1 Neoclassical Theories of Fragmentation

1.1 Fragmentation of production: Overview

- In recent years, a lot of attention has been given to “fragmentation of production” a.k.a. the “slicing of the value chains” or “trade in tasks”
  - Baldwin (2006) has referred to this period as “the great unbundling”
- Fragmentation is related to activities of MNEs, though less than perfectly
  - Intuitively, if US firm outsources services in India, we would like to say that there is “fragmentation”
  - but this may not show up in the data (in U.S. statistics, a U.S. company needs to hold 10% or more of the stock of a foreign company in order to be considered a MNE)

- Question:
  Is “fragmentation” just a fancy name for “trade in intermediate goods”?

- Answer(s):
  1. It is about trade in intermediate goods, but new models emphasize differences in trade costs across goods (e.g. how routine a particular “task” may be), which previous models abstract from
  2. It is not just about trade in intermediate goods, since "fragmentation" also usually includes a transfer of technology from one country to another

1.2 Grossman and Rossi-Hansberg (2008)

1.2.1 Assumptions

- As in Heckscher-Ohlin model:
  - There are two countries, Home and Foreign
  - There are 2 tradeable goods, $i = 1, 2$
  - There are two factors of production, $L$ and $H$

- In contrast with Heckscher-Ohlin model:

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1 The notes are based on lecture slides with inclusion of important insights emphasized during the class.
– Production process involves a large number of tasks $j \in [0, 1]$

- Tasks are of two types:
  - $L$-tasks which require 1 units of low-skilled labor
  - $H$-tasks which require 1 units high-skilled labor

### 1.2.2 Offshoring Costs

- Tasks vary in their offshoring costs
  - because some tasks are easier to codify
  - because some services must be delivered personally, while others can be performed at a distance with little loss in quality

- To capture this idea, GRH assume that:
  - $H$-tasks cannot be offshored
  - $L$-tasks can be offshored, but amount of low-skilled labor necessary to perform task $j$ abroad is given by $\beta t(j) > 1$

- Under this assumption,
  - $\beta$ reflects overall feasibility of offshoring at a point in time (e.g. communication technology)
  - $t(j)$ is an increasing function which captures differences in offshoring costs across tasks (e.g. cleaning room vs. call center)

### 1.2.3 The Offshoring Decision

- Suppose that wages for low-skilled labor are higher at Home

$$w_L > w^*_L$$

- Benefit of offshoring $\equiv$ lower wages abroad
- Cost of offshoring $\equiv$ loss in productivity captured by $\beta t(j)$
- In a competitive equilibrium, firm will offshore tasks if and only if:

$$\beta t(j)w^*_L < w_L$$

- Let $J \in [0, 1]$ denote the marginal task that is being offshored

$$\beta t(J)w^*_L = w_L \quad (1)$$
1.2.4 Offshoring as Factor Augmenting Technological Change

- The cost of producing one unit of some good is given by

\[
c_i = a_{Li} \left[ w_L (1 - J) + w_L^* \beta T(J) \right] + a_{Hi} w_H
\]

with \( T(J) = \int_0^J t(j) dj \), \( w_H \equiv \) wage of high-skilled workers at Home

- Substituting (1) into (2), we obtain

\[
c_i = a_{Li} w_L \Omega + a_{Hi} w_H
\]

where \( \Omega = (1 - J) + \frac{T(J)}{t(J)} < 1 \)

- This looks just like the cost equation of a firm that employs low-skilled workers whose productivity is (inversely) measured by \( \Omega \)

  - Hence, offshoring is economically equivalent to labor-augmenting technological progress

1.2.5 Productivity effect

- Proposition If Home is a small open economy that produces both goods, a decrease in \( \beta \) increases \( w_L \)

- Proof:

  1. Zero profit requires:

\[
p_i = a_{Li} w_L \Omega + a_{Hi} w_H, \ i = 1, 2
\]

