Decentralisation in Blockchain

A Multifaceted Overview

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Research and Insights

Senior Research Analyst
William Wu   PhD

Head of Research and Insights
Henry Hon   PhD, CFA

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Executive Summary

This report gives an overview of the various types of decentralisation in crypto. We mainly focus on **consensus decentralisation**, with additional insights into **governance decentralisation** and **wealth decentralisation.**

Consensus Decentralisation:

- Consensus decentralisation refers to the **distribution of mining in proof of work (PoW)**, and the **distribution of staking in proof of stake (PoS)**.

- **The largest Bitcoin mining pool is Foundry USA, with a 22.7% hashrate share as of 1 June 2022.** Stratum V2 is a new Bitcoin mining pool protocol currently under development that gives the individual miner the choice to choose their own transaction set. This helps to protect against network centralisation.

- Lido is dominating Ethereum Beacon Chain staking, accounting for 32.3% of all staked ETH. **Recently, on 21 May 2022, the Lido community drafted a proposal to limit Lido's stake to a fixed percentage of 15% to 33%.**

- **The United States has a high percentage share for both Bitcoin mining hashrate (37.84%) and Ethereum nodes (45%), but nevertheless is still below 50%.** There are attempts to decentralise blockchains to outer space. In June 2021, SpaceX sent an Ethereum node to the International Space Station (ISS).

Governance Decentralisation:

- **Governance decentralisation** refers to the **decentralisation of blockchain governance and decision-making power**.

- The **Bitcoin Improvement Proposal (BIP)** process is robust and decentralised, with opportunities for community involvement at various steps.

- The **Ethereum Improvement Proposal (EIP)** process is also decentralised and based on community support. Sometimes, even Vitalik's EIPs do not get adopted.

- Many blockchains have **open-source code**, allowing the community to audit the code and contribute to the ecosystem. Popular repositories such as Bitcoin Core and Go Ethereum have hundreds of contributors.
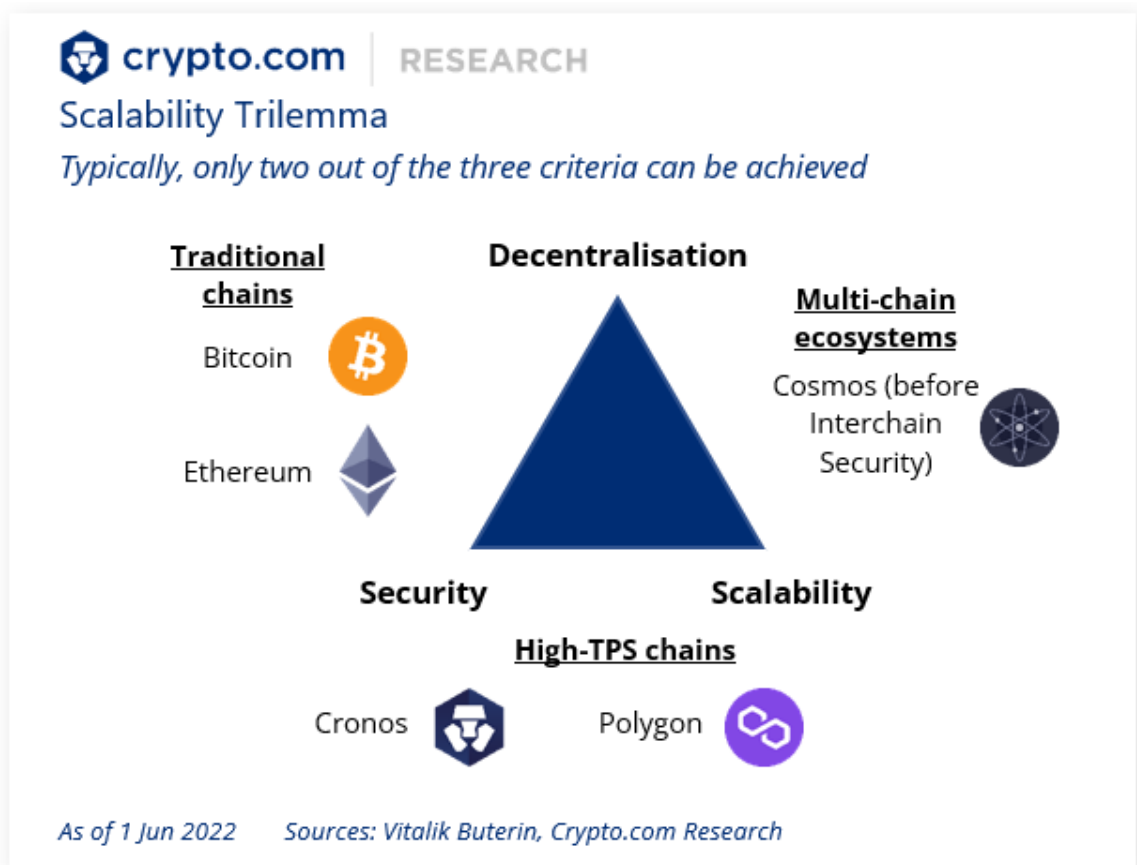
Wealth Decentralisation:

- Wealth decentralisation refers to the **decentralisation of crypto assets**, particularly the native token, that is distributed across blockchain users.

- We showcase how **Bitcoin wealth is becoming more evenly distributed**, using data from research papers.

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1. Introduction

Decentralisation is one of the core tenets of the crypto ecosystem. **In the context of blockchain technology, decentralisation refers to the shift of governance, control, and decision-making from a centralised entity to a distributed network of nodes.**

The scalability trilemma was first described by Vitalik Buterin, co-founder of Ethereum. **Essentially, the scalability trilemma states that (under usual circumstances) a blockchain can only satisfy two out of the three criteria: decentralisation, security, and scalability.**

Indeed, **traditional blockchains** such as Bitcoin and Ethereum have chosen to prioritise decentralisation and security.

According to Vitalik, **multi-chain ecosystems** can be relatively less secure since an attacker only needs to get a consensus node majority on one of the many chains.

For example, in the case of Cosmos, the network does not have shared security; each chain in the Cosmos network has its own validator set. Cosmos is in the process of launching its Interchain Security update, which will greatly improve its security.

Lastly, **high-TPS** (transactions per second) blockchains typically have a lower number of nodes (often 10-100). In exchange for the lower decentralisation, they can achieve high scalability and are able to swiftly process a large number of transactions.

At the same time, there are some exceptions to these classifications. For example, Solana has high TPS (2,454 TPS) as well as a high number of validators (1,786), due to its novel proof of history (PoH) consensus algorithm. However, there seems to be some drawbacks with this approach, judging from the persistent outages encountered recently.

1.1 Different Types of Decentralisation

While decentralisation has many facets, there are three major types of decentralisation in crypto: **consensus decentralisation, governance decentralisation, and wealth decentralisation.**

According to the review paper SoK: Blockchain Decentralisation, the above three types of decentralisation are the most commonly studied in the blockchain decentralisation literature.

Consensus decentralisation refers to the **distribution of mining in PoW**, and the **distribution of staking in PoS**. Usually, this is the main factor when discussing decentralisation, therefore we will direct our focus to this aspect.

