BITCOIN—An Introduction

Feb 2021

Digital Economics

Advantages: Lower

- Search Costs
- Replication Costs
- Transaction Costs
- Tracking Costs
- Verification Costs

Disadvantages: Higher chances for

- Hacking
- Losing Privacy

Origin of Bitcoin

- Financial crisis of 2008
- Fiat currency, Quantitative Easing and Satoshi Nakamoto
- Key: Decentralization via peer-peer network, open-ledger
- Bitcoin – Digital currency? Cashless Eco System?
- Is it Anonymous? Not really; Public vs Private ledgers
  Keep the wallet address new or secret or third party sources!
- Not fungible
- Decentralized Digital Currency
- hut8mining.com

Table 1: Bitcoin Activity to Date

	2015	2018	2021
Total bitcoins minted	$\approx$ 14 million	$\approx$ 17 million	$\approx$ 18.625 million
US dollar equivalent at market price	$\approx$ 3.5 billion	$\approx$ 100 billion	$\approx$ 868 billion
Total number of reachable Bitcoin nodes	$\approx$ 6,500	$\approx$ 9800	
Total (cumulative) number of transactions	62.5 million	$\approx$ 350 M	$\approx$ 615 M
Total number of accounts ever used	$\approx$ 109 million		$\approx$ 861 M
Block chain size	$\approx$ 30.3 GB	$\approx$ 173 GB	$\approx$ 327 GB
Number of blocks to date	$\approx$ 350,000		
Estimated daily transaction volume	$\approx$ 200,000 BTC ($\approx$ \$50 million)	$\approx$ 250,000 BTC ($\approx$ 1.56 billion)	$\approx$ 3 billion
Average transaction value	$\approx$ 2 BTC ($\approx$ \$500)	$\approx$ 2.56 BTC ($\approx$ \$16K)	
Computation invested in puzzle solutions	$\approx$ 4,254 exaflops		
Power consumption	$>$173 MW (continuously)		

Bohme et al. (2015)
Maximum $\sim$ 21 million – to be reached by 2140

Bitcoin Design Principles

- Scarcity
- No Counterfeiting
- Price Stability
- Correct Bookkeeping
- Underlying Technology: Blockchain

Buying/Storing Bitcoins

- Wallet Software: bitcoin.org/en/choose-your-wallet
- Bitcoin Exchanges similar to currency exchanges; coindesk.com
- How do exchanges operate? Fees, Limit order book.
- Peer to Peer Networks: gemini.com ; kraken.com etc

Mining

- Blockchain Foundation—keeping the transactional record operational and updated as a public good; users assistance is sought.
- Miners are awarded with new bitcoins; they solve a mathematical puzzle—computationally intensive/Random component — Pre-existing conditions of the block remain in fact; publishes a 'block' with proof-of-work—others verify—Entire process is called mining.
- Consensus reached by voting—May take six rounds/one hour.
- Computationally intensive.

Other Facts

- Ceiling of 21m bitcoins
- Miners can earn through transaction fee (0.0001 bitcoin)
- "One computational cycle, one vote" vs "one person, one vote;" cannot game the system with fake, multiple identities.
- No governance structure as in the conventional payment systems; no verification of transactors' credibility; no prohibition of items; no reversal of transactions.

