

Cryptos, NFTs, Digital Assets

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lvb.wiwi.hu-berlin.de

blockchain-research-center.com

Charles University, WISE XMU, NYCU 玉山學者

Hayek (1976) The Denationalization of Money

Instead of a national government issuing a specific currency,..., private businesses should be allowed to issue their own forms of money, deciding how to do so on their own. (From Wikipedia)



大元 Yuan Dynasty 1279+

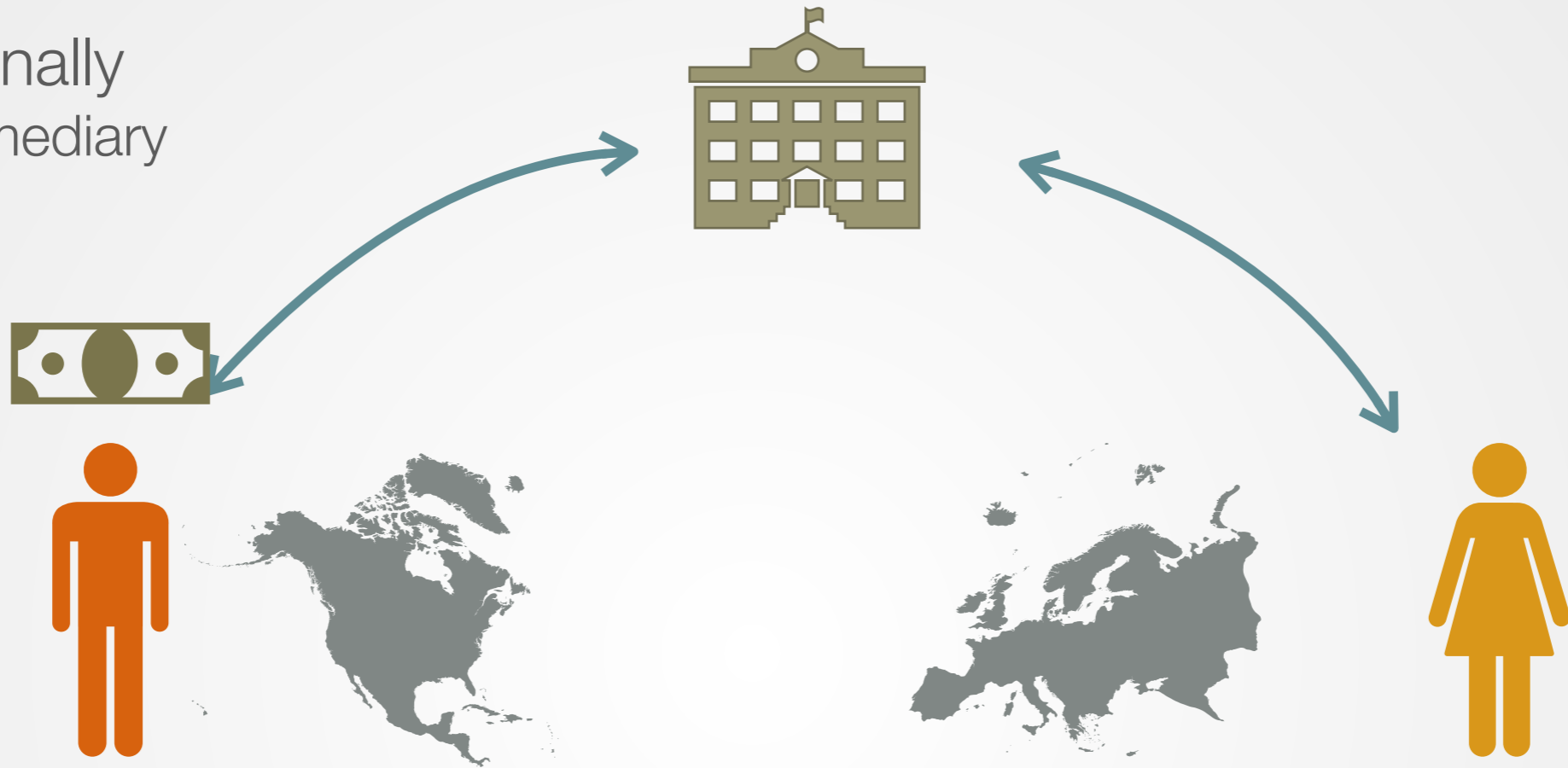


	USD	USD/EUR	EUR
USD	350,00 \$	1,1372	307,77 €
USD	350,00 \$	1,7047	205,31 €
P/L			-102,46 €

Verwendungszweck 1:	Interne Buchung
Verwendungszweck 2:	TRN/Re-Nr. 180607ABIB37267
Verwendungszweck 3:	TRN/MSG 180509ABSE34901
Verwendungszweck 4:	HU Jerusalem USD 350,00
Verwendungszweck 5:	Kurs EUR/USD 1,185100
Verwendungszweck 6:	EUR 295,33
Verwendungszweck 7:	Verwendungszweck:
Verwendungszweck 8:	Gutschrift Ihres zum Inkass
Verwendungszweck 9:	o
Verwendungszweck 10:	eingereichten Auslandsschec
Verwendungszweck 11:	ks-
Verwendungszweck 12:	Nr. 467640275 ueber 350,00
Verwendungszweck 13:	USD
Verwendungszweck 14:	abzueglich Eigen- und Fremd
Verwendungszweck 15:	entgelt
Verwendungszweck 16:	Abrechnung:
Verwendungszweck 17:	Courtage
Verwendungszweck 18:	EUR 2,50
Verwendungszweck 19:	Scheckverkehr/Gutschr. n.E
Verwendungszweck 20:	EUR 25,00
Verwendungszweck 21:	Fremdentgelt Dokumenteninka
Verwendungszweck 22:	EUR 62,52
Verwendungszweck 23:	Endbetrag
Verwendungszweck 24:	HU Berlin EUR 205,31
Verwendungszweck 25:	USt-IdNr.: DE 143589235
Verwendungszweck 26:	USt-befreite Finanzdienstl.



Traditionally
with intermediary



Now
permissionless,
decentralized, 24/7



20220604

<https://on.ft.com/3NhR7hS>

F Villeroy de Galhau, BdF:
I could say it this a way,
unregulated cryptos are so to say
a stimulator to general innovation

Opinion **Central banks**

CBDCs now hold wholesale appeal for central bankers

The slow nature of current cross-border payments systems creates an opportunity for blockchain technology

GILLIAN TETT [+ Add to myFT](#)





Berlin - Room 77

2011: „I believe in honest money, Gold, Silver and Bitcoin“.

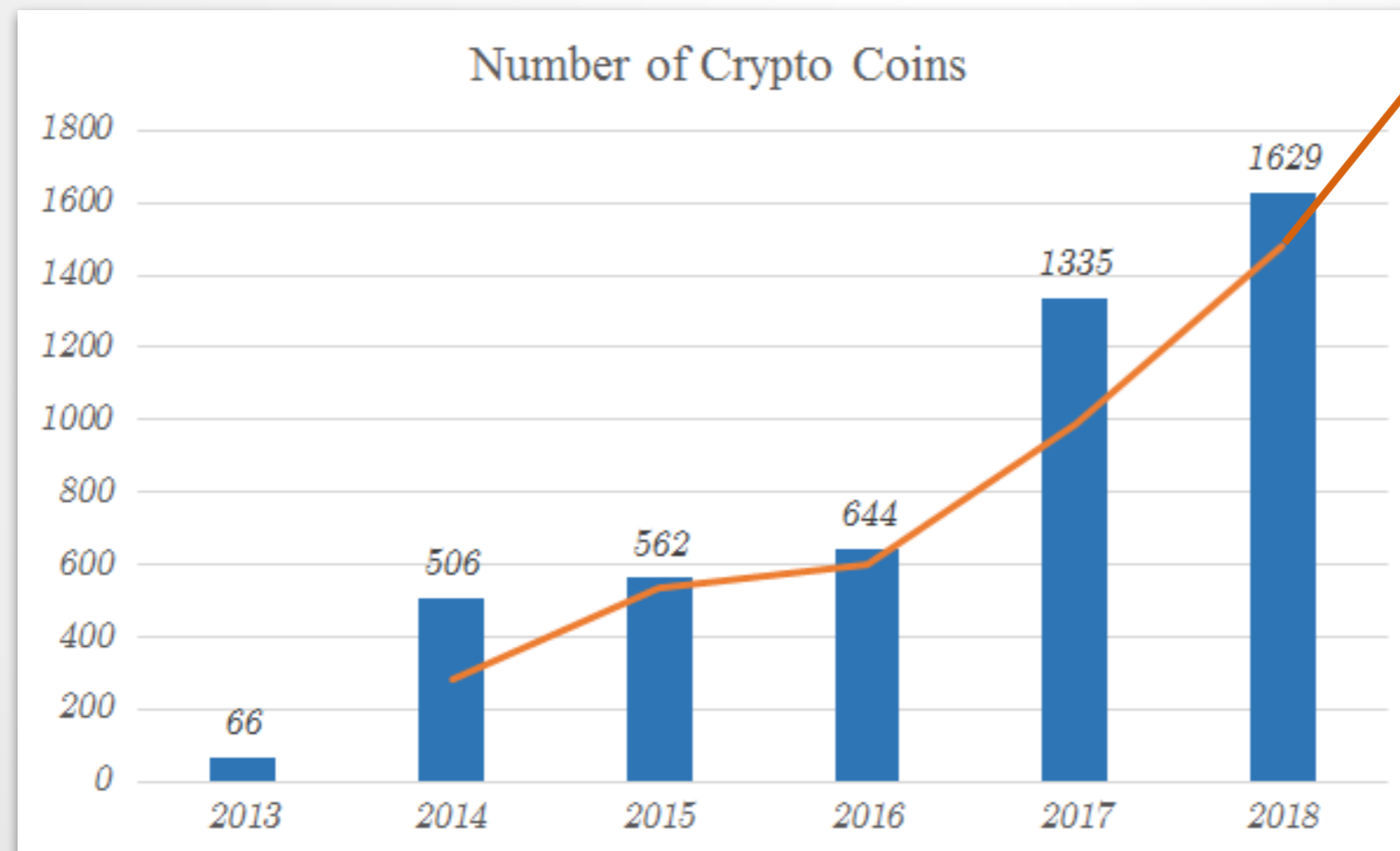
Outline

1. Motivation ✓
2. Cryptos
3. NFTs
4. Digital Assets
5. Risks and chances
6. Blockchain-Research-Center.com
7. References

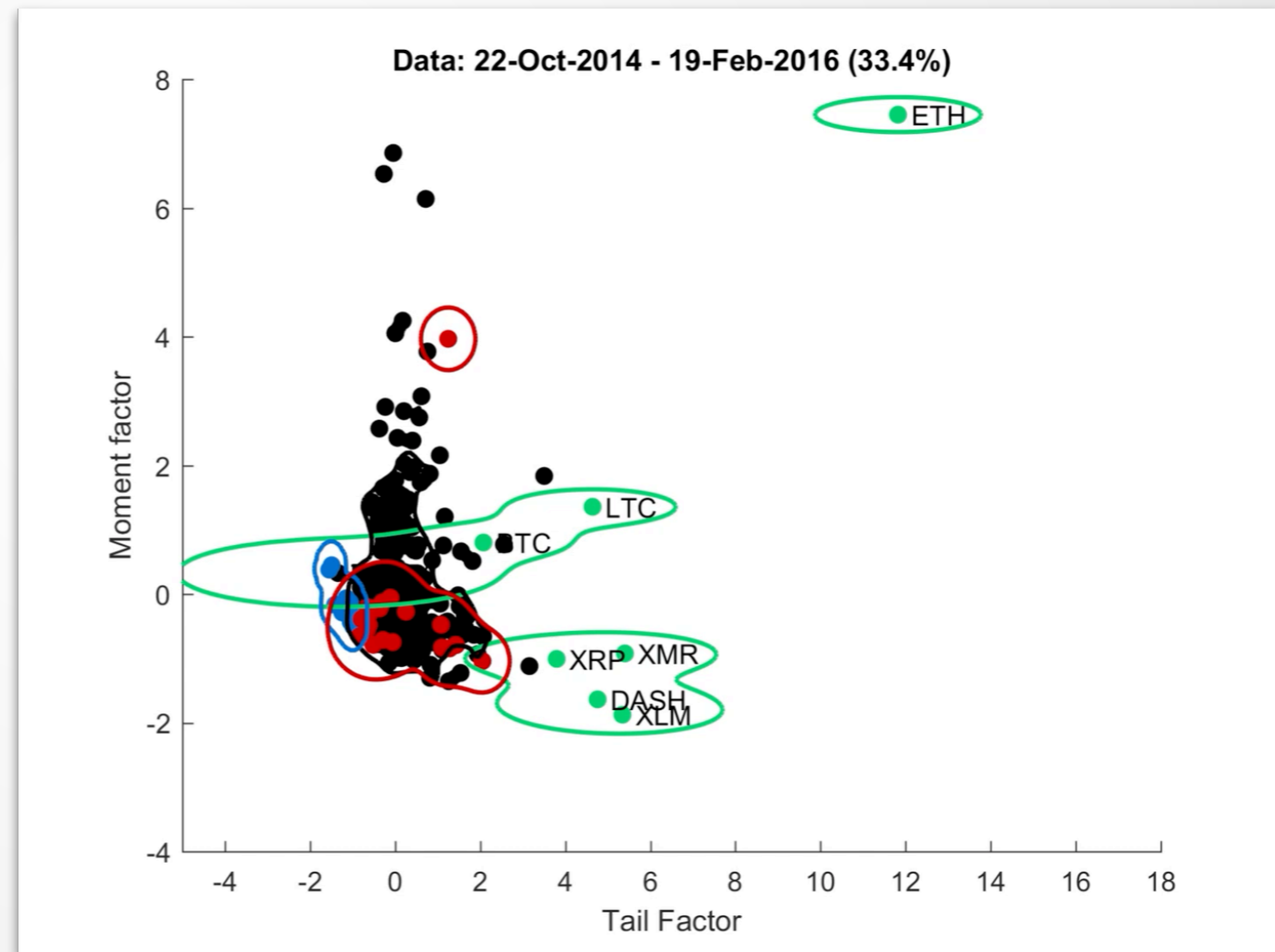
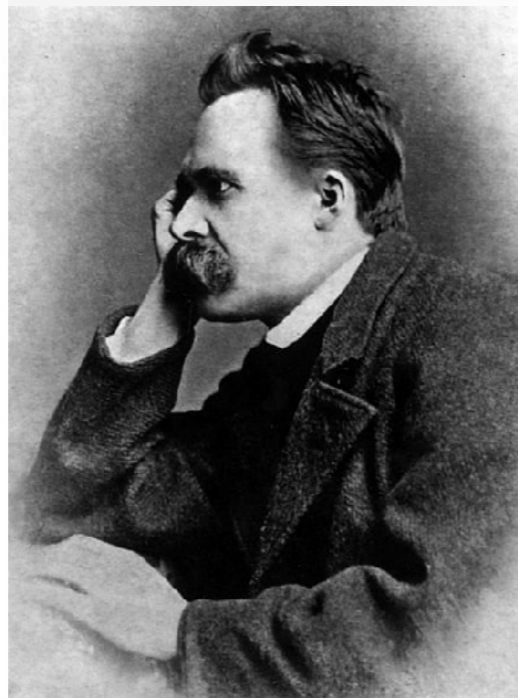
Emerging Cryptocurrencies

