

Multinationals and the Globalization of Production

Vertical FDI 2

Penn State // Fall 2017

Administrative things

- ▶ Sign in to Arkaive.com (course code: 84ST)
 - ▶ If not working, sign in up front
- ▶ Problem set #3
 - ▶ Due end of class, Thursday 10/19
 - ▶ Available on course website

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

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

Model summary

- ▶ Two stages to final good: components b ; assembly a
 - ▶ b is skilled-labor intensive ($\theta_{ub} = 1, \theta_{sb} = 10$)
 - ▶ a is unskilled-labor intensive ($\theta_{ua} = 5, \theta_{sa} = 1$)
- ▶ Final good cost
$$c(w_u, w_s) = c_a(w_u, w_s) + c_b(w_u, w_s)$$
- ▶ Two countries, $i = 1, 2$
 - ▶ Country 1: $w_u = 10$ (\$/h) and $w_s = 20$ (\$/h)
 - ▶ Country 2: $w_u = 2$ (\$/h) and $w_s = 30$ (\$/h)
- ▶ Two symmetric trade costs
 - ▶ τ_b = cost of shipping good b
 - ▶ τ = cost of shipping final good

Possible firm structures

- ▶ A firm in country 1 wants to sell final good in both countries
 - ▶ Firm wants lowest final good price in each country
-
1. **Horizontal FDI.** Produce a and b in each country.
 2. **Export.** Produce a and b in country 1, export final good to country 2.
 3. **Partial fragmentation.** Produce b in country 1, ship some of good b to country 2. Both countries produce a .
 4. **Complete fragmentation.** Produce b in country 1, ship all of good b to country 2. Produce a in country 2 and ship some of the final good to country 1.

Possible firm structures

1. **HFDI.** Do a and b in each country

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

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

2. **Export.** 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. **Partial fragmentation.** 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. **Complete fragmentation.** 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 example:
 - ▶ $\theta_{ua} = 5$ and $\theta_{sa} = 1$; $\theta_{ub} = 1$ and $\theta_{sb} = 10$
 - ▶ $w_u^1 = 10, w_s^1 = 20, w_u^2 = 2, w_s^2 = 30, \tau_b = 0.05, \tau = 0.05$
 - ▶ How should the firm structure itself?

In class problem: Where to produce?

1. **HFDI.** Do a and b in each country

$$c^1 = c_a(w_s^1, w_u^1) + c_b(w_s^1, w_u^1) = 280$$

$$c^2 = c_a(w_s^2, w_u^2) + c_b(w_s^2, w_u^2) = 342$$

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

$$c^1 = c_a(w_s^1, w_u^1) + c_b(w_s^1, w_u^1) = 280$$

$$c^2 = [c_a(w_s^1, w_u^1) + c_b(w_s^1, w_u^1)] (1 + \tau) = 294$$

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

$$c^1 = c_a(w_s^1, w_u^1) + c_b(w_s^1, w_u^1) = 280$$

$$c^2 = c_a(w_s^2, w_u^2) + c_b(w_s^1, w_u^1)(1 + \tau_b) = 260.5$$

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

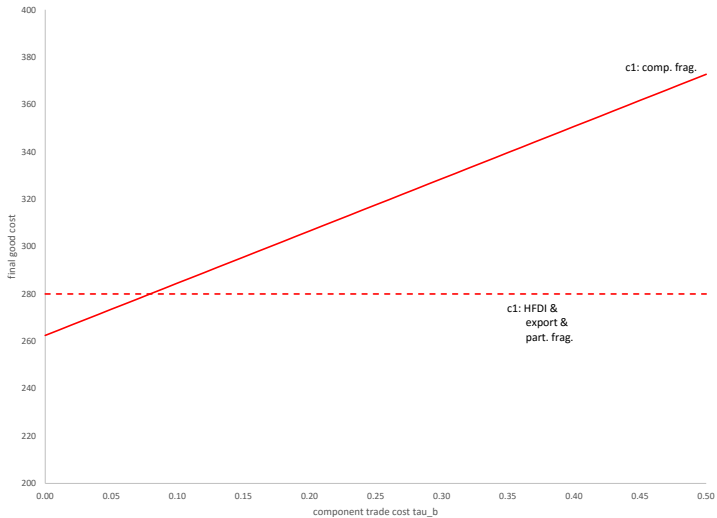
$$c^1 = [c_a(w_s^2, w_u^2) + c_b(w_s^1, w_u^1)(1 + \tau_b)] (1 + \tau) = 273.5$$

