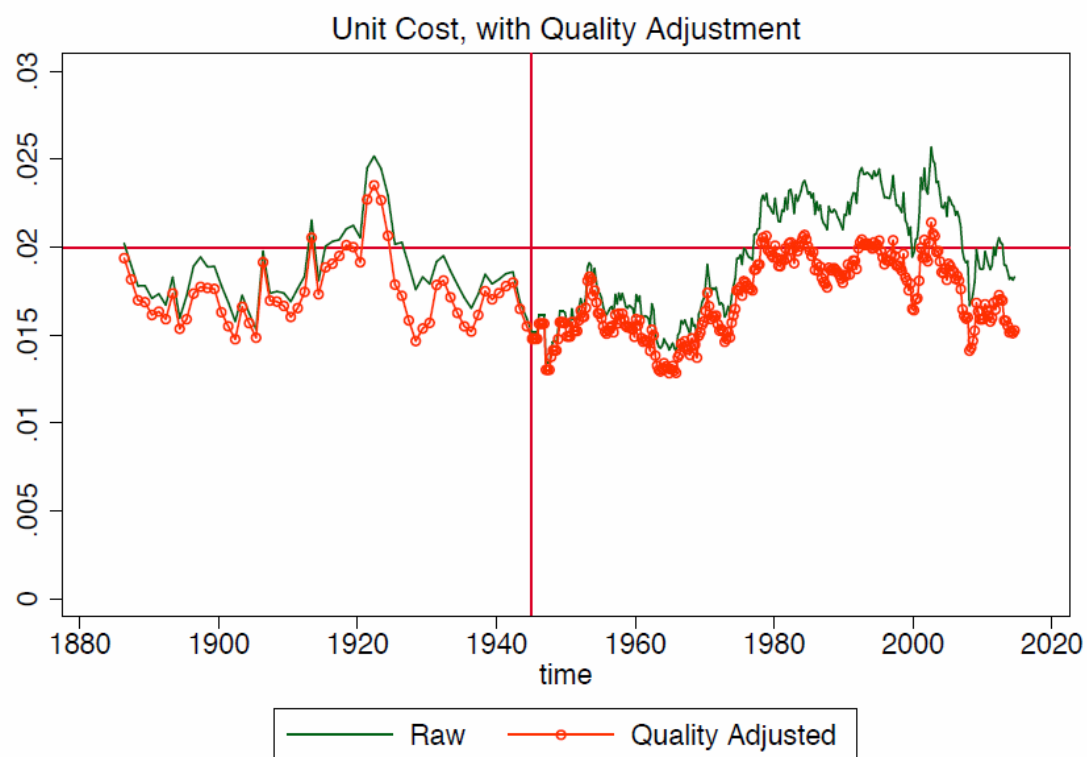


Emergence of digital currencies and blockchains

The cost of financial transactions

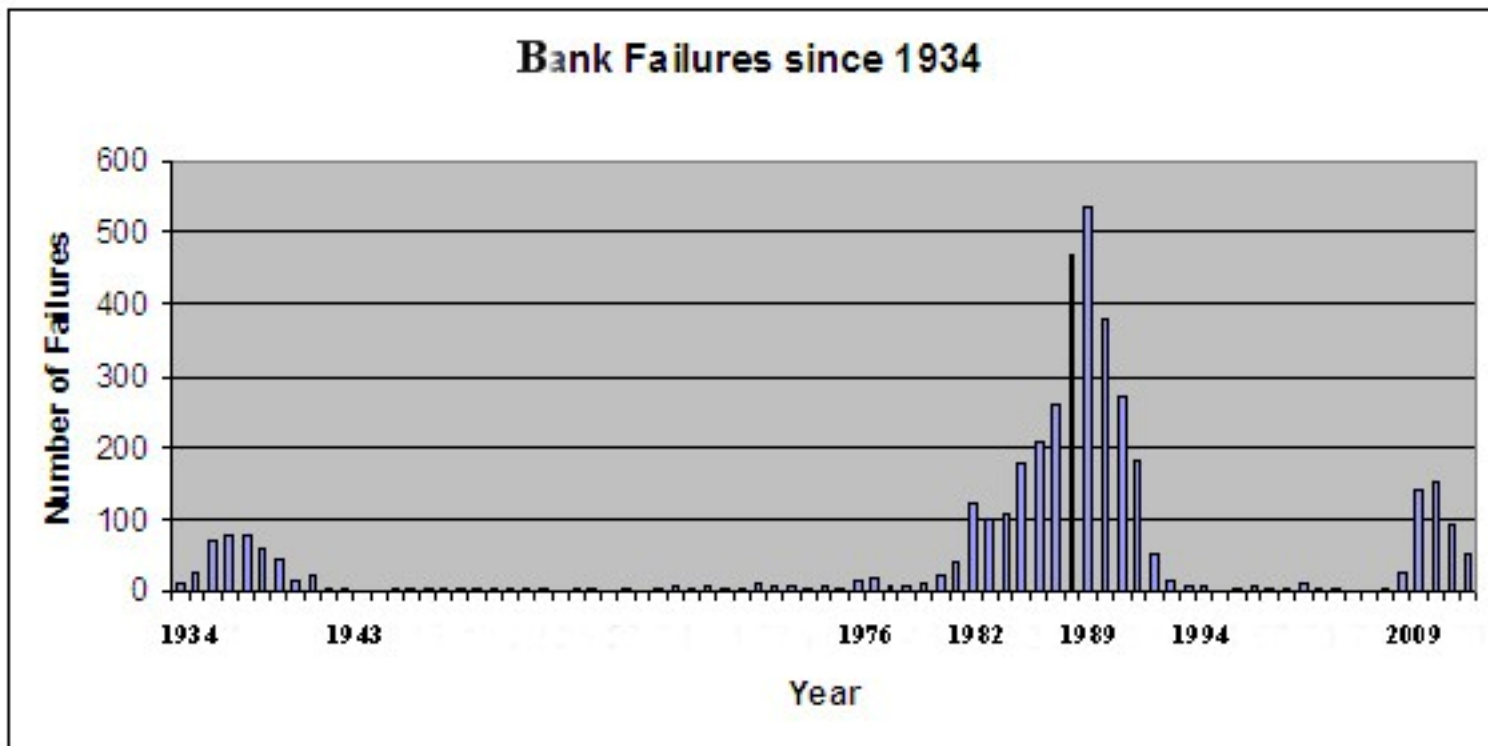
A long view: 1886-2015

- 2% per transaction, unchanged for 130 years



Source: Philippon (2016)

Instability of the banking system



Source: FDIC data, <https://the-end-time.blogspot.com>

Intelligent redesign of the financial system

Bitcoin network is launched, January 3, 2009

Bitcoin: A Peer-to-Peer Electronic Cash System

Satoshi Nakamoto
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www.bitcoin.org

Abstract. A purely peer-to-peer version of electronic cash would allow online payments to be sent directly from one party to another without going through a financial institution. Digital signatures provide part of the solution, but the main benefits are lost if a trusted third party is still required to prevent double-spending. We propose a solution to the double-spending problem using a peer-to-peer network. The network timestamps transactions by hashing them into an ongoing chain of hash-based proof-of-work, forming a record that cannot be changed without redoing the proof-of-work. The longest chain not only serves as proof of the sequence of events witnessed, but proof that it came from the largest pool of CPU power. As long as a majority of CPU power is controlled by nodes that are not cooperating to attack the network, they'll generate the longest chain and outpace attackers. The network itself requires minimal structure. Messages are broadcast on a best effort basis, and nodes can leave and rejoin the network at will, accepting the longest proof-of-work chain as proof of what happened while they were gone.



