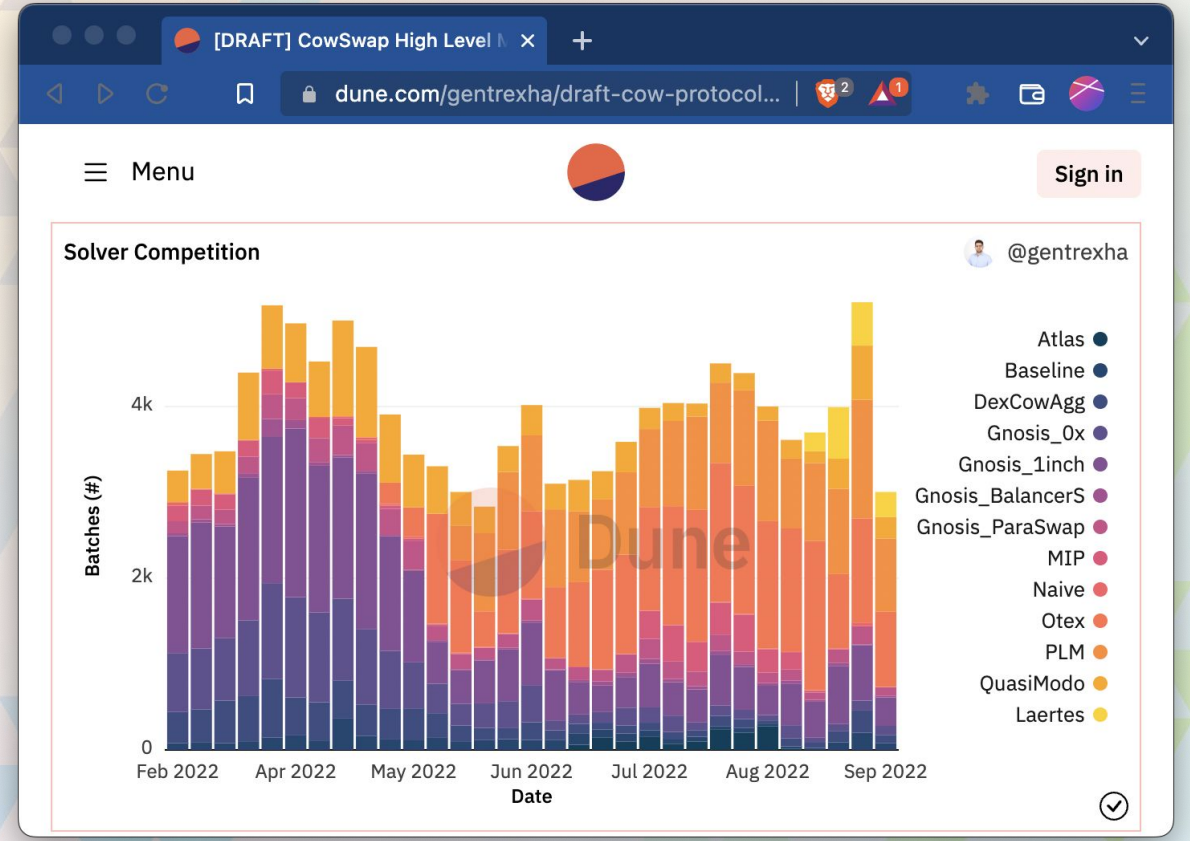




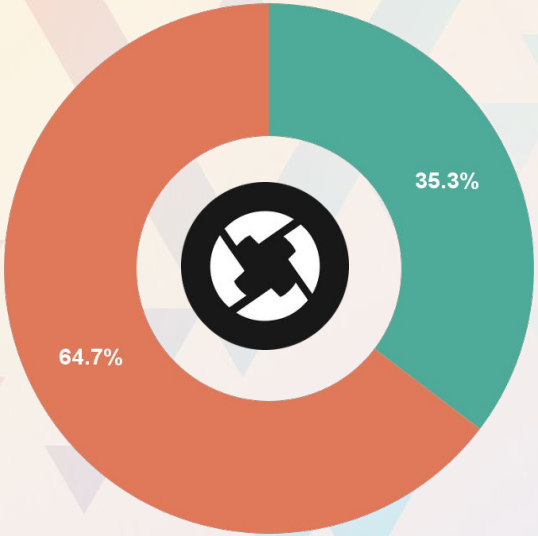
Clearing Price: $48.2

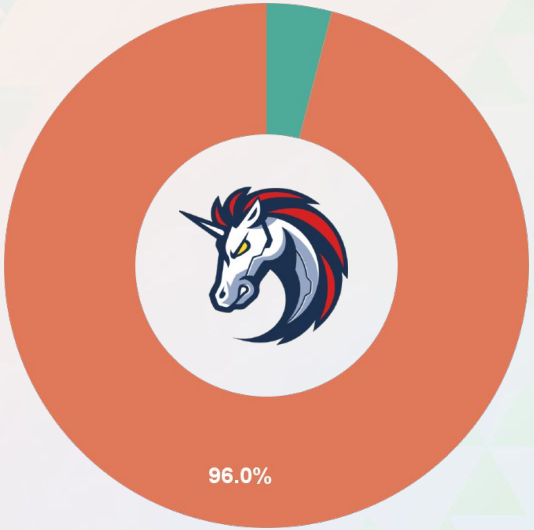
$2300 of added surplus from batching:

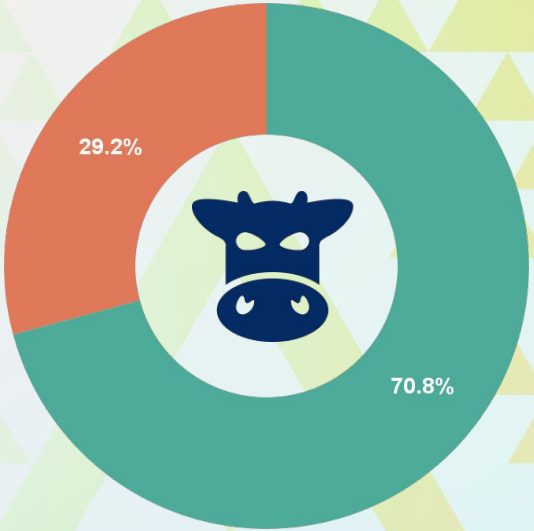
- $800 Reduced LP fees
- $1500 Reduced price impact


[DRAFT] CowSwap High Level
dune.com/gentrexha/draft-cow-protocol...
Menu
Sign in
Solver Competition
@gentrexha
Batches (#)
4k
2k
0
Feb 2022
Apr 2022
May 2022
Jun 2022
Jul 2022
Aug 2022
Sep 2022
Date
Atlas
