Antitrust Issue:
Implications for Blockchain Technology

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Overview

- Primer on blockchain technology

- Blockchain and competition

Blockchain: A Disruptive Technological Innovation

- Blockchain technology has been popularized by Bitcoin, but it is a versatile technology with a great number of different applications

- While it has the potential to revolutionize entire sectors, blockchain should be conceptualized as a tool to manage data in a wider ecosystem
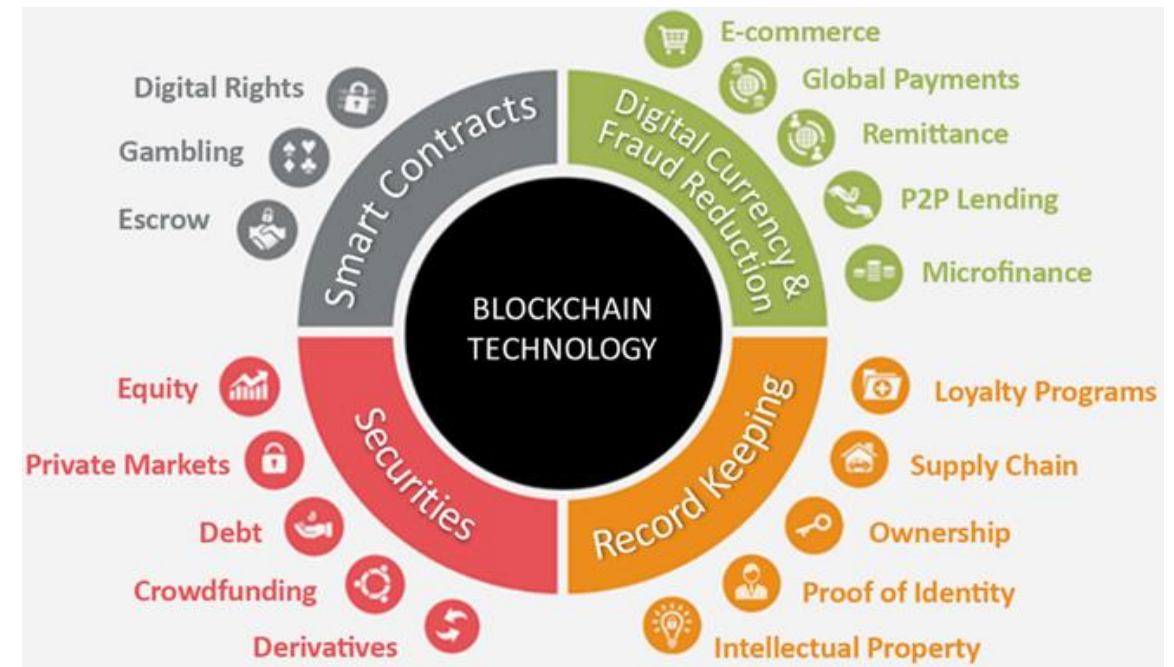

Source: ACIWorldWide.com

Primer on Blockchain Technology

■ What is blockchain technology? Why are so many firms interested in it?