Peer to peer

- The early breakthroughs

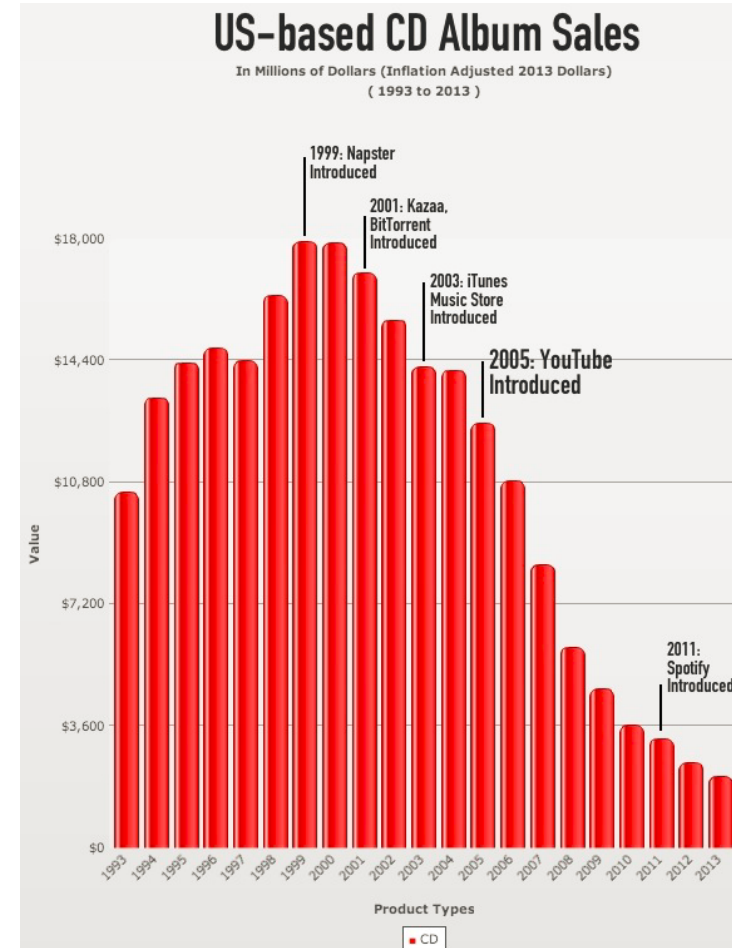


- Industries now being disrupted



Disruption in the music industry

- 1999 \$20.6 billion
- 2014 \$6.9 billion
(adjusted for inflation)



Disruption in the taxi industry

NEW YORK POST

Taxi medallion owners find their dreams dashed by Uber

By Danielle Furfaro

July 5, 2016 | 1:36pm



In early 1930s, New York had c. 30,000 taxi cabs.

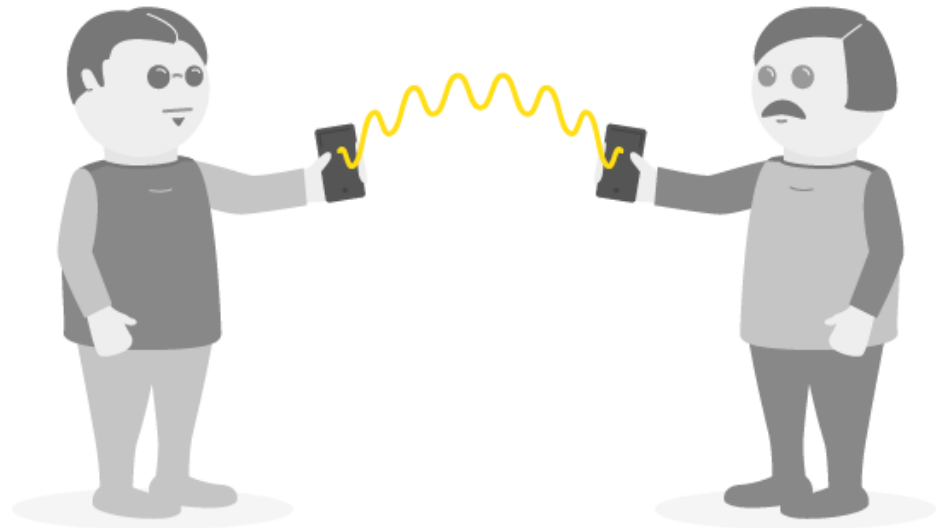
City limited supply to 13,566 in 1937 and sold the “medallions” for \$10 each. Supply has not been increased since then.

