

# Emergence of data-driven agricultural food & fibre supply chains into the future



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# I will argue

- Data & information costs are main trade costs
  - **Tradetech** will lower costs, change industrial organization
- Agriculture is production of food, fibre **& data**
  - Blockchain is new **economic infrastructure for data**
  - Data has different value for producers, governments, consumers
  - Esp. valuable for high-information goods like premium agriculture
- Coordinated tech adoption is hard
  - Add data? coordinate adoption? who pays?

# What are trade costs?



- Supply chains have physical & institutional infrastructure
- Trade costs are the **costs in addition to production costs**
  1. Transportation costs
  2. Regulatory and political costs.
  3. Information costs
- **These frictions in trade prevent mutually beneficial exchange**
- How can we use new technologies to reduce trade costs?

# We lowered transportation costs...

- E.g. **shipping container:**
  - Previously trade was dangerous, laborious and inefficient.
  - From 1956, the shipping container facilitated intermodal transport and lowered transportation costs (see Levinson 2015)
  - “...increasing the share of trade that is containerized lowers shipping costs from 3 to 13 percent.” (Hummels 2007)
- **proportion of trade costs that are transportation costs has generally been falling.**

# Then we lowered regulatory costs...



WORLD TRADE  
ORGANIZATION



- After World War II regulatory and political costs across the world increased.
- **costs of bringing goods across borders now exceeds transportation costs\***
  - **agreements and organisations (WTO)** to facilitate negotiation to reduce direct regulatory costs of international trade (e.g. tariffs)
  - Worldwide average import tariffs dropped from 8.6% (1960) to 3.2% (1995)

# Today we need to lower information costs

- costs of coordinating trusted information between distributed parties in a potentially hostile environment
- Supply chains carry (1) physical goods and (2) information about those goods
  - Particularly costly for more complex goods and longer supply chains
  - paper burden cost of international transit up to 50%\*
  - reducing supply chain barriers to trade could increase global GDP by 5% & global trade by 15% (WEF)

**We need better shared ledgers**

# information demands – who wants to use shared ledgers?

## Consumers

- Consumers demand information about where goods are from, characteristics, transported:
- But these information characteristics of the goods we buy are:
  - **Not always observable** (e.g. fair trade, organic...)
  - A critical input into consumer choice (how much will you pay?)

## Government

- **Governments demand information to comply with domestic regulations:**  
Biosecurity risks, Ethical standards, Import duties
- **Governments require many forms:**  
Bills of lading, Ship manifests, Certificates of origin
- increasingly costly in a world of **regulatory states** and **globalisation**

## Producers

- Many producers also demand information:
  - Is there fraudulent activity up or down the supply chain? Who are my final consumers? Can I optimise my supply chain?
- This problem is **compounded in a world of complex supply chains** with lots of **intermediate goods**.

# Who keeps these ledgers?

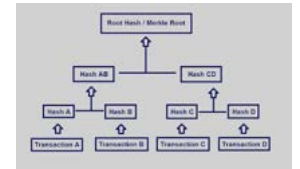
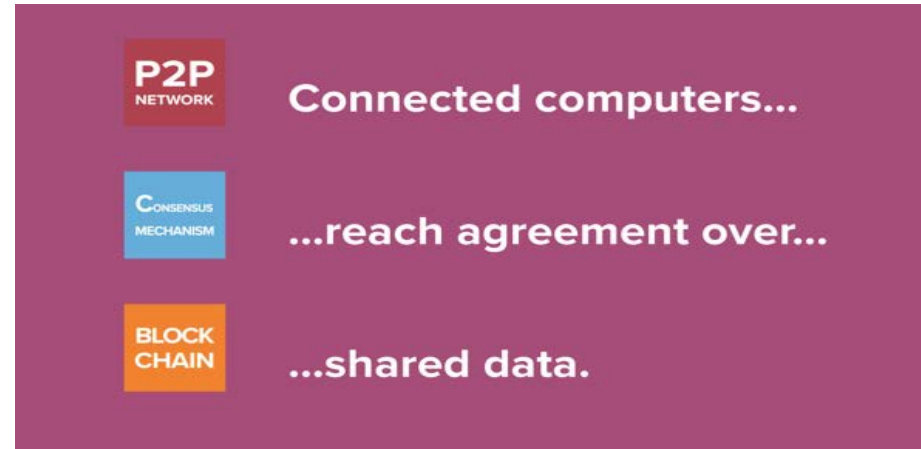
- Someone has to produce supply chain information
- often **pass information between hierarchical organisations** as goods move (e.g. entries in databases, digitised forms, etc.)
- This is often **manual paper-based communications** such as bills of lading, ship manifests, letters of credit, certificates of origin.
- These paper trails extremely long and burdensome
- how is the information governed? Often siloed within each hierarchy
- creates issues of **error** and **fraud**...

