Firms, Contracts, and Trade Structure

Pol Antràs

Massachusetts Institute of Technology

Introduction

- Roughly $\frac{1}{3}$ of world trade is intrafirm trade ($\frac{1}{3}$ of U.S. exports and more than 40% of U.S. imports).
- The volume of intrafirm trade shows some strong patterns:
  - it is heavily concentrated in capital-intensive industries;
  - it flows mostly between capital-abundant countries.
- I will show that these strong patterns can be rationalized combining elements of a Grossman-Hart-Moore view of the firm together with elements of a Helpman-Krugman view of international trade.

A Closer Look at the Facts

- Fact 1: In a cross-section of industries, the share of intrafirm imports in total U.S. imports is larger the higher the capital intensity of the exporting industry (Figure 1).
  - e.g., firms in the U.S. import chemical products from affiliate parties, but import textiles from independent firms overseas.

[FIGURE 1 HERE]

[FIGURE 1 AVERAGED HERE]

- Fact 2: In a cross-section of countries, the share of intrafirm imports in total U.S. imports is larger the higher the capital-labor ratio of the exporting country (Figure 2).
  - e.g., firms in the U.S. import from Switzerland within the boundaries of their firms, but import from Egypt at arm's length.

[FIGURE 2 HERE]

Main Questions

- Why are capital-intensive goods transacted within firm boundaries while labor-intensive goods are traded mostly at arm's length?

- Why is the share of intrafirm imports higher for capital-abundant countries?

- Are these facts related?

- To answer these questions we need to introduce some elements of the theory of the firm into standard trade models.

My Answers

- I develop a property-rights model of the boundaries of the firm in which the endogenous benefits of integration outweigh its endogenous costs only in capital-intensive industries $\rightarrow$ *close to* Fact 1.

- I then embed this framework in a general-equilibrium, factor-proportions model of international trade, with imperfect competition and product differentiation.

- In the general equilibrium, capital-abundant countries capture larger shares of a country's imports of capital-intensive goods.

- Fact 2 follows from the interaction of transaction-cost minimization (Fact 1) and comparative advantage.

Sketch of the Argument

A. Grossman-Hart-Moore helps explain Fact 1

- A final-good producer needs to obtain a special and distinct intermediate input from a supplier.

- Production of the input requires certain noncontractible and relationship-specific investments in capital and labor.

- Final-good producer contributes to some of these investments but cost-sharing is relatively more important in capital investments.

- No ex-ante contracts $\rightarrow$ Bargaining after intermediate input has been produced and manufacturing costs are bygones.

A. Grossman-Hart-Moore helps explain Fact 1 (continued)

- Ex-post bargaining + lock-in $\rightarrow$ underinvestment in both capital and labor.

- Two options: vertical integration or outsourcing. Ownership = entitlement of some residual rights of control $\rightarrow$ outside option for the final-good is higher under integration than under outsourcing.

- Inefficiency in labor investments is shown to be relatively higher under integration than under outsourcing; conversely for capital.

- Ex-ante: choose outsourcing only when the investment in labor is relatively important in production $\rightarrow$ *close to* Fact 1.

B. Helpman-Krugman and Fact 1 imply Fact 2

- Imperfect competition $+$ product differentiation $\rightarrow$ countries specialize in certain intermediate input varieties and export them worldwide.

- K-abundant countries tend to produce a larger share of K-intensive varieties than L-abundant countries.

- Demand side: identical homothetic preferences.

- The share of K-intensive (and *thus* intrafirm) imports in total imports is then shown to be an increasing function of the K-L ratio of the exporting country (Romalis, 2002) $\rightarrow$ Fact 2.

Empirical Support

- 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.

– 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
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Broad Road Map

- Related Literature
- Set-up of the Model.
- Sketch of Solution and Main Results.
- Econometric Evidence.
- Conclusions.

Related Literature

- General Equilibrium Models of the Multinational Firm:
  - Helpman (1984), Markusen (1984), Brainard (1997), Markusen & Venables (1998) - common failure to model internalization.
  - Ethier (1986), Ethier-Markusen (1996) study internalization, but not its implications for intrafirm trade.
- Incomplete Contracts in General Equilibrium:
  - Grossman-Helpman (2002) - closed economy, Williamsonian approach.

The Closed-Economy Model

- Two-factor (K, L), two-sector (Y, Z) closed economy.

- K and L are inelastically supplied and freely mobile across sectors.

- In each sector, firms use K and L to produce a continuum of differentiated varieties.

- Preferences of the representative consumer are of the form:

$$U = \left(\int_0^{n_Y} y(i)^\alpha di \right)^{\frac{\mu}{\alpha}} \left(\int_0^{n_Z} z(i)^\alpha di \right)^{\frac{1-\mu}{\alpha}}$$

  with $\mu, \alpha \in (0, 1)$.

- Demand for final-good varieties:

$$
\begin{aligned}
y(i) &= A_Y p_Y(i)^{-1/(1-\alpha)} \\
z(i) &= A_Z p_Z(i)^{-1/(1-\alpha)}.
\end{aligned}
$$

- Sale revenues are:

$$
\begin{aligned}
R_Y(i) &= p_Y(i) y(i) = A_Y^{1-\alpha} y(i)^{\alpha} \\
R_Z(i) &= p_Z(i) z(i) = A_Z^{1-\alpha} z(i)^{\alpha}
\end{aligned}
$$

Technology

- Each variety $y(i)$ requires a special and distinct intermediate input $x_Y(i)$ ($z(i)$ requires $x_Z(i)$).

- The input must be of high quality, otherwise output is zero.

- If the input is of high quality, production of the final good requires no further costs and $y(i) = x_Y(i)$, $z(i) = x_Z(i)$.