Value of one medallion:

2014: \$1,400,000

2016: \$400,000

Peer to peer payments



Peer to peer payments: who guarantees and regulates them?



Credit card companies



Mobile phone companies

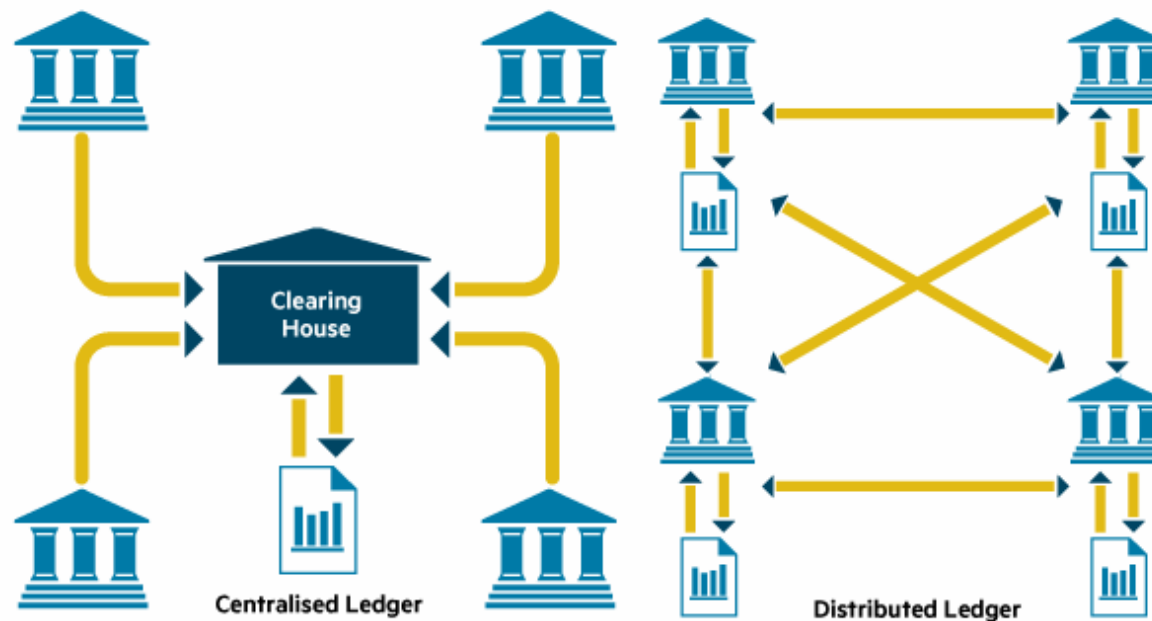


Consensus of the network

A distributed ledger with shared responsibility for updating

Embedding distributed ledger technology

A distributed ledger is a network that records ownership through a shared registry



In contrast to today's networks, distributed ledgers eliminate the need for central authorities to certify ownership and clear transactions. They can be open, verifying anonymous actors in the network, or they can be closed and require actors in the network to be already identified. The best known existing use for the distributed ledger is the cryptocurrency Bitcoin

FT graphic. Source: Santander InnoVentures, Oliver Wyman & Anthemis Partners

What could become unnecessary?

- No more banks
- No more stock exchanges
- No more government property registers
- No more accountants and auditors
- Far fewer lawyers
- Etc...