Governance decentralisation refers to the **decentralisation of governance and decision-making power** in blockchains, and how they are shared between the various participants.

Wealth decentralisation refers to the **decentralisation of the distribution of crypto assets (especially the native cryptocurrency)** across blockchain users. In PoS blockchains, wealth decentralisation is especially relevant, since more wealth potentially means more control over the network.

The subsequent chapters take a deep dive into these three types of decentralisation.

1.2 Benefits of Decentralisation

Firstly, decentralisation provides a trustless environment, where no one has to trust or know anyone else. Each node in the network has a copy of the same data, and any malicious altering or corruption of the data will be detected and rejected by the majority of the nodes in the network. **In other words, decentralised blockchains are immutable.**

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Three Benefits of Decentralisation

Decentralised blockchains have advantages over centralised systems

Provides a trustless environment

Reduces points of weakness

(Blockchains can still function with certain nodes removed)

Fosters an open culture

(For example, collaborating on open-source projects)

As of 1 Jun 2022   Sources: AWS, GitHub, Crypto.com Research

Secondly, decentralisation reduces points of weakness. In a [centralised system](#), the failure of a central server can cause a complete system breakdown. Decentralised blockchains can withstand the failure or shutting down of multiple nodes.

For instance, in [January 2022](#), Bitcoin survived a steep fall in hashrate amid Kazakhstan's internet shutdown. This is notable as Kazakhstan was the [second-biggest](#) mining country in the world, accounting for around [18%](#) of the world's Bitcoin hashrate.

Thirdly, decentralisation [fosters an open culture](#). Decentralised blockchains tend to be open-source projects, where anyone can contribute ideas and propose changes. The code of the blockchain is usually shared on [GitHub](#), where it is available for the public to read and verify.

For example, anyone within the Ethereum community can create an [Ethereum Improvement Proposal (EIP)](#). EIPs play an important role on Ethereum, and allow people to propose, debate, and adopt changes for the Ethereum blockchain.

1.3 Different Use Cases Require Different Levels of Decentralisation

Different blockchains can have their unique position in the trilemma depending on their niche and their different applications. For example, a blockchain whose niche is to act as a store of value could prioritise security and decentralisation over scalability (e.g. Bitcoin).

On the other hand, a private blockchain that has high scalability but low decentralisation could be suitable for logistics applications, for example.

According to an article by the [Harvard Business Review](#), supply chains can benefit from private blockchains among known parties, where each member of a supply chain can determine the source and quality of their inventory.

Another use case that requires prioritising scalability over decentralisation is [blockchain gaming](#). In order for a blockchain game to perform well in terms of speed and efficiency, the blockchain has to offer low fees and a fast transaction processing time.

Decentralisation is a spectrum. There are many levels of decentralisation ranging from low to high. **Based on their niche, blockchains need to strike a fine balance between decentralisation, scalability, and security.**

2. Consensus Decentralisation

In blockchains, a consensus mechanism helps to achieve agreement on a single state of the network among various distributed nodes. **There are two main classes of consensus mechanisms: PoW and PoS.**

Consensus decentralisation thus refers to the distribution of mining power in PoW, and the distribution of staking in PoS.

Consensus decentralisation is an important factor for the healthy functioning of blockchains. It is essential that the distribution is spread out such that no single entity controls the majority of the mining or staking power. For example, if a group of miners manage to amass more than 50% of a blockchain's mining hashrate, they can theoretically take control of the blockchain. This is known as a 51% attack.

The geographical distribution of mining/staking nodes is also a crucial factor. Ideally, the nodes should be spread across the globe for maximum decentralisation. This is to prevent disasters or incidents in a single country from affecting the entire blockchain.

2.1 A Brief History of Bitcoin Mining

Bitcoin's design in its whitepaper is highly favourable towards consensus decentralisation. **Bitcoin is permissionless, meaning that in theory, anyone can participate in its consensus validation. That is, anyone can mine Bitcoin.**

Indeed, in the early days of Bitcoin, mining with a CPU (which all ordinary computers have) was possible. On 3 January 2009, Satoshi Nakamoto mined the first batch of 50 bitcoins, utilising the CPU chip of his personal computer.

As the mining difficulty of Bitcoin increased, GPUs (graphics cards) were needed for mining. **This was in 2010, when the first software design for mining with a computer graphics card was released.** Soon, even GPUs did not have enough computing power to mine Bitcoin when ASIC miners were released in 2012. **The initial ASIC miners have 200 times the computing power of GPUs, effectively rendering GPUs obsolete.**

Ever since then, there has been an 'arms race' in computing power for mining Bitcoin. **According to Genesis Block, the current situation is that even with a few ASIC miners, it is almost impossible to (individually) mine Bitcoin.**

This brings us to the next topic — mining pools.

2.2 Mining Pools

Firstly, we discuss the benefits of mining pools.

Mining pools allow miners to pool their computational resources together in order to increase their chances of being awarded a coin.

As mentioned previously, it has become nearly impossible to do 'solo mining' for popular coins such as Bitcoin. **One benefit of mining pools is that they allow individuals to take part in the consensus process of mining.**

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BTC Mining Pool Distribution

Foundry USA is the largest mining pool with 22.7% hashrate share

- Foundry USA — 22.7%
- F2Pool — 15.6%
- AntPool — 13.6%
- ViaBTC — 11.7%
- Poolin — 11.0%
- Binance Pool — 10.4%
- BTC.com — 5.8%
- SBI Crypto — 3.3%
- Others — 5.8%

