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Exploring the Adoption and Impact of Bitcoin: A Comparative Analysis

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What is Bitcoin?

Bitcoin is a decentralized digital currency that operates on a peer-to-peer electronic cash network without the need for intermediaries like banks. It was created in 2009 by an unknown person or group of people using the pseudonym Satoshi Nakamoto. Bitcoin is designed to function as a store of value and a medium of exchange, allowing people to make transactions without the need for a central authority. Transactions on the Bitcoin network are verified through cryptography and recorded on a public ledger called the blockchain.

The Purpose of Bitcoin

The purpose of Bitcoin is to provide an alternative to traditional fiat currencies which are subject to inflation and can be manipulated by governments and central banks. Bitcoin enables financial inclusion by allowing people without access to traditional financial services to participate in the global economy. With a smartphone and internet connection, anyone can download a Bitcoin wallet and start using it. Bitcoin transactions are processed quickly, usually within minutes, extremely low fees, and are secure thanks to the Proof of Work (PoW) system. Bitcoin has a limited supply (21 million) which means that its value is not subject to dilution through inflation. This makes it an attractive store of value for people living in countries with unstable currencies.

Bitcoin Math

Bitcoin uses several formulas to perform different functions, but two of the most important ones are the formula used to calculate the mining difficulty and the formula used to calculate the reward for mining a new block.

The formula for mining difficulty adjusts the difficulty of mining a block to ensure that the rate of block creation stays constant. This formula takes into account the total network hash rate (the amount of computational power being used to mine bitcoins), the target block creation time (which is 10 minutes for each Block), and the current difficulty level. The formula is:

$$\text{New Difficulty} = \text{Current Difficulty} * (\text{Target Time} / \text{Actual Time}) * (\text{Total Hash Rate} / \text{Target Hash Rate})$$

In this formula, the "Target Time" is the time it should take to mine a block (10 minutes for Bitcoin), "Actual Time" is the time it actually took to mine the last 2016 blocks, "Total Hash Rate" is the total computational power of the network, and "Target Hash Rate" is the ideal hash rate for the network.

The formula for block reward determines how many new bitcoins are created with each new block that is added to the blockchain. This formula is designed to reduce the number of new bitcoins created over time and to ensure that there is a finite supply of bitcoins. The formula is:

$$\text{Block Reward} = (\text{Current Block Subsidy} / 2)^{(\text{Blocks Since Last Halving} / \text{Halving Interval})}$$

In this formula, the "Current Block Subsidy" is the number of bitcoins awarded for mining a block (which started at 50 bitcoins per block and is currently 6.25 bitcoins per block), the "Halving Interval" is the number of blocks until the block reward is halved (which is currently 210,000 blocks), and "Blocks Since Last Halving" is the number of blocks that have been mined since the last halving event. This formula ensures that the number of new bitcoins created with each block will continue to decrease over time until the total supply of bitcoins reaches 21 million.

The diagram shows the formula for block reward with handwritten annotations in red:

$$\sum_{i=0}^{32} 210,000 \left(\frac{50}{2^i} \right)$$

- An arrow points from the handwritten text "total # of halvings to ever occur" to the number 32 in the summation limit.
- An arrow points from the handwritten text "# of new bitcoins issued per block" to the number 50 in the numerator of the fraction.
- An arrow points from the handwritten text "# of blocks between halvings" to the number 210,000.
- An arrow points from the handwritten text "cumulative # of halvings so far" to the denominator 2^i .

The total amount of available Bitcoin will be the sum...

①

of the amount of Bitcoin mined in each block.

②

At block 6,930,000 (33 x 210,000) all Bitcoins will have been mined.

⑥

$$\sum_{n=0}^{32} 210,000 \cdot \frac{50}{2^n} = 20,999,999.97690000$$

Halving occurs every 210,000 blocks (~4 years), which is the reduction of the initial amount of 50 BTCs...

③

through a geometric progression, where n is the nth halving event...

④

ranging from 0 to 32, in a total of 33 reductions, one every 210,000 blocks.

