

Session 5, Measuring Innovation:
“Measurement of IPR Protection Effect on
International Technology Transfer:
Evidence from Japanese Firm-level Data

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Outline

1. Purpose and motives
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1. Purpose and motives

Purpose:

Empirically test the effect of stronger IPR on increasing international intra-firm and arm's length technology transfer using a sufficient size of firm data.

Motives:

- ***Increasing international technology transaction.***
Stronger IPR encourage not only innovation but also technology transaction.
- ***Conflict between north and south in the WTO/TRIPS context.***
Global stronger IPR increase rent from developing countries to developed countries in short term (McCalman, 2001).
What about cross-border technology transfer that will be benefit to developing countries economy?
- ***Important issue to encourage global innovation.***
Theoretical studies show that global innovation speed depend on whether global IPR protection spur technology transfer from north to south (Helpman, 1993; Lai, 1998; Grass and Saggi, 2002; Grossman and Lai, 2005).

2. Related studies

Economic impact of technology transfer

- Technology transfer affect positively economic growth in host country.
(e.g. Basant and Fikkert, 1996; Braga and Wilmore, 1991; Branstetter and Chen, 2006; Belderbos et al., 2008)

IPR vs Technology transfer

Branstetter et al. (2006), Wakasugi and Ito (2008)

- Technology payments from foreign affiliate to headquarters in home country as a measurement of intra-firm technology transfer.
- Foreign IPR protection increase intra-firm technology transfer by multinational firms.

2. Related studies (cont.)

Nagaoka (2008)

- 1,458 licensing transaction by 217 Japanese firm in 1999FY.
- Stronger IPR protection shift transaction from intra-firm to arm's-length.

Contribution of this paper

- Extend earlier studies using a large size of data.
- Find out relative effect of IPR on intra-firm and arm's-length technology transfer.
- Provide policy implications for the WTO/TRIPS context and global innovations.

3. Hypotheses (cont.)

Strengthening of IPR protection,,,

1. promotes *intra-firm technology transfer* by increasing advantage of knowledge property ownership of multinationals in the host country.
2. raise a contractivity of licensing, and promotes *arm's-length technology transfer* through a technology market.

4. Measurement (1)

1. Measurement of IPR protection

Two methods: institutional index and survey index

Institutional index

“Index of Patent Right” (Ginarte and Park, 1997; Park and Wagh, 2002)

Advantage:

- “Objectivity” based on whether the IPR system of each country fulfills the institutional side.

Disadvantage:

- Covers only patent right.
- Updated every 5 years until 2000.
- The possible gap between actual enforcement and legal provisions (Ito et al. 2007).

4. Measurement (2)

Survey index (World Economic Forum)

“Protection of Intellectual Property Rights” index

- based on annual questionnaire of the IPR protection to more than 10,000 firms.
- Construct the index as an average score for each country.

Advantage:

- Annually available.
- Covers all intellectual property rights.
- Index showing real enforcement of IPR.

Disadvantage:

- “Subjective” index. Do the firms really know the country?
- Difficult to compare serially because of changes in a population surveyed.

4. Measurement (3)

2. Measurement of technology transfer

We have 3 technology transaction data in Japan

(1) “Basic Survey of Japanese Business Structure and Activities” (firm-level data >50 employee)

- Technology payments and receipts data
- Disaggregated over property rights (patent, designs, a utility model right, copyright, software and other)
- Aggregated values for domestic and abroad.

(2) “Survey of Overseas Business Activities” (foreign Japanese affiliate firm-level data: invested capital of 10% or more)

- Royalty payments from foreign affiliate to headquarter.

4. Measurement (4)

(3) “Survey of Research Development”

Definition:

“exchange of technology with abroad in relation to or in the form of patents, know-how and technical guidance”

Advantage

- The total amount for every destinations is available.
- items to affiliates firms (more than 50% investment share) is available from 2001.

This data enable us to examine how a destination-specific factor (e.g. IPR) affect intra-firm(>50%) and arm's-length (<=50%) technology transfer.

5. Empirical study (1)

Trends in technology exports

Table 1: over destinations

- The total amount is increasing by 1.6 times in five years.
- The distribution over countries is heavily skewed (U.S, 45%).
- Arms-length export ratio changes greatly with destinations.

>>Country attributes (e.g. market size, IPR etc.) may have affected the decision of intra-firm and arm's-length.

