Multinationals and the Globalization of Production

Internalization 2

Penn State // Fall 2016

Administrative things

- Please sign in to Arkaive.com
- Final exam
  - Tuesday December 13, 2:30PM–4:20PM
  - Willard 073
  - Will discuss format, cumulative stuff 12/6
- Materials coming your way…
  - Ungraded problem set #5 (covers holdup, licensing)
  - Practice final exam

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?
  - Today: finish hold-up problems and contracts

  - Why not license to another firm?
  - Today: start technology diffusion

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?

A hold-up model

- A final-good firm i owns the final good production function

$$q = A_i m^\alpha$$

- Need components m to produce (if $m = 0$, then $q = 0$)
- Sell the final good for price p

Components

Relationship specificity. The components are relationship specific. The components are specially tailored to the final-good firm's application. The components have no value to anyone else but the final-good firm.

Difficult verification. It is difficult to verify the quality of the components. The final-good firm and the supplier can judge the quality of the components, but outside parties — like a court — cannot.

- This will make contracting difficult

Component costs

- A potential *supplier* firm can produce components for cost p_m per unit
- The final-goods firm can produce components
  - Cost of γp_m per unit, $\gamma > 1$
  - Fixed cost of operating the production line f^I
- Buying from a supplier is "cheaper," but not necessarily the best…

Hold up

- No contract + relationship specificity $\rightarrow$ hold up problem
- After components are produced:
- Final-good firm: "these components are junk, lower your price"
  - Supplier has already incurred cost of producing
  - Parts have no value to other firms
- Supplier: "you need my components to produce, raise the price"
  - $m = 0 \rightarrow q = 0$
- Firms will resort to bargaining

Final-good firm choices

- Given this setup, firm can choose to
  1. **Integrate**. Both stages of production are done within the final good firm.
  2. **Outsource**. Contract with an arm's-length firm (the supplier) to produce the components and produce the final good in house.
- Firm will choose whichever structure maximizes profit
- We will study 3 choice problems

  0. Complete contracts (set a benchmark, not available to the firms)

  1. Outsourcing

  2. Integration

Complete contracts: Best-case scenario

- Suppose we could write complete and enforceable contracts
- Such a contract would maximize joint profit
  - Would need a rule for splitting the joint profit
  - We do not need to know the profit split
  - We only want to know the "best" choice of m
- Provides a benchmark to measure the distorted decisions in the no-contracts case

Complete contracts: Best-case scenario

- Choose m to maximize joint profit

$$\max_{m} \quad \pi_F + \pi_S = pA_i m^{\alpha} - p_m m.$$

- First-order condition

$$\alpha p A_i m^{\alpha-1} - p_m = 0$$

- Solution is the amount of m that delivers the most joint profit

$$m^* = \left(\frac{\alpha p A_i}{p_m} \right)^{\frac{1}{1-\alpha}}$$

Option 1: Outsourcing

- What are profits if the final-good firm buys from the supplier?
- Contracts are not possible
  1. The supplier chooses how much m to produce.
  2. The final good firm and supplier bargain over the revenue the components will generate.
  3. The final good is made and sold at price p.
  4. The revenue from selling the final good is split between the two firms according to the deal struck in step 2.

- We are assuming the deal reached in 2. is enforceable
  - Outsider can observe revenue earned from selling q

Bargaining

- How does bargaining work?
- Potentially very complicated
- Something simple
  - Supplier has bargaining power $\beta \in [0, 1]$
  - Final-good firm has bargaining power $1 - \beta$
- The outcome of a *Nash Bargaining* protocol yields
  - Supplier gets share β of revenue
  - Final-good firm gets share $1 - \beta$ of revenue

Supplier choice problem

- Supplier understand it gets β of future revenues
- Choose m to maximize its profits (not joint profits!)

$$\max_{m} \quad \pi_S = \beta p A_i m^\alpha - p_m m$$

- First-order condition

$$\alpha \beta p A_i m^{\alpha-1} - p_m = 0$$

- Solution

$$m^B = \left(\frac{\alpha \beta p A_i}{p_m} \right)^{\frac{1}{1-\alpha}}$$

Underprovision of m

- The suppliers choice is

$$m^B = \left(\frac{\alpha\beta p A_i}{p_m}\right)^{\frac{1}{1-\alpha}} = \beta^{\frac{1}{1-\alpha}} \left(\frac{\alpha p A_i}{p_m}\right)^{\frac{1}{1-\alpha}} = \beta^{\frac{1}{1-\alpha}} m^*$$