Technology (2)

- Production of a high-quality intermediate input requires a combination of capital (K_x) and labor (L_x).

$$x_k(i) = \left(\frac{K_x(i)}{\beta_k}\right)^{\beta_k} \left(\frac{L_x(i)}{1-\beta_k}\right)^{1-\beta_k},$$

  for $k \in \{Y, Z\}$. Let $1 > \beta_Y > \beta_Z > 0$.

- Low-quality intermediate inputs can be produced at a negligible cost.

- Total fixed costs are $fr^{\beta_k} w^{1-\beta_k}$, $k \in \{Y, Z\}$.

Firm structure

- Before any production takes places, F decides whether it wants to enter a given market, and if so, whether to obtain the input from a vertically-integrated S or from a stand-alone S.

- Upon entry, S makes a lump-sum transfer $T_k(i)$ to F. $T_k(i)$ is such that S breaks even (ex-ante competitive fringe).

- F chooses the mode of organization so as to maximize its ex-ante profits.

Firm structure (2)

- The labor investment L_x is undertaken by S. The capital investment K_x is undertaken by F.

- These investments are incurred upon entry and are useless outside the relationship - Williamson's *fundamental transformation*.

Contract Incompleteness

- No outside party can distinguish between a high-quality and a low-quality intermediate input $x_k \Rightarrow F$ and S cannot sign **enforceable** quality-contingent contracts.

- K_x and L_x as well as sale revenues are not verifiable either.

- No contract ex-ante $\rightarrow F$ and S will bargain over the surplus of the relationship ex-post, when manufacturing costs are bygones.

- Contract incompleteness leads to a two-sided hold-up problem.

- Nash Bargaining leaves F with fraction ϕ of ex-post gains from trade.

Contract Incompleteness (2)

- As in Grossman and Hart (1986), ownership will affect the distribution of ex-post surplus through its effect on each party's outside option.

- Input is completely specific to $F \longrightarrow$ outside option for S is zero regardless of ownership structure.

- If S is a stand-alone firm $\longrightarrow$ F's outside option is also zero.

- By integrating S, F obtains the residual rights over a fraction $\delta \in (0, 1)$ of the amount of $x_k(i)$ produced, which translate into sale revenues of $\delta^\alpha R_k(i)$.

Payoffs in the Nash Bargaining

	Final-good producer	Supplier
Non-Integration	$\phi R_k(i)$	$(1-\phi)\, R_k(i)$
Integration	$\bar{\phi} R_k(i)$	$\left(1-\bar{\phi}\right) R_k(i)$

where

$$\bar{\phi} = \delta^{\alpha} + \phi\,(1-\delta^{\alpha}) > \phi$$

- K_x and L_x are set non-cooperatively to maximize these payoffs. Trade-off: $\bar{\phi} > \phi \rightarrow 1-\bar{\phi} < 1-\phi$.

[FIGURE 3 HERE]

Sketch of the Solution

1. Firm Behavior for a Given Demand

2. Factor Intensity and the Equilibrium Mode of Organization.

3. Industry Equilibrium.

4. General Equilibrium of the Integrated Economy.

5. Split the world endowment of K and L between $J \geq 2$ countries and study pattern of production and trade.

Firm Behavior for a Given Demand

The Program

$$\begin{aligned}
\max_{\widetilde{\phi} \in \{\phi, \bar{\phi}\}} \quad & \pi_F \left(K_x \left(\widetilde{\phi} \right), L_x \left(\widetilde{\phi} \right) \right) \\
s.t. \quad & K_x \left(\widetilde{\phi} \right) = \arg\max_{K_x} \widetilde{\phi} R_k \left(K_x, L_x \left(\widetilde{\phi} \right) \right) - r K_x \\
& L_x \left(\widetilde{\phi} \right) = \arg\max_{L_x} \left(1 - \widetilde{\phi} \right) R_k \left(K_x \left(\widetilde{\phi} \right), L_x \right) - w L_x
\end{aligned}$$

Integrated pairs

- Combining the FOCs of the two constraints with $\widetilde{\phi} = \bar{\phi}$, yields optimal $K_{x,Y}$, $L_{x,Y} \to x_{Y,V} \to y_V$ and $p_{Y,V}$.

- Transfer T_V is chosen s.t. $\pi^S_{Y,V} = 0$.

- F's profits are then

$$
\begin{aligned}
\pi^F_{Y,V} \;&=\; \left(1 - \alpha(1-\beta_Y) + \alpha\bar{\phi}(1-2\beta_Y)\right) A_Y \times \\
&\quad \times \left(\frac{r^{\beta_Y} w^{1-\beta_Y}}{\alpha\bar{\phi}^{\beta_Y}\left(1-\bar{\phi}\right)^{1-\beta_Y}}\right)^{\frac{-\alpha}{1-\alpha}} - f r^{\beta_Y} w^{1-\beta_Y}
\end{aligned}
$$

Stand-alone pairs

- Analogous with ϕ replacing $\bar{\phi}$ throughout.

- Find

$$\begin{aligned}\pi^F_{Y,O} &= \left(1-\alpha(1-\beta_Y)+\alpha\phi(1-2\beta_Y)\right)A_Y \times \\ &\times \left(\frac{r^{\beta_Y}w^{1-\beta_Y}}{\alpha\phi^{\beta_Y}(1-\phi)^{1-\beta_Y}}\right)^{\frac{-\alpha}{1-\alpha}} - fr^{\beta_Y}w^{1-\beta_Y}\end{aligned}$$

Comparison with Complete Contracts

- Compare to case in which the two parties could contract ex-ante and agree on maximizing the value of the relationship, given by

$$R_Y - rK_x - wL_x$$

- Incomplete contracts leads to underinvestment in K_x and L_x. Underinvestment in L_x is relatively more severe under integration. Underinvestment in K_x is relatively more severe under outsourcing (see Figure 4).

