



AMSA

Asset Management Study Association

# The sustainability and viability of Cryptocurrencies as an asset class - A case study of Bitcoin

Assets Team – December 2022

Lukas Dittrich – Analyst

Cedrick Badibanga – Analyst

Igor Uzelac – Analyst

Louis Börner – Head of Assets

## Introduction

1. What is Bitcoin? How does it work?
2. What makes Bitcoin an interesting investment? And when to buy?
  - 2.1. Restrictions and checks on those in power
  - 2.2. Free market monetary economics (sustainable economics)
  - 2.3. Gold 2.0
  - 2.4. Innovation
  - 2.5. Cycle psychology and when to buy
3. Bitcoin myths and dangers
  - 3.1. Environmental impact
  - 3.2. Volatility
  - 3.3. Criminal use
  - 3.4. 51% attack
  - 3.5. Centralised exchanges

## Evaluation

# Introduction

What are Bitcoin, Ethereum and Dogecoin? What these three have in common is that they are Cryptocurrencies. They have all had periods where they rallied to sky high prices, a means to make large amounts of fast money, and on the contrary they have also all had periods where they came crashing in value, making people lose large amounts of wealth. Whilst some may be older/younger, more or less complex ultimately the blockchain concept upon which they are built prevails and has existed for the better of the last decade. This poses the question: What is Blockchain? Can Blockchain be trusted? How can Blockchain benefit the everyday individual? Are Cryptocurrencies a viable and sustainable investment?

A further question to be asked is, how does this hold relevance to me if I don't intend on owning Cryptocurrencies? To begin with, Cryptocurrency are not to be underestimated as highly developed Cryptocurrencies are so much more than just a currency. Ethereum for instance has the ability to host smart contracts coded into the tokens. Besides currencies, blockchain has many more use cases, for example verified ownership, digital identity and supply chain monitoring. Some diamond mines are beginning to use the blockchain to verify and ensure the authenticity of exported diamonds; this paper will, however, focus on Bitcoin, the world's largest Cryptocurrency by market capitalization.

As will be discussed later, the nature of blockchain alleviates currencies from any influence of centralised institutional bodies and allows all financial interactions to be recorded and transparent, which not only opens up to an increased level of trust but if implemented worldwide would have an effect on the influence of those in power. The use of decentralised currency not only strips large centralised bodies of their absolute power but also forces a slew of checks and accountability on those that may wish to bend the rules.

This paper seeks to explore the sustainability and viability of Cryptocurrencies as an asset class by exploring the following avenues:

**Section 1.** What is Bitcoin? How does it work?

**Section 2.** What makes Bitcoin an interesting investment? And when to buy?

**Section 3.** Bitcoin myths and dangers

## **Abstract**

This paper summarises how Bitcoin works in simple terms. Exploring the path of a transaction including Bitcoin mining in careful steps by explaining wallets, keys, nodes, miners, hash-functions and their interactions. Moreover, Bitcoin economics in terms of fixed supply and issuances are described and shortly compared with Ethereum's tokenomics. Furthermore, interesting aspects including unseizable ownership, increased trust and adoption and a means to return to free market monetarism are discussed. It is also pointed out that Bitcoin makes a promising candidate for digital gold for future generations, is truly innovative in the financial space and has a strong growing community of investors sparking interest from large institutional investors. In addition to that, market cycles and investment strategies in relation to halvings, bear and bull markets and chart psychology are examined. Finally, Bitcoin myths and dangers including environmental concerns, volatility, criminal use, attacks on the mining network and the risk of centralised exchanges are addressed.

# 1. What is Bitcoin? How does it work?

Bitcoin is a digital currency and peer-to-peer global payment system that challenges the necessity for central banks and international transaction services (Flannelly, 2022). Bitcoin's underlying payment system does not require centralised intermediaries to process transactions and instead relies on Cryptography and a network of users (Ali et al., 2014). Users can set up their own digital non-custodial wallets, where they receive a private and a public key. The private key functions as the de facto password to the wallet and can also be used to set up the wallet on another device, the public key functions as the recipient address just like an IBAN (Akshay, 2022). There are full node wallets that contain a copy of the entire bitcoin ledger and can validate transactions, but full nodes therefore require a lot of data storage and need to run at all times. That's why most bitcoin users have light wallets. Light wallets are easy to use and install, but they rely on full nodes run by third parties to obtain their latest blockchain data. Currently light wallet users face a privacy trade-off for the convenience as IP addresses, wallet addresses and indirectly, transactions associated with the wallet address are shared with the third party. However, light wallets that achieve more privacy are already in development (Stevenot, 2022). In this way the blockchain is distributed across many nodes all over the world and does not rely on a central server like banks.

