

Exploring the Evolution and Future Perceptions of Cryptocurrencies in Financial Markets

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Abstract—Digital currency is a developing, innovative technology which has continued to evolve beyond its original purpose. The first iteration of cryptocurrency, Bitcoin, has since developed from medium of exchange to significant asset of value. It is widely recognised that cryptocurrency markets share properties of financial stock markets, yet are not enforced with any regulation or policies; thus, making economic-related illicit activity difficult to prevent. This concept presents a significant amount of risk when cryptocurrencies are viewed as potential investment assets, unveiling the question of future regulation and legislation. This paper identifies several attributes resulting in cryptocurrencies’ recent growth, including developing blockchain technology, increased support from institutions, and the markets durability following the Covid-19 pandemic. With a current global market capitalisation of \$1.5 trillion; cryptocurrency has considerably impacted financial markets, with ROI analysis establishing Bitcoin’s strength at consistently outperforming major stock indices. The research aims to investigate this emerging technology, its position in financial markets and how the perception of digital currency may develop further. Further sections will also explore previous trends to understand how cryptocurrency’s influence on society has evolved.

Index Terms—Altcoins, Bitcoin, Blockchain, Cryptocurrency, Consensus Mechanisms, Hashrate

I. INTRODUCTION

To this day, the creator of the first cryptocurrency remains anonymous, the white paper under the pseudonym Satoshi Nakamoto [1] detailed technical algorithms to conceptualize blockchain technology. From this platform emerged Bitcoin, a decentralized digital currency with emphasis on peer-to-peer transactions. It is widely considered that the creation of this technology was linked to the 2008 financial crisis, a period which raised questions regarding the ideology behind centralised banks. Nakamoto explained the limitations with reliance on third-party trust models, and instead presents the concept of digital transactions requiring cryptographic proof. Bitcoin offers pseudonymity through blockchain; although encrypted with SHA256, transactions are verified, recorded, and timestamped onto a public ledger. The cryptocurrency space is increasingly diverse, tracking site CoinMarketCap identifies that as of March 2021 there are now over 8000 cryptocurrencies, each competing as alternative tokens of value. Known as Altcoins, these new coins feature developed protocols and algorithms, intending to reduce the energy costs and related fees with Bitcoin.

Cryptocurrency has suffered from inconsistent acceptance over its existence; Xu [2] explains that lack of awareness and general misconception are factors which limit more widespread usage. Although this technology has existed since 2009, the authors describe how Bitcoin’s gradual evolution

from a digital currency to an investment asset has since sparked recent recognition in financial markets. An investigation by Liang [3] supports this concept after discovering that the cryptocurrency market shares qualities of financial stock markets, unveiling the question of future regulation and legislation. The volatile nature of cryptocurrency first emerged in 2017, when a sudden rise in value ignited global media attention. Although highly volatile and unregulated, support for cryptocurrency has grown exponentially in recent years, with exchanges like Coinbase and Binance taking majority of market trade.

Table I provides statistical data between six of the highest ranked cryptocurrencies, evaluated from market capitalisation; a term calculated by multiplying the currency’s current price with circulating supply. All monetary values were retrieved from CoinMarketCap.com on 27th Apr, 2021 and presented in the Appendix section.

II. MISCONCEPTIONS OF CRYPTOCURRENCY

A. Energy Consumption

Digital coins are generated from computer systems solving mathematical problems, through a process known as mining. This fundamental concept is utilised by many early cryptocurrencies, including Bitcoin. Bitcoin’s blockchain operates on a Proof of Work (PoW) concept, meaning each transaction must be verified and confirmed by miners before it is added to the complete ledger. An early study into the environmental cost of Bitcoin by O’Dwyert [4] discovered the PoW algorithm to be extremely computationally exhaustive. The authors detail the cryptographic process of mining, referring to how software is used to discover the nonce value of a SHA256 hashed equation. This process in turn creates the transaction signature required to add a block to the blockchain. Miners are rewarded with tokens of cryptocurrency by being the first to verify blocks of transactions, thus adding to the total blockchain. Hashrate difficulty is an incremental factor when discovering new blocks, introduced by Nakamoto to compensate for increasing hardware speed. On average, one block is added every 10 minutes, with difficulty increasing every 2016 blocks. Frankenfield [5] summarises that despite additional computing power required to verify transactions, a high hashrate difficulty also reduces the risk of attackers overcoming the blockchain network. Furthermore, in the case of Bitcoin, the reward for mining is halved every 210,000 blocks, equating to every four years. The increasing hashrate difficulty over time is visualised in figure 1.



