

# Studying Wash Trading Activities in Centralised Cryptocurrency Exchanges

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# Motivation

Decentralisation - Cryptocurrencies



# Motivation

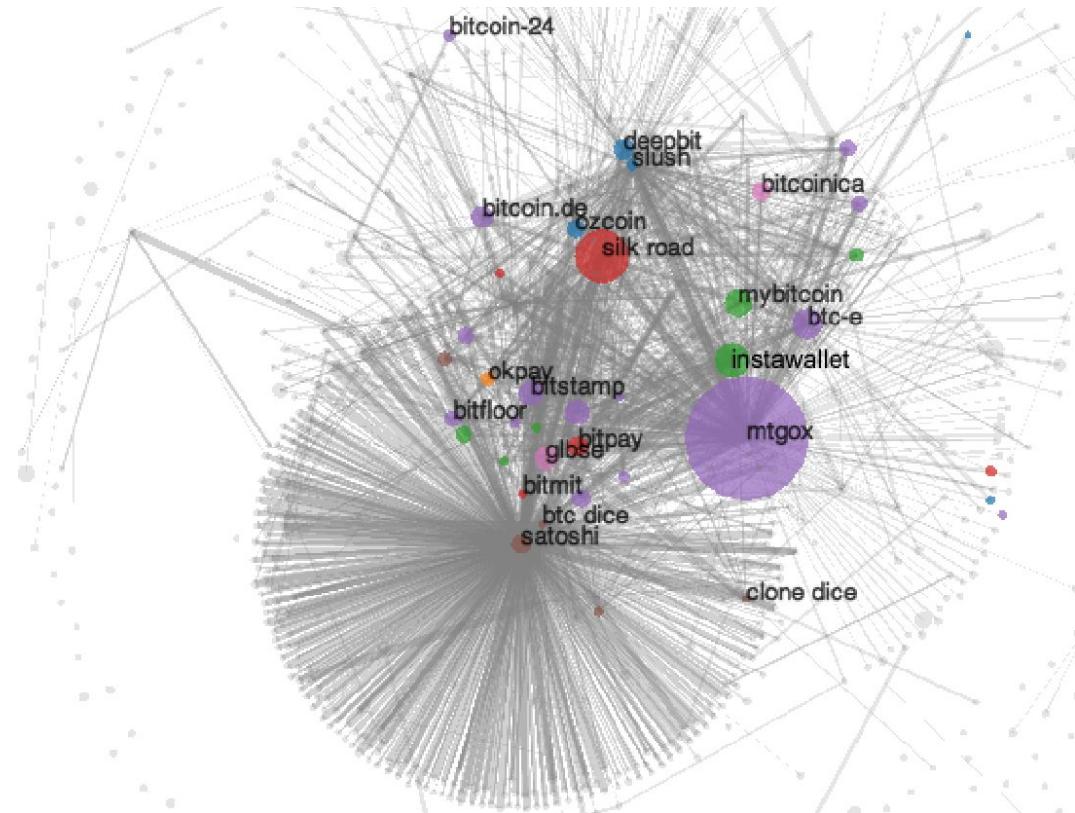
Decentralisation



# Motivation

Cryptocurrency exchanges  
are Trusted Third Parties

Intermediaries!



# Motivation

## Cryptocurrency exchanges

- centralised only
- malicious behaviour
  - goal of attracting more customers
  - matchmaking vs market maker
  - private data not just value
  - mimicry, price spoofing, ..., wash trading

# Guide casual users

Exchange choice is often reputation based

Aggregators based on tamperable objective metrics (wash trading)

#		Name	Price	1h %	24h %	7d %	Market Cap	Volume(24h)	Circulating Supply	Last 7 Days
☆	1	Bitcoin BTC	\$26,563.39	▼ 0.03%	▲ 0.11%	▲ 3.05%	\$517,677,522,034	\$6,579,509,858 247,672 BTC	19,488,381 BTC	
☆	2	Ethereum ETH	\$1,630.44	▼ 0.02%	▼ 0.34%	▲ 0.67%	\$196,019,126,291	\$2,723,471,353 1,670,226 ETH	120,224,407 ETH	
☆	3	Tether USDT USDT	\$1.00	▲ 0.00%	▲ 0.02%	▲ 0.06%	\$83,080,773,708	\$12,121,796,443 12,115,414,224 USDT	83,041,923,536 USDT	
☆	4	BNB BNB	\$216.47	▲ 0.02%	▲ 1.07%	▲ 1.73%	\$33,303,516,174	\$405,696,467 1,874,264 BNB	153,848,252 BNB	
☆	5	XRP XRP	\$0.4996	▼ 0.10%	▼ 0.09%	▲ 0.63%	\$26,565,823,803	\$465,162,594 931,368,965 XRP	53,175,400,720 XRP	
☆	6	USD Coin USDC	\$1.00	▲ 0.01%	▲ 0.01%	▲ 0.01%	\$26,172,297,960	\$1,519,720,551 1,519,373,774 USDC	26,166,103,217 USDC	