The easiest way to understand bitcoin's underlying blockchain technology is by looking at each block as a database containing every user's wallet address (public key) and the wallets associated with Bitcoin balance. On average every ten minutes a new block is mined by a miner to update the database to include the most recent transactions. Once Cryptographically confirmed by the nodes, the newly mined block gets added to the blockchain and cannot be altered. The so-called miners are responsible for the security of the network, together with the nodes they make sure that all transactions are valid by preventing double spending and checking whether the sender has a sufficient balance (Stevenot, 2022). The mining difficulty is adjusted every 2016 blocks or 2 weeks, relative to the total computational power of the miner network such that the average block time remains approximately 10 minutes. Therefore, the more miners join the network, the more secure the bitcoin network becomes but less also rewarding and as miners leave the network it becomes more rewarding for the remaining miners (Heller, 2020). At current hash rates of more than  $10^{20}$  hashes per seconds (CoinWarz, 2021) small fluctuations in miner participation are negligible to the network's security. Once a transaction is Cryptographically signed by the wallet, it is distributed by the nodes to the

miners. The miners choose pending transactions based on the availability and fee and add it into a block template until it reaches its capacity (Stevenot, 2022). All miners then compete to solve the Cryptographic SHA-256 hashing algorithm also known as the proof-of-work algorithm.

A hash function is a one-way, random mathematical function that has such characteristics that no matter the input, the output known as the hash is deterministic and will always be of the same length. This property is critical as it enables the rapid verification of arbitrary large data sets. Furthermore, the slightest change in input results in very different outputs. In bitcoins case, the output is represented as a hexadecimal number containing 64-digits, in this notation each digit represents 4 binary bits that can have 16 possible values that can range from 0-9&A-F totalling 256 bits (River Financial, 2021a). This potentially allows for  $16^{64}$  or  $2^{256}$  or  $10^{77}$  possible combinations. Lastly, since the output of the random one-way function does not display any information, the input cannot be used to predictably form a desired output and the output cannot be used to derive the input. Due to the randomised and unpredictable hash function, finding the valid hash must be achieved through intense guessing. Furthermore, the permanence of transactions is accomplished by constructing a Merkle tree that includes a single hash for all transactions in the block as well as the hash from the preceding block. (River Financial, 2021a).

Once a miner guesses a valid hash the new block is distributed back to the nodes to verify the blocks validity by checking if the miners strictly followed the ruleset. For this guessing process, miners use specialised ASIC computers designed to run the computationally intense proof-of-work algorithm at high speed (Titan, 2022). These computers can cost up to \$10,000 and require a lot of electricity to operate therefore miners are economically incentivised by the bitcoin protocol and the transaction fee selected by the user (VB, 2022). The fee increases when there is a high volume of transactions and users attempt to overbid each

other to prioritise their transaction being added to the next block template (Stevenot, 2022).

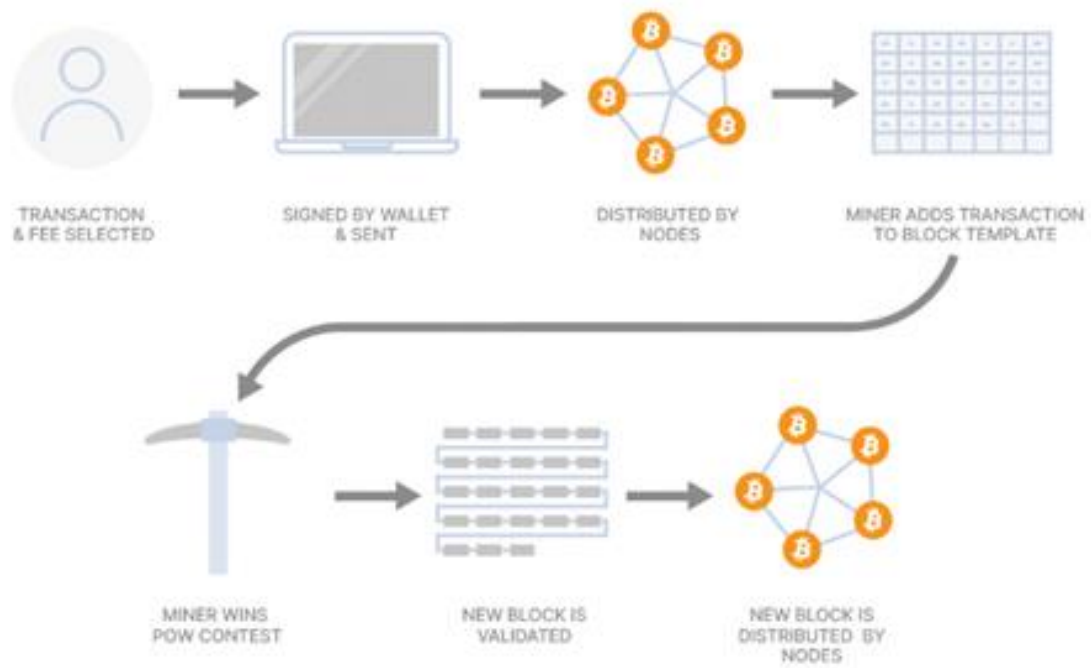


Fig. 1: Path of a bitcoin transaction (Stevenot, 2022).

