# 14.581 International Trade
# — Lecture 19: Offshoring (Theory) —

# Today's Plan

1. Neoclassical Theories of Fragmentation:
    1. Trade in Tasks
    2. Sequential Production
    3. Quantitative Work
2. Multinational Firms:
    1. Horizontal versus Vertical FDI
    2. The Boundary of Multinational Firms

# 1. Neoclassical Theories of Fragmentation

# 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, tough 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

# Grossman and Rossi-Hansberg (2008)

## 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:
  - 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

# Grossman and Rossi-Hansberg (2008)

## 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)

- 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

$$\beta t(J) w_L^* = w_L \tag{1}$$

# Grossman and Rossi-Hansberg (2008)

## Offshoring as Factor Augmenting Technological Change

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

$$c_i = a_{Li}\left[w_L(1-J) + w_L^*\beta T(J)\right] + a_{Hi}w_H \tag{2}$$

with $T(J) \equiv \int_0^J t(j)dj$, $w_H \equiv$ 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

# Grossman and Rossi-Hansberg (2008)

## 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 $\beta$

# Grossman and Rossi-Hansberg (2008)

## 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 $w_L\Omega$ 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
  - empirically, is it more or less important than the other two?

# 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

# Costinot, Vogel, and Wang (2013)

## Basic Environment

- Consider a world economy with multiple countries $c \in \mathcal{C} \equiv \{1, ..., C\}$
- 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 $s \in \mathcal{S} \equiv (0, S]$ 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

# Costinot, Vogel, and Wang (2013)

## Basic Environment (Cont.)

- 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

$$q(s + ds) = (1 - \lambda_c ds)\, q(s)$$

# Costinot, Vogel, and Wang (2013)

## 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)

# Costinot, Vogel, and Wang (2013)

## 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*

# Ramondo and Rodriguez-Clare (2012)

## 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, $i = l$)

# Ramondo and Rodriguez-Clare (2012)

## Basic Model (Cont.)

- 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

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

  where:
  - $d_{nl} \equiv$ iceberg trade costs from country $l$ to country $n$
  - $h_{li} \equiv$ iceberg costs from using technology from $i$ in $l$
  - $c_{li} \equiv$ average unit cost of production for firms from $i$ in country $l$
  - $z_{li}(v) \equiv$ productivity of firms from $i$ producing good $v$ in country $l$
- $\mathbf{z}_i(v) \equiv (z_{1i}(v), ..., z_{li}(v))$ is drawn from multivariate Fréchet

# Ramondo and Rodriguez-Clare (2012)

## 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

# 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** $\equiv$ Investment made by multinational in the Foreign country
  - **Parent** $\equiv$ Company making the investment abroad
  - **Affiliate** $\equiv$ Company receiving the investment abroad

# 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

# Helpman, Melitz and Yeaple (2004)

## Overview

- 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 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