As of 1 Jun 2022   Sources: BTC.com, Crypto.com Research
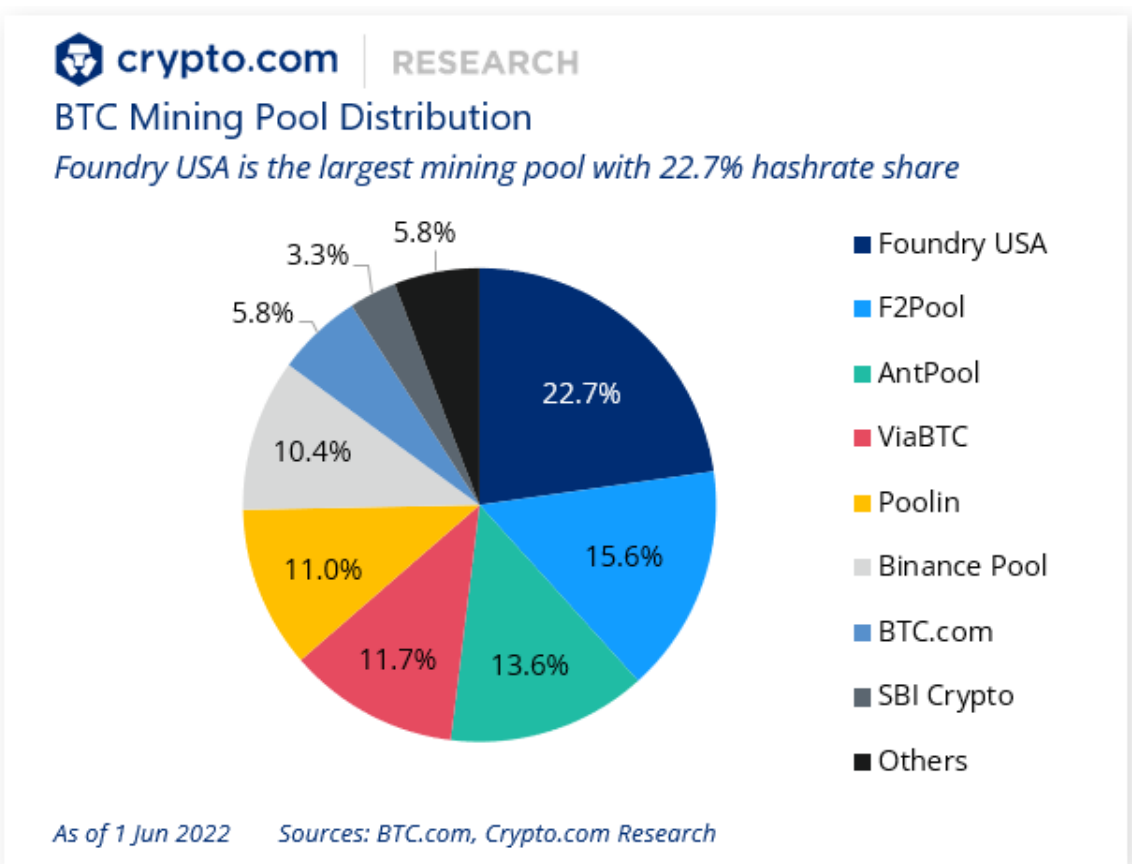
Certainly, there are also some downsides of mining pools. **If a mining pool becomes too large, then it becomes a source of centralisation.** According to MIT researchers, in theory, mining pools have the ability to harness their users' computing power to perform attacks such as block withholding or even 51% attacks.

As the pie chart above shows us, so far none of the BTC mining pools are large enough to command a majority. This is a good thing from the point of view of consensus decentralisation. The largest mining pool is Foundry USA, with a 22.7% hashrate share as of 1 June 2022.

Jurica Bulovic from Foundry brought up a valid point, which is that mining pools do not actually have a lot of real clout or influence. **This is because any miner can quickly switch mining pools if desired, given any signs of foul play.**

Stratum V2 Bitcoin Mining Pool Protocol

Stratum V2 is a new Bitcoin mining pool protocol that is under development.

Stratum V2 gives the individual miner the choice to choose their own transaction set and construct their own block templates (that determines which transactions are included). **In other words, Stratum V2 takes this power of constructing block templates from mining pools, and hands it over to individual miners.**

According to Rachel Rybarczyk from Galaxy Digital Mining, this power allows individual miners to 'revolt' against misbehaving mining pools. Protocols like Stratum V2 help to protect against network centralisation, and play a role in improving the consensus decentralisation of mining pools.

2.3 Staking Pools

The concept of staking pools is similar to mining pools, but for PoS blockchains. **Staking pools allow multiple crypto token holders to pool their tokens together, so as to allow the staking pool operator to achieve the requirements for being a validator.** The subsequent staking rewards earned are then shared among the various stakeholders.

For some PoS blockchains, the main barrier for individual staking is not the computer hardware requirements, but rather the monetary value required in terms of the native token.

For example, Ethereum requires 32 ETH for solo staking. At the ETH price of around US$1,800 (9 June 2022), this amounts to US$58K, which is out of reach for many crypto users.

Another benefit of staking pools is that the pool operator will take care of the hardware setup and node maintenance. This also helps to make staking more accessible to the public, since solo staking typically requires some technical knowledge, such as familiarity with the Linux command-line interface.

Lido and Its Efforts to Improve Decentralisation

Lido is a liquid staking solution for ETH (and other cryptocurrencies). It allows users to stake ETH without any lock-up periods or minimum deposits.

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Ethereum Beacon Chain Staking (Top Depositors)
Lido staking pool has amassed a 32.3% share of total ETH staked

As of 1 Jun 2022   Sources: Etherscan, Crypto.com Research
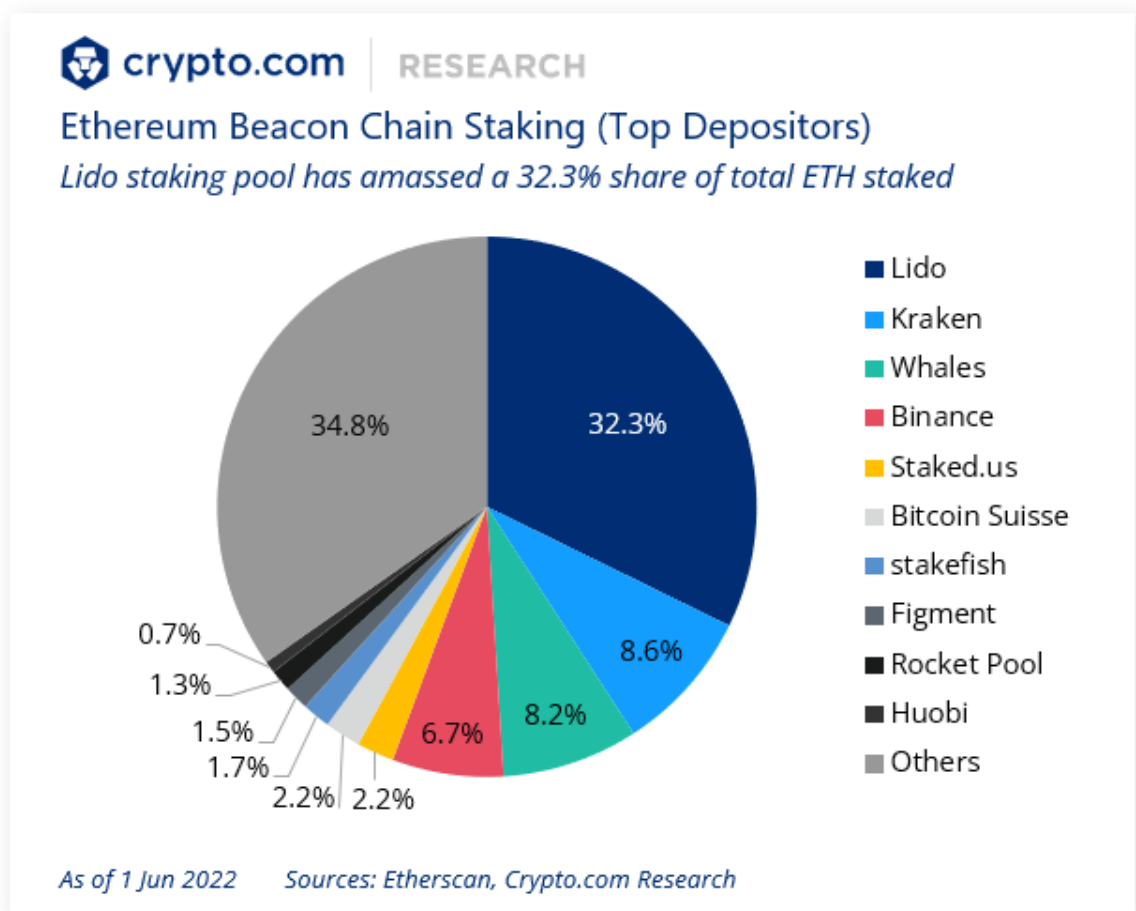
Lido is currently dominating Ethereum Beacon Chain staking, accounting for 32.3% of all staked ETH. Excluding Lido, the distribution of the other validators (including other staking pools, exchanges, and whales) look fairly decentralised.

