Multinationals and the Globalization of Production

Internalization: Licensing II

Penn State // Fall 2016

Administrative things

- Please sign in to Arkaive.com
- Final exam
  - Tuesday December 13, 2:30PM–4:20PM
  - Willard 073
- Materials coming your way…
  - Ungraded problem set #5 (covers holdup, licensing) ✓
  - Practice final exam — will be posted this afternoon

Final exam

- Place/Time
  - Tuesday 12/13/2016
  - 2:30PM–4:20PM (get here 5 minutes early)
- Calculator + 2 pages of notes
- Review Thursday 12/8/2016
- Office hours
  - Monday 12/12/2016 10AM–Noon, 4PM–6PM
  - Tuesday 12/13/2016 10AM–Noon

Exam format

1. Regular-length (1:15) exam covering material since last exam
   - Location: Taxes
   - Internalization: Contracting
   - Internalization: Licensing
2. Cumulative mini-exam (0:35) made up of
   - 2 short-answer “high-level” questions
   - 1 long-form “calculation” question

Cumulative questions

- Short-answer "high-level"
  - Short-answer: not more than 4 or 5 sentences
  - High-level: conceptual questions, not calculation questions
  - Still useful to have models to help frame answers

Example: "Give two motives for foreign direct investment. For each one: i) discuss the gains from FDI and the costs; ii) give an example of a firm (or industry) that uses FDI for that reason"

Cumulative questions

- Calculation questions
  - Same as in regular exams: some calculation, some writing
  - Will be a bit shorter than on regular exams
  - Will be either:
    - **Heterogeneous-firm HFDI/export platform** or
    - **VFDI model**
  - Example: plenty in exams I, II, and the practice exams...

Roadmap

- Past: Where do firms locate?
  - FDI for market access (Horizontal/Export platform)
  - FDI for factor cost savings (Vertical)
  - FDI for tax motives
- Present: Why do firms own affiliates?
  - Why not purchase from another firm?
  - Why not license to another firm?
  - Today: Technology diffusion and licensing

OLI framework

- Being a multinational comes with costs
- What are the benefits?
- For a firm we ask what *advantage* comes from
  - ownership? [Patents, brands, good ideas…]
  - location? [HFDI, VDFI, tax FDI]
  - internalization?

What is the benefit from **owning** the foreign producer?

Technology diffusion

- Licensee works with the new technology
- Over time, learns how the technology works
- Licensee tempted to break contract, produce on its own
  - Again, inability to write enforceable contracts

- How easy can the technology be transferred?
- How easy can the technology be "stolen?"
- These tend to be bigger problems in developing countries

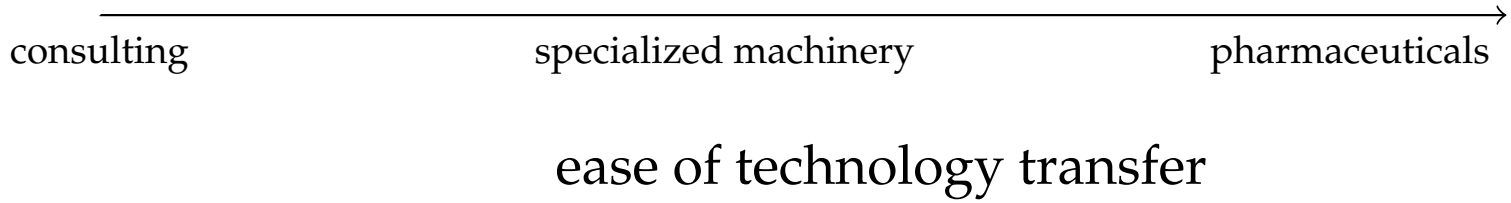
Underlying problems

- Problems often due to country-level factors
- Often severe in developing countries: Brazil, China, India, Russia…