[FIGURE 4 HERE]

Factor Intensity and Ownership Structure

- Let $\Theta(\beta_Y) \equiv \pi^F_{Y,V}/\pi^F_{Y,O}$ be profits under integration relative to outsourcing.

Proposition 1 *There exists a unique* $\widehat{\beta} \in (0,1)$ *such that* $\Theta(\widehat{\beta}) = 1$*. Furthermore, for all* $\beta < \widehat{\beta}$, $\Theta(\beta) < 1$, *and for all* $\beta > \widehat{\beta}$, $\Theta(\beta) > 1$*.*

- All firms with capital intensity below (above) a certain threshold $\widehat{\beta}$ choose to outsource (vertically-integrate) production of the intermediate input.

Factor Intensity and Ownership Structure (2)

- Getting closer to Fact 1.

- Cobb-Douglas assumption makes $\Theta(\beta)$ independent of factor prices. Block-recursiveness.

- Other Comparative Statics: $\partial\Theta(\cdot)/\partial\phi < 0$.

Why is F providing K_x?

- Otherwise, S would choose K_x and L_x to

$$\max \; (1-\phi) \, R_Y - rK_x - wL_x$$

Lemma 1 *If* $\bar{\phi} > \phi > 1/2$*, final-good producers will always decide to provide the capital* K_x *required for production.*

- **Key Point:** the supplier is never given full control. There is an unmodelled non-contractible and inalienable investment by F that is indispensable for sale revenues to be positive $\rightarrow$ No forward integration.

Empirical Support

- 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.
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How important is it that F provides K_x under non-integration?

- The result still holds true when $\phi < 1/2$, provided that $\bar{\phi} > 1 - \phi$.

Lemma A.1. *If $\bar{\phi} > 1 - \phi > 1/2$, final-good producers will provide K_x only when integrating the supplier. Letting $\Theta(\beta)$ be relative profits under integration, the following are still true: $\Theta'(\beta) > 0$, $\Theta(0) < 1$ and $\Theta(1) > 1$.*

The Program under Partial Contractibility

- Let $L_x = e_L L$, where L is contractible, and let $c(e, L) = we_L L$.

$$\begin{aligned} \max_{\widetilde{\phi}\in\{\phi,\bar{\phi}\},L} \quad & \pi_F\left(K_x\left(\widetilde{\phi}\right), e_L\left(\widetilde{\phi}\right)L\right) \\ s.t. \quad & K_x\left(\widetilde{\phi}\right) = \arg\max_{K_x} \widetilde{\phi} R_k\left(K_x, e_L\left(\widetilde{\phi}\right)L\right) - rK_x \\ & e_L\left(\widetilde{\phi}\right) = \arg\max_{e_L} \left(1-\widetilde{\phi}\right) R_k\left(K_x\left(\widetilde{\phi}\right), e_L L\right) - we_L L \end{aligned}$$

- $K_x\left(\widetilde{\phi}\right)$ and $Le_L\left(\widetilde{\phi}\right)$ are independent of L. Get same solution.

- **Key:** marginal cost of e is increasing in L. Setting L in advance does not solve hold-up.

Industry Equilibrium (Y industry)

- In equilibrium, free entry implies that no firm makes positive profits; n_Y will adjust to ensure $\pi_Y^F = 0$.

- Three potential equilibrium modes of organization in industry Y.

Lemma 3 *A mixed equilibrium in industry Y only exists in a knife-edge case, namely when $\beta_Y = \widehat{\beta}$. An equilibrium with pervasive integration in industry Y exists only if $\beta_Y > \widehat{\beta}$. An equilibrium with pervasive outsourcing in industry Y exists only if $\beta_Y < \widehat{\beta}$.*

General Equilibrium

Assumption 2: $\beta_Y > \widehat{\beta} > \beta_Z$.

- In the GE of the integrated economy, income equals spending,

$$E = rK + wL,$$

and the product, capital and labor markets clear:

$$\begin{aligned} \sum_{k \in \{Y,Z\}} n_k \left(K_{x,k} + K_{f,k} \right) &= K \\ \sum_{k \in \{Y,Z\}} n_k \left(L_{x,k} + L_{f,k} \right) &= L \end{aligned}$$

General Equilibrium (2)

- Equilibrium wage-rental is given by

$$\frac{w}{r} = \frac{\sigma_L}{1-\sigma_L}\frac{K}{L} = \frac{\mu(1-\widetilde{\beta_Y}) + (1-\mu)(1-\widetilde{\beta_Z})}{\mu\widetilde{\beta_Y} + (1-\mu)\widetilde{\beta_Z}}\frac{K}{L},$$

  where the effective capital shares are:

$$\begin{aligned}\widetilde{\beta_Y} &= \beta_Y\left(1+\alpha\left(1-\beta_Y\right)\left(2\bar{\phi}-1\right)\right)\\ \widetilde{\beta_Z} &= \beta_Z\left(1+\alpha(1-\beta_Z)(2\phi-1)\right)\end{aligned}$$

  Note that $\widetilde{\beta_Y} > \widetilde{\beta_Z}$, i.e., contract incompleteness does not create FIR.

- If $\phi > 1/2$, $\widetilde{\beta_Y} > \beta_Y$ and $\widetilde{\beta_Z} > \beta_Z \Longrightarrow w/r$ is depressed relative to complete-contracting world.

The Multi-Country Model

- Now suppose the world is divided in $J \geq 2$ countries, with country j receiving an endowment $\left(K^j, L^j\right)$.

- Assume that preferences are identical in all J countries.

- Factors of production are internationally immobile.

- Assume that for all $j \in J$, K^j/L^j is not "too different" from K/L (sufficient conditions below) $\rightarrow$ FPE $\rightarrow$ Integrated Equilibrium.