- A "blockchain" is a **distributed database** (or ledger) of records (e.g., transactions)
  - Database copies are shared by users across many locations ("nodes")
- Users exchange information (e.g., transact) with each other directly via a **peer-to-peer (P2P) network**
  - No need for a trusted third party intermediary (e.g., financial institution) to ensure the integrity of the information registered on the network
- New transactions are **turned into "blocks" via a "hash" function** and, once validated, are **added to the chain of prior transactions**
  - New blocks are validated via "consensus" across database copies
- Each new block is permanently linked onto the unbreakable chain of data
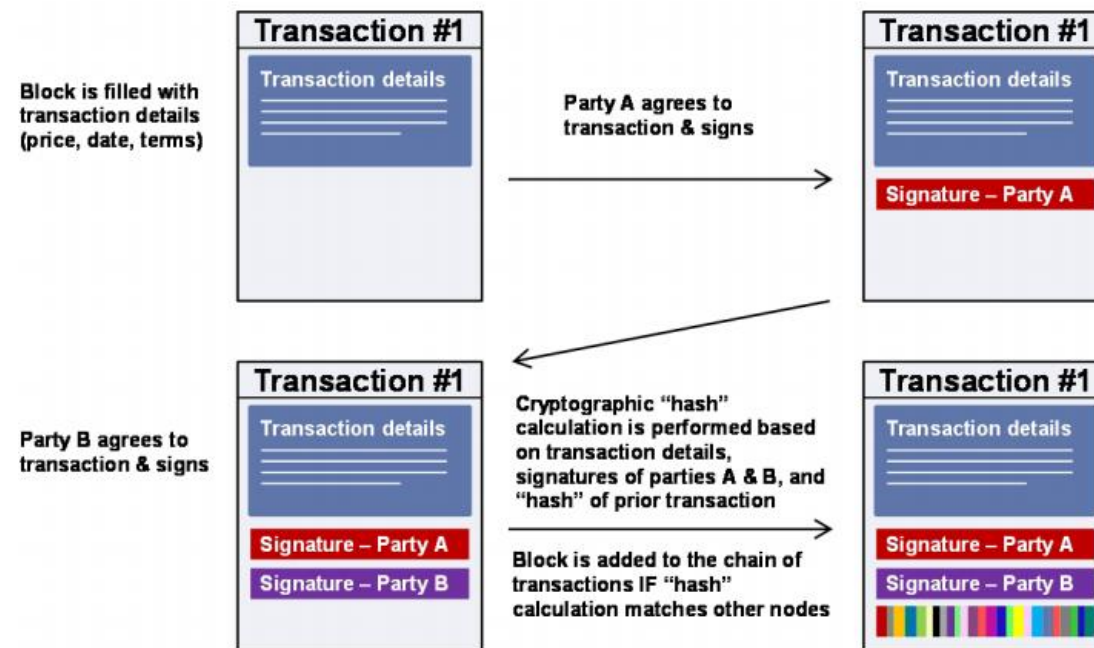
Blockchain – A Distributed Ledger of Transactions
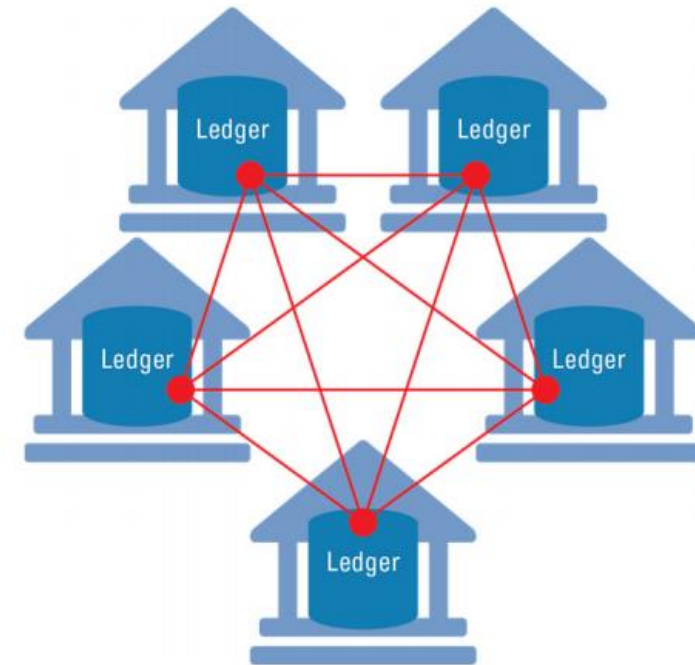
Source: Goldman Sachs Global Investment Research

Primer on Blockchain Technology (cont.)