$$c^2 = c_a(w_s^2, w_u^2) + c_b(w_s^1, w_u^1)(1 + \tau_b) = 260.5$$

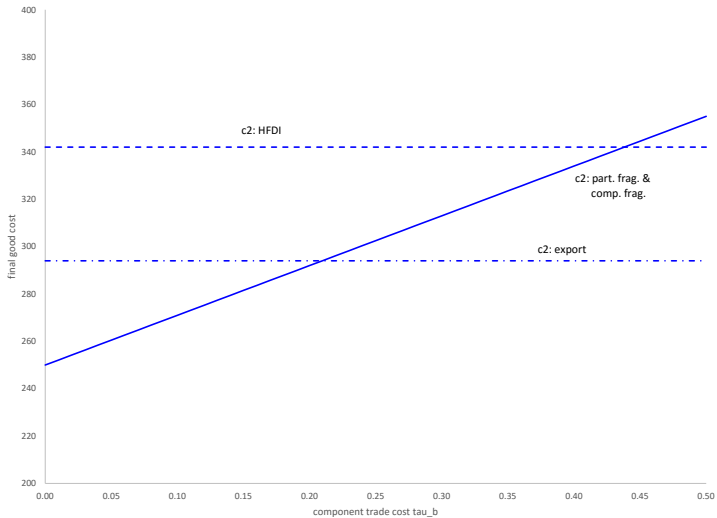
Component parts trade costs

- ▶ Increase τ_b
- ▶ How should the firm structure itself?

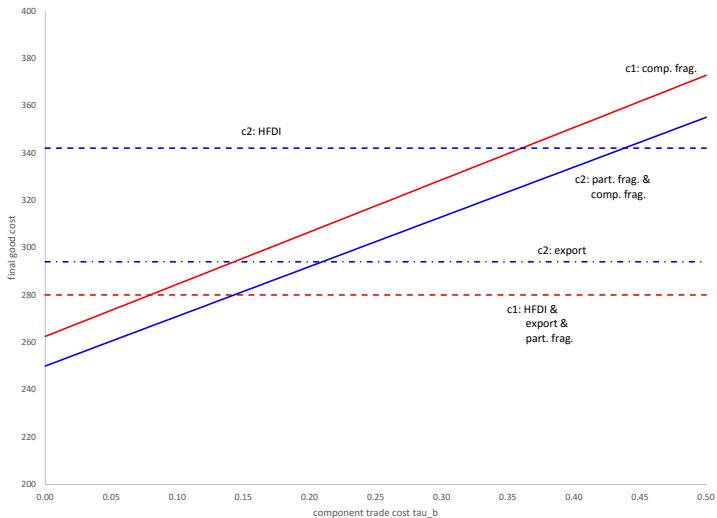
Final good cost in country 1



Final good cost in country 2



Determining firm structure ($\tau = 0.05$)



τ_b and firm structure

- ▶ When $\tau_b \in [0, 0.07]$
 - ▶ Complete fragmentation
 - ▶ Costs of trading b and the final good are low
- ▶ When $\tau_b \in (0.07, 0.21]$
 - ▶ Partial fragmentation
 - ▶ Trading b too expensive for roundtrip from country 1
 - ▶ Still worth sending b for the country-2 market
- ▶ When $\tau_b > 0.21$
 - ▶ Export from country 1
 - ▶ Gain from $w_u^1 > w_u^2$ no longer overcomes cost of trading b