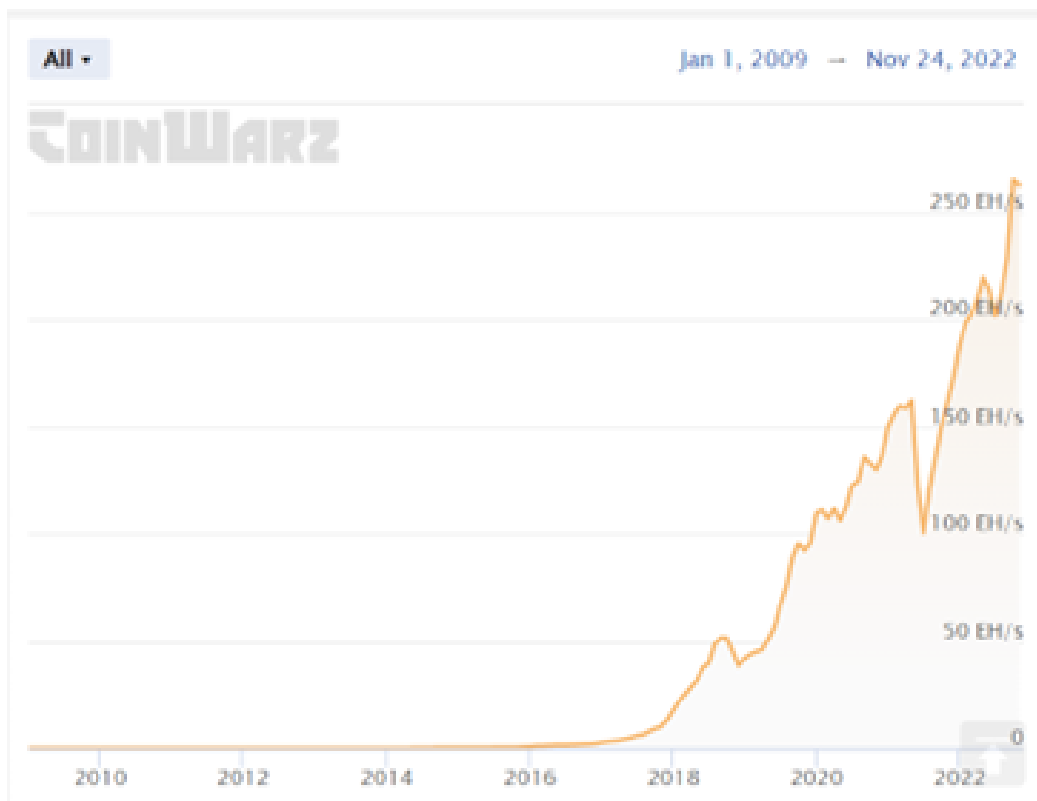


Fig. 2: Hash-rate of bitcoin network (CoinWarz, 2021).

Whenever a miner wins the proof-of-work contest and is confirmed by the nodes the protocol rewards him with newly issued bitcoin (Stevenot, 2022). This is the only mechanism that can create bitcoin, initially every block was rewarded with 50 bitcoins, however every 210,000 blocks, approximately 4 years, the block reward is halved. This event is known as the halving and has a significant impact on the value of bitcoin as it makes bitcoin disinflationary. In that way bitcoins total supply is fixed at 21,000,000, each bitcoin consisting of a 100 million satoshi. However, more than 3 million bitcoins are probably lost due to inactive wallets and most investors are taking their bitcoins off the market resulting in bitcoin becoming ever scarcer (Phillips, 2021).

Another extremely interesting project is the second largest Cryptocurrency, Ethereum. Currently Ethereum is transitioning from a proof-of-work to a proof-of-stake consensus mechanism. In Ethereum's proof-of-stake a person must stake a minimum of 32 ETH tokens to validate transactions; however if the validator attempts to falsify transactions, a part of the stake is lost (Ethereum, 2022). This is why Ethereum is said to be more sustainable than bitcoin because significantly less electricity is used, however centralisation increases as it results in less overall validators. Additionally, since the EIP-1559 update, Ethereum included in its protocol that for every transaction a small part of ETH is burned. Since Ethereum issues 2 ETH per mined block and does not have a fixed supply like bitcoin, this mechanism balances Ethereum's inflation and allows it to fluctuate between being overall inflationary and deflationary based on the volume of transactions (Barsby, 2022). The Ethereum project is extremely interesting and worth delving deeper into, however, it is not within the scope of this paper.

## **2. What makes Bitcoin an interesting investment? And when to buy?**

### *2.1. Restrictions and checks on those in power*

Banks and governments reserve the rights to seize assets, freeze accounts and claim assets, with decentralised Cryptocurrencies that allow users to own relatively anonymous Crypto wallets such actions can't be undertaken (Zafar, 2021). This means people are not only safer but governing bodies have less control over people's possessions.



As Cryptocurrencies operate outside of control of third parties they have the potential to serve us in ways fiat currencies couldn't. Their decentralised and coded nature prevents human biases, that could otherwise lead to discrimination and censorship. There are still centralised third party services that make Crypto easy-to-use that are used for convenience. Such service providers could still be pressured by governments to take discriminatory actions. Therefore, it is best to trust yourself with the keys to your wallet and to use decentralised services directly with your wallet instead of depositing funds at a centralised platform.

## *2.2. Free market monetary economics (sustainable economics)*

Free market monetary economics essentially describes a monetary system of ideal capitalism where all competition is permitted and unregulated. The economy is not artificially stimulated by central bank currency creation and government deficit spending and interest rates are determined by the free market. Furthermore, instead of fiat currencies, people use currencies of their choice (usually gold or silver) as long as they are commonly accepted for transactions.