Blockchain: The latest agricultural technology?



# What is a blockchain?

“a **distributed**, append-only **ledger** of provably signed, sequentially linked, and cryptographically secured transactions that is replicated across a network of computer nodes, with ongoing updates determined by software-driven consensus”



Blockchain is **economic infrastructure** for next generation autonomous digital technologies

# Industry Utility

Blockchain enables a decentralised industry architecture to supply trade and administrative services across the agricultural sector's value chain

- Identity
- Payments
- Trade finance and insurance
- Provenance and tracking
- Regulatory compliance



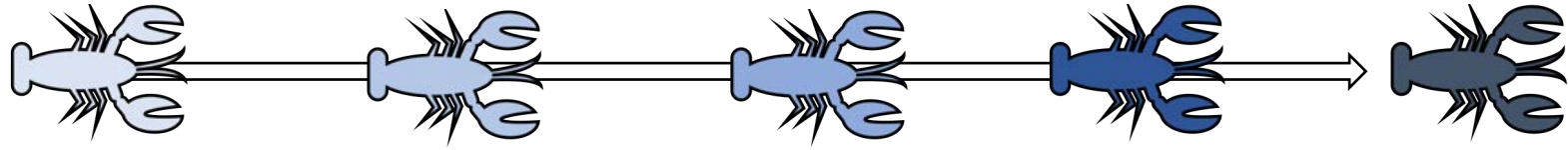
# Blockchain = trade infrastructure

- An **institutional alternative** for information sharing in firms along the supply chain
- Blockchain to create a **Digital Twin** that carries data
- A **decentralised ledger for supply chain participants to contribute and view supply chain information** (time stamped data about quality, location, ownership)
- facilitates trust between supply chain participants
- a **new approach to an old economic problem of economising on trade costs**

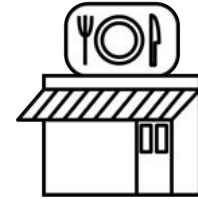
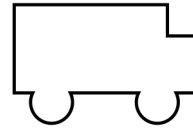
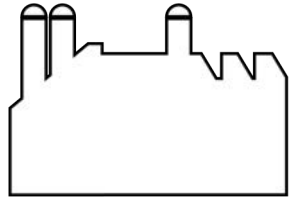
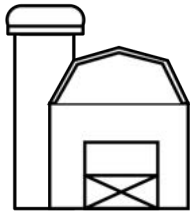
# Agriculture is the production of food, fibre and **data**

- data adds economic value
- Data is cheap to add, **but costly to verify**
  - costs of establishing provenance
  - costs of proving compliance with standards and regulations inspections, audits, and process monitoring
  - costs of intermediation
  - Costs of quality assurance and branding