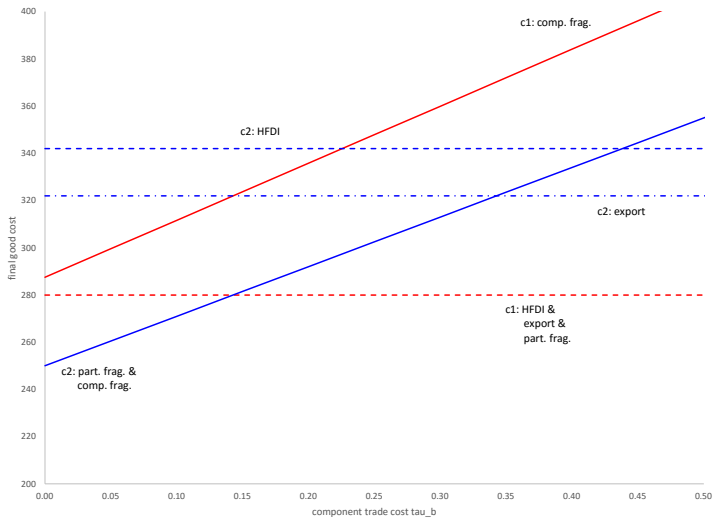
Final good trading costs

- ▶ Our analysis held τ fixed
- ▶ What happens to firm structure for different τ ?

τ_b cutoff values

	Complete frag.	Partial frag.	Export	HFDI
$\tau = 0.05$	[0,0.07]	(0.07,0.21]	>0.21	—
$\tau = 0.15$				
$\tau = 0.25$				

Determining firm structure ($\tau = 0.15$)



Final good trading costs

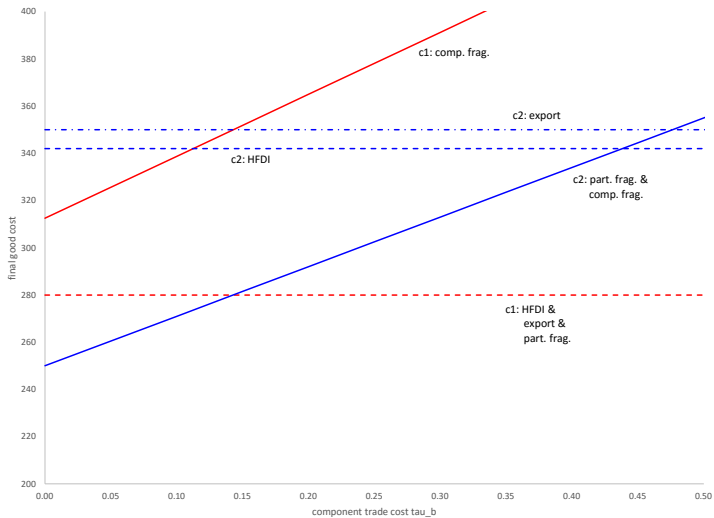
- ▶ Our analysis held τ fixed
- ▶ What happens to firm structure for different τ ?

τ_b cutoff values

	Complete frag.	Partial frag.	Export	HFDI
$\tau = 0.05$	[0, 0.07]	(0.07, 0.21]	>0.21	—
$\tau = 0.15$				
$\tau = 0.25$				

- ▶ As τ increases, complete fragmentation disappears

Determining firm structure ($\tau = 0.25$)