⑤

Peer to Peer System

Bitcoin's peer-to-peer (P2P) system is a decentralized network where users can send and receive Bitcoins permissionless. In this system, every user has a copy of the Bitcoin ledger, which is a record of all the transactions that have ever taken place on the network. The transaction contains the recipient's Bitcoin address, the amount of bitcoins being sent, and a digital signature that proves the transaction is legitimate. The transaction is then broadcasted to the entire network, and every node on the network validates the transaction using complex algorithms. Once the transaction is verified, it is added to a block, which is a group of transactions that are linked together. Once the block is added to the blockchain, the transaction is considered confirmed, and the bitcoins are transferred from the sender's wallet to the recipient's wallet. This process typically takes about 10 minutes, but it can vary depending on network congestion and other factors.

The peer-to-peer system describes how transactions are propagated and verified on the network, the proof-of-work system describes how new bitcoins are created and transactions are validated on the network. Both systems are integral to the functioning of the Bitcoin network.

Proof of Work

Bitcoin's proof-of-work (PoW) system is a consensus mechanism used to confirm transactions and add new blocks to the blockchain. It is a cryptographic puzzle that miners must solve in order to validate transactions and receive rewards in the form of newly minted bitcoins. The PoW system works by requiring miners to use their computational power to solve complex mathematical problems. The first miner to solve the puzzle and validate the transaction is rewarded with bitcoins. This creates an incentive for miners to contribute their computational power to the network and validate transactions. The PoW system is designed to be very difficult to solve, requiring a lot of computational power and energy. This is intentional, as it helps to prevent malicious actors from taking control of the network and manipulating transactions. The difficulty of the puzzle is adjusted regularly to ensure that blocks are added to the blockchain at a consistent rate. The PoW system is a crucial part of the Bitcoin network, as it ensures the security and integrity of the blockchain by incentivizing miners to validate transactions and add new blocks to the network. There is also an incentive for miners once the last Bitcoin is mined in roughly 120 years. Miners will be able to earn an income from transaction processing fees. This will ensure Bitcoin's network will be secured once block rewards stop.