When we first transitioned from trade and barter to a monetary system there weren't any central controlling bodies or complex financial processes and as such interest rates were determined by the market. The goldsmiths became the first bankers when they made it their business to store other people's gold. They soon realised that not everyone needs their gold at the same time and that people started transacting with the redeemable gold notes they issued rather than the actual gold bars. They then started to lend out more gold notes to people than they had gold and just like that fractional reserve lending was born. This practice became the norm in banking as it helped banks increase their returns at the risk of bank runs. Over time bank runs bankrupted the smaller banks and large banks began to dominate the market. These large banks then lobbied the government for the creation of a central bank to protect themselves from future bank runs. Nowadays, the same central banks actively regulate reserve ratios, interest rates and issue currency. This, however, gave the bankers and central bankers more power and control over people's currency and the economy as a whole. This is where Cryptocurrencies could make the difference, their transparent economics and their trustless process that is predetermined by their protocol and publicly available offers a trustable alternative and a free market environment.

Bitcoin's disinflationary system is more sustainable for the economy and population than the current inflationary system of central banks. It shifts focus towards preserving purchasing power rather than stimulating the economy and increasing tax income for the

government. Currency users would retain purchasing power and not have to deal with a ‘hot potato currency’ that pushes to be invested or spent to avoid losing hard earned value. This foggy environment (inflation in combination with low interest rates) makes poor investments profitable, creates zombie companies and prevents people from building up savings. This forces people to over invest when under optimal conditions that money could have compounded at a fair risk-free rate determined by the free market (instead an artificially low rate indirectly determined by central bank). If adopted Cryptocurrencies would shift power from government to people, however would make it harder for business to operate. All zombie companies and many unprofitable companies, that takeaway market share from economically healthy companies, would go bankrupt. Aggregate demand would go down, and could lead to a significant decrease in consumerism. GDP would decrease due to less short term spending but there should be a healthy increase in long-term investments.

### *2.3. Gold 2.0*

The latest data shows that the number of people who trust Bitcoin as opposed to large banks has increased over the past three years. Millennials lead the adoption of Bitcoin, with 44% hoping to buy some within five years. Over 45% of respondents preferred Bitcoin over stocks, real estate and gold. While millennials may be leading in Bitcoin adoption, the survey found “increased knowledge of, and growing confidence in, Bitcoin among all age and gender groups surveyed,” (Frost, 2020). This further demonstrates preference to store value in goods that the individual has complete ownership of. Not to mention that all of your wealth stored in Crypto can be accessed within less than an hour.

This makes Bitcoin a promising candidate to become the new and refurbished digital gold 2.0, hedging against inflation just like gold. Except, this version would have more benefits such as ease of transport, ease of crossing border, ease of transacting, cheaper storage, increasingly less inflation, divisibility to  $10^{-8}$  unlike stocks you don't need to purchase a full bitcoin any fraction is possible. Bitcoin does, however, suffer from a few disadvantages as well. For instance, being more volatile due to smaller market cap and less market participation, technological aspects might seem too complicated for older generations. Next halving in 2024, Bitcoin will become harder than gold (River Financial, 2021b). After the 2020 halving, Bitcoin issuance dropped below the Fed inflation target of 2%, officially becoming harder than the USD. However, in the meantime, the USD has been approaching double digit inflation while Bitcoin’s inflation can only decrease. As long as the Fed raises the interest rates and strengthens

the USD, Bitcoin can be kept in check momentarily, however the Fed can not allow the economy to collapse and the next Bitcoin halving is around the corner. That is why Bitcoin could be an interesting alternative inflation hedge while being more practical than gold. Similar to the strategy of investing in mining gold instead of purchasing from the market, Crypto investors have the opportunity to do this as well. Where gold mining facilities are rather expensive and encumbering, a Crypto mining rig is significantly cheaper as it is essentially a computer with strong processing power.

#### *2.4. Innovation*

Another aspect of Bitcoin is that it is the first of its kind, a true innovation in the financial space. People are encouraged to be a part of this emerging asset class as it is proven that the earlier people invest in innovation, the more potential returns they are likely to make in the future. Additionally a growing interest of large institutions, hedge funds, and banks which have all invested heavily in Bitcoin goes to show how important of an asset class it has become. Bitcoin has gained a strong growing community with iron hands which has led to a large increase in miner participation. For this to become a well established and strong market, people must learn to safely invest and follow basic rules and guidelines. Meaning don't invest more than you are willing to lose. Since Crypto is relatively volatile, it is important to diversify your portfolio in order to reduce the risk of losing currency. Most importantly since cycles are short, buying at the right time when people are silent is crucial and not to be influenced by other people to "buy the hype." Another safety measure would be to dollar-cost average during a bearish market and to continue doing so into the early stages of a bullish market. Overall, it would be beneficial to be a part of a loyal community of people who know exactly what they stand for and why, while at the same time contributing to a revolution in the financial world.