- Adding a new block to the chain
  - When users transact, a new block is created with a hash that is based on:
    - Transaction details (e.g., parties, price)
    - Digital signatures of parties
    - **The hash of the prior transaction in the chain**
  - The resulting hash is broadcast around the network and the block is added to the chain only if the hash matches that of every other database copy

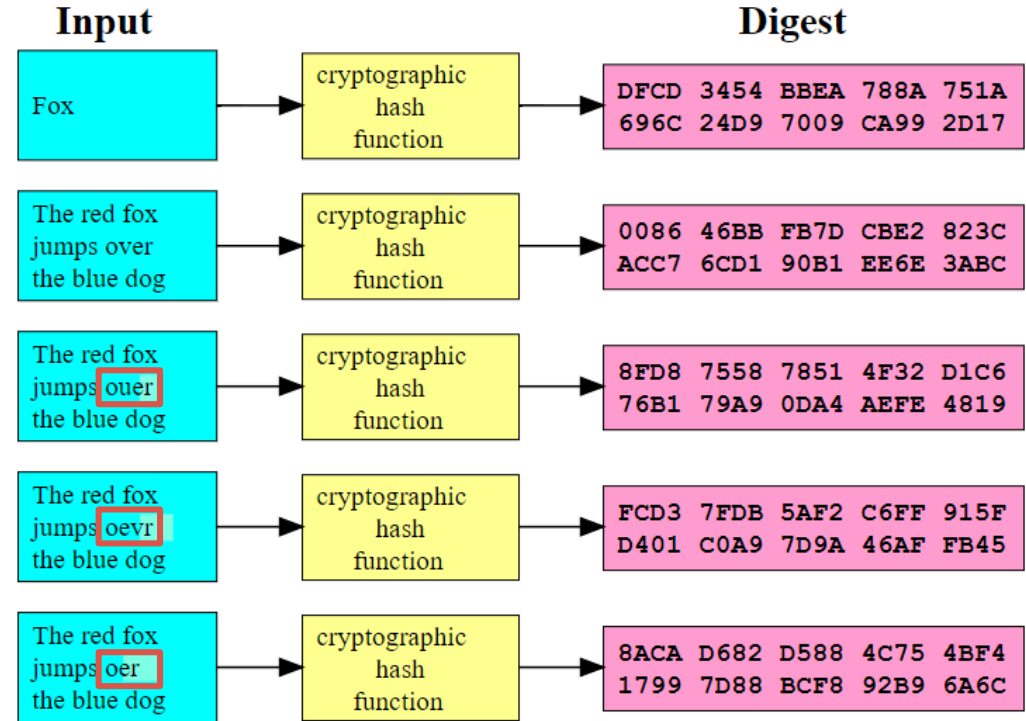**A Transaction Creates a New Block that Is Added to the Chain**

Transaction #1	Transaction #1
Transaction details	Transaction details
Block is filled with transaction details (price, date, terms)	Party A agrees to transaction & signs → Signature – Party A

Transaction #1	Transaction #1
Transaction details	Transaction details
Party B agrees to transaction & signs — Signature – Party A, Signature – Party B	Cryptographic "hash" calculation is performed based on transaction details, signatures of parties A & B, and "hash" of prior transaction. Block is added to the chain of transactions IF "hash" calculation matches other nodes → Signature – Party A, Signature – Party B

Source: Goldman Sachs Global Investment Research

Primer on Blockchain Technology (cont.)