- Intermediate inputs can be traded at zero cost. Final goods are non-tradable $\Rightarrow$ each F has J costless plants.

Pattern of Production

- The factor market clearing conditions in country $j \in J$ are now:

$$\begin{aligned} \sum_{k \in \{Y,Z\}} n_k^j \left(K_{x,k}^j + K_{f,k}^j \right) &= K^j \\ \sum_{k \in \{Y,Z\}} n_k^j \left(L_{x,k}^j + L_{f,k}^j \right) &= L^j \end{aligned}$$

- FPE $\Rightarrow$ Differences in production patterns are channelled through n_Y^j and n_Z^j.

- (Hecksher-Ohlin Theorem) *If country j is relatively capital-abundant (i.e. $K^j/L^j > K/L$), then $n_Y^j > s^j n_Y$ and $n_Z^j < s^j n_Z$, where s^j is j's share in world income, i.e*

$$s^j = \frac{rK^j + wL^j}{rK + wL}$$

- For the above allocation to be consistent with FPE, we require $n_Y^j > 0$ and $n_Z^j > 0$, or equivalently:

Assumption 3: $\frac{\widetilde{\beta_Y}\sigma_L}{\left(1-\widetilde{\beta_Y}\right)(1-\sigma_L)} > \frac{K^j/L^j}{K/L} > \frac{\widetilde{\beta_Z}\sigma_L}{\left(1-\widetilde{\beta_Z}\right)(1-\sigma_L)}$ for all $j \in J$.

[FIGURE 5 HERE]

Pattern of Trade

- All world trade is in intermediate inputs x_Y and x_Z.

- A given country $N \in J$ will host $n_Y + n_Z$ producers of final-good varieties.

  - a measure n_Y^j will be importing from their *integrated* suppliers in every country $j \neq N$;

  - a measure n_Z^j will be importing from their *independent* suppliers in every country $j \neq N$.

- Each of these final-good producers in N will import a fraction s^N of world output of the corresponding variety.

- Average cost transfer pricing $\rightarrow p_{x_Y} = p_Y$ and $p_{x_Z} = p_Z$.

- Volume of N imports from S is

$$M^{N,S} = s^N \left(n_Y^S p_Y y + n_Z^S p_Z z\right) = s^N s^S (rK + wL)$$

- Intrafirm imports from S are:

$$M_{i-f}^{N,S} = s^N n_Y^S p_Y y$$

- Hence, the share is simply:

$$S_{i-f}^{N,S} = \frac{\left(\left(1 - \widetilde{\beta_Z}\right)(1 - \sigma_L)\frac{K^S}{L^S} - \widetilde{\beta_Z}\sigma_L \frac{K}{L}\right)}{\left(\widetilde{\beta_Y} - \widetilde{\beta_Z}\right)\left((1 - \sigma_L)\frac{K^S}{L^S} + \sigma_L \frac{K}{L}\right)}$$

Main Predictions

- *Let* $N = USA$.

Lemma 3 *The volume $M_{i-f}^{USA,j}$ of U.S. intrafirm imports from country j is an increasing function of the capital-labor ratio K^j/L^j and the size s^j of the exporting country.*

Proposition 2 *The share $S_{i-f}^{USA,j}$ of intrafirm imports in total U.S. imports from country j is an increasing function of the capital-labor ratio K^j/L^j of the exporting country and is independent of its size s^j.*

[FIGURE 6 HERE]

[FIGURE 7 HERE]

Econometric Evidence

Specification

1. $\ln\left(S_{i-f}^{USA,ROW}\right)_k = \theta_1 + \theta_2 \ln(K/L)_k + W_k'\theta_3 + \epsilon_k$. Expect $\theta_2 > 0$.

2. $\ln\left(S_{i-f}^{USA,j}\right) = \gamma_1 + \gamma_2 \ln\left(K^j/L^j\right) + \gamma_3 \ln\left(L^j\right) + W_j'\gamma_4 + \varepsilon_j$. Expect $\gamma_2 = (1-\sigma_L)\,\sigma_L/\left(1-\sigma_L-\widetilde{\beta_Z}\right) \simeq 1.2$ and $\gamma_3 = 0$.

3. $\ln\left(M_{i-f}^{USA,j}\right) = \omega_1 + \omega_2 \ln\left(K^j/L^j\right) + \omega_3 \ln\left(L^j\right) + W_j'\omega_4 + \varepsilon_j$. Expect $\omega_2 = (1-\sigma_L)\left(1-\widetilde{\beta_Z}\right)/\left(1-\sigma_L-\widetilde{\beta_Z}\right) \simeq 1.55$ and $\omega_3 = 1$.

Data: LHS Variables

- Intrafirm U.S. imports are from BEA and comprise:

  1. imports shipped by overseas MOFA to their U.S. parents.

  2. imports shipped to M.O. U.S. affiliates by their foreign parent.

- Panel of 23 industries and 4 (benchmark) years: 1987, 1989, 1992, and 1994.

- Cross-section of 28 countries for 1992.

- Total U.S. imports are from Feenstra.