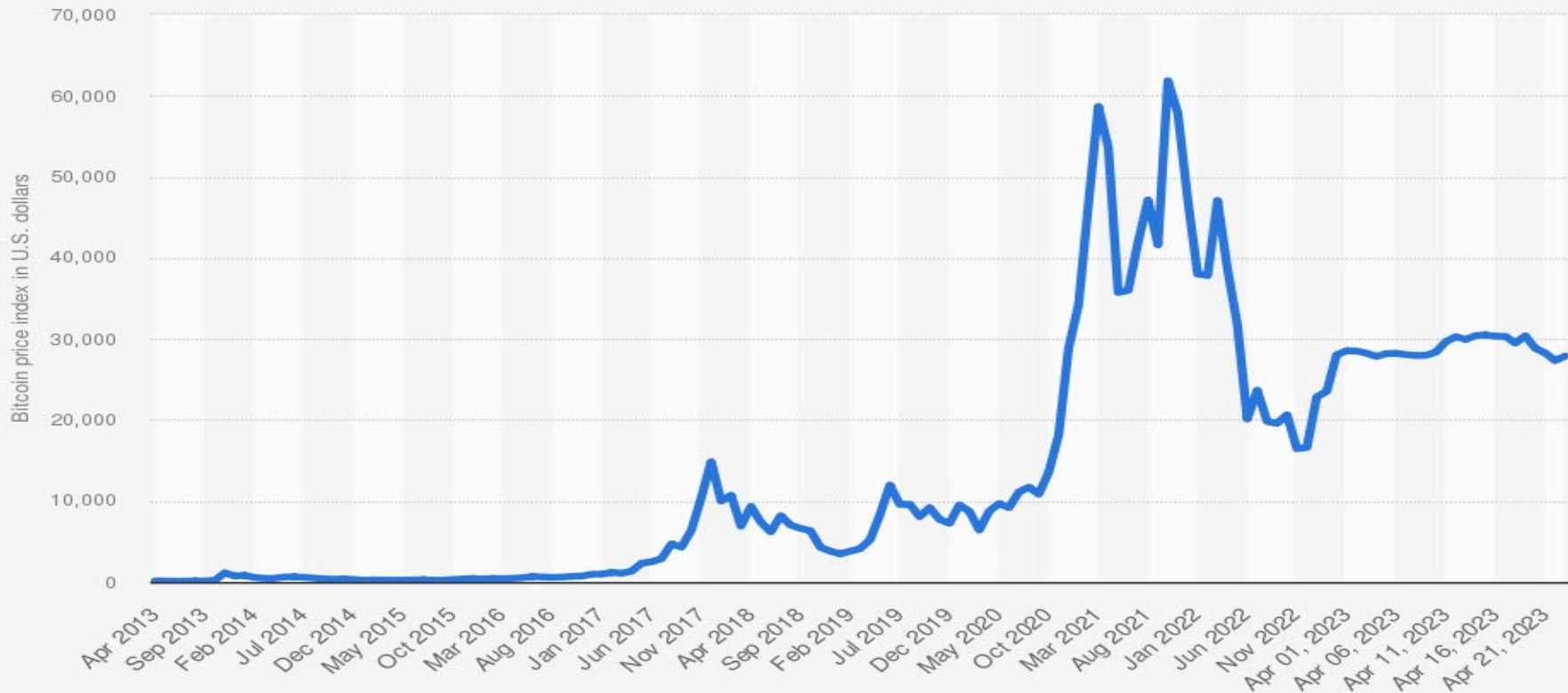
Historical Performance

The measures of central tendency and dispersion

<i>Bitcoin Price Close (D)</i>	<i>Volume (I)</i>	<i>Market Cap (I)</i>	<i>Hash Rate (I)</i>	<i>Total Circulating Supply (I)</i>	
Mean	8818.517316 Mean	16956936021 Mean	1.64015E+11 Mean	54813816.22 Mean	14425955.97
Standard Error	1132.919837 Standard Error	2286142202 Standard Error	21536464263 Standard Error	6718203.267 Standard Error	358474.1655
Median	866.359 Median	95623736.42 Median	13050052671 Median	1921242.57 Median	15988187.5
Mode	#N/A Mode	0 Mode	0 Mode	#N/A Mode	#N/A
Standard Deviation	14150.16423 Standard Deviation	28553906955 Standard Deviation	2.6899E+11 Standard Deviation	83910331.92 Standard Deviation	4477340.892
Sample Variance	200227147.7 Sample Variance	8.15326E+20 Sample Variance	7.23558E+22 Sample Variance	7.04094E+15 Sample Variance	2.00466E+13
Kurtosis	3.174763064 Kurtosis	2.10076235 Kurtosis	3.134640914 Kurtosis	1.769027453 Kurtosis	-0.21885737
Skewness	1.974576836 Skewness	1.753385942 Skewness	1.982512056 Skewness	1.599930762 Skewness	-0.914747653
Range	61238.5596 Range	1.24603E+11 Range	1.15164E+12 Range	351118491 Range	16417156.25
Minimum	0.0626 Minimum	0 Minimum	0 Minimum	0.000125573 Minimum	2935550
Maximum	61238.6222 Maximum	1.24603E+11 Maximum	1.15164E+12 Maximum	351118491 Maximum	19352706.25
Sum	1375688.701 Sum	2.64528E+12 Sum	2.55863E+13 Sum	8550955330 Sum	2250449131
Count	156 Count	156 Count	156 Count	156 Count	156

- 2009 - Bitcoin was first introduced and had no significant value.
- 2010 - the first Bitcoin transaction took place when a programmer bought two pizzas for 10,000 bitcoins, which is now considered the first "real-world" transaction using Bitcoin.
- 2011 - Bitcoin gained more widespread attention and its price rose from \$1 to \$30. However, it quickly fell back down to around \$2.
- 2013 - Bitcoin experienced a massive surge in value, with its price rising from around \$13 in January to over \$1,000 in December. This was due to increased media attention and wider adoption of the currency.
- 2014 - the price of Bitcoin declined significantly, dropping from over \$1,000 to around \$300.
- 2015\2016 - Bitcoin's price remained relatively stable, with some fluctuations between \$200 and \$500.
- 2017 - Bitcoin experienced another surge in value, reaching an all-time high of nearly \$20,000 in December. This was largely driven by increased adoption, media attention, and speculation.
- 2018 - the price of Bitcoin declined significantly again, dropping to around \$3,000 by the end of the year.
- 2019\2020 - Bitcoin's price remained relatively stable, fluctuating between \$3,000 and \$14,000.
- 2021 - Bitcoin reached another all-time high, surpassing \$64,000 in April before experiencing a significant decline in value.