Bitcoin Ecosystem

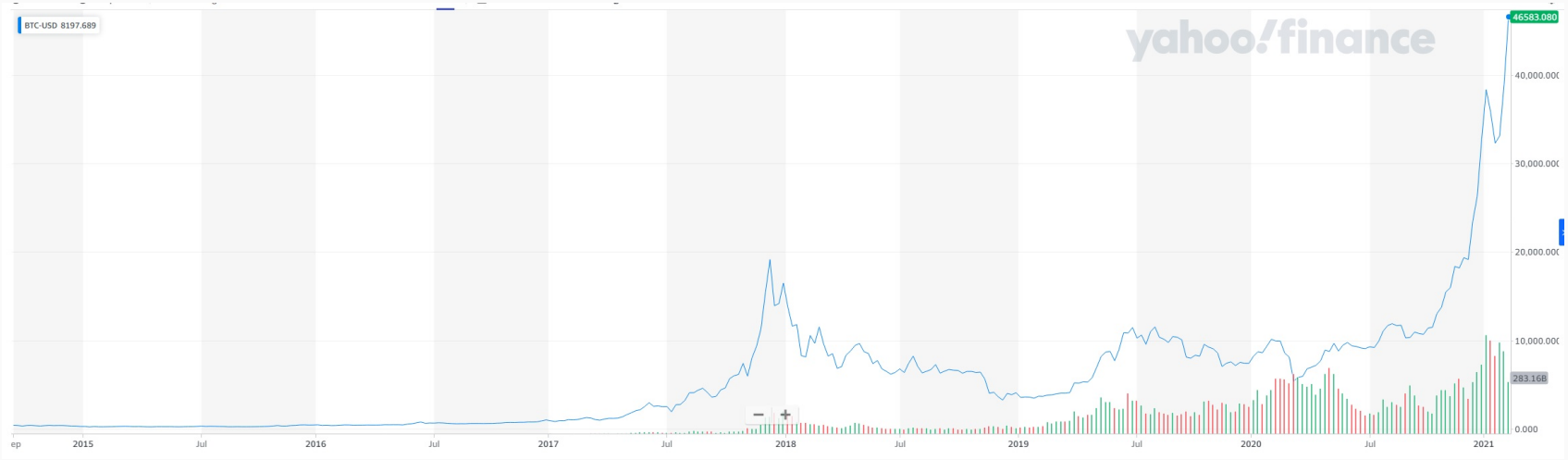
- Key Innovation: Decentralization of Core technologies, Privacy
- Intermediaries
  Currency Exchanges
  - BitForex, BitMEX, bitFlyer, etc.
  - Double Auctions (0.2 to 2% fee)
  - Bitcoin still a 'payment' system
- Digital Wallet Services
  - Holds account information
  - Imposes onerous technicality
  - Shared server vs own computer; private key is the key.
- Mixers
  - Promote Anonymity (Cost 1 to 3%.)
- Mining Pools

Uses of Bitcoin

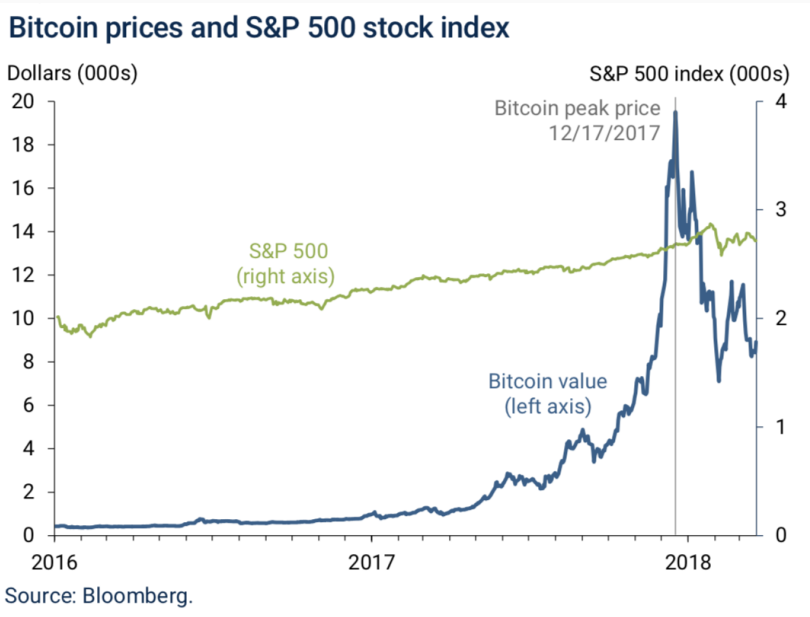
- Silk Road (Past)
  - Illicit Activities
  - High transaction cost (8%)
- Consumer Payments, Buy and Hold: (Current)
  - Low Cost, but no rebates
  - Strict book-keeping has costs
- Possibilites (Future)$\rightarrow$ Could be used for all-purpose payments (overstock.com accepts bitcoins)
  $\rightarrow$ can replace Western Union

