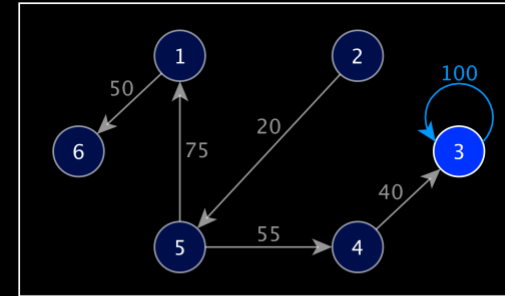


Crypto Wash Trading

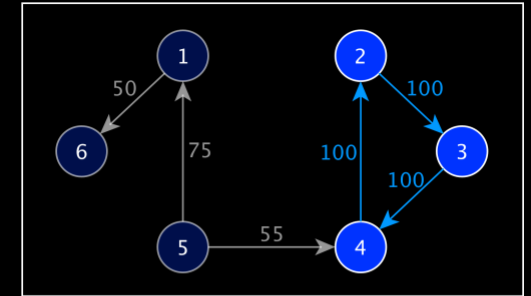
Presenter: Yu SHEN

What are wash trades?

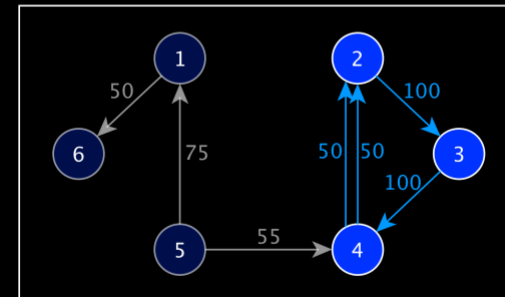
- Definition (from CFTC)
 - Entering into, or purporting to enter into, transactions to give the appearance that purchases and sales have been made, without incurring market risk or changing the trader's market position.
- Motivation
 - Generate fake trading volume, suggesting an active market.
- Is this legal?
 - Prohibited in most countries.
 - Questionable for cryptocurrencies.



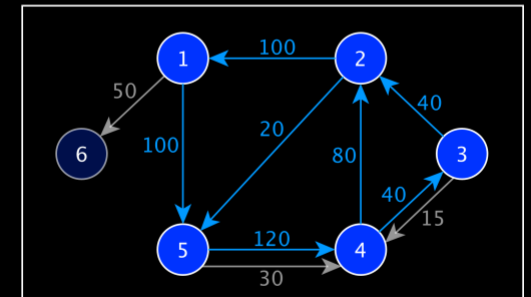
(a) A Loop



(b) A Cycle



(c) A Cycle With Parallel Edges



(d) A Cycle with Sub-Cycles

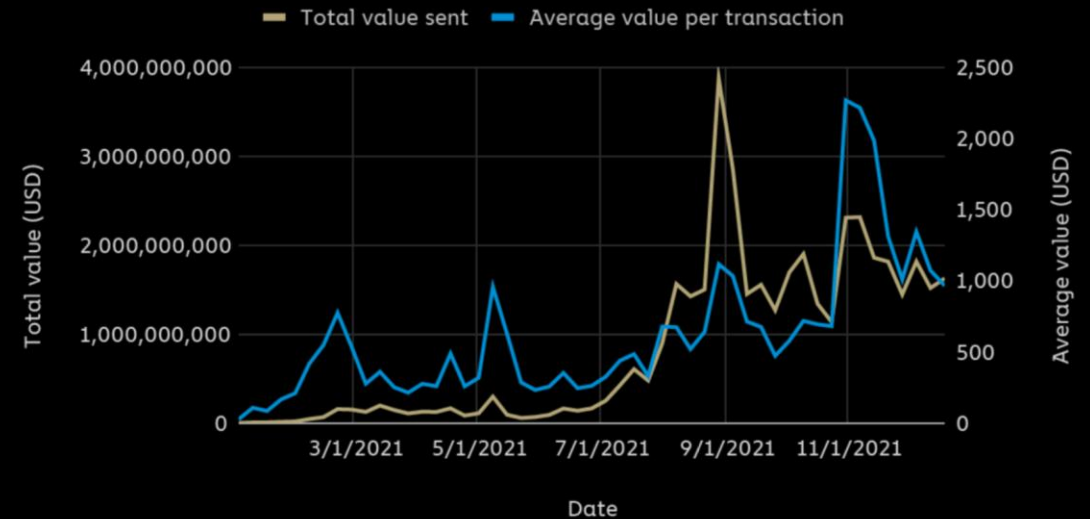
Today's Topics

- Wash Trading with NFTs
 - <https://blog.chainalysis.com/reports/2022-crypto-crime-report-preview-nft-wash-trading-money-laundering/>
- Wash Trading on Centralized Exchanges
 - Crypto Wash Trading
 - @Tokenomics '21
- Wash Trading on DEXes
 - Detecting and Quantifying Wash Trading on Decentralized Cryptocurrency Exchanges
 - @Web Conference 2021 (WWW '21)

NFTs

- NFT popularity skyrocketed in 2021.
- Illicit activities with NFTs:
 - Wash trading to artificially increase the value of NFTs.
 - Money laundering through the purchase of NFTs.

