

Multinationals and the Globalization of Production

Vertical FDI 1

Penn State // Fall 2016

Administrative things

- ▶ Arkaive.com course code: 3D0Y
 - ▶ Please sign in
- ▶ Problem set #3
 - ▶ Due end of class, Thursday 10/13
 - ▶ Will be posted on course web tomorrow

Roadmap

- ▶ Building a model of vertical FDI
 - ▶ Break up production across countries
 - ▶ FDI to save on factor costs (factors = inputs)
 - ▶ Need a model with multi-stage production

- ▶ Tuesday: work through the production function

- ▶ Today: how does firm structure depend on transport costs?

Fixed-proportions production function

- ▶ Often called the *Leontief production function*
- ▶ Big idea: Inputs are used in fixed proportions
 - ▶ No ability to substitute inputs
- ▶ Examples (simplified)
 - ▶ 4 tires + 1 motor + 2 windshield wipers = 1 car
 - ▶ 2 sq. yds. denim + 1 zipper + 3 ft. thread = 1 pair jeans
 - ▶ 1 screen + 1 keyboard + 1 case = 1 laptop
- ▶ Too few inputs → no output (car with 3 tires?)
- ▶ Too many inputs → inputs go unused (jeans with two zippers?)

Fixed-proportions production function

- ▶ Two inputs
 - ▶ ℓ_s = skilled labor (wage w_s)
 - ▶ ℓ_u = unskilled labor (wage w_u)
- ▶ Unit input requirements
 - ▶ θ_s = hours of skilled labor needed to make one unit output
 - ▶ θ_u = hours of unskilled labor needed to make one unit output

$$x = \min \left\{ \frac{\ell_u}{\theta_u}, \frac{\ell_s}{\theta_s} \right\}$$

- ▶ The unit cost is

$$c(w_u, w_s) = \theta_u w_u + \theta_s w_s$$

Two stage production

- ▶ 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

$$x = \min \{x_a, x_b\}$$

- ▶ The unit cost of the final good is

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

Factor intensity

- ▶ Two goods, a and b
- ▶ Good a : $\theta_{ua} = 5$ and $\theta_{sa} = 1$
- ▶ Good b : $\theta_{ub} = 1$ and $\theta_{sb} = 10$
- ▶ Good b is *skilled-labor* intensive
 - ▶ Good a skilled to unskilled labor ratio = $1/5$
 - ▶ Good b skilled to unskilled labor ratio = $10/1$
- ▶ Factor intensity is a relative concept

In class problem: Where to produce?

- ▶ $\theta_{ua} = 5$ and $\theta_{sa} = 1$; $\theta_{ub} = 1$ and $\theta_{sb} = 10$
- ▶ Two locations that differ by wages
 - ▶ Location 1: $w_u = 10$ (\$/h) and $w_s = 20$ (\$/h)
 - ▶ Location 2: $w_u = 2$ (\$/h) and $w_s = 30$ (\$/h)
- ▶ What is the unit cost of the final good in location 1?
- ▶ What is the unit cost of the final good in location 2?
- ▶ What is the unit cost of the final good when components and assembly are carried out in the cheapest locations?

Geography

- ▶ Missing from our simple example: trading costs
- ▶ Two trade costs
 - ▶ τ_b = cost of shipping good b
 - ▶ τ = cost of shipping final good
- ▶ Costs of shipping from 1 to 2 = costs of shipping from 2 to 1

Possible firm structures

1. Do a and b in each country (HFDI)
 2. Do a and b in country 1, export to country 2 (export)
 3. Do b in country 1, both countries do a (partial fragmentation)
 4. Do b in country 1, do a in country 2 and ship final good to 1 (complete fragmentation)
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- ▶ We can rule out
 - ▶ Do a and b in country 2, export final good to 1
 - ▶ Do b in country 2, do a in country 1 and ship final good to 2

