Lecture 1: Incomplete Contracts and International Trade

Economics 552

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The Property-Rights Approach in International Trade

- What defines the boundaries of the firm?
- Grossman and Hart argue that incomplete contracts are key
- They suggest that ownership is a source of power when contracts are incomplete. What does this mean?
  - integration means acquisition of physical assets;
  - when contracts are incomplete, the parties will often encounter contingencies that were not foreseen in the initial contract;
  - in those situations, the owner of the asset has these residual rights of control;
  - these residual rights of control are important because they are likely to affect how the surplus 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.

A Simple Property-Rights Model

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

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

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

$$y = \left(\frac{h}{\eta}\right)^{\eta} \left(\frac{m}{1-\eta}\right)^{1-\eta}, \quad 0 < \eta < 1, \tag{2}$$

  where a higher η 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 c_m. In addition, production requires fixed cost $f \cdot g\left(c_h, c_m\right)$.
- Both inputs are tailored specifically to the other party and are useless to anybody else.

A Simple Property-Rights Model

- **Contractual structure:** before investments h and m, 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 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 δ) – property rights over input.

Formulation of the Problem

- In light of equations (1) and (2), the potential revenue from the sale of y are given by

$$R(h,m) = A^{1-\alpha}\left(\frac{h}{\eta}\right)^{\alpha\eta}\left(\frac{m}{1-\eta}\right)^{\alpha(1-\eta)}. \tag{3}$$

- 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.
- The optimal ownership structure k^* is thus the solution to the following program:

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

  where $\overline{U}$ is the outside option of the operator S.
- First-best level of investments would simply maximize π_k.

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 $\hat{\eta}$ is independent of factor prices (Cobb-Douglas assumption important).

Another Look at the Result

- Suppose that instead of choosing $k \in \{V, O\}$, F could choose $\beta \in (0, 1)$.