- Since $\beta < 1$ and $\alpha < 1 \rightarrow \beta^{\frac{1}{1-\alpha}} < 1$

- The supplier does not produce as many components (or enough quality) because it knows it cannot earn its full value in the bargaining stage

Option 2: Integrate the firm

- Final good firm produces components
- Avoids hold-up bargaining problem, pays higher costs
- Final-good firm chooses m to solve

$$\max_{m} \quad \pi_F = pA_i m^{\alpha} - \gamma p_m m - f^I$$

- First-order condition

$$\alpha p A_i m^{\alpha} - \gamma p_m = 0$$

- Solution

$$m^I = \left(\frac{\alpha p A_i}{\gamma p_m} \right)^{\frac{1}{1-\alpha}}$$

Choice of m

- The final-good firm chooses

$$m^I = \left(\frac{\alpha p A_i}{\gamma p_m}\right)^{\frac{1}{1-\alpha}} = \left(\frac{1}{\gamma}\right)^{\frac{1}{1-\alpha}} m^*$$

- Again, less m is chosen compared to m^*
- The reason is different, though,
  - Incentives are aligned: marginal revenue = marginal cost
  - Marginal cost is higher $\gamma > 1$

Taking stock

- Best-case (but unobtainable) m

$$m^* = \left(\frac{\alpha p A_i}{p_m}\right)^{\frac{1}{1-\alpha}}$$

- When outsourcing, distorted by bargaining

$$m^B = \beta^{\frac{1}{1-\alpha}} m^*$$

- When integrating, face higher costs

$$m^I = \left(\frac{1}{\gamma}\right)^{\frac{1}{1-\alpha}} m^*$$

- Both options generate smaller joint profit than the best-case

Numerical example

- $\alpha = 0.75$, $A = 2$, $p_m = 1.1$, $p = 1.5$, $\beta = 0.7$, $\gamma = 1.3$, $f^I = 0.25$
- Complete contracts solution

$$m^* = 17.5, q^* = 17.1, R^* = 25.7, \pi^* = 6.45$$

- Outsource and bargain solution

$$m^B = 4.2, q^B = 5.9, R^B = 8.8, \pi_F^B = 2.64, \pi_S^B = 1.53, \pi^F = 4.17$$

- Integrated firm solution

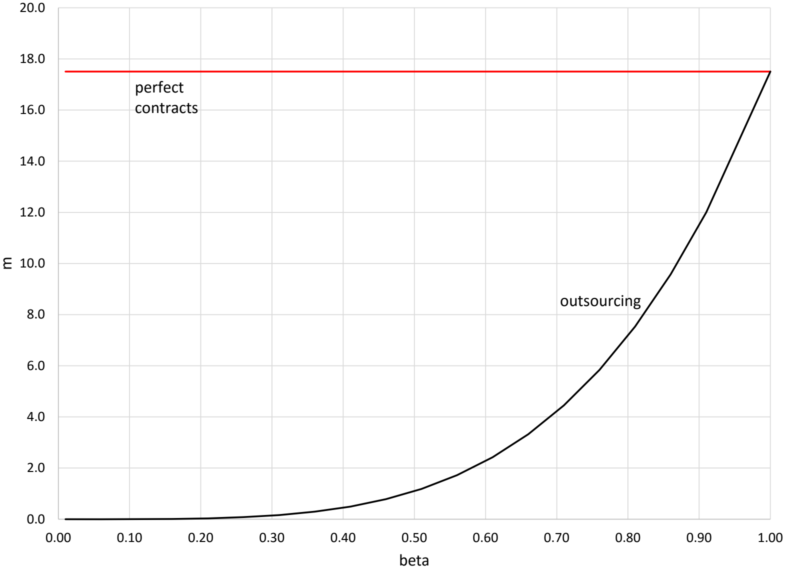
$$m^I = 6.1, q^I = 7.8, R^I = 11.7, \pi_F^I = 2.73$$

- Bargaining destroys joint profit (6.5 vs. 4.2)
- Firm chooses to integrate ($2.7 > 2.6$)

