Blockchain Disruption and Smart Contracts

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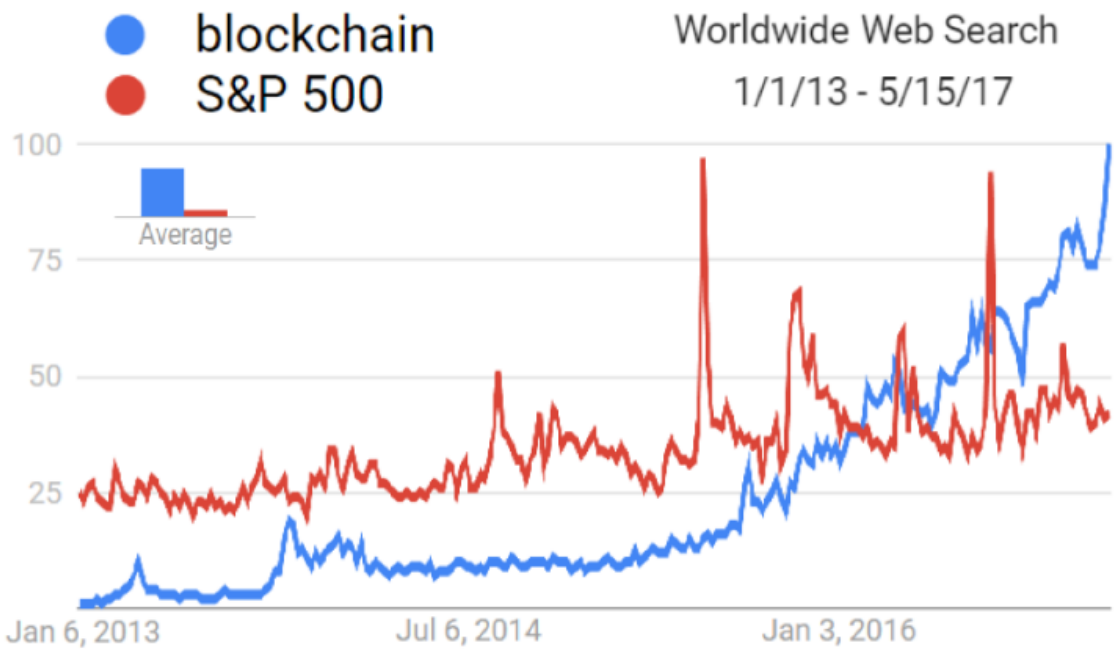
Oct 19, 2018

Fifty Shades of Blockchain

"The Trust Machine", "Distributed Trust Network",
"Bitcoin", "Ethereum", "Distributed Ledger"...
Smart Contracts



Crypto Zoo: Cryptocurrencies, digital cash, bitcoins, altcoins, crypto-tokens, platform currencies, etc.

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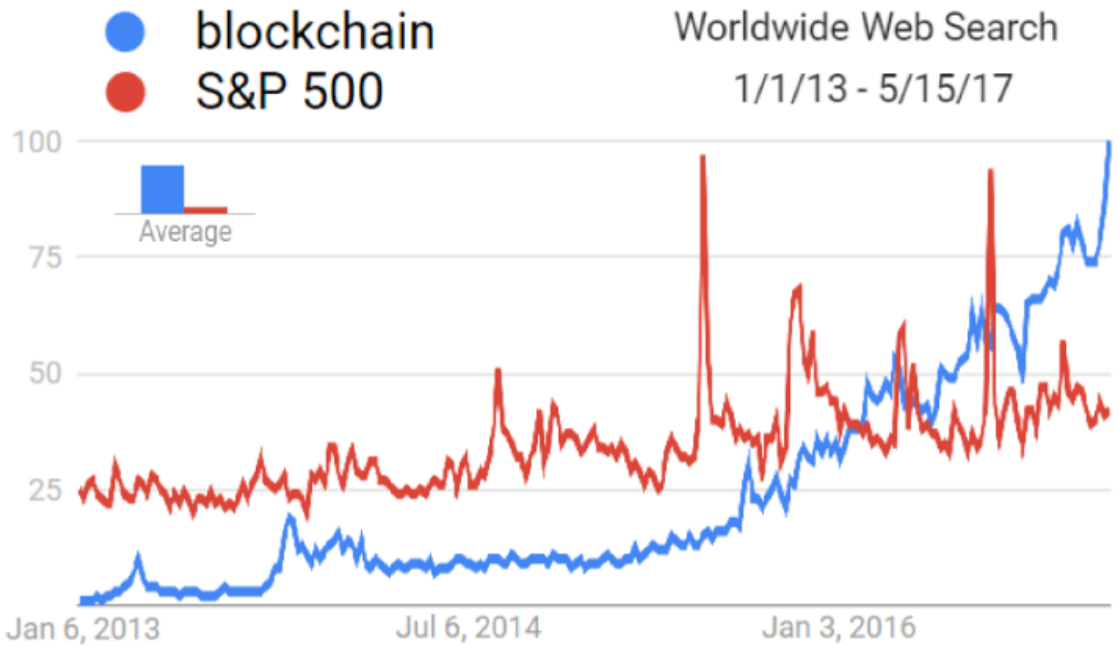