  2. Since Home a small open economy, \( p_i \) does not depend on \( \beta \)

  3. This implies that \( w_L \Omega \) (and \( w_H \)) do not depend on \( \beta \) either

  4. Since \( \Omega \) is decreasing in \( \beta \), we get \( w_L \) increasing in \( \beta \)

1.2.6 Other effects

- Productivity effect implies that workers whose jobs are being offshored benefit from decrease in offshoring costs

- In general, a decrease in offshoring costs would also have:

  1. Relative-price effect. If country is not small compared to the rest of the world, changes in \( \beta \) will also affect \( p_2/p_1 \)
2. **Labor-supply effect.** If there are more factors than produced goods, changes in $\beta$ will also affect $w_L$ and $w_H$ at constant prices.

- Simplest way to illustrate labor-supply effect is to consider case where Home is completely specialized in one good
  - this is the effect that has received the most attention in popular discussions

### 1.3 Costinot, Vogel, and Wang (2013)

An elementary theory of global supply chains

- A simple trade model with sequential production:
  - Multiple countries, one factor of production (labor), and one final good
  - Production of final good requires a continuum of intermediate stages
  - Each stage uses labor and intermediate good from previous stage
  - Production is subject to mistakes (Sobel 1992, Kremer 1993)

- Key simplifications:
  - Intermediate goods only differ in the order in which they are performed
  - Countries only differ in terms of failure rate
  - All goods are freely traded

#### 1.3.1 Basic Environment

- Consider a world economy with multiple countries $c \in C \equiv \{1, \ldots, C\}$
- There is one factor of production, labor:
  - Labor is inelastically supplied and immobile across countries
  - $L_c$ and $w_c$ denote the endowment of labor and wage in country $c$
- There is one final good:
  - To produce the final good, a continuum of stages $s \in S \equiv (0, S]$ must be performed (more on that on the next slide)
- All markets are perfectly competitive and all goods are freely traded
We use the final good as our numeraire

- At each stage, producing 1 unit of intermediate good requires a fixed amount of previous intermediate good and a fixed amount of labor
  - “Intermediate good 0” is in infinite supply and has zero price
  - “Intermediate good S” corresponds to final good mentioned before

- Mistakes occur at a constant Poisson rate, $\lambda_c > 0$
  - $\lambda_c$ measures total factor productivity (TFP) at each stage
  - Countries are ordered such that $\lambda_c$ is strictly decreasing in $c$

- When a mistake occurs, intermediate good is entirely lost

- Formally, if a firm combines $q(s)$ units of intermediate good $s$ with $q(s)ds$ units of labor, the output of intermediate good $s + ds$ is
  \[
  q(s + ds) = (1 - \lambda_c ds) q(s)
  \]

### 1.3.2 Free trade equilibrium

- In spite of arbitrary number of countries, unique free trade equilibrium is characterized by simple system of first-order difference equations

- This system can be solved recursively by:
  1. Determining assignment of countries to stages of production
  2. Computing prices sustaining that allocation as an equilibrium outcome

- Free trade equilibrium always exhibits vertical specialization:
  1. More productive countries, which are less likely to make mistakes, specialize in later stages of production, where mistakes are more costly
  2. Because of sequential production, absolute productivity differences are a source of comparative advantage between nations

- Cross-sectional predictions are consistent with:
  1. “Linder” stylized facts
  2. Variations in value added to gross exports ratio (Johnson Noguera 10)
1.3.3 Comparative statics

- Comprehensive exploration of how technological change, either global or local, affects different participants of a global supply chain

- Among other things, we show that:
  1. Standardization—uniform decrease in failure rates around the world—can cause welfare loss in rich countries: a strong form of immiserizing growth
  2. Spillover effects are different at the bottom and the top of the chain: monotonic effects at the bottom, but not at the top

- **Broad message:** *Important to model sequential nature of production to understand consequences of technological change in developing and developed countries on trading partners worldwide*

1.4 Ramondo and Rodriguez-Clare (2012)

1.4.1 Basic Model

- Extension of Eaton and Kortum (2002) with both trade and multinational production (MP)