Fig. 1. Bitcoin Network Difficulty in Terahashes — Retrieved from <https://btc.com/stats/diff> [6]

Before significant increases in hashrate difficulty, Bitcoins could be mined from personal workstations, taking advantage of Graphics Processing Unit (GPU) speed and efficiency when computing multiple parallel calculations. Hardware hashrate determines the speed in which blocks are mined and verified; technological evolution and increasing hashrate difficulty led to the eventual introduction of Application Specific Integrated Circuits (ASIC). Although these dedicated mining rigs can offer hashrate speeds up to 55 TH/s, the energy costs of running these machines are major factors which limit profitability. The Bitcoin network has since evolved into large scale operations, often involving several thousand ASIC miners performing as one network node. Although each dedicated mining rigs can offer hashrate speeds up to 55 TH/s, de Vreies [7] details the high costs associated with running and maintaining these machines.

Electricity bills are major limitations which affect profitability when mining Bitcoin, as a result many mining operations are located in regions with cheap energy. The Cambridge Bitcoin Electricity Consumption Index (CBECI) [8] measures that an estimated 65% of Bitcoin’s global hashrate comes from China, with the Xinjiang province alone providing 35%. This region is considerably reliant on renewable hydro-based electricity sources; a 2019 report by Bendiksen [9] found that hydro-power is not only abundant in southwestern China, but also under-utilised. The authors correlate this information to argue that most of Bitcoin’s electricity consumption is generated from sustainable and eco-friendly sources. Although the inefficiency of PoW based currencies is concerning for many environmentalists, Elmandjra [10] argues this theory by analysing Bitcoin’s energy expenditure against traditional banking systems. The author presented Bitcoin to be 40% more energy efficient, comparing Bitcoin’s 2020 annual cost of 51.1 Terawatt Hour (TWh) to global banking’s 638.8TWh. The CBECI [8] estimates Bitcoin’s current annual energy cost at 137TWh, equivalent to 0.6% of global electricity consumption.

B. Illicit Activities

Although the fundamental structure of cryptocurrency brings incentives with anonymity and privacy, it is widely acknowledged that these properties allow for illicit financial activities. Blockchain technology allows crypto transactions to be untraceable and irreversible, making digital currency like Bitcoin appealing for criminals to transfer money anonymously. An article by Cookson [11] expands on this by detailing related illegal activities involving Bitcoin, including money laundering, ransomware, tax evasion, and trafficking. The most familiar example is Silkroad, a darknet based marketplace which sold illegal goods in exchange for Bitcoin. Although shutdown in 2013 by the US government, alternative sites continue to operate using encrypted altcoin Monero as a medium of exchange.

Despite this, a recent report by Chainalysis [12] explores the current relationship between criminal activity and cryptocurrency, and shows that only 2.1% of transaction volume was identified as illegal activity in 2019. The authors address the appeal for criminals to use cryptocurrency, however their research shows that crypto-related crime has fallen in 2020. Figure 2 represents this information by visualising the downward trend of known illicit financial activity against total illicit share of cryptocurrency.