Indeed, there have been some concerns in the cryptosphere that Lido's growth could lead to increased centralisation of Ethereum (when Ethereum transitions to PoS).

Lido is making some attempts to improve the situation. **Recently, on 21 May 2022, the Lido community drafted a proposal to limit Lido's stake to a fixed percentage.**

The fixed percentage limit has not been determined, but the numbers range from 15% to 33%. **Notably, the 15% limit was proposed by Vitalik, who tweeted that 'if a stake pool controls > 15%, it should be accepted and even expected for the pool to keep increasing its fee rate until it goes back below 15%'.**

Lido also laid out a roadmap towards decentralisation on 15 April 2022. Firstly, Lido reiterated that it is already non-custodial and permissionless for

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stakers, and that it is also contributing to the decentralisation of Ethereum due to its diverse validator set.

One of the highlights in Lido's decentralisation roadmap includes the adoption of [Distributed Validator Technology (DVT)](#). DVT will group validators into independent committees that propose and attest to blocks together, which significantly reduces the risk of an individual validator misbehaving or underperforming.

2.4 Geographical Decentralisation

In order to minimise [geographic risk](#), it is better for mining and staking nodes to be spread out across the globe.

Throughout crypto's history, there have been cases of disasters or geopolitical events affecting crypto mining in specific countries. For example, the electricity blackout in Kazakhstan affected Bitcoin mining in [January 2022](#). Certain countries have also banned crypto mining to various extents. So far, thanks to crypto's geographical decentralisation, the major cryptocurrencies have largely managed to survive such setbacks unscathed.

For Bitcoin, the country with the highest hashrate share is the United States, with an estimated [37.84%](#) of the total global hashrate, as of January 2022. The second and third places are **China ([21.11%](#))** and **Kazakhstan ([13.22%](#))**.

For Ethereum, the United States hosts [45%](#) of the nodes, according to the site [ethernodes.org](#). Germany ranks second with 12.9%, followed by Finland and Singapore with 4.3% each.

While the United States' percentage share is quite high for both Bitcoin (37.84%) and Ethereum (45%), the total share is still below 50%.

We also remark that mining or staking using [VPNs](#) is possible, and this could conceal the real geographical location of the nodes.

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Distribution of Ethereum Nodes

The U.S. hosts 45% of nodes, while non-U.S. countries comprise the other 55%.

- United States (45.0%)
- Germany (12.9%)
- Finland (4.3%)
- Singapore (4.3%)
- United Kingdom (3.3%)
- France (2.8%)
- Canada (2.7%)
- South Korea (2.3%)
- China (2.3%)
- Japan (2.2%)
- Australia (2.0%)
- Netherlands (2.0%)
- Others (14.0%)

As of 6 Jun 2022   Sources: Ethernodes.org, Bing, Crypto.com Research
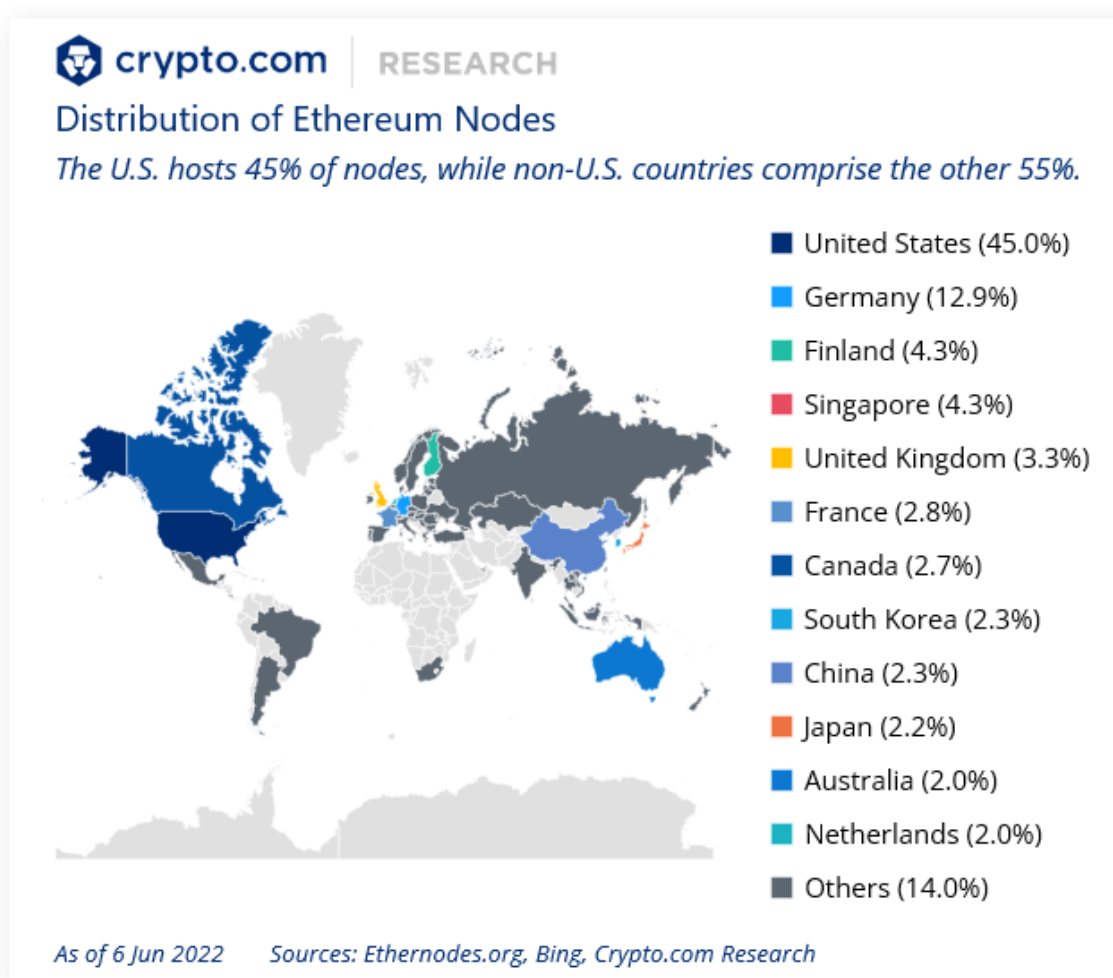
Multilingual Websites for Mining and Staking

Since blockchains are permissionless, in principle, people from all countries can participate in mining or staking. However, one possible practical barrier may be language. **After all, only 20% of the world speaks English.**

In order to participate in the consensus process, a user must first be able to understand the instructions on the website. **Providing multilingual translations on mining or staking websites could be one way to improve geographical decentralisation.**

For example, the mining pool BTC.com supports the top four languages: English, Chinese, Russian, and Spanish. This helps to meet the needs of global miners and improves accessibility for non-English speakers.