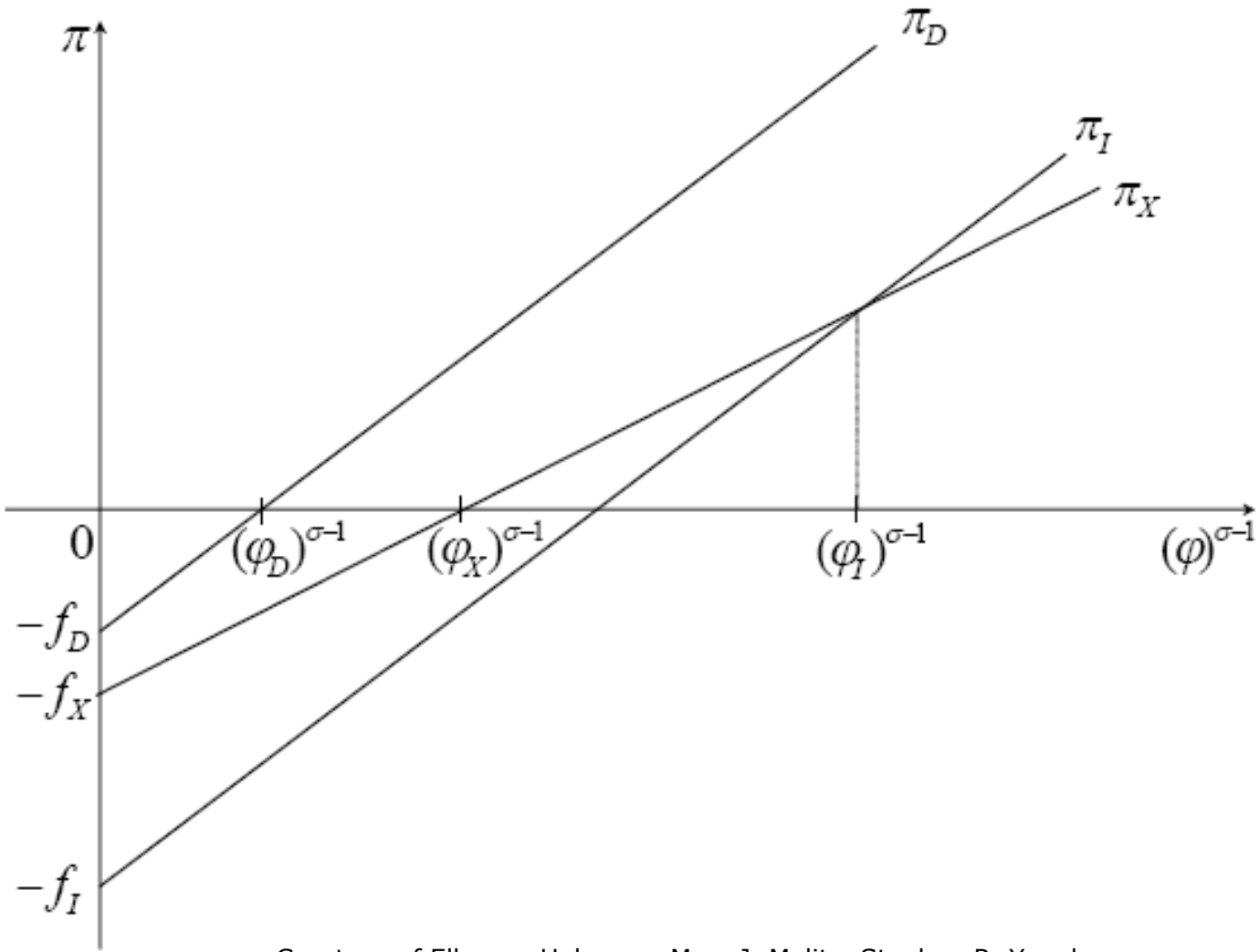
# Helpman, Melitz and Yeaple (2004)

## Model

- Firm productivity $\varphi$ 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: $f_I > f_X > f_D$

# Horizontal FDI: Helpman, Melitz and Yeaple (2004)

## Selection into exports and FDI



# Helpman, Melitz and Yeaple (2004)

## 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)

# 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

# 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.

# What Determines (Multinational) Firms' Boundaries?

- Over the last 10 years, trade economists have incorporated various theories of the firm into general equilibrium models:
  1. Williamson's transaction-cost approach [Grossman Helpman 2002]
  2. Grossman-Hart-Moore's property-rights approach [Antras 2003, Antras Helpman 2004]
  3. Aghion-Tirole's approach [Marin Verdier 2008, Puga Trefler 2007]
- 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

# 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

# Antràs (2003)

## A Simple Property Rights Model

- Consumer preferences are such that $F$ faces a demand given by

$$y = Ap^{-1/(1-\alpha)}, \qquad 0 < \alpha < 1. \tag{3}$$

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

$$y = \left(\frac{h}{\eta}\right)^{\eta} \left(\frac{m}{1-\eta}\right)^{1-\eta}, \quad 0 < \eta < 1, \tag{4}$$

  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 $f \cdot g\left(c_h, c_m\right)$.
- Inputs are tailored specifically to other party and useless to anybody else.

# Antràs (2003)

## A Simple Property Rights Model (cted.)

- **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.

