TRADE AND INDUSTRIAL POLICY SUBTLETIES WITH INTERNATIONAL LICENSING

by

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Introduction

- Various hybrid forms of organization and competition among rivals
  - Cooperation in some phases of production and competition in other phases
    - Technology transfer
      - Licensing
      - Key inputs
    - Joint venture
    - Service provisions
Introduction

- **Technology transfer between rivals**
  - Mitsubishi Motors Co. → Proton (Malaysian automaker) and Hyundai Motor Co.
  - Japanese steelmakers → POSCO (Korean steelmaker)
  - Japanese and European electronics companies → Samsung Electronics Co.
  - Toyota Motor Co. → Ford Motor Company
  - Samsung Electronics Co. → Apple Inc.
Introduction

- Why firms have incentive to transfer technologies to (potential) rivals?
  - One reason: (Potential) rivals may acquire technologies through R&D

- Which is better for firms with advanced technologies, technology transfer to rival or rival’s R&D?
  - Technology transfer
Purpose

1. To theoretically explore how the availability of both R&D and technology transfer affects optimal trade and industrial policies
   - in the framework of international duopoly
2. To obtain the optimal license fees
   - Non-linear fees (fixed fee + royalty)
Basic structure

Domestic country

Foreign firm

Domestic firm

Good X

Good Y

Market

Rent-shifting

Domestic government

Foreign government

Licensing (fees)

Rent-shifting

Foreign firm

Foreign country

R&D
Standard model  
(Model without interdependency)

Domestic country  
Domestic firm  
Good X  
Good Y  
Market  

Domestic government  

Brander & Spencer (1981, 1984a)

Foreign country  
Foreign firm  

Foreign government  

Subsidy  

Brander & Spencer (1985)  

tariff
Features

- International duopoly
  - Imperfect substitutes
- Foreign production
  - R&D or international licensing
- Intervention
  - Domestic government $\rightarrow$ tariff
  - Foreign government $\rightarrow$ export (production) subsidy
Interesting results

In the case of international licensing

- Domestic government may provide import subsidy instead of tariff

- Foreign government can shift rent from domestic firm
  - by export tax on foreign firm instead of subsidy
  - by R&D subsidy $\rightarrow$ no subsidy payment in equilibrium
Related literature

- Trade policy with technology transfer between rivals
  - Mukherjee & Pennings (*EER*, 2006)
  - Horiuchi & Ishikawa (*RIE*, 2009)
  - Gosh & Saha (*RIE*, 2008)

- Trade policy with R&D
  - Spencer & Brander (*RES*, 1983)
  - Bagwell & Staiger (*JIE*, 1994)
Related literature

- License fees
  - Fixed fee vs royalty
  - Wang (JEB, 2002)
Model: international Cournot duopoly with product differentiation

- Two goods
  - Good X: foreign firm (firm f)
  - Good Y: domestic firm (firm d)
- Utility function
  \[ U = \alpha x + \beta y - \frac{(x)^2}{2} - \frac{(y)^2}{2} - \phi xy + m \]
- Inverse demand
  \[ p_x = \alpha - x - \phi y \]
  \[ p_y = \beta - y - \phi x \]
- Profits with R&D
  \[ \pi^f = (p_x - c_x)x - F \]
  \[ \pi^d = (p_y - c_y)y \]
Stage game

1. Licensing stage
2. Competition stage: Cournot competition
Licensing

- Licensing from *firm d* to *firm f*
  - License fees
    - Take-it-or-leave-it licensing offer
    - Outside option: R&D
    - Patent or key input
Proposition 1 (License fees)

□ Profits with licensing
   \( (\text{non-linear pricing: } r \geq 0, \ R \geq 0) \)

\[
\pi^f = (p_x - c_x)x - (R + rx) \\
\pi^d = (p_y - c_y)y + (R + rx)
\]

□ \( \pi^{d}_L \equiv \max_{r,R} \pi^d; \ s.t. \ \pi^f \geq \pi^f_R, \ r \geq 0, \ R \geq 0 \)