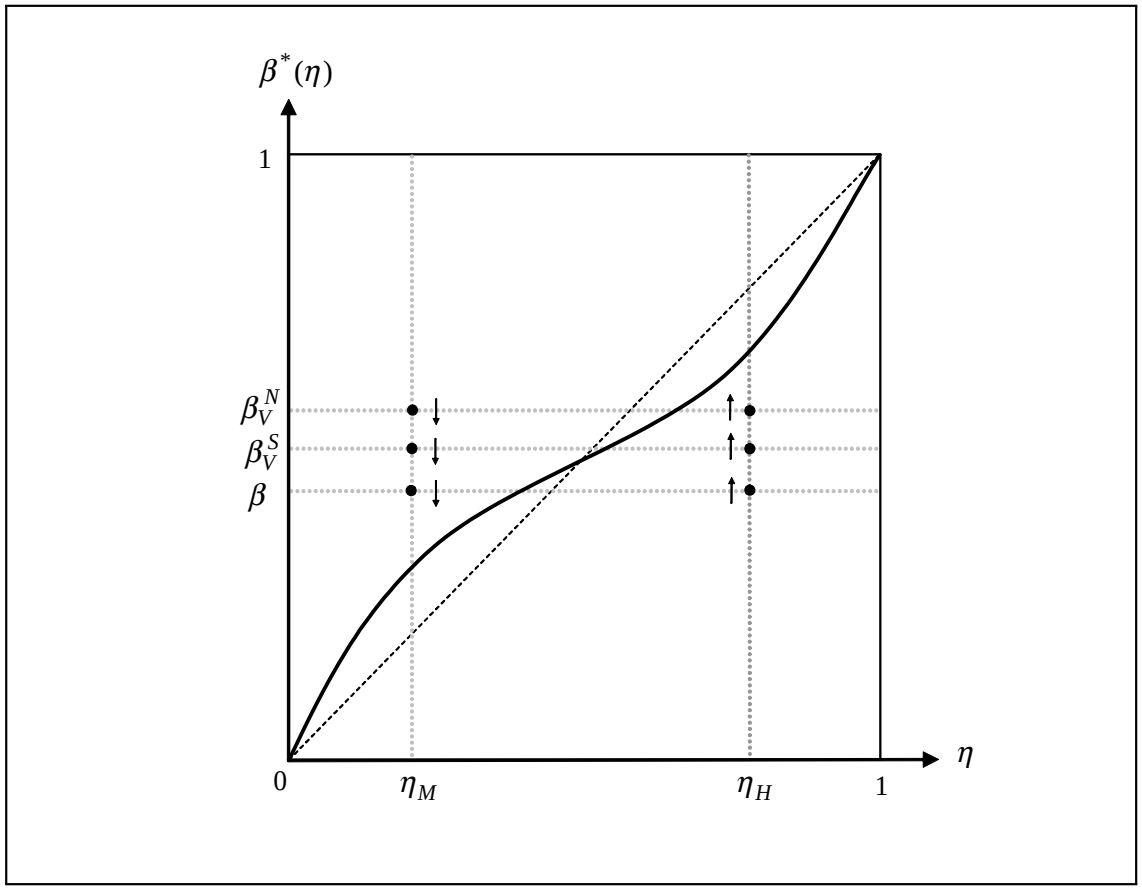


Figure 1

A General Open-Economy Formulation

- Introduce the location decision of firms.
- Consider a two-country version of the model in which firms are allowed to locate different parts of the production process in different countries.
- Denote by L the set of possible locational decisions (a mapping from production processes to locations) and by $\ell \in L$ a particular one.
- Different locational choices will in general entail different values of key parameters.
- The optimal ownership structure k^* and the optimal locational choice ℓ^* now solve the following program:

$$\max_{k \in \{V,O\}, \ell \in L} \quad \pi_k^\ell = R^\ell\left(h_k^\ell, m_k^\ell\right) - c_h^\ell \cdot h_k^\ell - c_m^\ell \cdot m_k^\ell - f_k^\ell \cdot g^\ell\left(c_h^\ell, c_m^\ell\right) - \overline{U}^\ell$$

$$s.t. \quad h_k^\ell = \arg\max_h \left\{\beta_k^\ell R\left(h, m_k^\ell\right) - c_h^\ell \cdot h\right\}$$

$$m_k^\ell = \arg\max_m \left\{\left(1 - \beta_k^\ell\right) R\left(h_k^\ell, m\right) - c_m^\ell \cdot m\right\} \tag{P2}$$

Firms, Contracts and Trade Structure: Antràs (2003)

- J countries produce differentiated varieties in two sectors (Y, Z) using two factors (K, L).
- 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 $z(i) = A_Z p_Z(i)^{-1/(1-\alpha)}$.

Firms, Contracts and Trade Structure: Antràs (2003)

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. Extreme factor intensity:* $c_h^\ell = r^\ell$ *and* $c_m^\ell = w^\ell$
- Key assumtion: S produces labor intensive good

Firms, Contracts and Trade Structure: Antràs (2003)

- Business practices suggest that cost-sharing is more common in capital expenditures than in labor expenditures.
  - Dunning (1993) - MNE with subcontractors - provision of machinery and specialized tools, prefinancing of machinery, procurement assistance in obtaining capital equipment, labor training.
  - Milgrom and Roberts (1993) - GM paid for firm- or product-specific capital equipment needed by the supplier to meet special requirements, even though this equipment would be located at the supplier's facility.
  - Aoki (1990) - Japanese firms - close connections with suppliers but considerable autonomy in personnel administration.

Firms, Contracts and Trade Structure: Antràs (2003)

- Young, Hood, and Hamill (1985).

Table 1. Decision-Making in U.S. based multinationals

% of British affiliates in which parent influence on decision is strong or decisive			
Financial decisions		Employment/personnel decisions	
Setting of financial targets	51	Union recognition	4
Preparation of yearly budget	20	Collective bargaining	1
Acquisition of funds for working capital	44	Wage increases	8
Choice of capital investment projects	33	Numbers employed	13
Financing of investment projects	46	Lay-offs/redundancies	10
Target rate of return on investment	68	Hiring of workers	10
Sale of fixed assets	30	Recruitment of executives	16
Dividend policy	82	Recruitment of senior managers	13
Royalty payments to parent company	82		

Firms, Contracts and Trade Structure: Antràs (2003)

- Tradable composite input can be produced in any country according to Cobb-Douglas technology as in (2) 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
- β_k^ℓ is independent of ℓ, same β and δ apply to both sectors, and $\overline{U}^\ell = 0$.