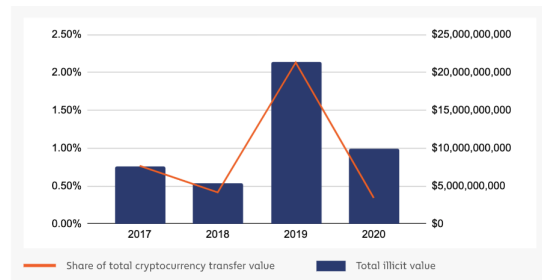


Fig. 2. Total cryptocurrency value sent and received by illicit entities vs. illicit share of all cryptocurrency activity —Retrieved from Chainalysis [12]

III. CRYPTOCURRENCY AS MEDIUMS OF EXCHANGE

As recognised in Satoshi’s whitepaper [1], Bitcoin’s core purpose was originally to be a new as medium of exchange. In the early days of its inception, before widespread adoption and the increase in price volatility, Bitcoin was used as a tradable asset by many early enthusiasts. When tokens of cryptocurrency are not used in a transaction, they are stored in digital files known as wallets. To perform a successful exchange of coins, the sender must enter the recipient’s wallet address along with confirming the wallet supports the same blockchain network.

The first goods purchase using a cryptocurrency was made by a developer named Laszlo Hanyecz in May 2010 [13]. This now historical forum recorded the first transaction across the Bitcoin network, 10,000 coins were sent to a second Bitcoin address in return for a pizza. At the time one Bitcoin was priced at just \$0.003, the public blockchain details this transaction worth to be \$627 million when factoring Bitcoin’s value today. Despite successfully operating as a

medium of exchange, the first iteration of cryptocurrency had many associated flaws; notably the transaction fees and speed. Transaction fees reward and incentivise miners to add pending transactions onto the next block. An article by Hooper [14] explains that Bitcoin's fee rate is measured in Satoshis per byte, the larger the transaction size the higher the fee will be. Blockspace demand is another factor which can increase fee size, numerous transactions cause network congestion as more time is required to validate onto the blockchain. The increased demand for Bitcoin has caused transaction fees to soar in recent years, now making it unsustainable to send small transactions.

Emerging altcoins like Cardano, Nano and XRP address these flaws by introducing new algorithms, protocols and upgrades to the original Bitcoin blockchain. Although revolutionary, the PoW consensus mechanism is time consuming and energy inefficient, and has been replaced by Proof of Stake (PoS). Developed in 2012 by Scot Nadal and Sunny King [15] and introduced through the Peercoin project, PoS attributes mining power to the proportion of coins held by a miner. This fairer method is less reliant on computational power to reward tokens; instead of mining, blocks are simply chosen and validated through a process known as attesting [16]. Although lower market capitalisation and less global acceptance when compared to Bitcoin, these altcoins support significantly lower transaction fees along with faster transaction speeds. These advantages make cryptocurrencies supporting the PoS algorithm viable and sustainable enough to be used as mediums exchange.

IV. CRYPTOCURRENCY AS INVESTMENT ASSETS

The financial attributes of cryptocurrency have developed significantly in recent years; despite being unaffected by traditional financial markets, similarities are observable. Terms previously associated with financial stock markets are now regularly used to describe cryptocurrency markets, highlighting the evolution from currency to investment asset. Nowadays cryptocurrency can be purchased, or invested into, with relative ease using online exchanges; converting fiat currency for fractions of digital currency based on current rates.

The fundamental ideology behind cryptocurrency is a factor of attraction for many investors, decentralised currency based on blockchain technology counters the limitations of government-controlled fiat. Furthermore, development of blockchain technology allowed new altcoin projects to surge in popularity, each offering new services and utility. A widely recognised example is the Binance Smart Chain, an alternative blockchain to Ethereum which provides an environment for the creation of open-source decentralised applications (DApps). These applications and projects can serve many purposes, with many popular altcoins developing support for Non-Fungible Tokens (NFTs) and Decentralised Finance (DeFi). Binance Smart Chain offers a low-cost alternative compared to the highly congested and expensive Ethereum network, figure 3 highlights how the number of BSC addresses have now surpassed the older Ethereum network.