Final good trading costs

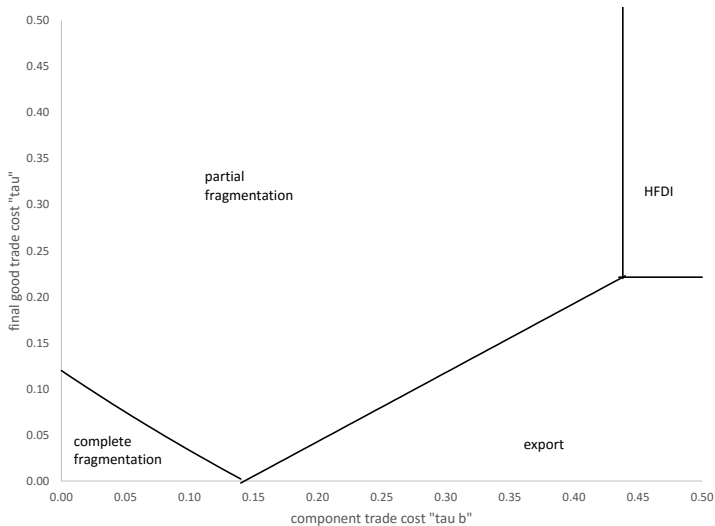
- ▶ Our analysis held τ fixed
- ▶ What happens to firm structure for different τ ?

τ_b cutoff values

	Complete frag.	Partial frag.	Export	HFDI
$\tau = 0.05$	[0, 0.07]	(0.07, 0.21]	>0.21	—
$\tau = 0.15$				
$\tau = 0.25$				

- ▶ As τ increases, complete fragmentation disappears
- ▶ As τ increases, exporting disappears

How trade costs shape firm structure



Trade costs and firm structure summary

- ▶ Tradeoff: factor costs savings vs. trade cost
- ▶ Model admits 4 firm structures:
 1. horizontal FDI
 2. exporting
 3. partial fragmentation
 4. complete fragmentation
- ▶ When both τ and τ_b are low \Rightarrow complete fragmentation
- ▶ When τ is low and τ_b is high \Rightarrow export
- ▶ When τ is high and τ_b is low \Rightarrow partial fragmentation
- ▶ When both τ and τ_b are high \Rightarrow horizontal FDI

Consequences of vertical FDI:

Trade policy and FDI
&
Supply chain fragility

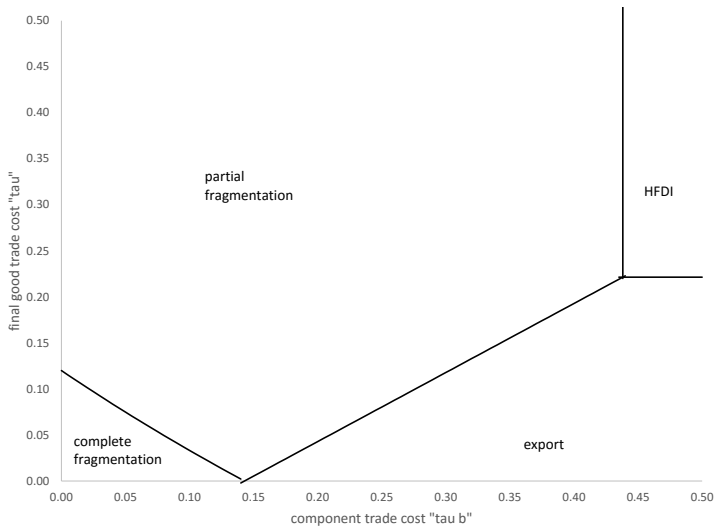
Trade policy and FDI

- ▶ How do trade agreements affect FDI?
- ▶ Trade agreements lower τ , τ_b , or both
- ▶ How do trade agreements affect FDI?
- ▶ Trade wars increase τ , τ_b , or both

Trade liberalization

- ▶ Suppose (in our previous model) $\tau_b = 0.25$ and $\tau = 0.05$
- ▶ If a trade agreement lowers $\tau_b = 0.15$, what happens to
 - ▶ FDI in country 2?
 - ▶ Exports from country 1?
 - ▶ Exports from country 2?
- ▶ If a trade agreement lowers $\tau_b = 0.0$, what happens to
 - ▶ FDI in country 2?
 - ▶ Exports from country 1?
 - ▶ Exports from country 2?