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

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

- 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:

$$\begin{aligned} \max_{k\in\{V,O\}} \quad & \pi_k = R(h_k,m_k) - c_h\cdot h_k - c_m\cdot m_k - f\cdot g(c_h,c_m) - \overline{U} \\ s.t. \quad & h_k = \arg\max_h \{\beta_k R(h,m_k) - c_h\cdot h\} \\ & m_k = \arg\max_m \{(1-\beta_k) R(h_k,m) - c_m\cdot m\} \end{aligned} \tag{P1}$$

  where $R(\cdot)$ is given in (5) and $\overline{U}$ is the outside option of the operator $S$
- First-best level of investments would simply maximize $\pi_k$

# Antràs (2003)

## A Useful Result

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

**Proposition**

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

# Antràs (2003)

## 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 $y(i) = A_Y p_Y(i)^{-1/(1-\alpha)}$ and $z(i) = A_Z p_Z(i)^{-1/(1-\alpha)}$
- Free entry $\Rightarrow$ zero expected profits for a potential entrant

# Antràs (2003)

## General Equilibrium Model

- 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: $g_j^\ell\left(r^\ell, w^\ell\right) = \left(r^\ell\right)^{\eta_j}\left(w^\ell\right)^{1-\eta_j}$ and $f_k^\ell = f$
- 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 $\overline{U} = 0$.

# Antràs (2003)

## 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.
- 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.

# 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

- **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

$$X_j = \left[\int x_j(i)^{\alpha} di\right]^{1/\alpha}, \ 0 < \alpha < 1,$$

  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 $j$:

$$p_j(i) = X_j^{\mu-\alpha} x_j(i)^{\alpha-1}.$$

# Antràs and Helpman (2004)

## The Model (cted.)

- **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 needs 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.

# Antràs and Helpman (2004)

## The Model (cted.)

- 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 $w^N f_k^\ell$ and satisfy

$$f_V^S > f_O^S > f_V^N > f_O^N. \tag{6}$$

- 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:

| | North | South |
|---|---|---|
| Non-Integration | $\beta_O^N = \beta$ | $\beta_O^S = \beta$ |
| Integration | $\beta_V^N = \left(\delta^N\right)^\alpha + \beta\left[1 - \left(\delta^N\right)^\alpha\right]$ | $\beta_V^S = \left(\delta^S\right)^\alpha + \beta\left[1 - \left(\delta^S\right)^$ |

- Notice that

$$\beta_V^N \geq \beta_V^S > \beta_O^N = \beta_O^S = \beta.$$

# Antràs and Helpman (2004)

## Equilibrium

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

$$\max_{\beta_k^\ell \in \left\{\beta_V^N, \beta_V^S, \beta_O^N, \beta_O^S\right\}} \pi_k^\ell(\theta, X, \eta) = X^{(\mu-\alpha)/(1-\alpha)} \theta^{\alpha/(1-\alpha)} \psi_k^\ell(\eta) - w^N f_k^\ell \quad (7)$$

where

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

- By choosing $k$ and $\ell$, $H$ is effectively choosing a triplet $\left(\beta_k^\ell, w^\ell, f_k^\ell\right)$. And:
  - $\pi_k^\ell$ is decreasing in $w^\ell$ and $f_k^\ell$.
  - $\pi_k^\ell$ is largest when $\beta_k^\ell = \beta^*(\eta)$, with $\beta^{*\prime}(\eta) > 0$, $\beta^*(0) = 0$ 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).