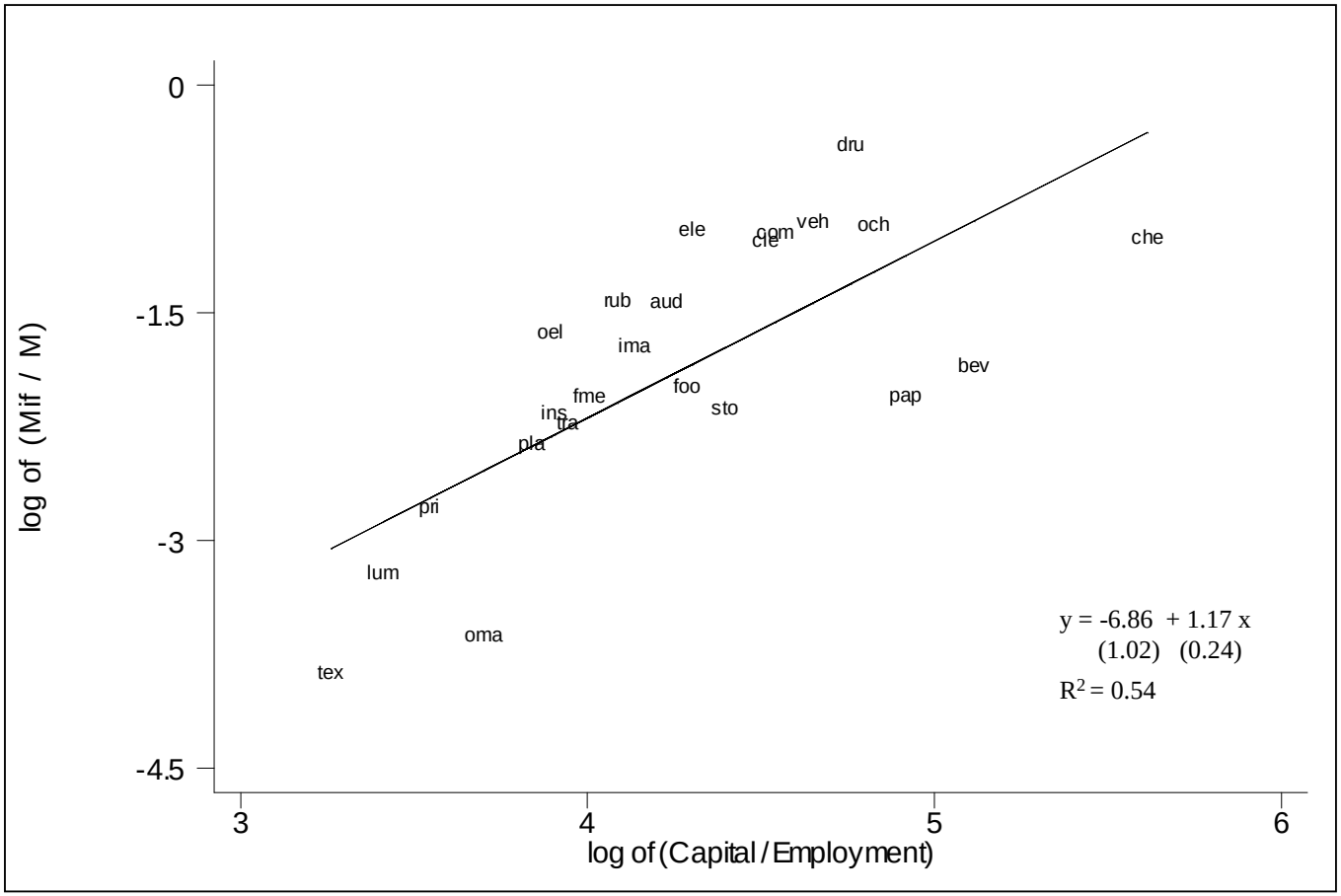
Firms, Contracts and Trade Structure: Antràs (2003) cted.

- 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.

Firms, Contracts and Trade Structure: Antràs (2003) cted.

- 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.