- CoinMarketCap.com : Actively Trading: >1000 CCs
- 20181115: \$ 98,151,606,541
- 20191206: \$ 201,108,754,538
- 20210324: \$ 1,499,642,521,153
- 20220614: \$ 931,959,622,606,869

20190530: 2213
20191206: 4890
20210324: 8936
20220614: 19855



- ▣ CCs, Commodities, FX rate, Stocks (23 dimensions)
- ▣ Quantile (0.5, 1, 2.5, 5, 95, 97.5, 99, 99.5) %
- ▣ Expected Shortfall ES (0.5, 1, 2.5, 5, 95, 97.5, 99, 99.5) %
- ▣ Skew, Kurt, Var, stable, AR(1), Hurst Exponent
- ▣ Tail + Moment Factor

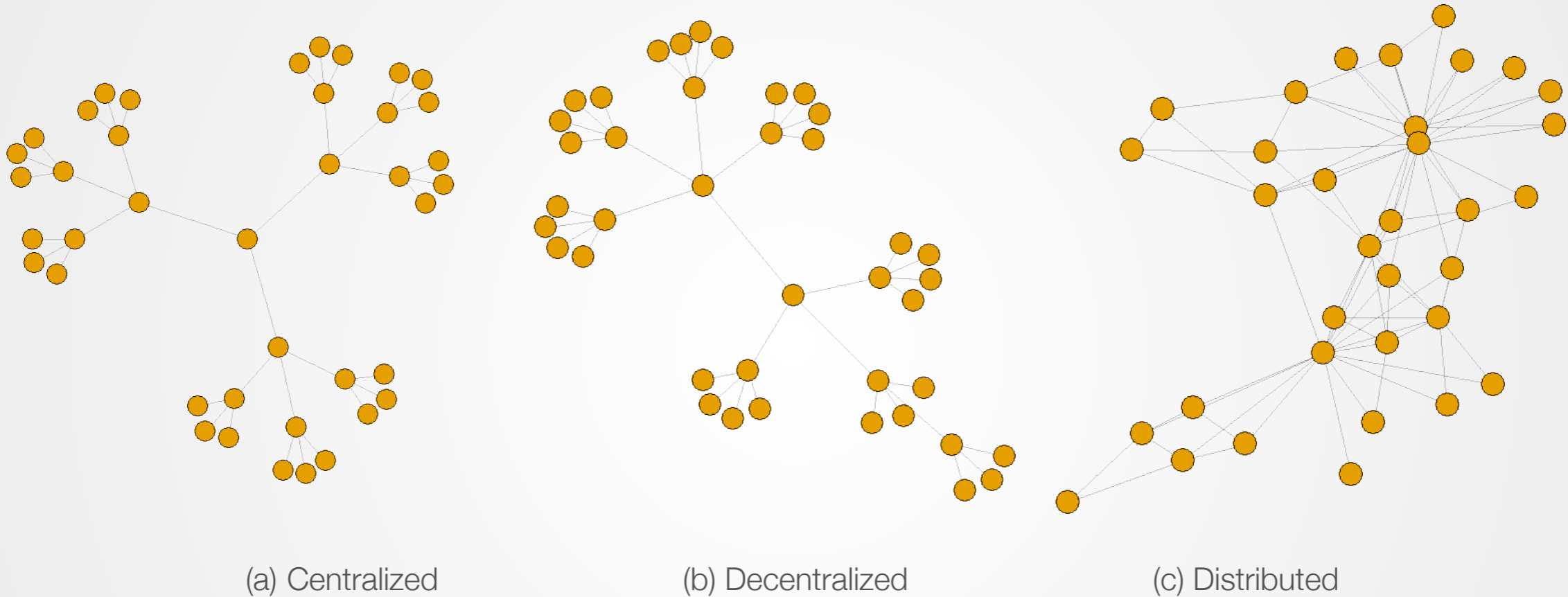


20141004 - 20181016 weekly data

input from Daniel Pele



Network fundamentals



Types of networks

How to run a network with increasing nodes/participants?

Consensus, Trust, Incentives for participation



input from Rafael Reule

SHA-256 Unique Output

In 1: Hello CRIX

Out 1: 4e0f6bbff658b4b12b01e5b5dc766316104b5cbbd1666284a61ee6ab39185823

In 2: Hallo CRIX

Out 2: 0f2de5d947b5780ab1b0cc4bae36268f4481eafa24b5bf7c6527bda7758ef2df

In 3: Asia is wonderful!

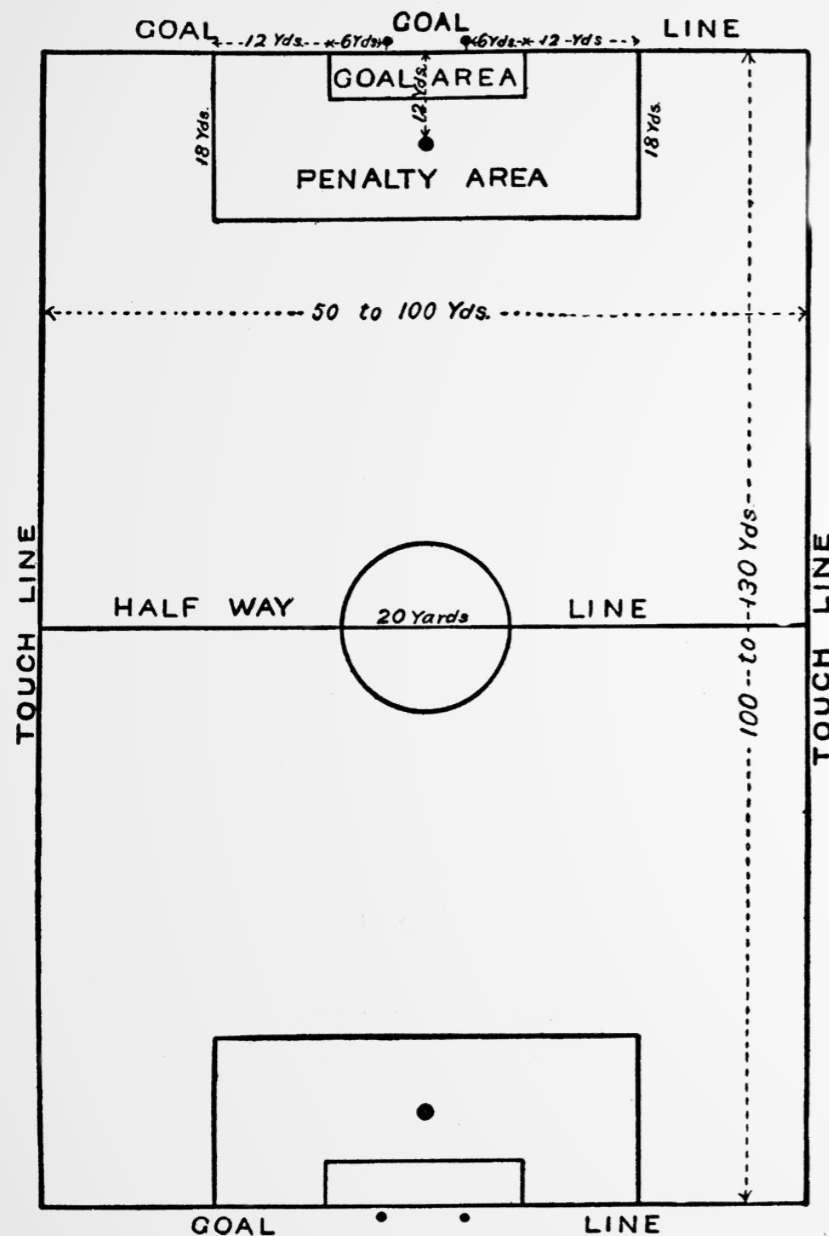
Out 3: d77146c8ca175d408173938a1b0568f6baae10ba46518b93682b3284dce85ff2

R package = `digest(„sha256“)`

```
library(digest)
digest("Asia is wonderful!", algo="sha256")
```



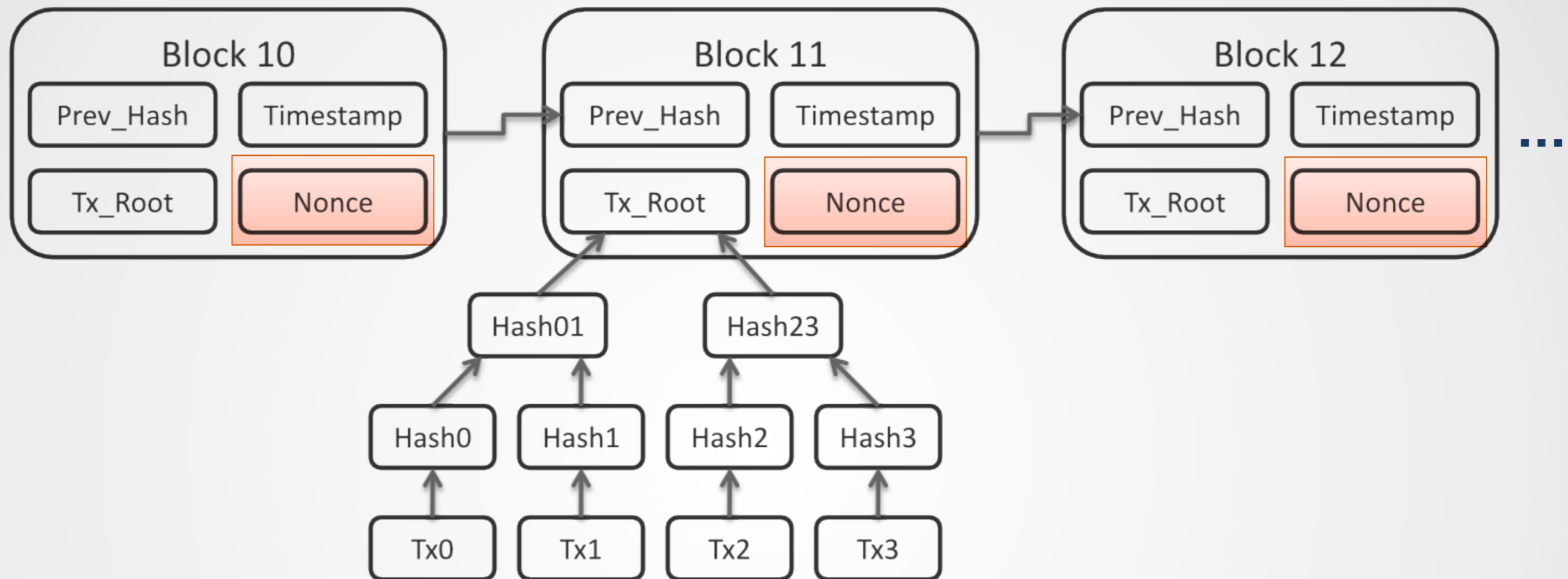
SHA-256 Maximum Theoretical Input



- Assume: **1 bit = 1 mm²**.
- Soccer field dimension = **7140 m²**.
- Then **2⁶⁴-1** bits fill **258357760136** soccer fields.
- The whole surface of the earth equals to **510072000000000 m² = 510072000 km²**
- Max theoretical input is therefore **36170** times the earth surface

<https://en.wikipedia.org/wiki/Earth>

BTC block creation & the „nonce“



- **BTC = proof-of-work** (everybody can participate) = nonce **N** & target value **t**
- **Nonce** = random number, leading to a **value lower than the target value given**
Target value = number of leading zeroes in a hash
- **Search for the „right“ nonce = brute force lottery**
immense amounts of computing power, single or „pooled“ **needed** to find the right nonce as fast as possible before the competition finds it

- „**Difficulty**“ = „**Find a hash with specified number of leading zeroes**“
i.e. here „**find 12 leading zeroes**“ (before the competition does)
- **Aim = Block creation every 10 minutes on average (BTC System)**
If blocks are being created too fast or too slowly, then the difficulty (the number of leading zeroes) is adjusted
- „**right**“ hash = **hard to find, easy to validate with given nonce (POW)**

In: $h + N_1$

Out: **00**da7e9f36f14c85a242a8113e53033ee5a9453d57dc7af26a6444a8e2704e99

In: $h + N_2$

Out: **0000000**dbae88544b993330777f448112f7df2daa12227143a74821bb315b9de

...

In: $h + N_{356}$

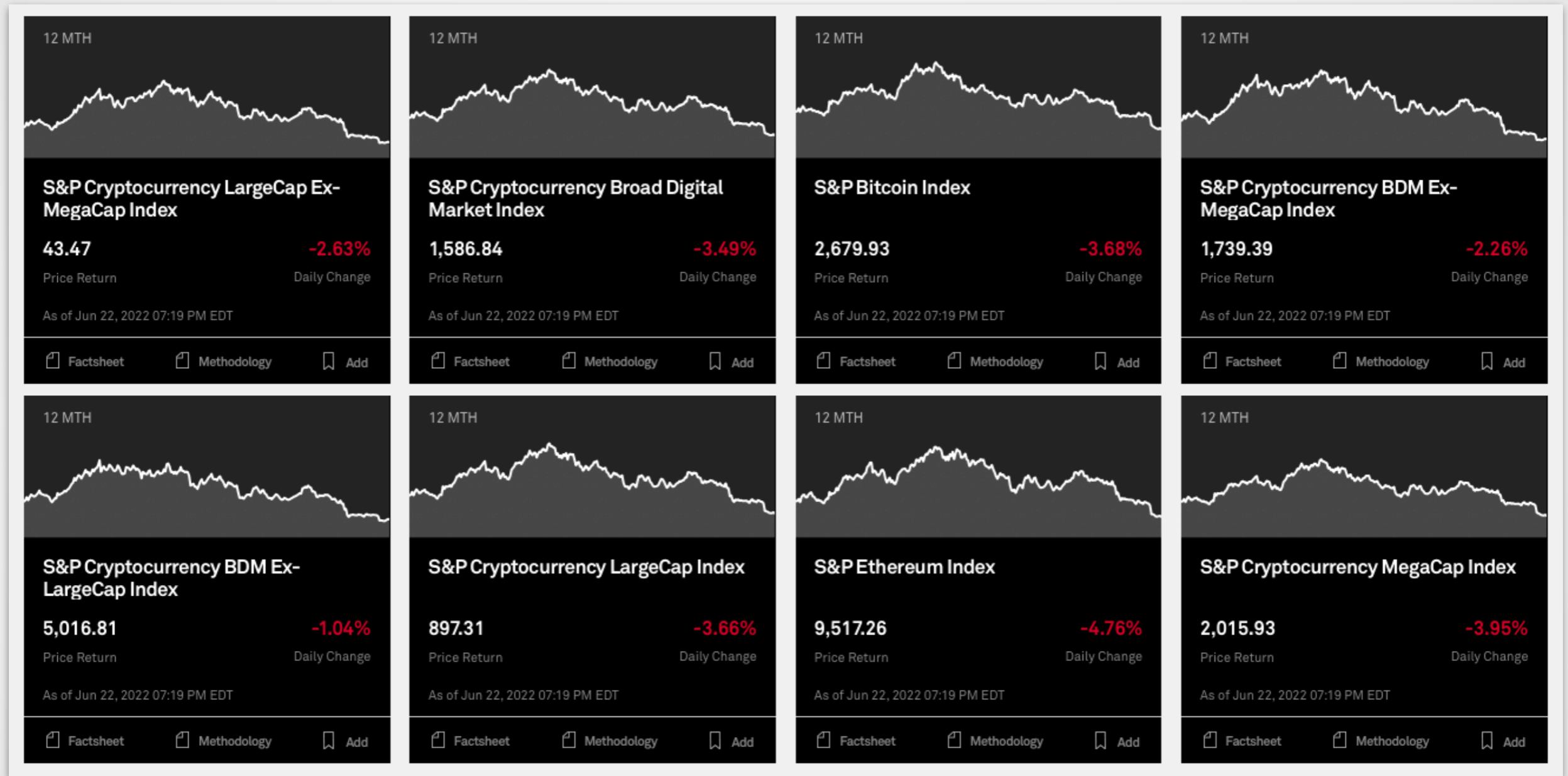
Out: **0000000000000**38b6ad3811370fe06b9a5854ebc62280e54a7dd6cf001a3505e3

