Food safety practices, quality control, and contracting in value chains: the case of dairy in Kyrgyzstan

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Dairy in Central Asia

- Important sector
  - majority of households consume milk
  - accounts for large share of trade in food and beverage
  - important source of income for smallholder farmers

- Transformation after the end of the Soviet period
  - initial contraction
  - from large dairy operations to households

- Dairy processing is developing (some FDI)

- Raw milk is supplied by household farms

Incentives for food safety and nutrition in value chains

- Food safety and nutrition are provided under asymmetric information
  - consumers cannot always tell if food is unsafe
  - hazards at each stage in sequential production
  - incentives to
    - decrease contamination
    - detect contamination
    - report contamination
    - react to contamination

- Food safety institutions in Central Asia
  - local food safety authorities
    - veterinary services at farm level
    - audit of equipment and compliance with labor norms at registered enterprises
  - few private food safety certification bodies
  - informal contracts

Survey of participants in dairy supply chains in Kyrgyzstan
(IFPRI, Kyrgyz National Academy of Sciences, 2014)

- **Dairy farmers**
- **Milk collectors**
- **Dairy processing plants**

food safety practices

quality control

contractual arrangements

Dairy farmers (520, 4 oblasts)

Capital inputs

- 2 cows, local breed
- no milking machines
- some cooling
- independent tanker truck

Feed and water

- 84% grow feed crops (small plots)
- 70% purchase feed
- overgrazing on local pastures
- feed contamination is rare
- standpipe, surface and ground water

Animal care and biosecurity

- public vaccination of livestock is common
- heterogeneous sanitation practices
  - treatment of sick cows and disposal
  - contact with wildlife
- small expenditures
- 44% experienced foot and mouth disease

Milk quantity and quality

- 20% of potential yield
- low fat content

Monitoring of quality of raw milk

- mobile, large collection center, small collection center
- visual inspection
- no individual quantitative assessments
- fat content at large collection centers

Financial incentives for farmers

- no cooperatives
- informal contracts
    - fixed price
    - weekly paid by collectors
    - long-term, disagreements are rare, high degree of trust
    - lack incentives to increase quality
    - no financing/credit provision

Milk collectors (9 large stations, 3 small stations, 53 mobile collectors)

	Tank trucks	Specialized stationary collector	Non-specialized stationary collector
legal form	• independent • owned by collection center • owned by plant	• independent • plant-owned	• independent (in small shops)
catchment	• 100 farmers	• 1000 farmers	• <100 farmers
equipment	• none	• cooling and storage • tank trucks	• minimal
standards		• more strict criteria for acceptance (fat, density, alcohol test)	

- Formal contract with buyer
- Buyers pay more for higher fat, density
- Buyers monitor daily
- Rejections by buyers are rare

- High trust in quality assessments by buyers
- Low trust in quality of raw milk
- Government certificates of cow health
- Permits for tank truck drivers

Dairy processing plants (26 out of 31)

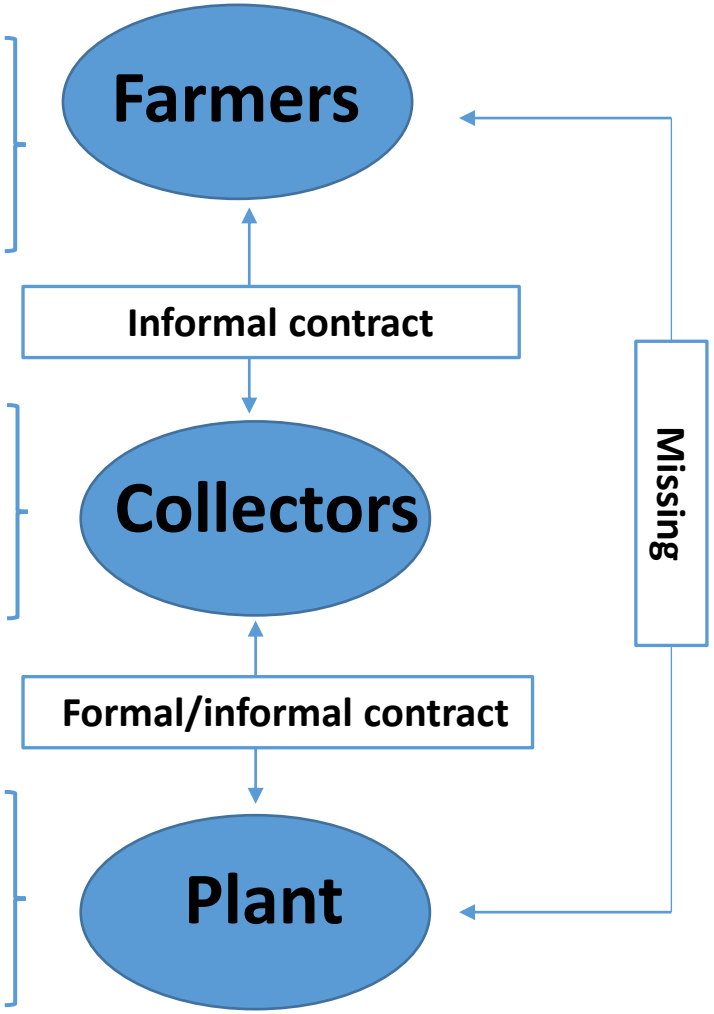
- >50% of capacity is underutilized
- main outputs: packaged milk and ice cream
- domestic market
- many export to Kazakhstan (one to Russia)
- 3000 farmers supply raw milk
- 30 tank trucks
- formal contracts with mobile collectors
    - payments
    - delivery schedule
    - veterinary certificates
- informal contracts with stationary collectors
- own milk testing laboratory
- government inspections of personnel and equipment