Table 2. Share of Intrafirm Imports in total U.S. Imports (%)

by Industry (avg. 1987-94)				by Country (1992)			
DRU	65.5	FOO	13.9	CHE	64.1	ESP	15.5
OCH	40.9	PAP	12.7	SGP	55.4	AUS	15.5
VEH	39.8	FME	12.6	IRL	53.7	JPN	14.2
ELE	37.3	STO	11.8	CAN	45.1	ISR	12.4
COM	36.7	INS	11.1	NDL	42.2	HKG	11.2
CHE	35.9	TRA	10.7	MEX	41.7	PHL	8.4
CLE	35.7	PLA	9.1	PAN	35.8	ITA	8.1
RUB	23.9	PRI	6.1	GBR	33.2	ARG	5.1
AUD	23.8	LUM	4.1	DEU	31.9	COL	4.6
OEL	18.9	OMA	2.6	MYS	30.1	OAN	4.6
IMA	17.3	TEX	2.3	BEL	27.3	VEN	1.4
BEV	15.1			BRA	25.9	CHL	1.3
				FRA	21.6	IDN	1.3
				SWE	16.8	EGY	0.1

Data: RHS Variables

- $\ln(K/L)_k$, $\ln(H/L)_k$ and $\ln(VAD/Sales)_k$ from NBER-Manufacturing
- $\ln(R\&D/Sales)_k$ and $\ln(ADV/Sales)_k$ from FTC line-of-business
- $\ln{(K/L)}_j$, $\ln{(L)}_j$, $\ln{(H/L)}_j$ and $EngFrac$ from Hall and Jones (1999)
- $OpFDI$ and $OpTrade$ from World Development Report (1992).
- $CorpTax$ from Price Waterhouse.

Table 3. Descriptive Statistics

	Obs	Mean	St. dev.	Min	Max
ln $\left(S_{i-f}^{US,ROW}\right)_m$	92	-1.90	0.92	-4.74	-0.19
ln$(K/L)_m$	92	4.26	0.57	3.21	5.73
ln$(H/L)_m$	92	-0.69	0.60	-1.78	0.60
ln$(R\&D/Sales)_m$	92	-4.20	1.00	-6.07	-2.47
ln$(ADV/Sales)_m$	92	-4.27	1.10	-6.63	-2.24
ln$(Scale)_m$	92	1.63	0.92	0.06	3.48
ln$(VAD/Sales)_m$	92	-0.66	0.18	-1.13	-0.32
ln $\left(S_{i-f}^{US,j}\right)$	28	-2.08	1.44	-6.67	-0.45
ln $(K/L)_j$	28	10.54	0.86	8.13	11.59
ln $(L)_j$	28	16.03	1.20	13.63	18.16
ln $(H/L)_j$	28	0.82	0.19	0.47	1.10
$CorpTax_j$	28	0.32	0.08	0.15	0.44
$EconFreedom_j$	28	6.36	1.22	4.19	8.24
$OpFDI$	26	7.83	1.23	4.73	9.57
$OpTrade$	26	6.70	1.22	3.52	8.67
ln $\left(M_{i-f}^{US,j}\right)$	28	6.36	2.64	-1.39	10.49

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

Dep. var. is	*Pooled Regressions*				
$\ln\left(S_{i-f}^{US,ROW}\right)_k$	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

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

Dep. var. is $\ln\left(S_{i-f}^{US,ROW}\right)_k$	*Random Effects Regressions* I	II	III	IV	V
$\ln(K/L)_k$	0.947***	0.861***	0.796***	0.789***	0.804***
	(0.187)	(0.190)	(0.160)	(0.161)	(0.184)
$\ln(H/L)_k$		0.369	-0.015	-0.078	-0.089
		(0.213)	(0.191)	(0.204)	(0.214)
$\ln(R\&D/Sales)_k$			0.485***	0.528***	0.520***
			(0.117)	(0.127)	(0.135)
$\ln(ADV/Sales)_k$				0.088	0.080
				(0.096)	(0.105)
$\ln(VAD/Sales)_k$					0.103
					(0.622)
R^2	0.50	0.55	0.72	0.73	0.73
No. of obs.	92	92	92	92	92

Table 5. Factor Endowments and the Share $S_{i-f}^{US,j}$

Dep. var. is $\ln\left(S_{i-f}^{US,j}\right)$	I	II	III	IV	V
$\ln(K/L)_j$	1.141***	1.110***	1.244***	1.049***	1.119**
	(0.289)	(0.299)	(0.427)	(0.368)	(0.399)
$\ln(L)_j$		-0.133	-0.159	-0.090	0.017
		(0.168)	(0.164)	(0.177)	(0.220)
$\ln(H/L)_j$			-1.024	-0.374	-0.822
			(1.647)	(1.584)	(1.389)
$OpFDI$				-0.202	-0.384*
				(0.156)	(0.218)
$OpTrade$					0.292
					(0.273)
$CorpTax$					1.856
					(2.932)
R^2	0.46	0.47	0.48	0.36	0.43
No. of obs.	28	28	28	26	26

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
$\ln(K/L)_j$	2.048***	2.192***	2.188***	1.841***	2.096***
	(0.480)	(0.458)	(0.716)	(0.623)	(0.695)
$\ln(L)_j$		0.607**	0.608**	0.435	0.700
		(0.229)	(0.268)	(0.332)	(0.419)
$\ln(H/L)_j$			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

Conclusions

What I did:

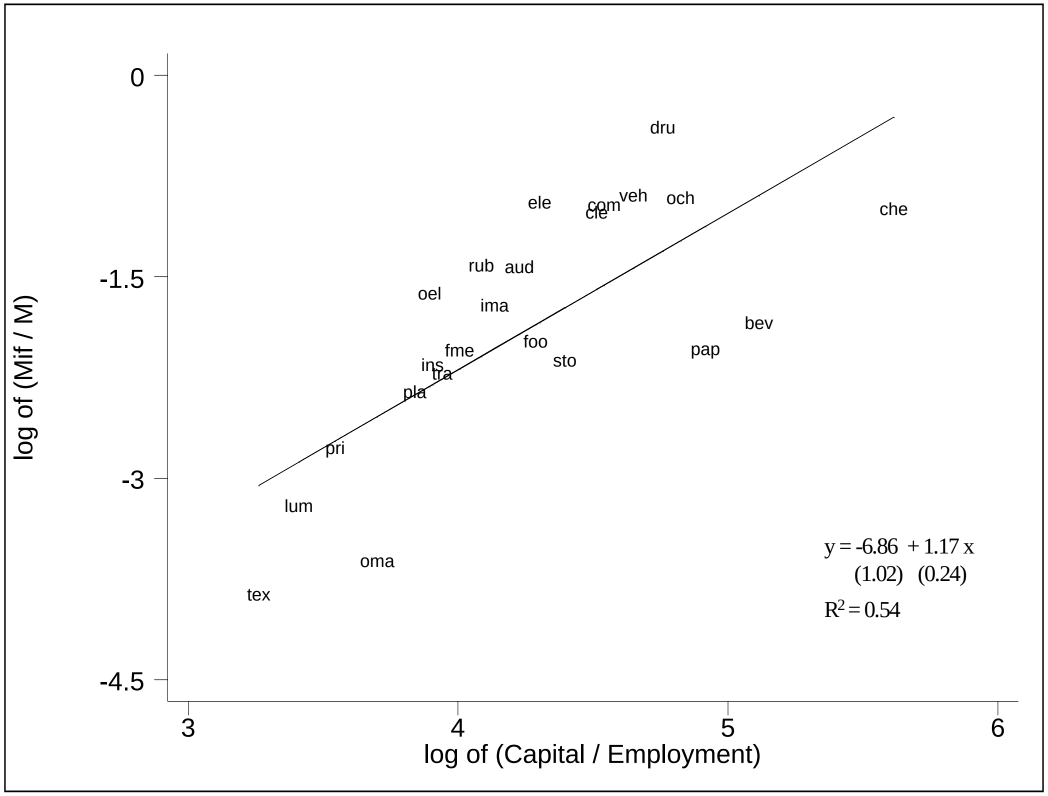
- I unveiled two systematic patterns in the intrafirm component of international trade.
- Traditional trade theory is silent on the boundaries of firms. The theory of the firm has mostly been partial-equilibrium in scope and has ignored the international dimensions of certain intrafirm transactions.
- Building on two workhorse models in international trade and the theory of the firm, I have constructed a model that, by determining both the pattern of international trade and the boundaries of firms in a unified framework, predicts these systematic patterns.

What next?

- Antràs (2002)
  - Dynamic, Ricardian model of North-South trade in which incomplete contracting leads to endogenous product cycles as well as endogenous organizational cycles.
  - New product cycle: manufacturing shifted to the South first within firm boundaries, and only later to independent firms in the South.

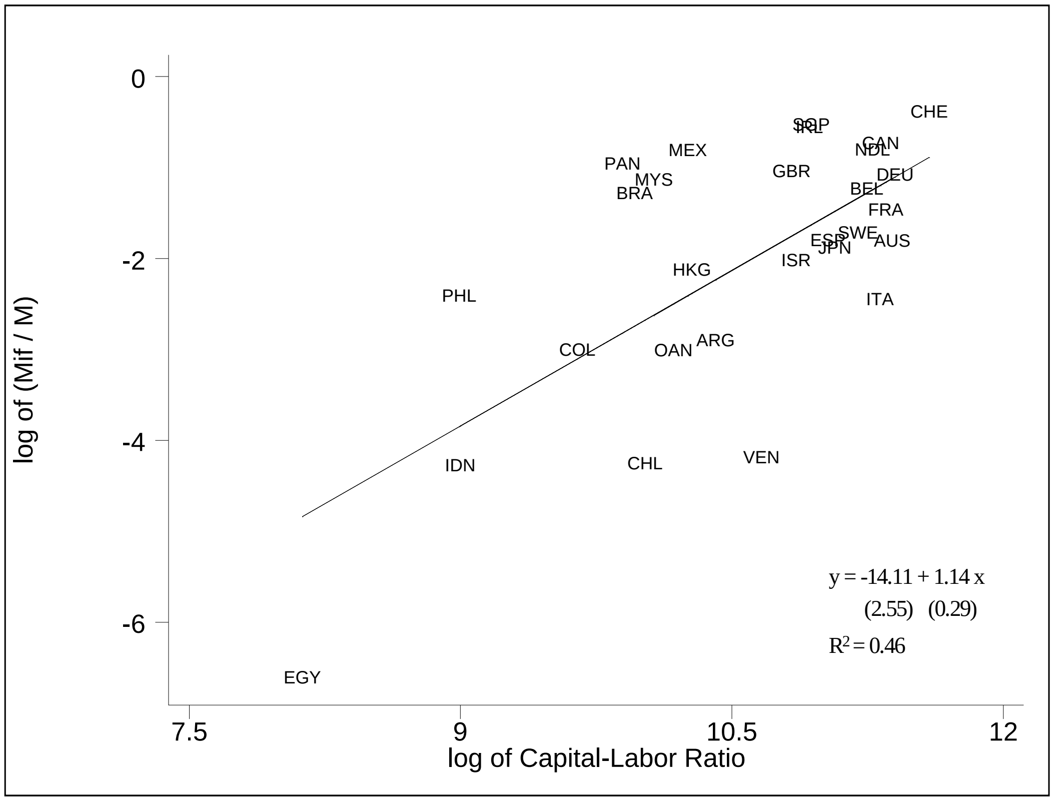
- Antràs and Helpman (2003)
  - Interaction of industry-wide determinants of integration with firm-level heterogeneity $\longrightarrow$ richer patterns of organizational structure both across and within industries.

Figure 1: Share of Intrafirm U.S. Imports and Relative Factor Intensities



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.

Figure 2: Share of Intrafirm Imports and Relative Factor Endowments



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.