# Data collection

## Scraping / API

- Aggregator services  
(coinmarketcap,  
coingecko)
- directly from the  
exchange services

10 target exchanges  
(January 2022- May 2023)  
40+  
(October 2024 - today)

SimilarWeb COinMarketCap

NAME	VOLUME	WEB TRAFFIC	EXCHANGE SCORE	YEAR	OFFICE	TRUST
Binance	\$215.9B	61.5M	9.9	2017	Cayman Islands	✓
Kraken	\$12B	4.8M	8.2	2011	U.S.A.	✓
Gemini	\$674M	1.5M	6.8	2014	U.S.A.	✓
LBank	\$22.9B	11.3M	6.7	2016	China	✗
Hotcoin	\$86.8B	7.3M	5.9	2017	Australia	✗
Bitmex	\$11.9M	892K	5.0	2014	Seychelles	✗
BTSE	\$15.8B	6.7M	4.8	2018	Virgin Islands	✗
HitBTC	\$14.9B	304.4K	4.2	2013	Virgin Islands	✗
Hotbit	\$2.3B	1M	3.3	2018	Estonia	✗
Changelly	\$11.6B	1.5M	3.2	2020	Seychelles	✗

# Transaction features

Open High Low Close



# Transaction features

## Order book (ask/bids)

Order book X		Market trades			
-	+ 0.10	Spread: 0,1 0,000%			
Total	Quantity	Price	Price	Quantity	Total
18,55362583	18,55362583	30,520,6	30,520,7	1,01761510	1,01761510
18,89755322	0,34392739	30,520,5	30,526,0	0,03275895	1,05037405
18,93874859	0,04119537	30,519,6	30,526,8	0,00100000	1,05137405
19,75765820	0,81890961	30,519,5	30,527,5	0,01000000	1,06137405
20,57656781	0,81890961	30,518,9	30,528,9	0,22599497	1,28736902
21,23169549	0,65512768	30,518,4	30,529,7	0,00011815	1,28748717
21,65669549	0,42500000	30,518,1	30,533,0	2,78039762	4,06788479
24,11535976	2,45866427	30,516,7	30,533,1	0,42500000	4,49288479
25,87257217	1,75721241	30,515,6	30,534,3	0,06550010	4,55838489
28,35790715	2,48533498	30,515,2	30,534,8	0,00686580	4,56525069
28,84940715	0,49150000	30,514,6	30,535,7	2,45614769	7,02139838
29,27440715	0,42500000	30,514,4	30,536,2	0,42500000	7,44639838
29,27790715	0,00350000	30,514,2	30,537,7	0,32582718	7,77222556
29,38083703	0,10292988	30,513,7	30,539,2	2,35819420	10,13041976
29,47383703	0,09300000	30,513,6	30,539,3	0,42500000	10,55541976
29,47547603	0,00163900	30,513,3	30,540,2	0,09180000	10,64721976
29,90047603	0,42500000	30,512,8	30,542,1	0,00558211	10,65280187
29,93718333	0,03670730	30,512,2	30,542,3	0,39200000	11,04480187
36,56443009	6,62724876	30,511,2	30,542,7	0,25000000	11,29480187
36,58593009	0,02150000	30,510,8	30,542,8	0,02340000	11,31820187