# A good + a digital twin



Export  
good



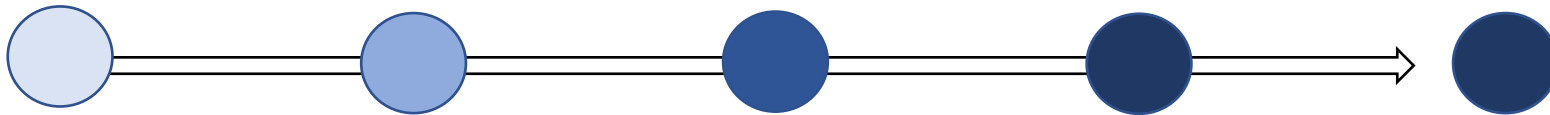
Primary input  
-----  
+ Provenance

Producer  
-----  
+ Transformations  
+ Attributes  
+ Liabilities

Transport  
-----  
+ Stewardship  
+ Tracking

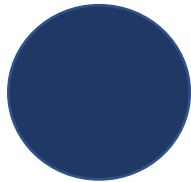
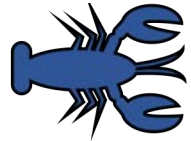
Transport  
-----  
+ Stewardship  
+ Tracking

Retailer  
-----  
+ Transformations



blockchain

# Provable qualities of farm produce:



- Commodity type or grade
- Quantity measures (e.g. tonnage delivered, headcount)
- Quality measures (e.g. milkfat content, protein yield, fibre diameter)
- Specific batch conditions (e.g. harvest time and location)
- Consistency or purity (e.g. blended or not)
- Compliance with standards (e.g. organic, GMO, pest free area status)
- Compliance with rules (e.g. workplace laws, regs, trade agreements)
- Safety information (e.g. preparation, toxins, handling, etc)
- Provenance and authenticity (e.g. farmer identity, regional identity)
- Complementary information (e.g. tasting notes, nutritional qualities)
- Organisational conditions (e.g. coop, small farmer, agribusiness)
- Legal properties (e.g. ownership, contract conditions)

# Agriculture remains one of the least digitised industries in the world



- data create value when attached to products leaving the farm
- data must be created, attached **and trusted** to have value

# Blockchain can lower costs, better pricing



- agricultural supply chains long and complex
- adds value by lowering cost of moving data created on-farm for off-farm processing and consumption
- a technology for trusted updates of records across a distributed system



# value chain economics

**'cost of trust' savings accrue to the entire value chain**

**Competition with alternative technologies of trust:**

- Brands
- Regulations
- Local consumption & proximity

# value chain economics

## **Price effect: specific vs commodity**

- Total value produced increases by information value added
- Price wedge incentivises information provision where quality exists
- Adoption calculation is risk of being shut out of data-premium prices & locked into low-information commodity prices

## **Redistribute value along supply chain (toward farm)**

- Rents flow to where value and information added

Increased return to on-farm digital investment, but requires learning and coordination for payoff