5. Empirical study (2)

Trends in technology exports

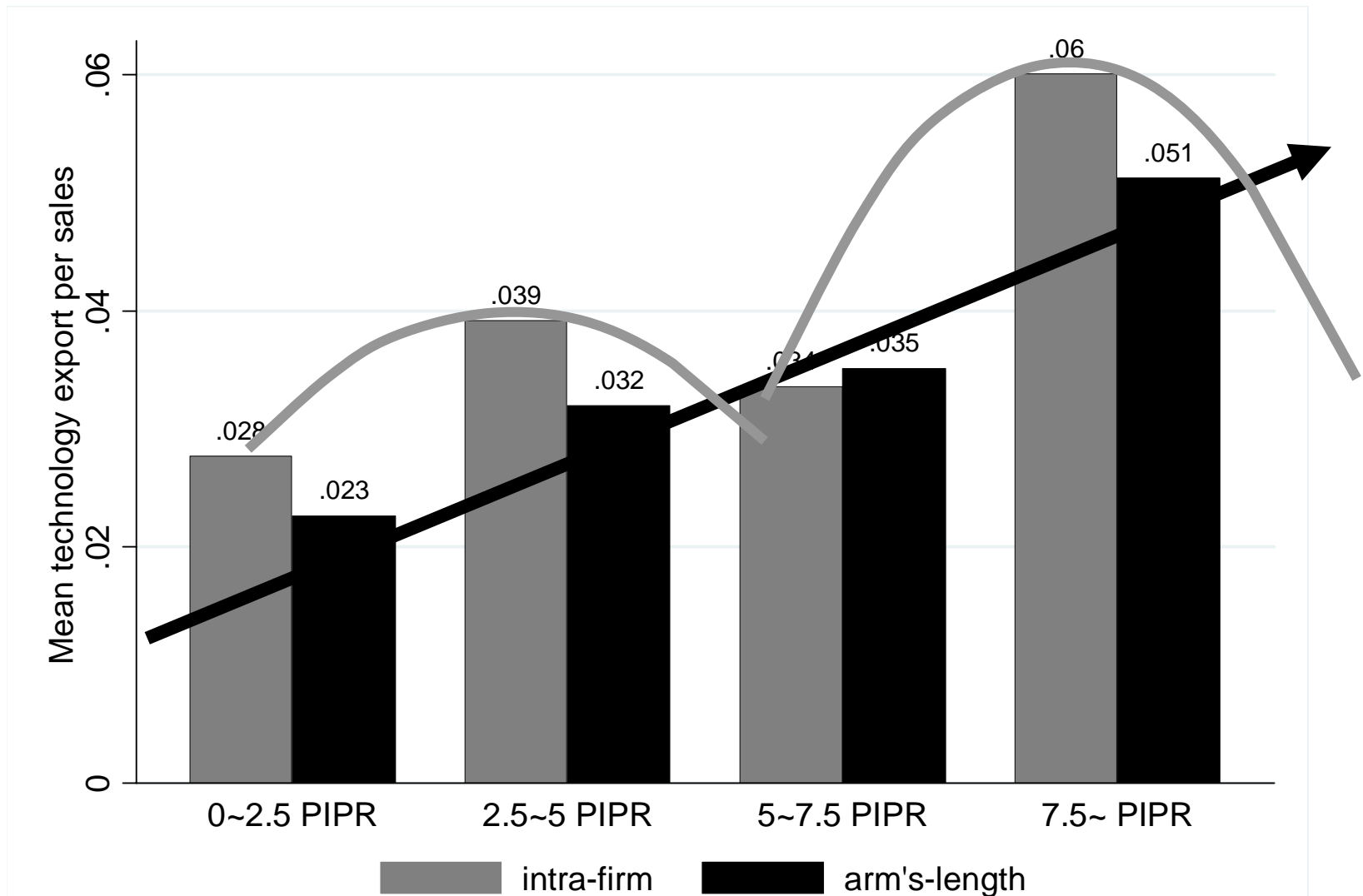
Table 2: over industries

- Transport machinery responsible for more than half.
- Industry with higher patentability has a higher arm's-length ratio (e.g. Pharmaceutical, Chemical).

>>Industry-specific factor should be controlled.

5. Empirical study (4)

Figure 2: IPR vs technology exports



Source: Ito (2008)

5. Empirical study (5)

Empirical Methodology

- Assume that the volume of technology exports is determined by exporting firm attributes F_{it} , and receiving country attributes, H_{jt} .

$$TechExport_{ijt} = f(H_{jt}, F_{it})$$

- Estimate two equations on intra-firm and arm's-length T.T using same set of explanatory variables and check how the IPR effect differ.
- To allow the correlation of error terms between two equations, the SUR (Seemingly Unrelated Regression) procedure is used.