# Transaction features

## Trades

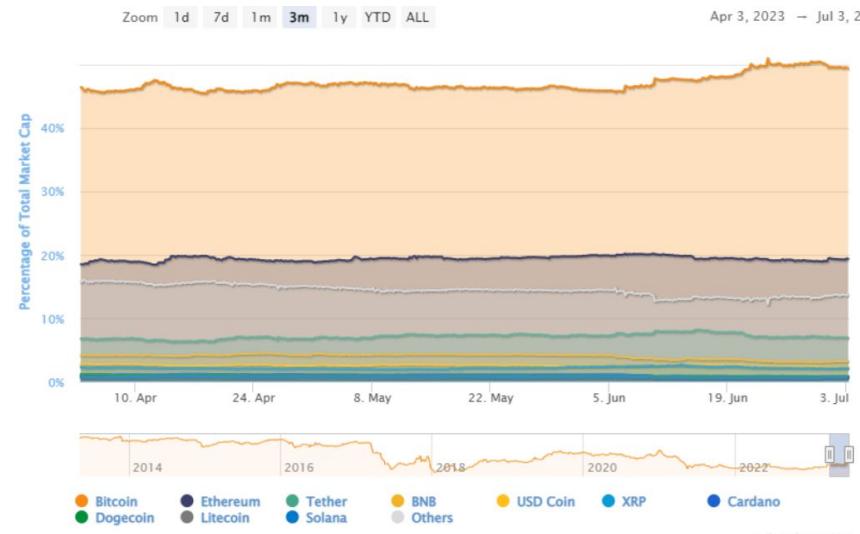
BTC/USD		Last price <b>30.516,2 USD</b>	Index price <b>30.524,0 USD</b>	24H Change <b>-0,19%</b>	24H Volume <b>468 BTC</b>	Fee <b>0,16% / 0,26%</b>	
Order book	Market trades						+
		Price			Quantity	Side	Time
		30.514,3			0,00010000	Buy	14:37:24
↑		30.514,3			0,00413178	Buy	14:37:02
		30.514,2			0,00247568	Sell	14:36:59
		30.514,2			0,00376817	Sell	14:36:59
↓		30.514,2			0,00635615	Sell	14:36:59
		30.514,3			0,00290289	Buy	14:36:55
		30.514,3			0,00030000	Buy	14:36:45
		30.514,3			0,00136638	Buy	14:36:24
		30.514,3			0,00010000	Buy	14:36:19
		30.514,3			0,00303640	Buy	14:36:03
		30.514,3			0,01287614	Buy	14:36:01
↑		30.514,3			0,00309957	Buy	14:35:57
		30.514,2			0,00011388	Sell	14:35:31
↓		30.514,2			0,01260000	Sell	14:35:29
		30.514,3			0,00010000	Buy	14:35:15
		30.514,3			0,00100000	Buy	14:35:07
		30.514,3			0,00245800	Buy	14:35:07

# Suspect behaviour analysis sample

# Tradable pairs

Traded pairs BTC-USD ETH-USD ADA-USD XRP-USD e ETH-BTC

	TRADES	BTC-USD	ETH-USD	ADA-USD	XRP-USD	ETH-BTC
Binance	114M	51.1%	30.6%	8.29%	5.34%	4.7%
Kraken	2.9M	63.1%	22.3%	7.16%	4.86%	2.56%
Gemini	704K	59.5%	37.2%	-	-	3.29%
LBank	9.6M	26.6%	23.6%	20.1%	8.84%	20.9%
Hotcoin	12M	42.8%	36.9%	8.17%	7.88%	4.29%
Bitmex	6.5M	60.6%	30.7%	3.2%	5.47%	-
BTSE	9.9M	27%	39.9%	15.9%	14%	3.25%
HitBTC	3M	30.1%	30%	10.9%	15.1%	13.8%
Hotbit	639K	41.8%	16.4%	13.9%	14.3%	13.6%
Changelly	2.6M	37.3%	21.5%	11.7%	15%	14.6%