In: $h + N_{357}$

Out: **0000000**db5e8d544b993a30737eae8112f7df2daa122f7143a74821bb315b911

$$h_{\text{BTC}} = H_{\text{BTC}} (m_{\text{Prehash+Timestamp+List of transactions}} + \boxed{N}) \leq t$$

Indices



20220623

<https://www.spglobal.com/spdji/en/index-family/digital-assets/cryptocurrency/#overview>

Indices

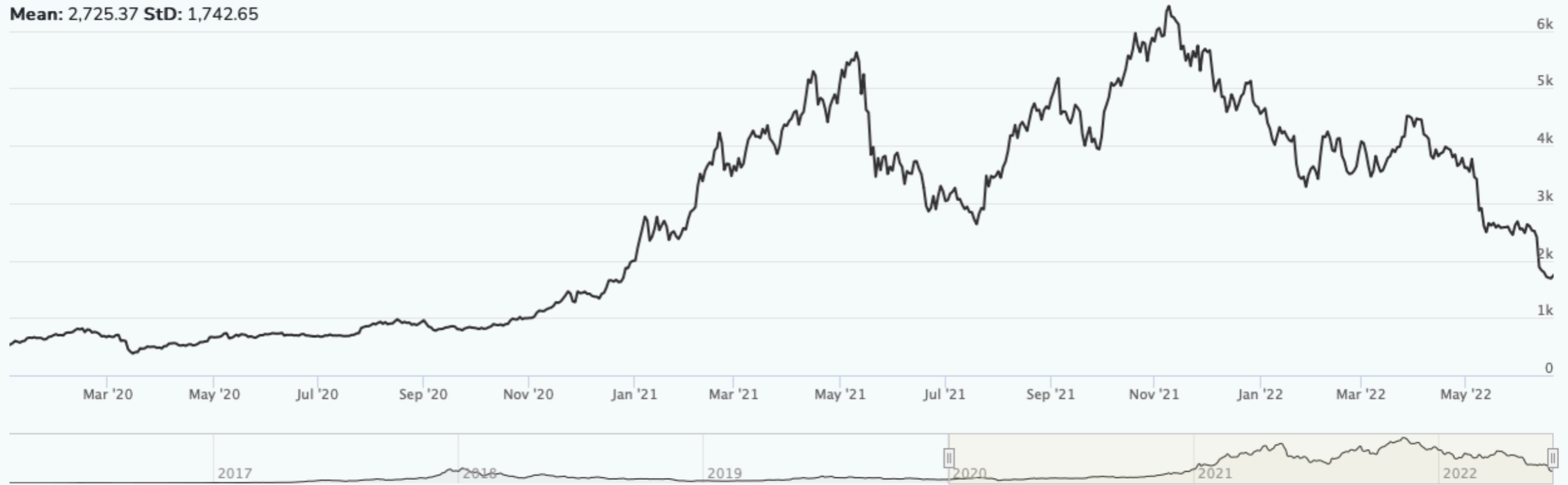


Royalton CRIX Index

Zoom 1m 3m 6m YTD 1y All

Jan 2, 2020 → Jun 21, 2022

Min: 379.71 Max: 6,434.41
Mean: 2,725.37 StD: 1,742.65



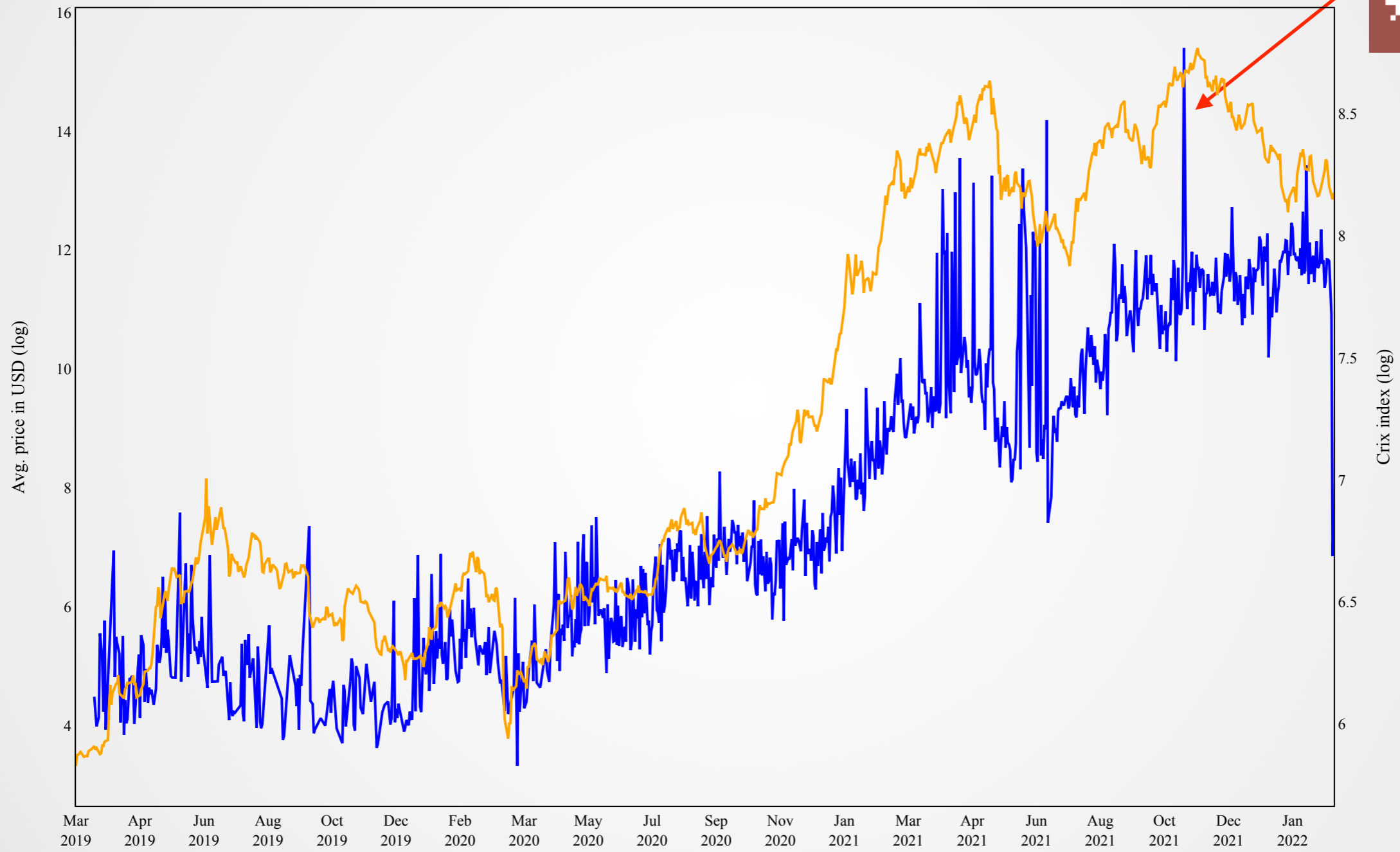
20220623

<https://www.royalton-crix.com>



Average Price & CRIX

CryptoPunk #9998



(2019-03-20, 2022-03-08)

— Avg. price — CRIX

input from Min-Bin LIN, Bingling WANG

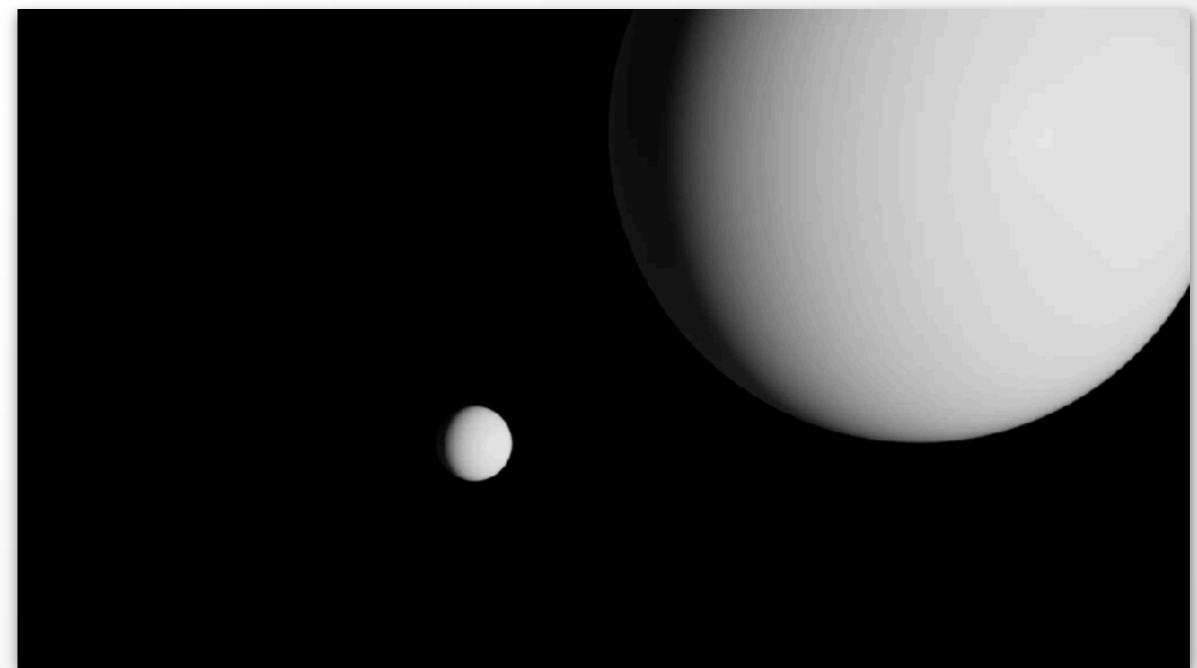


NFT Craze

- ▣ Marketcap: US\$ 41 billion in 2021 (30 % growth from 2020)
- ▣ Sales in conventional art market: US\$ 50 billion in 2020 (22% decline from 2019)
- ▣ Ease of access and anonymity



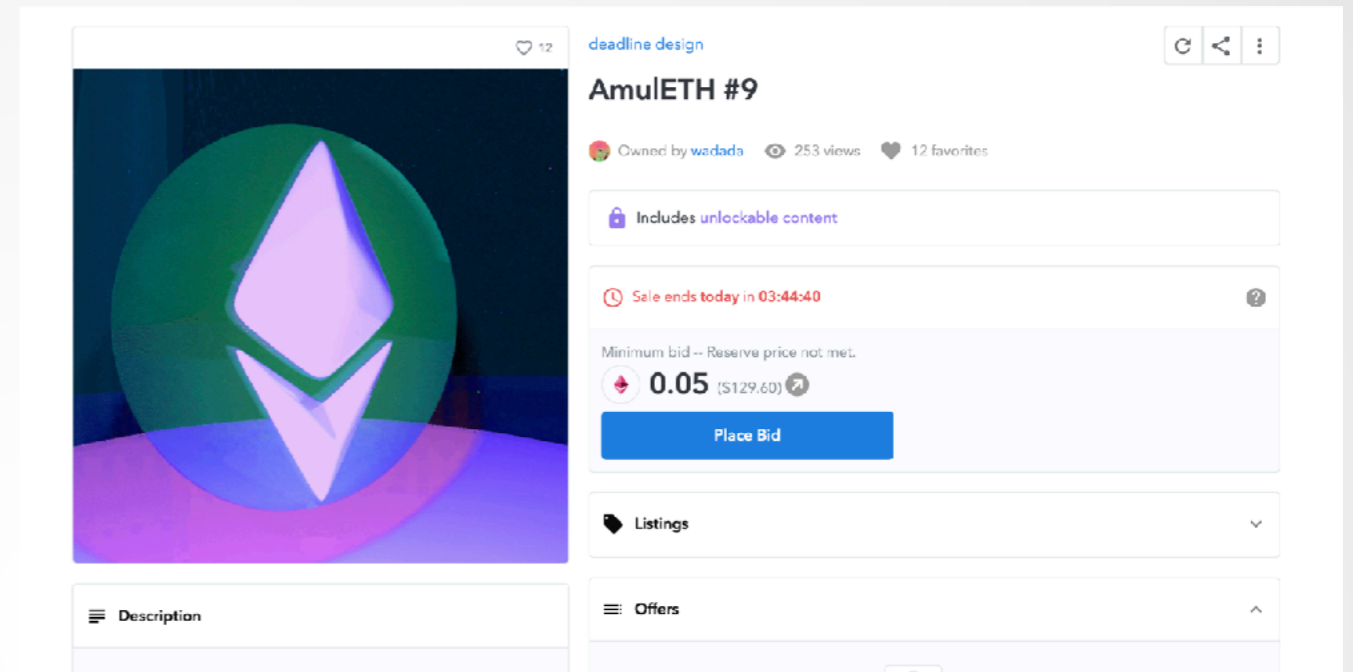
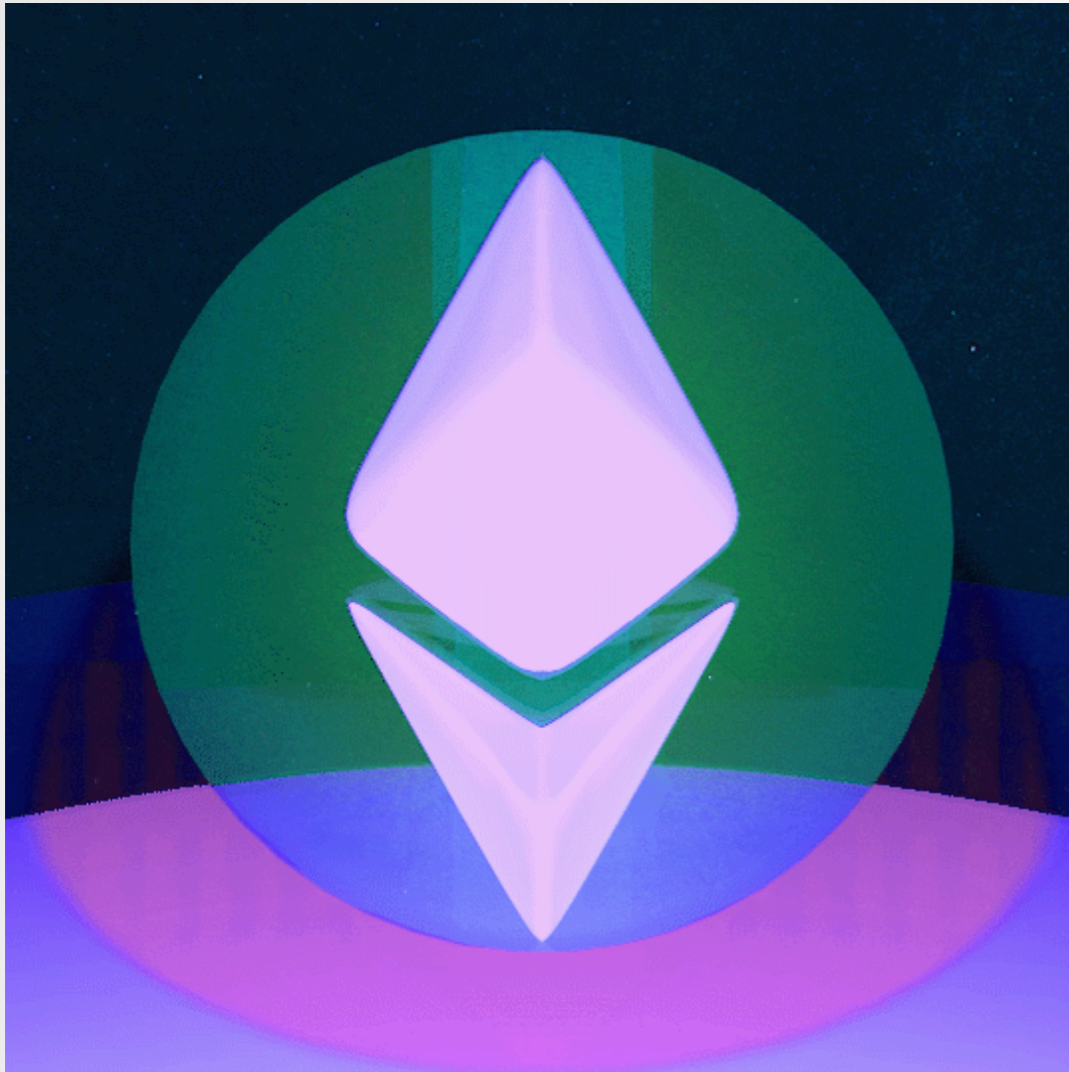
Leonardo da Vinci "Salvator Mundi" (c. 1500)
US\$ 475.4 million (2017)