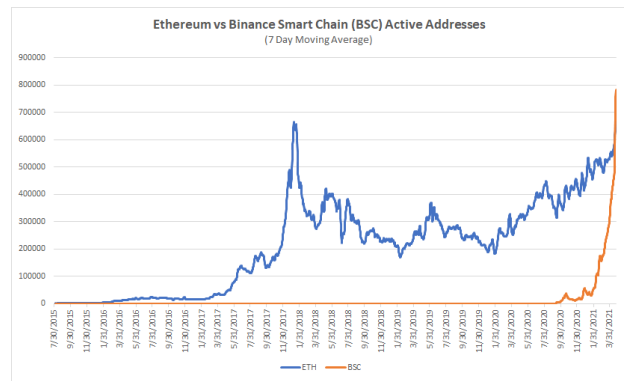


Fig. 3. Ethereum vs BSC Active Addresses — Retrieved from Fadilpašić [17]

Another aspect which attracts investors is the scarce supply of many cryptocurrencies. Bitcoin's hashrate reducing technology will eventually limit the total supply to 21 million coins, making the most popular cryptocurrency a finite resource. Combining this limited supply with increasing demand is one explanation why this currency is so volatile. The instability of Bitcoin's market price is a result of many factors, thus making it challenging to predict and analyse. Correlation analysis by Xu [2] centres around financial market's influence on Bitcoin; presenting a variety of accurate prediction models to measure and forecast relation. Similar research by Saadah [18] applies machine learning algorithms like KNN, Support Vector Machine and Long Short-Term Memory; aiming to predict cryptocurrencies influence on the future financial stability of Indonesia. Despite the comprehension of these research papers, both authors conclude that cryptocurrency is unpredictable, unstable and too volatile to effectively predict. The high volatility and regular market fluctuations makes investing in cryptocurrency projects a considerable risk.

Many researchers liken Bitcoin to a bubble, with Conlon [19] describing Bitcoin's maximum 24hour loss as 66%, compared with 12.77% for the S&P 500 market. Despite these massive historical market corrections, research by Baltrusaitis [20] reports how Bitcoin's Return On Investment (ROI) has significantly outperformed five major stock indices. Figure 4 visualises that Bitcoin's ROI measured at 3456.98% over a 5-year period.

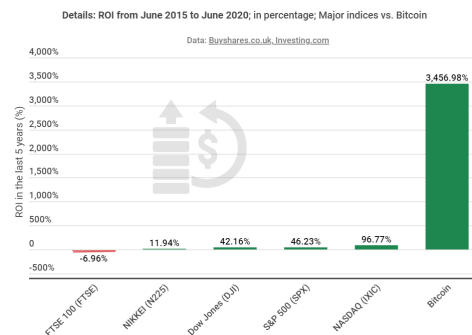


Fig. 4. ROI from June 2015 to June 2020, Major indices vs. Bitcoin — Retrieved from Baltrusaitis [20]

Despite the risks, cryptocurrency is a significant asset of value; many early adopters of Bitcoin have generated significant amounts of wealth from simply holding coins in digital wallets, Bitcoin's complete ROI currently measures at 51,120%. The recent surges in price have increased public awareness for Bitcoin and in turn the global cryptocurrency ecosystem; with the global crypto market capitalisation reaching £1.4 trillion in March 2021. This value emphasises the scale of digital currency, with Bitcoin currently ranking as the 8th most valuable global asset [21]. The distribution of Bitcoin is visualised in figure 5, it should be noted that only 2.53% of addresses hold more than 1 Bitcoin.

