

Global Cryptocurrency Benchmarking Study and Market Analysis

Jackie Chong Cheong Sin

*International Institute of Applied Science of Swiss School of Management,
Switzerland
jackie@unies.my*

Abstract

In 2009, there was only one cryptocurrency, Bitcoin, which has stood the test of time and remains the primary gold standard for the overall industry. There are now over 2000 altcoins but only a dozen has proven to be sustainable projects worth serious investor money. The idea of decentralisation propped up the idea that cryptocurrencies represent the future of money. This subsequently led to hype and interest beyond the investing public. Adoption and popularity of cryptocurrencies hit a high in 2017 with Bitcoin, the leading cryptocoin, hitting an all-time high of circa \$20,000 in December of that year. But the market always faced regulatory risk, and 2018 was the year serious efforts were made by various government agencies to clip the wings of assets that seemingly had no wings. On January 2018, major tokens lost more than 40% of their values and were suppressed throughout the year. Yet, regulation was not a curse to the industry entirely. Firstly, when the market was in its infancy, the headlines were of a blanket ban. So, the shift to regulation meant there was appreciation of the disruptive potential of the industry and the need to deal with possible negative effects. Secondly, regulation headlines have also helped generate interest in the cryptocurrency space, attracting more participants and fuelling adoption. Most regulators now consider crypto assets as legitimate financial assets. Crypto ETFs (electronic-traded funds) have already been launched in major exchanges around the world. Also, in the US, a previous crypto critic, Bitcoin futures are already trading at the Chicago Board Options Exchange (CBOE). CBOE has also consistently lobbied the US Securities and Exchange Commission (SEC) to soften its stance on crypto assets. As of August 2019, there were proposals to launch tradable crypto ETFs, with the SEC expected to make a decision before the end of 2019. Cryptocurrencies have come a long way and headlines will continue to excite investors focused in this space.

Keywords: *Cryptocurrency, Market Analysis, Data Mining, Blockchain, Global Finance, International Economy, cryptography*

1. Introduction

In 1983, the American cryptographer David Chaum conceived an anonymous cryptographic electronic money called ecash.[14][15] Later, in 1995, he implemented it through Digicash,[16] an early form of cryptographic electronic payments. Digicash required user software in order to withdraw notes from a bank and designate specific encrypted keys before it can be sent to a recipient. This allowed the digital currency to be untraceable by the issuing bank, the government, or any third party.

In 1996, the National Security Agency published a paper entitled How to Make a Mint: the Cryptography of Anonymous Electronic Cash, describing a Cryptocurrency system, first publishing it in an MIT mailing list [17] and later in 1997, in The American Law Review (Vol. 46, Issue 4).[18]

In 1998, Wei Dai published a description of "b-money", characterized as an anonymous, distributed electronic cash system.[19] Shortly thereafter, Nick Szabo described bit gold.[20] Like Bitcoin and other cryptocurrencies that would follow it, bit gold (not to be confused with the later gold-based exchange, BitGold) was described as an electronic currency system which required users to complete a proof of work function with solutions being cryptographically put together and published.

In 2009, the first decentralized cryptocurrency, Bitcoin, was created by presumably pseudonymous developer Satoshi Nakamoto. It used SHA-256, a cryptographic hash function, in its proof-of-work scheme.[21][22] In April 2011, Namecoin was created as an attempt at forming a decentralized DNS, which would make internet censorship very difficult. Soon after, in October 2011, Litecoin was released which used scrypt as its hash function instead of SHA-256. Another notable cryptocurrency, Peercoin, used a proof-of-work/proof-of-stake hybrid.[23]

On 6 August 2014, the UK announced its Treasury had commissioned a study of cryptocurrencies, and what role, if any, they could play in the UK economy. The study was also to report on whether regulation should be considered.[24] Its final report was published in 2018,[25] and it issued a consultation on cryptoassets and stablecoins in January 2021.[26]

In June 2021, El Salvador became the first country to accept Bitcoin as legal tender, after the Legislative Assembly had voted 62–22 to pass a bill submitted by President Nayib Bukele classifying the cryptocurrency as such.[27]

In August 2021, Cuba followed with Resolution 215 to recognize and regulate cryptocurrencies such as Bitcoin.[28]

In September 2021, the government of China, the single largest market for cryptocurrency, declared all cryptocurrency transactions illegal, completing a crackdown on cryptocurrency that had previously banned the operation of intermediaries and miners within China.[29].

2. Global cryptocurrency

A cryptocurrency, crypto-currency, or crypto is a digital currency designed to work as a medium of exchange through a computer network that is not reliant on any central authority, such as a government or bank, to uphold or maintain it.[2]

Individual coin ownership records are stored in a digital ledger, which is a computerized database using strong cryptography to secure transaction records, to control the creation of additional coins, and to verify the transfer of coin ownership.[3][4][5] Despite their name, cryptocurrencies are not considered to be currencies in the traditional sense and while varying treatments have been applied to them, including classification as commodities, securities, as well as currencies, cryptocurrencies are generally viewed as a distinct asset class in practice.[6][7][8] Some crypto schemes use validators to maintain the cryptocurrency. In a proof-of-stake model, owners put up their tokens as collateral. In return, they get authority over the token in proportion to the amount they stake. Generally, these token stackers get additional ownership in the token over time via network fees, newly minted tokens or other such reward mechanisms.[9]

Cryptocurrency does not exist in physical form (like paper money) and is typically not issued by a central authority. Cryptocurrencies typically use decentralized control as opposed to a central bank digital currency (CBDC).[10] When a cryptocurrency is minted or created prior to issuance or issued by a single issuer, it is generally considered centralized. When implemented with decentralized control, each cryptocurrency works through distributed ledger technology, typically a blockchain, that serves as a public financial transaction database.[11] Traditional asset classes like currencies, commodities, and stocks, as well as macroeconomic factors, have modest exposures to cryptocurrency returns.[12]

The first decentralized cryptocurrency was Bitcoin, which first released as open-source software in 2009. As of March 2022, there were more than 9,000 other cryptocurrencies in the marketplace, of which more than 70 had a market capitalization exceeding \$1 billion.[13].