Baseline
DexCowAgg
Gnosis_0x
Gnosis_1inch
Gnosis_BalancerS
Gnosis_ParaSwap
MIP
Naive
Otex
PLM
QuasiModo
Laertes
Dune

MEV Protection in Practice







Negative Slippage **Positive Slippage**

Section 3

Proposer Builder Separation

> Crypto is in the business of constantly rediscovering the basic ideas of financial history.

Matt Levine (MoneyStuff)

Where Ethereum is headed

Intent

Sell USDC for ETH

Wallets

Other builders

Tx

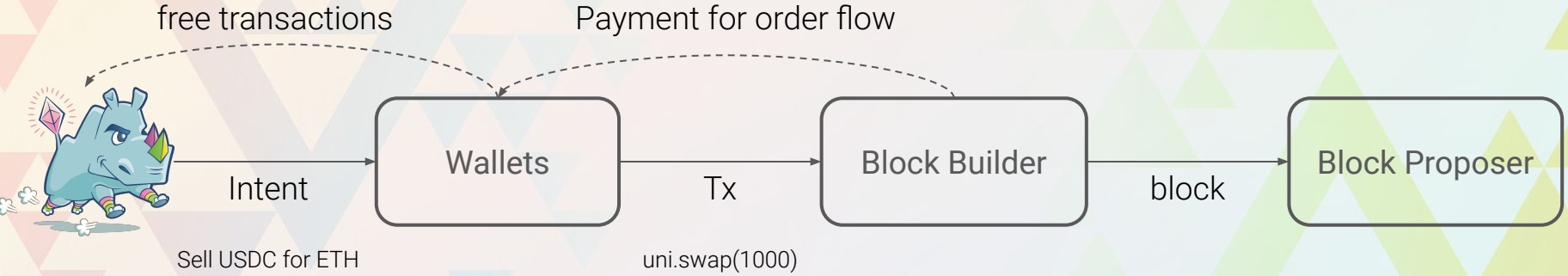
uni.swap(1000)

