Corporate Governance and Blockchains

Author: David Yermack

Presenter: Brandon Chen

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How Blockchain Works

Original Design of Haber and Stornetta (1991)

Time-stamping the creation of intellectual property, such as digital document, to fix property rights with the creator before it can be copied by others

Original Design of Haber and Stornetta (1991)

- Strategy 1: assure the authenticity of each time stamp of using hash function, a type of cryptography that transforms data into a hexidecimal code of fixed length which cannot be inverted to recover the original input
- Transform each entry in the sequence into a hash code, which could then be combined with the raw data for the subsequent entry, ad infinitum
- The archive cannot be forged, cause forging the information retroactively by changing a prior entry in the archive could cause changes in the sequence of all subsequent entries, since any minor alteration to the input of a hash function causes a significant change in its output

Original Design of Haber and Stornetta (1991)

- Strategy 2: publish the sequence of records in a public forum, where data can be verified by any interested user
- The strategy, known as “distributed ledger”, crowd-sources the verification function classically played by auditors or bank inspectors

Essential component of the open blockchain structure introduced by Nakamoto (2008) for Bitcoin

Modification on Original Design

- Problem: In such a large markets with millions of assets, the original design, one entry at a time, is unreasonable
- Modification 1: Bundle large volumes of transactions together into “blocks” and arrange these blocks in chronological sequence using hash function
- Modification 2: Within each block, individual transactions would be condensed using a separate hierarchical system of hash pointers known as a Merkle tree

Bitcoin blockchain bundles together up to 1 MB volume of transactions culled from the network into a new block approximately every 10 min

Private and Public Blockchain

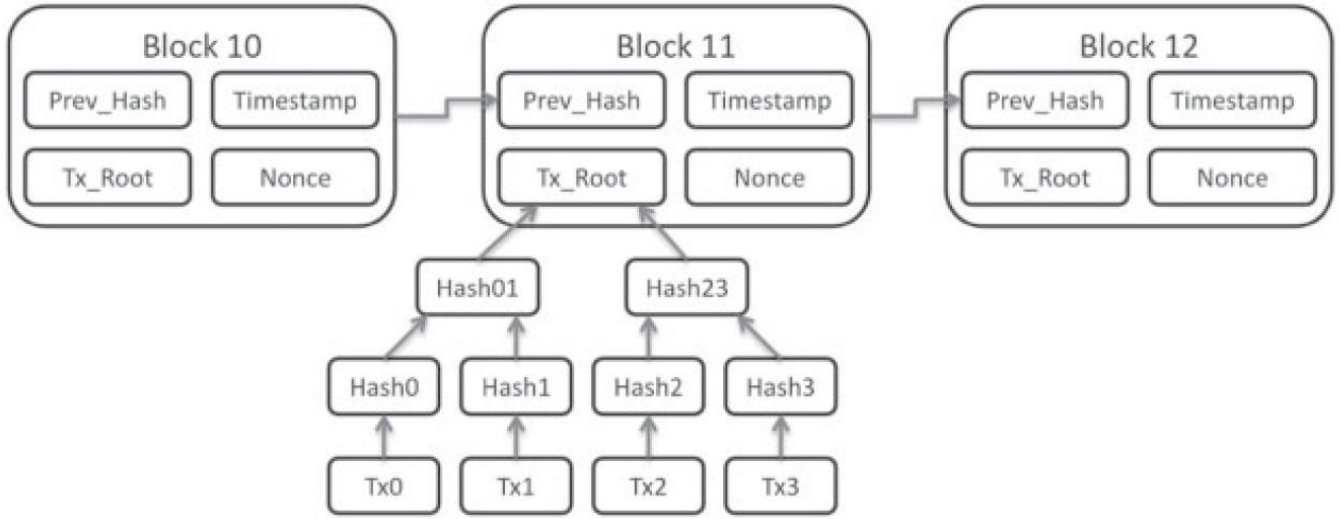
Private Blockchain: gatekeeper of the archive has authority to encode new transactions into a blockchain, is assumed by an established “trusted third party” whose actions are constrained by government regulators as well as reputational considerations

- Example: the Australian Securities Exchange in Sydney and the Depository Trust Clearing Corp. in New York
- Cons: Potentially pose great risks to individual blockchain participants, since gatekeeper can:
  - restrict entry into a market
  - assess monopolistic user fees
  - edit incoming data
  - treat some users preferentially
  - limit users’ access to market data
  - Possibly share user data with outsiders