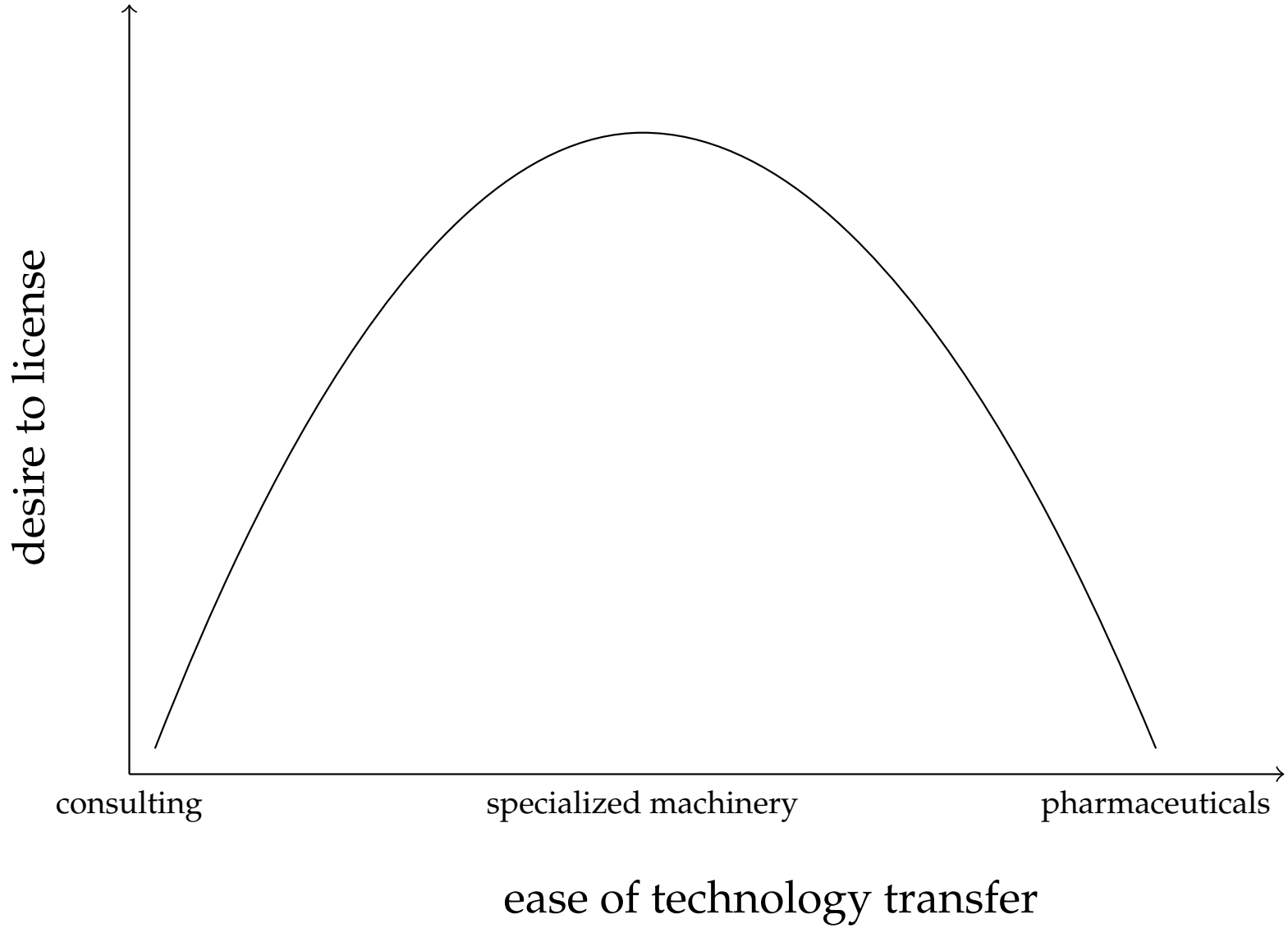
"Many issues are the same: poor legal environments for IPR [intellectual property rights], protectionist industrial policies, and a sense that IP [intellectual property] theft is justified by a playing field that benefits developed countries."

– IP Commission Report

Ease of technology transfer



Desire to license



A model of licensing

- When should a firm license? Integrate?
- How should the license agreement look?
- Model similar to hold up model in some ways
  - Final good firm; potential licensee (supplier)
  - Need supplier to produce an intermediate
  - Final good firm owns the final good technology
  - **Contracts are still not enforceable**
- Model differences
  - Dynamic: Two periods, t and $t+1$
  - Need exactly one unit of m to produce (simplification)
  - One unit of m generates revenues R

Integrated firm

- Final good firm produces $m = 1$ and the final good
- Costs γp_m per unit of m
- Cost to "support" final good technology is f
- Final good firm profit when integrated

$$\pi_F^I = (R - \gamma p_m - f) + \frac{(R - \gamma p_m - f)}{1 + r}$$

- Prices, revenues, and costs same in t and $t + 1$
- Firm discounts the future at rate $1 + r$

