Reputation Mechanism and Technology Transfer

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Motivation

Large and persistent technology differences between firms of similar natures (Syverson (2011)).

Existing explanations: factor specificity.

New explanation based on the following observations:
  - Tacitness;
  - Inter-firm transmission (IO, trade on vertical business relationships);
  - Facilitated by reputation mechanisms.
Toyota’s Subcontracting Model

Toyota subcontracts a significant fraction of designs and productions to small suppliers.

How to acquire the tacit knowledge that suppliers learn through first-hand experience, given potentially misaligned incentives?

Tacitness implies:
▶ Learning by doing;
▶ Imperfect gauge of the outcome.

Solution: reputation mechanism.
The implication of tacitness on inter-firm technology transfers:

- Learning by doing;
- Imperfect gauge of the outcome (adverse selection & moral hazard).

The reputation mechanism generates:

- Macro level: (long-term) heterogeneity in technology adoptions.
- Micro level: profitable vs. transferability; new vs. existing technology; other organizational remedies (e.g., vertical integration)
Roadmap

1. Set Up
2. Reputation mechanism
3. Result
Set Up

Time is discrete, $t = 0, \Delta, 2\Delta, \ldots, \infty$.

A principal and an agent: risk neutral, interest rate $r$, zero outside option.

Each period, the principal obtains one unit of capital at cost $\kappa \Delta$. 
A productive arm $X^0$ appears with prob. $p$ in each period.

Activated with probability $q\Delta$ if the agent directs the capital to it ("pull").

Under complete information, NPV$= S$. 
Lack of Language

Infinitely many unproductive arms $X^1, X^2, ...$:

- Appear independently with prob. $p$ in each period.
- Convert capital to a private benefit $\pi \Delta$ to the agent.

At $t = 0$, all arms are covered by identical looking boxes.

Only the agent knows if $X^0$ is present and where it is located:

- Can’t describe $X^0$.
- The agent’s participation is crucial.
Locate the productive arm through experimentation:

- When $X^0$ is activated for the first time, the box containing it is opened once and for all.
- The boxes that contain $X^{\geq 1}$ can never be opened.
Roadmap

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The Problem

Objective: incentivize the agent to pull the productive arm.

Challenge: private state, private action, limited liability:
  ▶ The agent tends to (1) overclaim, and (2) divert the resource to private use.
  ▶ Not subject to severe monetary penalty.

Solution: reputation mechanism (assume that the principal has full commitment power)
Reputation Mechanism

The reputation mechanism assigns a trustworthiness score $W$ to the agent.

Each period, the agent announces whether $X^0$ is present.

If “no”, then upgrade the agent’s score.

If “yes”, then the parties experiment:

▸ If a box is opened ⇒ consolidation phase and the agent receives $\beta(W)$ share of the continuation surplus $S$.

▸ If no box is opened ⇒ experimental phase and downgrade the agent’s score.
Optimal Reputation Mechanism (Cont.)

Figure: The Principal’s Value Function

$V(W)$

$W^+$

$W$
Roadmap

1. Set Up
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3. Result
Main Results

Macro level: long-run heterogeneity in technology adoption.

Micro level:
1. Profitability vs. transferability
2. Existing vs. new technologies
3. Other solution: e.g., vertical integration
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Profitability vs. Transferability (Cont.)

Case 1:  
\[ V'(W^+) = -1 \]

Case 2:  
\[ V'(W^+) < -1 \]

Case 3:  
\[ W^+ = 0 \]

Figure: The Principal’s Value Function as \( q \) Changes
Main Results

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1. Profitability vs. transferability
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Existing vs. New Technologies

$X^1$: new and superior technology; mixed with infinitely many faked arms $X^3, X^4, \ldots$.

$X^2$: existing technology.

All arms appear independently with prob. $p$ in each period. $X^1$ and $X^2$ are activated by one unit of capital.

Each period, the principal has access to at most one unit of capital.
Existing vs. New Technologies (Cont.)

**Figure:** Optimal Speed of Experimentation
The willingness to explore the technology frontier depends on the relationship status with the partner.

Slow down experimentation as reputation deteriorates.
Main Results

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1. Profitability vs. transferability
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Vertical Integration

Vertical integration is more profitable than the reputation mechanism iff

\[ U - V(W_0) \geq J \]

- \( U = p(qS - \kappa)/(r + pq) \): gross benefit of integration.
- \( V(W_0) \): value of the reputation mechanism.
- \( J \): (unmodeled) cost of integration.
Vertical Integration (Cont.)

Figure: Reputation mechanism vs. vertical Integration
Conclusion

Reputation mechanism facilitates the transfer of tacit technologies.

The frictions (private state; imperfect monitoring) result in:

- (Long-run) heterogeneity in technology adoptions.
- Trade-off between profitability and transferability; bias against new technologies.

A framework to compare various organizational remedies.