Figure 3: Timing of Events

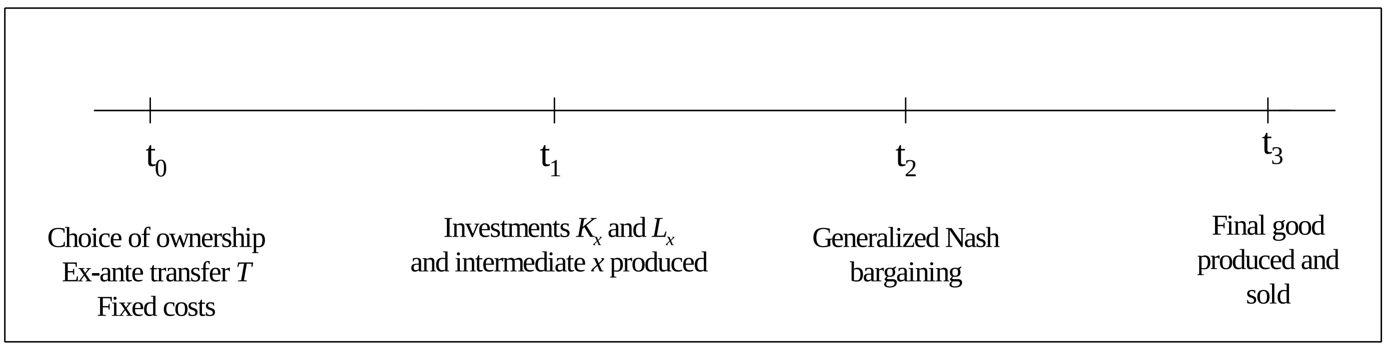


Figure 4: Complete vs. Incomplete Contracts

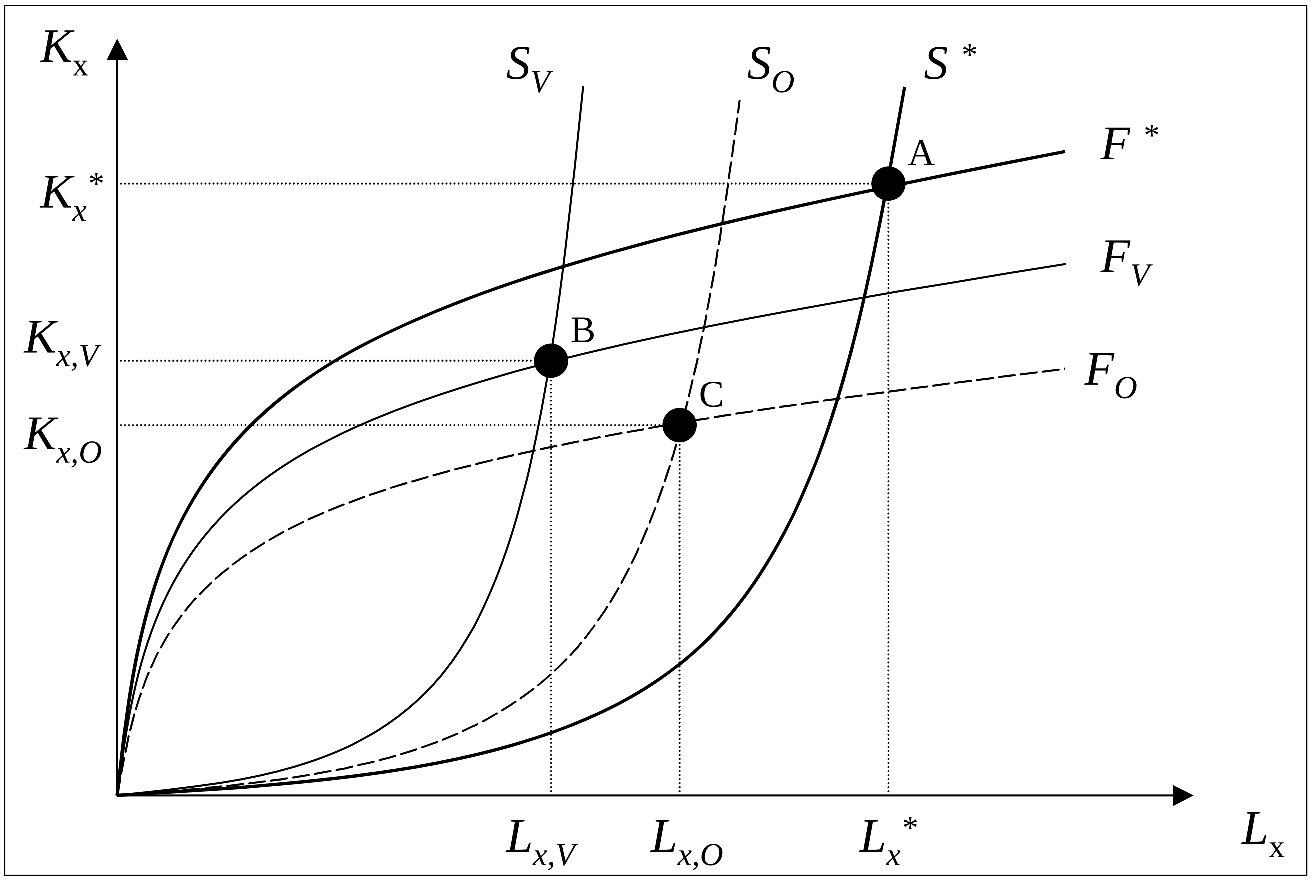


Figure 5: Pattern of Production for $J = 2$