- For each good $v \in (0, 1)$:
  - Ideas gets originated in country $i = 1, ..., I$
  - Production takes place in country $l = 1, ..., I$
  - Consumption takes place in country $n = 1, ..., I$

- Trade versus MP:
  - If $l \neq n$, then good $v$ is traded
  - If $i \neq l$, then MP occurs (in EK, $i = l$)

- Model is Ricardian:
  - Labor is the only factor of production
  - Constant returns to scale
  - (Like EK, full model also includes tradable intermediate goods)

- Constant unit cost of production and delivery for a good $v$ given by
  \[
  \frac{d_{nl} h_l w_i}{z_{li}(v)}
  \]

  where:
\[ d_{nl} = \text{iceberg trade costs from country } l \text{ to country } n \]
\[ h_{li} = \text{iceberg costs from using technology from } i \text{ in } l \]
\[ c_{li} = \text{average unit cost of production for firms from } i \text{ in country } l \]
\[ z_{li}(v) = \text{productivity of firms from } i \text{ producing good } v \text{ in country } l \]

- \[ z_{i}(v) \equiv (z_{1i}(v), ..., z_{IIi}(v)) \text{ is drawn from multivariate Fréchet} \]

1.4.2 Results

- **Main result:**
  - Gains from trade are larger in the presence of MP because trade facilitates MP
  - Gains from openness are larger than gains from trade because of MP and complementarity between trade and MP

- **A model of MP without a model of MNEs?**:
  - in any given country and sector, technology is assumed to be freely available to a large number of price-taking firms
  - discipline only comes from aggregate predictions of the model

2 Multinational Firms

2.1 What Are Multinational Enterprises (MNEs)?

- **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** ≡ Investment made by multinational in the Foreign country
– **Parent** ≡ Company making the investment abroad
– **Affiliate** ≡ Company receiving the investment abroad

### 2.2 Horizontal MNEs

The proximity-concentration trade-off

- **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** [Markusen and Venables 2000]: 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

### 2.2.1 Helpman, Melitz and Yeaple (2004)

**Overview**


- **Basic Idea:**
  - Low-variable 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
Model

- Firm productivity $\varphi$ is drawn from a Pareto, $G(\varphi) = 1 - (\varphi/\varphi)^k$
- 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: $f_I > f_X > f_D$

Selection into exports and FDI

2.2.2 Prediction

- 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-$\varphi$ firms
- high-$\varphi$ firms are more likely to select in $I$ than $X$

Formally:

$g$ is log-supermodular in $\varphi$ and $-k$; $r$ is supermodular in $\varphi$ and $\tau^{1-\sigma}$; and log-supermodularity is preserved by integration (Costinot 2009)
2.3 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 [Helpman 1984]:**
  Ability of MNEs to spread their facilities across several countries enlarges the region of factor price equalization

2.4 Why Do Multinational Firms Exist?

- **Answer so far:** “Technological” theories of the multinational firm
  - According to these theories, MNEs will emerge whenever concentrating production in a unique location is *not* profit-maximizing
  - Horizontal vs. Vertical FDI

- In developing global sourcing strategies, firms not only decide on where to locate different stages of value chain, but also on extent of **control**:
  - Why is fragmentation occurring within or across firm boundaries?
  - This is nothing more than the classical **make-or-buy** decision in IO.