■ **Hash functions drive blockchain**

- A hash function takes a data input of any length, and converts it into a string of characters of a fixed length
- A given input always produces the same hash, but even the slightest change to the input completely alters the hash
  - Hash functions are one-way functions. It is impossible to go back to the original input from the hash
- Because a block's hash is built upon the hash of the prior transactions, they are all linked, and the slightest change to any block will change the hash for every block that relies on it
- If a malicious actor commits a fraud or theft and attempts to alter a transaction's data in their database copy to cover up the crime, it will be spotted immediately

Small Changes to Inputs Dramatically Change Resulting Hashes

Input		Digest
Fox	cryptographic hash function	DFCD 3454 BBEA 788A 751A 696C 24D9 7009 CA99 2D17
The red fox jumps over the blue dog	cryptographic hash function	0086 46BB FB7D CBE2 823C ACC7 6CD1 90B1 EE6E 3ABC
The red fox jumps ouer the blue dog	cryptographic hash function	8FD8 7558 7851 4F32 D1C6 76B1 79A9 0DA4 AEFE 4819
The red fox jumps oevr the blue dog	cryptographic hash function	FCD3 7FDB 5AF2 C6FF 915F D401 C0A9 7D9A 46AF FB45
The red fox jumps oer the blue dog	cryptographic hash function	8ACA D682 D588 4C75 4BF4 1799 7D88 BCF8 92B9 6A6C

Source: Wikipedia

Primer on Blockchain Technology (cont.)

- **Blockchain ensures data integrity**
  - Errors on the blockchain are easily identified because:
    1. New blocks must be validated across every database copy
    2. An error for a single block flows forward and causes errors for all blocks further in the chain, making error locations easy to spot

There is an apparent error in block 2 in the fifth database copy.

Identifying an Incorrect Block via "Consensus"

Source: Goldman Sachs Global Investment Research

Primer on Blockchain Technology (cont.)

- Public versus private blockchain networks

  - Both public and private blockchain networks utilize:

    - Distributed ledgers
    - P2P networks

  - However, a public blockchain is:

    - Permissionless, decentralized, open to all, and often relies on users to crowd-source block validation

  - While a private blockchain is:

    - Permissioned, and relies on an administrator to perform or delegate authority to grant users access and validate blocks

  - Hybrid blockchains can mix features from each

Shared and Distinct Features of Public and Private Blockchain Networks

Network Feature	Public Blockchain	Private Blockchain
Distributed ledger	Yes	Yes
P2P network	Yes	Yes
Permissioned	No	Yes
Governance	Decentralized	Centralized
Transparency	Greater (more ledgers / open to public)	Less (fewer ledgers / limited access)
Anonymous users	More likely	Less likely
Responsibility for validating blocks	Likely many users across the network	Likely only select entities
Speed	Slower	Faster
Energy requirements	Higher (more users validating across larger network)	Lower (less users validating across smaller network)

Blockchain networks are just customizable database management structures that can serve a variety of important business functions

Primer on Blockchain Technology (cont.)

- Public blockchain application: **Bitcoin**

  - Crowd-sourced competitive block validation with rewards ('mining') allows users to trade digital currency directly without a financial institution

  - Open mining competition makes it prohibitively infeasible to reverse-engineer hashes to cover up fraud or theft without detection

  - Security of blockchain gives users confidence that transactions will be honored and their currency valid