According to Jan Lansky, a cryptocurrency is a system that meets six conditions:[30]

- The system does not require a central authority; its state is maintained through distributed consensus.
- The system keeps an overview of cryptocurrency units and their ownership.
- The system defines whether new cryptocurrency units can be created. If new cryptocurrency units can be created, the system defines the circumstances of their origin and how to determine the ownership of these new units.
- Ownership of cryptocurrency units can be proved exclusively cryptographically.
- The system allows transactions to be performed in which ownership of the cryptographic units is changed. A transaction statement can only be issued by an entity proving the current ownership of these units.

- If two different instructions for changing the ownership of the same cryptographic units are simultaneously entered, the system performs at most one of them.

In March 2018, the word cryptocurrency was added to the Merriam-Webster Dictionary.[31]

Tokens, cryptocurrencies, and other types of digital assets that are not Bitcoin are collectively known as alternative cryptocurrencies,[32][33][34] typically shortened to "altcoins" or "alt coins",[35][36] or disparagingly known as "shitcoins".[37] Paul Vigna of The Wall Street Journal also described altcoins as "alternative versions of Bitcoin"[38] given its role as the model protocol for altcoin designers.

Altcoins often have underlying differences when compared to Bitcoin. For example, Litecoin aims to process a block every 2.5 minutes, rather than Bitcoin's 10 minutes, which allows Litecoin to confirm transactions faster than Bitcoin.[39] Another example is Ethereum, which has smart contract functionality that allows decentralized applications to be run on its blockchain.[40] Ethereum was the most used blockchain in 2020, according to Bloomberg News.[41] In 2016, it had the largest "following" of any altcoin, according to the New York Times.[42]

Significant rallies across altcoin markets are often referred to as an "altseason".[43][44]

Stablecoins are altcoins that are designed to maintain a stable level of purchasing power.[45] Notably, these designs are not foolproof, as a number of stable coins have crashed or lost their peg, including the May 11, 2022 crash of Terra, with UST falling from \$1 to 26 cents, and affiliated token Luna falling 99.9%.[46][47].

3. Cryptocurrency (active currencies, inactive currencies and benchmark)

After the creation of bitcoin, the number of cryptocurrencies available over the internet is growing.[1] This is a list of notable cryptocurrencies.

3.1 Active currencies by date of introduction

Year of introduction	Currency	Symbol	Founder(s)
2009	Bitcoin	BTC, ^[2] XBT, ₿	Satoshi Nakamoto ^[nt 1]
2011	Litecoin	LTC, Ł	Charlie Lee
2011	Namecoin	NMC	Vincent Durham ^{[10][11]}
2012	Peercoin	PPC	Sunny King (pseudonym)

2013	Dogecoin	DOGE, XDG, Ð	Jackson Palmer & Billy Markus ^[14]
2013	Gridcoin	GRC	Rob Hälford ^[16]
2013	Primecoin	XPM	Sunny King (pseudonym)
2013	Ripple ^{[21][22]}	XRP	Chris Larsen & Jed McCaleb ^[23]
2013	Nxt	NXT	BCNext (pseudonym)
2014	Auroracoin	AUR	Baldur Odinson (pseudonym) ^[28]
2014	Dash	DASH	Evan Duffield & Kyle Hagan
2014	NEO	NEO	Da Hongfei & Erik Zhang
2014	MazaCoin	MZC	BTC Oyate Initiative
2014	Monero	XMR	Monero Core Team
2014	Titcoin	TIT	Edward Mansfield & Richard Allen ^[34]
2014	Verge	XVG	Sunerok
2014	Stellar	XLM	Jed McCaleb
2014	Vertcoin	VTC	David Muller ^[40]
2015	Ethereum	ETH, ð	Vitalik Buterin ^[43]
2015	Ethereum Classic	ETC	
2015	Nano	Nano	Colin LeMahieu
2015	Tether	USDT	Jan Ludovicus van der Velde ^[50]
2016	Firo	FIRO	Poramin Insom ^[53]
2016	Zcash	ZEC	Zooko Wilcox
2017	Bitcoin Cash	BCH ^[58]	
2017	EOS.IO	EOS	Dan Larimer
2017	Cardano	ADA, ₳	Charles Hoskinson
2017	TRON	TRX	Justin Sun

2018	AmbaCoin		
2019	Algorand	ALGO	Silvio Micali
2020	Avalanche	AVAX	Emin Gün Sirer, Kevin Sekniqi, Maofan “Ted” Yin
2020	Shiba Inu	SHIB	Ryoshi
2020	Polkadot	DOT	Gavin Wood
2021	DeSo	DESO	Nader al-Naji (<i>aka diamondhands</i>) ^[68]
2021	SafeMoon	SAFEMOON	SafeMoon LLC
2021	Internet Computer	ICP	Dominic Williams, DFINITY Foundation

Table 1 The Active Cryptocurrencies

3.2 Inactive currencies

Release	Currency	Symbol	Founder(s)
2014	Coinye	KOI, COYE	
2015 or before	OneCoin		Ruja Ignatova and Stephen Greenwood
2017	BitConnect	BCC	
2018	KodakCoin		Kodak and WENN Digital
	Petro		Venezuelan Government

Table 2 The Inactive Cryptocurrencies

3.3 Benchmark Cryptocurrencies

The Crypto10 Index, also known as or the B10 index, as it is also known is provided run by a company named BITA. It, represents the performance of the top 10 largest cryptocurrencies in the market, based on market capitalisation. By monitoring the top blockchain projects in the industry, the Crypto-10 Index is widely considered as the benchmark cryptocurrency index for the cryptocurrency the crypto market. By tracking this index, global investors can quickly gauge the volatility and sentiment of the overall cryptocurrency market, see Figure 1.