2.5 What Determines (Multinational) Firms’ Boundaries?

- Over the last 10 years, trade economists have incorporated various theories of the firm into general equilibrium models:


- We will focus on **property-rights approach**:
– Integration means acquisition of assets; when contracts are incomplete, the parties encounter contingencies that were not foreseen in the initial contract, and the owner of the asset has the residual rights of control; the residual rights of control affect the outside options and therefore how the surplus from the relationship is divided ex-post (ownership = power)

– In the presence of relationship-specific investments, these considerations lead to a theory of the boundaries of the firm in which both the benefits and the costs of integration are endogenous

2.5.1 Antràs (2003)

Overview

• **Fact 1:** In cross-section of industries, share of intra-firm imports in total US imports increases with capital intensity

• **Fact 2:** In cross-section of countries, share of intra-firm imports in total US import increases with capital labor ratio of exporting country

• In order to explain facts 1 and 2, Antras (2003) proposes to combine Grossman-Hart and Helpman-Krugman:

  1. If final good producers always need an intermediate producer for labor decision, these producers should keep property rights when their decision matters more, i.e. in the labor-intensive sectors
  2. Since capital abundant countries produce capital intensive goods, and these goods are produced within the boundary of the firm, their share of intra-firm trade will be higher

A Simple Property-Rights Model

• Consumer preferences are such that \( F \) faces a demand given by

\[
y = Ap^{-1/(1-\alpha)}, \quad 0 < \alpha < 1.
\]  \hspace{1cm} (3)

• Production of good \( y \) requires the development of *two* specialized intermediate inputs \( h \) and \( m \). Output is Cobb-Douglas:

\[
y = \left( \frac{h}{\eta} \right)^{\eta} \left( \frac{m}{1-\eta} \right)^{1-\eta}, \quad 0 < \eta < 1,
\]  \hspace{1cm} (4)

where a higher \( \eta \) is associated with a more intensive use of \( h \) in production.
There are two agents engaged in production:

– a final-good producer (denoted by $F$) who supplies the input $h$ and produces the final good $y$,
– an operator of a manufacturing plant (denoted by $S$) who supplies the input $m$.

$F$ can produce $h$ at a constant marginal cost $c_h$; $S$ can produce $m$ at $MC = c_m$. In addition, production requires fixed cost $f \cdot g(c_h, c_m)$.

Inputs are tailored specifically to other party and useless to anybody else.

**Contractual structure:** before investments $h$ and $m$ are made, the only contractibles are the allocation of residual rights (i.e., the ownership structure) and a lump-sum transfer between the two parties.

Ex-post determination of price follows from generalized Nash bargaining.

*Ex-ante*, $F$ faces a perfectly elastic supply of potential $S$ agents so that, in equilibrium, the initial transfer will be such that it secures the participation of $S$ in the relationship at minimum cost to $F$.

**Key features:**

1. ex-post bargaining takes place both under outsourcing and under integration;
2. the distribution of surplus, however, is sensitive to the mode of organization because the outside option of $F$ is naturally higher when it owns $S$ than when it does not.

**Outside options are as follows:**

– under outsourcing, contractual breach gives 0 to both agents;
– under integration, $F$ can selectively fire $S$ and seize input $m$ (at a productivity cost $\delta$) – because of property rights over input.

**Formulation of the Problem**

In light of equations (3) and (4), the potential revenue from the sale of $y$ is

$$R(h, m) = \lambda^{1-\alpha} \left( \frac{h}{\eta} \right)^{\alpha\eta} \left( \frac{m}{1-\eta} \right)^{\alpha(1-\eta)}.$$ (5)

Given the specification of the ex-post bargaining, $F$ obtains share $\beta_O = \beta$ of sale revenue under outsourcing and share $\beta_V = \delta^\alpha + \beta (1-\delta^\alpha) > \beta_O$ under integration.
Optimal ownership structure $k^*$ is thus the solution to:

$$\max_{k \in \{V, O\}} \pi_k = R(h_k, m_k) - c_h \cdot h_k - c_m \cdot m_k - f \cdot g(c_h, c_m) - \U$$

s.t. \hspace{1cm} h_k = \arg \max_h \{\beta_k R(h, m_k) - c_h \cdot h\}

m_k = \arg \max_m \{(1 - \beta_k) R(h_k, m) - c_m \cdot m\}

(P1)

where $R(\cdot)$ is given in (5) and $\U$ is the outside option of the operator $S$

First-best level of investments would simply maximize $\pi_k$

A Useful Result

The solution to the constrained program (P1) delivers the following result (see Antràs, 2003 for details):

**Proposition 1** There exists a unique threshold $\eta \in (0, 1)$ such that for all $\eta > \eta$, integration dominates outsourcing ($k^* = V$), while for all $\eta < \eta$, outsourcing dominates integration ($k^* = O$).