Block Builder

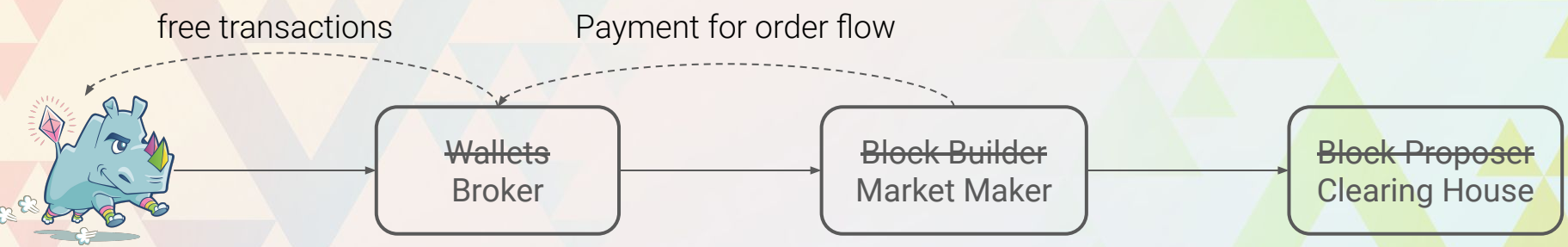
block

Block Proposer

Where Ethereum is headed

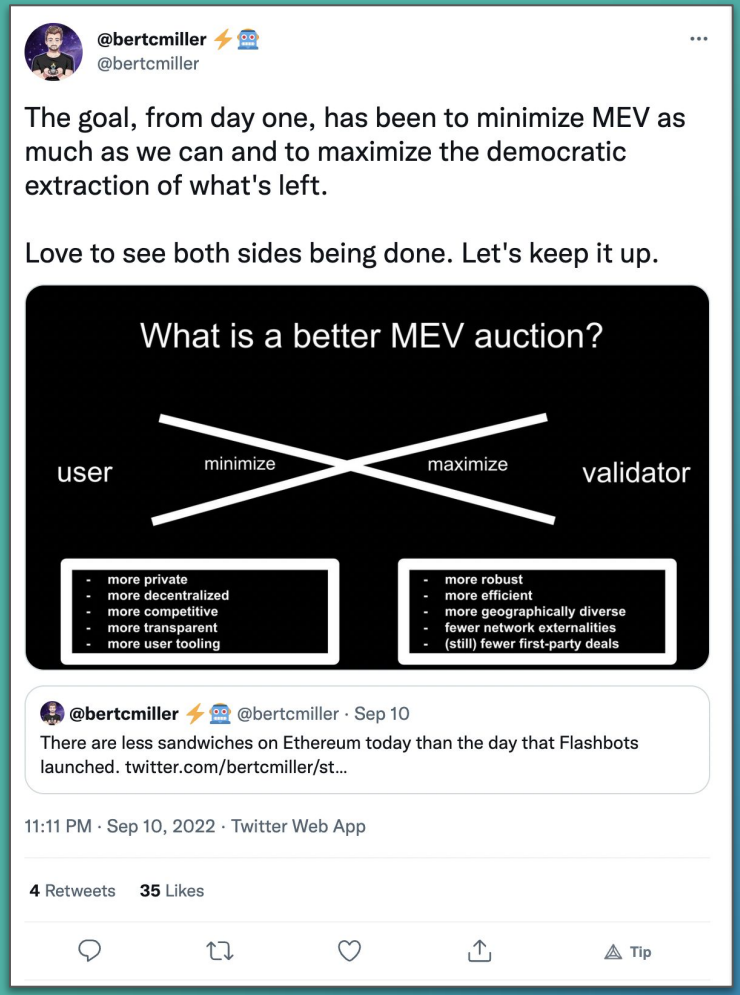


Traditional Finance



MEV
maximization
vs
minimization

Can they coexist?