#### *2.5. Cycle psychology and when to buy*

Just like any other asset class, Cryptocurrencies go through cycles. In general, cycles can be hard to predict and asset classes can be influenced by fiscal and monetary policies. What makes bitcoin special, is that despite the impact that a strong dollar can have on bitcoins price in the short-term, in the long run bitcoin gathers more and more strength and is fundamentally unstoppable as long as its users base keeps growing and more miners flock to support the network. This strength is derived from the halving event that happens roughly every 4 years. Every halving event, bitcoin becomes more scarce and therefore more valuable, this usually

initiates a steady rally to incorporate this new value into bitcoin's price (see fig. 3). Investors gain back hope and become optimistic (see fig. 4). In this phase it is the safest time to invest because just after the halving bitcoin is still undervalued and the market is slowly adjusting to this fact. As soon as the previous all-time-high is broken the market enters into a phase of price discovery, this time the rally becomes explosive (see fig. 3) and bitcoin is all over the news. During this time investors' greed and euphoria peak (see fig. 4) and it's the most risky and least recommended to invest as the exponential growth becomes unsustainable. Over the previous years, most investors got used to high volatility and are blind to warning signs and when the market finally crashes, they don't take profits and expect another rally. However, the smarter and more experienced investors that are not trading or investing based on emotions start selling. In this phase, the media floods investors with negative coverage and the emotional investors and traders witness their portfolio crash as they go through stages of anxiety, disbelief, panic and finally capitulation (see fig. 4). It is common that emotional investors or weak hands at this point sell their position at an enormous loss and leave the market. This phase is followed by a painfully slow bear market that patiently seeks a bottom (see fig. 3) attempting to shake out uncertain investors, whilst turning the leftover inexperienced investors into depression and pessimism (see fig. 4). This also happens to be a great time to use the investment strategy of dollar-cost-averaging as this prevents an investor from entering the market at a suboptimal time. This trend is expected to continue as long as central banks all around the world create inflationary and stagflationary environments that sow distrust for their respective national currencies and push people towards alternative currencies and inflation hedging assets. At the time of writing this report the next halving is still 19 months away (BitDegree, 2022) and we are about to enter the less volatile phase of the bear market (see fig. 3) while the hashrate is at all time highs (see fig. 2). This offers a great opportunity to carefully explore the emerging asset class of Cryptocurrencies and their underlying blockchain technology without having to rush.

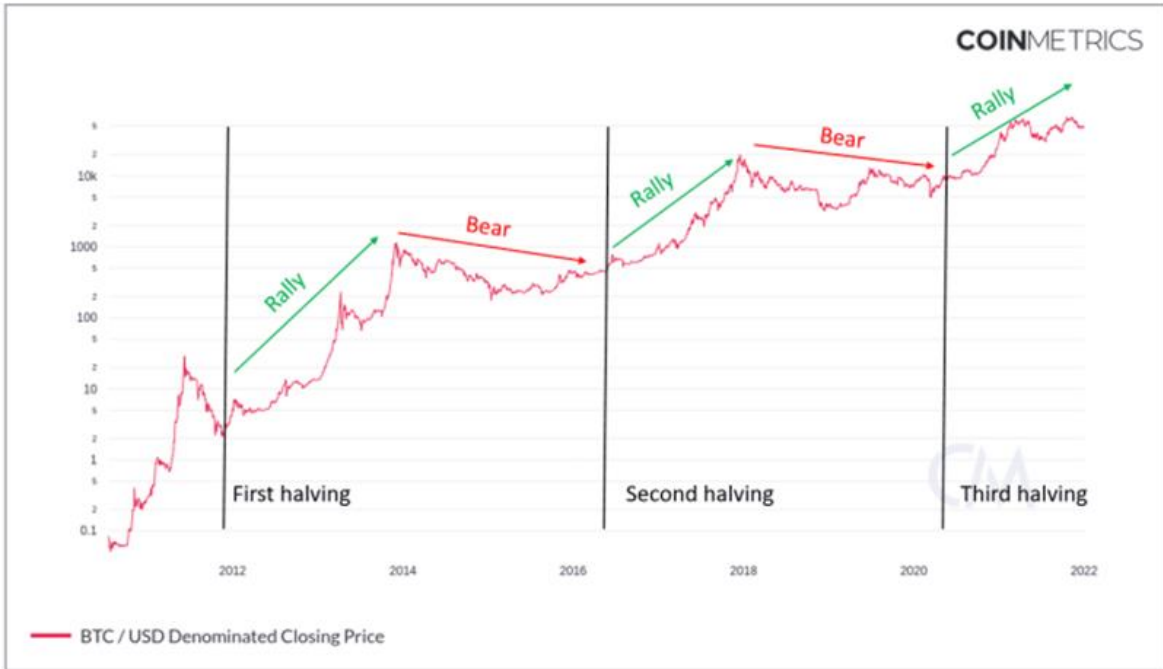


Fig. 3: Halvings and bull & bear markets on log price chart (Tětek, 2022).