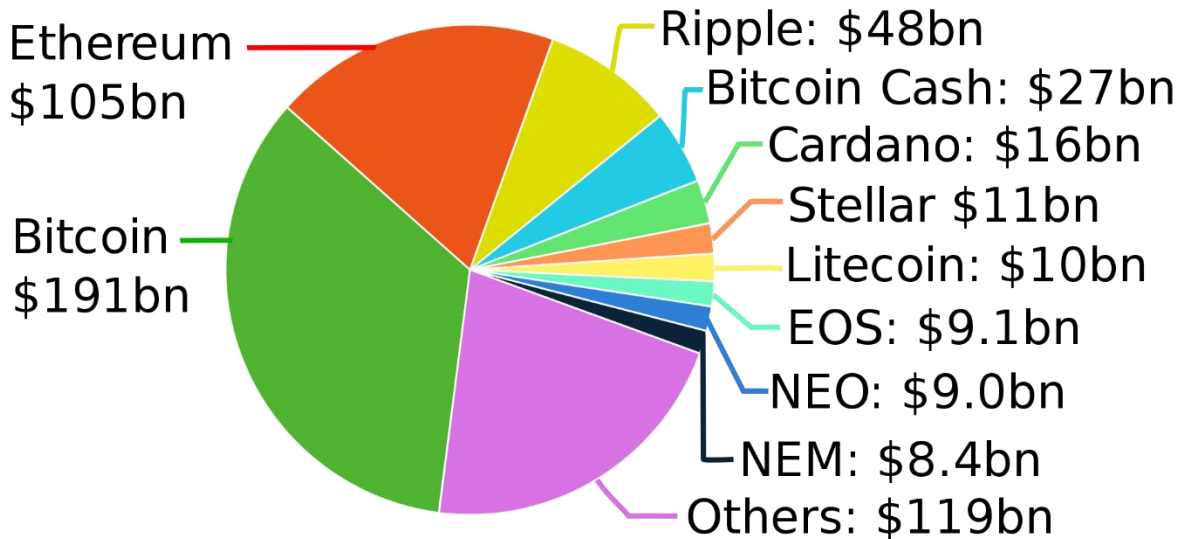


Figure 1 Market capitalizations of cryptocurrencies as of January 27, 2018

The BITA10 Index 10 was first introduced on the 20th of September 2018, by BITA, a Germany-based Fintech company that is responsible for providing enterprise-grade indexes, data and infrastructure to institutions operating in the investment space. The Crypto10 Index is calculated in US dollars (USD), and it is calculated daily, with no exceptions. This calculation takes place between 00:00 and 23:00 UTC. The B10 Index was launched with a standardised baseline value of 5000 points and its value has since mirrored the performance of the overall cryptocurrency market. Ultimately, this index can also be used as a benchmark for a wide variety of financial and non-financial products.

To calculate the price of the Index, BITA uses data from a variety of sources, including trading platforms, regulatory agencies, token issuers, real-time data from approved 3rd party sources and any related data from service providers. The B10 Index is measured in points and it tracks the prices of the top ten tokens in the market based on trading volumes and market capitalisation, which is, the token price * the number of units in circulation.

- In order to be included in the index, the following conditions must be met:
- A coin or token must be traded on at least two exchanges in order to be considered. Tokens traded in multiple exchanges are often accredited with market acceptance.
- A coin or token must have been traded for at least 3 calendar months.
- A coin or token must have, at some point, been in the top 200 tokens by market capitalisation.

#	Cryptocurrency	Distribution by Weight
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1	Bitcoin (BTC)	25.000%
2	Ethereum (ETH)	25.000%
3	Binance Coin (BNB)	20.385%
4	Cardano(ADA)	8.657%
5	Solana (SOL)	5.141%
6	Dogecoin (DOGE)	4.042%
7	Polkadot(DOT)	3.735%
8	Tron (TRX)	3.279%
9	Shiba (SHIB)	2.383%
10	Avalanche (AVAX)	2.378%

Table 3 Coins and token included in the BITA10 Index as of February 2021

- Only tokens or coins that are traded exclusively at exchanges, which have passed quantitative and qualitative requirements are taken into consideration and ranked by market capitalisation.
- The top 10 tokens are then selected as the initial components of the BITA10 Index. Composition buffers are used in order to achieve this fixed number of components and this ensures the stability of the index. The end result is that the Crypto index accurately represents the performance of only the largest and most traded tokens in the world.
- The largest positions, based on market capitalisation, are capped at 25%, to ensure greater diversification.
- BITA evaluates changes in rankings at each reconstitution period, taking into account a 30% selection buffer. This means that any token that falls below the 13th position is removed and replaced by an incoming token. Any token that successfully grows into the first 30% of the ranking, are exempt from the selection buffer and they enter the index automatically.

The cryptocurrency market is very dynamic and to reflect any changes that may occur, BITA provides a wide range of data. At 00:00 UTC daily, the opening price of the BITA10 index is released, while the index settlement values are released daily between 11:50 – 12:00 UTC. At 23:00 UTC, the closing price of the index is released together with the index value, the composition of the index with weights and prices. The Cryptocurrencies Index also rebalances quarterly so as to delete or add eligible assets.

Due to the composition of the Crypto Market Index 10 and the general nature of the crypto market, various factors may impact its price level. The crypto market is headline sensitive and will particularly react to loud news from regulatory agencies, such as the US's SEC and China's CSRC, as well as other relevant headlines, such as hacks on

major crypto exchanges. Other news that may impact the index's price are mining and trading legislation in different countries.

The index will also be heavily impacted by significant price shifts of one of its constituent components, especially Bitcoin. As stated above, Bitcoin acts as the gold standard of the cryptocurrency market, and it usually provides the cue for price direction for other coins and tokens.

Bitcoin is often known as a safe haven asset. This means that much like Gold when markets are in turmoil and all of the money is running away from the US dollar and the stock market in a "risk on" environment, it tends to run towards the safe haven assets, Bitcoin included. If you look at Bitcoin on a price chart in comparison to the USD, you will often see it inversely correlated. This is not a hard and fast rule; however, it is common. Bitcoin like Gold is a good store of wealth and due to anonymity can be a great way for people to get money out of a restrictive country quickly. When this happens, it pushes up the price of the Bitcoin.