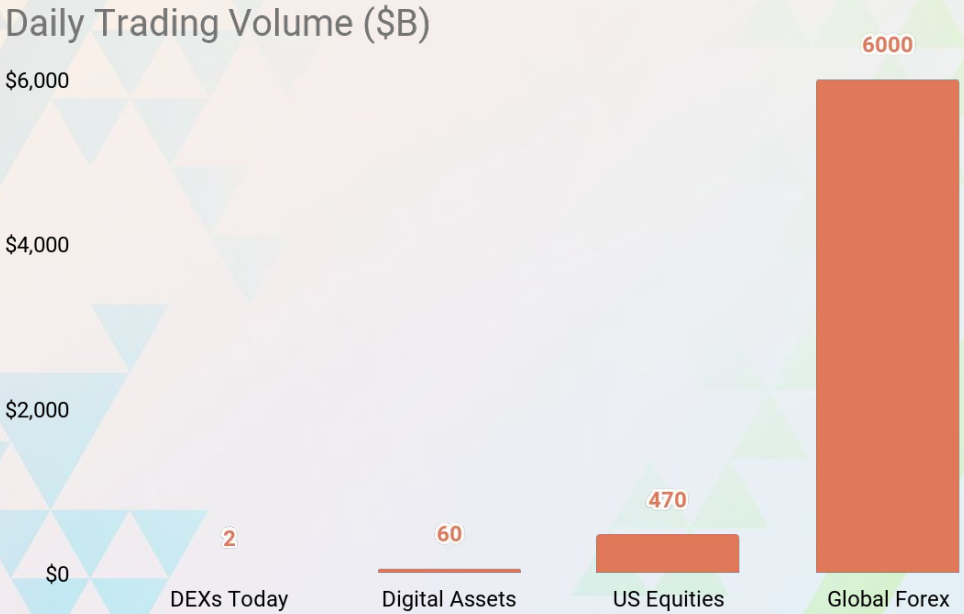


	extract	minimize
extract	(1, 1)	(2, 0)
minimize	(0, 2)	(3, 3)

MEV maximization leads to dangerous incentives

- Adopting a MEV reducing mechanism is a **repeated prisoner's dilemma**
- Block builders operating **without rent from MEV** receive lower rewards compared to others
- Only if **all builders co-operate** we reach a new equilibrium with larger social returns
- Block builders are incentivized to **stick to the status quo** (perhaps even fight new entrants)

Let's grow the pie, rather than splitting it



Thank you!

Felix Leupold

CoW Swap

@fleupold_

Section 4

Why is this a better mechanism?

Advantages of “intent based trading”

1. Decoupling the **“what to trade”** from the **“how to trade”**
2. Transaction management abstracted away from the user
3. Introduces composability

Advantages of batch auctions

1. Peer to peer matching (**coincidence of wants**) leads to better prices
    - No price impact
    - No LP fee
    - Reduced gas fees (even when trading in the same direction)
2. Uniform price clearing removes intra-batch MEV
3. Ring trades **re-aggregate fragmented markets** (e.g. stablecoins)

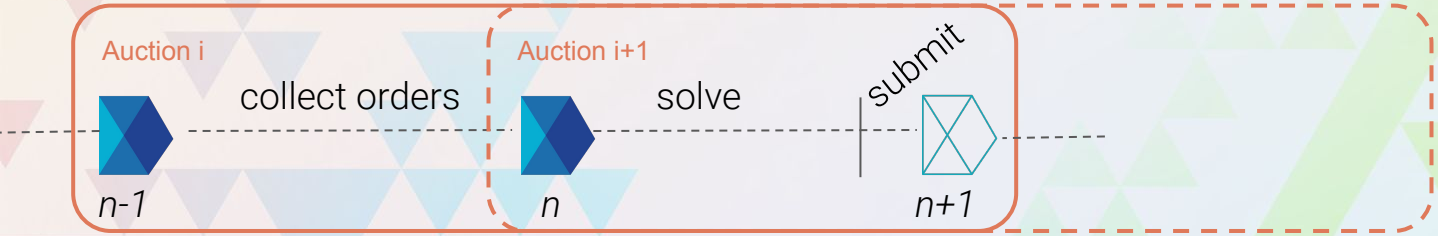
Criticism (1) - Shared price impact

- This is not true in expectation: big trades could go in opposite direction with equal probability
- In reality, the chance of 🐟 getting ordered before 🐳 in the face of MEV is small

Criticism (2) - Batch auctions are slow

"[Batching] … means that users face higher latencies for trade confirmation"
[Chitra, Angeris, Evan 2021]

- While in practice CoW Swap auctions are slow today, it is possible to run one auction per block
- Ethereum confirmation time (12s) is the lower bound for trade confirmation



Difference to Flashbots protect / PFOF

- While the type of optimisation (finding optimal routing/arbitrage) is similar, the outcome is the exact opposite

Are Batch Auctions Safe?