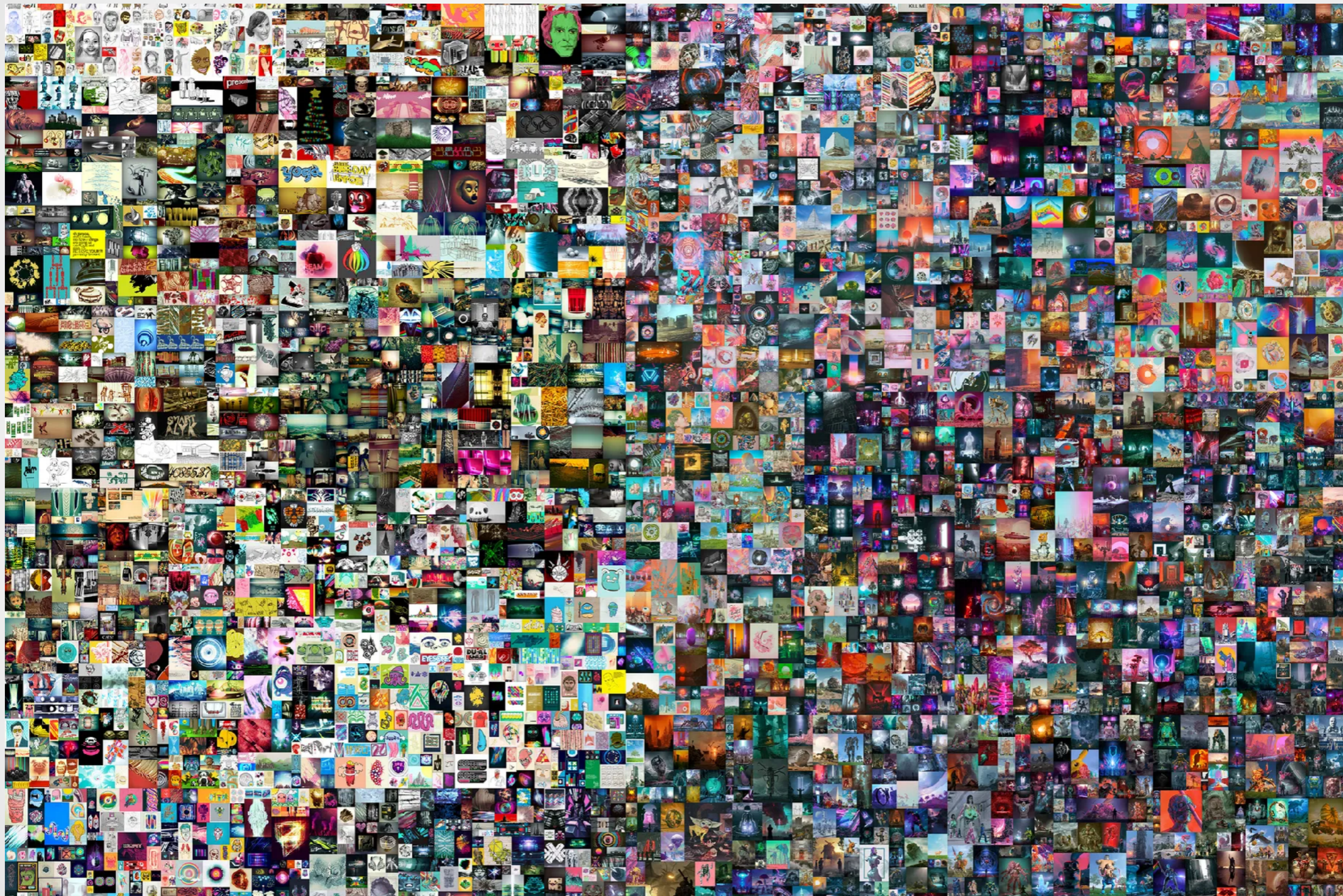
Pak "The Merge" (2021)
US\$ 91.8 million (2021)

Source: The Chainalysis 2021 NFT Market Report
<https://markets.businessinsider.com/news/currencies/nft-market-41-billion-nearing-fine-art-market-size-2022-1>

A GIF file for 0.05 ETH?



Beeple Everyday: the First 5000 Days



Sotheby: Sold 20210311 for USD 69,346,250

Satoshi's Goodbye (SuperRare)



Artist: Not Satoshi

Owner: muumi (2.0Ξ, \$743)

```
From: Satoshi Nakamoto <satoshin@gmx.com>  
Date: Sat, Apr 23, 2011 at 3:40 PM  
To: Mike Hearn <mike@plan99.net>  
Subject: Re: Holding coins in an unspendable state for a rolling time window
```

```
>I had a few other things on my mind (as always). One is, are you planning on rejoining the  
community at some point (eg for code reviews), or is your plan to permanently step back from the  
limelight?
```

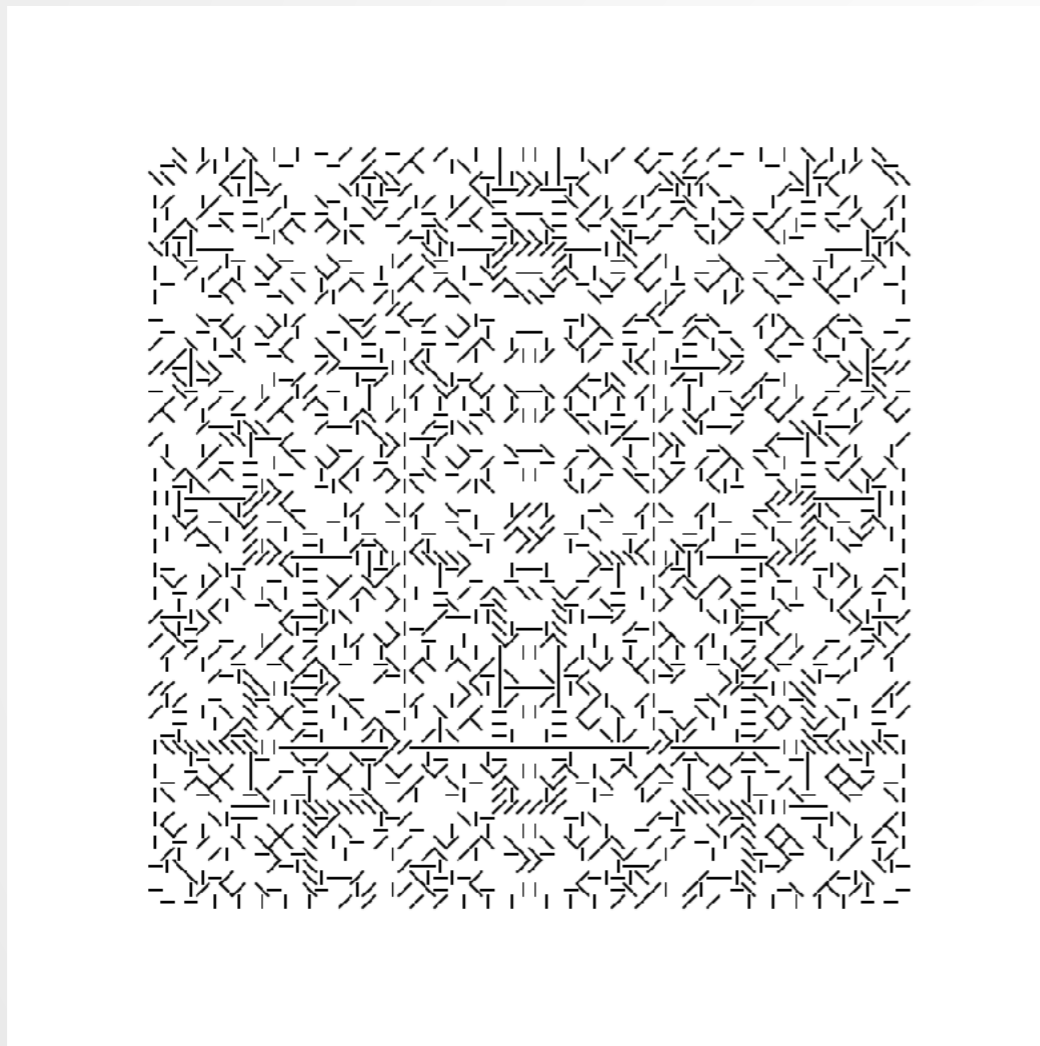
```
I've moved on to other things. It's in good hands with Gavin and everyone.
```

```
I do hope your BitcoinJ continues to be developed into an alternative client. It gives Java devs  
something to work on, and it's easier with a simpler foundation that doesn't have to do everything.  
It'll get critical mass when impatient new users can get started using it while the other one is  
still downloading the block chain.
```

<https://www.bitcoin.com/satoshi-archive/emails/mike-hearn/16/#selection-25.0-25.798>

Autoglyph #423

- On-chain generative art on the Ethereum blockchain
- Limited to 512 Autoglyphs
- Creation fee (0.20Ξ, \$521) goes to charity (350.org, 0x50990F09d4)



Source: larvalabs.com

```
// The following code generates art.  
  
function draw(uint id) public view returns (string) {  
    uint a = uint(uint160(keccak256(abi.encodePacked(idToSeed[id]))));  
    bytes memory output = new bytes(USIZE * (USIZE + 3) + 30);  
    uint c;  
    for (c = 0; c < 30; c++) {  
        output[c] = prefix[c];  
    }  
    int x = 0;  
    int y = 0;  
    uint v = 0;  
    uint value = 0;  
    uint mod = (a % 11) + 5;  
    bytes5 symbols;  
    if (idToSymbolScheme[id] == 0) {  
        revert();  
    } else if (idToSymbolScheme[id] == 1) {  
        symbols = 0x2E582F5C2E; // X\  
    } else if (idToSymbolScheme[id] == 2) {  
        symbols = 0x2E2B2D7C2E; // +-|  
    } else if (idToSymbolScheme[id] == 3) {  
        symbols = 0x2E2F5C2E2E; // \  
    } else if (idToSymbolScheme[id] == 4) {  
        symbols = 0x2E5C7C2D2F; // \|-/  
    } else if (idToSymbolScheme[id] == 5) {  
        symbols = 0x2E4F7C2D2E; // 0|_  
    } else if (idToSymbolScheme[id] == 6) {  
        symbols = 0x2E5C5C2E2E; // \  
        .  
        .  
        .  
    }  
}
```

Drawing function from the Solidity contract

Understanding the NFT Market?

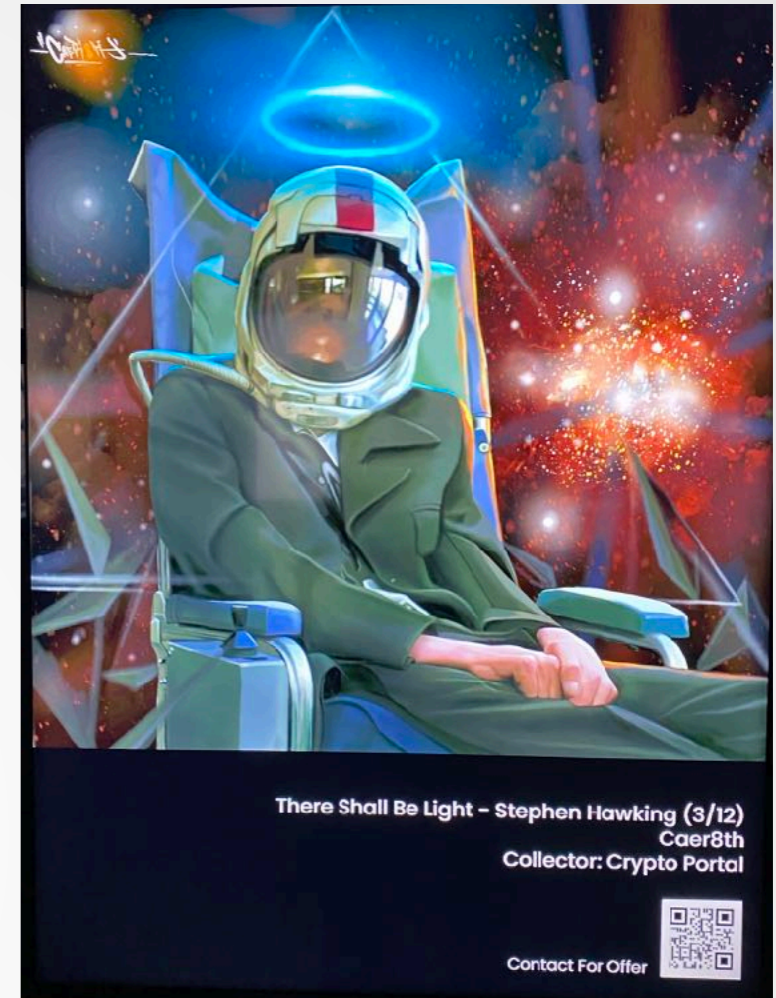
- ▣ Boom caused by Covid pandemic?!
- ▣ Adoption of cryptocurrency!
- ▣ Liquidity depends on collection
- ▣ Fair value?!
- ▣ Participants have preferences!