Bitcoin Uses Public Blockchain to Allow Users to Trade Currency Directly

1	Counterparty A sends funds to Counterparty B
2	The transaction is configured into a block
3	The transaction is broadcast across the entire network which validates it
4	The block is then added to the chain which records the entire non-reversible history of transactions in a public ledger
5	Counterparty B receives funds from Counterparty A
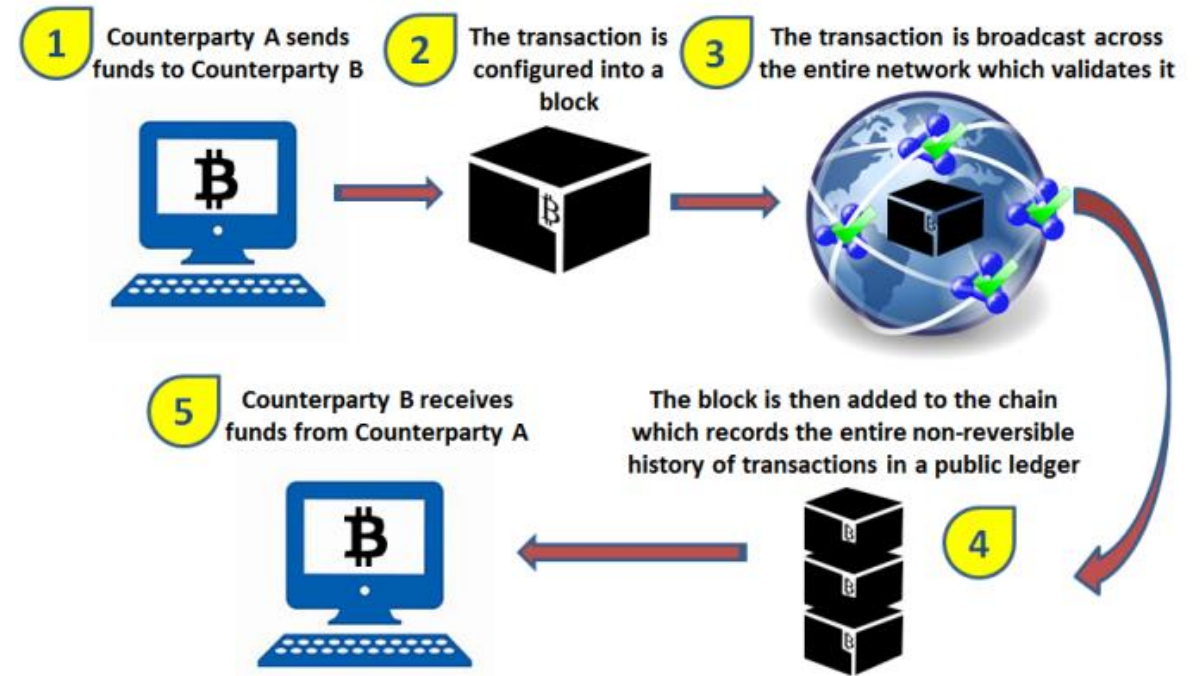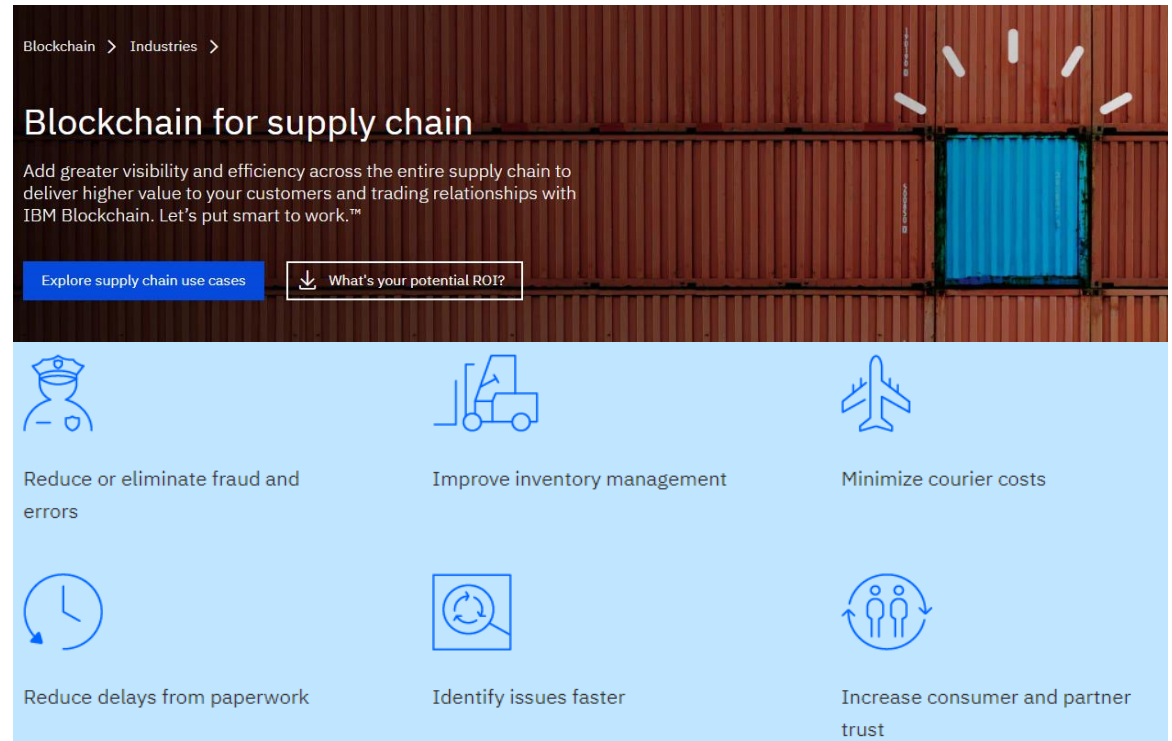
Source: Goldman Sachs Global Investment Research

