Global Sourcing and Multinational Activity:

A Unified Approach

Pol Antràs, Evgenii Fadeev, Teresa C. Fort, Felix Tintelnot

Henry Minör
UW-ID: 9084959072

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Prof. Kim J. Ruhl, Ph.D.

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Setting the scene

1. **Empirical evidence** from US MNE manufacturing
   - Small share (1.5%) of firms; large share of employment (41%); dominant in sales (74%), imports (87%), and exports (84%), in absolute and relative terms, at the extensive and intensive margin of trade
   - MNEs more likely to import from countries/regions with affiliates, but not more intensely. Exports are more likely and more intense

2. **Theoretical framework** to study *joint* decision of sourcing and assembly locations
   - Builds on Melitz (2003), Tintelnot (2017), and Antràs, Fort, Tintelnot (2017)
   - Extract conditions for complementarity and cannibalization effects in sourcing and assembly

3. **Some notation:** Firms φ are located in $h \in J$, produce variety $\omega \in [0,1]$ in location $l \in \mathcal{L}_h(\varphi)$, and sell in market $m \in \mathcal{M}_h(\varphi)$ using inputs $v \in [0,1]$ from source $j \in \mathcal{J}_h(\varphi)$.
   - Fixed number of countries J: $\mathcal{M}_h(\varphi), \mathcal{L}_h(\varphi), \mathcal{J}_h(\varphi) \subseteq J$

Consumer Demand

- *Consumers* in market m gain utility consuming varieties ω produced by firm φ :

$$U_m = \Big(\int_{\varphi \in \Omega_m} \Big[\Big(\int_0^1 q_m(\varphi, \omega)^{\frac{\sigma_\omega - 1}{\sigma_\omega}} d\omega \Big)^{\frac{\sigma_\omega}{\sigma_\omega - 1}} \Big]^{\frac{\sigma - 1}{\sigma}} d\varphi \Big)^{\frac{\sigma}{\sigma - 1}} \tag{1}$$

- *Firm-level prices*:

$$p_m(\varphi) = \Big(\int_0^1 p_m(\varphi, \omega)^{1 - \sigma_\omega} d\omega \Big)^{\frac{1}{1 - \sigma_\omega}} \tag{2}$$

- *Economywide price level*:

$$P_m = \Big(\int_{\varphi \in \Omega_m} p_m(\varphi)^{1 - \sigma} d\varphi \Big)^{\frac{1}{1 - \sigma}} \tag{3}$$

- *Demand for variety ω from firm φ*:

$$q_m(\varphi, \omega) = (p_m(\varphi, \omega))^{-(\sigma_\omega - 1)} (p_m(\varphi))^{\sigma_\omega - \sigma} E_m P_m^{\sigma - 1} \tag{4}$$

- *Within-firm complementary*: If $\sigma_\omega < \sigma$, lower firm-level prices $p_m(\varphi)$ overproportionally redirects demand towards all of firm φ's varieties!

Final-good production by firm φ located in h

- Monopolistic competition: Learn core productivity φ drawn from $G_h(\varphi)$ after paying entry costs f_h^e
- Pay initial $w_h f_h^g$ to become 'global': sell and produce *anywhere* abroad
- Source inputs $v \in [0,1]$ with CES ρ from country j after paying fixed costs $w_h f_{hj}^s$
  - Produced in competitive market with CRS technology under input-specific assembling efficiency $a_j(v,\varphi)$ and subject to shipping costs τ_{jl}^s
  - Total cost $\tau_{jl}^s a_j(v,\varphi) w_j$, with $a_j(v,\varphi) \sim$ Fréchet: $Pr(1/a_j(v,\varphi) \geq a) = e^{-T_j^s a^{\theta^s}}$
  - Every plant l solves $\min_{j(v) \in \mathcal{J}_h(\varphi)} \{\tau_{j(v)l}^s a_{j(v)}(v,\varphi) w_{j(v)}\}$
- Combine labor and intermediaries with CRS technology in location l after paying fixed cost $w_h f_{hl}^a$
  - Firm-location specific productivity $z_l(\varphi,\omega) \sim$ Fréchet: $Pr(1/z_l(\varphi,\omega) \geq a) = e^{-T_l^a a^{\theta^a}}$
  - Eisberg costs of shipping from l to m: τ_{lm}^a
  - Location l chosen solving $\min_{l(\omega) \in \mathcal{L}_h(\varphi)} \{\tau_{l(\omega)m}^a c_{hl(\omega)}(\varphi,\omega)\}$
- Overall marginal cost for firm φ in h of producing ω in l is given by

$$c_{hl}(\{j(v)\}_{v=0}^1, \varphi, \omega) = \frac{1}{\varphi} \frac{1}{z_l(\varphi,\omega)} (w_l)^{1-\alpha} \left(\int_0^1 (\tau_{jl(v)}^s a_{j(v)}(v,\varphi) w_{j(v)})^{1-\rho} dv \right)^{\frac{\alpha}{(1-\rho)}} \quad (5)$$