Bitcoin (BTC) price per day from Apr 2013 - Apr 23, 2023 (in U.S. dollars)



Supply and Demand

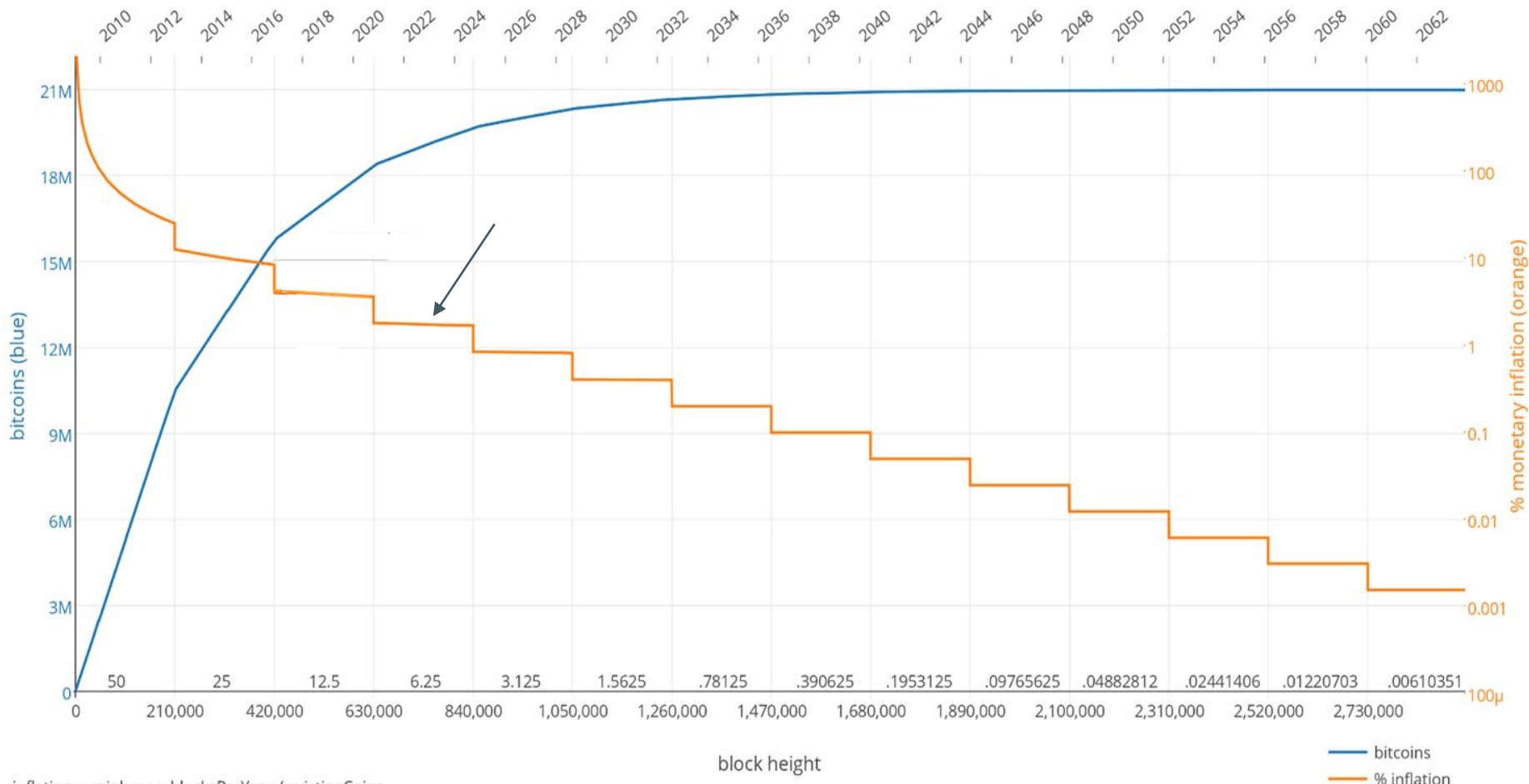
Bitcoin is the only asset in the world that is inelastic to price. Inelastic means that a 1% change in the price of a good or service has less than a 1% change in the quantity demanded or supplied.