For Ethereum, the Ethereum.org website (including the page on staking ETH) is natively translated into over 40 languages. The full list of languages can be found on the languages page, which range from Arabic to Vietnamese.

To Outer Space and Beyond

Geographical decentralisation is not just limited to Earth. Entrepreneur Zheng Zee (listed in Forbes 30 under 30) cofounded SpaceChain, which aims to bring blockchains to outer space via a network of satellites.

In June 2021, SpaceX sent an Ethereum node to the International Space Station (ISS). The node was delivered via SpaceX's Falcon 9 rocket, and the project was done in collaboration with SpaceChain.

2.5 Other Factors for Improving Consensus Decentralisation

Reducing Minimum Staking Amount Required

One of the main barriers preventing users from participating in staking is often the high minimum staking amount required. Hence, if this minimum requirement is lowered, more people can afford to stake.

The minimum requirement for becoming a validator node on **Fantom** used to be as high as 3,175,000 FTM. **After an on-chain governance proposal, the minimum stake was lowered to 500,000 FTM on 6 October 2021.** While admittedly this is still a high amount (FTM was US$1.41 on 6 October 2021), it represents a significant reduction.

For **Avalanche**, the current requirement to be a validator is 2,000 AVAX. On their official website, the developers have mentioned this amount 'can be reduced over time as price increases'.

Actively Improving The Validator Ecosystem

Both the quantity and quality of validators are important. A validator that is misbehaving or underperforming is not useful, or even harmful, to the blockchain.

Polygon has been playing an active role in improving its validator ecosystem. Firstly, it distributes generous rewards to its validators. More than 483M MATIC of total rewards (over US$700M) has been distributed among validators.

Secondly, Polygon also actively communicates with its validator community through Discord and Telegram, informing them of hotfixes, upgrades, and security alerts. Periodically, there are even one-on-one calls with the validators to

understand their concerns and help fix potential issues. **This helps to improve the quality of Polygon's validators.**

Polygon's quantity of validators effectively doubled from 53 on 28 October 2020, to 100 as of 10 March 2022 (capped at 100). This is fairly impressive for a high-TPS chain like Polygon, since high-TPS chains typically have fewer validators.

2.6 Consensus Decentralisation Metrics

In the table below, we list some metrics relevant to consensus decentralisation, such as the **number of active nodes/validators.**

We also include the **minimum stake requirement** to be a **validator**, both in terms of the native token and in fiat currencies.

Lastly, we also include the **hardware RAM requirements**. Notably for **Solana**, there is no strict minimum stake requirement, however the high hardware requirements could be a possible barrier preventing users from staking.

Consensus Decentralisation Metrics · crypto.com | RESEARCH

Blockchain	Market Cap	# of Nodes/ Validators	Minimum Stake Required	RAM Required
Ethereum	$130.7B	5,581	32 ETH ($35K)	16 GB
Binance Smart Chain	$33.9B	21	PoSA[1], 10K BNB ($2.1M)	32 GB
Solana	$11.0B	1,786	N.A.	128 GB
Avalanche	$4.4B	1,416	2K AVAX ($31K)	16 GB
Polygon	$2.5B	80	1 MATIC[2] ($0.37)	32 GB
EOS	$0.9B	21	DPoS[3]	80 - 128 GB
Fantom	$0.6B	70	500K FTM ($122K)	16 GB

[1] *Proof of Staked Authority (PoSA)*

[2] *The number of validator slots is limited to 100, hence a substantially higher amount is needed to be competitive.*

[3] *EOS uses Delegated Proof of Stake (DPoS), which involves the community selecting trusted accounts to produce blocks. The top 21 entities that receive the most votes are chosen as Block Producers.*

As of 20 Jun 2022   Sources: CoinGecko, Ethernodes, BscScan, Solana Beach, Avascan, Polygonscan, EOS Authority, FTMscan, Crypto.com Research

3. Governance Decentralisation

Governance decentralisation refers to the **decentralisation of blockchain governance and decision-making power**, and how they are shared between various participants.

A decentralised governance structure allows blockchains to harness the 'wisdom of the crowd'. It also helps to promote the 'BUIDL' culture in crypto, which refers to building cryptocurrency projects, often in a decentralised and open-source manner.

3.1 Governance Processes

Blockchain codes are not static and are constantly evolving to keep up with the times. **A decentralised governance process is needed in order to determine who can propose and make changes to the codebase.**

Ideally, there should be many developers making updates to the code, while at the same time there should be a robust process to weed out bad suggestions.

Bitcoin Improvement Proposal (BIP)

The Bitcoin Improvement Proposal (BIP) process is robust and decentralised, with opportunities for community involvement at various steps.

Anyone with a new idea can propose improvements to Bitcoin at the **Draft** stage. To save the author and the community time, it is recommended that the author first ask the Bitcoin community whether the idea has good chances of acceptance.

At the draft stage, the author can withdraw their own BIP from consideration (**Withdrawn**). If there is no progress made, either the BIP editor or the author can assign it the **Deferred** status.

In order to move to the **Proposed** stage, the BIP has to include a working implementation with a plan for deploying the BIP. The author has to revise the BIP to address any objections from the community.

Finally, the BIP can be implemented (**Final/Active**) by a soft fork or a hard fork. Soft-fork BIPs require a "clear miner majority", which is recommended to be 95% of the miners. Hard-fork BIPs have to meet a very high requirement of "adoption from the entire Bitcoin economy", including BTC holders and service providers.

Lastly, if the BIP becomes outdated or replaced by a newer BIP, it gets assigned the **Obsolete/Replaced** status.