Firm Behavior for Fixed Assembly and Sourcing Strategies

Assume fixed $E_m P_m^{\sigma-1}$, $\mathcal{J}_h(\varphi)$, and $\mathcal{L}_h(\varphi)$

- *Sourcing capability* from country j by plant in l are decreasing in wage w_j and trade cost τ_{jl}^s, but increasing in input-production technology T_j^s
  - *Sourcing capability* of plant in l from country j: $\xi_{jl}^s(\varphi) \equiv T_j^s(\tau_{jl}^s w_j)^{-\theta^s}$
  - *Global sourcing capability*: $\Theta_{hl}(\varphi) \equiv \sum_{j' \in J_h(\varphi)} \xi_{j'l}^s(\varphi)$

- *Assembly potential* in l to market m are decreasing in wage w_l and trade cost τ_{lm}^a, but increasing in assembly technology T_l^a
  - *Assembly potential* of plant in l selling in m: $\xi_{lm}^a(\varphi) \equiv T_l^a (\tau_{lm}^a)^{-\theta^a} (w_l)^{-(1-\alpha)\theta^a}$
  - *Global production capability*: $\Psi_{hm}(\varphi) = \sum_{l' \in \mathcal{L}_h(\varphi)} \xi_{l'm}^a (\Theta_{hl'}(\varphi))^{\frac{\alpha\theta^a}{\theta^s}}$
  - Sales share of φ in h from l to m

$$\mu_{hlm}(\varphi) = \frac{\xi_{lm}^a (\Theta_{hl}(\varphi))^{\frac{\alpha\theta^a}{\theta^s}}}{\Psi_{hm}(\varphi)} \tag{6}$$

Firm Behavior for Fixed Assembly and Sourcing Strategies

Firm's imports by plant l from each country j

$$M_{hlj}(\varphi) = \hat{\kappa}\varphi^{\sigma-1} T_l^a (w_l)^{-(1-\alpha)\theta^a} \xi_{jl}^s(\varphi) (\Theta_{hl}(\varphi))^{\frac{\alpha\theta^a}{\theta^s}-1} \sum_{m\in J} (\tau_{lm}^a)^{-\theta^a} (\Psi_{hm}(\varphi))^{\frac{\sigma-1}{\theta^a}-1} E_m P_m^{\sigma-1}$$

- Increase in *assembly potential* ξ_{lm}^a:
  1. Increases input purchases by plant l, M_{hlj}
  2. *Complementarity*: increases input purchases by plant $l' \neq l$, $M_{hl'j}$, if $(\sigma-1)/\theta^a > 1$
- Decrease in bilateral input trade cost τ_{jl}^s:
  1. Increases input purchases by plant in l, $M_{hlj}(\varphi)$, from origin j
  2. *Complementarity*: increases input purchases by plant l from all other countries $j' \neq j$, $M_{hlj'}(\varphi)$, if $(\sigma-1) \geq \theta^a > \theta^s/\alpha$

Total sales of plant l in market m:

$$S_{hlm}(\varphi) = \tilde{\kappa}\varphi^{\sigma-1} T_l^a (w_l)^{-(1-\alpha)\theta^a} (\Theta_{hl}(\varphi))^{\frac{\alpha\theta^a}{\theta^s}} (\tau_{lm}^a)^{-\theta^a} (\Psi_{hm}(\varphi))^{\frac{\sigma-1}{\theta^a}-1} E_m P_m^{\sigma-1}$$

- Increase in *assembly potential* ξ_{lm}^a:
  1. Increases sales $S_{hlm}(\varphi)$ of plants in l to m
  2. *Complementarity*: Increases sales of plants in $l' \neq l$, $S_{hl'm}(\varphi)$, if $(\sigma-1)/\theta^a > 1$

Optimal Choice of Assembly and Sourcing Locations

Firms' optimization problem

$$\max_{\mathcal{I}_l^a \in J, \mathcal{I}_j^s \in J} \pi_h(\varphi, \mathcal{J}_h(\varphi), \mathcal{K}_h(\varphi)) = \kappa \varphi^{\sigma-1} \sum_{m \in J} E_m P_m^{\sigma-1} \Big(\sum_{l \in J} \mathcal{I}_l^a \xi_{lm}^a \Big(\sum_{j \in J} \mathcal{I}_j^s \xi_{jl}^s \Big)^{\frac{\alpha \theta^a}{\theta^s}} \Big)^{\frac{\sigma-1}{\theta^a}}$$
$$- \sum_{j \in J} \mathcal{I}_j^s w_h f_{hj}^s - \sum_{l \in J} \mathcal{I}_l^a w_h f_{hl}^a - w_h f_h^g$$

Conditions for *complementarity*:

1. Increasing Differences in *assembly locations* if $\sigma - 1 > \theta^a$
2. Increasing Differences in *sourcing locations* if $\sigma - 1 \geq \theta^a > \theta^s / \alpha$
3. Increasing Differences in *pairs of assembly and sourcing locations* if $\sigma - 1 \geq \theta^a$
4. Firms' global production capabilities are nondecreasing in the number of firms

Conclusion

1. Firms solve complicated combinatory problem, modeling is difficult
2. However, MCS techniques shed light on conditions for complementary effects

References

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