Bargaining power effects

- β is not a choice in this model
- But we can learn more about the model by changing β

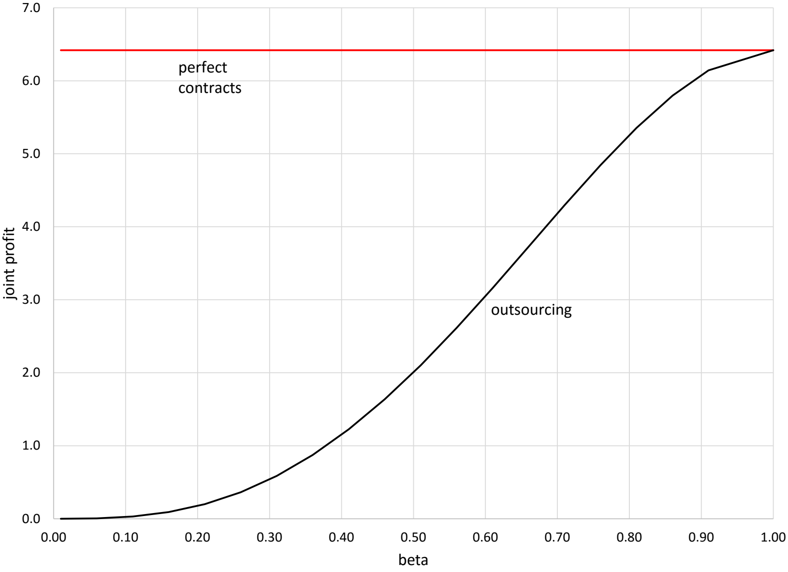
Input choice and β



Bargaining power effects

- β is not a choice in this model
- But we can learn more about the model by changing β
- As we increase β
  - Supplier delivers more inputs ($\beta = 1 \rightarrow m = m^*$)