Weekly total cryptocurrency value and average value per transaction sent to NFT platforms, 2021

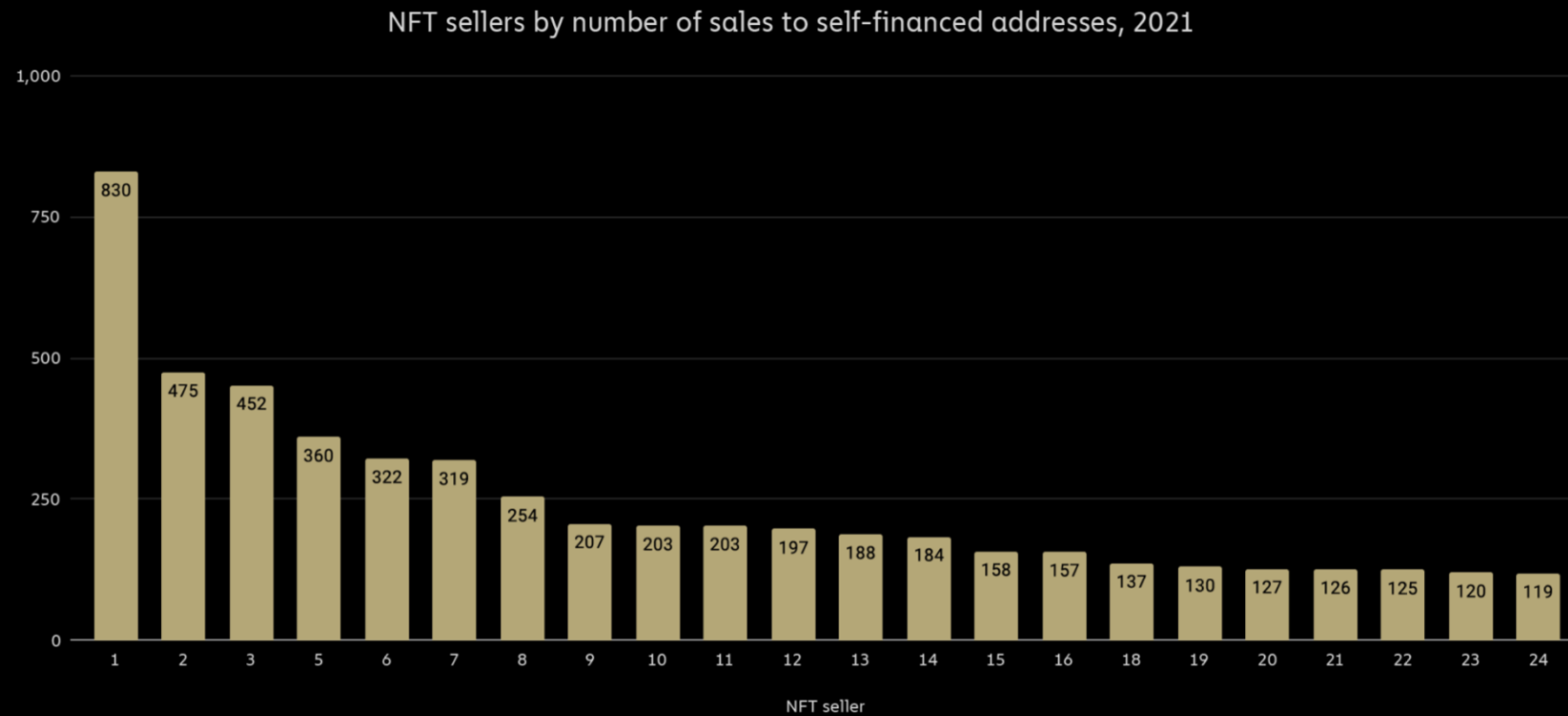


Wash Trading with NFTs

- Goal: make one's NFT appear more valuable than it really is by “selling it” to a new wallet the original owner also controls.
- NFT wash trading can be tracked by analyzing sales of NFTs to addresses that were *self-financed*.
 - Funded by the selling address.
 - Funded by the address that initially funded the selling address.

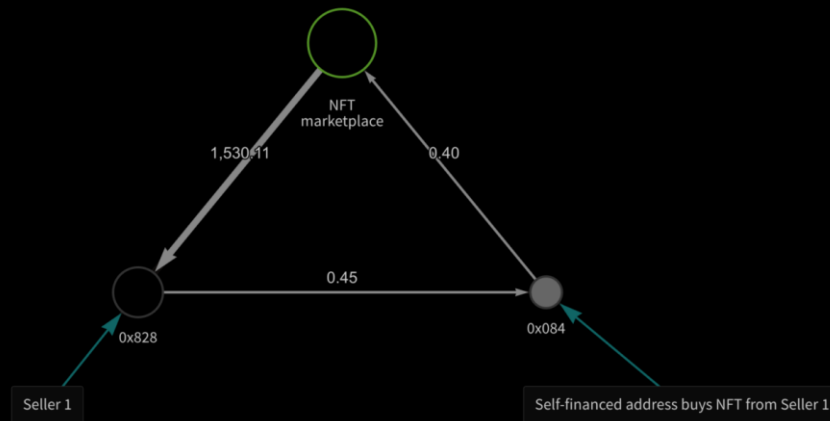
Wash Trading with NFTs

- NFT sellers have conducted hundreds of wash trades.