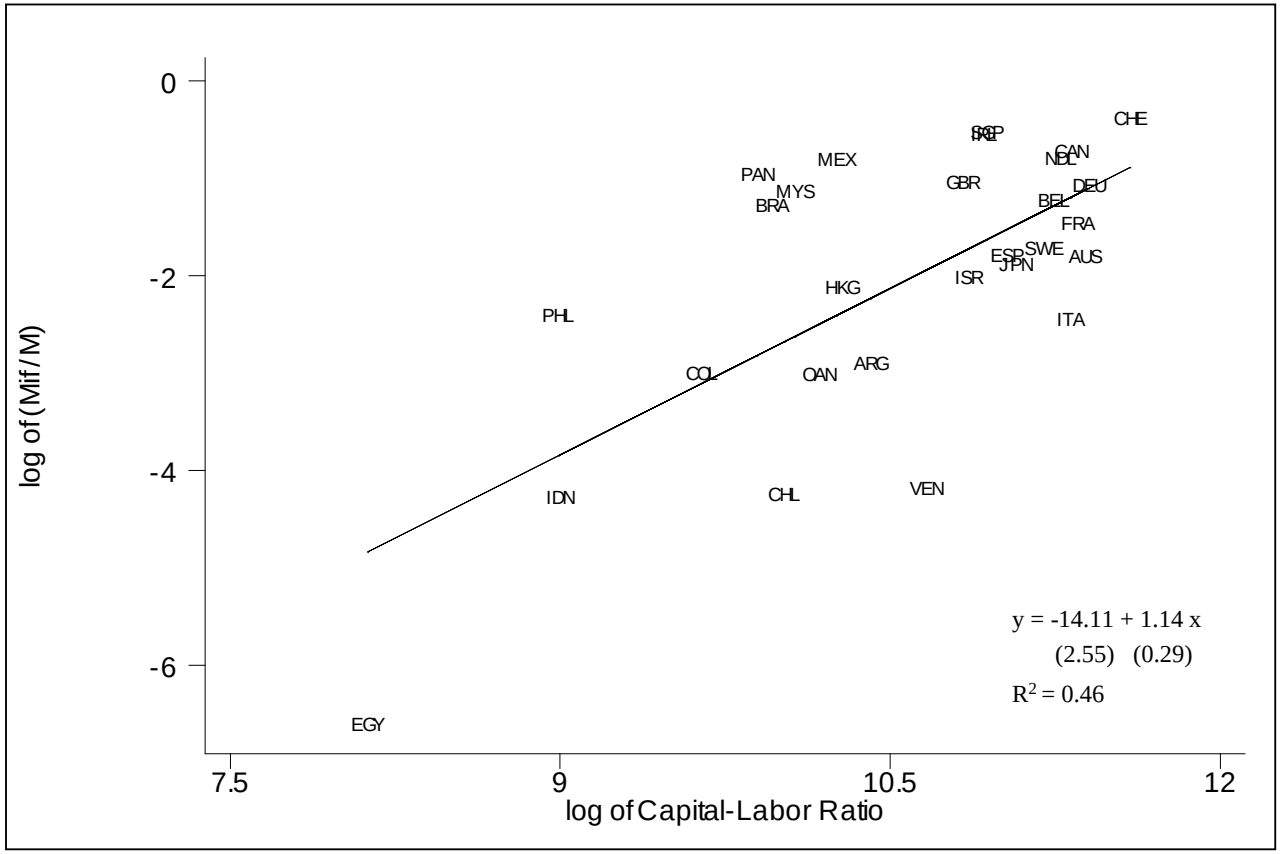
Firms, Contracts and Trade Structure: Antràs (2003) cted.



Notes: The Y-axis corresponds to the logarithm of the share of intrafirm imports in total U.S. imports for 23 manufacturing industries averaged over 4 years: 1987, 1989, 1992, 1994. The X-axis measures the average log of that industry's ratio of capital stock to total employment, using U.S. data. See Table A.1. for industry codes and Appendix A.4. for data sources.

Share of Intrafirm U.S. Imports and Relative Factor Intensities

Firms, Contracts and Trade Structure: Antràs (2003) cted.



Notes: The Y-axis corresponds to the logarithm of the share of intrafirm imports in total U.S. imports for 28 exporting countries in 1992. The X-axis measures the log of the exporting country's physical capital stock divided by its total number of workers. See Table A.2. for country codes and Appendix A.4. for details on data sources.

Share of Intrafirm Imports and Relative Factor Endowments

Antràs (2003): Econometric Evidence

- The last section of Antràs (2003) attempts to provide evidence that the patterns in these Figures are not driven by third omitted factors. The purpose is also to unveil additional factors affecting the relative prevalence of intrafirm trade.
- First run $\ln\left(S_{i-f}^{USA,ROW}\right)_k = \theta_1 + \theta_2 \ln\left(K/L\right)_k + W_k'\theta_3 + \epsilon_k$, where the implication is that $\theta_2 > 0$ (smoothed version of Proposition 1).
- Then run $\ln\left(M_{i-f}^{USA,j}\right) = \omega_1 + \omega_2 \ln\left(K^j/L^j\right) + \omega_3 \ln\left(L^j\right) + W_j'\omega_4 + \varepsilon_j$, where the implication is that $\omega_2 > \gamma_2$.
- The results are very supportive of the theory.

Antràs (2003): Econometric Evidence

Table 4a. Factor Intensity and the Share $S_{i-f}^{US,ROW}$

Dep. var. is $\ln\left(S_{i-f}^{US,ROW}\right)_k$	*Pooled Regressions*				
	I	II	III	IV	V
$\ln(K/L)_k$	1.149***	0.996***	0.859***	0.852***	0.709***
	(0.272)	(0.253)	(0.192)	(0.186)	(0.177)
$\ln(H/L)_k$		0.386*	-0.000	-0.060	0.045
		(0.197)	(0.148)	(0.162)	(0.179)
$\ln(R\&D/Sales)_k$			0.468***	0.508***	0.569***
			(0.077)	(0.089)	(0.086)
$\ln(ADV/Sales)_k$				0.098	0.141
				(0.055)	(0.096)
$\ln(VAD/Sales)_k$					-0.897*
					(0.527)
R^2	0.50	0.55	0.72	0.73	0.74
No. of obs.	92	92	92	92	92