Structure 1 (HFDI)

country 1



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

no trade

country 2



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

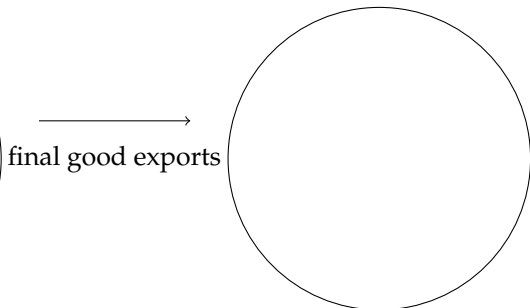
Structure 2 (Export)

country 1



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

country 2



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

Structure 3 (Partial fragmentation)

country 1



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

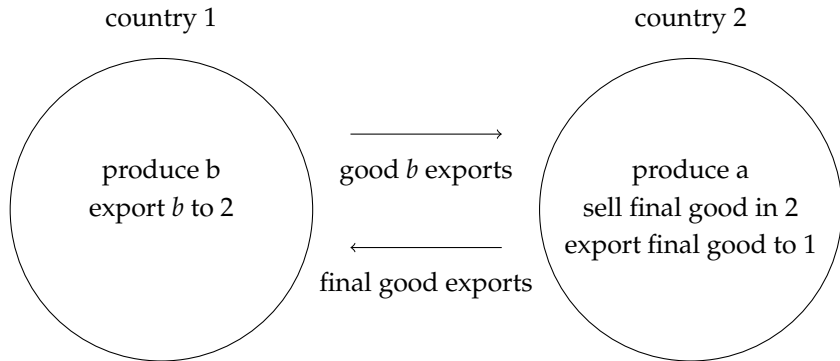
country 2

—————→
good *b* exports



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

Structure 4 (Complete fragmentation)



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

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

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

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

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

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

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

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

Which firm structure?

- ▶ Which production structure would a firm choose?
- ▶ Depends on $w_s^1, w_u^1, w_s^2, w_u^2, \tau_b,$ and τ
- ▶ Hold fixed wages, focus on trading costs

In class problem: Where to produce?

- ▶ $\theta_{ua} = 5$ and $\theta_{sa} = 1$; $\theta_{ub} = 1$ and $\theta_{sb} = 10$
- ▶ $w_u^1 = 10, w_s^1 = 20, w_u^2 = 2, w_s^2 = 30, \tau_b = 0.05, \tau = 0.05$
- ▶ Already know: $c^1 = c_a(w_s^1, w_u^1) + c_b(w_s^1, w_u^1) = 280$
- ▶ Already know: $c^2 = c_a(w_s^2, w_u^2) + c_b(w_s^2, w_u^2) = 342$

- ▶ How should the firm structure itself?

In class problem: Where to produce?

- ▶ Now increase τ_b
- ▶ $\theta_{ua} = 5$ and $\theta_{sa} = 1$; $\theta_{ub} = 1$ and $\theta_{sb} = 10$
- ▶ $w_u^1 = 10, w_s^1 = 20, w_u^2 = 2, w_s^2 = 30, \tau_b = 0.15, \tau = 0.05$
- ▶ Already know: $c^1 = c_a(w_s^1, w_u^1) + c_b(w_s^1, w_u^1) = 280$
- ▶ Already know: $c^2 = c_a(w_s^2, w_u^2) + c_b(w_s^2, w_u^2) = 342$
- ▶ How should the firm structure itself?

Increasing the trade cost of intermediates

- ▶ Increasing the trade cost of b ...
 - ▶ did not shut down trade in b
 - ▶ it shut down trade in the final good?!
- ▶ What happened?
 - ▶ The b goods have to pay 2 trade costs to get to country 1, then back to country 2
 - ▶ This double “tax” makes the cost of structure 4 (specialization) increase quickly with τ_b

In class problem: Where to produce?

- ▶ Now increase τ_b even more
- ▶ $\theta_{ua} = 5$ and $\theta_{sa} = 1$; $\theta_{ub} = 1$ and $\theta_{sb} = 10$
- ▶ $w_u^1 = 10, w_s^1 = 20, w_u^2 = 2, w_s^2 = 30, \tau_b = 0.30, \tau = 0.05$
- ▶ Already know: $c^1 = c_a(w_s^1, w_u^1) + c_b(w_s^1, w_u^1) = 280$
- ▶ Already know: $c^2 = c_a(w_s^2, w_u^2) + c_b(w_s^2, w_u^2) = 342$
- ▶ How should the firm structure itself?

Increasing the trade cost of intermediates

- ▶ For small enough τ_b ...
 - ▶ Complete fragmentation
- ▶ Increasing the trade cost of b ...
 - ▶ Move to incomplete fragmentation
- ▶ Increasing the trade cost of b more...
 - ▶ Move to exporting

- ▶ How does this depend on final good trade costs (τ)?