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Blockchain Disruption

- Bitcoin as an early experiment.
  - Anonymity a feature of Bitcoin.
  - Not a defining feature of blockchain.
- Decentralized Consensus
  1. Preventing single points of failure.
  2. Reducing intermediary rent/market power.

1. Blockchain Economics: Internal System

- Decentralization & incentive provision:
  - Market and games of decentralized record-keeping
    - General: Harvey (2016), Catalini & Gans (2016)
    - Protocol games: Eyal & Sirer (2014); Biais et.al. (2018); Saleh (2018), etc.
    - Market micro-structure: Easley, O'Hara & Basu (2018); Huberman et.al. (2017)
  - Centralizing versus decentralizing forces:
    - Duplication & energy: O'Dwyer & Malone (2014), etc.
    - **Information distribution**: Cong & He (2018).
    - Issues requiring central authority: Abadi & Brunnermeier (2018).
    - Risk-sharing & IO: Cong, He, & Li (2018)

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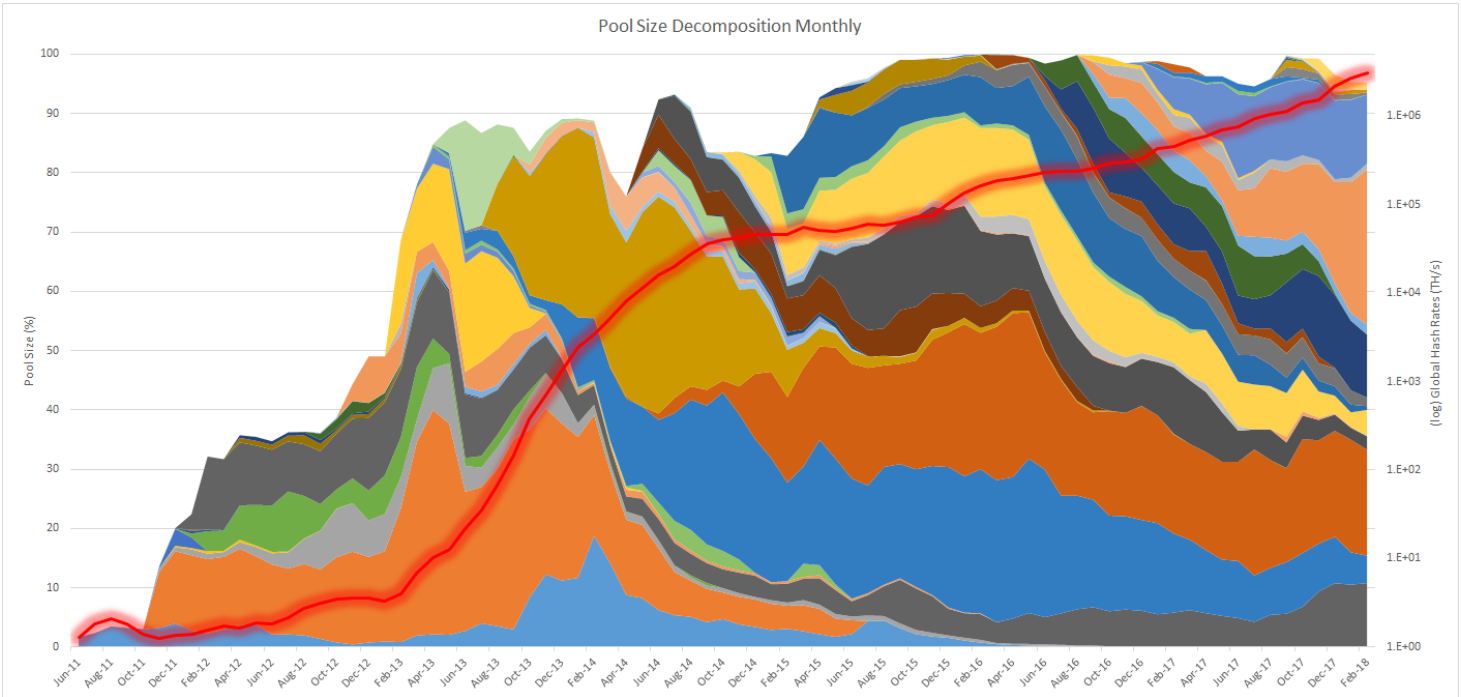
Centralization: the rise of mining pools



The evolution of Bitcoin mining pool size shares

Overview of results

Miners'/pools' decision makings

- Mining pools' (significant) risk-sharing benefits.
- MM: diversification *across* pools v.s. risk-sharing *within* a pool.
- "Passive miners": larger pools charge higher fees, leading to slower growth.
- Financial innovation and arms race.