Antràs (2003): Econometric Evidence

Table 6. Factor Endowments and the volume $M_{i-f}^{US,j}$

Dep. var. is $\ln\left(M_{i-f}^{US,j}\right)$	I	II	III	IV	V
$\ln\left(K/L\right)_j$	2.048***	2.192***	2.188***	1.841***	2.096***
	(0.480)	(0.458)	(0.716)	(0.623)	(0.695)
$\ln\left(L\right)_j$		0.607**	0.608**	0.435	0.700
		(0.229)	(0.268)	(0.332)	(0.419)
$\ln\left(H/L\right)_j$			0.031	0.892	0.708
			(3.289)	(3.147)	(3.052)
OpFDI				-0.624**	-1.006**
				(0.259)	(0.474)
OpTrade					0.674
					(0.560)
CorpTax					-0.647
					(5.295)
R^2	0.44	0.52	0.52	0.42	0.49
No. of obs.	28	28	28	26	26

Global Sourcing with Heterogenous Firms: Antràs and Helpman (2004)

- **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 μ 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:

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

Global Sourcing: 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 η_j. Furthermore, within sectors, firms differ in productivity θ.
  - 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.

Global Sourcing: The Model (cted.)

- After observing θ, 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

$$f_V^S > f_O^S > f_V^N > f_O^N. \tag{4}$$

- Contracting is as in the previous models, but they 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	$\beta_V^N = \left(\delta^N\right)^\alpha + \beta\left[1 - \left(\delta^N\right)^\alpha\right]$	$\beta_V^S = \left(\delta^S\right)^\alpha + \beta\left[1 - \left(\delta^S\right)^\alpha\right]$

- Notice that

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

Global Sourcing: Equilibrium

- After solving for investment levels (in the constraints), the general program in (P2) reduces to

$$\max_{\beta_k^\ell \in \left\{\beta_V^N, \beta_V^S, \beta_O^N, \beta_O^S\right\}} \pi_k^\ell(\theta, X, \eta) = X^{(\mu-\alpha)/(1-\alpha)} \theta^{\alpha/(1-\alpha)} \psi_k^\ell(\eta) - w^N f_k^\ell \quad (5)$$

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 ℓ, H is effectively choosing a triplet $\left(\beta_k^\ell, w^\ell, f_k^\ell\right)$. And:
  - π_k^ℓ is decreasing in w^ℓ and f_k^ℓ.
  - π_k^ℓ 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 also solve for the industry equilibrium as in Melitz (2003) or HMY (2004).