# Tech adoption coordination problem

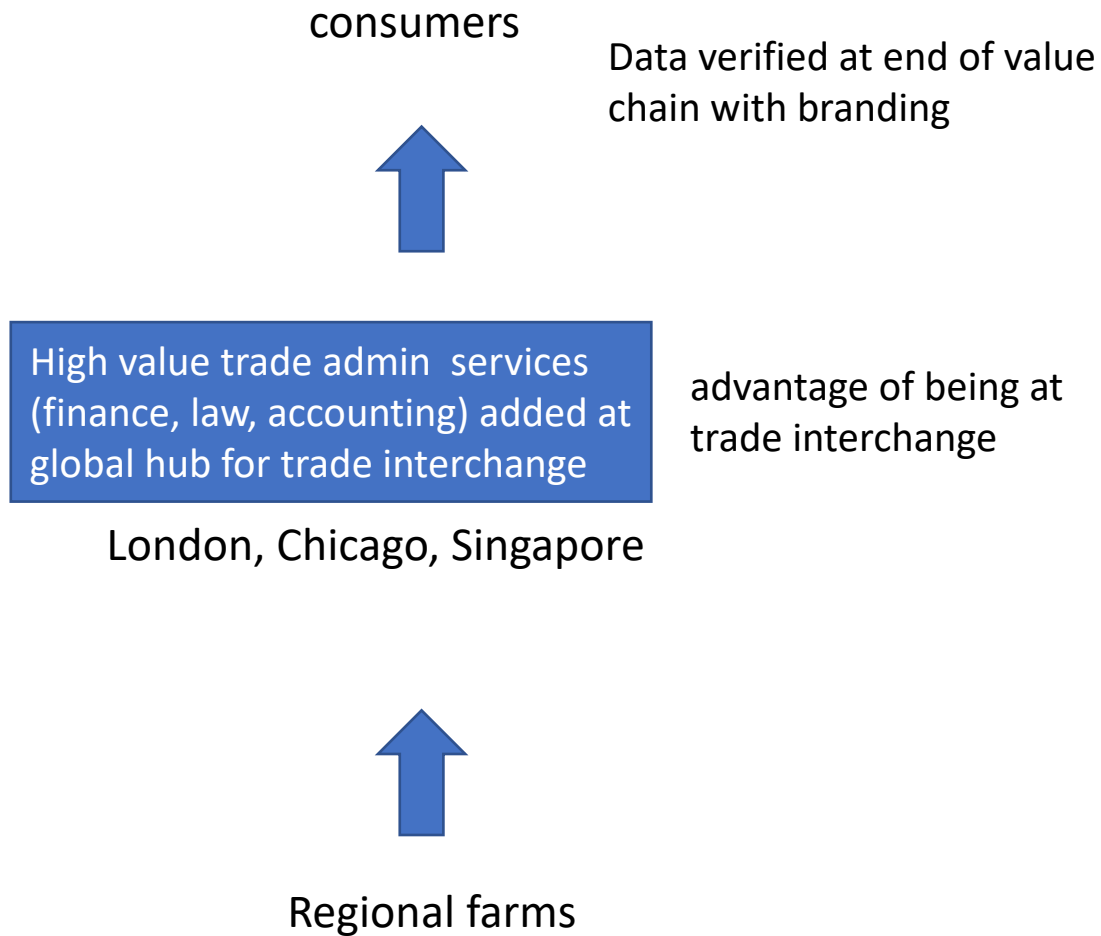
**distributed parties who don't trust each other with expensive infrastructure rebuilds and built-up entrenched interests**

- 1. Dominant player monopsony power. Walmart & leafy greens**
- 2. Third party coordination (same consultants, bank, tech provider)**
- 3. Government regulation (minimum standards)**
- 4. Industry associations**