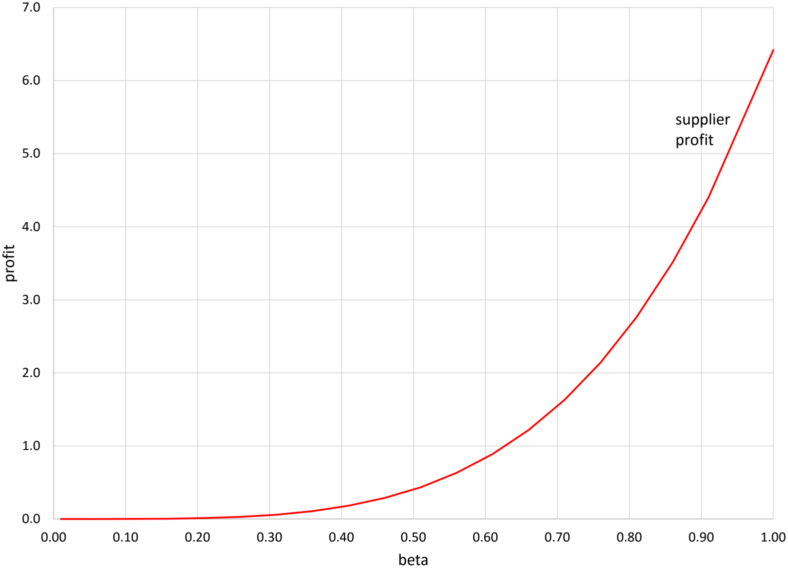
Joint profit and β



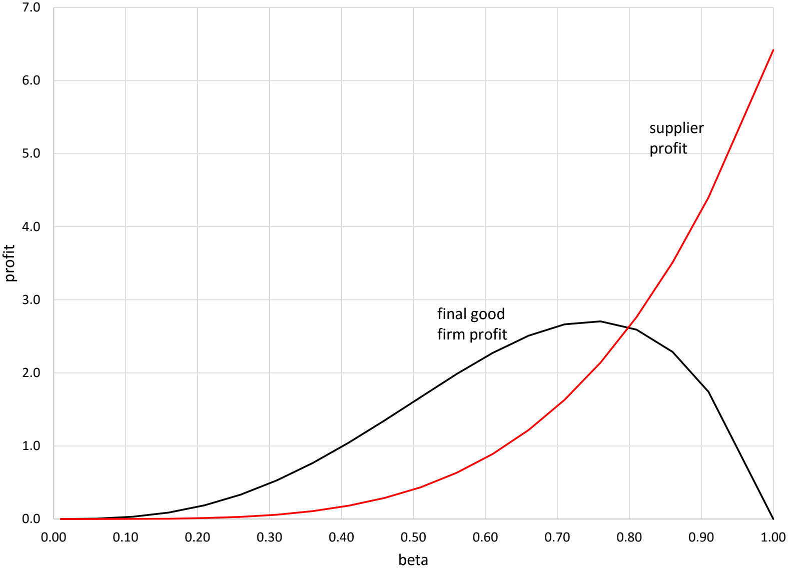
Bargaining power effects

- β is not a choice in this model
- But we can learn more about the model by changing β
- As we increase β
  - Supplier delivers more inputs ($\beta = 1 \rightarrow m = m^*$)
  - Joint profit increases ($\beta = 1 \rightarrow \pi_F^B + \pi_S^B = \pi_F^* + \pi_S^*$)

Profit and β



Profit and β



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- As we increase β
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  - Joint profit increases ($\beta = 1 \rightarrow \pi_F^B + \pi_S^B = \pi_F^* + \pi_S^*$)
  - Supplier profit increases
  - Final-good firm profit increases, then decreases

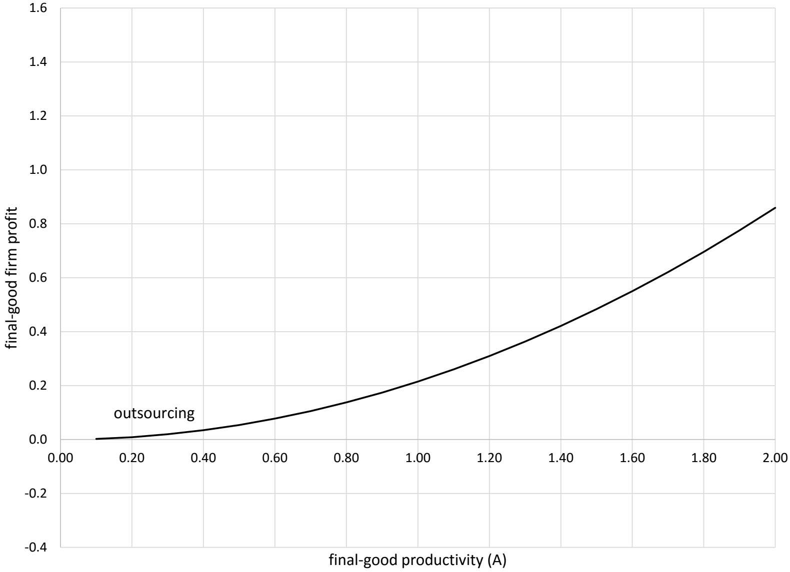
Bargaining power

- Tension between two forces
    1. Increase $\beta \rightarrow$ improve supplier incentives
    2. Increase $\beta \rightarrow$ give up share of revenues
- When β is low, 1. dominates
- When β is high, 2. dominates

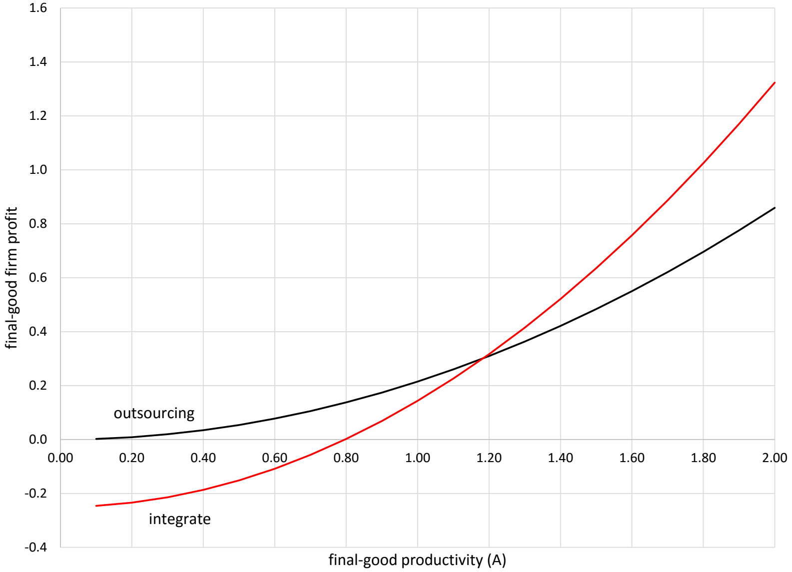
Final-good firm productivity

- Final-good firms differ by productivity, A_i
- Increasing A increases profit level, π_F
- Fixed cost of component production
- Leads to "cutoff" productivity for make/buy decision