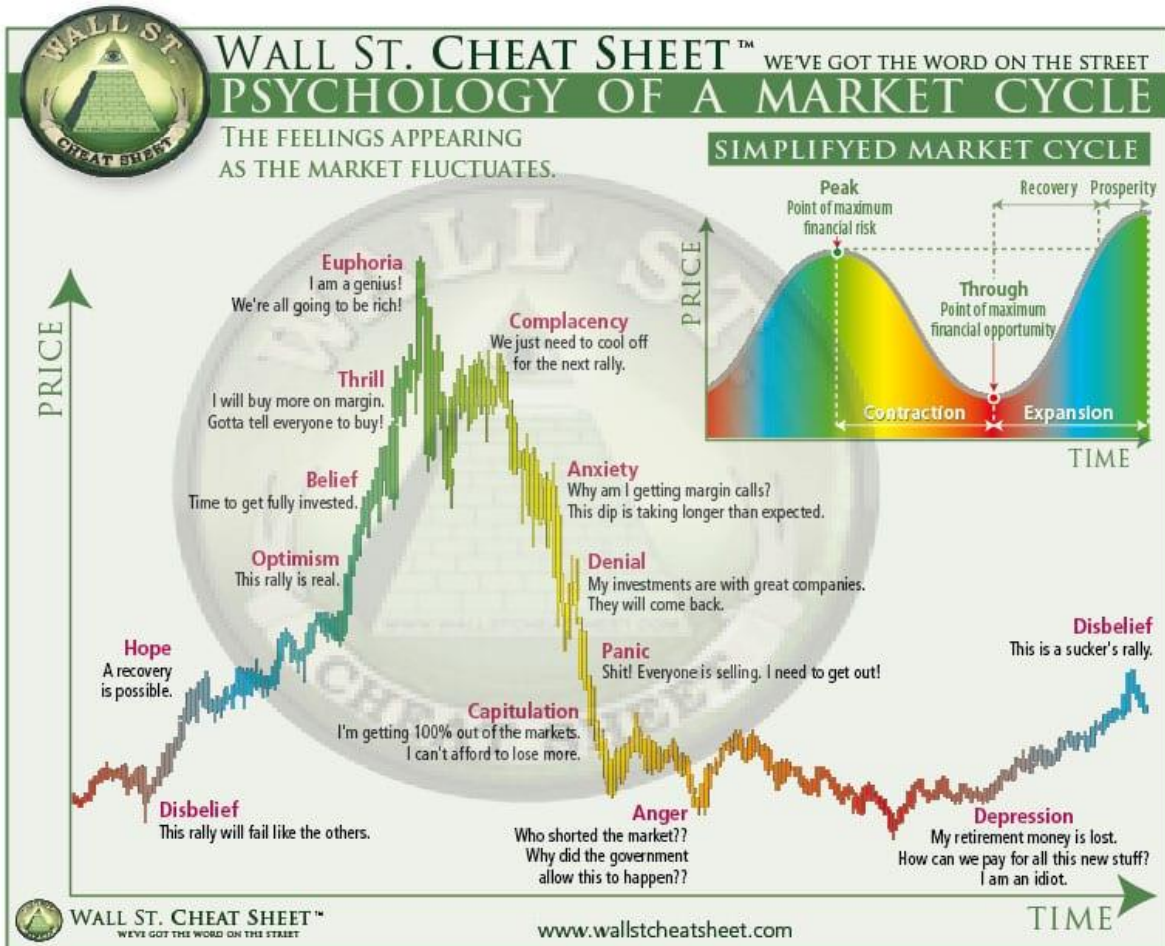


Fig. 4: Psychology of a market cycle (The Fifth Person, 2016).

### **3. Bitcoin myths and dangers**

#### *3.1. Environmental Impact*

Cryptocurrencies, more specifically Bitcoin have been under attack by society due to their carbon footprint and environmental status. When looking at the facts, Bitcoin miners alone consume 0.7% of global electricity while at the same time annually consuming the same amount of energy as some countries such as Austria, Norway, and the Philippines. While these numbers may seem big, they are often misunderstood and misrepresented. Contrary to widespread belief bitcoin is in fact environmentally friendlier than the banking and monetary system currently in place. When looking at the worldwide banking system as a whole, it is estimated to consume around 50 times as much energy and electricity per annum when compared to Bitcoin (Constantino, 2022). Moreover, the traditional banking system uses physical monetary currency such as cash and coins as a form of exchange. Meaning that on top of all the excess energy and electricity consumption, banks use and burn many other resources such as paper, metals, and ink leading to even more pollution (Eugenia, 2022). Another benefit of Bitcoin is that it shows the public exactly how much energy and electricity it has used while complex calculations and estimations are needed to compute how much energy and electricity traditional banks use.

#### *3.2. Volatility*

Volatility takes the measurement of how much the price of an asset has increased or decreased. As a general rule, the more volatility an asset has, the riskier of an investment it is. Volatility does have some advantages and many disadvantages. At times of high volatility, investors who know what they are doing could make use of this and make high returns. On the other hand, volatility creates massive uncertainty and fear within investors which could sometimes lead to positive returns, but unfortunately most of the time it causes bad investment decisions and destruction of wealth. Since Cryptocurrencies are a relatively newer asset class, it is considered to be a volatile asset, with prices having the potential to surge and plummet in the short-run (Kumar, 2021). However, when looking at Bitcoin's volatility over the past decade, its volatility has nearly halved. In 2011, the average 30-day volatility was 8.26% while in 2021 it dropped to 4.56% and the latest 30-day average volatility in 2022 was estimated to be 2.92% (Buybitcoinworldwide, 2022). Currently, Bitcoin's volatility is lower than the volatility of some stock indexes such as NASDAQ and the S&P 500, according to Kaiko (Macheel, 2022).