Throughout the BIP process, there is high community involvement, which implies that Bitcoin has high governance decentralisation.
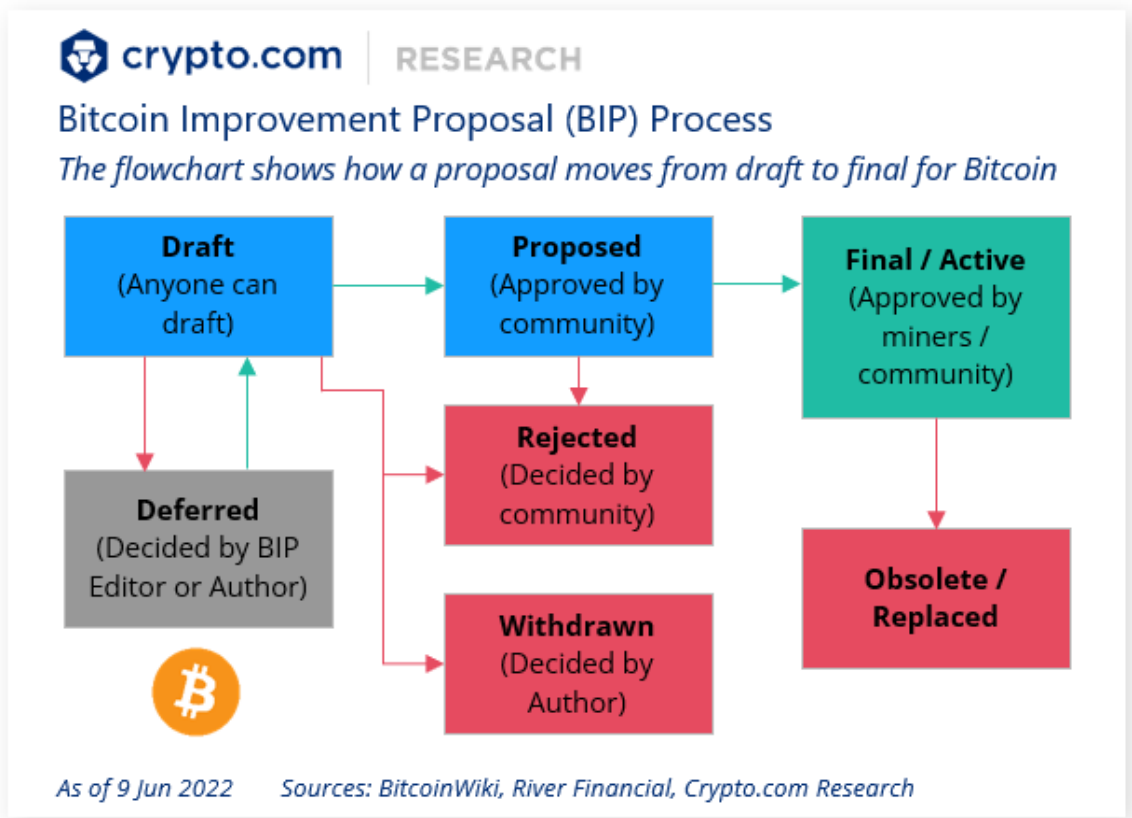
Ethereum Improvement Proposal (EIP)

Ethereum also has its own improvement proposal framework, called the Ethereum Improvement Proposal (EIP). The EIP process is similar in nature to Bitcoin's BIP, and we refer interested readers to the Ethereum EIP webpage.

Anyone within the Ethereum community can create an EIP. Notably, the authors of EIP-721, a highly important EIP that standardised NFTs, were regular community members who did not directly work on Ethereum's protocol development.

Sometimes, even Vitalik's EIPs do not get adopted. In an interview, Vitalik (co-founder of Ethereum) mentioned, "If you watch some of the EIPs that I personally promote, some of them don't even make it." He cited EIP-4488 as an example, saying that it would have been in Ethereum if he had more control.

The above-mentioned points show that Ethereum also has high governance decentralisation. Ethereum proposals are adopted based on merit and community support.

3.2 On-Chain Governance

On-chain governance is a system for managing and implementing changes to blockchains, whereby each node or participant votes on-chain regarding whether to accept a proposed change.

Avalanche provides on-chain governance for key parameters of the network, such as minimum staking amount and time, minting rate, transaction fees, and more. Participants are able to vote on changes and upgrades to the network in a democratic way.

Fantom also supports on-chain governance, allowing FTM holders to create new proposals and vote on existing ones to improve the network. The voting takes place entirely on-chain and 1 FTM equals one vote.

Interestingly, Fantom proposals allow voters to express their level of agreement, where 0 is disagreement, and 4 is full agreement. Fantom also has a system that takes the vote of the validator if a delegator does not vote. This can help to solve the problem of low voter turnout.

Community Proposals

0x54443b ... 03e721

Do you agree that community members can submit proposal through the Fantom fWallet?

Total Votes
51.02% (min. 55%)

Option	Agreement (min. 55%)
Level of agreement (0-4)	99.61%

Source: Fantom Foundation Twitter

3.3 DAOs

Blockchains can also improve their governance decentralisation by transitioning into Decentralised Autonomous Organisations (DAOs).

Polygon has established the [Polygon Ecosystem DAO](#). A Genesis Team was established from community members with the aim of growing the ecosystem. Projects in the Polygon ecosystem are also invited to participate in the DAO's growth-focused governance.

In December 2021, Polygon also ['removed' all C-suite positions](#). Polygon co-founders Sandeep Nailwal and Jaynti Kanani, who were previously COO and CEO respectively, have removed the positions from their job titles on LinkedIn. According to Polygon co-founder Mihailo Bjelic, this shift is to make Polygon even more decentralised.

3.4 Open-Source Code

In order to allow the community to contribute, the blockchain's code should be [open source](#). This also contributes to increasing governance decentralisation, as it means more people have the ability to audit, as well as make changes and decisions through code.

Cronos is [open source](#) and [publicly available](#) for interested users to audit and contribute towards its development. Cronos utilises the Ethermint framework, which allows it to adopt the [best of both worlds](#) from the Ethereum and Cosmos ecosystems. That is, Cronos offers EVM-compatibility as well as cross-chain compatibility with Cosmos SDK-based networks.

The Cronos and Crypto.com team has been praised by [Sunny Aggarwal](#), co-founder of Osmosis Foundation, for [actively contributing to the Cosmos ecosystem](#) (which is also [open source](#)).

Sunny [tweeted](#) that unlike others that "fork the Cosmos SDK and then never contribute back", "**the @cryptocom team has been a nonstop good ecosystem contributor for years**".

3.5 GitHub Contributors and Commits

In the table below, we list down some metrics regarding GitHub contributors and commits of various blockchains.

In general, the more contributors, the more decentralised the blockchain is. [Balaji Srinivasan](#), a prominent crypto entrepreneur and essayist, calls this '**Dev Decentralisation**'.

Each blockchain can have multiple GitHub repositories, in which case we study the most popular one by GitHub stars. **For example, for Bitcoin the most popular**

repository is [Bitcoin Core](#), while for Ethereum it is Geth ([Go Ethereum](#)). These two are also the repositories analysed by [Balaji](#).

Developer Decentralisation Metrics   crypto.com | RESEARCH

Blockchain	Repository (Starting Date)	Contributors	Total Commits	Average Commits	Top Contributor's Commits (% of Total Commits)
Bitcoin	Bitcoin Core (30 Aug 2009)	868	34,196	39	MarcoFalke 2,291 (7%)
Ethereum	Go Ethereum (29 Dec 2013)	775	13,413	17	obscuren (Jeffrey Wilcke) 2,620 (20%)
Binance Smart Chain	BSC (29 Dec 2013)[1]	148	12,836	87	obscuren (Jeffrey Wilcke)[1] 2,620 (20%)
Solana	Solana (11 Feb 2018)	348	19,214	55	mvines (Michael Vines) 3,944 (21%)
Avalanche	Avalanche Go (8 Mar 2020)	66	8,147	123	StephenButtolph 1,946 (24%)
Polygon	Matic Network Contracts (19 Nov 2017)	16	1,859	116	0xAshish 660 (36%)
Fantom	Go Lachesis (15 Jan 2017)	33	3,346	101	devintegral 372 (11%)

[1] The Binance Smart Chain client is based on a go-ethereum fork, which explains why both Go Ethereum and BSC display the same starting date and top contributor.