Wash Trading with NFTs

- Seller 1 (830 self-financed sales)
- Victims: accounts that bought NFTs from Seller 1 and are not funded by Seller 1
 - Victims are unaware that the NFTs they're buying have been wash traded



Address	0x828...
Spent on gas fees in wash trading txs	– \$35,642
Revenue from sales of wash traded NFTs to victims	\$27,258
Profits	– \$8,383

Wash Trading with NFTs

- If we look at a bigger piece of the NFT ecosystem...
- 262 addresses have sold an NFT to a self-financed address more than 25 times.

Wash trader group	Number of addresses	Profits from wash trading
Profitable wash traders	110	\$8,875,315
Unprofitable wash traders	152	– \$416,984
All	262	\$8,458,331

- Most NFT wash traders have been unprofitable, but the successful NFT wash traders have profited so much that, as a whole, this group of 262 has profited immensely overall.

Wash Trading in Crypto Exchanges

- Crypto Wash Trading
 - Tokenomics '21

Crypto Wash Trading*

Lin William Cong

Xi Li

Ke Tang

Yang Yang

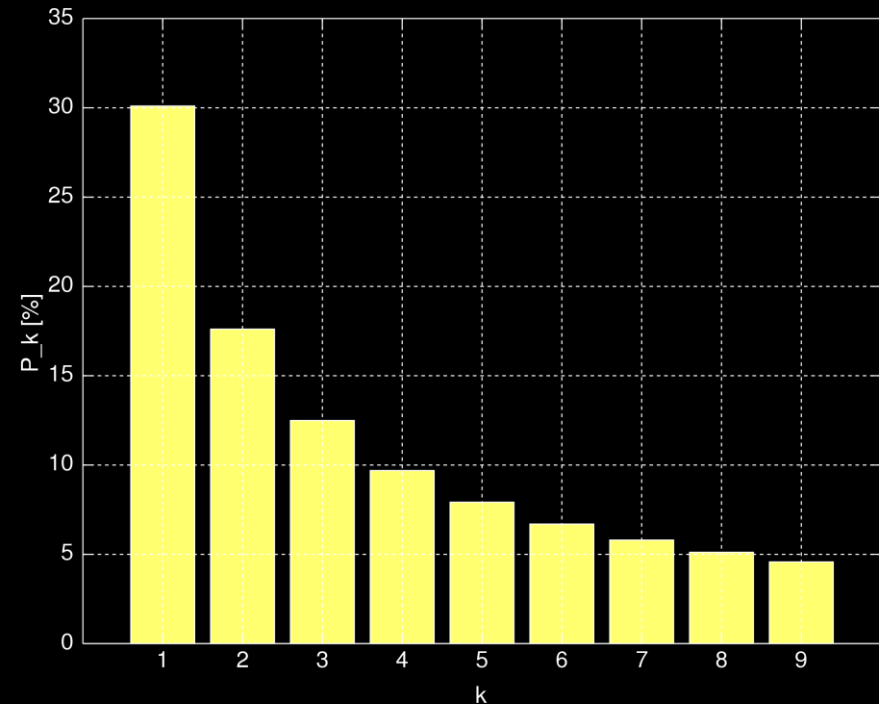
First draft: December 2019; current draft: July 2021

Wash Trading in Crypto Exchanges

- Systematic tests exploiting robust statistical and behavioral patterns in trading to detect fake transactions on 29 cryptocurrency exchanges.
 - Regulated exchanges: patterns consistently observed in financial markets and nature.
 - Unregulated exchanges: *abnormal first-significant-digit distributions, size rounding, and transaction tail distributions*
- Quantifying the wash trading on each unregulated exchanges.

Benford's law

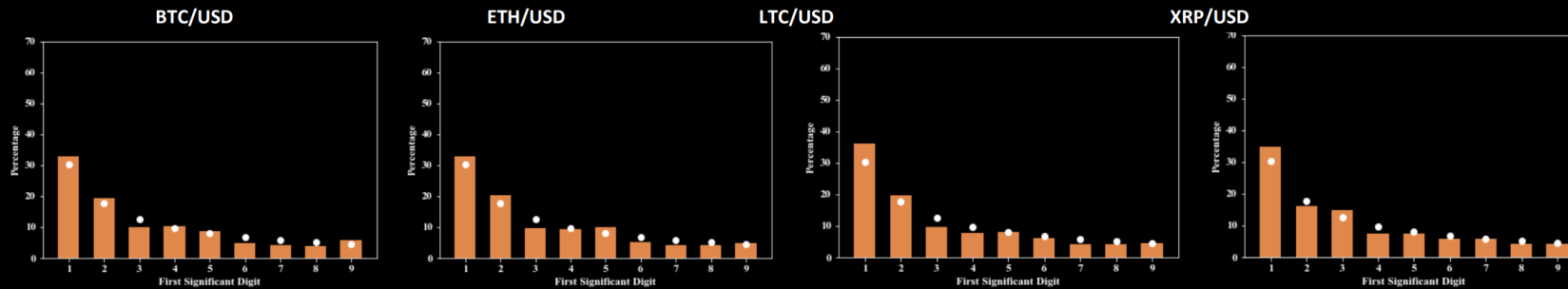
- The first-digit law is an observation that in many real-life sets of numerical data, the leading digit is likely to be small.
- $Prob(N) = \log(1 + N^{-1})$, $N = \{1, \dots, 9\}$
- Check whether the leading digits of trade sizes follow Benford's law on the exchanges.