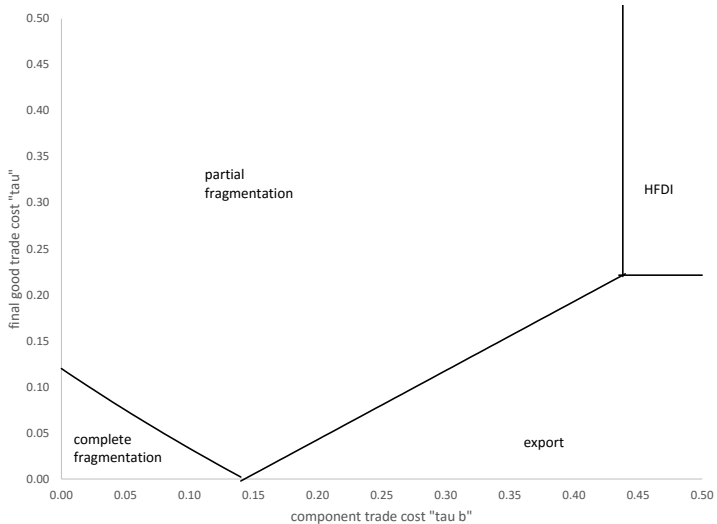
Trade liberalization



US trade policy

- ▶ Administration wants to re-negotiate NAFTA
- ▶ Suppose (in our previous model) $\tau_b = 0.05$ and $\tau = 0.05$
- ▶ If the countries raise $\tau = 0.2$, what happens to
 - ▶ FDI in country 2?
 - ▶ Exports from country 1?
 - ▶ Exports from country 2?
 - ▶ Production in country 1?
- ▶ Can you construct a situation in which raising the tariff decreases production in country 1?

Trade wars



Supply chain disruptions

- ▶ Moving production abroad generates possibility of supply chain disruptions
- ▶ Not unique to multinationals, but an important consideration when assessing vertical FDI potential
- ▶ Problems in other countries that stop production
 - ▶ Floods (Thailand/hard drives), earthquakes (Japan/autos), volcanic eruptions...
 - ▶ Strikes (Europe/transportation & cargo)
 - ▶ Political unrest, nationalization (Mexico/oil)

Japanese earthquakes and autos

- ▶ Auto industry very fragmented
- ▶ Toyota, Honda, & Nissan assemble cars in the US w/Japanese parts
 - ▶ Prox-concentration: large US market + expensive to ship cars
 - ▶ VFDI: lower cost labor in Southern US
 - ▶ Voluntary export restraints (ask your trade professor)

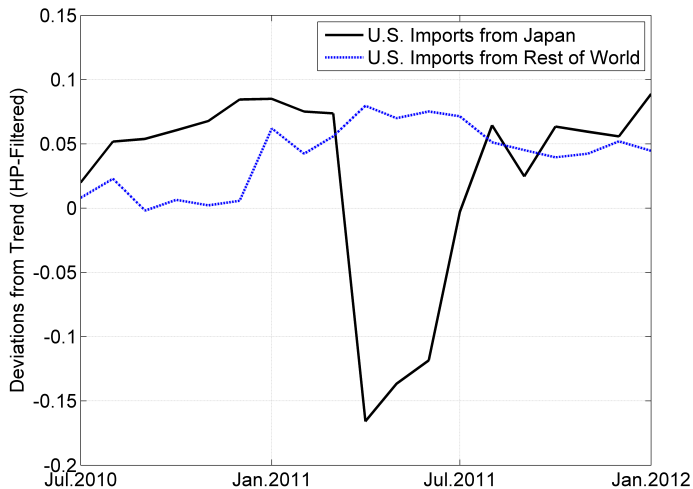
- ▶ Tohoku earthquake in 2011

- ▶ Following figures from Boehm, Flaaen, and Pandalai-Nayar (2016)