# Benford's Law ("First Digit Law")

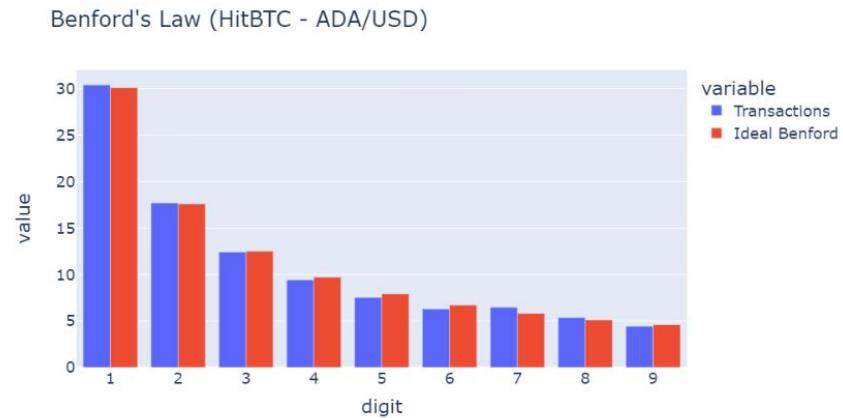
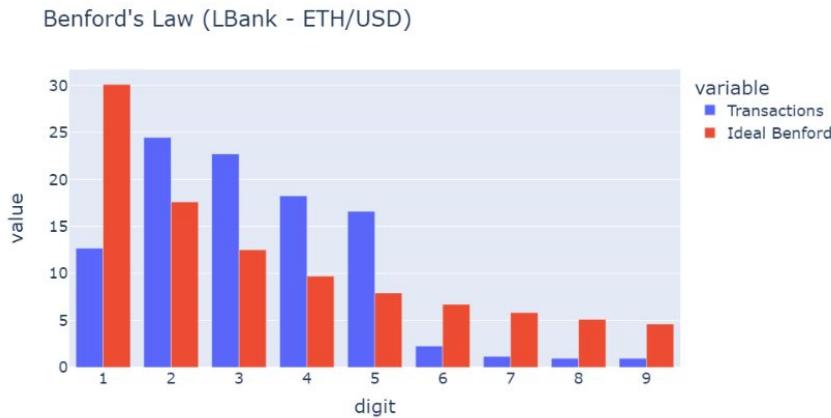
Numbers starting with a certain digit decrease logarithmically as the digit increases

Average deviation on trade value (price of the coin times the amount traded)

	BTC-USD	ETH-USD	ADA-USD	XRP-USD	AVERAGE
Binance	2.65%	1.84%	0.86%	1.08%	1.6%
Kraken	1.72%	1.47%	1.8%	0.89%	1.47%
Gemini	3.18%	3.43%	-	-	3.3%
LBank	6.75%	7.62%	5.18%	2.39%	5.48%
Hotcoin	0.94%	0.53%	0.76%	0.42%	0.66%
Bitmex	2.85%	2.52%	1.07%	1.52%	1.99%
BTSE	6.06%	5.46%	3.53%	4.09%	4.78%
HitBTC	2.22%	4.05%	0.3%	1.53%	2.03%
Hotbit	4.99%	4.52%	3.25%	3.52%	4.07%
Changelly	2.66%	5.9%	0.25%	1.51%	2.58%

# Benford's Law (“First Digit Law”)

Numbers starting with a certain digit decrease logarithmically as the digit increases

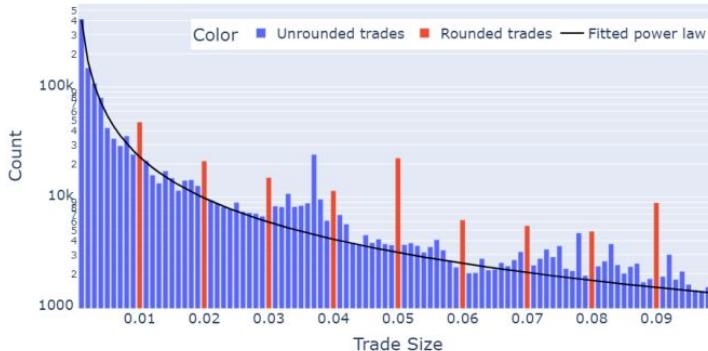


(a) Distribution of first digit (LBank - ETH/USD). (b) Distribution of first digit (HitBTC - ADA/USD).

# Round numbers bias

Number of trades

Trade Size Clustering (Kraken BTC/USD)



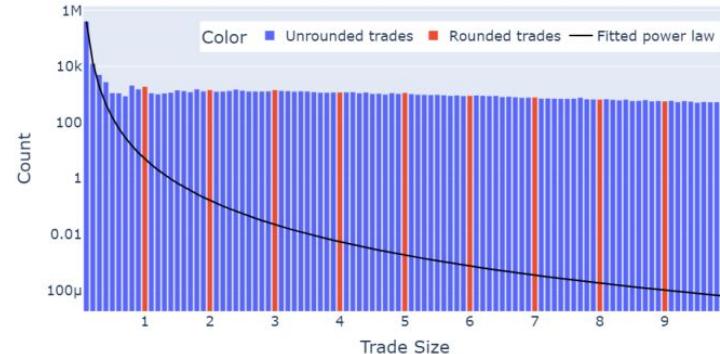
Trade Size Clustering (HitBTC - ETH/USD)