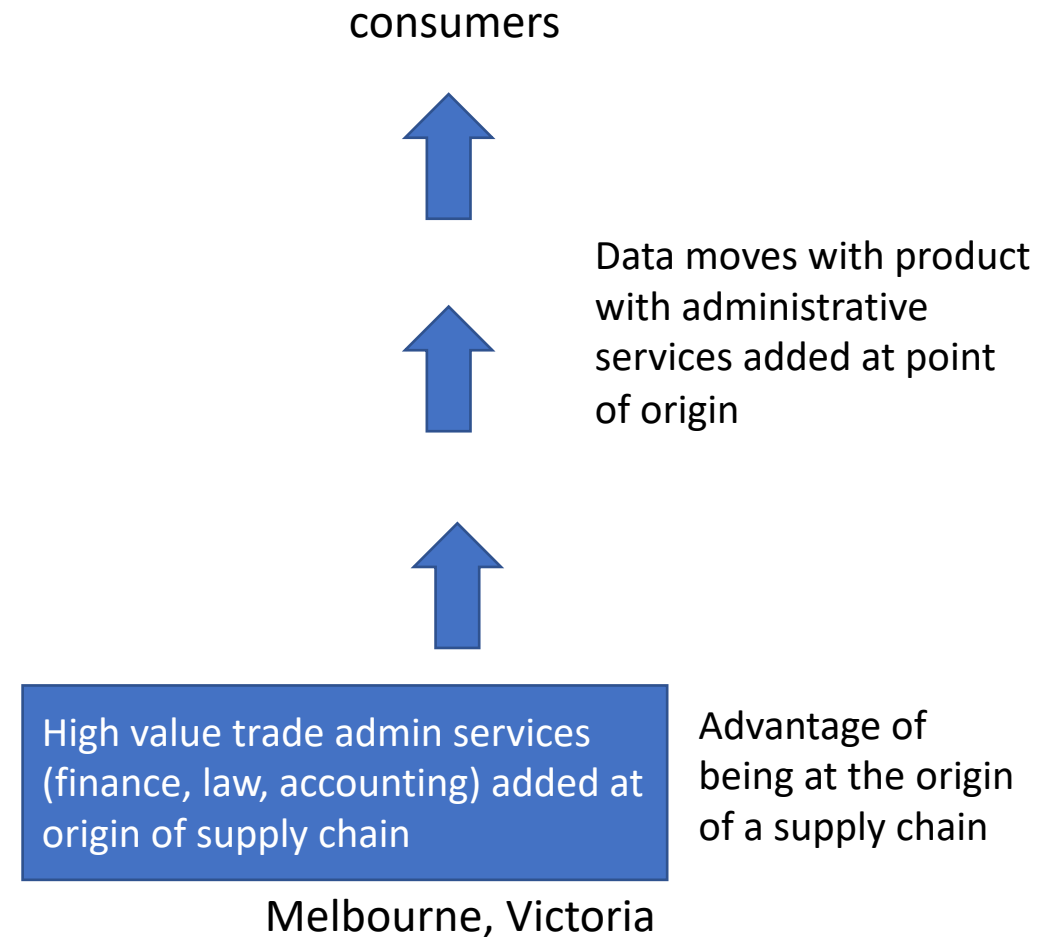
# Future of trade predictions

1. More niche markets
2. Value to the edges
3. Fewer brands
4. More platforms

# Industrial-era trade



# Digital-era trade



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## Blockchain in Agriculture

15 Pages · Posted:

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**Abstract**  
Agriculture is the production of food, fibre and data. The data attests to the qualities and properties of the food and fibre, and is therefore economically valuable. Yet while data is cheap to add, it is often costly to verify. In consequence, a significant percentage of the final cost of agricultural produce goes to costs of establishing provenance, proving compliance with standards and regulations, undergoing inspections, audits, and process monitoring, as well as costs of intermediation, quality assurance, and branding. Blockchain, a new technology that enables different parties along a supply chain to trust digital data (it is sometimes called a 'trustless' technology), has the potential to lower transaction costs and improve the efficiency of agricultural supply chains by reducing the need for monitoring and verification of data. Yet while hugely promising, the technology is still new and experimental, and faces a number of significant barriers to adoption.

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**JEL Classification:** Q1, O3

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### Blockchain and Supply Chains: V-form Organisations, Value Redistributions, De-commoditisation and Quality Proxies

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**Abstract**

We apply institutional cryptoeconomics to the information problems in global trade, model the incentives under which blockchain-based supply chain infrastructure will be built, and make predictions about the future of supply chains. We argue blockchain will change the patterns and dynamics of how, where and what we trade by: (1) facilitating new forms of economic organisation governing supply chain coordination (such as the V-form organisation); (2) decreasing information asymmetries and shifting economic power towards the ends of supply chains (e.g. primary producers); (3) changing the dimensions along which we can reliably differentiate goods and therefore de-commoditising goods and disaggregating price signals; and (4) decreasing consumer reliance on quality proxies (e.g. production within national borders).

# Conclusion

- Data increasingly valuable— esp. in ag supply chains
- Supply chains face an information cost problem. These **costs of trust** can be ameliorated by new technologies
- Blockchain is **new economic infrastructure** for **coordinating trusted information between supply chain participants**
- Long-run impacts: de-commoditization, shifts in value chain, v-form organisations, fewer quality proxies