Trade the Crypto Market Index 10 or any other individual cryptocurrency CFDs at AvaTrade and enjoy the following benefits:

- Regulation: AvaTrade is a highly regulated and award-winning broker and we are in the process of expanding our regulation even further.
- Intuitive Trading Platforms: We offer access to a choice of intuitive trading platforms and effective solutions to maximise trading accuracy. These include the highly popular (MetaTrader) and trading platforms, WebTrader, AvaTradeGO app, the and AvaOptions, AvaTrade's exclusive .
- Choice of Assets: AvaTrade offers access to a wide range of tradeable assets including cryptocurrencies, forex pairs, commodities, stocks, indices, bonds and ETFs. Our clients can also use with API Trading, and DupliTrade. AvaTrade is also one of the few companies to offer.
- Leverage: Enjoy leverage of up to 20:1 on crypto assets.
- No Wallet Required for Cryptos: With AvaTrade, you do not need a wallet in order to trade cryptos. Simply trade your favourite assets from the comfort of one of our trading platforms.
- Safety First: AvaTrade is globally regulated via 8 authorities across 5 continents so your safety is not just assured, it is guaranteed. Our clients' funds are held in a segregated account, plus with the help of negative balance protection, we protect our clients and ensure a trader's account will never go below zero.
- Variety of Payment Solutions: We offer a choice of secure deposit methods including credit cards, wire transfer, WebMoney, Dinpay, Boletto and FasaPay. AvaTrade does not charge any commissions and there is no margin interest
- Comprehensive Educational Resources: You can access our wide collection of informative educational materials including articles, videos, eBooks and weekly webinars.

- Professional & Responsive Support: AvaTrade operates professional customer support available in your language.

4. Cryptocurrency structure and analysis

Decentralized cryptocurrency is produced by an entire cryptocurrency system collectively, at a rate which is defined when the system is created and which is publicly stated. In centralized banking and economic systems such as the US Federal Reserve System, corporate boards or governments control the supply of currency. In the case of decentralized cryptocurrency, companies or governments cannot produce new units, and have not so far provided backing for other firms, banks or corporate entities which hold asset value measured in it. The underlying technical system upon which decentralized cryptocurrencies are based was created by the group or individual known as Satoshi Nakamoto.[48]

As of May 2018, over 1,800 cryptocurrency specifications existed.[49] Within a proof-of-work cryptocurrency system such as Bitcoin, the safety, integrity and balance of ledgers is maintained by a community of mutually distrustful parties referred to as miners. Miners use their computers to help validate and timestamp transactions, adding them to the ledger in accordance with a particular timestamping scheme.[21] In a proof-of-stake (PoS) blockchain, transactions are validated by holders of the associated cryptocurrency, sometimes grouped together in stake pools.

Most cryptocurrencies are designed to gradually decrease the production of that currency, placing a cap on the total amount of that currency that will ever be in circulation.[50] Compared with ordinary currencies held by financial institutions or kept as cash on hand, cryptocurrencies can be more difficult for seizure by law enforcement.[3]

- **Blockchain**

The validity of each cryptocurrency's coins is provided by a blockchain. A blockchain is a continuously growing list of records, called blocks, which are linked and secured using cryptography.[48][51] Each block typically contains a hash pointer as a link to a previous block,[51] a timestamp and transaction data.[52] By design, blockchains are inherently resistant to modification of the data. It is "an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way".[53] For use as a distributed ledger, a blockchain is typically managed by a peer-to-peer network collectively adhering to a protocol for validating new blocks. Once recorded, the data in any given block cannot be altered retroactively without the alteration of all subsequent blocks, which requires collusion of the network majority, see Figure 2.

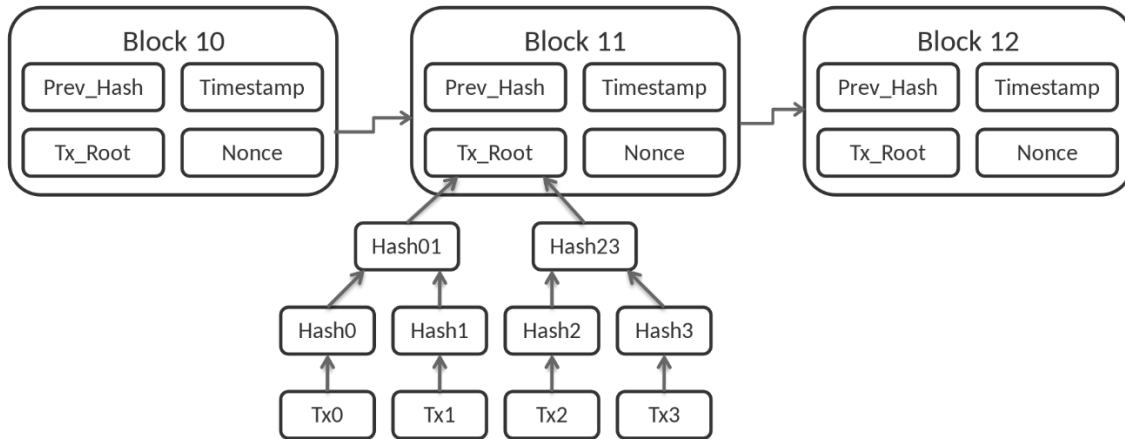


Figure 2 Bitcoin Blockchain Structure

Blockchains are secure by design and are an example of a distributed computing system with high Byzantine fault tolerance. Decentralized consensus has therefore been achieved with a blockchain.[54]

A blockchain is a growing list of records, called blocks, that are securely linked together using cryptography.[1][2][3][4] Each block contains a cryptographic hash of the previous block, a timestamp, and transaction data (generally represented as a Merkle tree, where data nodes are represented by leafs). The timestamp proves that the transaction data existed when the block was published to get into its hash. As blocks each contain information about the block previous to it, they form a chain, with each additional block reinforcing the ones before it. Therefore, blockchains are resistant to modification of their data because once recorded, the data in any given block cannot be altered retroactively without altering all subsequent blocks.