Since Bitcoin was traded publicly, its average 1-year volatility percentage over the past decade was around 37% which is much higher than other assets such as Gold which was around 5%, US stocks which were around 6%, and US real estate which was around 8%. (Charts.woobull, 2022)

### *3.3. Criminal use*

Due to bitcoin's relative anonymity it can be used as a means for criminals to transact and irrevocably receive ransom funds over the internet, however their wallets can be traced from the moment the criminal reveals his public key, furthermore public keys associated with further transactions will be visible for the majority of Cryptocurrencies. To circumvent this, criminals sometimes use Cryptocurrencies that have a transaction privacy feature or scrambling services to obscure the source of their Crypto. However, criminal activity has existed long before Cryptocurrencies and criminal actors will always find a way to break the rules in their favour. At this moment most criminals probably still find cash more practical due to its private and frictionless nature of transacting.

### *3.4. 51% attack*

The only way bitcoin or other proof-of-work Cryptocurrencies could be breached is by the 51% attack. If a malicious group were to hold more than 50% of the network's mining hash-rate they would have the capacity to tamper with the ledger and enter fraudulent data into the blockchain (Frankenfield, 2022). This is a threat that is beginning to arise mainly in Chinese Crypto mining projects. Since the government is heavily investing in the Crypto space many parties have the funds to build massive Crypto mining firms, amassing larger hash-rate shares that if used with malicious intent could cause massive damage and eradicate the safe environment that the current "trust free system" operates on. One possible solution would be to encourage more miner participation by subsidising it in the EU or USA or encourage miners where electricity is cheap due to natural resources. Additionally, if such an attack would ever be successfully carried out robbing innocent users, the Crypto community already has a solution for it, forking. For this an exact copy of the blockchain before the attack is made. Miners and users then switch to the copied version, leaving the malicious attacker with the original but user and miner deprived version. This highlights that the value of a currency stems from the trust and belief of the users or community not the currency itself.

### *3.5. Centralised exchanges*

Centralised exchanges have become the banks of the Crypto sector. These exchanges serve as the bridge between the traditional banking system and Cryptocurrencies. On them fiat currencies and Cryptocurrencies are traded every day of the year, 24/7. Exchanges like Binance have significantly increased the user experience with their easy-to-use platform. However, placing Crypto and fiat on such centralised exchanges instead of self-custodial Crypto wallets adds additional third party risk to people's holdings. Exchanges like FTX have shown that one can't blindly trust any exchange and that their fund can always be embezzled by bad actors. "Not your keys, not your Crypto", that's why it is always recommended to hold Crypto in a self-custodial wallet and to use decentralised exchanges and not trust a centralised exchange with funds out of mere convenience (Younkin, 2022).

## **Evaluation**

This report touched on various topics concerning why Cryptocurrencies and more specifically Bitcoin are rising in popularity, and have the potential to disrupt the banking sector as well as



offering a more economically sustainable and decentralised alternative to central banking. Cryptocurrencies have the capability to take back power from unaccountable centralised bodies and return it to their users. Besides unseizable ownership, the key strength of Bitcoin is its disinflationary monetary model, leading to an increase in purchasing power over time periods exceeding a halving cycle. Due to this property, Bitcoin has the potential to become a modern inflation hedge and serve future generations as a form of digital gold. Bitcoin is in many ways superior and more practical than gold, due to its divisibility, ease of storage, transport and transaction. These characteristics make Bitcoin a truly interesting long-term hold. However, it is important to understand the risks and cycles of this new asset class. That's why such investments should be made in periods of low volatility around the halving event and investors should be aware of other risks, like losing keys, attacks on the network e.g. by governments, defraud by criminals and third party risks like holding funds on centralised exchanges. Despite these risks, the intriguing concept of Cryptocurrencies, has sparked growing interest from many institutional investors, hedge funds and public companies in recent years and some have already started buying Bitcoin and other Cryptocurrencies. Regardless, Cryptocurrencies are still an emerging asset class but with growing acceptance and participation there is the potential to become a pivotal asset class in the future and challenge a reform of the current financial markets and the banking sector. The fact that Cryptocurrencies are such a new and innovative phenomena hints at this just being the beginning. Nonetheless, investors need to remain cautious and aware of the risks this asset class brings to the table.

## Bibliography

- Akshay. (2022, February 11). *Different Types of Bitcoin Wallets Explained*. TheCryptoInsight. Available at: <https://www.thecryptoinsight.com/2022/02/different-types-of-bitcoin-wallets-explained.html>
- Ali, R., Barrdear, J., Clews, R., & Southgate, J. (2014). Innovations in payment technologies and the emergence of digital currencies. *Bank of England Quarterly Bulletin*, Q3.
- Barsby, O. (2022, September 1). *Ethereum Burn Rate: How Much ETH Has Burned Since EIP-1559 London Hard Fork, And Is Ethereum Deflationary?* Gfinity Esports. Available at: <https://www.gfinityesports.com/Cryptocurrency/ethereum-burn-rate-how-much-eth-burned-deflationary-eip-1559-london-hard-fork/>
- BitDegree. (2022). *Next Bitcoin Halving Dates 2024: BTC Countdown & History*. BitDegree.org Crypto Learning Hub. Available at: <https://www.bitdegree.org/halving/next-bitcoin-halving-dates>
- Buybitcoinworldwide. (2022). (3.51%) Bitcoin Volatility Index - Charts vs Dollar & More. (2022). Available at: <https://buybitcoinworldwide.com/volatility-index/>
- Charts.woobull. (2022). *Bitcoin volatility vs other assets*. Available at: <https://charts.woobull.com/bitcoin-volatility-vs-other-assets/>
- Chau, A., & Ramachandran, R. (2022, February 10). *Evaluating cryptocurrencies as an asset class*. Wellington. Available at: <https://www.wellington.com/en/insights/evaluating-cryptocurrencies-asset-class>
- Coinbase. (n.d.). Available at: <https://www.coinbase.com/learn/Crypto-basics/what-is-volatility>
- CoinWarz. (2021). *Bitcoin Hashrate Chart*. Available at: <https://www.coinwarz.com/mining/bitcoin/hashrate-chart>
- Constantino, T. (2022, June 17) *Bitcoin uses 50 times less energy than traditional banking, new study shows*. The Motley Fool. Available at: <https://www.fool.com/the-ascent/Cryptocurrency/articles/bitcoin-uses-50-times-less-energy-than-traditional-banking-new-study-shows>