Bitcoin distribution					
Balance, BTC	Addresses	% Addresses (Total)	Coins	\$USD	% Coins (Total)
(0 - 0.001)	20016312	51.46% (100%)	4,262 BTC	229,528,771 USD	0.02% (100%)
(0.001 - 0.01)	9734741	25.02% (48.54%)	37,282 BTC	2,007,991,739 USD	0.2% (99.98%)
(0.01 - 0.1)	5896359	15.16% (23.52%)	190,825 BTC	10,277,783,550 USD	1.02% (99.78%)
(0.1 - 1)	2436548	6.26% (8.36%)	762,974 BTC	41,093,521,566 USD	4.08% (98.76%)
(1 - 10)	669440	1.72% (2.1%)	1,707,040 BTC	91,940,525,824 USD	9.13% (94.67%)
(10 - 100)	130934	0.34% (0.38%)	4,258,320 BTC	229,351,545,114 USD	22.78% (85.54%)
(100 - 1,000)	13891	0.04% (0.04%)	3,886,926 BTC	209,348,394,118 USD	20.8% (62.76%)
(1,000 - 10,000)	2151	0.01% (0.01%)	5,223,512 BTC	281,336,457,876 USD	27.95% (41.97%)
(10,000 - 100,000)	81	0% (0%)	2,084,145 BTC	112,251,306,324 USD	11.15% (14.02%)
(100,000 - 1,000,000)	4	0% (0%)	536,316 BTC	28,885,799,568 USD	2.87% (2.87%)

Fig. 5. Distribution of Bitcoin wallet addresses — Retrieved from <https://bitinfocharts.com> [22]

V. CURRENT LANDSCAPE AND FUTURE PERCEPTIONS

The current cryptocurrency market is experiencing massive growth, with Bitcoin leading the upwards trend. Several months of increasing buying pressure indicates that Bitcoin is in a bull market phase, a term previously associated with financial stock markets to describe growth. Conlon [19] explores the correlation between the Covid-19 pandemic's effect on financial and cryptocurrency markets. Bitcoin's recovery against the economic collapse following the pandemic is illustrated in figure 6. The study found that Bitcoin's properties compared with financial markets, thus encouraging investors to diversify their portfolio into cryptocurrency during the global market crash. This evidence suggests that Covid-19 played a part in accelerating the growth of cryptocurrency markets. Figure 7 visualises the current Bitcoin/GBP market, analysing the price difference between April 26th 2020 and April 26th 2021 reveals an increase of 526%.

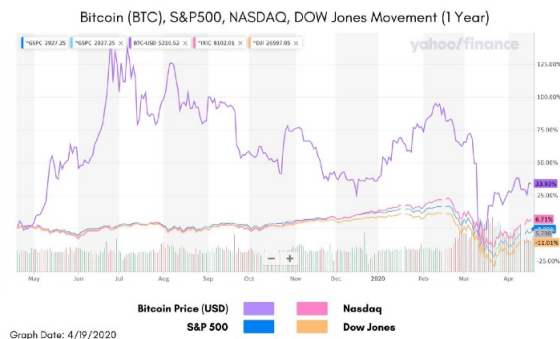


Fig. 6. Bitcoin vs. Major Stock Indices following Covid-19 — Retrieved from Powell [23]

An article by MacLellan [24] describes how the current position differs from the last market run of 2017; a period where a lack of supporting infrastructure resulted in demand exceeding supply. Original enthusiasm came from retail investors during previous market runs; whereas evidence suggests that the growth of the global crypto market has now sparked an interest among major institutions and corporations. In February 2021, car manufacturer Tesla announced it purchased \$1.5 billion worth of Bitcoin, and will begin accepting the currency as a form of payment for products [25]. Banking giant Paypal soon followed suit and began allowing US customers to utilise cryptocurrency as a payment option, opening the cryptocurrency market for millions of supporting merchants [26]. Many investment firms have also publicly announced interest in Bitcoin, with companies like MicroStrategy publicly sharing they hold 91,850 BTC as a primary reserve asset [27]. This growing support from large institutions reinforces the long-term theory of increasing market value.



