Multinationals and the Globalization of Production

Final Exam Review

Penn State // Fall 2016

Administrative things

- Arkaive.com course code: 3D0Y
  - Please sign in
- Old problem sets, exams
  - Pick up from up front
- Final exam
  - Tuesday 12/13/2016 2:30PM-4:20PM
  - Willard 073
- Course evaluations

Final exam: Tuesday 12/13

- Exam duration is 110 minutes
- We will start on time; arrive early
- Bring
  - Calculator
  - Two pages of notes (8.5″x11″)
  - No wireless devices or other materials
- Show your work!

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 6 or 7 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

- Big picture
    1. **1.** Horizontal FDI model
    2. **2.** Vertical FDI model
    3. **3.** Taxes and MNEs
    4. **4.** Incomplete contracts, outsourcing, and holdup
    5. **5.** Licensing

Heterogeneous firm model

- Horizontal FDI: export or use a foreign affiliate?
  - Trade costs vs fixed costs of production
- Firms differ in productivity φ
- More productive firms have lower prices, larger shares
- Better firms more likely to be MNEs
- Parameters:
  - wage w;
  - elasticity ϵ;
  - trade cost τ;
  - expenditure E,
  - fixed cost to export f^e;
  - fixed cost to produce in foreign country f^p

Horizontal FDI with heterogeneous firms

- Shares depend on firm productivity (through price)

$$p_e = \frac{w_1}{\varphi}\frac{\epsilon_2}{\epsilon_2 - 1}(1+\tau) \qquad p_m = \frac{w_2}{\varphi}\frac{\epsilon_2}{\epsilon_2 - 1}$$

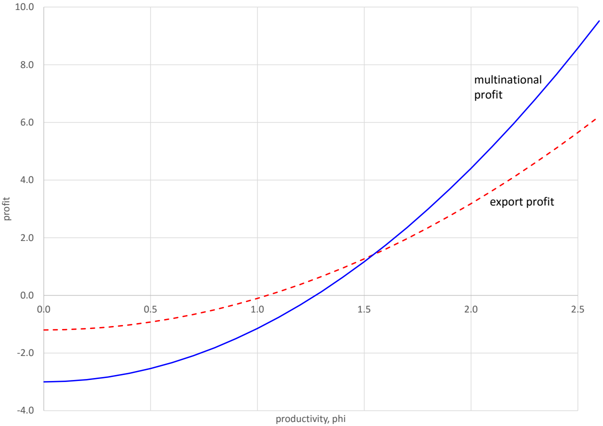
- Export profit

$$\pi_1^e(\varphi) = \left(\frac{\epsilon_2}{\epsilon_2 - 1}\frac{1}{\varphi}w_1(1+\tau)\right)^{1-\epsilon_2}\frac{E_2}{\epsilon_2} - w_1 f^e$$

- Multinational profit

$$\pi_1^m(\varphi) = \left(\frac{\epsilon_2}{\epsilon_2 - 1}\frac{1}{\varphi}w_2\right)^{1-\epsilon_2}\frac{E_2}{\epsilon_2} - w_2 f^p$$

Profits and productivity



- Which firms export? Which firms become MNEs?

Heterogeneous firm model, low productivity

- $w_1 = w_2 = 2$, $E_2 = 50$, $\epsilon_2 = 3$, $f^p = 1.5$, $f^e = 0.6$, $\tau = 0.3$
- Let $\varphi = 1.5$. Compute p_e, p_m. Should the firm export to serve the foreign market or use a foreign affiliate?

Heterogeneous firm model, high productivity

- $w_1 = w_2 = 2, E_2 = 50, \epsilon_2 = 3, f^p = 1.5, f^e = 0.6, \tau = 0.3$
- Let $\varphi = 2.0$. Compute p_e, p_m. Should the firm export to serve the foreign market or use a foreign affiliate?

Vertical FDI model

- Factor price differences encourage VFDI
- Costs of trading goods limits VFDI

- The final good is made up of two parts
  1. Component parts b (b for circuit *boards*)
  2. Assembly services a
- 1 unit of parts and 1 unit of assembly combine to make the final good
- The unit cost of the final good is

$$c(w_u, w_s) = c_a(w_u, w_s) + c_b(w_u, w_s)$$

Vertical FDI model

- $\theta_{ua} = 5$ and $\theta_{sa} = 1$; $\theta_{ub} = 1$ and $\theta_{sb} = 10$ [b is skill-intensive]
- Two countries that differ by wages
  - Country 1: $w_u^1 = 10$ (\$/h) and $w_s^1 = 20$ (\$/h)
  - Country 2: $w_u^2 = 2$ (\$/h) and $w_s^2 = 30$ (\$/h)
- Two trade costs
  - τ_b = cost of shipping good b
  - τ = cost of shipping final good
- What firm structure delivers the lowest cost final good in each country?