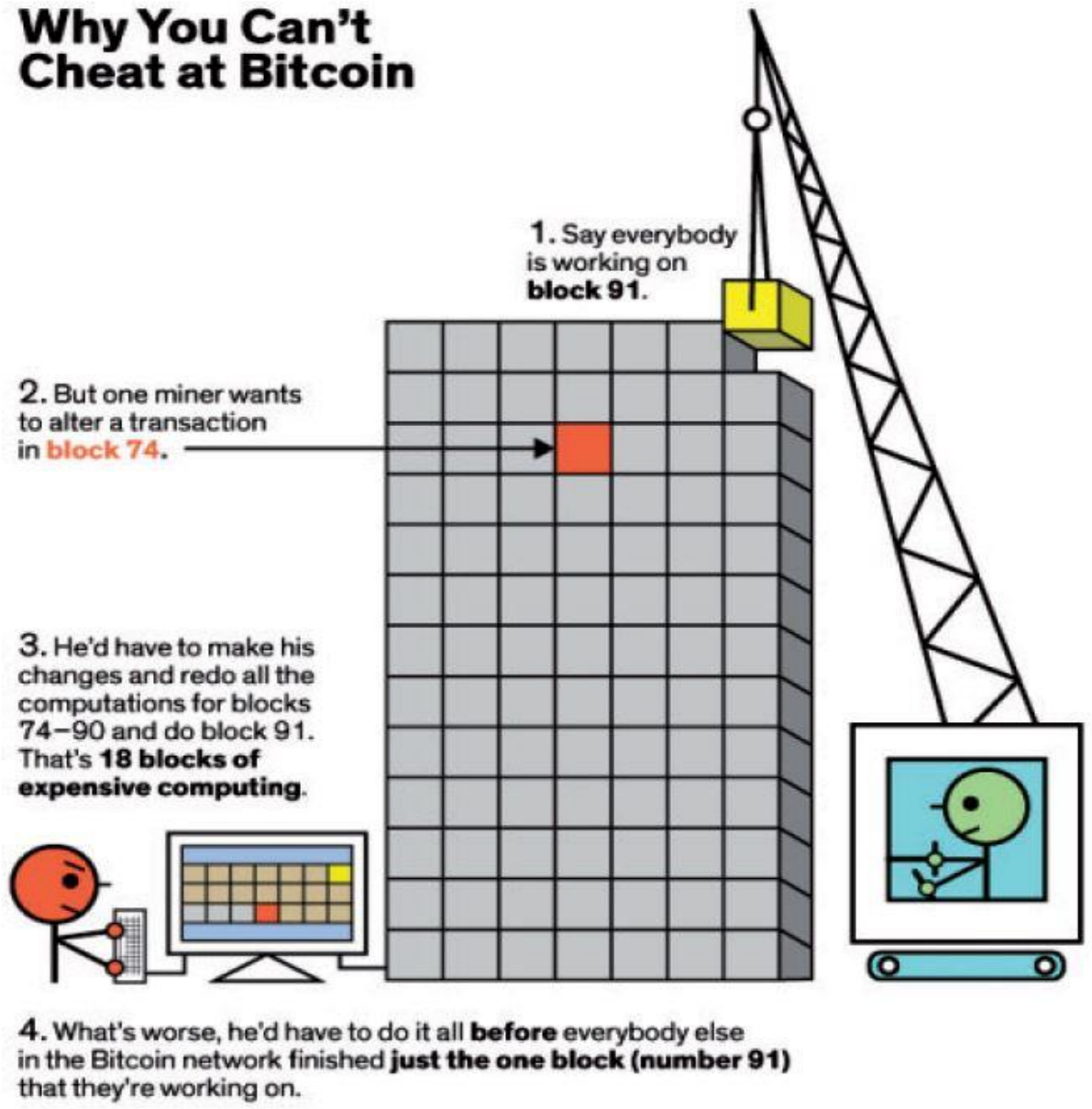
Public Blockchain: no Gatekeeper, the update function was decentralized to all market participants in an ongoing competition catalyzed by the award of new bitcoins to the winner

How to create a new block in Bitcoin blockchain

- The operator of a “node” on the network must bundle together transaction data, the hash code from the head of the prior block, the time stamp, and a further piece of data known as “nonce”
- Nonce: random number with the property that, when added to the other information in a block, it generates a hash with a certain number of leading zeroes
- The fastest miner finds a nonce and completes a block with the required hash, network members then verify and acknowledge the new block
- Incentive to miners: rewards of new bitcoins



Immutable Bitcoin Blockchain



The figure illustrates how a proof-of-work scheme makes altering historical data in a blockchain prohibitively costly, since a potential thief or forger would have to alter not only the transaction record they wished to divert, but also all subsequent blocks up to the current one

Balancing Problem in Bitcoin Network

- How to maintain an equilibrium between the number of miners, the size of mining rewards, the work required to create each new block, all while meeting the needs of network?
  - Adjust the difficulty of finding a winning hash by requiring either more or fewer leading zeroes in the hash of a new block
  - Every 4 years the reward cut in half
  - The reward will disappear by 2140, at which point 21 million bitcoins will be mined
  - After that, voluntary user fees from agents seeking fast verification of transactions (i.e., liquidity) will serve as incentives for miners to include them in their next blocks

Corporate Governance of Firms Traded on Blockchains

Greater Transparency of ownership

When used in an open form with free entry and exit, blockchains generate an archive of transactions known as a distributed ledger, because a copy of each block of transactions is distributed or made visible to all members of the network

For a company with shares listed on a public blockchain, all shareholders and other interested parties would be able to view the arrangement of ownership at any time and identify changes instantly as they occurred