Fig. 7. Snapshot of BTC/GBP Annual Market Growth as of 26th April 2021 — Retrieved from TradingView.com

Due to the continuous volatility and lack of regulation, there is growing concern among government bodies regarding financial fraud and exploitation. A study by Li [28] notes that the development of BSC and Ethereum blockchains have opened a path for several altcoins to take advantage of market instability through Pump-and-Dump (P&D) schemes. Declared illegal in financial stock markets by the US Securities and Exchange Commission (SEC), these manipulative events aim to generate capital by artificially inflating the price of an asset. Generating demand for a coin further increases its market price, yet a significant price crash follows after holders sell their coins, a result of supply surpassing demand. The short time period in which a token's value can rise and fall means an incredibly short window to accumulate profits, organisers are often more successful as they purchase coins ahead of the scheduled pump. When these schemes target low market capitalisation coins, a rug pull can occur. This is when a sudden price collapse reduces a project's liquidity pool, completely removing support for market trading and leaving token holders unable to sell, causing significant losses.

The absence of regulation, guidelines and policies in the crypto space is a factor which attracts many investors; however, it can also be viewed as a threat from a government

perspective. A 2019 paper by Wilson [29] explores the future of cryptocurrency and concludes that further advancements in digital currency is likely to challenge existing financial institutions. The author goes further to claim that a new generation of cryptocurrency has the potential to eventually supersede fiat money. This theory is firmly justified, as of 18th May, 2021, China, Europe, US and UK governments have all expressed an interest in developing their own digital currencies, intending to introduce a form of regulation to the market [30]. This however has raised questions among existing investors regarding centralisation of an asset originally designed to be decentralised. Despite this lack of regulation, support for cryptocurrencies has been continuous; further reflecting the increasing global market capitalisation. Historically Bitcoin's quadrennial halving event triggers a period of growth among the entire cryptocurrency markets. However, research by Held [31] theorises that the current market cycle is different than before, explaining that growing adoption, awareness and availability are supporting factors which could lead to a possible economic super-cycle. In traditional stock markets, super-cycles are periods of sustained growth in value above predicted trends.

VI. CONCLUSION

Despite the massive growth in recent years, researchers acknowledge that cryptocurrency is not yet fully understood. Still a developing technology with limitations and flaws, this paper addresses the two main misconceptions; finding that Bitcoin's energy expenditure was found to be 40% more efficient than traditional banking systems, and only 2.1% of transaction volume was identified as illicit activity.

As an investment asset, high volatility causes significant short-term risks, yet long term analysis proves cryptocurrencies' durability even among stock market crashes. Although many developing projects are increasing global awareness by implementing new utility, the ecosystem is highly competitive and not all altcoins will remain successful. This is evidenced through historical market corrections from several previously popular altcoin projects, like PayCoin and BitShares. Between January and May 2021, Bitcoin's market domination has dropped from 50% to 40%, emphasising the growing significance in altcoin projects. Analysts suggest that the current market phase will continue to grow in popularity, bringing more investors in and thus increasing market value over time.

Although it is unlikely for Bitcoin to become a global medium of exchange in the future; many experts believe a next generation, PoS-based altcoin will. The increase in mainstream adoption further suggests Bitcoin will continue to remain a store of value against traditional inflation, with more investors and institutions realising cryptocurrencies potential to outperform traditional stock markets.








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APPENDIX

TABLE I
HISTORICAL CRYPTOCURRENCY STATISTICS

Icon	Cryptocurrency	Ticker	Year Released	Algorithm	1 Year ROI	ATH	Current Price	Market Capitalization
	Bitcoin	BTC	2009	SHA256	526%	£47,094.56	£39,479.00	£738,910,225,787
	Ethereum	ETH	2015	Ethash	1,208.94%	£1,915.83	£1,903.17	£220,820,268,056
	Binance Coin	BNB	2017	DBFT	2,808.70%	£443.65	£402.83	£62,267,947,838
	Ripple	XRP	2012	Ripple Protocol	377.47%	£2.50	£1.01	£45,499,307,243
	Cardano	ADA	2015	Ouroboros	2904%	£1.0780	£0.9404	£30,223,786,288
	Dogecoin	DOGE	2013	Scrypt	11,033.09%	£0.301119	£0.195080	£25,194,343,038
	Litecoin	LTC	2011	Scrypt	339.70%	£269.56	£186.63	£12,458,878,669