Blockchains are typically managed by a peer-to-peer network for use as a publicly distributed ledger, where nodes collectively adhere to a protocol to communicate and validate new blocks. Although blockchain records are not unalterable as forks are possible, blockchains may be considered secure by design and exemplify a distributed computing system with high Byzantine fault tolerance.[5]

The blockchain was popularized by a person (or group of people) using the name Satoshi Nakamoto in 2008 to serve as the public transaction ledger of the cryptocurrency bitcoin, based on work by Stuart Haber, W. Scott Stornetta, and Dave Bayer.[3][6] The identity of Satoshi Nakamoto remains unknown to date. The implementation of the blockchain within bitcoin made it the first digital currency to solve the double-spending problem without the need of a trusted authority or central server. The bitcoin design has inspired other applications [3][2] and blockchains that are readable by the public and are widely used by cryptocurrencies. The blockchain is considered a type of payment rail.[7]

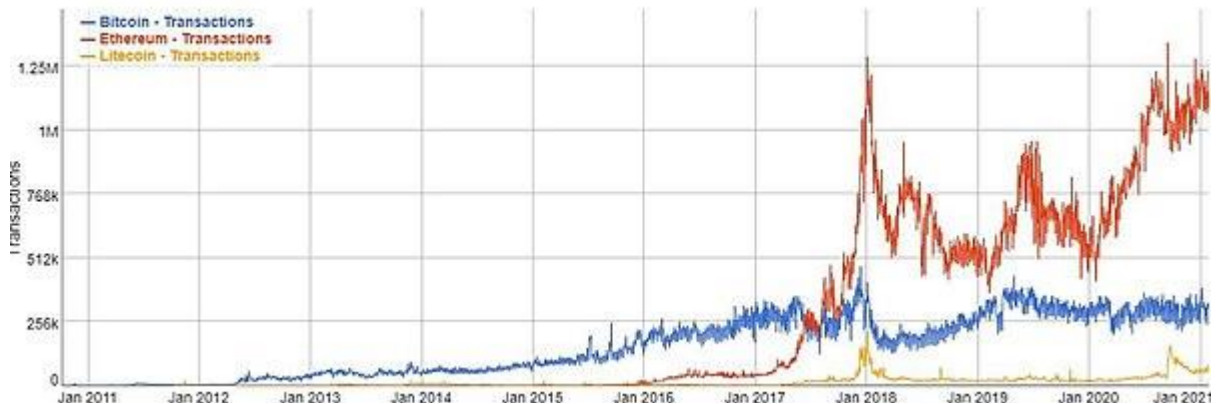


Figure 3 Bitcoin, Ethereum and Litecoin transactions per day (January 2011 – January 2021)

Private blockchains have been proposed for business use. Computerworld called the marketing of such privatized blockchains without a proper security model "snake oil";[8] however, others have argued that permissioned blockchains, if carefully designed, may be more decentralized and therefore more secure in practice than permissionless ones.[4][9]

- **Nodes**

In the world of cryptocurrency, a node is a computer that connects to a cryptocurrency network. The node supports the cryptocurrency's network through either; relaying transactions, validation or hosting a copy of the blockchain. In terms of relaying transactions each network computer (node) has a copy of the blockchain of the cryptocurrency it supports. When a transaction is made the node creating the transaction broadcasts details of the transaction using encryption to other nodes throughout the node network so that the transaction (and every other transaction) is known.

Node owners are either volunteers, those hosted by the organization or body responsible for developing the cryptocurrency blockchain network technology, or those who are enticed to host a node to receive rewards from hosting the node network.[55]

- **Timestamping**

Cryptocurrencies use various timestamping schemes to "prove" the validity of transactions added to the blockchain ledger without the need for a trusted third party.

The first timestamping scheme invented was the proof-of-work scheme. The most widely used proof-of-work schemes are based on SHA-256 and script.[23]

Some other hashing algorithms that are used for proof-of-work include CryptoNight, Blake, SHA-3, and X11.

Another method is called the proof-of-stake scheme. Proof-of-stake is a method of securing a cryptocurrency network and achieving distributed consensus through requesting users to show ownership of a certain amount of currency. It is different from proof-of-work systems that run difficult hashing algorithms to validate electronic

transactions. The scheme is largely dependent on the coin, and there's currently no standard form of it. Some cryptocurrencies use a combined proof-of-work and proof-of-stake scheme.[23]

- **Mining**

In cryptocurrency networks, mining is a validation of transactions. For this effort, successful miners obtain new cryptocurrency as a reward. The reward decreases transaction fees by creating a complementary incentive to contribute to the processing power of the network. The rate of generating hashes, which validate any transaction, has been increased by the use of specialized machines such as FPGAs and ASICs running complex hashing algorithms like SHA-256 and scrypt.[56] This arms race for cheaper-yet-efficient machines has existed since Bitcoin was introduced in 2009.[56]

With more people venturing into the world of virtual currency, generating hashes for validation has become more complex over time, forcing miners to invest increasingly large sums of money to improve computing performance. Consequently, the reward for finding a hash has diminished and often does not justify the investment in equipment and cooling facilities (to mitigate the heat the equipment produces), and the electricity required to run them.[57] Popular regions for mining include those with inexpensive electricity, a cold climate, and jurisdictions with clear and conducive regulations. By July 2019, Bitcoin's electricity consumption was estimated to be approximately 7 gigawatts, around 0.2% of the global total, or equivalent to the energy consumed nationally by Switzerland.[58]

Some miners pool resources, sharing their processing power over a network to split the reward equally, according to the amount of work they contributed to the probability of finding a block. A "share" is awarded to members of the mining pool who present a valid partial proof-of-work.