- Maybe a bad thing for activists, raiders and managers
- Good news for small shareholders and fund mangers
- A range of blockchains offering varying degrees of investor anonymity might compete in the market to attract corporate listings, with companies sorting themselves among different platforms that appealed to different shareholder clienteles based on their preferences for ownership

Improvements in Liquidity

Blockchains offer the possibility of significant improvements in liquidity, due to their potential to reduce costs and shorten the time required for executing and settling securities trades

- Used as the main platform for share registration and exchange
- Alternatively, introduced by stock markets in a more limited way to streamline the post-trade clearing and settlement process

Improving liquidity could increase the demand for stocks and have many significant effects on patterns of investment and ownership. For instance, high frequency equity trading might become much more common if the cost of trading were reduced through this type of innovation

Impact on Institutional Investors and Activists

Greater transparence: be seen as costly by activists and raiders, and as a result they might be more reluctant to invest in firms that were traded in blockchain markets

Great liquidity: impact upon institutional investors and shareholder activists seems complex

- In a blockchain market, cheaper and faster trade execution and settlement would facilitate both easier entry and easier exit by major shareholders. The greater ease of entry would probably promote ownership by institutions and activists
- Once investors have purchased their position, they can choose to influence a firm's management through the threat of sale, or exit, or through negotiation and participation in corporate voting, or voice. The increased liquidity of a blockchain market should reduce the costs of selling and therefore lead to more emphasis on exit as opposed to voice

Impact on Managers

Larger transparency allows outsiders to observe managers' trade in real time and restricts inside trading benefits for managers

A blockchain registration system would also preclude managers' backdating of compensation instruments

The transparency afforded by a blockchain system would illuminate managers' ownership positions not only in their own firms, but also in other companies' shares, including those of competitor firms

Impact on Market Microstructure

Improve the transparency of investor identities, then informed selling could become easier to differentiate than before, whether it's liquidity driven or information driven, and the speed with which adverse news is impounded into share prices could therefore increase

The increased transparency of a blockchain share registration system could permit market makers to observe investors' ownership positions not only in the shares they are transacting, but in other shares as well. More informative prices would in turn improve the allocative efficiency of the real economy by enabling managers, investors, suppliers, and others to make better decisions about the price and volume of capital allocated to different firms and projects

Voting in Corporate Elections

Blockchain technology has been proposed as a platform for voting in all types of elections and it appears to be a viable substitute for the archaic corporate proxy voting system

In a blockchain election, eligible voters would receive tokens (sometimes called “votecoins”) that they could transmit to addresses on the blockchain to register their preferences

- Improve the accuracy of elections: faster, more precise vote tabulation, and equal real-time transparency of the likely voting outcome for both management and dissident shareholders
- Make empty voting, which occurs when an investor uses borrowed shares or certain combinations of derivative securities to acquire voting rights temporarily, without economic exposure to the cash flow rights connected to the underlying shares, transparent to outside

Real-time Accounting

Firms post all of its ordinary business transactions.

Like all blockchain transactions, the firm's routine accounting data could be recorded permanently with a time stamp, preventing it from being altered ex-post.

The company's entire ledger would then be visible immediately to any shareholder, customer, lender, trade creditor, or other interested party.

Anyone could aggregate the firm's transactions into the form of an income statement and balance sheet at any time, and they would no longer need to rely on quarterly financial statements prepared by the firm and its auditors

- Cons: make proprietary information available to outsiders
- Pros: Increase trust in data integrity and no costly auditors

Smart Contracts

A smart contract is a computerized protocol that executes the terms of a contract

Current: A number of new platforms such as Ethereum are designed to apply blockchain technology to execute smart contracts based on simple events such as the passage of time or complicated contingencies such as future financial outcome.

Potential: The mechanical exercise of options embedded in derivative securities and other contingent claims, the instant transfer of collateral in the event of default, and the payment of employee compensation if performance goals are achieved

Long-term Effect: Deter widely known agency costs of debt such as risk shifting and strategic default. This would have beneficial effects such as reduced adverse selection in credit markets and a lower cost of debt market-wide.

Governance of Blockchains

Governance of Blockchains

An open public blockchain is operated autonomously by computer software, more specifically, by large numbers of miners who run the open source code.

This code specifies basic inputs for each transaction, the timing and priority for encoding these transactions into the blockchain, and limits on the sizes or contingencies associated with each transaction, among other issues.

These software parameters are akin to the rules and regulations of a stock exchange in which firms agree to list their shares

Some crisis and problems emerge in the governance of Blockchains:

- So-called 51% attack
- A successful hack occurred against the Ethereum platform, an open blockchain

Conclusions

Blockchain technology offers a novel method for trading and tracking the ownership of financial assets.

Stock exchanges around the world have begun to experiment with blockchains as a method for companies to list, trade, and vote their shares, and stockholders may benefit from lower costs of trading, faster transfers of ownership, more accurate records, and greater transparency of the entire process.

Corporate governance could change in many ways under a blockchain regime:

- Institutional Investors, raiders and activists
- Managers
- For companies: shareholder voting, real-time accounting and smart contracts