As of 10 Jun 2022   Sources: GitHub, Crypto.com Research

We also included the **starting date** of the repository. **We need to take into account that newer blockchains (e.g. Avalanche) need time to gradually increase their developer decentralisation.**

We also track the average number of commits (total commits divided by total contributors), as well as the commit statistics of the top contributor. **For Bitcoin, the title of 'most prolific contributor' goes to [Marco Falke](#), who has made thousands of commits to Bitcoin Core's codebase.**

4. Wealth Decentralisation

Wealth decentralisation refers to the decentralisation of crypto assets, particularly the native token, that is distributed across blockchain users.

For PoS blockchains, wealth decentralisation goes beyond the financial aspects and potentially also affects the security of the blockchain. This is because if a group or individual owns more than 50% of the staked cryptocurrency, they can launch a 51% attack on the blockchain.

4.1 Initial Distribution Should be Fair

The initial distribution of a cryptocurrency should be as fair as possible, to get off to a good start. Once the blockchain is launched, free-market forces will make it harder to improve wealth decentralisation (e.g. people are free to accumulate more crypto by buying).

According to a study by Dan Held, Bitcoin's initial distribution is believed to be the 'fairest' possible system. Firstly, there was no **'premine'**, which is the practice of mining coins privately, usually by the developers. Nor was there any '**instamine**', where a large quantity of crypto tokens are brought into existence at once.

Secondly, Satoshi gave the public a two-month lead time, before mining the first block. According to Held, Satoshi also left the mining scene once the network had stabilised to the point where it no longer required Satoshi's own mining output.

For **Ethereum**, there was a public ether presale of about 60M ETH. The public sale comprised 80% of the initial supply, while the other 20% was allocated to the Ethereum Foundation and early Ethereum contributors.

Ethereum's initial distribution can be considered relatively fair, due to its high percentage (80%) for the public sale, especially when compared to other projects.

4.2 Lower Issuance

Researchers have observed that PoS blockchains are susceptible to the Matthew Effect, i.e. the rich gets richer. **This is because PoS blockchains give out rewards to validators based on a percentage of their stake.**

A high staking APY benefits whales more than smaller investors (in terms of absolute rewards), causing whales to get even more tokens which they can

potentially dump on the market. Lowering the issuance can help to mitigate this issue, as well as having other benefits like reduced inflation.

Ethereum is pursuing a monetary policy of [Minimum Necessary Issuance](#). Ethereum's current yearly network issuance is approximately [4.5%](#). Ethereum's monetary policy can be described as "**minimum issuance to secure the network**".

The combination of [EIP-1559](#) (Ethereum's fee-burning proposal) and the impending transition to PoS is expected to cause a '**triple halving**' effect for Ethereum — the equivalent of three Bitcoin halvings.

4.3 Bitcoin Wealth Is Becoming More Evenly Distributed

The [E-Commerce Institute Cologne](#) wrote a fairly recent (March 2022) and comprehensive four-part article on how **Bitcoin wealth is becoming more evenly distributed**, i.e. higher wealth decentralisation.

Importantly, the article also **dispels several myths about Bitcoin wealth concentration**, such as the misleading (but often reported) statement that '[2% of Bitcoin holders control 95% of the current supply](#)'.

Firstly, the article mentioned that **estimating Bitcoin wealth concentration is a non-trivial task, and "pinpointing it is impossible"**. Furthermore, the article lists **10 factors that may make Bitcoin wealth appear more concentrated than it actually is.** We include the top five factors here:

1. **Exchange wallets**
   - The [top 4 richest Bitcoin](#) addresses belong to exchanges (note that individuals could deposit/buy/hold crypto in exchanges).
   - As of 14 June 2022, these 4 addresses own [673,632 BTC](#) in total (3.53% of the circulating supply of [19,067,100 BTC](#)).
2. **Users can have multiple addresses**
3. **Peeling Chains**
   - Transactions are often channelled through many different addresses.
4. **Public and private companies**
   - Companies have begun to add BTC to their balance sheets.
   - As of 14 June 2022, public companies hold [268,271 BTC](#), while private companies hold [202,068 BTC](#).
   - In total, that would be 470,339 BTC (2.47% of circulating supply).
5. **Bitcoin Funds, ETFs, and ETPs**

○ As of 14 June 2022, Bitcoin ETFs hold 828,641 BTC (4.35% of circulating supply).

There are also other factors like countries holding BTC, lost Bitcoins, wrapped BTC, and hacked exchanges.

Dispelling the Myth: '2% of Bitcoin holders control 95% of the current supply'

In March 2022, an article by E-Commerce Institute Cologne found that the statement '2% of addresses control 95% of the supply' is true, but is also misleading and irrelevant. We repeated the analysis on 14 June 2022 using BitInfoCharts, and found that indeed **2.02% of BTC addresses (not individual holders) control 94.27% of the circulating supply**.
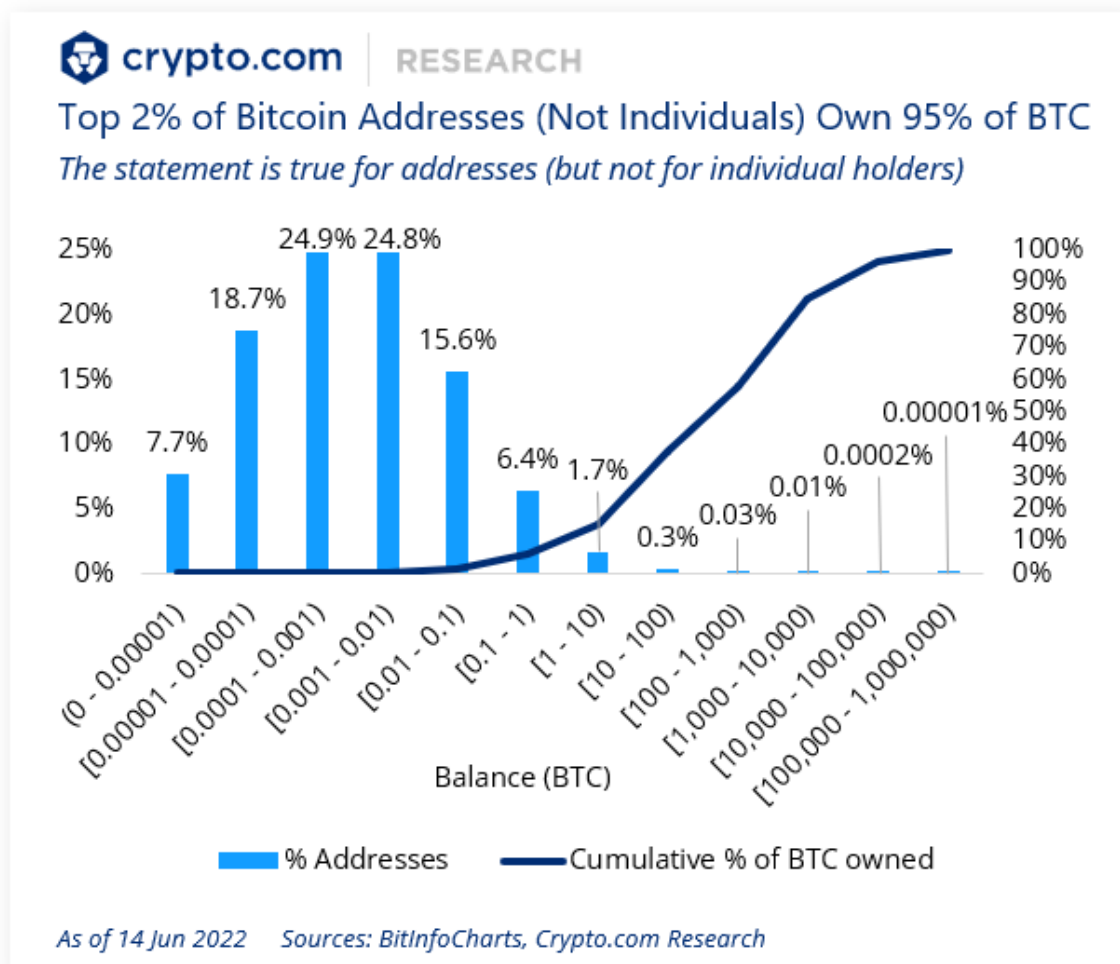
There is a big difference between addresses and individual holders. Many of the top Bitcoin addresses are exchanges, companies, ETFs, or even countries, which represent many individual holders.