Licensing: Final good firm

- Licensee pays the final-good firm L_t and L_{t+1}
- Final-good firm still pays tech support f
- Final-good firm pays cost of transferring tech T
- Final-good firm profit when licensing

$$\pi_F = (L_t - f - T) + \frac{(L_{t+1} - f - T)}{1 + r}$$

- License fees may differ in t and $t + 1$

- Final-good firm no longer produces

Licensing: Licensee

- Is the *residual claimant* of final-good revenue
- Profit of licensee if licenses for both periods

$$\pi_S = (R - p_m - L_t) + \frac{(R - p_m - L_{t+1})}{1 + r_S}$$

- Licensee may have different interest rate

Licensing: Licensee defection

- Contracts / IPR not enforceable
- After t, licensee learns how to use the final-good tech...
- ...but not as well. Pays $f^S > f$ to support tech
  - f^S vs. f is the ease of "stealing" the tech
- Profit of a one-period licensee (D for defect)

$$\pi_S^D = (R - p_m - L_t) + \frac{\left(R - p_m - f^S\right)}{1 + r_S}$$

Incentive compatibility

- Since the license contract is not enforceable, it must be structured in a way that makes the licensee not want to defect
- We say the contract must satisfy the licensee's *incentive compatibility constraint*
- It must be better for the licensee to stay in the contract than to defect

$$\pi_S \geq \pi_S^D$$

- From the definition of the two profit functions

$$L_{t+1} \leq f^S$$

- The best choice for the final-good firm is $L_{t+1} = f^S$

Licensee profit

- In the incentive compatible contract

$$\pi_S = (R - p_m - L_t) + \frac{\left(R - p_m - f^S\right)}{1 + r_S}$$

- What is L_t?

License fee in t

- Many ways to sell license
- Our assumption: Many potential licensees
- Final-good firm takes bids from potential licensees
- Drives value of contract for licensee to zero

$$\begin{aligned} \pi_S &= (R - p_m - L_t) + \frac{\left(R - p_m - f^S\right)}{1 + r_S} = 0 \\ L_t &= (R - p_m) + \frac{\left(R - p_m - f^S\right)}{1 + r_S} \end{aligned}$$

Integrate or license?

- Our usual discrete choice: Which provides higher profits?

$$\pi_F^I \geq \pi_F$$

$$(R - \gamma p_m - f) + \frac{(R - \gamma p_m - f)}{1 + r} \geq (L_t - f - T) + \frac{(L_{t+1} - f - T)}{1 + r}$$

$$(R - \gamma p_m - f) + \frac{(R - \gamma p_m - f)}{1 + r} \geq \left((R - p_m) + \frac{\left(R - p_m - f^S\right)}{1 + r_S} - f - T \right) + \frac{\left(f^S - f - T\right)}{1 + r}$$

In-class example I

- Take 5 minutes, work with neighbors
- $R = 5, p_m = 1, f = 1.1, f^S = 1.2, T = 0.2, r = 0.03, r^S = 0.03, \gamma = 1.4$
- Compute L_t, L_{t+1}, and $V_F = L_t + L_{t+1}/(1 + r)$
- Compute the license agreement surplus = $(R - p_m) + (R - p_m)/(1 + r)$
- Compute π_F^I and π_F, should the firm integrate, or license?

Identical discount rates

- When $r = r^S$ both firms value the future the same
- The final-good firm can extract the entire surplus from the licensee
  - Need $r = r^S$ and $\pi_S = 0$
- Can now simplify the $\pi_F^I \geq \pi_F$ expression

Integrate or license?