Supporting empirical evidence using Bitcoin data.

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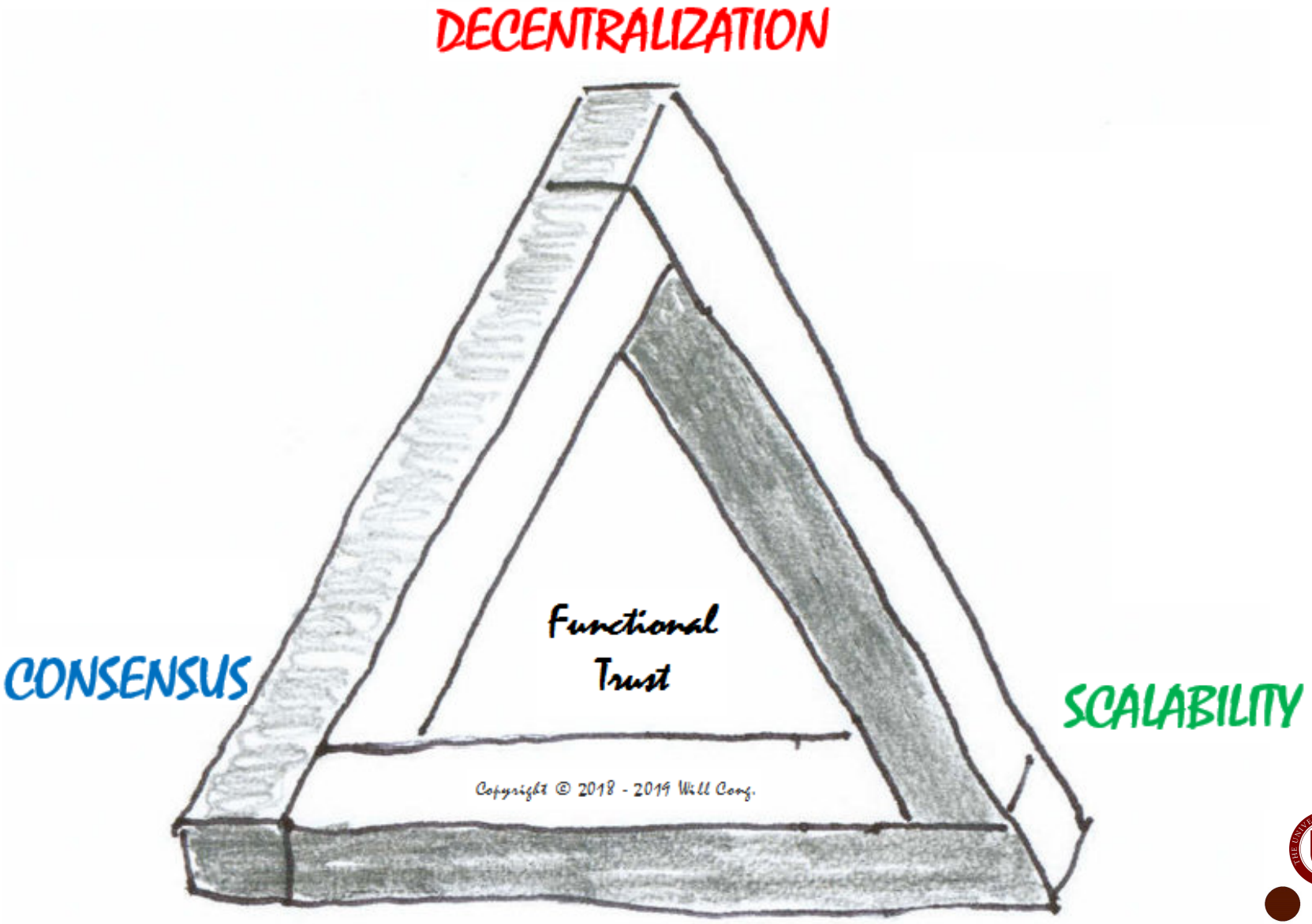
Trilemma?