□ 3 cases
   1. Fixed fee (\( R = F > 0 \)) and per-unit royalty (\( r = 0 \))
   2. Fixed fee (\( R = 0 \)) and per-unit royalty (\( r > 0 \))
   3. Fixed fee (\( R > 0 \)) and per-unit royalty (\( r > 0 \))
Proposition 1 (License fees)

- When \( \phi(4B + B\phi^2 - 4A\phi) \leq 0 \) \( (A \equiv \alpha - cy, B \equiv \beta - cx) \)
  \[ r = 0, \quad R = F \]

- When \( \phi(4B + B\phi^2 - 4A\phi) > 0 \)
  \[ r = r, \quad R = 0 \text{ if } r^* \geq r \]

\[ r^* = \frac{-\phi(4B + B\phi^2 - 4A\phi)}{2(3\phi^2 - 4)}, \]
\[ \overline{r} = A - \frac{1}{2}B\phi + \frac{1}{2}\sqrt{\pi^f_\Phi(\phi^2 - 4)}, \]
\[ R^* = \left(\frac{2(A - r^*) - \phi B}{4 - \phi^2}\right)^2 - \pi^f_\Phi. \]
3 types of licensing (Fig. 1)

Fixed fee alone
Royalty alone
Fixed fee & royalty

Licensing arises only in this domain
Intuition

\[ \pi^d = (p_y - c_y)y + (R + rx) \]

\( r \uparrow \rightarrow \text{1\textsuperscript{st} term: profits from producing good Y} \uparrow \)

\( \text{2\textsuperscript{nd term: license revenue from fixed payment} \downarrow} \)

\( \text{3\textsuperscript{rd term: license revenue from royalty ?} \downarrow} \)

\( \phi (4B + B \phi^2 - 4A \phi) \leq 0 \)

\( \rightarrow \text{the effective market size for good Y (B) is small relative to that for good X (A)} \)

\( \rightarrow \text{effect on the 1\textsuperscript{st term is small}} \)

\( \rightarrow \text{set } r=0 \ (\text{firm d actually wants to set } r<0 \text{ which is not allowed}) \)
R&D equilibrium vs Licensing equilibrium

Suppose MCs of production are identical between R&D and licensing

- Licensing increases profits of firm $d$ relative to R&D
  - Revenue from licensing
  - Firm $f$'s effective MC $\uparrow$ if $r > 0$

- Consumer surplus (CS)
  - $r > 0 \Rightarrow$ prices of both goods $\uparrow \Rightarrow$ CS $\downarrow$
Proposition 2 (welfare comparison without intervention: licensing vs R&D)

- If $0 \leq r < 2A/3$, then domestic welfare is higher under licensing than under R&D
  - Tradeoff: domestic firm vs domestic consumers
- Foreign welfare is the same between the licensing case and the R&D case
Stage game with rent-shifting

1. Government intervention stage
   1. Only domestic government intervenes
   2. Only foreign government intervenes
   3. Both governments intervene
2. Licensing stage
3. Competition stage: Cournot competition
Proposition 3 (Optimal intervention by domestic government alone)

- Fixed fee \((R=F>0)\) and per-unit royalty \((r = 0)\)
  - Import subsidy
    - \(r \geq 0, R \geq 0\) \(\Rightarrow\) Subsidy makes the situation just like \(r<0\)
- Fixed fee \((R=0)\) and per-unit royalty \((r > 0)\)
  - A royalty and a tariff are perfect substitutes: \(r + T = r \Rightarrow\) Optimal tariff is not unique
  - R&D could be better than licensing \(\Rightarrow\) Set a tariff so that R&D arises
- Fixed fee \((R>0)\) and per-unit royalty \((r > 0)\)
  - Import subsidy
Figure 2: Optimal tariff with licensing with royalty alone
Proposition 4 & 5 (Optimal intervention by foreign government alone)

Proposition 4

- R&D → export (production) subsidy
- Licensing → export (production) tax

Proposition 5

- Rent-shifting through
  - R&D subsidy
  - Tax on license fees
Export tax on firm $f$

- Reduce room for arbitrage

  $\rightarrow$ indirect rent-shifting

  $\pi_{L\tau}^d \equiv \max_{r, R} \pi^d; s.t. \pi_f^d - \tau x_L \geq \pi_R^d, r \geq 0, R \geq 0$