NFT Museum "Go! NFT Berlin (Game over)" in Nollendorfplatz

Source: <https://www.gonft.berlin/>

Cryptos, NFTs, Digital Assets



20220124 NFT Gallery Prague, CZ

Art Market Share USD

Collection	Volume	24h %	7d %	Floor Price	Owners	Assets
1 CryptoPunks	200,238.79	-16.83%	+29.31%	---	2.6K	10.0K
2 Rarible	89,774.44	+267.87%	+37.69%	---	159.6K	> 1 billion
3 SuperRare	38,500.66	-15.61%	+56.22%	0.15	4.3K	24.1K
4 Bored Ape Yacht Club	36,996.83	-16.20%	+532.75%	7.66	4.5K	10.0K
5 Hashmasks	30,945.37	+30.25%	+37.77%	0.51	4.5K	6.4K
6 Art Blocks Curated	20,510.39	-69.45%	+476.74%	0.3	4.0K	31.1K
7 MakersPlace	13,801.3	+2.53%	+48.13%	0.02	10.8K	68.7K
8 Wrapped Cryptopunks	8,923.75	---	-100.00%	5	30	233
9 Autoglyphs	8,729.01	---	+545.91%	94.44	137	512
10 BEEPLE: EVERYDAY...	5,165.34	---	-100.00%	20	126	722

20220626

Total NFT Market 12 207 760 170 USD
 Art NFT Market 4 000 000 000 USD

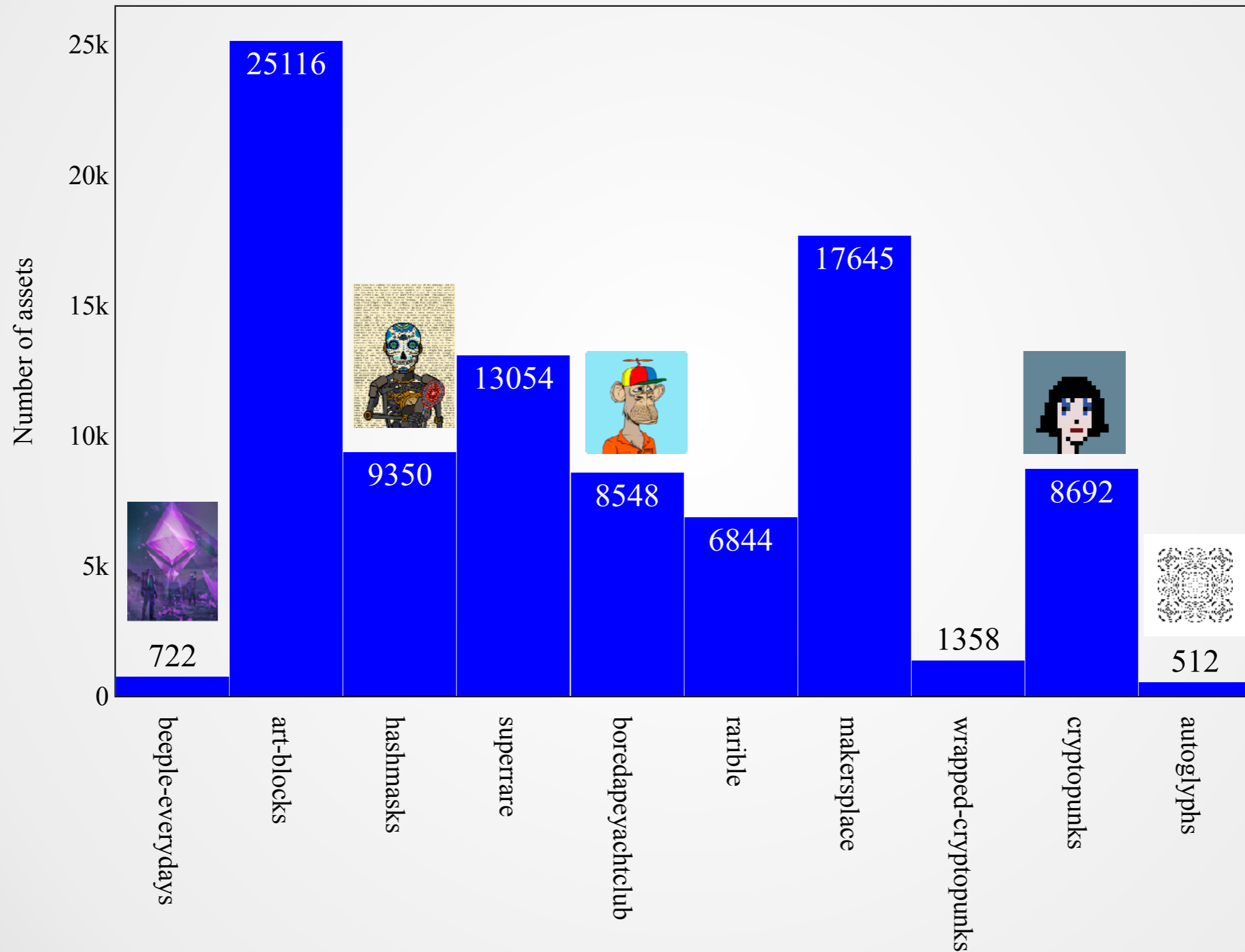
$$\frac{\text{Volume of 10}}{\text{Volume of total market}} = 83.71\%$$

20210815 art NFT snapshot

<https://coinmarketcap.com/nft/>

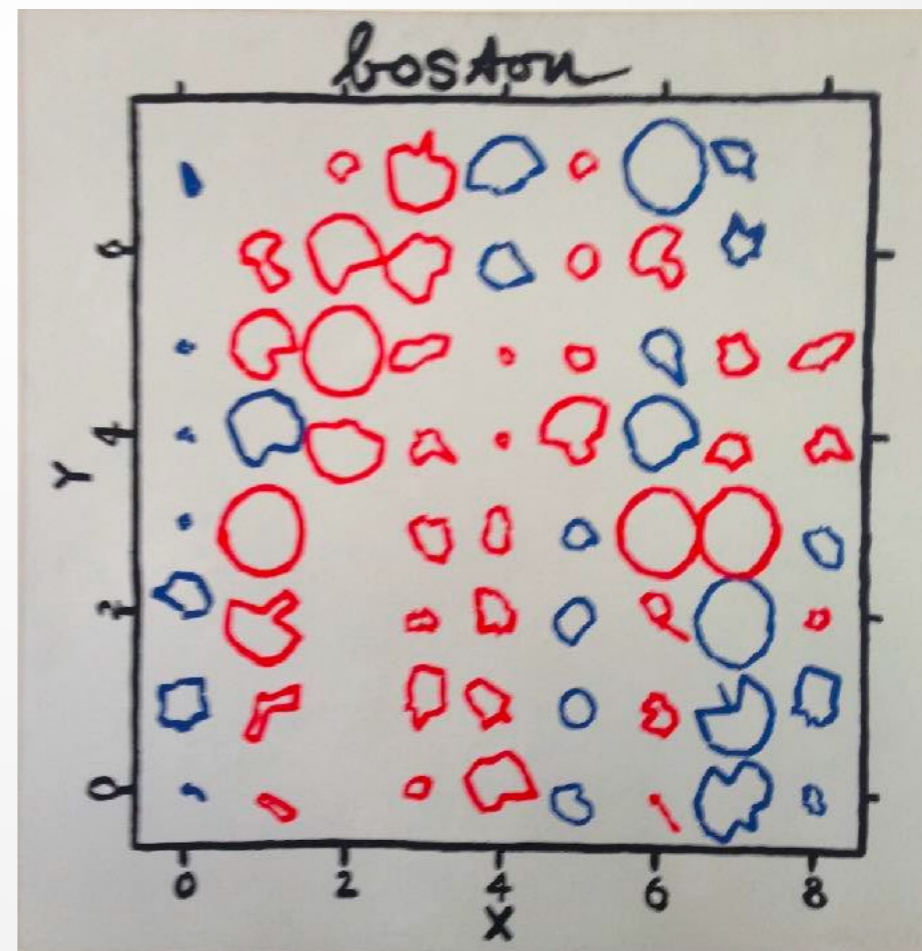


Asset Distribution



artnet

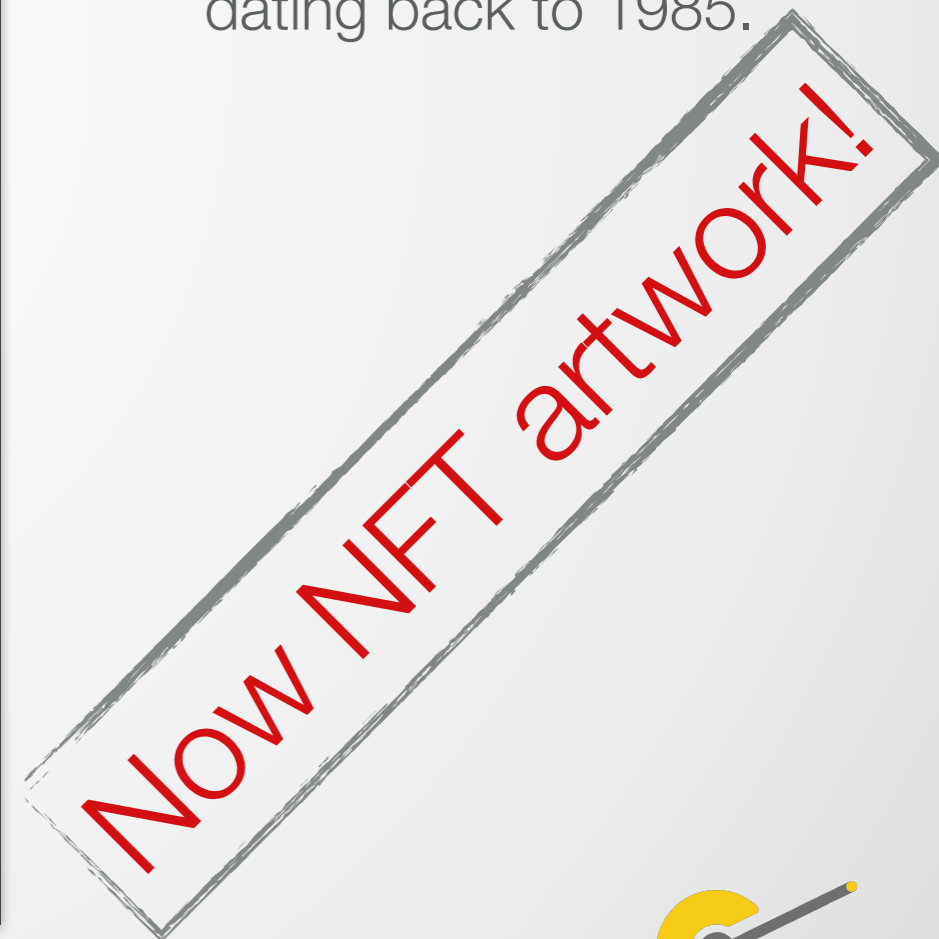
- ▣ International research and trading platform for the art market
- ▣ Services: online auctions, price database (comprehensive database of fine art prices), online gallery network, Artnet news
- ▣ Allow users to research art, contact galleries directly, and to attain price transparency in the art market






artnet

- Price Database is the art market research tool

From Michelangelo drawings to WKH Warhol paintings, Le Corbusier chairs to Banksy prints, you will find over 12 million color-illustrated art auction records dating back to 1985.



<input type="checkbox"/> 	<p>Title Medium Year of Work Size Misc. Sale of</p>	<p>Vincent van Gogh Portrait du Dr. Gachet Oil on Canvas 1890-1890 Height 26 in.; Width 22.4 in. / Height 66 cm.; Width 57 cm. Signed Christie's New York: Tuesday, May 15, 1990 [Lot 00021] Impressionist and Modern Paintings & Sculpture, Part II 40,000,000—50,000,000 USD ? 82,500,000 USD Premium ?</p>
<input type="checkbox"/> 	<p>Title Medium Year of Work Size Sale of</p>	<p>Vincent van Gogh Portrait de l'artiste sans barbe Oil on Canvas 1889-1889 Height 16.1 in.; Width 12.8 in. / Height 41 cm.; Width 32.6 cm. Christie's New York: Thursday, November 19, 1998 [Lot 00325] Twentieth Century Art No Estimate Received 71,502,496 USD Premium ?</p>
<input type="checkbox"/> 	<p>Title Description Medium Year of Work Size Sale of</p>	<p>Vincent van Gogh L'Allée des Alyscamps Estimate Upon Request Oil on canvas 36 1/8 by 28 7/8 in. 91.7 by 73.5 cm oil on canvas 1888 Height 36.1 in.; Width 28.9 in. / Height 91.7 cm.; Width 73.5 cm. Sotheby's New York: Tuesday, May 5, 2015 [Lot 00018] Impressionist & Modern Art Evening Sale No Estimate Received 66,330,000 USD Premium ?</p>

CryptoPunk








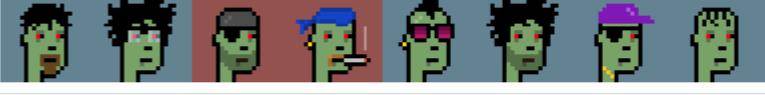

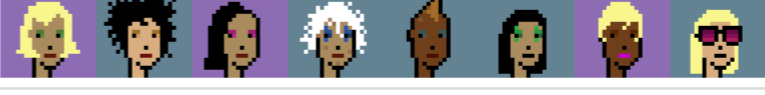


CryptoPunk Images
Source: larvalabs.com

- Cryptopunk a NFT non-fungible token
- Are there clusters in high dim?
- Dim reduction provides a good start







Wang B, Lin MB, Härdle WKH (2022) Understanding NFTs

Some Stats

Punk Types

Attribute	#	Avail	Avg Sale ①	Cheapest ①	More Examples
Alien	9	3	8KΞ	 10KΞ	
Ape	24	3	0	 4.16KΞ	
Zombie	88	4	1.05KΞ	 1.11KΞ	
Female	3840	506	56.27Ξ	 49.94Ξ	
Male	6039	825	68.43Ξ	 51.50Ξ	