DECENTRALIZATION
CONSENSUS
SCALABILITY
Functional
Trust
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2. Blockchain Economics: External Impact

- Applications and impact:
  - *Corporate governance*: Yermack (2017)
  - *Trading & transparency*: Katya & Park (2016)
  - *Smart contracts*: Cong & He (2018); Tinn (2018)
  - *Platform growth*: Gans & Halaburda (2016); **this paper**
  - *ICOs*: Li & Mann (2018); Sochin & Xiong (2018); Howell, Niessner, and Yermack (2018)
  - *Monetary policy & design*: Balvers & McDonald (2017); Schilling & Uhlig (2018)
  - *Auditing*: Cao, Cong, & Yang (2018)
  - *Payment and remittance*: Athey et.al. (2016)
  - *Alternative asset*: Hu, Parlour, & Rajan (2018)
  - *Valuation*: **this paper**; Buraschi and Pagnotta (2018)
  - *International finance*: Yu & Zhang (2017); Makarov & Schoar (2018), etc

Valuation and adoption dynamics: Ethereum

Tokenomics: Dynamic Adoption and Valuation

- A dynamic model of cryptocurrencies and tokens:
  - Co-evolution of **token price** and **platform adoption**.
  - Endogenous adoption by heterogeneous agents.
  - Assets with surplus/dividend flow and network effect.
- Fundamental-based valuation of tokens:
  1. A pricing formula.
  2. Contemporaneous & Inter-temporal network externality.
  3. Cross section and volatility implications.
- The role of tokens on platform growth:
  1. Security tokens vs utility tokens.
  2. Adoption acceleration.
  3. User base volatility reduction.

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Blockchain Disruption and Smart Contracts

1. What is blockchain?
   - **Decentralized consensus**.
   - Tension between **decentralized consensus generation** and **information distribution.**

2. What are its economic impacts and implications?
   - Greater contractibility: **mitigate informational asymmetry** and pro competition.
   - Greater information distribution: easier to **sustain collusion**, anti-competition.

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Information Distribution

- Bank of Canada Jasper Project, Chapman et.al. (2017) "More robust data verification requires wider sharing of information. The balance required between transparency and privacy poses a fundamental question to the viability of the system for such uses once its core and defining feature is limited."
- Brazilien central bank, Burgos et. al. (2017): just encrypting sensitive data is not a viable solution because smart contracts then cannot function properly. Using trusted nodes impairs the resiliency of the system.
- "...the technology really facilitates is *Cartel management* for groups that don't trust each other but which still need to work together....", *Financial Times*, May 2015

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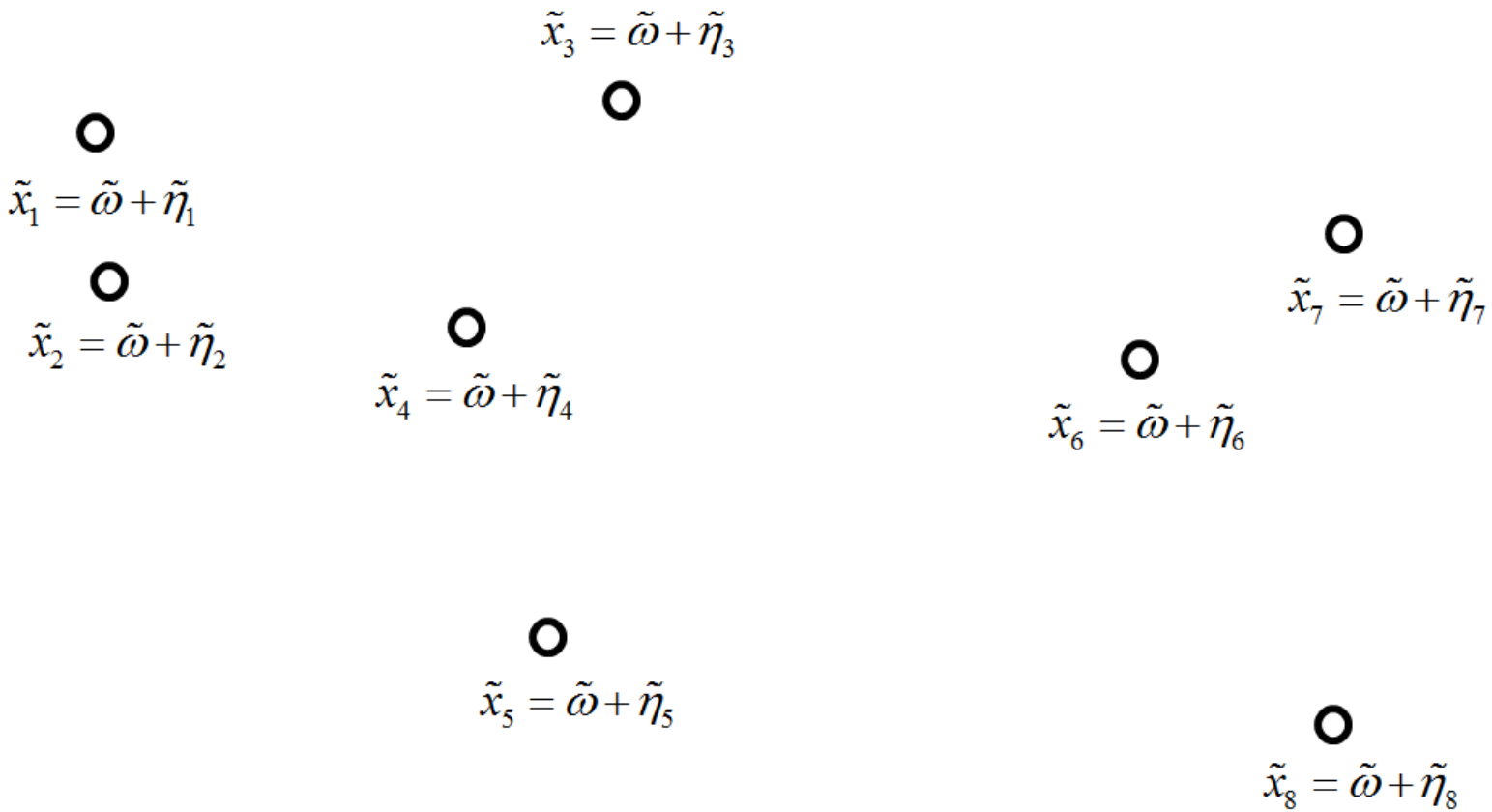
Information and Keeper's Problem