# Antràs and Helpman (2004)

## Relevant Trade offs

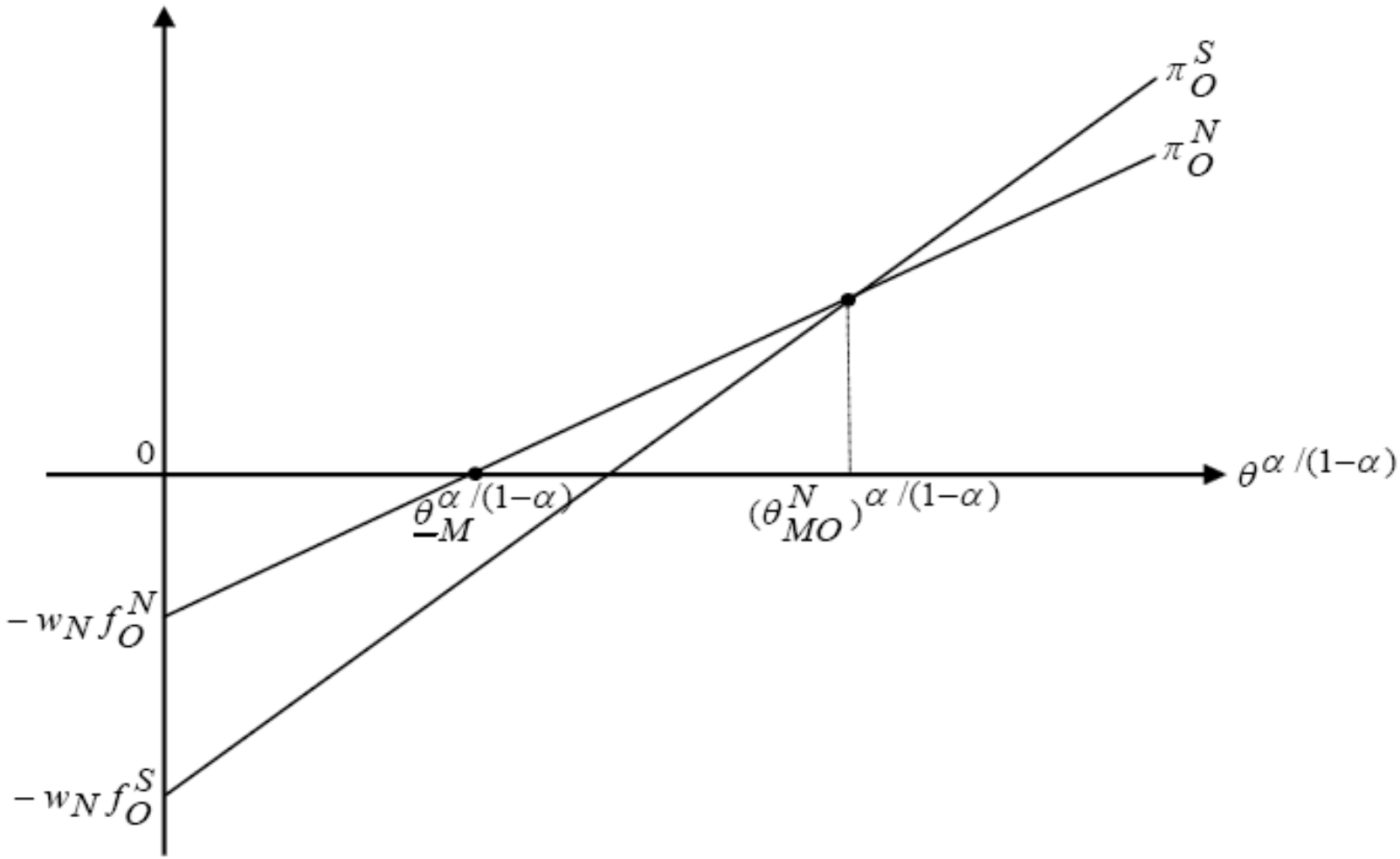
- The choice of an organizational form faces two types of tensions:
  - Location decision: variable costs are lower in the South, but fixed costs are higher there – a firm's productivity $\theta$ will turn out to affect crucially the participation in international trade;
  - Integration decision: integration 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** ($\eta < \beta^{*-1}(\beta)$ and $w^N/w^S < \left(f_O^S/f_O^N\right)^{(1-\alpha)/\alpha(1-\eta)}$):
     - This implies $\psi_O^\ell(\eta) > \psi_V^\ell(\eta)$ for $\ell = N, S$, which together with (6), implies that any form of integration is dominated in equilibrium (see Figure).
  2. A **Heaquarter-intensive sector** with $\eta > \beta^{*-1}\left(\beta_V^N\right)$, and $\left(w^N/w^S\right)^{1-\eta}$ "high enough"
     - This implies the ranking of slopes