As of February 2018, the Chinese Government has halted trading of virtual currency, banned initial coin offerings and shut down mining. Many Chinese miners have since relocated to Canada [59] and Texas.[60] One company is operating data centers for mining operations at Canadian oil and gas field sites, due to low gas prices.[61] In June 2018, Hydro Quebec proposed to the provincial government to allocate 500 Megawatts of power to crypto companies for mining.[62] According to a February 2018 report from Fortune, Iceland has become a haven for cryptocurrency miners in part because of its cheap electricity.[63]

In March 2018, the city of Plattsburgh in upstate New York put an 18-month moratorium on all cryptocurrency mining in an effort to preserve natural resources and the "character and direction" of the city.[64] As of February 2022, Kazakhstan became the second-biggest crypto-currency mining country, producing 18.1% of the global hash rate. The country has built a compound containing 50,000 computers near Ekibastuz.[65]

- **GPU price rise**

An increase in cryptocurrency mining increased the demand for graphics cards (GPU) in 2017.[66] (The computing power of GPUs makes them well-suited to generating hashes.) Popular favorites of cryptocurrency miners such as Nvidia's GTX 1060 and GTX 1070 graphics cards, as well as AMD's RX 570 and RX 580 GPUs, doubled or tripled in price – or were out of stock.[67] A GTX 1070 Ti which was released at a price of \$450 sold for as much as \$1100. Another popular card, the GTX 1060 (6 GB model) was released at an MSRP of \$250, and sold for almost \$500. RX 570 and RX 580 cards from AMD were out of stock for almost a year. Miners regularly buy up the entire stock of new GPU's as soon as they are available.[68]

Nvidia has asked retailers to do what they can when it comes to selling GPUs to gamers instead of miners. "Gamers come first for Nvidia," said Boris Böhles, PR manager for Nvidia in the German region.[69]

- **Wallets**

A cryptocurrency wallet stores the public and private "keys" (address) or seed which can be used to receive or spend the cryptocurrency.[70] With the private key, it is possible to write in the public ledger, effectively spending the associated cryptocurrency. With the public key, it is possible for others to send currency to the wallet.

There exist multiple methods of storing keys or seed in a wallet. These methods range from using paper wallets (which are public, private or seed keys written on paper), to using hardware wallets (which are hardware to store your wallet information), to a digital wallet (which is a computer with a software hosting your wallet information), to hosting your wallet using an exchange where cryptocurrency is traded, or by storing your wallet information on a digital medium such as plaintext.[71]

- **Anonymity**

Bitcoin is pseudonymous rather than anonymous in that the cryptocurrency within a wallet is not tied to people, but rather to one or more specific keys (or "addresses").[72] Thereby, Bitcoin owners are not identifiable, but all transactions are publicly available in the blockchain. Still, cryptocurrency exchanges are often required by law to collect the personal information of their users.[73]

Additions such as Monero, Zerocoin, Zerocash and CryptoNote have been suggested, which would allow for additional anonymity and fungibility.[74][75]

5. Global economy and financial environment effected by cryptocurrency

Cryptocurrencies are used primarily outside existing banking and governmental institutions and are exchanged over the Internet.

- **Block rewards**

Proof-of-work cryptocurrencies, such as Bitcoin, offer block rewards incentives for miners. There has been an implicit belief that whether miners are paid by block rewards or transaction fees does not affect the security of the blockchain, but a study suggests that this may not be the case under certain circumstances.[76]

The rewards paid to miners increase the supply of the cryptocurrency. By making sure that verifying transactions is a costly business, the integrity of the network can be preserved as long as benevolent nodes control a majority of computing power. The verification algorithm requires a lot of processing power, and thus electricity in order to make verification costly enough to accurately validate public blockchain. Not only do miners have to factor in the costs associated with expensive equipment necessary to stand a chance of solving a hash problem, they further must consider the significant amount of electrical power in search of the solution. Generally, the block rewards outweigh electricity and equipment costs, but this may not always be the case.[77]

The current value, not the long-term value, of the cryptocurrency supports the reward scheme to incentivize miners to engage in costly mining activities. Some sources claim that the current Bitcoin design is very inefficient, generating a welfare loss of 1.4% relative to an efficient cash system. The main source for this inefficiency is the large mining cost, which is estimated to be US\$360 Million per year. This translates into users being willing to accept a cash system with an inflation rate of 230% before being better off using Bitcoin as a means of payment. However, the efficiency of the Bitcoin system can be significantly improved by optimizing the rate of coin creation and minimizing transaction fees. Another potential improvement is to eliminate inefficient mining activities by changing the consensus protocol altogether.[78]

- **Transaction fees**

Transaction fees for cryptocurrency depend mainly on the supply of network capacity at the time, versus the demand from the currency holder for a faster transaction. The currency holder can choose a specific transaction fee, while network entities process transactions in order of highest offered fee to lowest. Cryptocurrency exchanges can simplify the process for currency holders by offering priority alternatives and thereby determine which fee will likely cause the transaction to be processed in the requested time.

For Ether, transaction fees differ by computational complexity, bandwidth use, and storage needs, while Bitcoin transaction fees differ by transaction size and whether the transaction uses SegWit. In September 2018, the median transaction fee for Ether corresponded to \$0.017,[79] while for Bitcoin it corresponded to \$0.55.[80]

Some cryptocurrencies have no transaction fees, and instead rely on client-side proof-of-work as the transaction prioritization and anti-spam mechanism.[81][82][83]

- **Exchanges**

Cryptocurrency exchanges allow customers to trade cryptocurrencies [84] for other assets, such as conventional fiat money, or to trade between different digital currencies.