Contractual arrangements and quality control

- paid for accrued volume
- visual inspection by collectors
- cannot observe and verify quantitative quality assessments
- no cooperatives (except for some pasture activities)

- informally, individually contract with 100 farmers
- aggregate milk
- no quantitative assessment of individual milk quality
- quantitative assessment of aggregated milk quality

- no contracts with farmers
- contracts with 30 collectors
- acceptance/rejection based on aggregate quality
- internal quality control



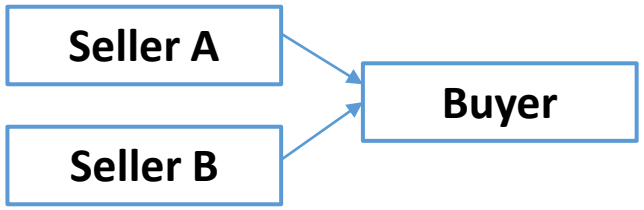
Some policy problems in the organization of value chain

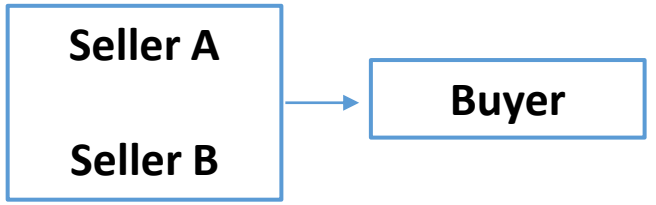
1. Assessment of milk quality from groups of farmers

2. Contracting with farmers: informal and decentralized

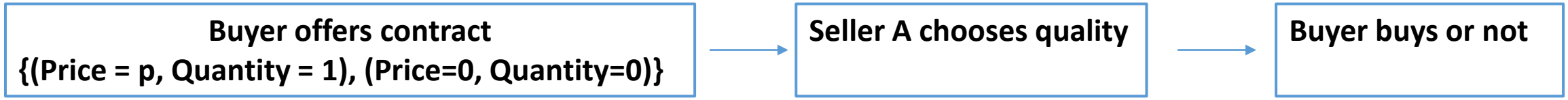
3. Internal quality control at plants

1. Milk pooling





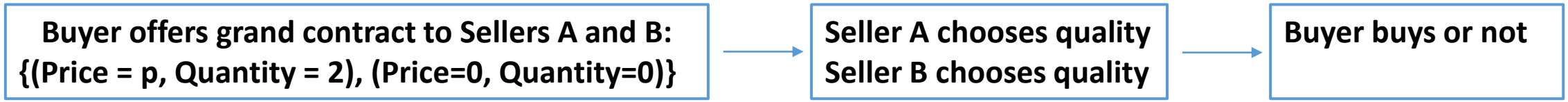
Individual selling with non-contractible quality



	Buyer buys	Buyer does not buy
Seller A	Price – Cost(Quality of A)	– Cost(Quality of A)
Buyer	Utility (Quality of A) – Price	0

⇒**Seller A holds-up Buyer**: Seller A chooses Quality such that Utility (Quality)=Price
Buyer buys and gets no profit

Team selling with non-contractible quality



	Buyer buys group output	Buyer does not buy
Seller A	Price – Cost (Quality of A)	– Cost (Quality of A)
Buyer	Utility (Quality of A and B) – 2 x Price	0

⇒Team selling cannot do worse for Buyer

Additional features in team production:

- Heterogeneous costs among sellers
- Uncertainty about quality choices among sellers
- Average quality conditional on purchase *increases*