- $\max_{\tau} \tau x_L; s.t. \pi_{L\tau}^d \geq \pi_R^d$

- Suppose $\pi_f^d - \tau x_L = \pi_R^f$ at $r = R = 0 \& \tau = \tau^*$

  - with $\tau = \tau^*$ firm $f$’s effective MC is $c_f^f + r + \tau = c_f^f + \tau^*$

  and hence $\pi_{L}^d > \pi_R^d$
Profits of firm $f$ under licensing

Loss due to the higher effective MC of firm $f$

$$R = r = 0$$

$$r = \bar{r}, R = 0$$
Production tax under licensing

Firm f

Firm d

License fees

Gain due to the higher effective MC of firm f

Profits of firm d under R&D

Profits of firm f under R&D

License fees

Gain due to the higher effective MC of firm f
Commitment to an R&D subsidy to \( \text{firm } f \)

- \( \pi_R^f < 0 \) could hold
  - No incentive for R&D without subsidy
    \[ \Rightarrow \pi_R^f + \boxed{S} > 0 \]
  - Incentive for licensing
  - Choose \( S \) such that
    \[ \pi_{LS}^d (\equiv \max_{r,R} \pi_{r,R}^d, \text{s.t. } \pi_f^R \geq \pi_R^f + S, r \geq 0, R \geq 0) \geq \pi_R^d \]
    \[ \Rightarrow S=F \]
    \[ \Rightarrow \text{No subsidy payment} \]
- Subsidy \( \Rightarrow \text{Reduce room for arbitrage} \)
Commitment to an R&D subsidy to $firm_f$

- Subsidy
- Profits of firm $f$ under R&D
- Profits of firm $d$ under R&D

Firm $f$  
Firm $d$
Tax on license fees

Firm f

Profile of firm f under licensing
Profile of firm f under R&D

Firm d

Profile of firm d under R&D

License fees
Gain due to the higher effective MC of firm f

Tax on License fees
License fees with foreign intervention

- License fees:
  \[
  \pi_L^d \equiv \max_{r, R} \pi^d; \ s.t. \ \pi^f \geq \pi_R^f, \ r \geq 0, \ R \geq 0
  \]
  1. \[
  \max_{r, R} \pi^d - tx_L; \ s.t. \ \pi^f \geq \pi_R^f, \ r \geq 0, \ R \geq 0
  \]
  2. \[
  \max_{r, R} \pi^d; \ s.t. \ \pi^f - \tau x_L \geq \pi_R^f, \ r \geq 0, \ R \geq 0
  \]
  3. \[
  \max_{r, R} \pi^d; \ s.t. \ \pi^f \geq \pi_R^f + S, \ r \geq 0, \ R \geq 0
  \]
Interventions by both governments

- Domestic government
  - Tariff
- Foreign government
  - Export tax
- Reaction correspondence (curve)
Figure 3: Tariffs and export tax under R&D
Figure 4: Tariffs and export taxes under licensing with a fixed fee alone
Figure 5: Tariffs and export taxes under licensing with a royalty alone
Panel (a)
Figure 5: Tariffs and export taxes under licensing with a royalty alone
Panel (b)
Figure 5: Tariffs and export taxes under licensing with a royalty alone
Panel (c)
Figure 6: Tariffs and export taxes under licensing with both a fixed fee and a royalty.
Interesting results

In the case of international licensing

- Domestic government may provide import subsidy instead of tariff
- Foreign government can shift rent from domestic firm
  - by export tax on foreign firm instead of subsidy
  - by R&D subsidy → no subsidy payment in equilibrium
Remarks

- Other policies → rent-shifting
- Purchase of key intermediate inputs from rival firms instead of licensing
- R&D → externalities
- Bargaining power in the licensing stage
  - Some bargaining power by domestic firm
  - No bargaining power by domestic firm
    - Tiny fixed fee → tariff reduction
Remarks

- 3rd country market
  - Domestic policy: export subsidy $\rightarrow$ export tax
- Incentive to lower tariffs
  - To "benefit" domestic firm and raise domestic welfare