Crypto marketplaces do not guarantee that an investor is completing a purchase or trade at the optimal price. As a result, many investors take advantage of this by using arbitrage to find the difference in price across several markets.[85]

- **Atomic swaps**

Atomic swaps are a mechanism where one cryptocurrency can be exchanged directly for another cryptocurrency, without the need for a trusted third party such as an exchange.[86]

- **ATMs**

Jordan Kelley, founder of Robocoin, launched the first Bitcoin ATM in the United States on 20 February 2014. The kiosk installed in Austin, Texas, is similar to bank ATMs but has scanners to read government-issued identification such as a driver's license or a passport to confirm users' identities.[87]

- **Initial coin offerings**

An initial coin offering (ICO) is a controversial means of raising funds for a new cryptocurrency venture. An ICO may be used by startups with the intention of avoiding regulation. However, securities regulators in many jurisdictions, including in the U.S., and Canada, have indicated that if a coin or token is an "investment contract" (e.g., under the Howey test, i.e., an investment of money with a reasonable expectation of profit based significantly on the entrepreneurial or managerial efforts of others), it is a security and is subject to securities regulation. In an ICO campaign, a percentage of the cryptocurrency (usually in the form of "tokens") is sold to early backers of the project in exchange for legal tender or other cryptocurrencies, often Bitcoin or Ether.[88][89][90]

According to PricewaterhouseCoopers, four of the 10 biggest proposed initial coin offerings have used Switzerland as a base, where they are frequently registered as non-profit foundations. The Swiss regulatory agency FINMA stated that it would take a "balanced approach" to ICO projects and would allow "legitimate innovators to navigate the regulatory landscape and so launch their projects in a way consistent with national laws protecting investors and the integrity of the financial system." In response to numerous requests by industry representatives, a legislative ICO working group began to issue legal guidelines in 2018, which are intended to remove uncertainty from cryptocurrency offerings and to establish sustainable business practices.[91]

- **Price trends**

The "market cap" of any coin is calculated by multiplying the price by the number of coins in circulation. The total cryptocurrency market cap has historically been dominated by Bitcoin accounting for at least 50% of the market cap value where altcoins have increased and decreased in market cap value in relation to Bitcoin. Bitcoin's value is largely determined by speculation among other technological limiting factors known as block chain rewards coded into the architecture technology of Bitcoin itself. The cryptocurrency market cap follows a trend known as the "halving", which is when the block rewards received from Bitcoin are halved due to technological

mandated limited factors instilled into Bitcoin which in turn limits the supply of Bitcoin. As the date reaches near of a halving (twice thus far historically) the cryptocurrency market cap increases, followed by a downtrend.[92]

By mid-June 2021 cryptocurrency as an admittedly extremely volatile asset class for portfolio diversification had begun to be offered by some wealth managers in the US for 401(k)s. [93][94][95]

- **Volatility**

Cryptocurrency prices are volatile compared with established financial assets such as company stocks. In one week in May 2022, Bitcoin lost 20 per cent of its value and Ethereum lost 26 per cent, while Solana and Cardano lost 41 and 35 per cent respectively. The falls were attributed to warnings about inflation. In the same week, the Nasdaq tech stock index fell 7.6 per cent and the FTSE 100 was 3.6 per cent down.[96]

In the longer term, of the 10 leading cryptocurrencies identified by the total value of coins in circulation in January 2018, only four (Bitcoin, Ethereum, Cardano and Ripple (XRP)) were still in that position in early 2022.[97]

- **Databases**

There are also centralized databases outside of the blockchain that store crypto market data. The difference between these databases and the blockchain is that a database is controlled by an administrator, while the blockchain is decentralized. The administrator manages the data and controls when the public can view it. Compared to the blockchain, databases perform fast as there is no verification process. Four of the most popular cryptocurrency market databases are Coinmarketcap, Coingecko, BraveNewCoin and Cryptocompare.[98]

According to Alan Feuer of The New York Times, libertarians and anarchists were attracted to the philosophical idea behind Bitcoin. Early Bitcoin supporter Roger Ver said: "At first, almost everyone who got involved did so for philosophical reasons. We saw Bitcoin as a great idea, as a way to separate money from the state." [99] Economist Paul Krugman argues that cryptocurrencies like Bitcoin are "something of a cult" based in "paranoid fantasies" of government power.[100]

Nigel Dodd argues in The social life of Bitcoin that the essence of the Bitcoin ideology is to remove money from both social and governmental control.[101] Dodd discusses the "Declaration of Bitcoin's Independence" a message of crypto-anarchism with the words: "Bitcoin is inherently anti-establishment, anti-system, and anti-state. Bitcoin undermines governments and disrupts institutions because Bitcoin is fundamentally humanitarian." [102][103]

David Golumbia says that the ideas influencing Bitcoin advocates emerge from right-wing extremist movements such as the Liberty Lobby and the John Birch Society and their anti-Central Bank rhetoric, or, more recently, Ron Paul and Tea Party-style libertarianism.[104] Steve Bannon, who owns a "good stake" in Bitcoin, sees

cryptocurrency as a form of disruptive populism, taking control back from central authorities.[105]

Bitcoin's founder, Satoshi Nakamoto has supported the idea that cryptocurrencies go well with libertarianism: "It's very attractive to the libertarian viewpoint if we can explain it properly." Nakamoto said in 2008.[106]

According to the European Central Bank, the decentralization of money offered by Bitcoin has its theoretical roots in the Austrian school of economics, especially with Friedrich von Hayek in his book *Denationalisation of Money: The Argument Refined*,[107] in which Hayek advocates a complete free market in the production, distribution and management of money to end the monopoly of central banks.[108].

6. Global cryptocurrency market analysis

The rise in the popularity of cryptocurrencies and their adoption by financial institutions has led some governments to assess whether regulation is needed to protect users. The Financial Action Task Force (FATF) has defined cryptocurrency-related services as "virtual asset service providers" (VASPs) and recommended that they be regulated with the same money laundering (AML) and know your customer (KYC) requirements as financial institutions.[109]

In May 2020, the Joint Working Group on interVASP Messaging Standards published "IVMS 101", a universal common language for communication of required originator and beneficiary information between VASPs. The FATF and financial regulators were informed as the data model was developed.[110]

In June 2020, FATF updated its guidance to include the "Travel Rule" for cryptocurrencies, a measure which mandates that VASPs obtain, hold, and exchange information about the originators and beneficiaries of virtual asset transfers.[111] Subsequent standardized protocol specifications recommended using JSON for relaying data between VASPs and identity services. As of December 2020, the IVMS 101 data model has yet to be finalized and ratified by the three global standard setting bodies that created it.[112]

The European Commission published a digital finance strategy in September 2020. This included a draft regulation on Markets in Crypto-Assets (MiCA), which aimed to provide a comprehensive regulatory framework for digital assets in the EU.[113][114]

On 10 June 2021, The Basel Committee on Banking Supervision proposed that banks that held cryptocurrency assets must set aside capital to cover all potential losses. For instance, if a bank were to hold Bitcoin worth \$2 billion, it would be required to set aside enough capital to cover the entire \$2 billion. This is a more extreme standard than banks are usually held to when it comes to other assets. However, this is a proposal and not a regulation.