Hypothesis Plant buys from a team of farmers if

- contractible quantity
- non-contractible quality
- costless or costly (non-contractible) quality assessment
- cost shocks
- no collusion among farmers
- small uncertainty about willingness to pay for quality

Limitations

- aggregation across many farmers
- farmers interact repeatedly and can collude against the plant
- uncertainty about willingness to pay can be significant
- farmers and collectors jointly monitor individual quality

Policy implications

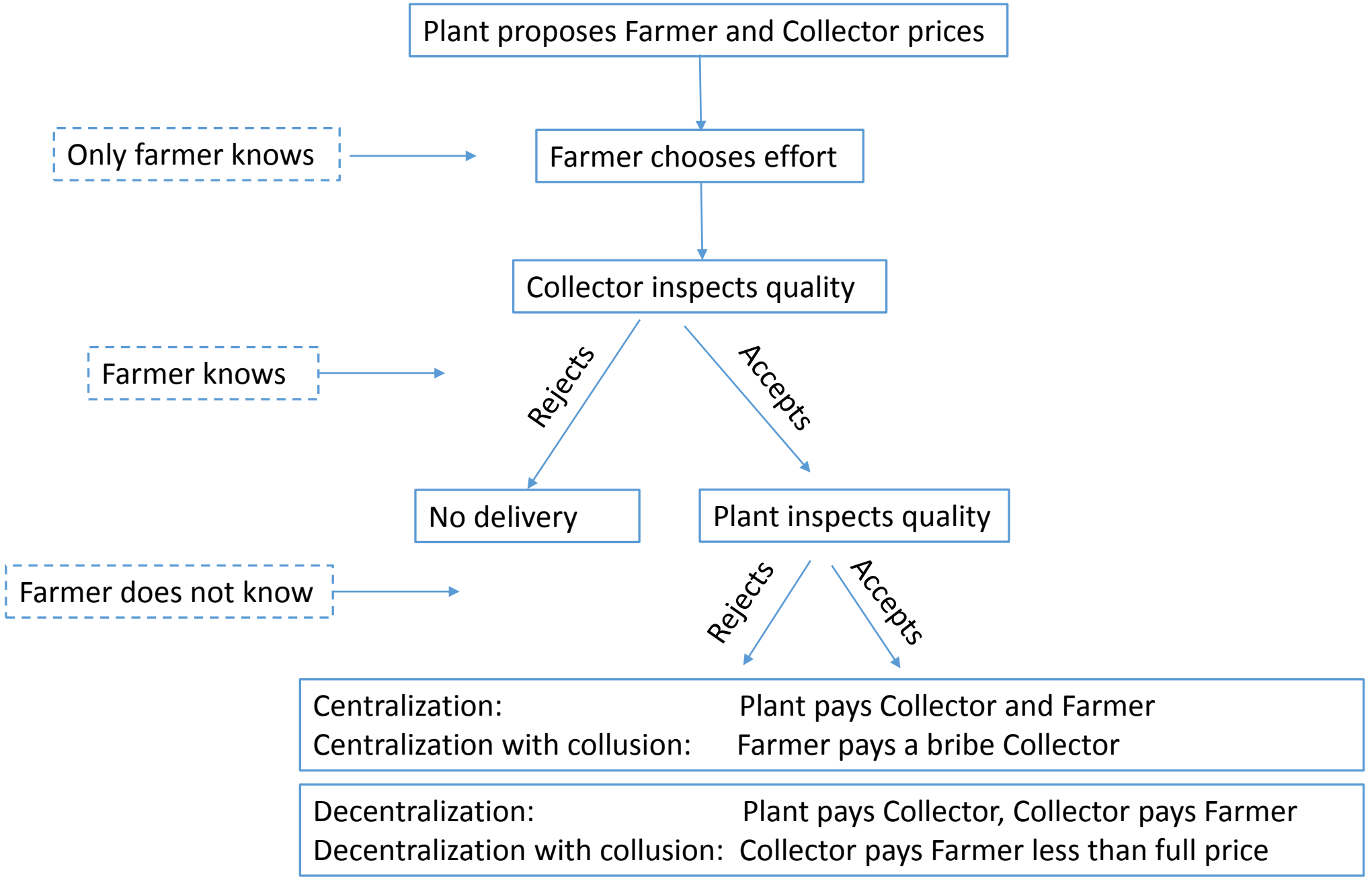
- Non-verifiability can lead to team production/milk pooling