Bitcoin's supply is limited to 21 million coins, and this is hard-coded into the protocol. This means that the supply of Bitcoin is fixed, and no more coins can be created beyond this limit. This is in contrast to traditional currencies, which can be created or destroyed by central banks in response to changing economic conditions.

Supply and Demand

The factors that contribute to Bitcoin's inelasticity to price. As mentioned, Bitcoin's supply is hard-capped at 21 million coins, which means that the rate of supply growth is predetermined and cannot be altered by market demand. Additionally, the halving events, which cut the rate of new supply issuance in half, occur at regular intervals and are programmed into the Bitcoin protocol. As a result, the rate of new supply growth in Bitcoin decreases over time, regardless of the price. This is because the rate of supply growth is algorithmically determined by the protocol, not by market demand. This makes the supply of Bitcoin increasingly scarce over time, which can drive up its price as demand increases for Bitcoin.

Bitcoin Monetary Inflation



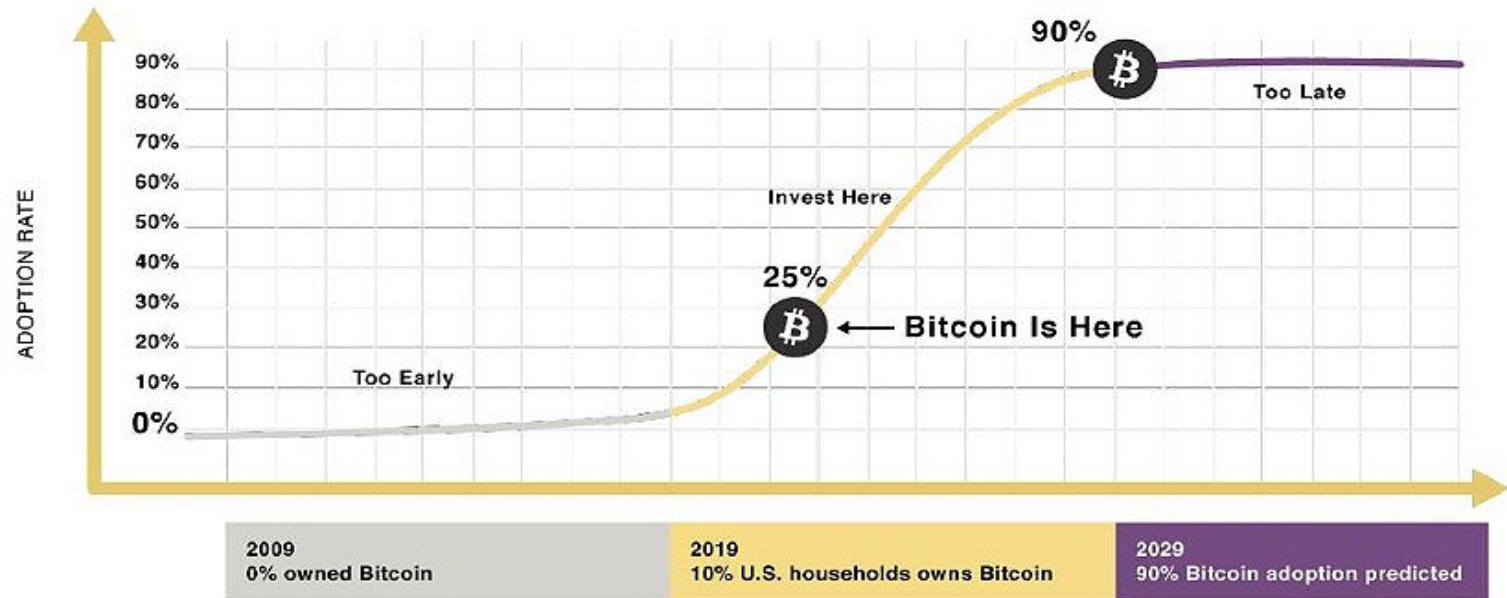
$$\text{inflation} = \frac{\text{coinbase} \times \text{blocksPerYear}}{\text{existingCoins}}$$