Attributes

Attribute	#	Avail	Avg Sale ①	Cheapest ①	More Examples
Beanie	44	10	450Ξ	 399.69Ξ	
Choker	48	10	0	 135Ξ	
Pilot Helmet	54	11	164.50Ξ	 185Ξ	

Alien Id: 635, 2890, 3100, 3443, 5822, 5905, 6089, 7523, 7804

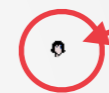
CryptoPunk types & attributes

Source: <https://cryptopunks.app/cryptopunks/attributes>

Image data: CryptoPunks



3777
Check on
interactive plot

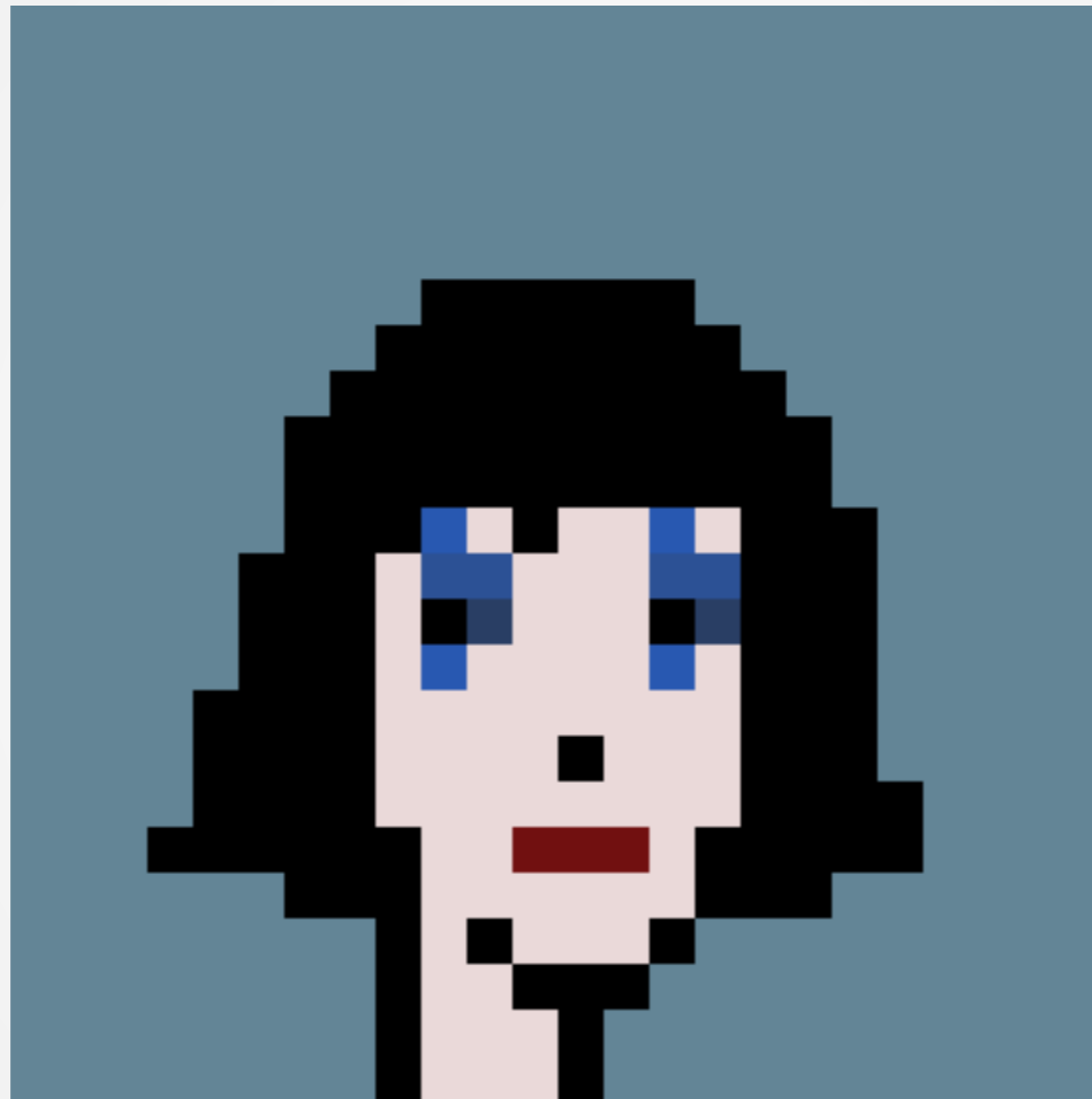


id the Aliens!

[Click here for interactive plot](#)



An isolated punk



an isolated Punk?!

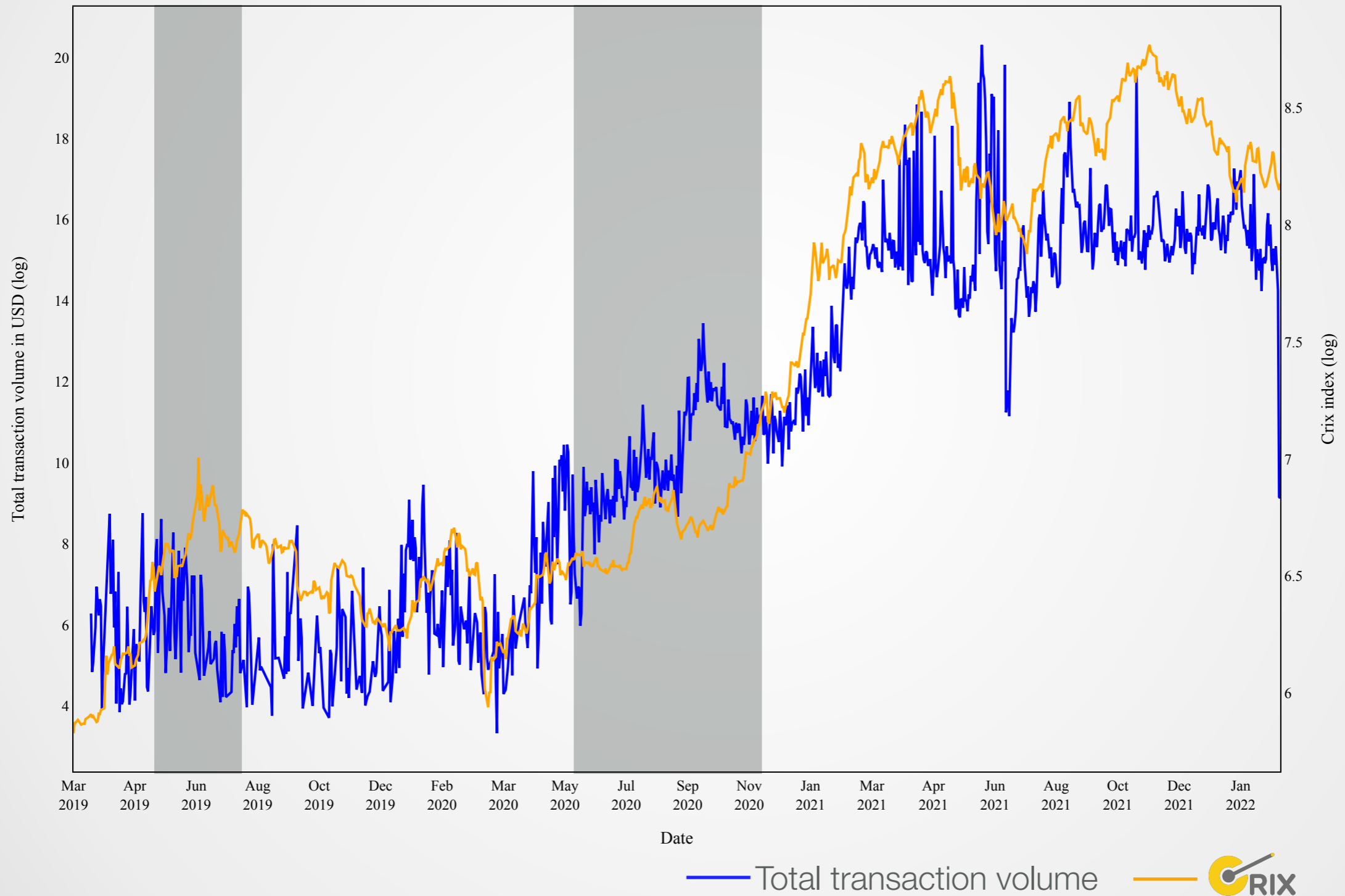
#3777 punk has **2 attributes:**
Dark Hair / Clown Eyes Blue
has not been listed for sale

[Click here for interactive plot](#)



Transaction volume & CRIX (2019-03-20, 2022-03-08)

(20190320, 20220308)



Traits

V

```
trait_df['traits'][10000]
```

```
[{'trait_type': 'Eye Color', 'value': 'Dark', 'display_type': None, 'max_value': None, 'trait_count': 7419, 'order': None}, {'trait_type': 'Item', 'value': 'No Item', 'display_type': None, 'max_value': None, 'trait_count': 14533, 'order': None}, {'trait_type': 'Character', 'value': 'Female', 'display_type': None, 'max_value': None, 'trait_count': 5480, 'order': None}, {'trait_type': 'Skin Color', 'value': 'Dark', 'display_type': None, 'max_value': None, 'trait_count': 3784, 'order': None}, {'trait_type': 'Mask', 'value': 'Animal', 'display_type': None, 'max_value': None, 'trait_count': 2061, 'order': None}, {'trait_type': 'Token ID', 'value': 7510, 'display_type': 'number', 'max_value': None, 'trait_count': 0, 'order': None}, {'trait_type': 'Background', 'value': 'Street Art', 'display_type': None, 'max_value': None, 'trait_count': 2012, 'order': None}]
```



```
trait_df['trait_type'][10000]
```

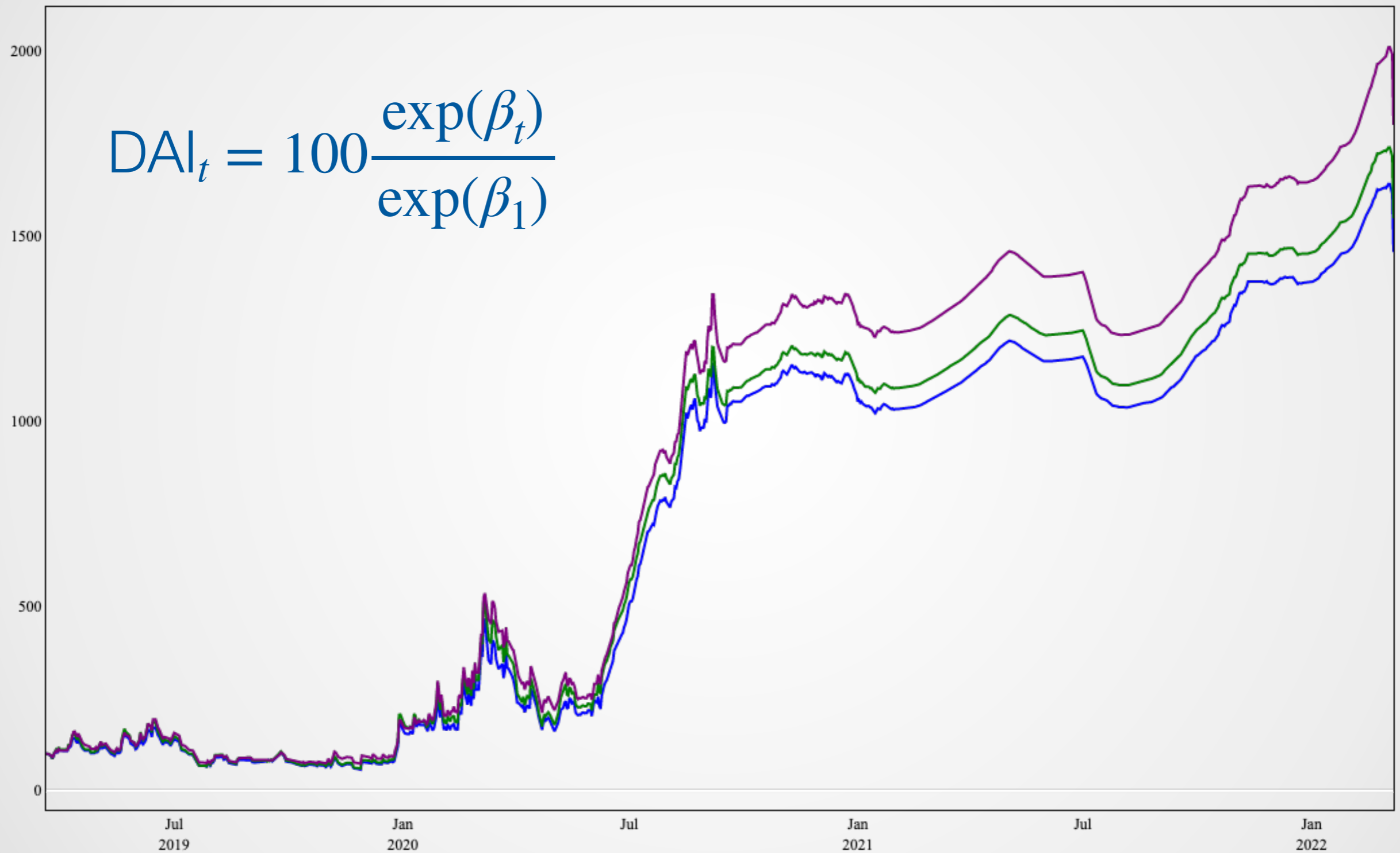
```
nan
```

```
trait_df['trait_value'][10000]
```

```
nan
```

from Hashmask

代 DAI Digital Art Index



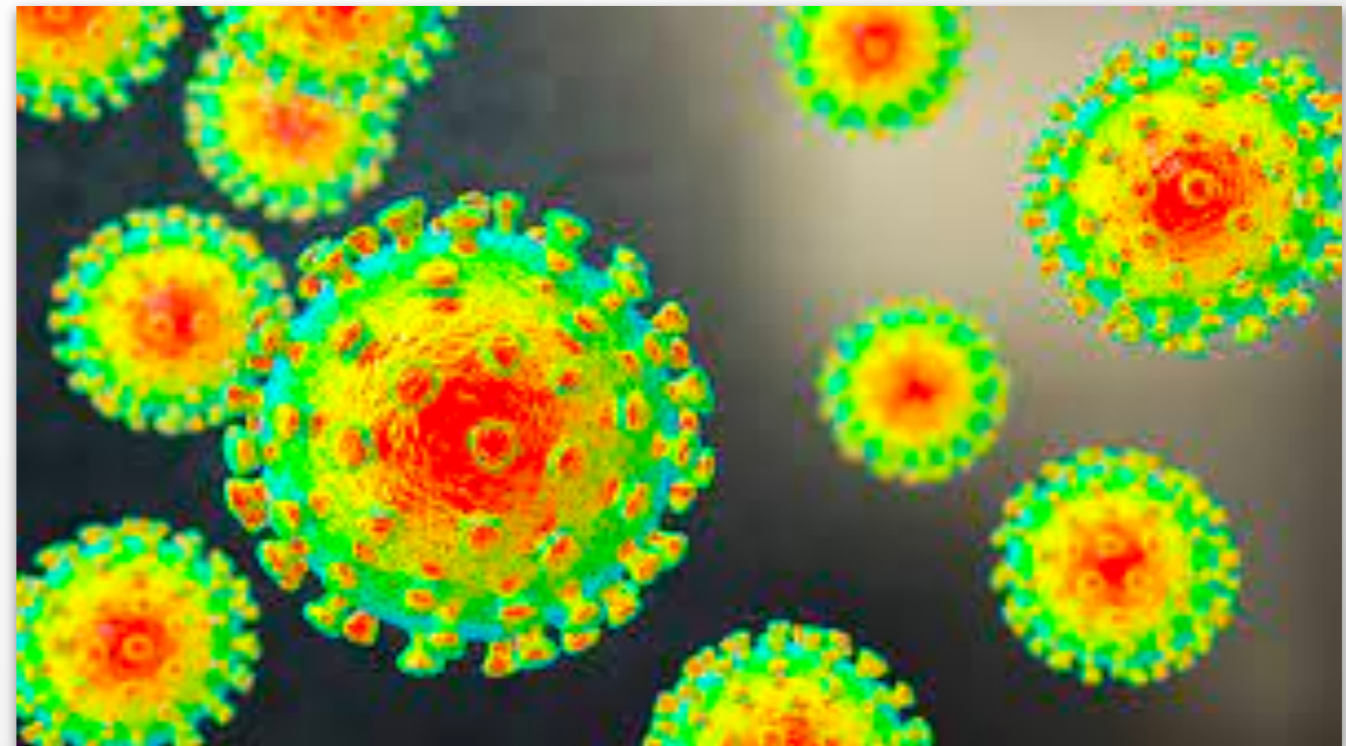
Huberized OLS Huberized Heckman LASSO after Heckman

Diversity of DAs

- ▣ Artworks
- ▣ Tweets
- ▣ GIFs
- ▣ Songs
- ▣ In-app purchases
- ▣ Essays
- ▣ Domain names



<https://www.coindesk.com/business/2022/04/13/jack-dorseys-first-tweet-nft-went-on-sale-for-48m-it-ended-with-a-top-bid-of-just-280/>



Source: <https://fortune.com/2021/12/13/covid-19-nft/>

Conversion of „truth“ into DAs!