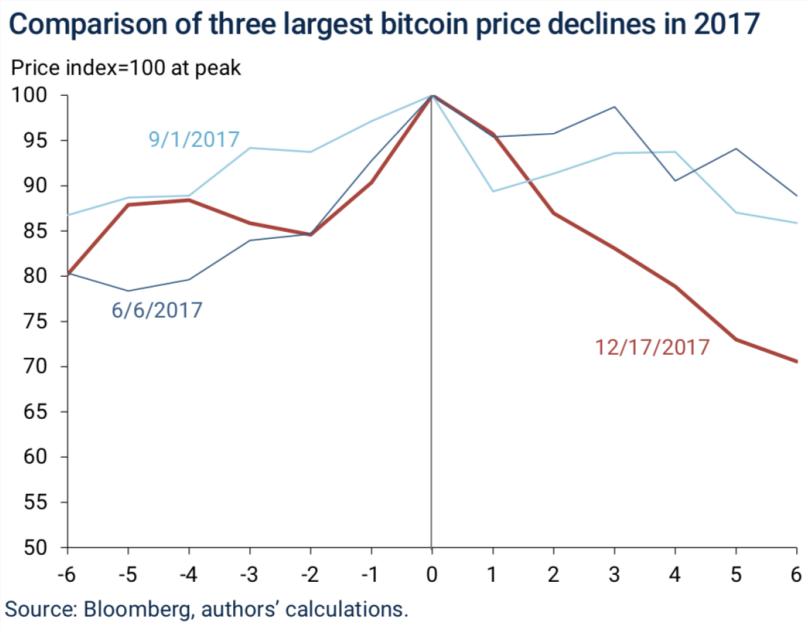
Risks in Bitcoin

- Market Risk—fluctuates with exchange rate.
- Shallow Market
- Counterparty risk (several exchanges have disappeared!)
- Transaction Risk (Irreversibility) (some can double spend as it takes time to update a block chain)
- Operational Risk (Infrastructure/security risk: Hacking)
- Privacy Risk (Pseudonymous)
- Yellen (NYT, Feb 24,2021): Skeptical about Bitcoin;
  : Proposes Digital Dollar.



US Dollar-Bitcoin Exchange Rate along with daily Bitcoin Trade Volume





(Effect of Starting Futures)

Key References:

R. Böhme, N. Christin, B. Edelman, and T. Moore (2015): *BitCoin: Technology and Governance*, Journal of Economic Perspectives, Vol 2, p 213–238.

A. Berentsen and F. Schar (2018): *A Short Introduction to the World of Cryptocurrencies*, Rserve Bank of St. Louis Review, Vol 100, p 1–16.

G. Hale, A. Krishnamurthy, M. Kudlyak, and P. Shultz (2018): *How Future Trading Changed Bitcoin Prices*, FRBSF Economics Letter, 12, May 7.

Cryptocurrency: Economics/Trading

- Is Bitcoin a currency, a commodity or a security
- How did Fiat currency come about- Barter/ Ledger
- Austrian School (Market) VS Modern Monetary Theory (Government).

Bitcoins—Design Issues

- Rate of Money Creation: Used as a speculative investment rather than as a means of payment.
- Rewards the adopters and speculators.
- Less secure than national currencies.

Some Key Comparisons:

- Cash: Physical object, can be transferred, no need for a third party.
- Digital Cash: Money transferred via cash data files; if duplicated, 'Double Spending Problem.'
- Electronic Payment Systems: Central authority (bank) tracks the ownership.
- Bitcoin: No centrally managed ledger
  No intrinsic value; Price is solely determined by its future expected price.
- Fiat: US$, Euro, etc.; What is the intrinsic value? How are exchange rates determined? IMF?