— bitcoins
— % inflation

Adoption

Bitcoin adoption has been steadily increasing since its creation in 2009, with individuals, businesses, and institutions recognizing its value as a decentralized, secure, and transparent form of currency. Here is an S-curve analysis showing that ~90% of US households will own Bitcoin by 2029.

S-CURVE ANALYSIS



Adoption in Europe, Africa, North America, and Asia

North America:

As of September 2021, there were over 42 million active Bitcoin wallets in North America, with the United States accounting for the majority of those wallets.

Africa:

Africa has seen steady growth in Bitcoin adoption in recent years, with Nigeria and South Africa being the most active countries in the region. As of September 2021, there were over 12 million active Bitcoin wallets in Africa.

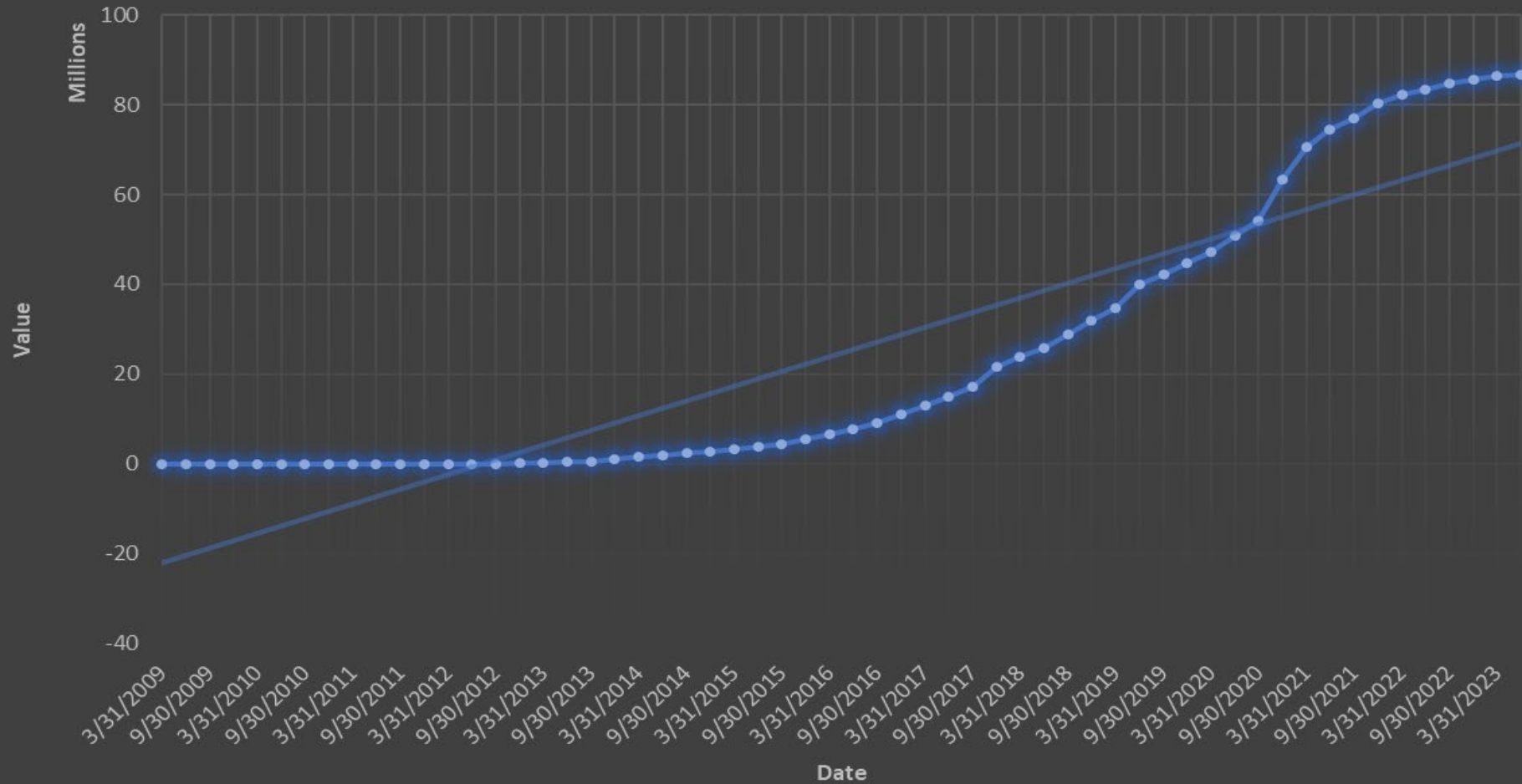
Europe:

Europe has a significant presence in the Bitcoin market, with countries such as Germany, France, and the UK leading in terms of adoption. As of September 2021, there were over 56 million active Bitcoin wallets in Europe.

Asia:

Asia is the largest market for Bitcoin adoption, with countries such as China, Vietnam, Japan, and South Korea being major players in the market. As of September 2021, there were over 110 million active Bitcoin wallets in Asia.

of Bitcoin Wallets



Regulatory Environment

The regulatory environment for Bitcoin in the US is complex and multi-layered, with various regulatory bodies taking different approaches to regulating the space. Some of the key regulations and guidelines for Bitcoin in the US include Securities Laws: The Securities and Exchange Commission (SEC) has issued guidelines stating that some cryptocurrencies, such as ICOs, may be considered securities and subject to federal securities laws. Commodity Regulations: The Commodity Futures Trading Commission (CFTC) has classified Bitcoin as a commodity and has issued guidelines on its regulation. Money Transmission Laws: Bitcoin exchanges and other businesses that deal with cryptocurrencies may be subject to state-level money transmission laws and may require a money transmitter license in order to operate. Taxation: The Internal Revenue Service (IRS) treats Bitcoin and other cryptocurrencies as property for tax purposes, which means that they are subject to capital gains taxes. Anti-Money Laundering (AML) and Know Your Customer (KYC) Requirements: Financial institutions and businesses dealing with cryptocurrencies are required to comply with AML and KYC regulations under federal law. State-Level Regulations: Some states, such as New York, have introduced their own regulatory frameworks for cryptocurrencies, such as the BitLicense, which requires businesses dealing with cryptocurrencies to comply with a range of regulations.

Risks and Challenges

There are several risks associated with holding Bitcoin on exchanges. Firstly, exchanges are centralized and therefore vulnerable to hacking attacks, which could result in the loss of your Bitcoin. Additionally, exchanges may go out of business or face regulatory issues, potentially leaving you unable to access your Bitcoin. Another risk is that exchanges may freeze or restrict your account, preventing you from accessing your Bitcoin for a variety of reasons, such as suspected fraud or non-compliance with regulations. It is also important to note that when you hold Bitcoin on an exchange, you do not have control over the private keys associated with your Bitcoin, which means that you are not in full control of your own funds.

Volatility, Bitcoin's value is highly volatile, and its price can fluctuate widely within short periods. This makes it challenging to use as a store of value to an average investor or as a means of payment. It also makes Bitcoin less suitable for certain types of financial transactions, such as long-term contracts, as the value of the asset may be unpredictable over long periods of time.

Conclusion

In conclusion, Bitcoin is a decentralized digital currency that operates on a peer-to-peer electronic cash network without the need for intermediaries like banks. It was designed to function as a store of value and a medium of exchange, enabling people to make transactions without the need for a central authority. Bitcoin's blockchain technology ensures secure and transparent transactions, and its limited supply makes it an attractive alternative to traditional fiat currencies. Bitcoin's proof-of-work system, which incentivizes miners to contribute their computational power to the network, is an integral part of the network's security and integrity. While it started as a small experiment with no significant value, Bitcoin has since grown into a global phenomenon with a market capitalization in the Billions of dollars, providing financial inclusion to millions of people who were previously excluded from traditional financial services.

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