Possible firm structures

1. Do a and b in each country (HFDI)

$$c^1 = c_a(w_s^1, w_u^1) + c_b(w_s^1, w_u^1)$$
$$c^2 = c_a(w_s^2, w_u^2) + c_b(w_s^2, w_u^2)$$

2. Do a and b in country 1, export to country 2

$$c^1 = c_a(w_s^1, w_u^1) + c_b(w_s^1, w_u^1)$$
$$c^2 = \left[c_a(w_s^1, w_u^1) + c_b(w_s^1, w_u^1)\right](1+\tau)$$

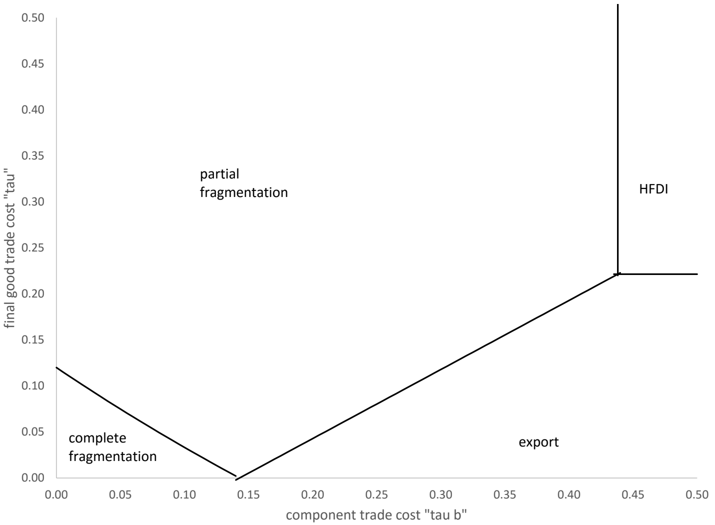
3. Do b in country 1, both countries do a

$$c^1 = c_a(w_s^1, w_u^1) + c_b(w_s^1, w_u^1)$$
$$c^2 = c_a(w_s^2, w_u^2) + c_b(w_s^1, w_u^1)(1+\tau_b)$$

4. Do b in country 1, do a in country 2 and ship final good to 1

$$c^1 = \left[c_a(w_s^2, w_u^2) + c_b(w_s^1, w_u^1)(1+\tau_b)\right](1+\tau)$$
$$c^2 = c_a(w_s^2, w_u^2) + c_b(w_s^1, w_u^1)(1+\tau_b)$$

How trade costs shape firm structure



Where to produce?

- $\theta_{ua} = 4$ and $\theta_{sa} = 1$; $\theta_{ub} = 1$ and $\theta_{sb} = 6$
- $w_u^1 = 5$, $w_s^1 = 20$, $w_u^2 = 2$, $w_s^2 = 30$, $\tau_b = 0.15$, $\tau = 0.10$

- How should the firm structure itself?

Possible firm structures

1. Do a and b in each country (HFDI)

   $c^1 = c_a(w_s^1, w_u^1) + c_b(w_s^1, w_u^1)$

   $c^2 = c_a(w_s^2, w_u^2) + c_b(w_s^2, w_u^2)$

2. Do a and b in country 1, export to country 2

   $c^1 = c_a(w_s^1, w_u^1) + c_b(w_s^1, w_u^1)$

   $c^2 = \left[c_a(w_s^1, w_u^1) + c_b(w_s^1, w_u^1)\right](1+\tau)$

3. Do b in country 1, both countries do a

   $c^1 = c_a(w_s^1, w_u^1) + c_b(w_s^1, w_u^1)$

   $c^2 = c_a(w_s^2, w_u^2) + c_b(w_s^1, w_u^1)(1+\tau_b)$

4. Do b in country 1, do a in country 2 and ship final good to 1

   $c^1 = \left[c_a(w_s^2, w_u^2) + c_b(w_s^1, w_u^1)(1+\tau_b)\right](1+\tau)$

   $c^2 = c_a(w_s^2, w_u^2) + c_b(w_s^1, w_u^1)(1+\tau_b)$

Where to produce?

- $\theta_{ua} = 4$ and $\theta_{sa} = 1$; $\theta_{ub} = 1$ and $\theta_{sb} = 6$
- $w_u^1 = 5$, $w_s^1 = 20$, $w_u^2 = 2$, $w_s^2 = 30$
- Suppose $\tau_b = 0.0$, $\tau = 0.0$
- How should the firm structure itself? [Don't compute anything!]

Tax principles

Residence principle Taxpayer's residence is the basis for taxation. For firms, this is typically the country in which the firm is incorporated. Walmart's residence in the United States.

Source principle Where the income is earned is the basis for taxation. Walmart earns income in the United States and Mexico.

- US taxes its firms on residency basis and foreign firms on source basis
  - Walmart pays US tax on its total income — wherever it is earned.
  - Toyota only pays US tax on the income it earns in the US.
- Foreign profit is taxed when it is repatriated

Foreign tax credits

- If $\tau^H \geq \tau^F$, then $C = \tau^F \pi^F$

$$T = \tau^H \left(\pi^H + \pi^F\right) - \tau^F \pi^F + \tau^F \pi^F = \tau^H \left(\pi^H + \pi^F\right)$$

- If $\tau^H < \tau^F$, then $C = \tau^H \pi^F$

$$T = \tau^H \left(\pi^H + \pi^F\right) - \tau^H \pi^F + \tau^F \pi^F = \tau^H \pi^H + \tau^F \pi^F$$

- Why two different rules?