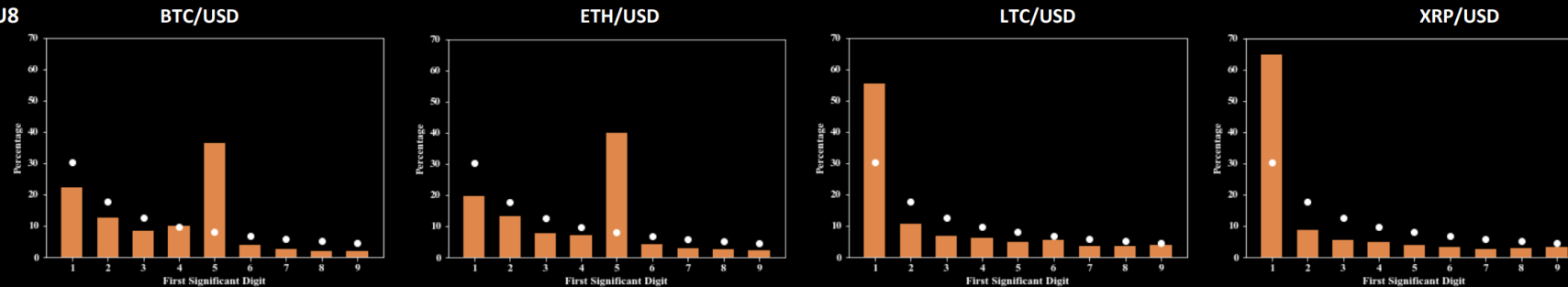
Abnormal first-significant-digit distributions

- Check the leading digits of trade sizes

Panel R: Regulated Exchanges
R2



Panel U: Unregulated Tier-2 Exchanges
U8



Trade Size Clustering

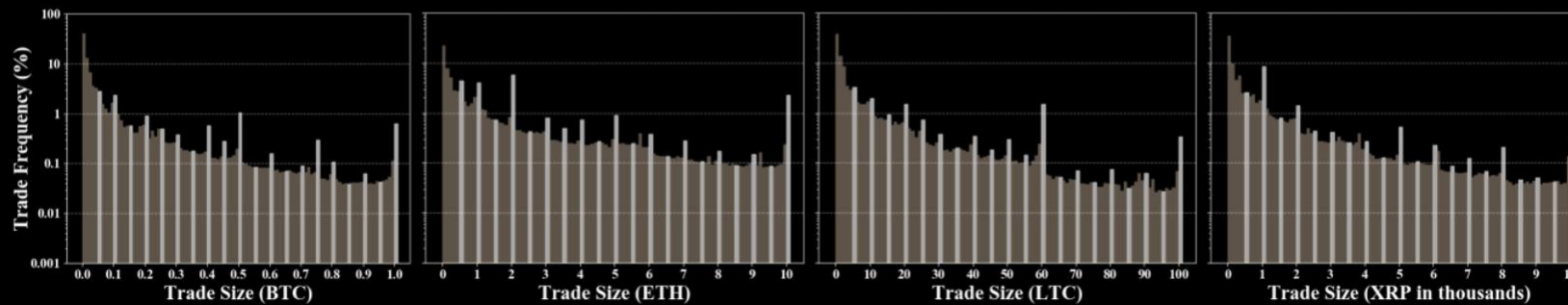
- Traders have the tendency to use round trade sizes and round prices.
 - This is the classical behavioral regularity commonly observed in financial markets.
 - Clustering occurs because authentic traders tend to use round numbers as cognitive reference points to simplify and save effort in the decision-making and evaluation process.
- Wash traders use machine-based automated trading programs to save manpower, especially when fake orders feature small trade sizes but large total amounts.

Trade Size Clustering

- Histograms of trade size (round trade sizes highlighted).

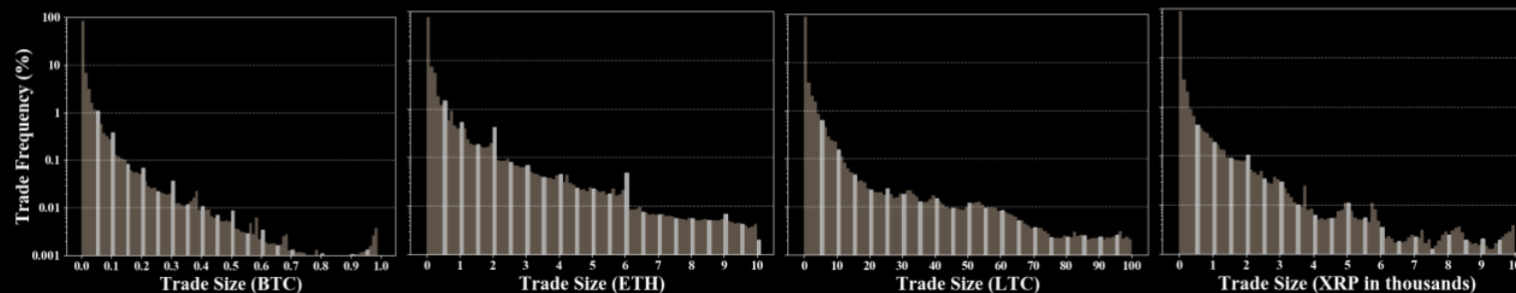
Panel R: Regulated Exchanges

R2



Panel U: Unregulated Tier-2 Exchanges

U8



Summary of this paper

- On average, wash trades account for over 70% of total trading volume on each unregulated exchange.
- Incentives
 - Brand awareness and website traffic are two critical factors for customer acquisition.
 - Wash trading impacts prices.
- Criticism
 - The data adopted by this paper are collected from the exchange operators, which have never actually taken place.
 - Account level information is unavailable.