Ethereum. (2022). *Ethereum staking*. ethereum.org. Available at: <https://ethereum.org/en/staking/>

Eugenia, O. (2022, June 15). *Energy consumption: Cryptocurrency vs traditional banks*. IYOPS. Available at: <https://www.iyops.org/post/energy-consumption-cryptocurrency-vs-traditional-banks>

Flanelly, M. (2022, March 2). *What is the SWIFT banking system?* SoFi. Available at: <https://www.sofi.com/learn/content/what-is-swift-payment-system/>

Floyd, D. (2022, May 11). *How Bitcoin Works*. Investopedia. Available at: <https://www.investopedia.com/news/how-bitcoin-works/>

Frankenfield, J. (2021, July 26). *Merkle Tree*. Investopedia. Available at: <https://www.investopedia.com/terms/m/merkle-tree.asp>

Frankenfield, J. (2022, September 29). *51% Attack: Definition, Who Is At Risk, Example, and Cost*. Investopedia. Available at: <https://www.investopedia.com/terms/1/51-attack.asp>

Frost, L. (2020) *An increasing number of people trust bitcoin over big banks, says survey*, Decrypt. Decrypt. Available at: <https://decrypt.co/32378/bitcoin-is-becoming-more-trustworthy-than-big-banks-says-survey>

Heller, T. (2020, September 18). *What is Bitcoin Difficulty and why does it matter? — HASHR8*. Newsroom – Compass. Available at: <https://education.compassmining.io/education/what-is-bitcoin-difficulty-and-why-does-it-matter/>

Kumar, H. (2021, October 28). *Here is why cryptocurrencies are so volatile*. Outlook India Available at: <https://www.outlookindia.com/website/story/business-news-here-is-why-are-cryptocurrencies-so-volatile/398988>

Phillips, D. (2021, January 3). *Lost Bitcoin: 3.7 million Bitcoin are probably gone forever*. Decrypt. Available at: <https://decrypt.co/37171/lost-bitcoin-3-7-million-bitcoin-are-probably-gone-forever>

River Financial. (2021a). *How Bitcoin Uses Cryptography*. Available at: <https://river.com/learn/how-bitcoin-uses-cryptography/>

River Financial. (2021b). *What Will Happen After All Bitcoin Are Mined?* Available at: <https://river.com/learn/what-will-happen-after-all-bitcoin-mined/>

Stevenot, T. (2022, November 2). *What is a bitcoin node and how does one work?* Unchained Capital. Available at: <https://unchained.com/blog/what-is-a-bitcoin-node/>

Tanayamac. (2022, October 21). *Bitcoin's volatility falls below Nasdaq and S&P 500's for first time since 2020*. CNBC. Available at: <https://www.cnbc.com/2022/10/21/bitcoins-volatility-falls-below-nasdaq-and-sp-500s-for-first-time-since-2020.html>

The Fifth Person. (2016, January 15). *The Psychology of Market Cycles*. Available at: <https://fifthperson.com/psychology-market-cycles/>

Titan. (2022, June 21). *What Is Bitcoin Mining and How Does It Work?* Available at: <https://www.titan.com/articles/what-is-bitcoin-mining>

Tětek, J. (2022, January 15). *Bitcoin Bear Markets: What, Why, When?* Bitcoin Magazine - Bitcoin News, Articles and Expert Insights. Available at: <https://bitcoinmagazine.com/markets/bitcoin-bear-markets-what-why-when>

VB (2022) *How much do ASIC miners cost?*, *Crypto Miner Tips*. Available at: <https://Cryptominertips.com/how-much-do-asic-miners-cost/#:~:text=Between%20%248%2C000%20and%20%2410%2C000%20would%20be%20the%20cost,astronomical%20power%20expenses%20required%20to%20keep%20it%20running.>

Younkin, T. M. (2022, December 2). *Lesson #1 From the FTX Collapse: "Not your keys, not your crypto."*. Available at: <https://www.linkedin.com/pulse/lesson-1-from-ftx-collapse-your-keys-crypto-teresa-younkin-mshi/>

Zafar, T. (2021) *Crypto vs. banking: Which is a better choice?*, *Entrepreneur*. Entrepreneur. Available at: <https://www.entrepreneur.com/money-finance/Crypto-vs-banking-which-is-a-better-choice/399503#:~:text=Cryptocurrencies%20are%20completely%20free%20of,anonymous%20ID%20numbers%20in%20transactions>