A disruptive technology

THE WALL STREET JOURNAL.
WSJ.com

September 3, 2015, 1:33 PM ET

UBS Building Virtual Coin For Mainstream Banking

By Anna Irera



The logo of Swiss bank UBS is seen at its headquarters Zurich.

Swiss bank UBS is working on a prototype virtual currency that it hopes will be used by banks and financial institutions as a basis to settle mainstream financial markets transactions.

But unlike the bitcoin digital currency, the Swiss bank's proposed "utility settlement coin," would be linked to real-world currencies and central bank accounts.

The virtual coin would be used to power transactions on institutional financial platforms built on blockchain technology, similar to the distributed, peer-reviewed online ledger which currently powers bitcoin.

For instance, UBS might have its own blockchain-based platform to issue bonds, and another bank might have a blockchain-based stock trading platform, but both would use the same utility coin for settlement.

Distributed ledgers such as the blockchain enable ownership of assets to be verified by a network of computers on the Internet rather than a centralized authority. The first use of digital ledgers was to create bitcoin, the virtual currency linked to money-laundering and online drugs markets, but also increasingly to a growing number of legitimate businesses and new financial services startups around the world. Over the

“ . . . The blockchain has been increasingly eyed by mainstream financial institutions as a breakthrough.

. . . it could enable financial institutions to settle trades in seconds rather than two or three days

. . . blockchain technology could reduce the bank's infrastructure costs . . . by as much as \$20 billion a year by 2022.”

The changing job market in finance

THE WALL STREET JOURNAL.

Commerzbank to Slash Jobs, Scrap Dividend in Broad Revamp

German lender to lay off 9,600 as part of new CEO's plan to shrink the bank



FRANKFURT— Commerzbank AG on Thursday said it plans a wide-ranging overhaul that includes laying off close to 10,000 employees, or roughly 20% of its workforce, merging two large units and scrapping its dividend.

The bank simultaneously plans to hire around 2,300 new staff focused on digitizing internal processes, meaning the net number of job cuts will be near 7,300.