Wash Trading in DEXes

- Detecting and Quantifying Wash Trading on Decentralized Cryptocurrency Exchanges
 - Web Conference 2021 (WWW '21)
- Systematic analysis of wash trading behavior on the decentralized exchanges IDEX and Etherdelta.

Detecting and Quantifying Wash Trading on Decentralized Cryptocurrency Exchanges

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Wash Trading in DEXes

- Data collection

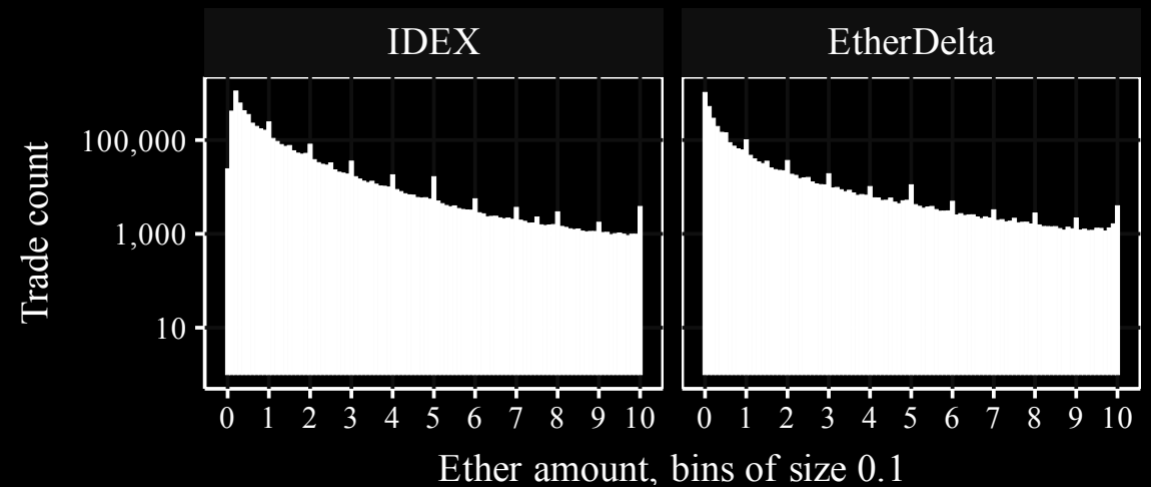
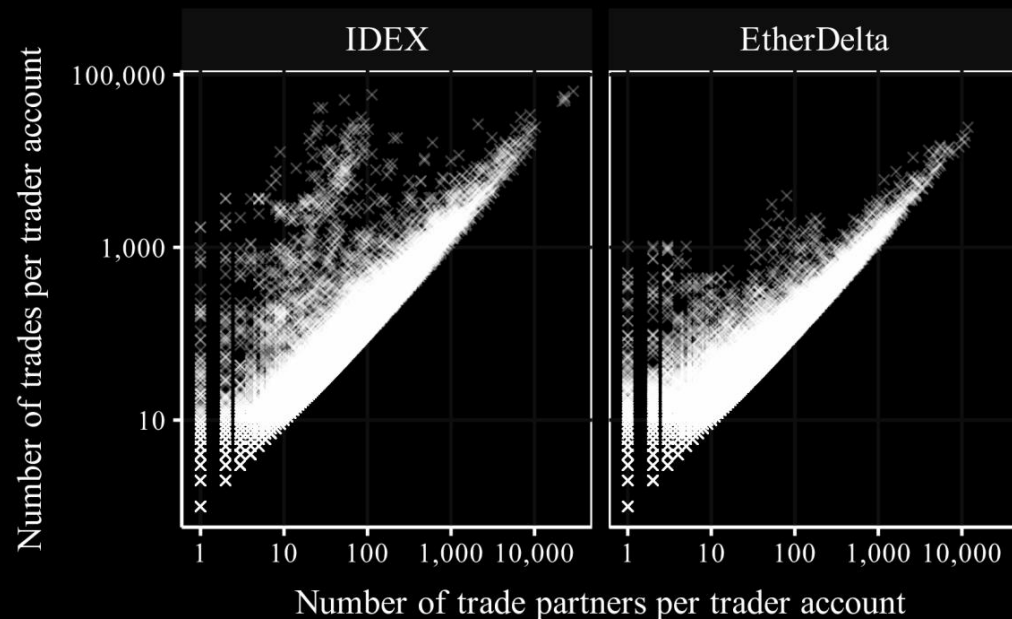
	IDEX	EtherDelta
Start date (UTC)	09/27/2017 10:57pm	02/09/2017 11:56pm
End date (UTC)	05/04/2020 1:22pm	05/04/2020 1:22pm
# of trades	5,340,537	3,573,512
# of traders	249,911	323,598
# of tokens	1,206	6,551

- Pre-processing

- Prices of the involved assets are computed based on exchanged amounts, and U.S. Dollar values are joined.
- Define a token trade graph $G(V, E)$ to be a directed multigraph, where V is the set of trading account addresses, and E is the set of trades.

High Level Insights

- Some accounts have vastly more trades than trade partners.
 - This conflicts the fact that traders usually do not know who they are trading with when issuing a trade order.
- There exist local peaks at round numbers.