As in Grossman and Hart (1986), in a world of incomplete contracts, ex-ante efficiency dictates that residual rights should be controlled by the party undertaking a relatively more important investment:

– if production is very intensive in the $m$ input, then choose outsourcing to alleviate the underinvestment in the provision of the $m$ input,

– when production is intensive in the $h$ input, $F$ will optimally choose to tilt the bargaining power in its favor by obtaining these residual rights, thus giving rise to vertical integration.

Convenient Feature: threshold $k^*$ is independent of factor prices (Cobb-Douglas assumption important).

**General Equilibrium Model**

Antràs (2003) embeds this structure in a Helpman-Krugman model of trade

- $J$ countries produce differentiated varieties in two sectors ($Y, Z$) using two factors ($K, L$)

- $K$ and $L$ are inelastically supplied and freely mobile across sectors
Preferences of the representative consumer in each country are of the form:

\[ U = \left( \int_0^{n_Y} y(i)^\alpha \, di \right)^{\frac{\mu}{\alpha}} \left( \int_0^{n_Z} z(i)^\alpha \, di \right)^{\frac{1-\mu}{\alpha}}, \quad \mu, \alpha \in (0, 1). \]

Demands are then

\[ y(i) = A_Y y_Y(i)^{-1/(1-\alpha)} \]
\[ z(i) = A_Z z_Z(i)^{-1/(1-\alpha)} \]

Free entry ⇒ zero expected profits for a potential entrant

Production is as described before with the following new features:

- \( h \) and \( m \) are nontradable, but combined yield a tradable composite input
- \( h \) is capital-intensive relative to \( m \) (cost-sharing in capital expenditures).

Extreme factor intensity: \( c_h^\ell = r^\ell \) and \( c_m^\ell = w^\ell \)

- see Table 1 in paper for a supportive evidence

- tradable composite input can be produced in any country according to Cobb-Douglas technology as in (4) with \( \eta_Y > \eta_Z \)
- homothetic cost functions: \( g_j^f (r^\ell, w^\ell) = (r^\ell)^{\eta_j} (w^\ell)^{1-\eta_j} \) and \( f_k^f = f \)
- final goods are nontradable, but can be produced one-to-one with inputs (helps pin down world trade flows)
- the same \( \beta \) and \( \delta \) apply to both sectors and \( U = 0 \).

**Firms, Contracts and Trade Structure**

- Under these assumptions the ownership structure and locational decisions in (P2) can be analyzed separately.

  - Optimal ownership structure in sector \( j \in \{Y, Z\} \) solves (P1) – Proposition 1 applies;
  - Optimal location decision solves \( \min_{\ell} \left\{ \left( r^\ell \right)^{\eta_j} \left( w^\ell \right)^{1-\eta_j} \right\} \).

- Pattern of specialization of intermediate inputs responds to Heckscher-Ohlin forces as well as Helpman-Krugman forces:

  - because of IRS and product differentiation, countries specialize in certain intermediate input varieties and export them worldwide,
  - but capital-abundant countries tend to produce a larger share of capital-intensive varieties than labor-abundant countries.

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• Intermediate inputs can be traded at zero cost, while final goods are nontradable so that each $F$ (costlessly) sets $J$ plants to service the $J$ markets.

• It can then be shown that, with FPE, for any country $j \in J$:
  
  – “probability” of imports being intrafirm is increasing in capital-intensity of the industry.
  
  – the share of capital-intensive (and thus intrafirm) imports in total imports is an increasing function of the capital-labor ratio of the exporting country.