$$\psi_V^S(\eta) > \psi_O^S(\eta) > \psi_V^N(\eta) > \psi_O^N(\eta). \tag{8}$$

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

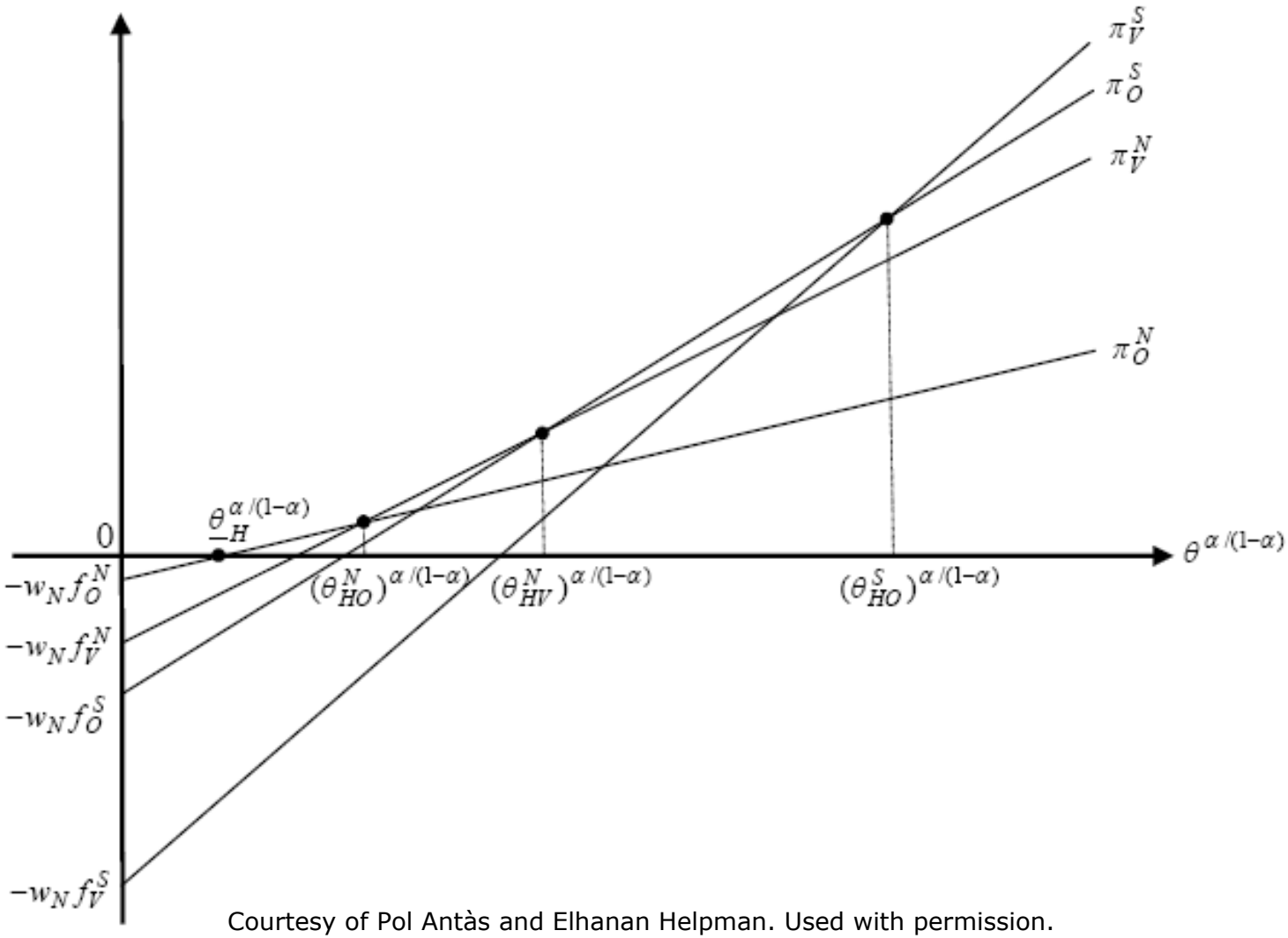
# Antràs and Helpman (2004)

## Equilibrium in the component intensive sector



# Antràs and Helpman (2004)

## Equilibrium in the headquarter intensive sector




Courtesy of Pol Antàs and Elhanan Helpman. Used with permission.

# Antràs and Helpman (2004)

## 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.,

$$G(\theta) = 1 - \left(\frac{b}{\theta}\right)^z \text{ for } \theta \geq b > 0. \tag{9}$$

  - 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.

# Antràs and Helpman (2004)

## 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

# More Recent Work at the Frontier

- **North-North Fragmentation:**
  - In GRH (2008), rationale for offshoring $\equiv$ factor price differences
  - Likely to be important for "North-South," but not "North-North" fragmentation
  - In GRH (2012), rationale for offshoring $\equiv$ external economies of scale (at the task level)
- **Quantitative Work:**
  - Irarrazabal, Moxnes, and Opromolla (2012)
  - Arkolakis, Ramondo, Rodriguez-Clare, and Yeaple (2013)
- **Sequential Production:**
  - Antras and Chor (2013)
  - Johnson and Moxnes (2013)
- **Trade Agreements:**
  - Antras and Staiger (2012)

# 14.581 International Economics I

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