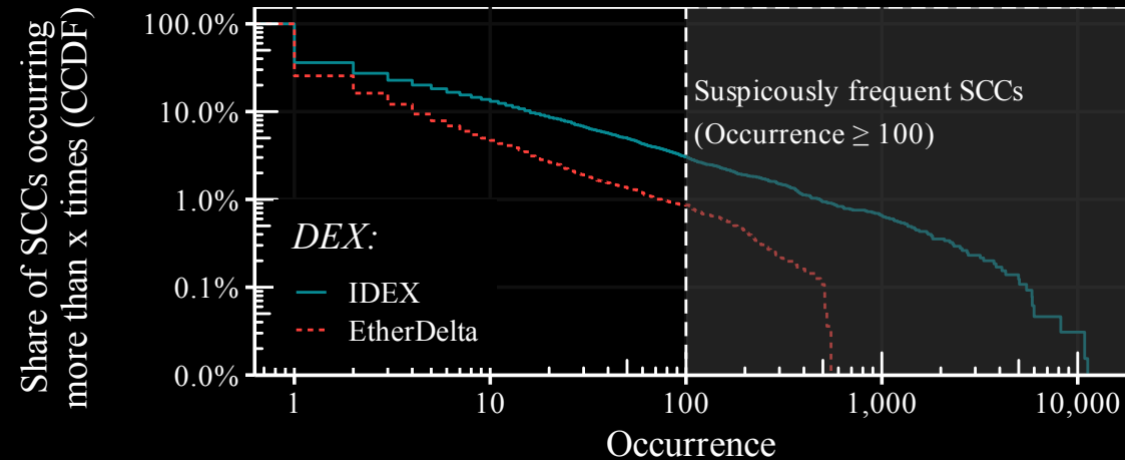
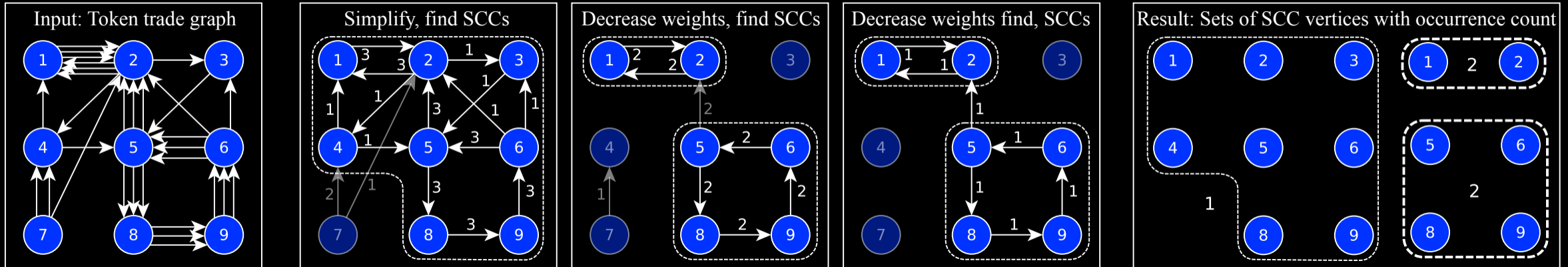
Wash Trade Detection

- Identity sets of trades between collusive trading accounts that lead to no change in the individual position of each participating trader.
 - For each account within a set of trading accounts, the total amount of purchased assets equals the total amount of sold assets, such that the involved traders essentially hold the same position they had initially.
- Technical obstacles
 - Very high number of trades in the datasets, hence infeasible to check the power set.

Wash Trade Detection

- Two step process:
 - *Account Candidate Set Generation*: We determine candidate sets of potentially collusive traders via an iterative counting of strongly connected components (SCCs) in each token trade graph.
 - *Trade Volume Matching*: For time windows of trades within frequently occurring SCCs, we determine if there exists a trade subset that leads to no position change for each trader.

Candidate Set Generation with SCCs



Volume matching

- We can formalize a trade T as $T = (+a_i, -a_j)_V$.

- Two (or more) trades are sum up:

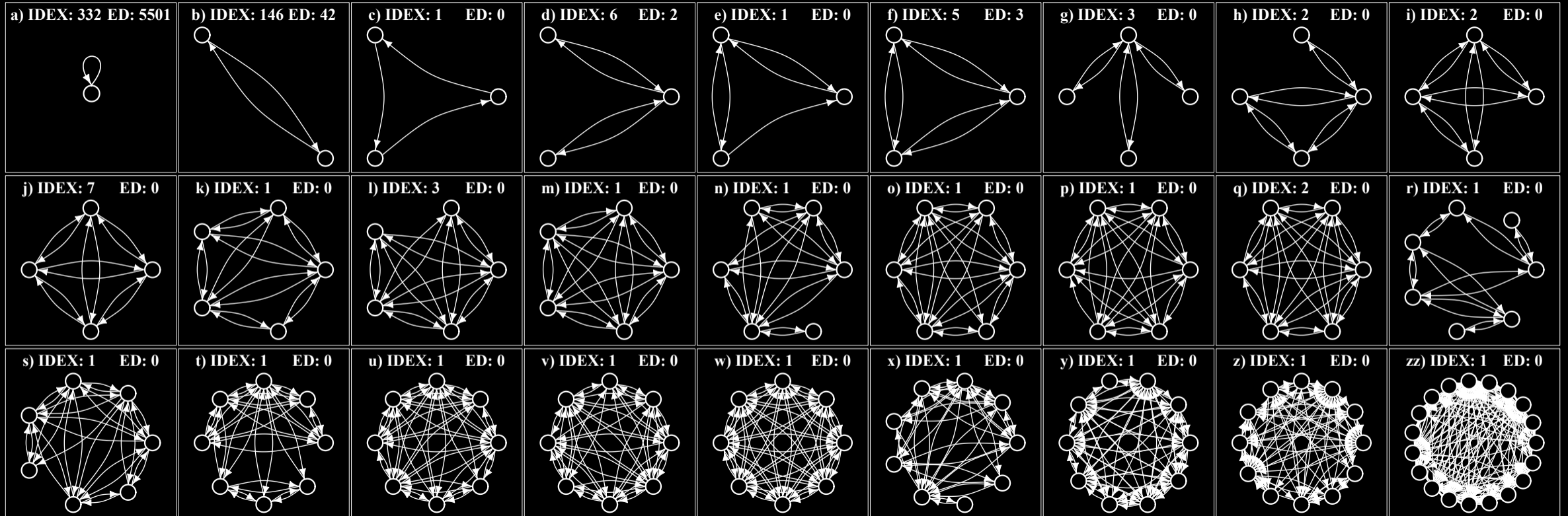
$$T_1 + T_2 = (+a_i, -a_j)_{V_1} + (+a_i, -a_j)_{V_2} = \{[a_i]_{p_i}, [a_j]_{p_j}\}$$

- For a given trade set S_T the goal is to find a subset $S_W \subseteq S_T$ such that

$$\sum S_W = \sum T_k \in S_W = \sum (a_i, a_j)_{V_k} = \{[a_i]_{p_i}, \dots, [a_j]_{p_j}\} = \{[a_i]_{0 \pm v}, \dots, [a_j]_{0 \pm v}\}$$

- v is a small deviation defined as a percentage (margin) m of the mean trading volume of S_W . ($m = 1\%$)
 - In order to make a wash trade less obvious, traders might not buy and sell exactly the same volumes when wash trading
 - each trade incurs a cost, which may decrease a trader's capital with every trade and therefore also be reflected in slightly decreasing wash trade volumes.