2.5.2 Antràs and Helpman (2004)

Global Sourcing with Heterogenous Firms

• The technological theories of MNEs emphasizes the location decision

• Antras (2003) emphasizes the boundary decision

• Antras and Helpman (2004) offer a model in which final good producers will simultaneously decide:
  
  1. Where to source their inputs, North or South
  2. Whether to make or buy these inputs

• As in Melitz (2003) and HMY (2004), they introduce firm-level heterogeneity
  
  – Global sourcing decisions will depend both on firm- and industry-characteristics

The Model

• **Environment and Preferences:** Consider a world with two countries, the North and the South, and a unique factor of production, labor. There is a representative consumer in each country with quasi-linear preferences:

  $$U = x_0 + \frac{1}{\mu} \sum_{j=1}^{J} X_j^\mu, \ 0 < \mu < 1.$$  

  where $x_0$ is consumption of a homogeneous good, $X_j$ is an index of aggregate consumption in sector $j$, and $\mu$ is a parameter.
• Aggregate consumption in sector $j$ is a CES function
\[ X_j = \left( \int x_j(i)^\alpha \, di \right)^{1/\alpha}, \quad 0 < \alpha < 1, \]
of the consumption of different varieties $x_j(i)$, where the range of $i$ will be endogenously determined.

• This specification leads to the following inverse demand function for each variety $i$ in sector $j$:
\[ p_j(i) = X_j^{\mu - \alpha} x_j(i)^{\alpha - 1}. \]

• **Technology:** Producers of differentiated goods face a perfectly elastic supply of labor. Let the wage in the North be strictly higher than that in the South ($w^N > w^S$). The market structure is one of monopolistic competition.

  – As in Melitz (2003), producers need to incur sunk entry costs $w^N f_E$, after which they learn their productivity $\theta \sim G(\theta)$.
  – As in Antràs (2003), final-good production combines two specialized inputs according to the technology:
\[ x_j(i) = \theta \left( \frac{h_j(i)}{\eta_j} \right)^{\eta_j} \left( \frac{m_j(i)}{1 - \eta_j} \right)^{1 - \eta_j}, \quad 0 < \eta_j < 1. \]

  – $h$ is controlled by a final-good producer (agent $F$), $m$ is controlled by an operator of the production facility (agent $S$).
  – Sectors vary in their intensity of headquarter services $\eta_j$. Furthermore, within sectors, firms differ in productivity $\theta$.
  – Intermediates are produced using labor with a fixed coefficient.
  – $h_j(i)$ is produced only in the North, which implies that the headquarters $H$ are always located in the North.
  – Productivity in the production of $m_j(i)$ is assumed identical in both countries.

• After observing $\theta$, $H$ decides whether to exit the market or start producing.

• In the latter case additional fixed cost of organizing production need to be incurred.

  – It is assumed that these additional fixed cost are a function of the structure of ownership and the location of production.
  – In particular, if an organizational form is $k \in \{V, O\}$ and $\ell \in \{N, S\}$, these fixed costs are $w^N f^\ell_k$ and satisfy
\[ f^S_V > f^S_O > f^N_V > f^N_O. \quad (6) \]
• Contracting is as in the previous models, but we let $\delta^N \geq \delta^S$.

• Following Antràs (2003), the ex-post division of surplus is as follows:

<table>
<thead>
<tr>
<th>Non-Integration</th>
<th>North</th>
<th>South</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta^N_O = \beta$</td>
<td>$\beta^N = (\delta^N)^\alpha + \beta \left[ 1 - (\delta^N)^\alpha \right]$</td>
<td>$\beta^S_O = \beta$</td>
</tr>
<tr>
<td>Integration</td>
<td>$\beta^N = (\delta^N)^\alpha + \beta \left[ 1 - (\delta^S)^\alpha \right]$</td>
<td>$\beta^S_O = \beta$</td>
</tr>
</tbody>
</table>

• Notice that $\beta^N_O > \beta^S_O > \beta^N = \beta^S = \beta$.