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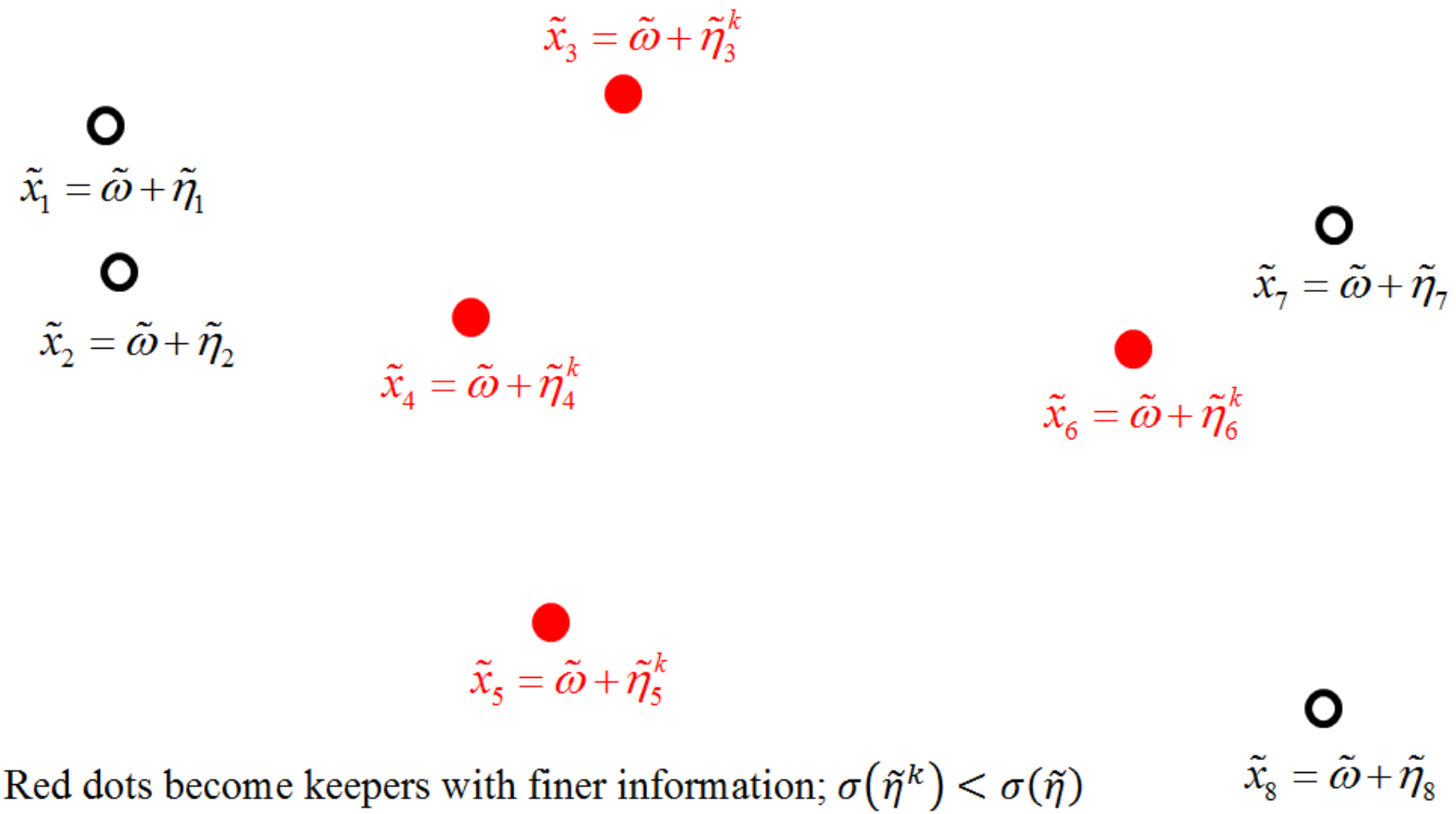