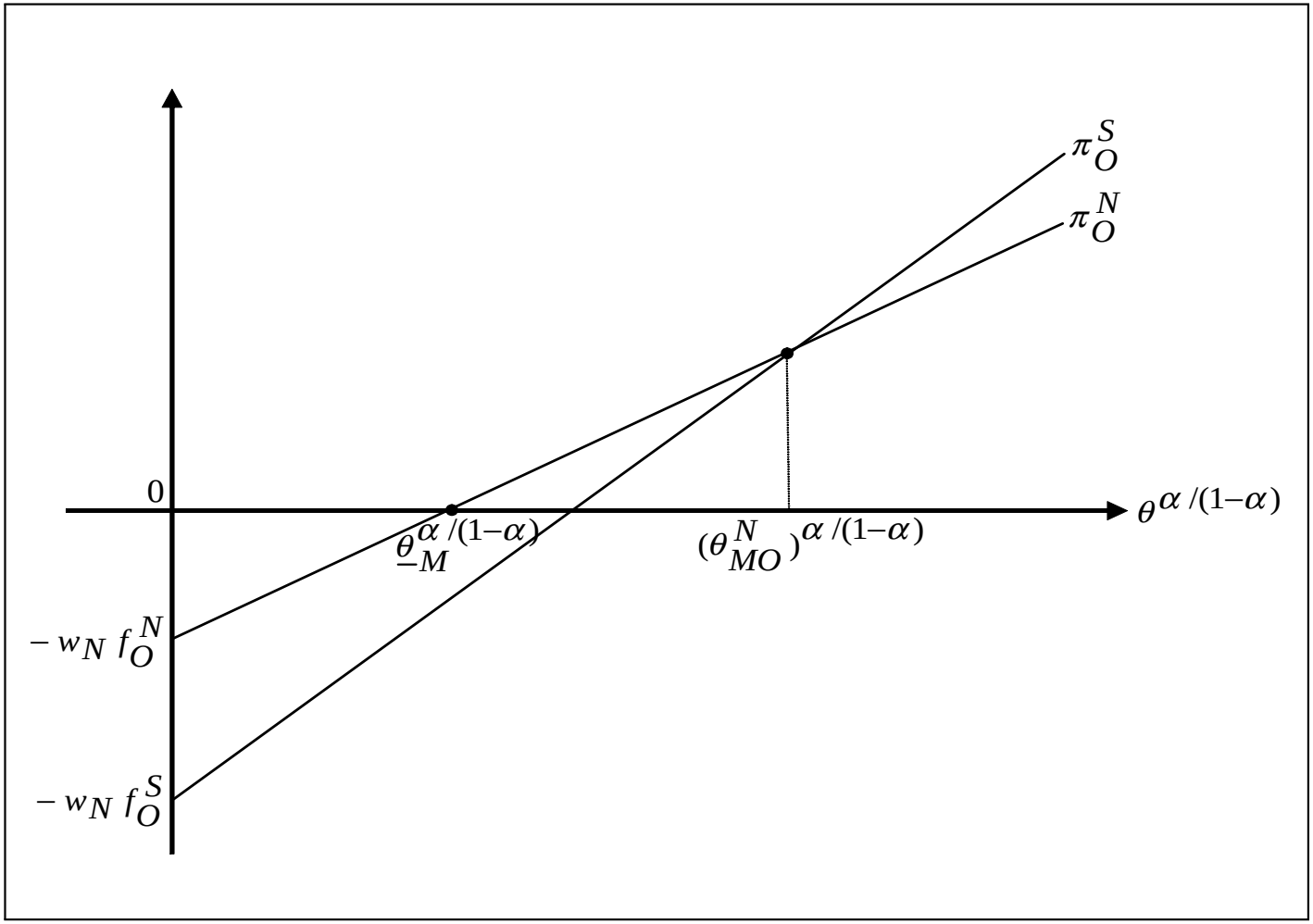
Global Sourcing: Relevant Trade-Offs

- 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 θ will turn out to affect crucially the participation in international trade;
  - Integration decision: integration improves efficiency of variable production when the η is high, but involves higher fixed costs. This decision will thus crucially depend on η but also on θ.
- To simplify the discussion, focus on two types of sectors:
- 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 (4), implies that any form of integration is dominated in equilibrium.
- 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

$$\psi_V^S(\eta) > \psi_O^S(\eta) > \psi_V^N(\eta) > \psi_O^N(\eta). \tag{6}$$

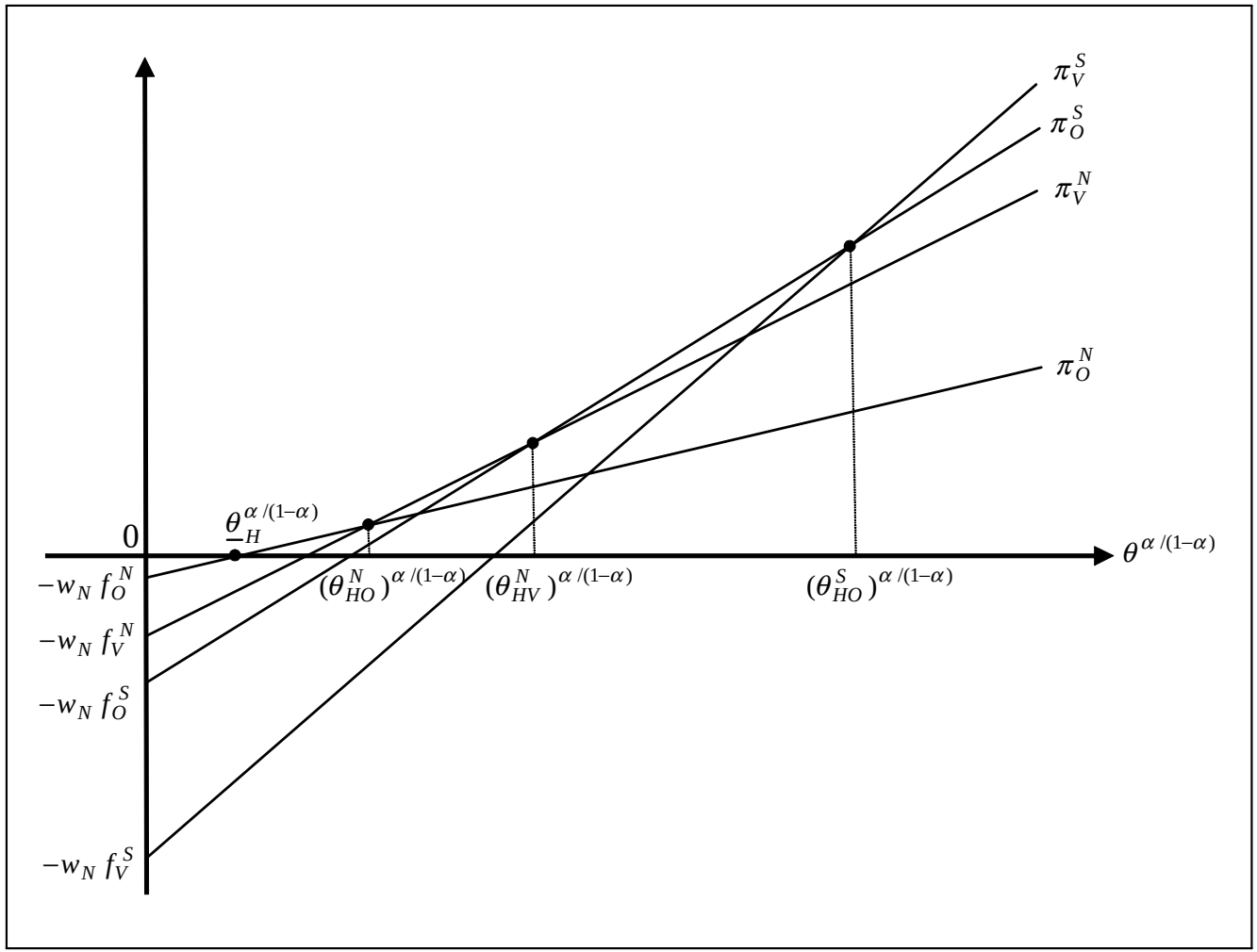
  which together with (4) leads to the Figure below.