Equilibrium

• We show that after solving for investment levels (in the constraints), the general program in (P2) reduces to

$$\max_{\theta, X, \eta} \pi_k^f (\theta, X, \eta) = X^{(\mu-\alpha)/(1-\alpha)} \theta^\alpha/(1-\alpha) \psi_k^f (\eta) - w^N f_k^f \quad (7)$$

where

$$\psi_k^f (\eta) = \frac{1 - \alpha \left[ \beta_k^f \eta + \left( 1 - \beta_k^f \right) (1 - \eta) \right]}{\left( \frac{\eta}{\eta - \beta_k^f} \right)^{\alpha/(1-\alpha)}}.$$

• By choosing $k$ and $f$, $H$ is effectively choosing a triplet $(\beta_k^f, w^f, f_k^f)$. And:

  - $\pi_k^f$ is decreasing in $w^f$ and $f_k^f$.
  - $\pi_k^f$ is largest when $\beta_k^f = \beta^* (\eta)$, with $\beta^* (\eta) > 0$, $\beta^* (0) = 0$ and $\beta^* (1) = 1$ (remember Figure 1). Intuitively, $H$ wants to allocate relatively more power to the party undertaking a relatively more important investment in production.

• One can solve for industry equilibrium as in Melitz (2003) or HMY (2004).

Relevant Trade-offs

• The choice of an organizational form faces two types of tensions:

  - Location decision: variable costs are lower in the South, but fixed costs are higher there – a firm’s productivity $\theta$ will turn out to affect crucially the participation in international trade;
  - Integration decision: integration improves efficiency of variable production when the $\eta$ is high, but involves higher fixed costs. This decision will thus crucially depend on $\eta$ but also on $\theta$.

• To simplify the discussion, we focus on two types of sectors:
1. A **Component-intensive sector** \((\eta < \beta^{*^{-1}}(\beta) \text{ and } w^N/w^S < \left(\frac{f_O^S}{f_O^N}\right)^{(1-\alpha)/\alpha(1-\eta)}\)):

- This implies \(\psi^\ell_O(\eta) > \psi^\ell_V(\eta)\) for \(\ell = N, S\), which together with (6), implies that any form of integration is dominated in equilibrium (see Figure).

2. A **Headquarter-intensive sector** with \(\eta > \beta^{*^{-1}}(\beta^N)\), and \((w^N/w^S)^{1-\eta}\) “high enough”

- This implies the ranking of slopes

\[
\psi^S_V(\eta) > \psi^S_O(\eta) > \psi^N_V(\eta) > \psi^N_O(\eta).
\]

which together with (6) leads to the Figure below.

**Equilibrium in the component-intensive sector**

**Equilibrium in the headquarter-intensive sector**

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Prevalence of various organizations

- Last part of the paper quantifies the relative prevalence of different organizational forms.

- This requires parameterizing the distribution of $\theta$. Following HMY (2004), we choose $G(\theta)$ to be a Pareto distribution with shape $z$, i.e.,

\[ G(\theta) = 1 - \left( \frac{b}{\theta} \right)^z \text{ for } \theta \geq b > 0. \]  

  - Remember that $z$ is inversely related to the variance of the distribution.

- In the component-intensive sector, foreign outsourcing is more prevalent:
  - the higher is $w^N/w^S$ (or the lower are transport costs $\tau$),
  - the lower are $z$ and $\eta$.

- In the headquarter-intensive sector:
  - the share of intrafirm imports in total imports should be higher in industries with higher $\eta$, but also in industries with higher productivity dispersion (lower $z$) and higher transport costs ($\tau$).
  - a higher $w^N/w^S$ (or lower $\tau$) increase the amount of international sourcing, but also increase the share of foreign outsourcing in total foreign sourcing.
Comments

- Antràs and Helpman (2004) offer a rich set of *positive* predictions:
  1. Share of intra-firm trade
  2. Prevalence of offshoring

- We now much less about the *normative* and *policy* implications of contractual theories of MNEs