Red dots become keepers with finer information; $\sigma(\tilde{\eta}^k) < \sigma(\tilde{\eta})$

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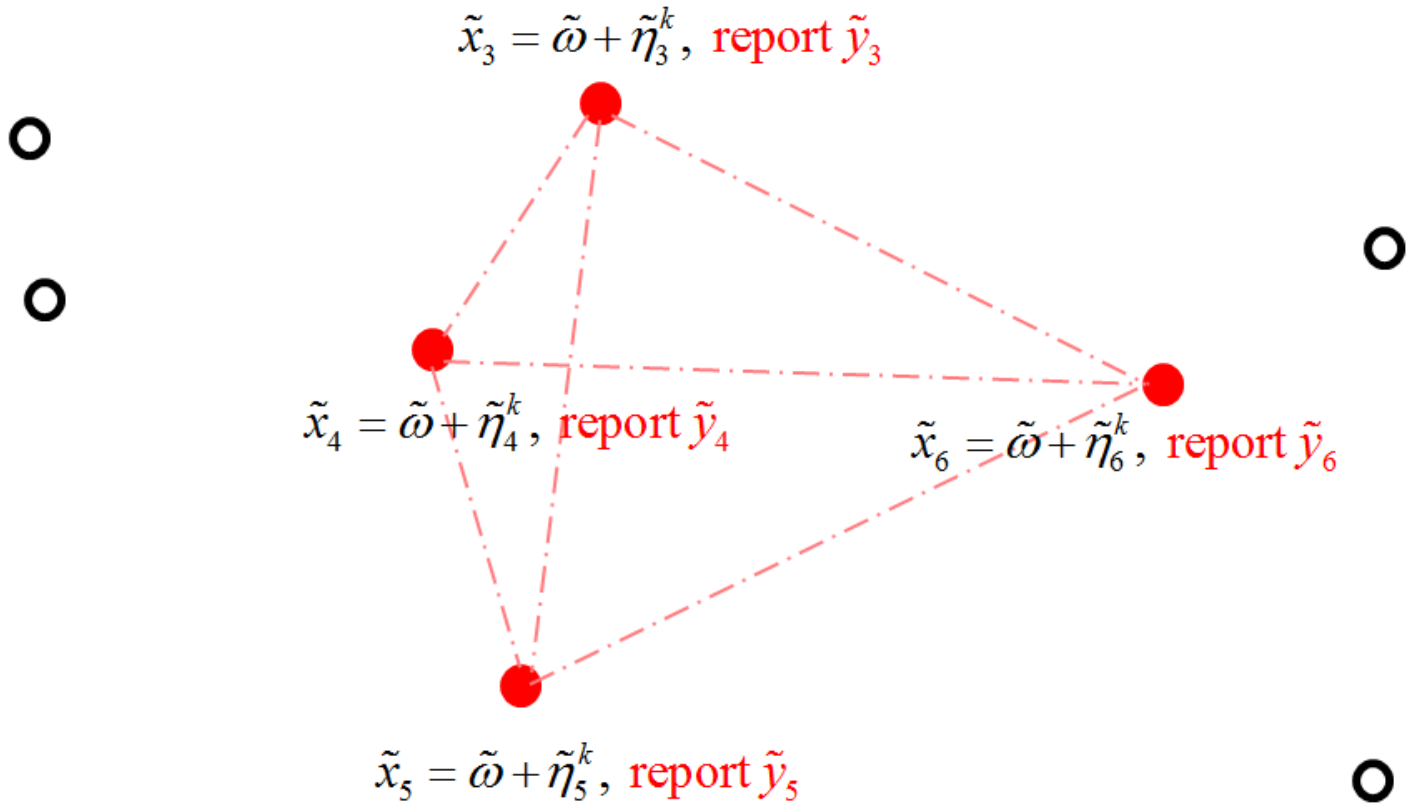
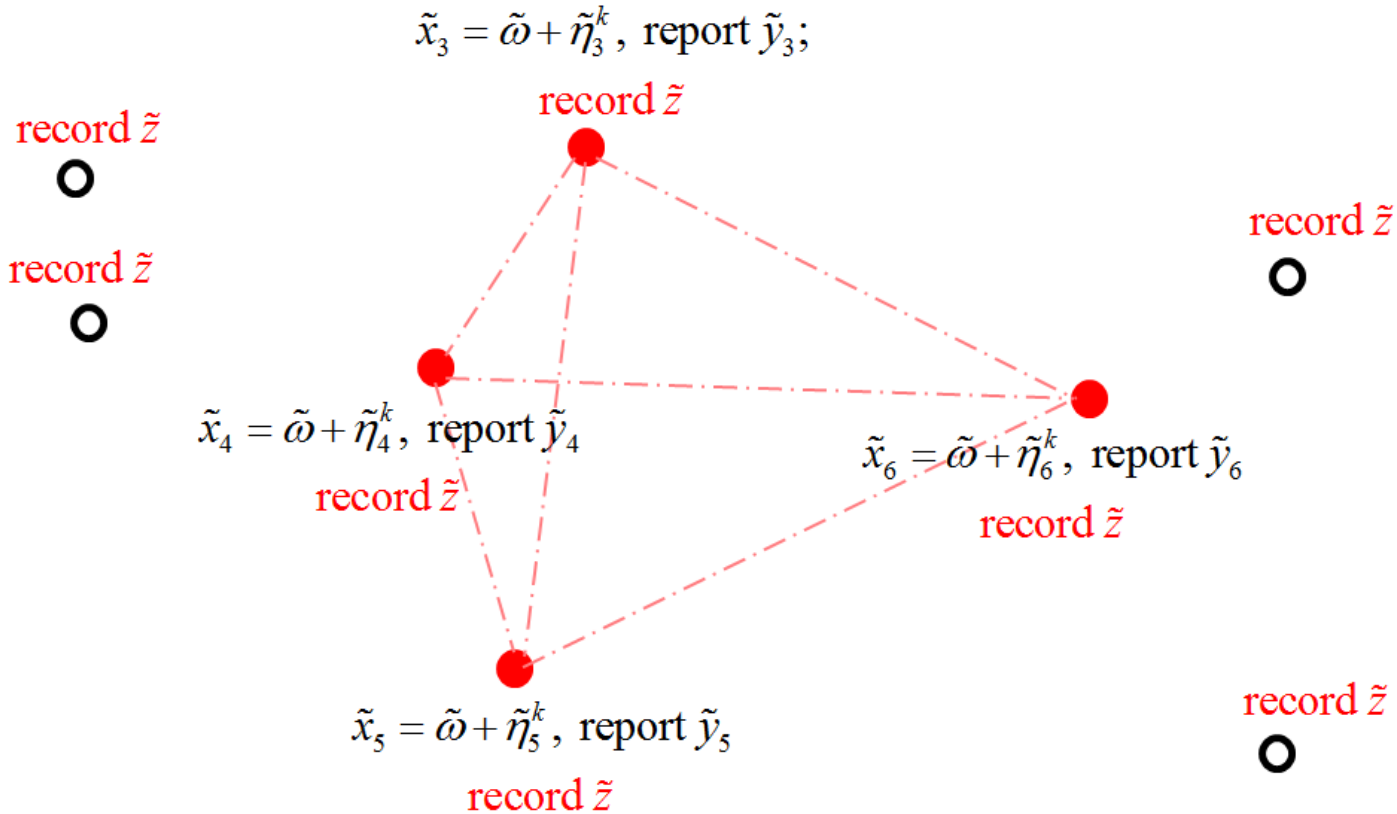