Primer on Blockchain Technology (cont.)

- Private blockchain application: **IBM Blockchain**
  - The IBM Blockchain platform helps firms know the status and condition of every product in their supply chain, giving a complete historical record of the ownership and location of parts and products in real time
  - Allows firms to restrict access to authorized users and establish what are appropriate records that can be added

IBM Leverages Private Blockchain to Help Firms Manage Their Supply Chain

Blockchain > Industries >

Blockchain for supply chain

Add greater visibility and efficiency across the entire supply chain to deliver higher value to your customers and trading relationships with IBM Blockchain. Let's put smart to work.™

Explore supply chain use cases   ⤓ What's your potential ROI?

Reduce or eliminate fraud and errors

Improve inventory management

Minimize courier costs

Reduce delays from paperwork

Identify issues faster

Increase consumer and partner trust

Source: IBM

Primer on Blockchain Technology (cont.)

- How can businesses leverage blockchain?

  - **Lower transaction costs**
    - Parties transact directly with each other, removing costs of paying a third party intermediary (e.g., financial institution, Paypal) to facilitate a deal

  - **Traceability**
    - Firms are given an audit trail to trace the lifecycle of an asset, improving analytics and preventing fraud in areas like supply chain and health care

  - **Data security and quality**
    - Changing the shared ledger requires consensus across the entire network, so records are more likely to be accurate and consistent than in traditional data management systems