- Compare $\pi_F^I \geq \pi_F$. When $r = r^S$,

$$(R - \gamma p_m - f) + \frac{(R - \gamma p_m - f)}{1 + r} \quad \geq \quad \left((R - p_m) + \frac{\left(R - p_m - f^S\right)}{1 + r_S} - f - T \right) + \frac{\left(f^S - f - T\right)}{1 + r}$$

Identical discount rates

- When $r = r^S$ both firms value the future the same
- The final-good firm can extract the entire surplus from the licensee
  - Need $r = r^S$ and $\pi_S = 0$
- Can now simplify the $\pi_F^I \geq \pi_F$ expression

$$T \geq p_m(\gamma - 1)$$

- Integrate when the costs of licensing are greater than the gains from having the supplier produce
- When $T = 0$ the firm always licenses (because the final-good firm extracts all the surplus)

In-class example II

- Take 5 minutes, work with neighbors
- $R = 5, p_m = 1, f = 1.1, f^S = 1.2, T = 0.2, r = 0.03, r^S = 0.25, \gamma = 1.4$
- Compute L_t, L_{t+1}, and $V_F = L_t + L_{t+1}/(1+r)$
- Compute the lic. agreement surplus = $(R - p_m) + (R - p_m)/(1+r)$
- Compute π_F^I and π_F, should the firm integrate, or license?
- Compare V_F to the V_F from the last example. Why are they different?

Heterogenous discount rates

- When $r < r^S$ licensor values future more than licensee
- The final-good firm can no longer extract the entire surplus from the licensee
  - Can only extract the licensee's value of the agreement
- Can now simplify the $\pi_F^I \geq \pi_F$ expression

Integrate or license?

- Compare $\pi_F^I \geq \pi_F$. When $r = r^S$,

$$(R - \gamma p_m - f) + \frac{(R - \gamma p_m - f)}{1 + r} \quad \geq \quad \left((R - p_m) + \frac{\left(R - p_m - f^S\right)}{1 + r_S} - f - T \right) + \frac{\left(f^S - f - T\right)}{1 + r}$$

- After some algebra...

$$\left(\frac{R - p_m - f^S}{1 + r} - \frac{R - p_m - f^S}{1 + r^S} \right) + T \left(1 + \frac{1}{1 + r} \right) \geq p_m (\gamma - 1) \left(1 + \frac{1}{1 + r} \right)$$

Integrate or license?

$$\pi_F^I \geq \pi_F$$

$$\left(\frac{R - p_m - f^S}{1+r} - \frac{R - p_m - f^S}{1+r^S}\right) + T\left(1 + \frac{1}{1+r}\right) \geq p_m(\gamma - 1)\left(1 + \frac{1}{1+r}\right)$$

- First term on LHS: loss of surplus to the licensor
  - $r = r^S$ this term is zero
  - $r < r^S$ this term is positive, makes firm more likely to integrate
  - Intuition: Cannot make licensee pay more than **it** thinks the contract is worth
- Second term on LHS: NPV cost of transferring technology
- RHS: NPV of benefit from transferring technology

Integrate or license?

$$\pi_F^I \geq \pi_F$$

$$\left(\frac{R - p_m - f^S}{1+r} - \frac{R - p_m - f^S}{1+r^S}\right) + T\left(1 + \frac{1}{1+r}\right) \geq p_m(\gamma - 1)\left(1 + \frac{1}{1+r}\right)$$

1. Larger f^S makes the costs of licensing smaller

- Harder to steal the technology, more likely to license

2. Larger T makes the costs of licensing larger

- Harder to transfer the technology, less likely to license

3. Larger γ makes the gains from licensing larger

- More gain from licensing makes licensing more likely

In-class example III

- $R = 5, p_m = 1, f = 1.1, f^S = 1.2, T = 0.0, r = 0.03, r^S = 0.25, \gamma = 1.2$

$$\begin{aligned} \pi_F^I &\geq \pi_F \\ \left(\frac{R - p_m - f^S}{1+r} - \frac{R - p_m - f^S}{1+r^S}\right) + T\left(1 + \frac{1}{1+r}\right) &\geq p_m(\gamma - 1)\left(1 + \frac{1}{1+r}\right) \end{aligned}$$

Licensing summary

- Licensing is another way that firm cannot use its ownership advantages (patents, production processes, trade secrets) without internalizing the transaction
- Licensing eliminates the incentive problem that leads to under-production in the contracting model
- When the licensee can break the licensing agreement, the licensor needs to worry about technology "leakage"
- License agreement is front loaded: must decrease license payments in the future to keep licensee from defecting from the agreement
  - This is a *self-enforcing* contract

Licensing summary

- License agreement (and whether to license or integrate) depends on
  - Gain from licensing γ
  - Cost of technology transfer T
  - Discounting r vs. r^S
  - When $r \neq r^S$ also depends on f^S and R
- Cost of licensing vs. benefit from licensing
- When discount rates do not agree, depends on the licensee's value of future profit