Equilibrium Consensus

Reach consensus from reports: $\tilde{z}(\tilde{y}_3, \tilde{y}_4, \tilde{y}_5, \tilde{y}_6) = \tilde{z}(\mathbf{y})$.



Smart Contracts

Smart contracts are digital contracts allowing terms contingent on decentralized consensus (ideally through automated execution).

1. self-enforcing
2. tamper-proof

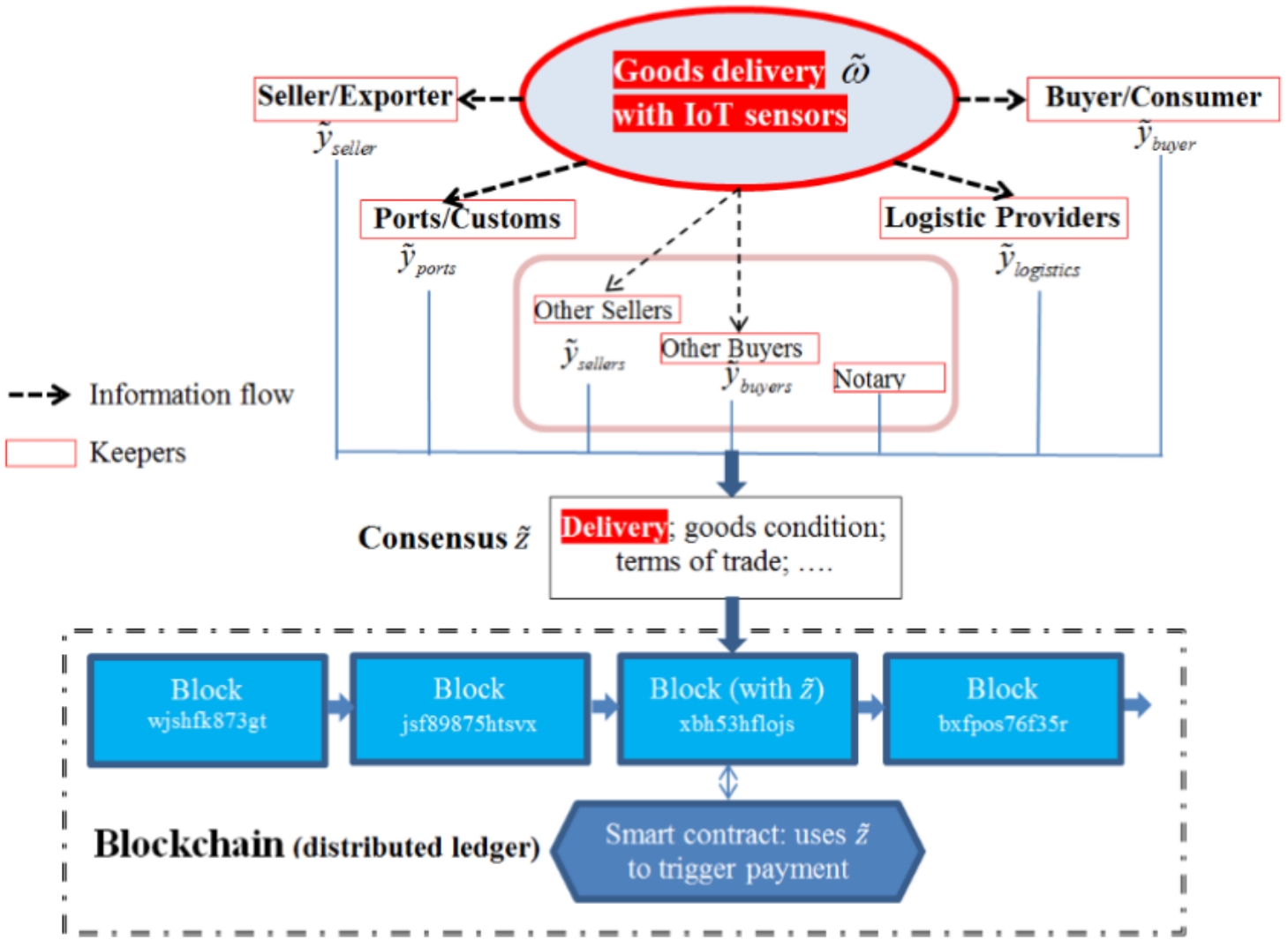
Applications of Blockchain and Smart Contracts in Finance

- Trusted Payments
  - SWIFT vs **Bitcoin**, **Lightning Stellar**
  - **Ethereum**, **Phi**, complex logic (smart contract).
  - **Ripple**, integration with existing system: permissioned blockchain, alternative consensus generation.
- Syndicated loans: led by Credit Suisse and 12 other banks, and **Symbiont**.

Applications of Blockchain and Smart Contracts in Finance

- Trade and Trade finance: **R3 CEV, IBM, Wave, HK Blockchain, DTC,** etc.
  - Flow of goods and/or money: a network of shippers, ocean carriers, ports and custom authorities, and banks.
  - In 2016, **Barclays** and **Wave**, first to complete a global trade transaction using blockchain technology.
  - Exporting US$100K worth of cheese and butter from Ireland to Seychelles, involving a blockchain-based letter of credit.
  - Commonwealth Bank of Australia, Wells Fargo, and trading firm Brighann Cotton, 88 bales of cotton $35K from Texas US to Qingdao China.
  - Hong Kong's banking regulator and seven banks build a blockchain trade finance **platform** in Sept 2018.

A Trade Finance Example



Blockchain Disruption

- Smart-contracting to encourage entry vs collusion.
- Blockchain helps sustain a larger set of equilibria: a double-edged sword that leads to both entry (pro-competition) and collusion (anti-competition)

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Conclusion

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  1. Decentralized consensus, low-cost, tamper-proof algorithmic execution.
  2. Greater contractibility: Smart Contracts.
  3. Consensus generation: distributing information.

- Economic impact on Industrial Organization and Competition.
  1. Mitigates information asymmetry; facilitates entry and competition.
  2. More (perfect) monitoring; enhance collusion.
  3. Regulation; separation of users and keepers.

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