- Verifiable quality assessments can increase milk quality

- Third-party or government quality monitoring can improve welfare

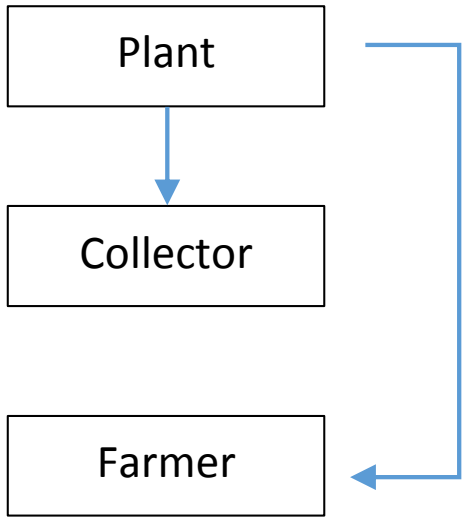
2. Collectors contract with farmers

- Diversity of contractual arrangements between farmers and buyers
    - centralized model: plant contracts and pays farmers
    - intermediary model: plant contracts/pays middlemen who contract/pay farmers
    - informal contacting: reneging on promises results in future retaliation


Plant proposes Farmer and Collector prices
Only farmer knows
Farmer chooses effort
Collector inspects quality
Farmer knows
Rejects
Accepts
No delivery
Plant inspects quality
Farmer does not know
Rejects
Accepts
Centralization: Plant pays Collector and Farmer
Centralization with collusion: Farmer pays a bribe Collector
Decentralization: Plant pays Collector, Collector pays Farmer
Decentralization with collusion: Collector pays Farmer less than full price

Contracting arrangements

Buying agent

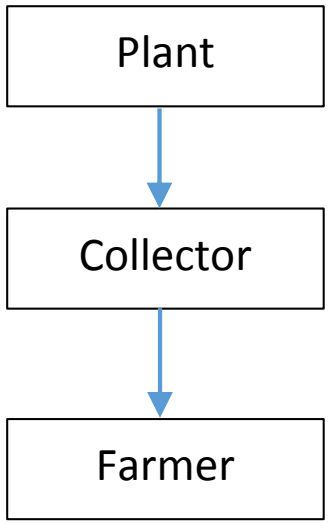


(+) Plant controls payments to Farmer

(**-**) Farmer is tempted to corrupt Collector to

maximize total payments from Plant

Independent collector



(+) Collector internalizes the cost of procurement

(-) Collector controls payments to Farmer

(-) Collector is tempted to corrupt Farmer to maximize his

net payment from Plant

Hypothesis Intermediary model of contracting is more profitable if

1) frequent deliveries
2) collector imprecisely measures quality

Intuition

- collusion under centralization: credible bribe is limited by Farmer's future **incremental gain from collusion**
- collusion under decentralization: Collector pays more than Farmer's **non-collusive rent**
- high trust (assurance) makes it easy to incentivize Collector to pay Farmer as promised