Ioannidis Critique

- “there is a widespread notion that medical research articles should be interpreted based only on p-values”

p-hacking

Critical examples 35

p-value vs. nCOV-19 data controversy ?

welt DEBATTE UM CORONA-STUDIE

Kinder, Viren, Schule. Die Drogen-Kontroverse

Logarithmische Skala
Fehlerbalken
Quelle: Charité

- „However, the authors' very own statistical analysis contradicts their central conclusion.“ (Prof. Dominik Liebl, Uni Bonn)
- „There are many good arguments against a quick reopening of schools, but the Charit' e study does not add to them.“ (Prof. Stoye, Cornell University)
- „The original analysis by Jones et al. (2020) suffers from small sample sizes among children and adolescents.“ (Prof. Leonhard Held, Uni Zürich)
- „Kinder haben in dieser Coronavirus Studie im Schnitt 67-85% weniger Viruslast als Erwachsene. Dass derart große Unterschiede von den Autoren als "nicht signifikant" eingestuft werden, liegt daran dass die verwendeten statistischen Methoden sehr schwach sind.“ (Prof. Christoph Rothe, Uni Mannheim)

The attractiveness of p-hacking



input from Ilyas Agashiev



p2p knowledge platform for student

- ▣ Create **Courselets (CL)**
 - ▶ short presentation about a research task
 - ▶ Slides + Presentation video
 - ▶ include code and data
- ▣ Online **Courses** from top universities
 - ▶ Certified by online exam
- ▣ Run **Quantlets** cloud wise
- ▣ Explore data, repos and models
- ▣ Share your ideas, code and data



p2p knowledge platform for teachers

- Create and download CLs, i.e. go knowledge shopping
- Create own courses by grabbing existing CLs
- Get money/crypto, reputation, citations from used CLs



Scagnostics

2 Classes 7 Students All Levels
Scagnostics

Free



0 Rating

0 Reviews



GANs for Time Series

2 Classes 4 Students All Levels
Generative Adversarial Networks for Time Series

Free



0 Rating

0 Reviews

The DA based review system

- ▣ Publish CLs for articles and projects
- ▣ Get money/coin/„miles“, reputation, citations from used CLs
- ▣ Official publication with p2p review process
- ▣ Reproducibility certification
- ▣ Fully transparent research
 - ▶ Article
 - ▶ Presentation
 - ▶ Code
 - ▶ Data

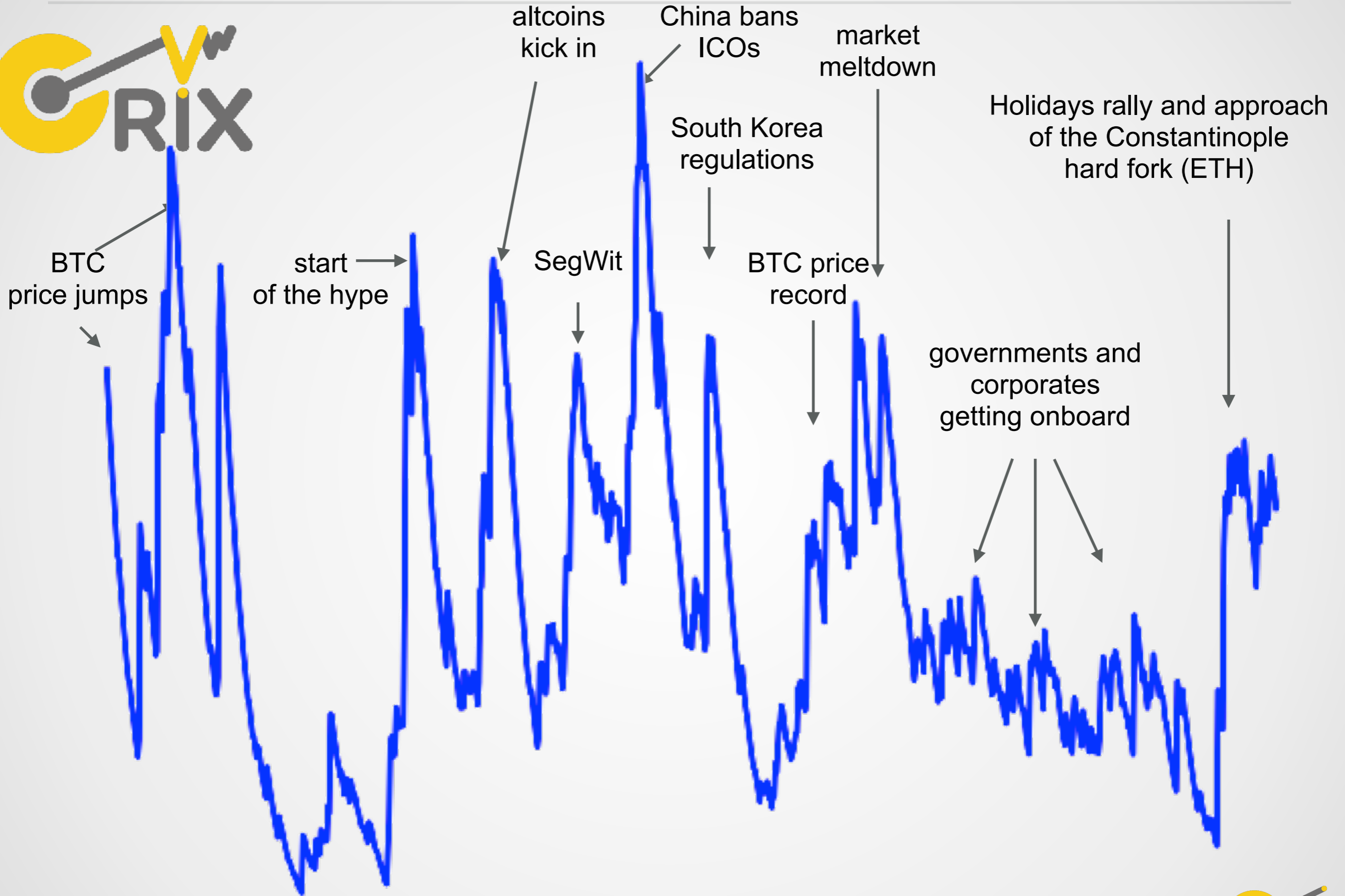


DAO Decentralised Autonomous Organisation

- ▣ a virtual entity with shareholders
- ▣ Smart contracts define rules and organisation purpose
- ▣ Modification after majority vote



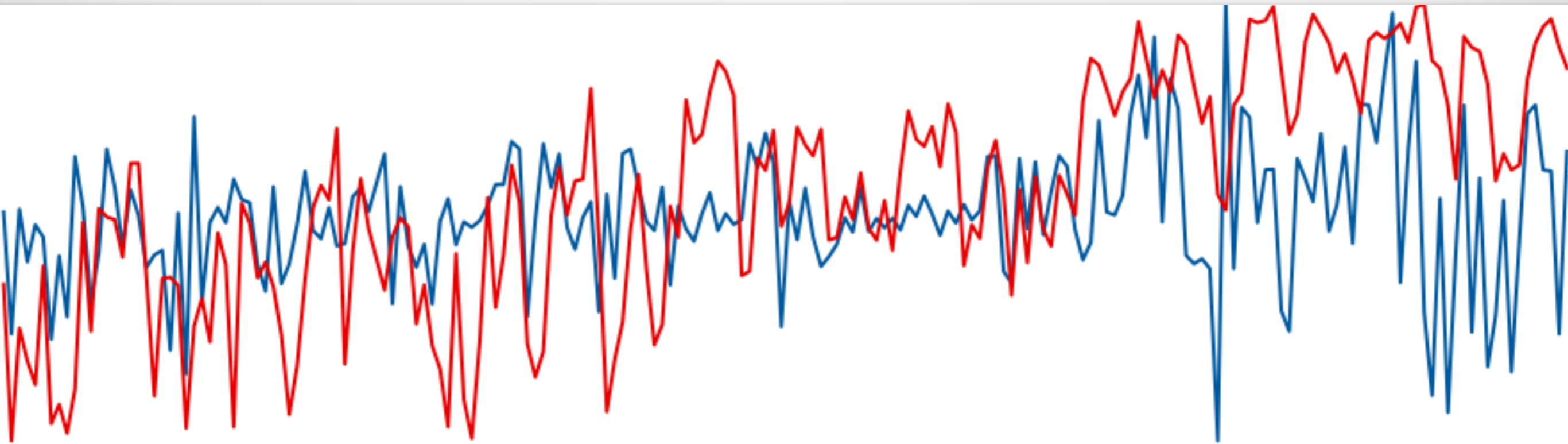
https://en.wikipedia.org/wiki/Decentralized_autonomous_organization



input from Alisa KIM





CRIX and sentiments



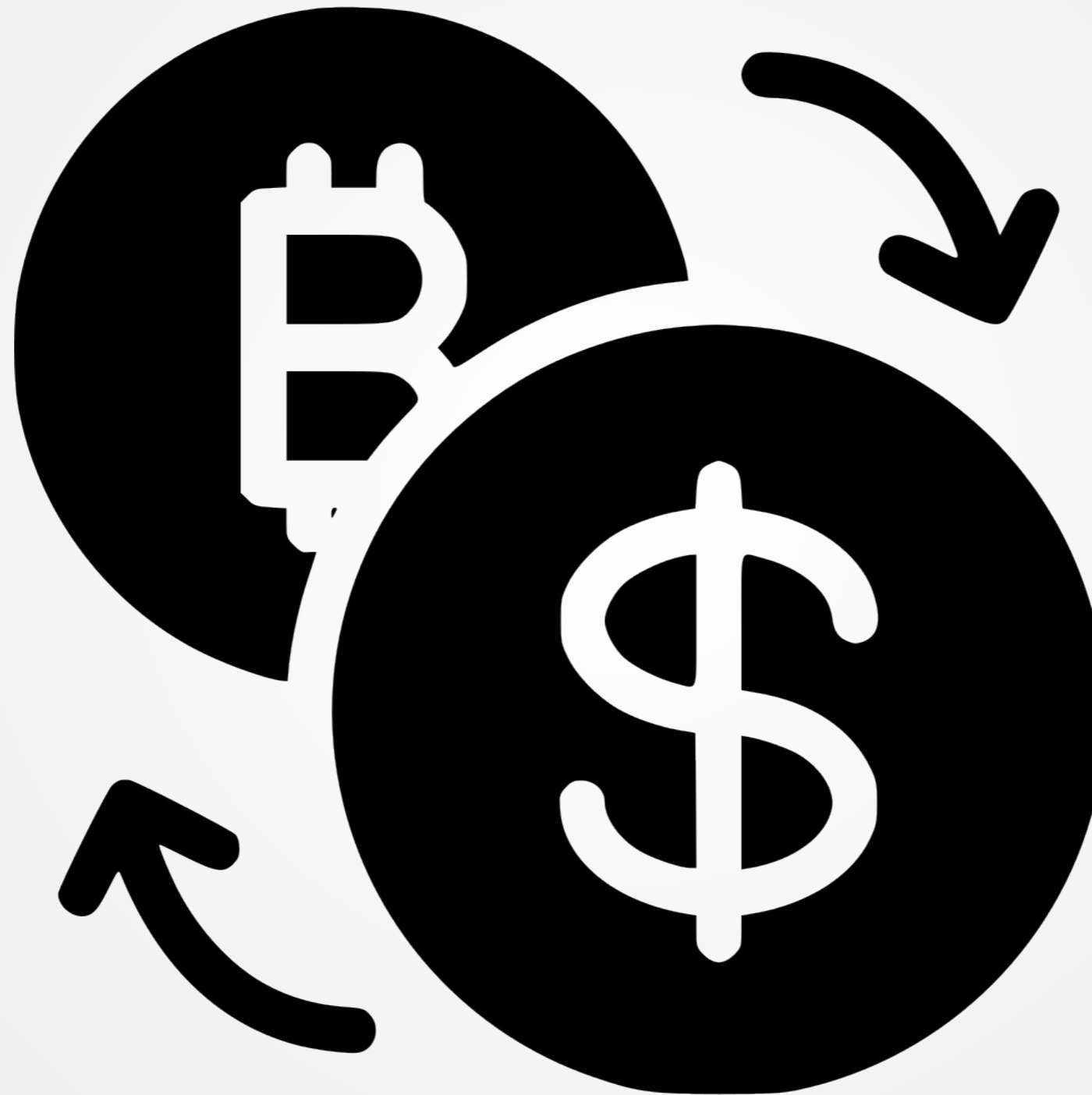
Daily CRIX log-return, Daily stock twits sentiment
201407 - 201807

Després R, Chen CYH, Renault T (2019)

Term	Sentiment weight
	0.90
hodl	0.54
hodl !	0.85
hackers	-0.74
miner	0.62
bitcoin 	-0.73
scam	-0.77
fixing scam	-0.86