5. Empirical study (6)

$$\begin{aligned}\ln(TechExport_{ijt}) = & \alpha_0 + \beta_1 \ln(PIPR_{jt}) + \beta_2 \ln(GDPPC_{jt}) + \beta_3 \ln(MSIZE_{jt}) + \beta_4 \ln(DIST_{jt}) \\ & + \beta_5 \ln(FDI_{jt}) + \beta_6 (TRADE_{jt}) + \beta_7 (TAX_{jt}) + \beta_8 \ln(FSIZE_{it}) \\ & + \beta_9 \ln(R \& D_{it}) + \beta_{10} (AFF_{it}) + \alpha_t + \varepsilon_{ijt}\end{aligned}$$

- *TechExport*: Intra-firm or arm's-length Technology exports amount from firm *i* to country *j* at time *t*
- *PIPR*: Index of IPR protection (WEF)
- *GDPPC*: GDP per capita (WDI)
- *MSIZE*: Population (WDI)
- *DIST*: Distance from Tokyo to a capital city in receiving country
- *FDI*: FDI openness (WEF)
- *TRADE*: Trade openness as a (exports+imports)/GDP (WDI)
- *TAX*: Corporate tax rate in receiving country (KPMG website)
- *FSIZE*: Total sales of exporting firm (Survey of R&D)
- *R&D*: Total R&D expenditures of exporting firm (Survey of R&D)
- *AFF*: Dummy taking 1 if the exporting firm has an affiliate firm in the receiving country, and 0 if no affiliate firm. (Toyo Keizai Survey)

5. Empirical study (7)

Data samples

- An observation is a pair of exporting firm and receiving country in manufacturing industries from 2001 to 2005.
- **12,142** pairs of 1,207 firms and 33 countries in five years are available to estimate.
- The export amount of this data covers 90% of the total exports in the whole sample.

5. Empirical study (8)

Dependent variable: lnTechExport	[1]		[2]		[3]	
	arm's-length	intra-firm	arm's-length	intra-firm	arm's-length	intra-firm
ln(FSIZE): Total sales	0.539 [0.033]**	0.287 [0.035]**	0.510 [0.040]**	0.507 [0.042]**	0.541 [0.033]**	0.290 [0.035]**
ln(R&D): Total R&D expenditures	-0.012 [0.022]	-0.020 [0.023]	0.017 [0.032]	-0.242 [0.034]**	-0.011 [0.022]	-0.019 [0.023]
AFF: Dummy for ownership of affiliate firm in the country	-2.530 [0.073]**	4.003 [0.077]**	-2.524 [0.073]**	3.959 [0.077]**	-2.537 [0.073]**	3.995 [0.077]**
ln(PIPR): IPR protection	1.175 [0.198]**	-0.339 [0.209]	1.272 [0.214]**	-1.086 [0.225]**	1.228 [0.199]**	-0.276 [0.210]
ln(PIPR* R&Dint): cross term of IPR protection and R&D			-0.102 [0.085]	0.789 [0.089]**		
ln(PIPR)* OECD: cross term of IPR protection and OECD					-0.324 [0.128]*	-0.383 [0.135]**
ln(GDPPC): GDP per capita	0.368 [0.055]**	0.070 [0.058]	0.370 [0.055]**	0.051 [0.058]	0.547 [0.090]**	0.281 [0.095]**
ln(MSIZE): Population size	0.371 [0.041]**	0.439 [0.044]**	0.370 [0.041]**	0.447 [0.043]**	0.331 [0.044]**	0.392 [0.047]**
ln(DIST): Distance from Tokyo to the capital city	-0.685 [0.061]**	0.59 [0.064]**	-0.684 [0.061]**	0.584 [0.064]**	-0.754 [0.067]**	0.508 [0.070]**
ln(FDI): FDI openness index	0.138 [0.265]	-0.682 [0.279]*	0.137 [0.265]	-0.678 [0.278]*	0.258 [0.269]	-0.540 [0.283]
TRADE: Trade openness as a (exports+imports)/GDP	-0.151 [0.070]*	0.603 [0.073]**	-0.151 [0.070]*	0.608 [0.073]**	-0.362 [0.109]**	0.353 [0.115]**
TAX: Corporate tax rate	3.012 [1.289]*	-6.868 [1.360]**	3.027 [1.289]*	-6.982 [1.355]**	3.467 [1.301]**	-6.331 [1.372]**

6. Conclusion

Main findings

- Stronger IPR stimulates arm's-length T.T uniformly.
- The positive effect of IPR on intra-firm T.T is restricted to the firms with high R&D intensity.
- IPR effect on T.T concentrates in Non OECD countries rather than OECD countries.

Implications

- In TRIPS context, Stronger IPR may benefit developing countries through increasing arm's-length T.T.
- Global IPR protection spur T.T. As a result global innovation might be stimulated as suggested by theoretical analyses (e.g. Helpman, 1993; etc.).