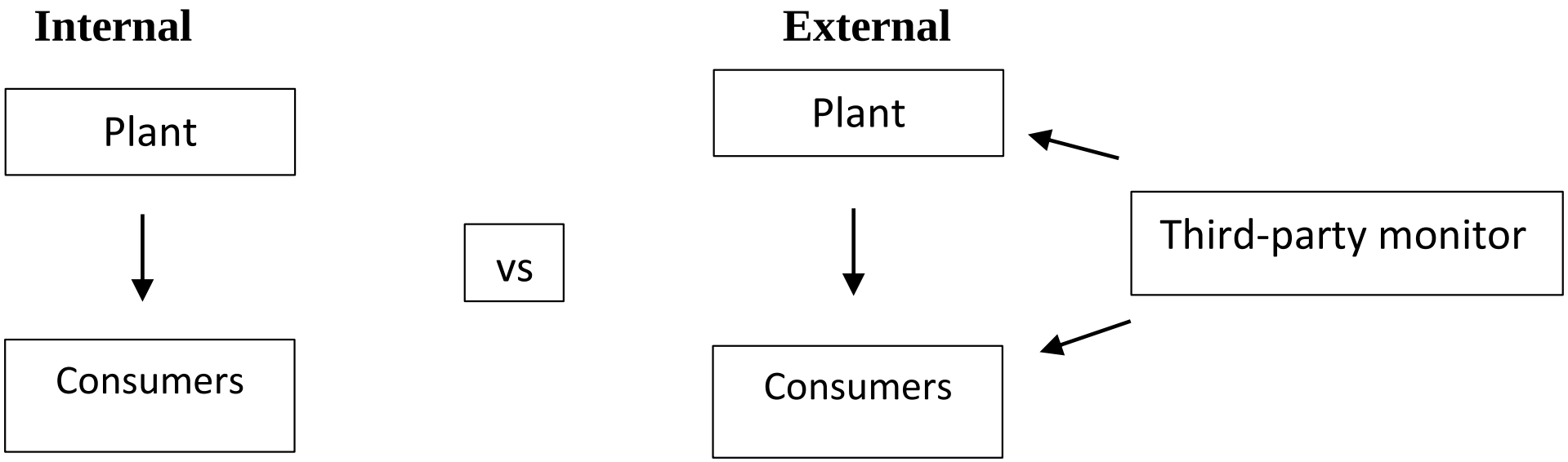
Decentralization

(-) reduces efficiency: double marginalization of rents
(+) increases efficiency: span of control

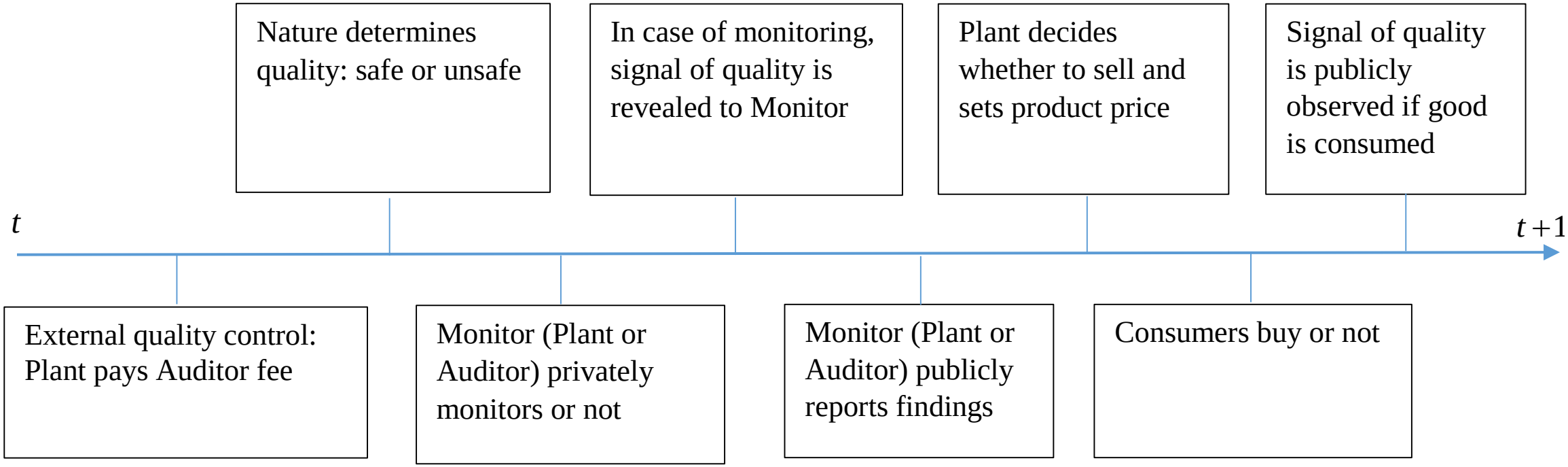
Policy implications

- improving **quality assessment** at farmer level can lead to centralized contracting
- contractual arrangement **interacts** with productivity, quality, and monitoring

3. Internal control of milk quality: When is external quality control more profitable?



Sequence of decisions



Incentives to engage in quality control

- Moral hazard concerns in quality control
  - obtain information about quality
  - react to this information

Internal monitoring	External monitoring
advantage: no third-party rents	**advantage**: concern with allocation is gone, if reports are observable to consumers
disadvantage: both concerns are present	**disadvantage**: incentives through fixed fee are costly

Hypothesis Internal quality control is more profitable if

1) frequent trading

2) precise consumer information about product quality

Intuition

- third-party certification makes it easier to maintain consumer trust
- costs of hiring third-party auditor offset benefits if feedback from consumers is effective

Policy of mandatory third-party certification of food safety

- too little voluntary certification, if consumer information is noisy
- mandatory certification decreases welfare, if otherwise

Discussion

- Different problems at different points in the value chain
  - **aggregation** of raw milk from multiple farmers: free-riding problem among upstream suppliers
  - **intermediary model of contracting**: intermediated links between farmers and processing plants
  - **internal quality control**: good or bad for consumers' trust in local industry?

Policies and regulation to improve food safety and nutritional characteristics

- smaller farmer teams
- individual milk testing
- centralized model of contracting
- formal contracts
- government food safety audits and training throughout value chain
- private third-party certification of quality to increase consumer trust in industry