Global Sourcing



Equilibrium in the Component-Intensive Sector

Global Sourcing



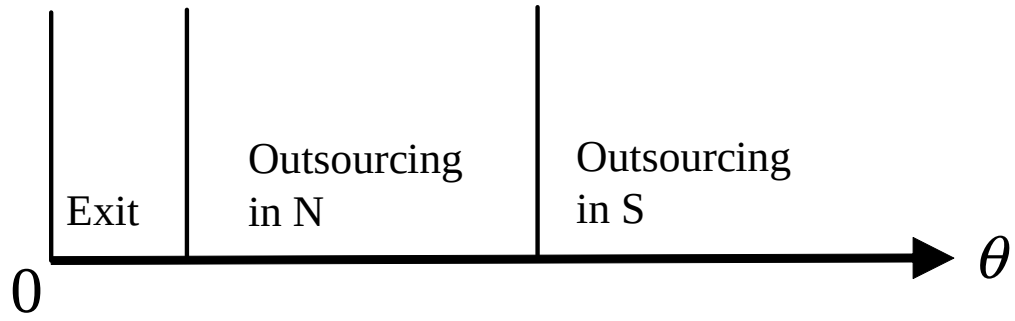
Equilibrium in the Headquarter-Intensive Sector

Global Sourcing: Relative Prevalence

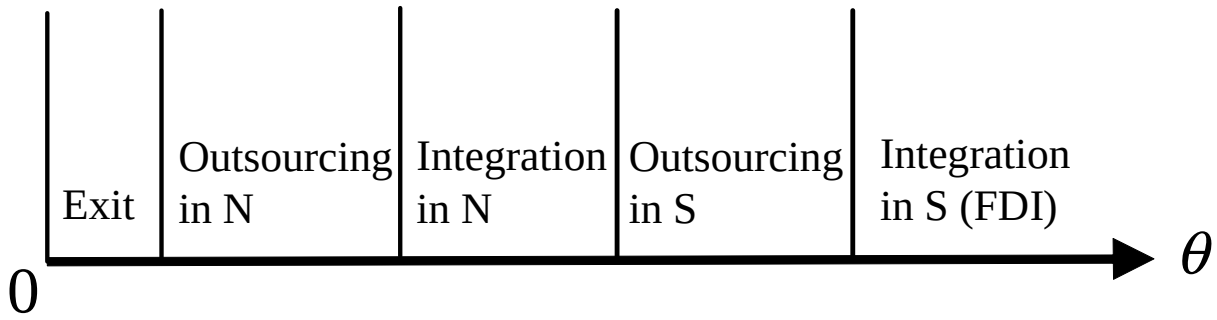
- The final section of the paper quantifies the relative prevalence of the different organizational forms and how this prevalence varies across industries.
- This requires parameterizing the distribution of θ. Following HMY (2004), choose $G(\theta)$ to be a Pareto distribution with shape z, i.e.,

$$G(\theta) = 1 - \left(\frac{b}{\theta}\right)^z \text{ for } \theta \geq b > 0. \tag{7}$$