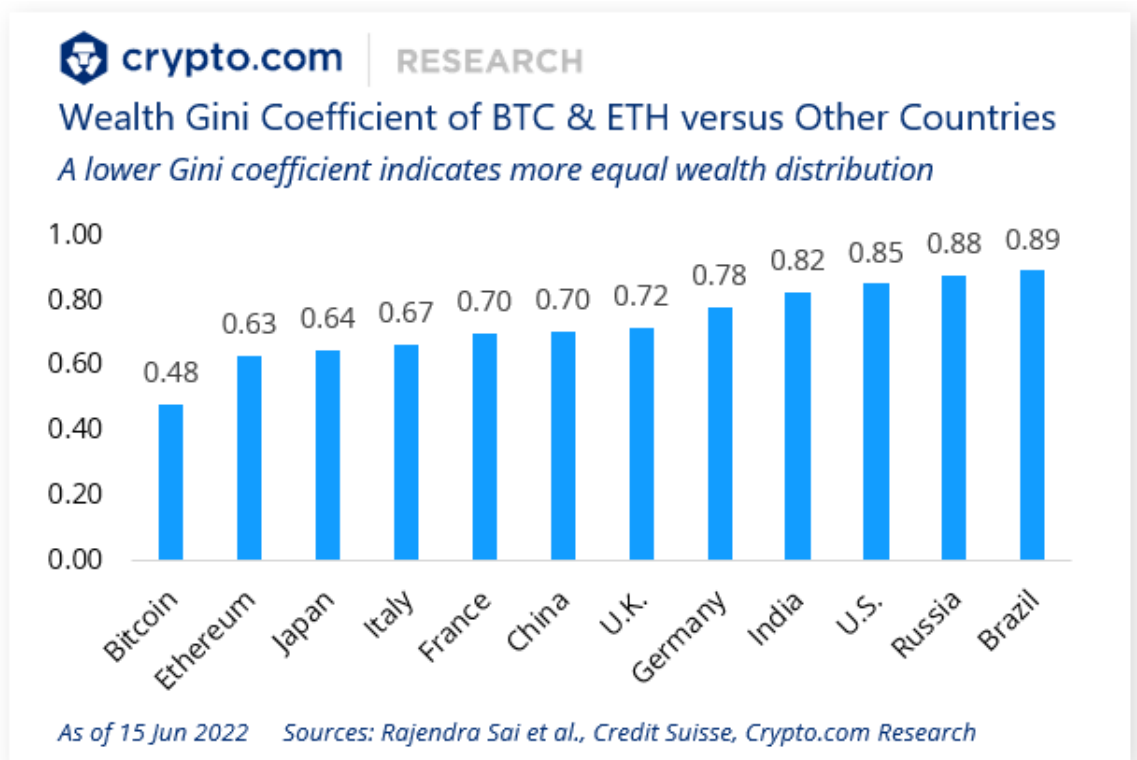Published on 27 Jun 2022

Gini Coefficient of Bitcoin and Ethereum

Since Bitcoin went live in 2009, its Gini coefficient has been declining steadily (meaning Bitcoin's wealth decentralisation has improved).

Different research reports give different Gini coefficient numbers for Bitcoin ranging from 0.48 to 0.73 (due to the different methodologies), though they have the common similarity of showing that it is declining throughout the years.

According to graphs in the research article 'Characterising Wealth Inequality in Cryptocurrencies' published on 20 December 2021, **Bitcoin's Gini coefficient is around 0.48**. In the same paper, **Ethereum's Gini coefficient is around 0.63**. Another source (Cylynx) also independently obtained similar numbers for BTC and ETH.

Hence, Bitcoin and Ethereum's wealth decentralisation can be said to be on par with (or even better than) many countries (when comparing with countries' Wealth Gini, not Income Gini).

For example, according to Credit Suisse's Global Wealth Report 2021, **many major countries have a Wealth Gini higher than 0.7: Brazil (0.89), China (0.704), United Kingdom (0.717), and United States (0.85).**

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Wealth Gini Coefficient of BTC & ETH versus Other Countries
A lower Gini coefficient indicates more equal wealth distribution

Bitcoin 0.48, Ethereum 0.63, Japan 0.64, Italy 0.67, France 0.70, China 0.70, U.K. 0.72, Germany 0.78, India 0.82, U.S. 0.85, Russia 0.88, Brazil 0.89

As of 15 Jun 2022   Sources: Rajendra Sai et al., Credit Suisse, Crypto.com Research

5. Conclusion

In this article, we covered the three facets of decentralisation: **consensus decentralisation**, **governance decentralisation**, and **wealth decentralisation**.

For **consensus decentralisation**, we see that the blockchains of Web3 are indeed more decentralised than the centralised servers of Web2, with blockchains having up to thousands of nodes, spread across various entities, countries, and continents.

For **governance decentralisation**, the various on-chain and off-chain governance processes of blockchains have proven to be effective in allowing the global community to contribute new ideas and suggestions.

Regarding **wealth decentralisation**, various cryptocurrencies such as Bitcoin and Ethereum have a fair initial distribution, as well as on-chain metrics showing that wealth is becoming more evenly distributed.

Vitalik Buterin once said, "**In order to have a decentralised database, you need to have security. In order to have security, you need to have incentives.**" The decentralisation, security, and financial aspects of blockchains are all interconnected.

Decentralisation is a key piece in the Blockchain Trilemma, and is likely to bring about profound beneficial changes in technology, culture, and economics in the near future.

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e. contact@crypto.com

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