14.581 MIT PhD International Trade
— Lecture 21: International Organization of Production (Theory part I) —

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A lecture on theories of multinational enterprises (MNEs):

- **Horizontal MNEs**

- Vertical MNEs

- Quantitative Models of MNEs

Our next lecture (continuing the 'international organization of production' theme) will cover theories of international outsourcing and offshoring.

Multinational Enterprises (MNEs)
Definitions

- **MNE** $\equiv$ *"An enterprise that controls and manages production establishments (plants) located in at least two countries. It is simply one subspecies of multiplant firms."* Caves (1996)

- The trade literature distinguishes between two broad types of MNEs:

  1. **Horizontal MNE** $\equiv$ Because of trade costs, firms duplicate production facilities and sell locally in two or more markets (Toyota, Nestle).

  2. **Vertical MNE** $\equiv$ Because of factor price differences, firm locates its headquarter in one country but does production in another (Nike, Intel).

- Other useful definitions:
  - **FDI** $\equiv$ Investment made by multinational in the Foreign country
  - **Parent** $\equiv$ Company making the investment abroad
  - **Affiliate** $\equiv$ Company receiving the investment abroad

- **Basic Idea:**
  - Under free trade, you would never want to have production facilities in multiple countries (why replicate fixed costs?)
  - But in the presence of transport costs, firms may be willing to set up a new plant in order to avoid these costs.
- **Proximity-concentration trade-off:**
  - *Domestic firm*: low fixed cost, but high variable costs
  - *Horizontal multinational*: high fixed cost, but low variable costs
- **Main insight:** Multinationals will be more likely if
  1. Transport costs are higher.
  2. Plant-specific costs are lower.
  3. GDPs are higher or more similar across countries.

- Consider a world economy with:
  - Two countries indexed by $c = H, F$.
  - One differentiated good produced under IRS by monopolistically competitive firms as in Krugman (1980).
  - One factor of production, labor.

- Labor requirement is given by:

$$l = f + q$$

  where $f \equiv$ *plant-specific* fixed cost.

- There are iceberg trade costs between countries:
  - In order to sell 1 unit abroad, domestic firms must ship $\tau > 1$

- The profits of multinationals and domestic firms are given by

$$
\Pi^M = \frac{1}{\sigma}\left(\frac{p^H}{P^H}\right)^{1-\sigma} Y^H + \frac{1}{\sigma}\left(\frac{p^F}{P^F}\right)^{1-\sigma} Y^F - \left(w^H + w^F\right) f
$$

$$
\Pi^H = \frac{1}{\sigma}\left(\frac{p^H}{P^H}\right)^{1-\sigma} Y^H + \frac{1}{\sigma}\left(\frac{\tau p^F}{P^F}\right)^{1-\sigma} Y^F - w^H f
$$

$$
\Pi^F = \frac{1}{\sigma}\left(\frac{\tau p^H}{P^H}\right)^{1-\sigma} Y^H + \frac{1}{\sigma}\left(\frac{p^F}{P^F}\right)^{1-\sigma} Y^F - w^F f
$$

where:
- $p^c \equiv \left(\frac{\sigma-1}{\sigma}\right)\beta w^c$,
- $w^c \equiv$ wage in country c,
- $Y^c \equiv$ GDP in country c

- **Claim:** *MNEs are more likely if: (i) transport costs are high, (ii) fixed costs are low, or (iii) GDPs are higher or more similar.*

- **Sketch of Proof:**
  - MNEs will be observed iff

$$\frac{1}{\sigma}\left(\frac{p^F}{P^F}\right)^{1-\sigma} Y^F - w^F f \geq \frac{1}{\sigma}\left(\frac{\tau p^F}{P^F}\right)^{1-\sigma} Y^F$$

$$\frac{1}{\sigma}\left(\frac{p^H}{P^H}\right)^{1-\sigma} Y^H - w^H f \geq \frac{1}{\sigma}\left(\frac{\tau p^H}{P^H}\right)^{1-\sigma} Y^H$$