UBS's trading floor

Stamford, Ct., USA



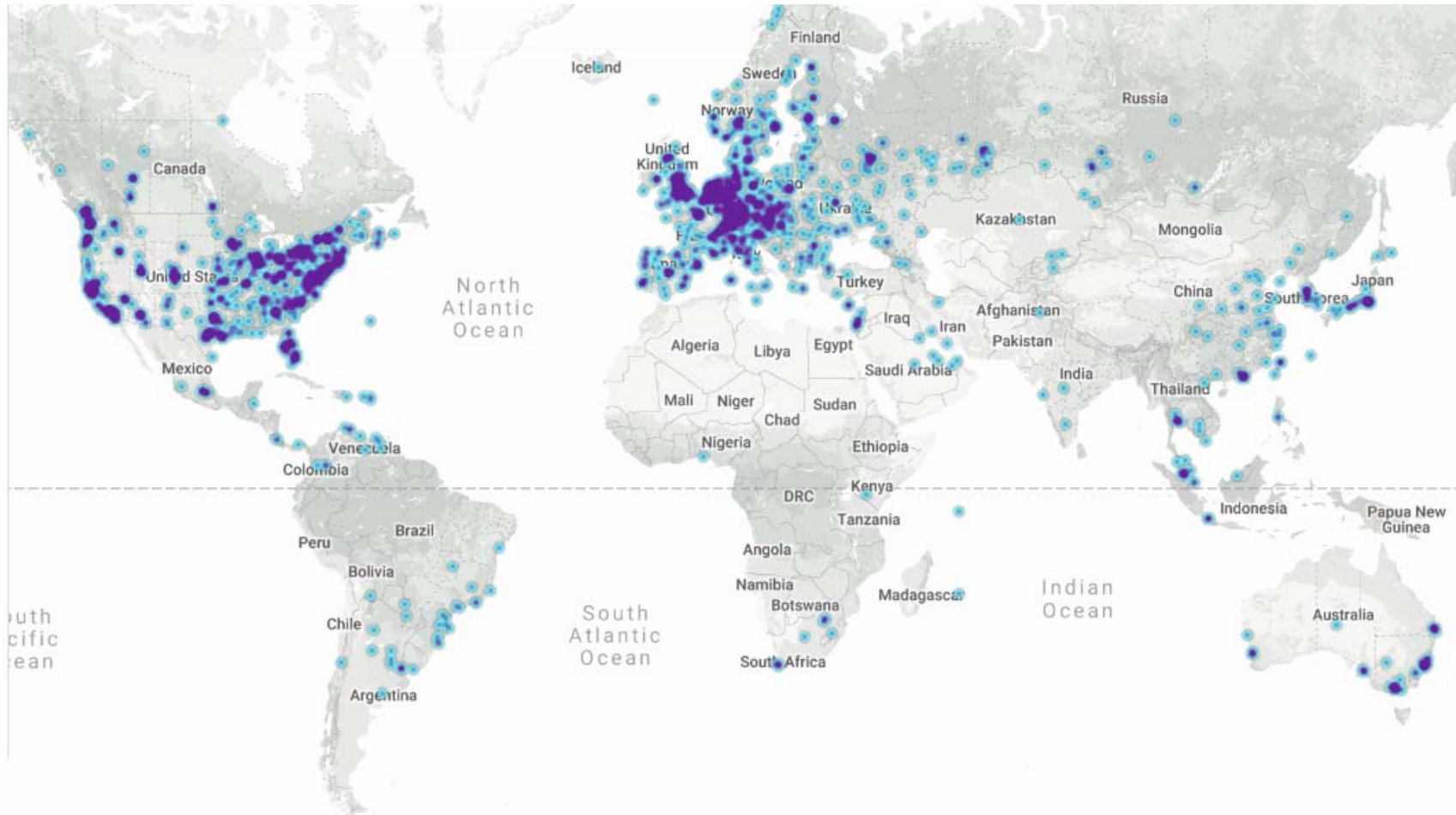
2005



2016

Bitcoin's open network of 9,500 nodes

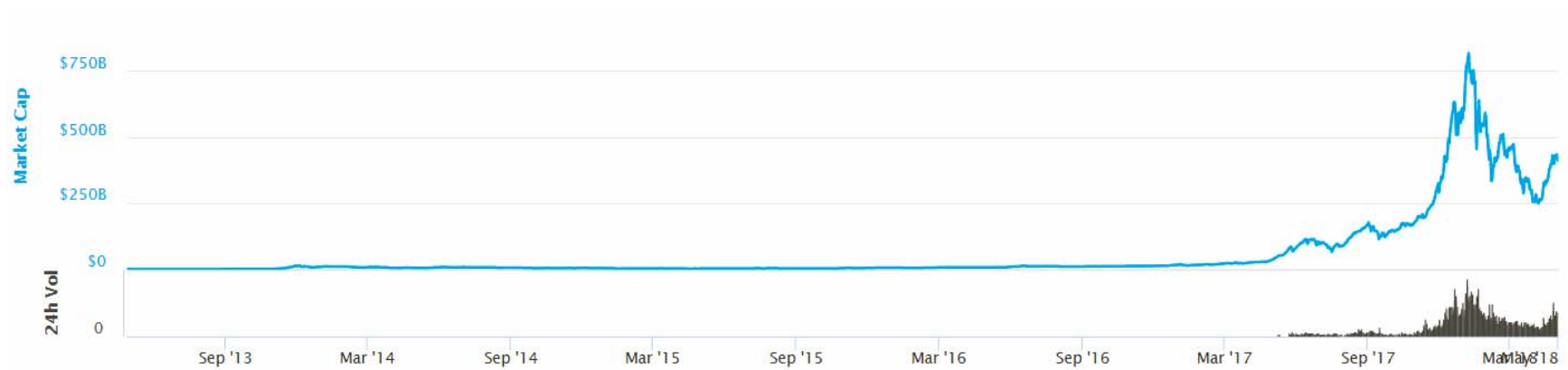
20 April 2019



<https://bitnodes.earn.com>

Total cryptocurrency market value

\$181 billion as of 20 April 2019



Milton Friedman

1999 interview

- “I think that the Internet is going to be one of the major forces for reducing the role of government. The one thing that’s missing, but that will soon be developed, is a reliable e-cash, a method whereby on the Internet you can transfer funds from A to B without A knowing B or B knowing A.”
- “Of course, it has its negative side. It means the gangsters, the people who are engaged in illegal transactions, will also have an easier way to carry on their business.”