Trade Size Clustering (Binance BTC/USD)



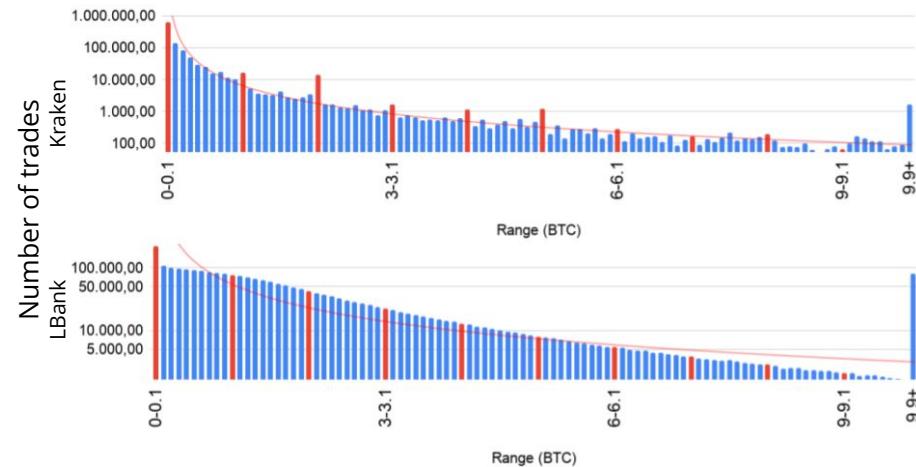
Trade Size Clustering (Changelly - ETH/USD)



# Round numbers bias

Student's independent t-test

t-value: ratio of the difference between the sample means to the variance within the samples

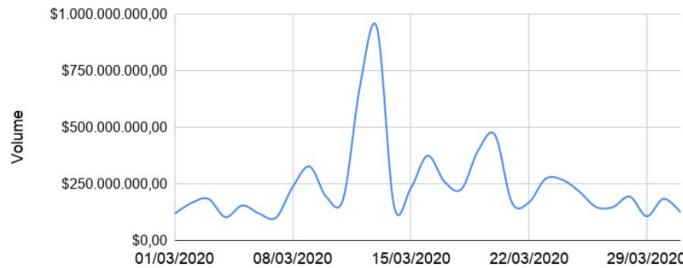


2.12 statistical threshold wrt null hypothesis

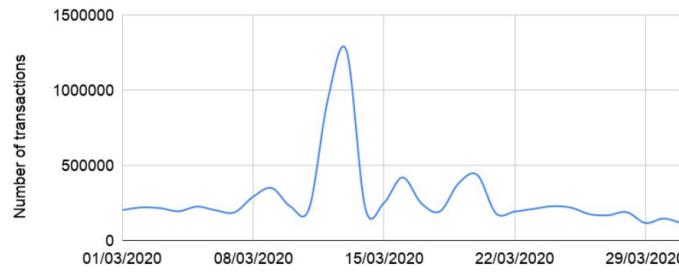
	BTC-USD	ETH-USD	ADA-USD	XRP-USD
Binance	3.6	4.74	4.4	3.6
Kraken	4.47	7.1	5.024	4.13
Gemini	3.12	3.82	-	-
LBank	2.15	0.8	1.53	0.11
Hotcoin	1.5	1.5	0.92	1.67
Bitmex	0.52	2.07	0.41	0.48
BTSE	29.3	1.24	2.5	1.23
HitBTC	1.75	1.29	0.69	1.42
Hotbit	1.05	2.33	1.23	0.31
Changelly	1.58	1.78	0.39	1.51