  - This implies

$$\left[1 - \left(\tau^2\right)^{1-\sigma}\right] Y^H Y^F \left(\frac{p^H p^F}{P^H P^F}\right)^{1-\sigma} \geq$$

$$\sigma w^H f Y^F \left(\frac{\tau p^H}{P^F}\right)^{1-\sigma} + \sigma w^F f Y^H \left(\frac{\tau p^F}{P^H}\right)^{1-\sigma} + \sigma^2 w^H w^F f^2$$

- **Sketch of Proof (Cont.):** (i) and (ii) directly follow. In order to get (iii), let us divide the previous inequality by $Y^H + Y^F$

$$\left[1 - \left(\tau^2 \right)^{1-\sigma} \right] \left(Y^H + Y^F \right) \left[1 - \left(s^H \right)^2 - \left(s^F \right)^2 \right] \left(\frac{p^H p^F}{P^H P^F} \right)^{1-\sigma} \geq$$

$$\sigma w^H f s^F \left(\frac{\tau p^H}{P^F} \right)^{1-\sigma} + \sigma w^F f s^H \left(\frac{\tau p^F}{P^H} \right)^{1-\sigma} + \frac{\sigma^2 w^H w^F f^2}{Y^H + Y^F}$$

- **Intuition for (iii):** it is not profitable to pay extra fixed cost to serve a very small market (no matter how large the trade costs).

- With multiple factors of production, MNEs are more likely if factor endowments are similar across countries.

- Helpman, Melitz and Yeaple (2004) revisit the proximity-concentration trade-off in the presence of firm-level heterogeneity à la Melitz (2003).

- **Basic Idea:**
    - Low-variable trade costs matter relatively more for more productive firms.
    - So high productivity firms will become multinationals, whereas less productive firms will become exporters.

- **Main insight:**
    - Differences in the distribution of firm productivity across sectors has implication for export vs. FDI.
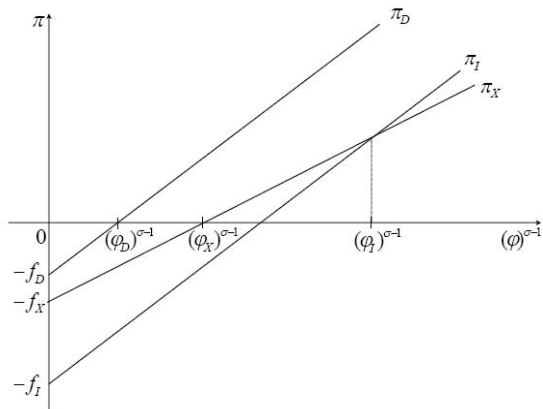
- Firm productivity φ is drawn from a Pareto, $G(\varphi) = 1 - \left(\underline{\varphi} / \varphi \right)^k$

- Firm in country i chooses whether to become domestic producers (D) or to serve country j via exports (X) or FDI (I).

- Foreign revenues are given by $r_O(\varphi) = (\varphi / \tau_O)^{\sigma - 1} B$, with $O \in \{D, X, I\}$.

- Variable transport costs satisfy: $\tau_I^{1-\sigma} = 1 > \tau_X^{1-\sigma} > \tau_D^{1-\sigma} = 0$

- Fixed transport costs satisfy: $f_I > f_X > f_D$

- Industries with higher dispersion of productivity across firms—i.e. a lower shape parameter k—should have a higher ratio of FDI versus export sales.

- **Intuition:**
    - Low-k sectors have relatively more high-φ firms.
    - high-φ firms are more likely to select in I than X.

- **Formally:**
  g is log-supermodular in φ and $-k$; r is supermodular in φ and $\tau^{1-\sigma}$; and log-supermodularity is preserved by integration (Costinot 2009).

A lecture on theories of multinational enterprises (MNEs):

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- **Vertical MNEs**

- Quantitative Models of MNEs

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Vertical MNEs

- In models of horizontal MNEs, trade and FDI are substitutes.

  - But MNEs account for a very significant fraction of world trade flows and FDI is rising with trade!

  - There is substantial trade of intermediate inputs within MNEs.

- **Basic Idea:**
  Factor price differences may provide incentives to operate (skill intensive) headquarter services in North and do (labor intensive) production in South.