Volume matching

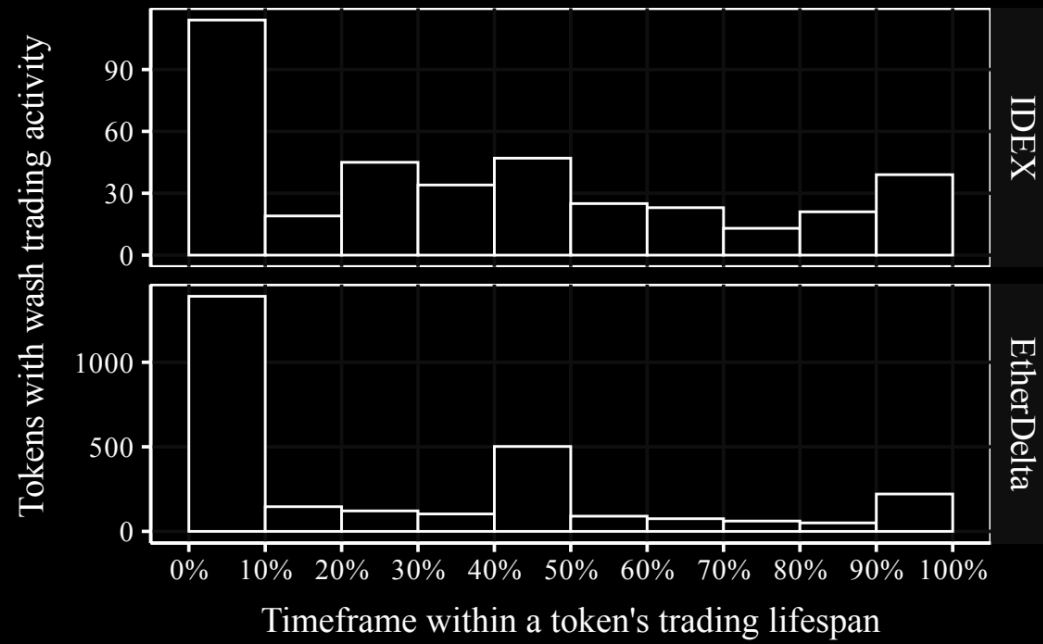


Quantification

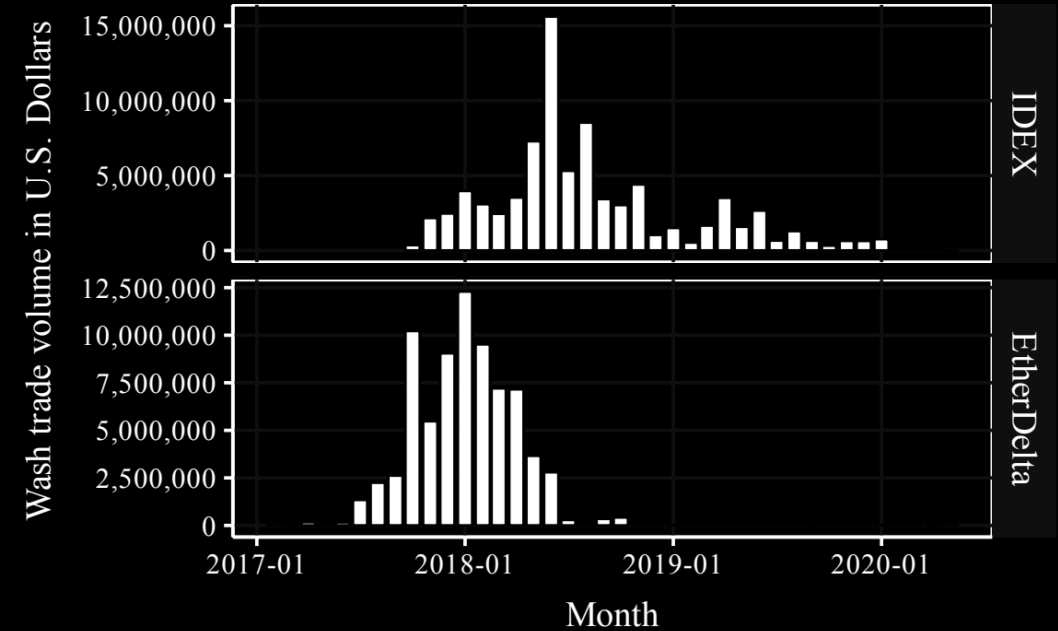
- Threshold for candidate set of SCCs: 100 occurrences across all traded token types.
- Margin m at which we define that the trader position basically did not change: 1% of the mean trade volumes within a set of analyzed trades.
- Time windows of trades in which we perform volume matching: 1 hour, 1 day and 1 week.

Quantification

- Wash Trade Activity in a Token's Lifespan

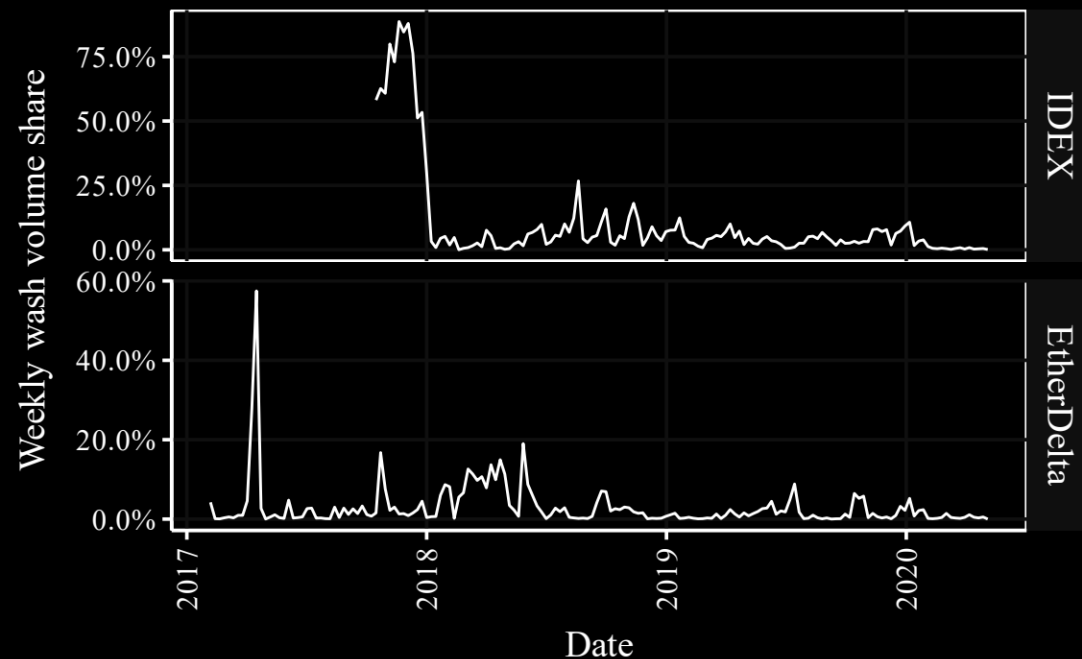


- Wash Trade Activity Over Time



Quantification

- Weekly share of wash trade volume on both IDEX and EtherDelta.



- Wash Trades Summary for IDEX and EtherDelta.

	IDEX	EtherDelta
# Self-Trades	28,193	58,791
# Wash Trades	213,029	69,711
Self-Trades Share (Of All Trades)	0.53%	1.09%
Wash Trades Share (Of All Trades)	3.99%	1.30%
Total Self-Traded Volume ETH	23,716.08	136,548.22
Total Wash Volume ETH	273,027	155,155
Total Self-Traded Volume USD	12,587,517	64,801,288
Total Wash Volume USD	83,531,254	75,846,518
Wash Trade Fees Received USD	250,594	227,540
# Self-Traded Tokens	239	2,758
# Wash Tokens	380	2,759
Wash Token Share	31.54%	42.12%
# Self-Trader Accounts	332	5,501
# Wash Trader Accounts	659	5,533
# Analyzed SCCs	199	48
# SCCs with Wash Trading	193	47
Mean # Tokens Washed per SCC	2.46	1.62

Summary

- NFT wash trading exists in a murky legal area.
 - Wash trading involving NFTs has yet to be the subject of an enforcement action.
- Wash trades flood in unregulated (centralized) crypto exchanges.
- Wash trading on DEXes
 - Self-trades occur frequently, which are easily detectable and preventable.
 - Many tokens have been subject to wash trading activities.