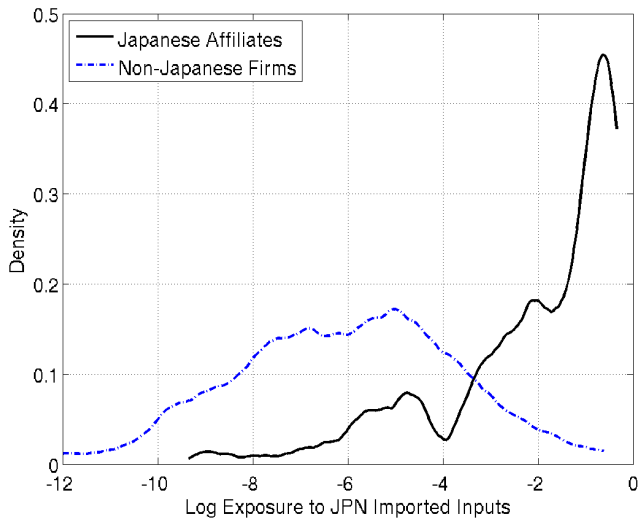
Output in Japan



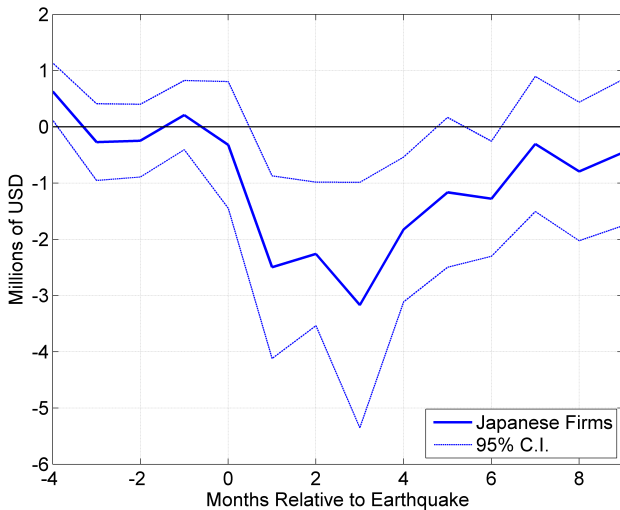
US imports



Dependence on Japanese inputs



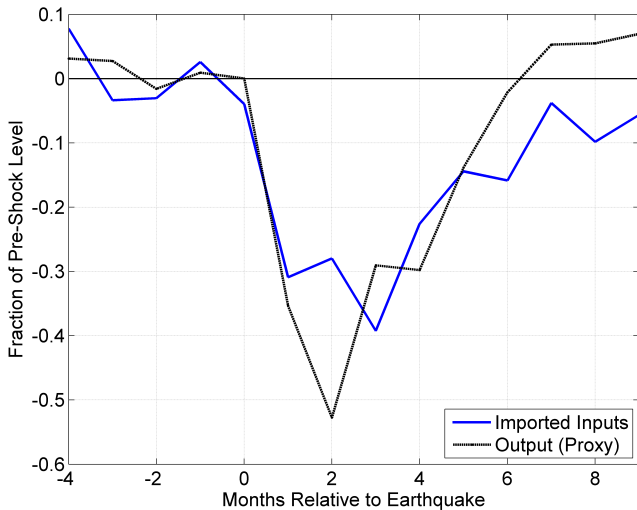
Imports of Japanese multinationals



Toyota in the United States

- ▶ Vehicle assembly in Indiana, Kentucky, Mississippi, and Texas
- ▶ Toyota (and many others) use “just in time” supply chains
 - ▶ Hold very small inventories
 - ▶ Minimize inventory costs
 - ▶ Better input quality monitoring
 - ▶ Trade off between efficiency and risk mitigation
- ▶ Shortage of parts made in Japan
- ▶ Forced to operate below capacity; close some assembly lines
- ▶ Many other firms faced similar challenges (Caterpillar, GM, Sony)

Output of Japanese multinationals



Another earthquake in Japan

- ▶ Again! Kumamoto earthquake in April 2016
- ▶ Disruptions were smaller
- ▶ After 2011 firms change parts of supply chain