- **Key insight:**
  Ability of MNEs to spread their facilities across several countries enlarges the region of factor price equalization.

- The basic environment is a $2 \times 2 \times 2$ HO model with monopolistic competition in one sector:
  - 2 goods, 1 and 2
  - 2 factors, H and L

- Good 1 is homogeneous good produced with CRS production:

  $a_{1L} \equiv$ unskilled labor requirement per unit of good 1

  $a_{1H} \equiv$ skilled labor requirement per unit of good 1

- Good 2 is a differentiated good produced under MC:

$$c_2 \left(w^u, w^s, \overline{y} \right) = w^s f + w^u \overline{y}$$
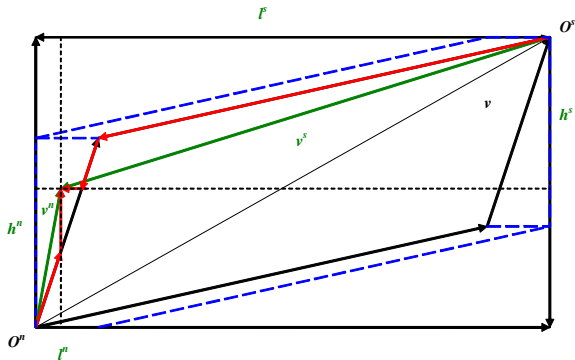
- Factor content of production in sector 2:
  $a_{2L} = \overline{y} \equiv$ unskilled labor requirement per variety of good 2
  $a_{2H} = f \equiv$ skilled labor requirement per variety of good 2

- The model does not feature intrafirm trade in physical goods. Notice, however, that in the model there are invisible exports of headquarter services from the parent to its subsidiaries.

    - This may explain why observe trade deficits in skill-abundant countries (these are offset by receipts from subsidiaries abroad).

- Assuming that these services are valued at average cost, Helpman (1984) derives some interesting results that complement and qualify the predictions of the benchmark Helpman-Krugman for the volume of international trade and its components.

    - The larger the role of multinational firms in the world economy, the weaker the effects of relative country size dispersion on the volume of trade.

    - For a given relative size of countries, the share of intrafirm trade in the total volume of trade is increasing in relative factor endowment differences.

    - The larger the role of multinational firms in the world economy, the weaker the effects of relative factor endowments on the share of intraindustry trade in the total volume of trade.

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Quantitative Models of MNEs

- Main focus of previous papers is to explain why MNEs may emerge.
  - But there is little discussion of the welfare implications of MNEs.

- Ramondo and Rodriguez-Clare (2010) have developed an extension of Eaton and Kortum (2002) with both trade and multinational production (MP):
  - As in models of horizontal MNEs, trade and MP are alternative ways to serve a foreign market.
  - As in models of vertical MNEs, foreign affiliates import intermediates from parent.
  - Also "Bridge MP": firm from country 1 produces in country 2 and exports in country 3.

- Using trade and MP data, model can be calibrated to quantify gains form openness, trade, and MP.

- Ideas get originated in country i.

- Production take place in country l.

- Consumption takes place in country n.

- Model is Ricardian with constant unit cost of production *and* delivery for a good v given by

$$\frac{d_{nl} c_{li}}{z_{li}(v)}$$

where:

  - $d_{nl} \equiv$ iceberg trade costs between production country l and consumption country n.

  - $c_{li} \equiv$ average unit cost of production for firms from i in country l (this can include communication costs associated with country i firms running a plant in country l).

  - $z_{li}(v) \equiv$ productivity of firms from i producing good v in country l. These are drawn from a multivariate Frechet distribution (which includes a parameter that governs the correlation of country i's productivity draws across each foreign production site l).

- **Main result:**
  - Gains from trade are larger in the presence of MP because trade facilitates MP.
  - Gains from openness (ie MP plus trade) are larger than gains from trade because of MP and complementarity between trade and MP.
- Compared to previous models of MNEs, model is very reduced form:
  - in any given country and sector, technology is assumed to be freely available to a large number of price-taking firms.
  - discipline comes from aggregate predictions of the model
- Remainder of paper concerns estimation and calibration of model's parameters.

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