# Pearson correlation

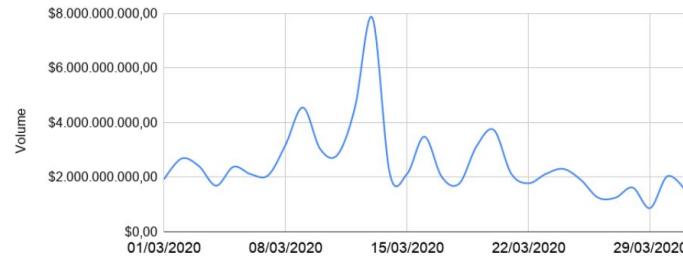
## Number of trades - traded volume



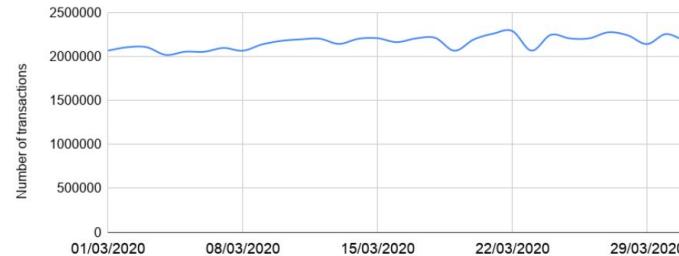
(a) Reported volume by Kraken.



(b) Number of transactions reported by Kraken.



(a) Reported volume by LBank.



(b) Number of transactions reported by LBank.

# Pearson correlation

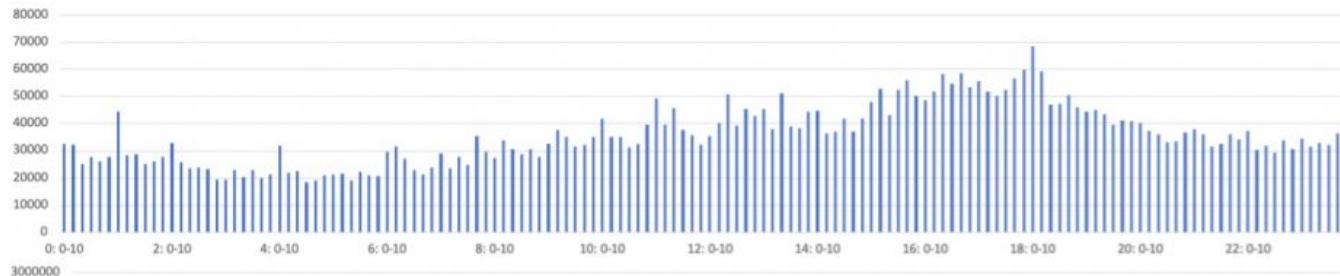
Number of trades - traded volume

	BTC-USD	ETH-USD	ADA-USD	XRP-USD	AVERAGE
Binance	0.96	0.98	0.99	0.97	0.97
Kraken	0.92	0.95	0.91	0.91	0.92
Gemini	0.81	0.77	-	-	0.79
LBank	0.77	0.57	0.47	0.5	0.57
Hotcoin	0.44	0.45	0.33	0.35	0.39
Bitmex	0.82	0.84	0.36	0.73	0.68
BTSE	0.96	0.93	0.95	0.93	0.94
HitBTC	0.64	0.52	0.46	0.67	0.57
Hotbit	0.75	0.88	0.71	0.7	0.76
Changelly	0.53	0.69	0.29	0.62	0.53

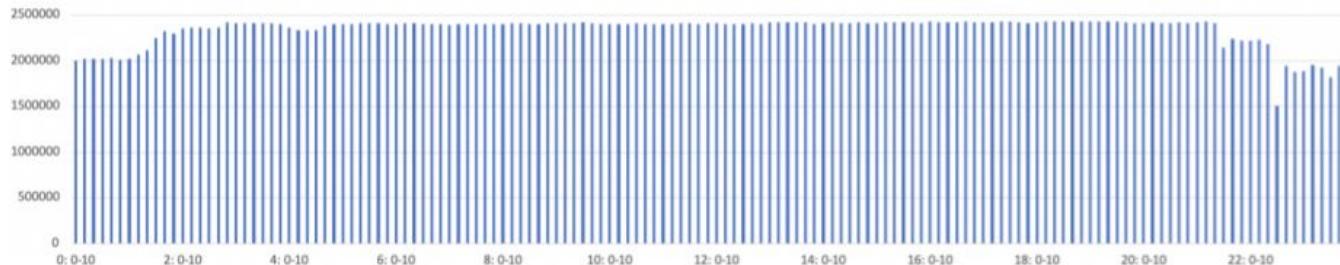
# Trade times

Number of trades by timestamp during the day

Kraken



LBank



# Our work

Beyond the “statistical” approach.

“On chain deanonymization” correlation.

# Questions