Transaction Costs: Some Comparisons

High Cost

- Notary cost:
  House buyer pays 1% of the house price in Germany.
- Cross border transactions:
  Minimum $20–$30 fee on both side of the transaction.
- Official document certification:
  UK birth certification requires the certification for EU bodies.
- Land ownership registrar:
  Certified statement from the land registrar costs 0.5% of the house price.

Transaction Costs: Some Comparisons

Federal Reserve System published *The Federal Payments Study* in 2016.

144 billion payments; $178 trillion.

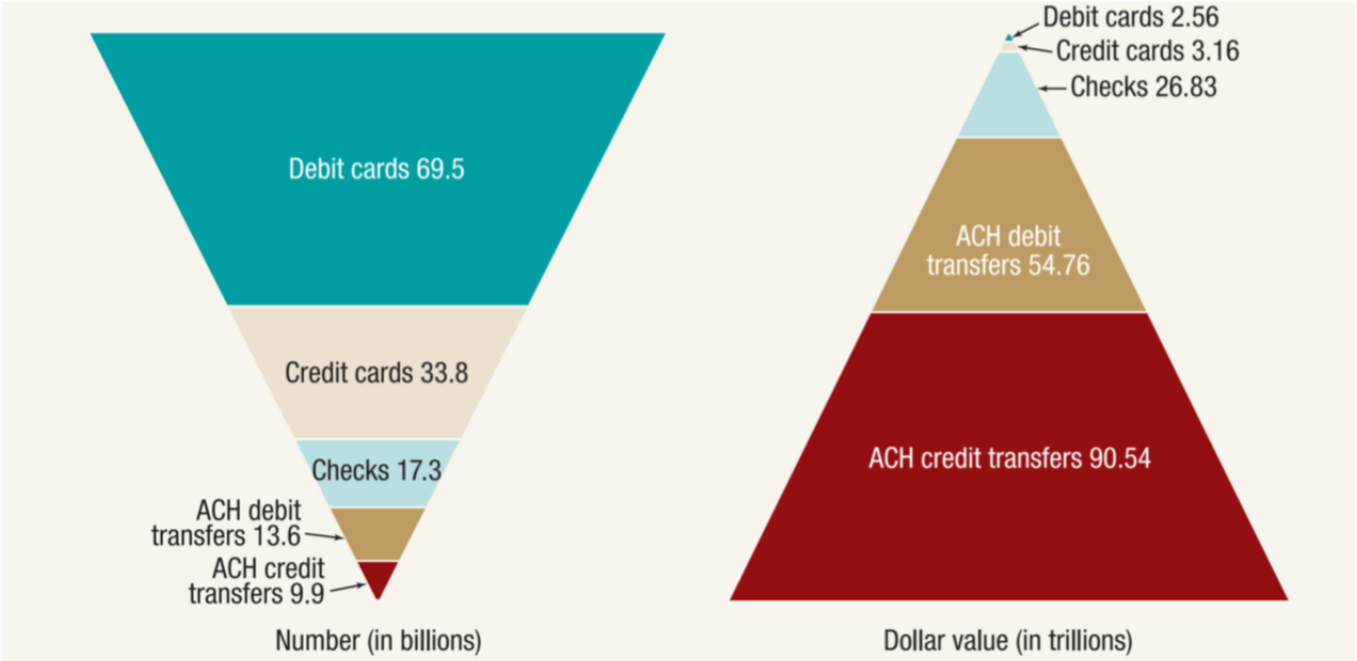


Figure 1: Distribution of core non-cash payments by type, number, and value, 2015.

Transaction Costs: Some Comparisons

From *The Federal Reserve Payments Study*, we know:

- 5.8 billion cash withdrawals at ATMs.
- The average cash value of ATM cash withdrawals is $122.
- Less than 0.4% in dollar terms.
- Around 4% of transactions.