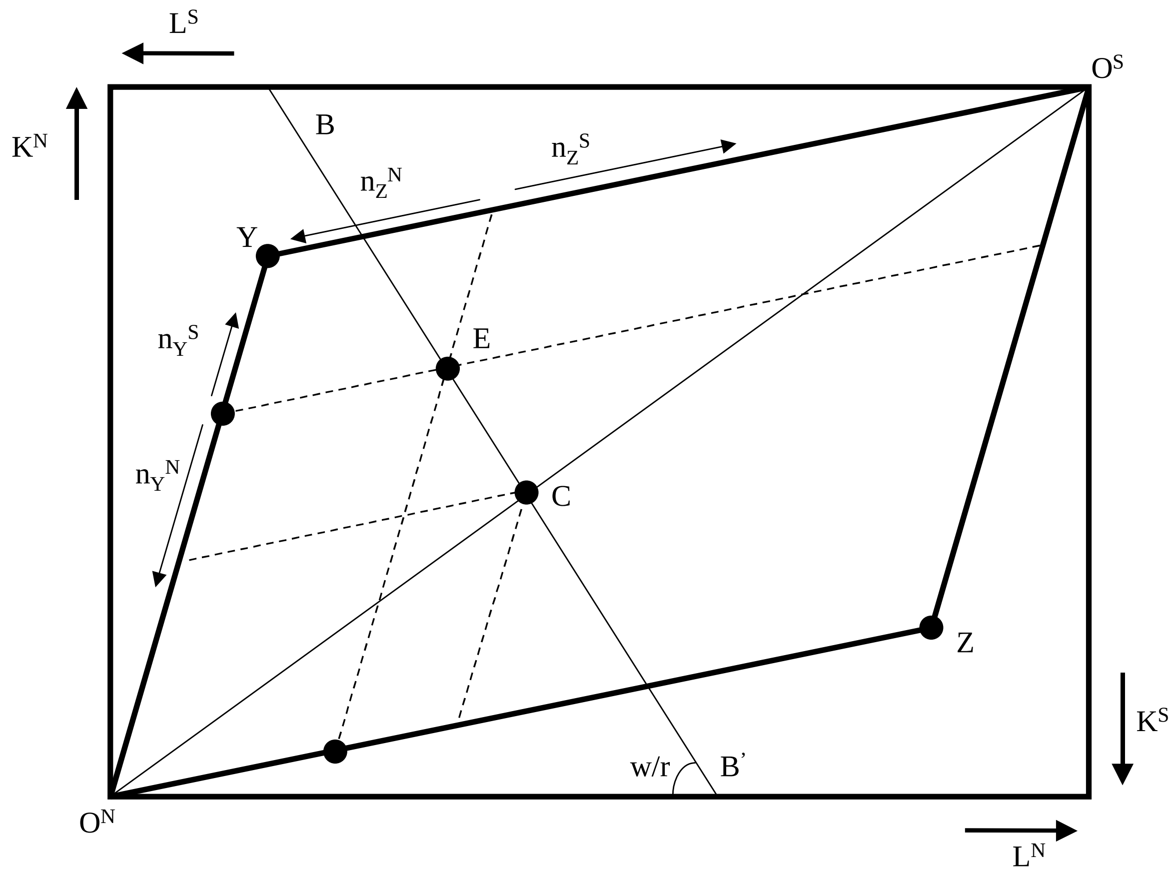


Figure 6: Volume of Intrafirm Imports

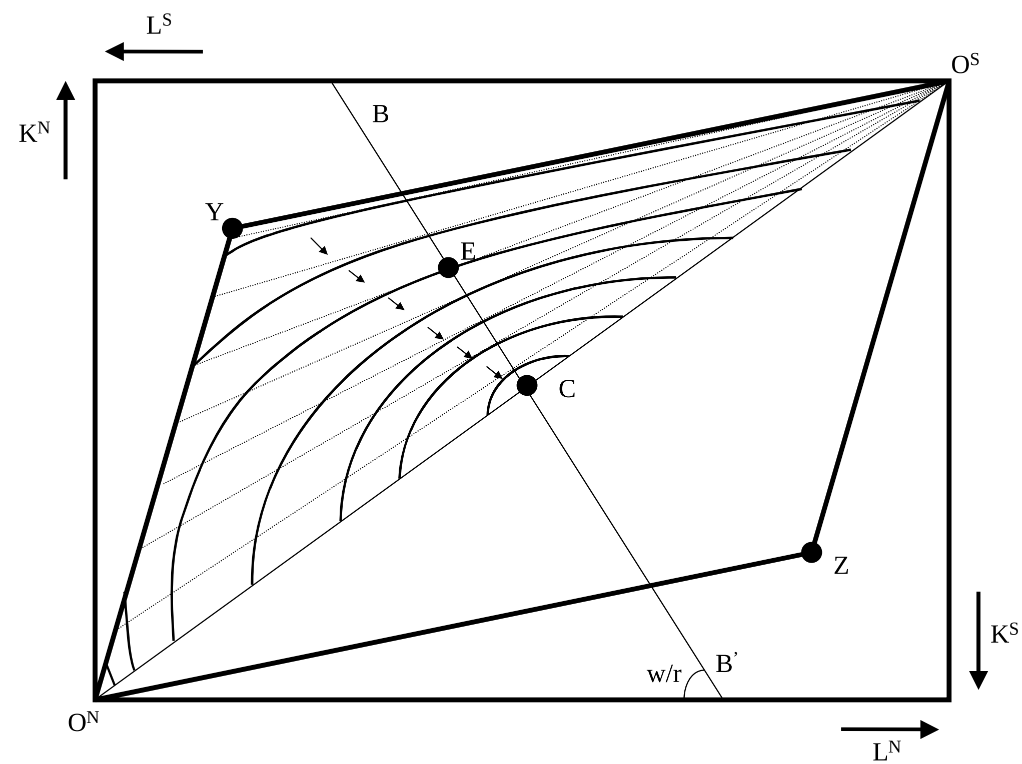


Figure 7: Share of Intrafirm Imports