  - Remember that z is inversely related to the variance of the distribution.
- In the component-intensive sector they find that, foreign outsourcing is more prevalent:
  - the higher is w^N/w^S (or the lower are transport costs τ),
  - the lower are z and η.
- In the headquarter-intensive sector they find that:
  - the share of intrafirm imports in total imports should be higher in industries with higher η, but also in industries with higher productivity dispersion (lower z) and higher transport costs (τ).
  - a higher w^N/w^S (or lower τ) increase the amount of international sourcing, but also increase the share of foreign outsourcing in total foreign sourcing.



Component-Intensive Sector



Headquarter-Intensive Sector

Empirical Tests and Other Applications

- Yeaple (2006, JEEA, "Offshoring, Foreign Direct Investment, and the Structure of U.S. Trade") used the BEA dataset to test some of the cross-industry implications of the Antràs and Helpman (2004) model:
  - he finds that the share of intrafirm imports in total U.S. imports (a measure of the relative prevalence of FDI over outsourcing) is higher in industries with high R&D intensity and high productivity dispersion.

Yeaple (2006, JEEA)

Table 3: Industry Characteristics and U.S. Intra-firm Imports as a share of U.S. Imports

	(1) Full Sample	(2) LDCs	(3) Emerging	(4) Developed	(5) Mexico	(6) Canada
KAPINT	**0.74**	**1.15**	**0.79**	0.17	0.24	0.20
	(0.22)	**(0.33)**	**(0.23)**	(0.21)	(0.21)	(0.18)
RDINT	**0.24**	0.18	**0.26**	**0.41**	**0.35**	**0.46**
	(0.10)	(0.20)	**(0.14)**	**(0.09)**	**(0.14)**	**(0.11)**
ADINT	0.06	0.52	-0.11	0.23	-0.35	0.35
	(0.21)	(0.46)	(0.36)	(0.20)	(0.36)	(0.23)
SKILLINT	0.21	**-1.40**	**0.96**	-0.21	0.50	-0.11
	(0.46)	**(0.85)**	**(0.53)**	(0.41)	(0.60)	(0.49)
DISPERSE	**1.42**	**2.20**	**1.47**	0.41	**1.58**	0.51
	(0.51)	**(0.55)**	**(0.67)**	(0.51)	**(0.52)**	(0.44)
SCALE	**-0.53**	-0.25	**-0.74**	-0.25	**-0.63**	-0.18
	(0.22)	(0.50)	**(0.29)**	(0.18)	**(0.33)**	(0.22)
VERT	-0.17	-1.25	-0.22	**-1.25**	1.18	**-1.13**
	(0.48)	(1.19)	(0.71)	**(0.44)**	(0.93)	**(0.39)**
N	51	51	51	51	51	51
Positive Obs	51	37	45	51	39	50
Pseudo R-Sq.	0.11	0.14	0.14	0.07	0.12	0.11

Independent variables are in logs. Standard errors in parentheses are robust to heteroskedasticity. Constant suppressed. Coefficients statistically significant at the 10 percent level in bold.

Yeaple (2006, JEEA)

Table 4: Industry Characteristics and U.S. Parent Intermediate Exports to Their Affiliates as a share of Total U.S. Exports

	(1) Full Sample	(2) LDCs	(3) Emerging	(4) Developed
KAPINT	0.19	**0.57**	0.27	0.21
	(0.17)	**(0.28)**	(0.22)	(0.18)
RDINT	**0.31**	0.24	**0.34**	**0.31**
	(0.14)	(0.19)	**(0.20)**	**(0.13)**
ADINT	0.16	0.51	-0.04	0.10
	(0.25)	(0.40)	(0.37)	(0.24)
SKILLINT	0.19	-0.16	0.22	0.08
	(0.39)	(0.61)	(0.57)	(0.39)
DISPERSE	0.10	-0.04	0.49	0.14
	(0.57)	(0.77)	(0.70)	(0.56)
SCALE	-0.23	**-0.67**	-0.22	-0.33
	(0.22)	**(0.40)**	(0.33)	(0.22)
VERT	-0.72	0.22	-0.81	-0.69
	(0.50)	(0.52)	(0.73)	(0.44)
N	51	51	51	51
Positive Obs	50	42	47	50
Pseudo R-Sq.	0.05	0.06	0.06	0.05

Independent variables are in logs. Standard errors in parentheses are robust to heteroskedasticity. Constant suppressed. Coefficients statistically significant at the 10 percent level in bold.