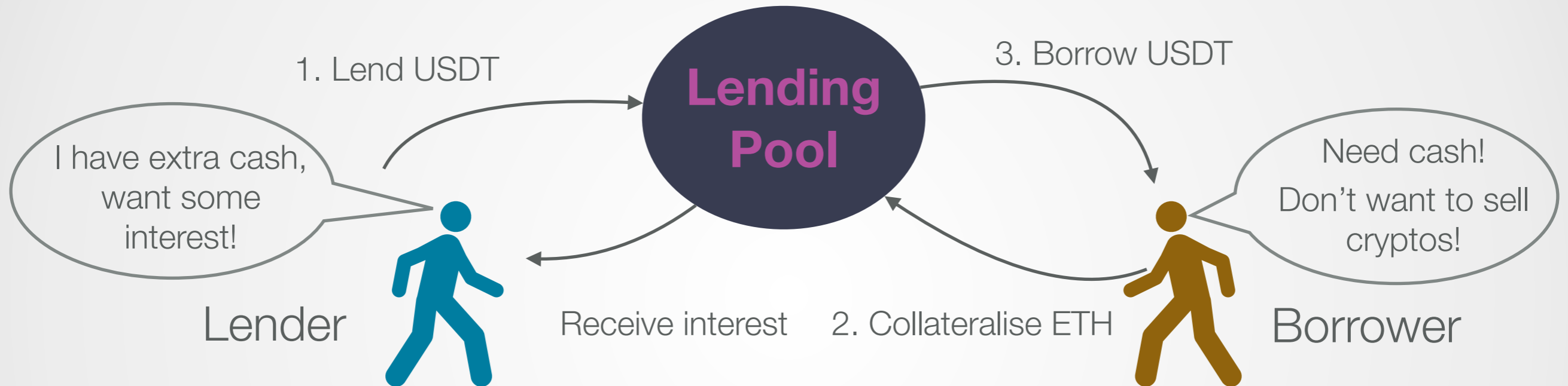
Crypto specific terms

Crypto-Backed Lending



input from Francis LIU

Crypto-Backed Lending



- ❑ Individual lenders provide liquidity to earn interest
- ❑ Individual borrowers deposit crypto as collateral to borrow other cryptos they want
- ❑ Non-recourse loans: borrowers can choose to default by forfeiting the collateral, no further consequences

Crypto-Backed Lending Landscape

On-Chain

AAVE 

 **Compound**


MAKER


$\delta Y / \delta X$

Off-chain

AQRU






 crypto.com

 **BlockFi**

 YOUHODLER


nexo

What is the deal?

Asset ↕		Total supplied ↕	Supply APY ↕	Total borrowed ↕	Borrow APY, variable ⓘ ↕
 USD Coin USDC	Stable coin	2.28B \$ 2.28B	0.85 %	1.04B \$ 1.04B	2.05 %
 Ethereum ETH		1.04M \$ 1.59B	0.72 %	448.82K \$ 685.54M	1.87 %
 Tether USDT	Stable coin	923.60M \$ 928.85M	1.17 %	485.60M \$ 488.36M	2.36 %
 DAI DAI	Stable coin	455.68M \$ 455.23M	1.41 %	250.77M \$ 250.52M	2.79 %
 Wrapped BTC WBTC		48.25K \$ 1.37B	0.02 %	2.25K \$ 63.72M	0.57 %

- Top 5 coins most borrowed on AAVE
- Supply APY \succ yearly interest rate (compounded every second) for lenders supplying the coin
- Borrow APY \succ yearly interest rate (compounded every second) for borrowers borrowing the coin

- Lenders earn interest rate from collateralised loans
- Stable coins, BTC, and ETH are popular

Open questions:

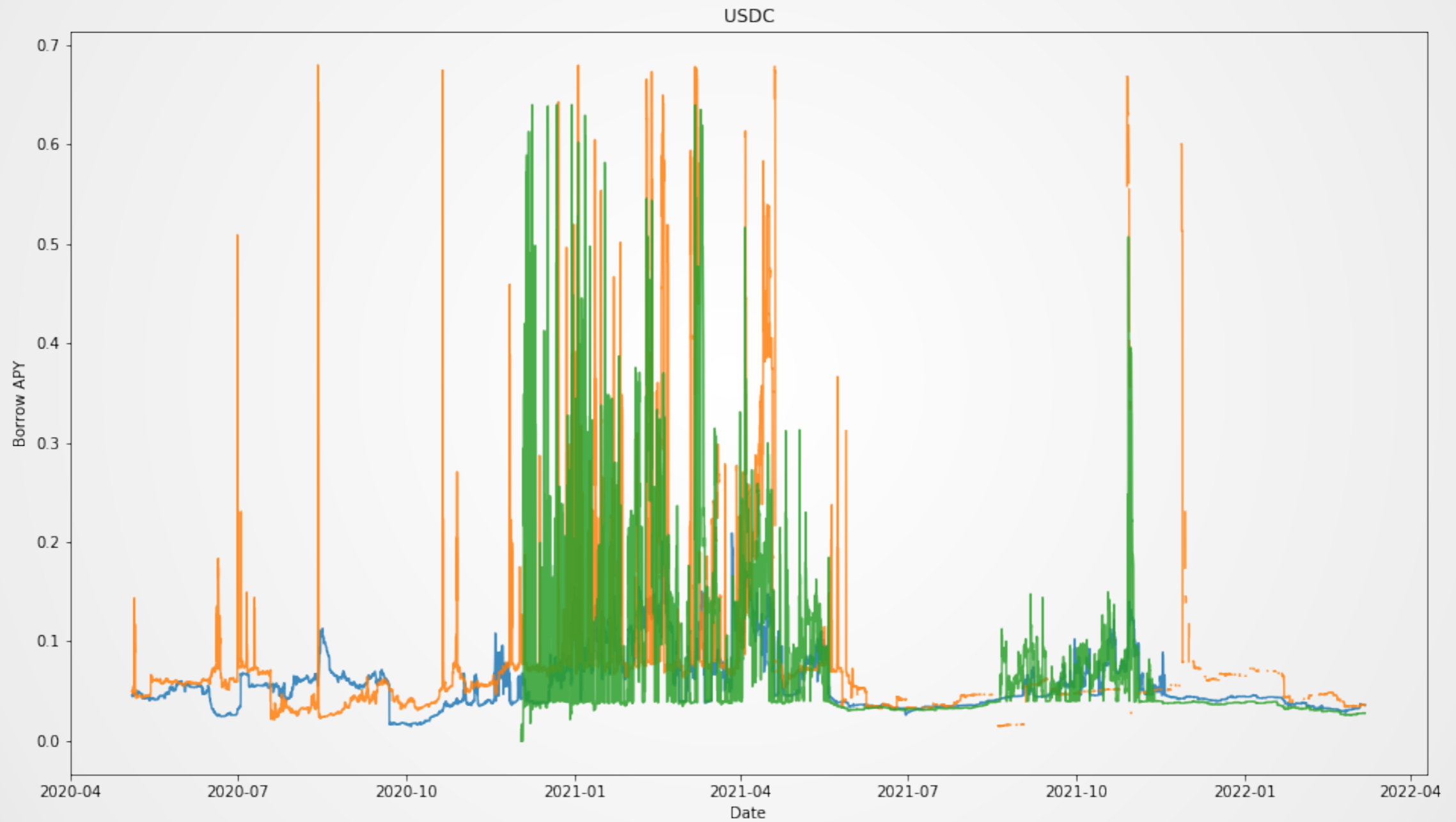
What is the *fair* interest rate?

What is the *appropriate* size of collateral given the volatility of cryptos?

How to *hedge* (for both sides)?

Risk?

1. Volatile interest rate



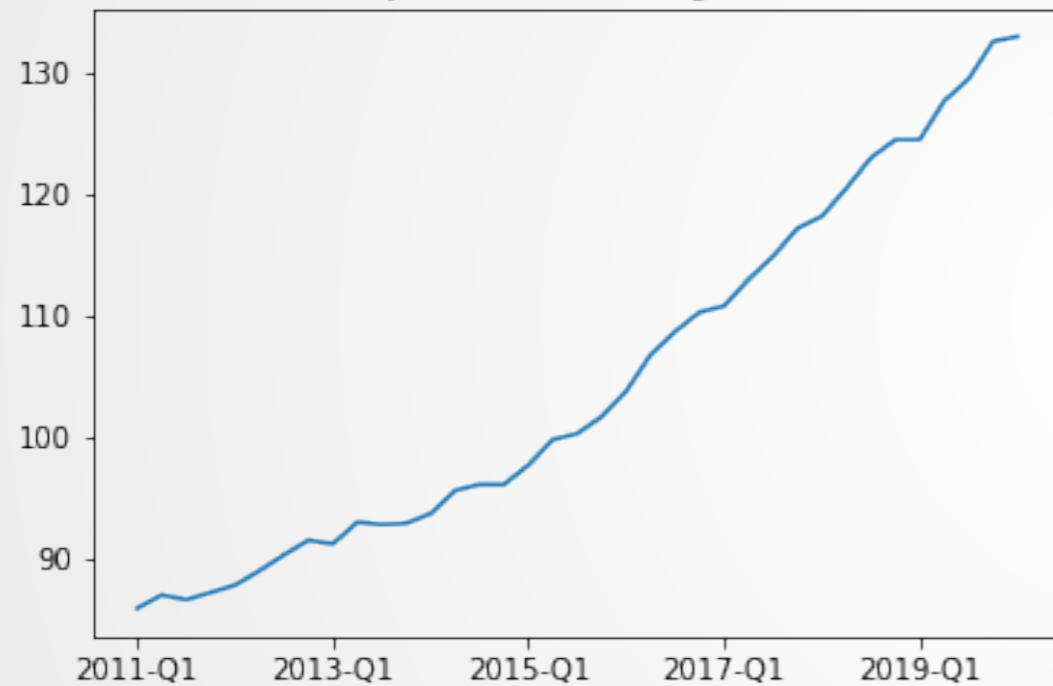
Compound, AAVE v1, AAVE v2



Risk?

2. Volatile collateral \succ loans are easily called!

Quarterly German Housing Price Index



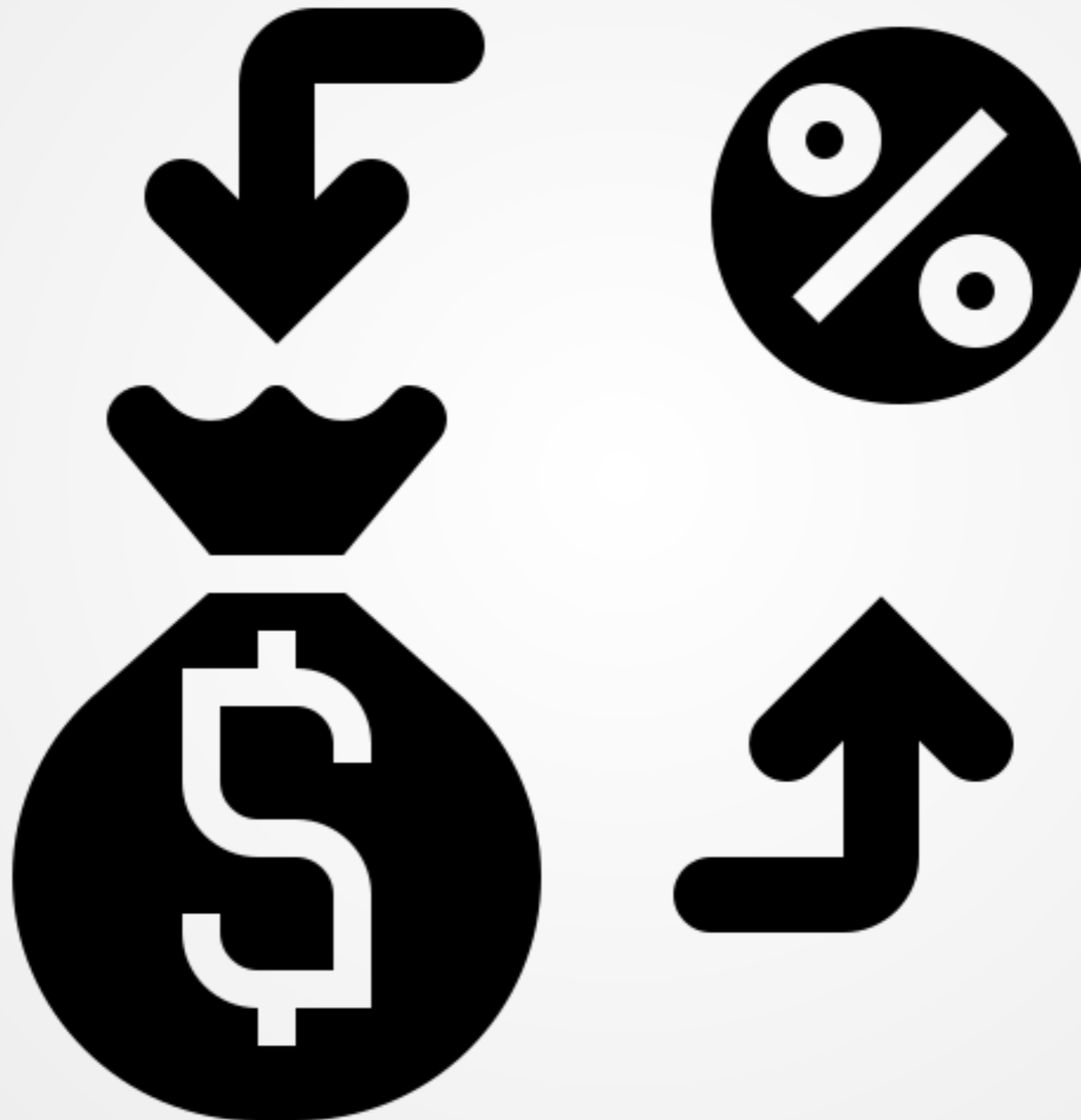
Source: [eurostat](#)

BTC values over one year

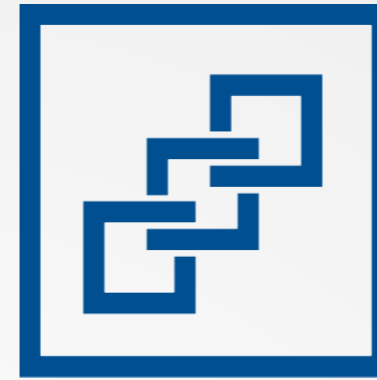


Source: [Yahoo Finance](#)

Cryptos lending is a highly speculative market!



Blockchain Research Center



University of Zurich
UZH



SOCIETY FOR
BUSINESS EXCELLENCE



University of Glasgow



Hochschule für Technik
und Wirtschaft Berlin

University of Applied Sciences

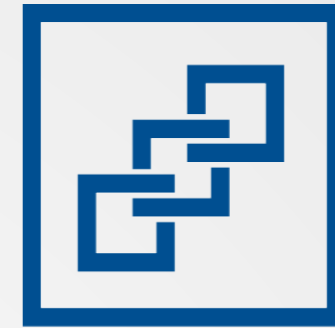




In  we trust

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Cryptos, NFTs, Digital Assets

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