The IMF is seeking a co-ordinated, consistent and comprehensive approach to supervising cryptocurrencies. Tobias Adrian, the IMF's financial counsellor and head

of its monetary and capital markets department said in a January 2022 interview that "Agreeing global regulations is never quick. But if we start now, we can achieve the goal of maintaining financial stability while also enjoying the benefits which the underlying technological innovations bring,"[115]

- **United States**

In 2021, 17 states passed laws and resolutions concerning cryptocurrency regulation.[116] The U.S. Securities and Exchange Commission (SEC) is considering what steps to take. On 8 July 2021, Senator Elizabeth Warren, who is part of the Senate Banking Committee, wrote to the chairman of the SEC and demanded that it provide answers on cryptocurrency regulation by 28 July 2021,[117] due to the increase in cryptocurrency exchange use and the danger this poses to consumers. On 17 February 2022, the Justice department named Eun Young Choi as the first director of a National Cryptocurrency Enforcement Team to aid in identification of and dealing with misuse of cryptocurrencies and other digital assets.[118]

- **China**

On 18 May 2021, China banned financial institutions and payment companies from being able to provide cryptocurrency transaction related services.[119] This led to a sharp fall in the price of the biggest proof of work cryptocurrencies. For instance, Bitcoin fell 31%, Ethereum fell 44%, Binance Coin fell 32% and Dogecoin fell 30%.[120] Proof of work mining was the next focus, with regulators in popular mining regions citing the use of electricity generated from highly polluting sources such as coal to create Bitcoin and Ethereum.[121]

In September 2021, the Chinese government declared all cryptocurrency transactions of any kind illegal, completing its crackdown on cryptocurrency.[29]

- **United Kingdom**

In the United Kingdom, as of 10 January 2021, all cryptocurrency firms, such as exchanges, advisors and professionals that have either a presence, market product or provide services within the UK market must register with the Financial Conduct Authority. Additionally, on 27 June 2021, the financial watchdog demanded that Binance, the world's largest cryptocurrency exchange,[122] cease all regulated activities in the UK.[123]

- **South Africa**

South Africa, who has seen a large amount of scams related to cryptocurrency is said to be putting a regulatory timeline in place, that will produce a regulatory framework.[124] The largest scam occurred in April 2021, where the two founders of an African-based cryptocurrency exchange called Africrypt, Raees Cajee and Ameer Cajee, disappeared with \$3.8 billion worth of Bitcoin.[125] Additionally, Mirror Trading International disappeared with \$170 million worth of cryptocurrency in January 2021.[125]

- **South Korea**

In March 2021, South Korea implemented new legislation to strengthen their oversight of digital assets. This legislation requires all digital asset managers, providers and exchanges to be registered with the Korea Financial Intelligence Unit in order to operate in South Korea.[126] Registering with this unit requires that all exchanges are certified by the Information Security Management System and that they ensure all customers have real name bank accounts. It also requires that the CEO and board members of the exchanges have not been convicted of any crimes and that the exchange holds sufficient levels of deposit insurance to cover losses arising from hacks.[126]

- **Turkey**

Turkey's central bank, the Central Bank of the Republic of Turkey, banned the use of cryptocurrencies and crypto assets for making purchases from 30 April 2021, on the ground that the use of cryptocurrencies for such payments poses significant transaction risks.[127]

- **El Salvador**

On 9 June 2021, El Salvador announced that it will adopt Bitcoin as legal tender, the first country to do so.[128]

- **India**

At present, India neither prohibits nor allows investment in the cryptocurrency market. In 2020, the Supreme Court of India had lifted the ban on cryptocurrency, which was imposed by the Reserve Bank of India.[129][130][131][132] Since then the investment in cryptocurrency is considered legitimate though there is still ambiguity about the issues regarding the extent and payment of tax on the income accrued thereupon and also its regulatory regime. But it is being contemplated that the Indian Parliament will soon pass a specific law to either ban or regulate the cryptocurrency market in India.[133]

Expressing his public policy opinion on the Indian cryptocurrency market to a well-known online publication, a leading public policy lawyer and Vice President of SAARCLAW (South Asian Association for Regional Co-operation in Law) Hemant Batra has said that the "cryptocurrency market has now become very big with involvement of billions of dollars in the market hence, it is now unattainable and irreconcilable for the government to completely ban all sorts of cryptocurrency and its trading and investment".[134] He mooted regulating the cryptocurrency market rather than completely banning it. He favoured following IMF and FATF guidelines in this regard.

7. Conclusion

Finally, based on user data obtained from some participating incorporated wallet providers and payment platforms, we can break down customer share by world region. It turns out that nearly 40% of cryptocurrency users are based in the Asia Pacific region, followed by Europe with 27%. The share of North American users is

surprisingly low and not in-line with the above-mentioned figures. However, it should be noted that these figures only represent data from a limited number of wallet providers and payment platforms, and do not take into account users from exchanges as well as mining pools. In addition, figures are not weighted by the number of users as these are mostly secret and/or difficult to establish given the type of service that the respective companies are providing.

In conclusion, it appears that cryptocurrency adoption is most advanced in North America and Europe, but an increasing number of activity (and users) can be observed in other regions as well, with activity growing relatively quickly in some emerging countries in Asia, Latin America, and Africa and the Middle East..

8. References

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