Living only on Bitcoin

101 days, 4 countries



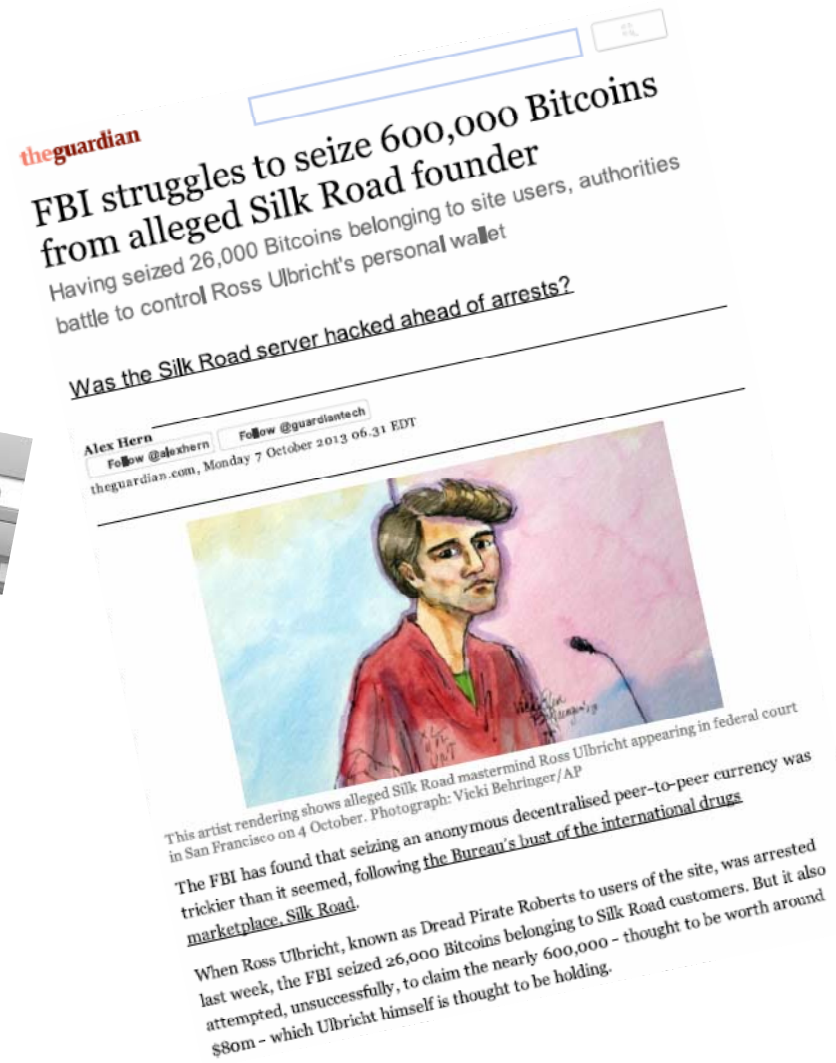
Important Bitcoin milestones

- Bitcoin is proposed by Satoshi Nakamoto via an online posting, October 2008.
- First 50 Bitcoins mined by Nakamoto in Block 0, January 3, 2009.
- 10 coins sent by Nakamoto to Hal Finney, January 12, 2009
 - <https://www.blockchain.com/btc/tx/f4184fc596403b9d638783cf57adfe4c75c605f6356fbc91338530e9831e9e16>
- First purchase with Bitcoin by Laszlo Hanyecz : two pizzas for 10,000 BTC.
 - Request posted on May 17, 2010, and accepted by Jeremy Sturdivant on May 22, 2010.
 - <https://blockchain.info/tx/a1075db55d416d3ca199f55b6084e2115b9345e16c5cf302fc80e9d5fbf5d48d?>
- U.S. Treasury Financial Crimes Enforcement Network issues first regulatory guidance for virtual currencies, March 2013.
- U.S. regulators, including Bernanke, comment favorably upon Bitcoin at a U.S. Senate committee hearing, November 2013.

How Bitcoin grew popular – the legend

Silk Road anonymous marketplace

- Silk Road accepted only Bitcoin



<https://blockchain.info/en/address/1F1tAaz5x1HUXrCNLbtMDqcw6o5GNn4xqX>

Panel A: Example of illegal drugs that can be purchased with bitcoin on the Silk Road marketplace

The screenshot displays the Silk Road anonymous marketplace interface. At the top, the header includes the Silk Road logo, the text "anonymous market", and user statistics: "messages 0 | orders 0 | account ฿0.00". A search bar is located to the right of the header. Below the header, a "Shop by Category" sidebar lists various categories and their item counts: Drugs (8,670), Cannabis (2,066), Dissociatives (166), Ecstasy (660), Opioids (591), Other (455), Precursors (50), Prescription (2,146), Psychedelics (981), Stimulants (1,102), Apparel (264), Art (127), Biologic materials (1), Books (861), Collectibles (5), Computer equipment (32), Custom Orders (68), Digital goods (509), Drug paraphernalia (305), Electronics (77), Erotica (540), Fireworks (2), Food (9), Forgeries (81), Hardware (23), Herbs & Supplements (8), Home & Garden (8), Jewelry (54), Lab Supplies (71), and Lotteries & games (77). The main content area displays a grid of 12 items for sale, each with an image, description, and price in Bitcoin (฿). The items include: 1g MDMA 82%+ High Quality -Made in Germany- (฿1.30), 50 gr. Crystal MDMA Rocks (฿23.33), Valium 10mg/ Diazepam (100 Pills) (฿2.32), 3g XxX AAA QUALITY WEED,AMAZING (฿0.98), Kamagra jelly (India), 1 week pack (฿0.98), Honeycomb Wax (85+% THC) Fully Purged (฿1.45), 1 gram Moroccan Hash DUTCH QUALITY (฿0.27), Citalopram 10x 20mg table (฿0.10), 10 grams ketamine crystals (฿7.15), [3g] Greenstone NZ Hash (B Grade) (฿2.49), +++ 100 x 25i-NBOMe Strawberry Snuff Caps +++ (฿3.80), and 300x 25i/25c-NBOMe Liquid Dropper 1200µg (฿4.14).

Item	Price (฿)
1g MDMA 82%+ High Quality -Made in Germany-	1.30
50 gr. Crystal MDMA Rocks	23.33
Valium 10mg/ Diazepam (100 Pills)	2.32
3g XxX AAA QUALITY WEED,AMAZING	0.98
Kamagra jelly (India), 1 week pack	0.98
Honeycomb Wax (85+% THC) Fully Purged	1.45
1 gram Moroccan Hash DUTCH QUALITY	0.27
Citalopram 10x 20mg table	0.10
10 grams ketamine crystals	7.15
[3g] Greenstone NZ Hash (B Grade)	2.49
+++ 100 x 25i-NBOMe Strawberry Snuff Caps +++	3.80
300x 25i/25c-NBOMe Liquid Dropper 1200µg	4.14