- Uniform clearing prices make intra batch price manipulation impossible
- Competition allows users to specify their true limit price (slippage tolerance)
-

Enter your main point / statement here.

Here’s the timeline.

Event 1

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam.

Event 2

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam.

Event 3

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam.

Regulation ensures “fair” pricing

Buys from market maker
at $1305

$10
spread

$1295 $1305

National
Best Bid
$1290

National
Best Offer
$1310

Sells to market maker
at $1290

Lessons from traditional finance

1. Pay for order flow may lead to centralization
2. Centralization leads to regulation and a higher barrier to entry
3. High barrier to entry stifles permissionless innovation

Root Cause

One asset, many prices

E.g. Block 15634029:

>0.75% price range for ETH/USD trades

Transaction	Type	Index	Price (Ξ/$)
0x280a...	Buy	1	**$1344.7**
0x2473...	Buy	2	**$1346.2**
0xb61b...	Sell	3	**$1348**
0x9caa...	Sell	14	**$1337.6**
0xf437...	Buy	15	**$1336.7**
0x8a84…	Buy	55	**$1336.7**

Will the Market Fix the Market?
A Theory of Stock Exchange Competition and Innovation*

Eric Budish[†] Robin S. Lee[‡] and John J. Shim[§]

February 27, 2019

Abstract

As of early 2019, there are 13 stock exchanges in the U.S., across which over 1 trillion shares ($50 trillion) are traded annually. All 13 exchanges use the continuous limit order book market design, a design that gives rise to latency arbitrage—arbitrage rents from symmetrically observed public information—and the associated high-frequency trading arms race (Budish, Cramton and Shim, 2015). Will the market adopt new market designs that address the negative aspects of high-frequency trading? This paper builds a theoretical model of stock exchange competition to answer this question. Our model, shaped by institutional details of the U.S. equities market, shows that under the status quo market design: (i) trading behavior across the many distinct exchanges is as if there is just a single "synthesized" exchange; (ii) competition among exchanges is fierce on the dimension of traditional trading fees; but (iii) exchanges capture and maintain significant economic rents from the sale of speed technology—arms for the arms race. Using a variety of data, we document seven stylized empirical facts that align with these predictions. We then use the model to examine the private and social incentives for market design innovation. We show that the market design adoption game among exchanges is a repeated prisoner's dilemma. If an exchange adopts a new market design that eliminates latency arbitrage, it would win share and earn economic rents; perhaps surprisingly, the usual coordination problems associated with getting a new market design off the ground are not central. However, imitation by other exchanges would result in an equilibrium that resembles the status quo with competitive trading fees, but now without the rents from the speed race. We conclude that although the social returns to adoption are large, the private returns are much smaller for an entrant exchange and *negative* for an incumbent that currently derives rents from the inefficiencies that the new design eliminates. Nevertheless, our analysis does not imply that a market-wide market design mandate is necessary. Rather, it points to a more circumscribed policy response that would tip the balance of incentives and encourage the "market to fix the market."

*Project start date: April 2015. We are especially grateful to Larry Glosten and Terry Hendershott for serving as discussants of an early version of this project. We also thank Jason Abaluck, Susan Athey, John Campbell, Dennis Carlton, Judy Chevalier, John Cochrane, Christopher Conlon, Peter Cramton, Doug Diamond, David Easley, Alex Frankel, Joel Hasbrouck, Kate Ho, Anil Kashyap, Pete Kyle, Donald Mackenzie, Neale Mahoney, Paul Milgrom, Ariel Pakes, Al Roth, Fiona Scott Morton, Andrei Shleifer, Jeremy Stein, Mike Whinston, Heidi Williams, Luigi Zingales, and numerous industry practitioners and seminar participants for helpful discussions and suggestions. Paul Kim, Cameron Taylor, Matthew O'Keefe, Natalia Drozdoff, and Ethan Che provided exceptional research assistance. Budish acknowledges financial support from the Fama-Miller Center, the

MEV maximization leads to dangerous incentives

- Adopting a MEV reducing mechanism is a **repeated prisoner's dilemma**
- Block builders operating **without rent from MEV** receive lower rewards compared to others
- Only if **all builders co-operate** we reach a new equilibrium with larger social returns
- Block builders are incentivized to **stick to the status quo** (perhaps even fight new entrants)