Blockchain Use Cases
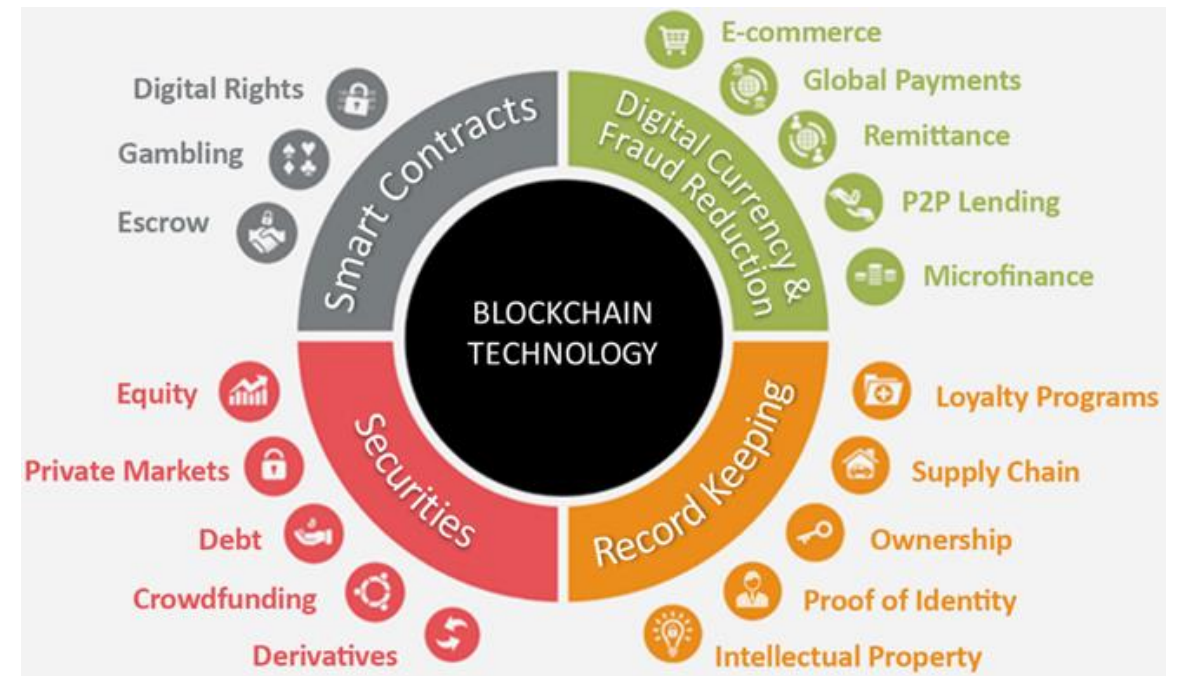
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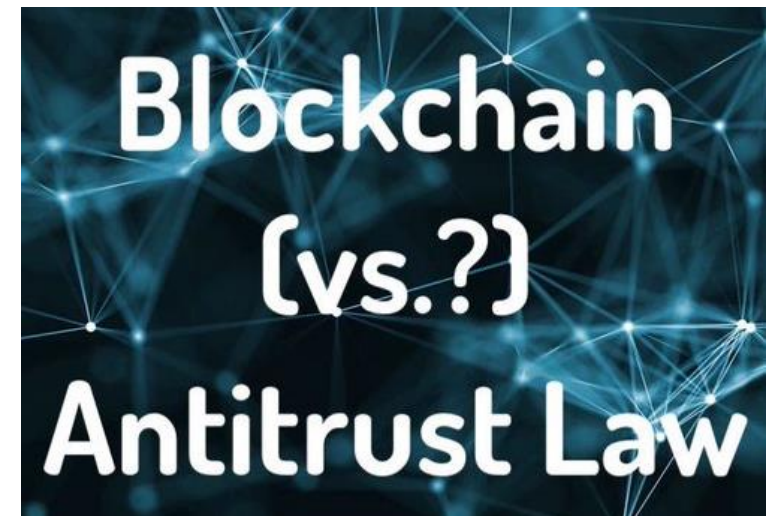# Blockchain Network Design Strategies to Promote Competition

- Will blockchain hurt competition?
  - Critics argue that blockchain technology will lead to anticompetitive outcomes, including:
    - <u>Collusion</u>: Distributed ledgers will allow competitors to share sensitive data, which could aid in collusion (e.g., price-fixing).
    - <u>Competitor exclusion</u>: Competitors could be excluded from a blockchain that is vital to competing in a market.
    - <u>Inhibited regulation</u>: A decentralized network may prevent regulators from enacting sanctions/remedies and identifying perpetrators
  - These are real risks, but ultimately blockchain is just another tool to manage data
  - The impact blockchain has on competition will depend on whether:
    1. Firms actively utilize thoughtful network design strategies to promote competition
    2. Regulators create and enforce clear guidelines for firms to follow while designing and operating their blockchain networks
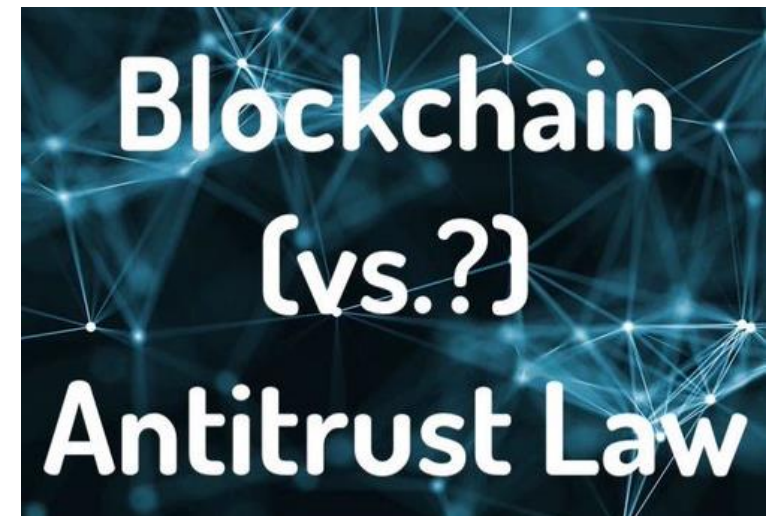
Source: PBS