Practice question

- $\pi^H = 75$, $\pi^F = 25$, $\tau^H = 0.35$, $\tau^F = 0.45$
- What is the value of C?
- What is the firm's total tax rate, $\tau = T/(\pi^H + \pi^F)$?
- What are the tax revenues for F and H?

Tax strategy

- Focus on US tax system

1. Do not repatriate foreign profit
    - Wait for repatriation tax holiday
2. Earn profit in low-tax countries
    - Transfer pricing
    - Intangible asset location
    - Inversions

Outsourcing and incomplete contracts

- Final good firm $q = Am^{\alpha}$
- Needs components m
- Potential supplier produces m at cost p_m
- Final good firm produces m at cost γp_m per unit, fixed cost f^I

- No contract + relationship specificity $\rightarrow$ hold up problem
- After components are produced, both firms want to renegotiate
- No contract enforceable, so bargain after production

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

- 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

- 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

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

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

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

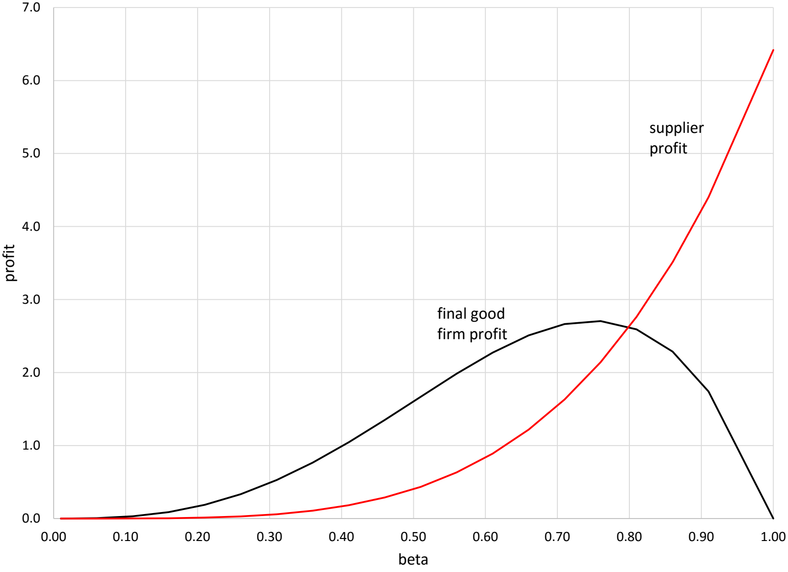
- Solution

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

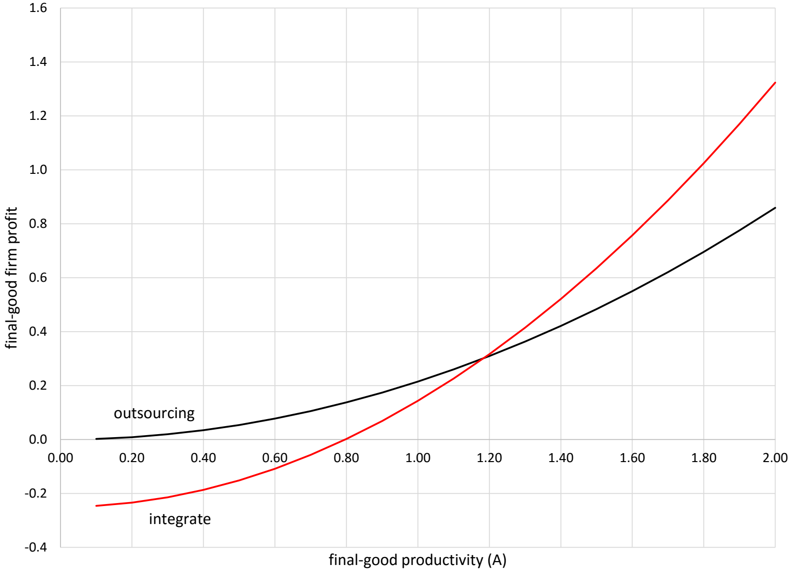
Practice question

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

Profit and β



Final-good firm profit and productivity



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

- Profit of licensee if licenses for both periods

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

- If licensee leaves the contract after t

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

- So any incentive-compatible (or self-enforcing) contract has $L_{t+1} = f^S$

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

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

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

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

Practice question ($r = r^S$)

- $R = 5, p_m = 1, f = 1.1, f^S = 1.2, T = 0.2, r = 0.03, r^S = 0.03, \gamma = 1.4$
- 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

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

- 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)

Different discount rates

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

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

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

Practice question ($r < r^S$)

- $R = 5$, $p_m = 1$, $f = 1.1$, $f^S = 1.2$, $T = 0.2$, $r = 0.03$, $r^S = 0.25$, $\gamma = 1.4$
- 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?