The main property of cash is **anonymity**.

Bitcoin: The Risks

- Confidence
  - Could rules of the game change?
  - Could a competitive product dominate Bitcoin?
  - Could governments ban Bitcoin?
  - Could reputation for being used for illegal transactions damage confidence?
  - Given limited supply of bitcoins, could industries using Bitcoin fall into a deflation spiral?

Bitcoin: The Risks

- Technology
  - Anonymity Failure (mainly due to people posting their on-line public keys and repeatedly using the same key).
  - Flaws in code.
  - DoS. It is possible that a mining pool could turn against Bitcoin.
  - Theft (stored on computer or mobile devices which is subject theft). Mt. Gox hacked in June 2011, where 25,000 bitcoins were stolen. The price went from $17.50 to $0.01 in one hour after the stolen bitcoins were dumped on the market (note the only seller at the price point was the hacker!)
  - Mt. Gox II on Feb 24, 2014, the site shut down with 850,000 bitcoins missing.

Bitcoin: The Risks

- Regulatory
  - U.S. Internal Revenue Service, March 31,2014
  - Bitcoin should be treated as "property" and any capital gain is taxable.
- This means if you bought a coin for $100 but it appreciated to $500, you are taxed on the capital gain.
- Positive is that bitcoin is officially recognized and treated no differently than if I bought Euros and Yen to speculate on appreciation.

The Controversy

Con

- Fiat money without any backing.
- USD is also fiat money–but USD is legal tender for all transactions in the US and it is backed by the government that has the ability to tax and incarcerate if you do not pay your taxes.
- Gold has been around for thousands of years. It has some industrial uses. It also has uses in art and jewelry. Gold has lower bound (fundamental usefulness and upper bound, as it rises in value, new technologies will be discovered to mine more–asteroids!!)
- Potential to disintermediate central banks.

The Controversy

Con

- Will not replace credit cards because these cards provide "credit" as well as transactions
- Similar point for banks.
- Currently, there is no way to earn interest.
- What will happen when there are no bitcoins to pay the miners?
- Mining is a risky business (depends on the value of Bitcoin and subject to technological shocks).

The Controversy

Pro

- It is true that there is no floor on the value of a bitcoin. The bitcoin will only be valuable if it is an efficient method for transferring ownership.
- What is the value of Bitcoin?
  - Valuing bitcoin is difficult. One proposed approach is to determine the amount savings. Given the volume of transactions, we could approximate the savings on, say transactions fees.
  - Suppose on average a bitcoin is used 20 times a year and the average transaction size is $100 (hence, $2,000 of turnover).
  - Assume that the average savings of eliminating the third party is 3% per transaction.
  - That amounts to $60 per year on average.
  - However, this is all very rough. The difficulty in establishing a value has likely contributed to bitcoin's extreme volatility.

The Controversy

Pro

- It is true that there is no floor on the value of a bitcoin. The bitcoin will only be valuable if it is an efficient method for transferring ownership.
- What is the value of Bitcoin?
  - Alternative method to value bitcoin would be an answer to the question: how much would it cost to acquire 10% of the computing power of the network?
  - You could calculate how many bitcoins you would win over the period before the computer power become obsolete.
  - The bitcoin should not be worth less or people will not invest in mining.

Some Views

- The key issue is:
  - Is the high volatility a result of lack of liquidity?
  - Is the high volatility a result of lack of collateral?
- Is Bitcoin just a classic bubble?
- Alternatively, is Bitcoin an innovative, disruptive new technology that could be the next big thing?

Bitcoin or any other cryptocurrency is a bubble–just like any fiat currency. Bitcoin has value because people find it useful and believe it has value. The key innovation is the blockchain. There are many types of blockchain with the strongest being the Bitcoin blockchain. Finance is the low hanging fruit– ripe for distribution by blockchain technology.