Blockchain Network Design Strategies to Promote Competition (cont.)

▪ Can networks be designed to promote competition?

– Regulators and firms are actively considering how to offset antitrust risks associated with blockchain

– One approach to promote competition is through thoughtful network design and governance

– While every network will require a unique design for the relevant industry/business need, these network design strategies may help promote competition in the areas of:

  • Sensitive data management

  • Centralized governance

  • Transparency for regulators

Source: PBS

Blockchain Network Design Strategies to Promote Competition (cont.)

- Network design strategy: **sensitive data management**
  - To offset the risk of competitors sharing sensitive data via distributed ledgers, the following sensitive data management strategies could be employed:
    - Encryptions: If certain types of data are particularly sensitive, those entries can be encrypted on the blockchain to limit access by other network users
    - Firewalls: A network administrator can manage which parties have permission to access underlying block data
    - Keep certain data off the network: Not all information needs to be stored on the blockchain, so certain sensitive information could be kept off

Source: PBS

Blockchain Network Design Strategies to Promote Competition (cont.)

- Network design strategy: **centralized governance**
  - To offset the risk of competitor exclusion and inhibited regulation, the following centralized governance strategies could be employed:
    - <u>Membership rules</u>: Regulators can offer guidance to administrators of centralized blockchain networks as they define enforceable membership rules for accessing networks
    - <u>Government entry points</u>: Administrators of centralized blockchain networks can provide governments with entry points to access networks and carry-out enforcement measures
    - <u>Encode rules directly into governance</u>: Measures can be encoded into centralized blockchain networks to define appropriate use and combat anticompetitive behavior before it even occurs
    - *Mr. Ullman will discuss competitor favoring and exclusion mitigation strategies, such as establishing clear membership rules, in more detail from a legal perspective*

Source: PBS

Blockchain Network Design Strategies to Promote Competition (cont.)

▪ Network design strategy: **transparency for regulators**

- To improve regulators' ability to investigate anticompetitive claims, the following transparency strategies could be employed:

  • <u>Audit-trail data</u>: Provide antitrust investigators with a clear audit-trail of the lifecycle of an asset as it moves through a firm's supply chain

  • <u>Firm transaction data</u>: Blockchain networks will provide antitrust investigators with more accurate, reliable, and comprehensive transaction data than what regulators typically receive from non-blockchain networks

  • <u>Industry-wide data</u>: Develop a blockchain, potentially accessible only to select parties/regulators, that contains industry-wide transaction data to provide a new tool to antitrust investigators

Source: PBS

Blockchain Network Design Strategies to Promote Competition (cont.)

- In summary
  - Blockchain technology is a powerful tool that could transform how firms operate
  - There are real antitrust concerns related to the blockchain ecosystem adoption
  - Firms and regulators may be able to actively utilize thoughtful blockchain network design strategies and oversight to promote competition

Source: PBS