Final-good firm profit and productivity



Final-good firm profit and productivity



Apple

- Apple Inc., does not own Foxconn
- iStuff manufacturing requires very specialized equipment
  - A relationship-specific investment
  - Subject to under-investment by Foxconn
- Apple invests in equipment instead of Foxconn
  - Buys/build equipment, places it in Foxconn
  - Could lead Foxconn to hold up Apple
- Apple "CapEx" $\approx$ 10 bil. USD per year ($\approx$ GM CapEX)
- Bonus: Use tax-deferred foreign profits to make investments!
- Not Apple's only reason to own equipment...

Summary

- When contracts are difficult to enforce…
  - Poor enforcement from government
  - Hard to verify contract parameters
- …and investment is relationship specific
- Hold-up problems tend to lead to under-investment
- Ex post bargaining distorts firm incentives
- Inefficient production shrinks joint profit
- Solutions
  - Integrate all production into the firm
  - Firm with more bargaining power makes bigger investment
  - Next up: License the technology

Technology transfer

- Problem with outsourcing
  - Downstream firm was residual claimant [earned $(1 - \beta)R$]
  - Distorts incentives of the supplier firm
- A possible solution is to license the final-good technology
  - Supplier (licensee) pays final-good firm a license fee
  - Final-good firm (licensor) gives licensee its technology
  - Supplier is now the residual claimant $\rightarrow$ incentive aligned
- Nice! What could go wrong?

Technology diffusion

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

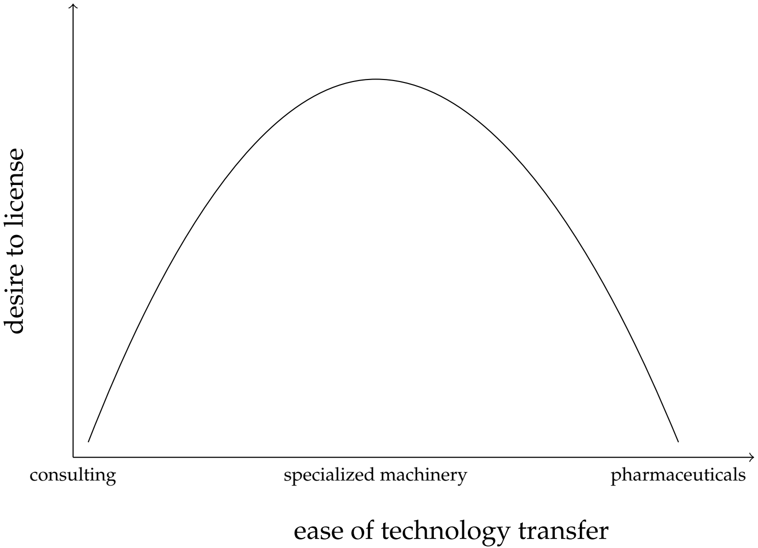
- How easy can the technology be transferred?
- How easy can the technology be "stolen?"

Complete fragmentation

consulting — specialized machinery — pharmaceuticals →

ease of technology transfer

Complete fragmentation



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 cost same in t and $t + 1$
- Firm discounts the future at rate $1 + r$

Aside: Discounting

- The one-period interest rate is r
- To have \$100 in $t+1$, I invest $x = 100/(1+r)$ in t
- So \$100 in $t+1$ is worth the same as $100/(1+r)$ at t
- Dividing future values at the appropriate interest rate makes them comparable to present values
- Example $r = 0.05$
  - \$100 in $t+1$ is worth $100/1.05 = \$95.24$ at t
- The greater is the interest rate, the less I care about the future
  - $r = 0.2 \rightarrow \$100/1.2 = \$83.3$

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 $t + 1$

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

- 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

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

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