GROSSMAN-HART (1986) GOES GLOBAL

Incomplete Contracts, Property Rights, and the International Organization of Production

Pol Antràs (Harvard University)

I. Two features of the world economy particularly relevant to understand the influence of G-H 1986 in International Trade
   1. Fragmentation of the production process across countries
   2. Limited enforceability of contracts in international transactions

II. Briefly review theoretical implementation of G-H(-M) in general-equilibrium, open-economy environments
   1. See survey paper for more details

III. Review empirical implementation of these theories

IV. Broader impact of the GHM approach

I. THE SLICING OF THE VALUE CHAIN AND THE INTERNATIONAL ENFORCEABILITY OF CONTRACTS

A Flashback to 1986

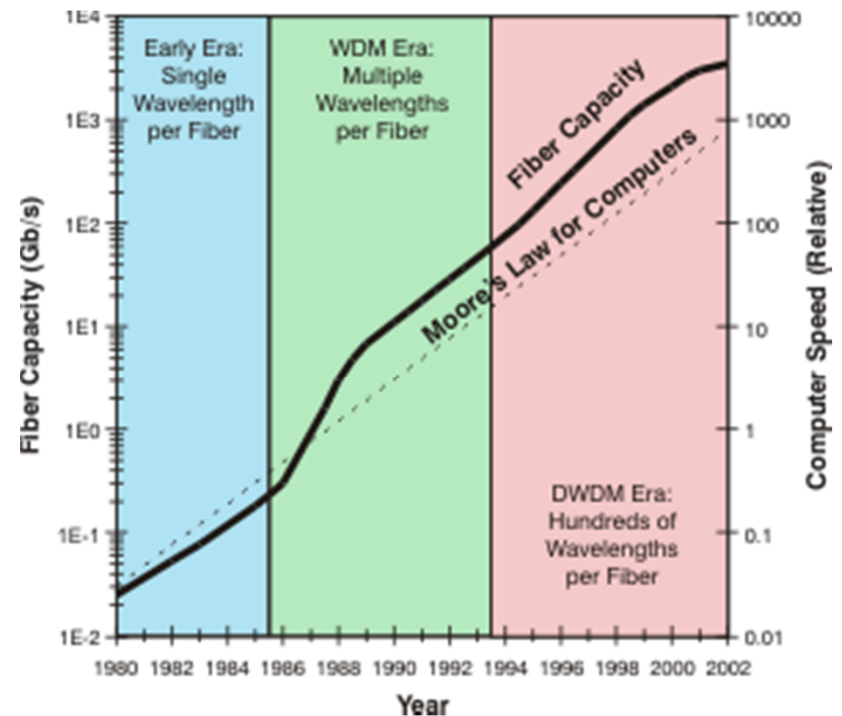A cell phone in 1986 looked like this…

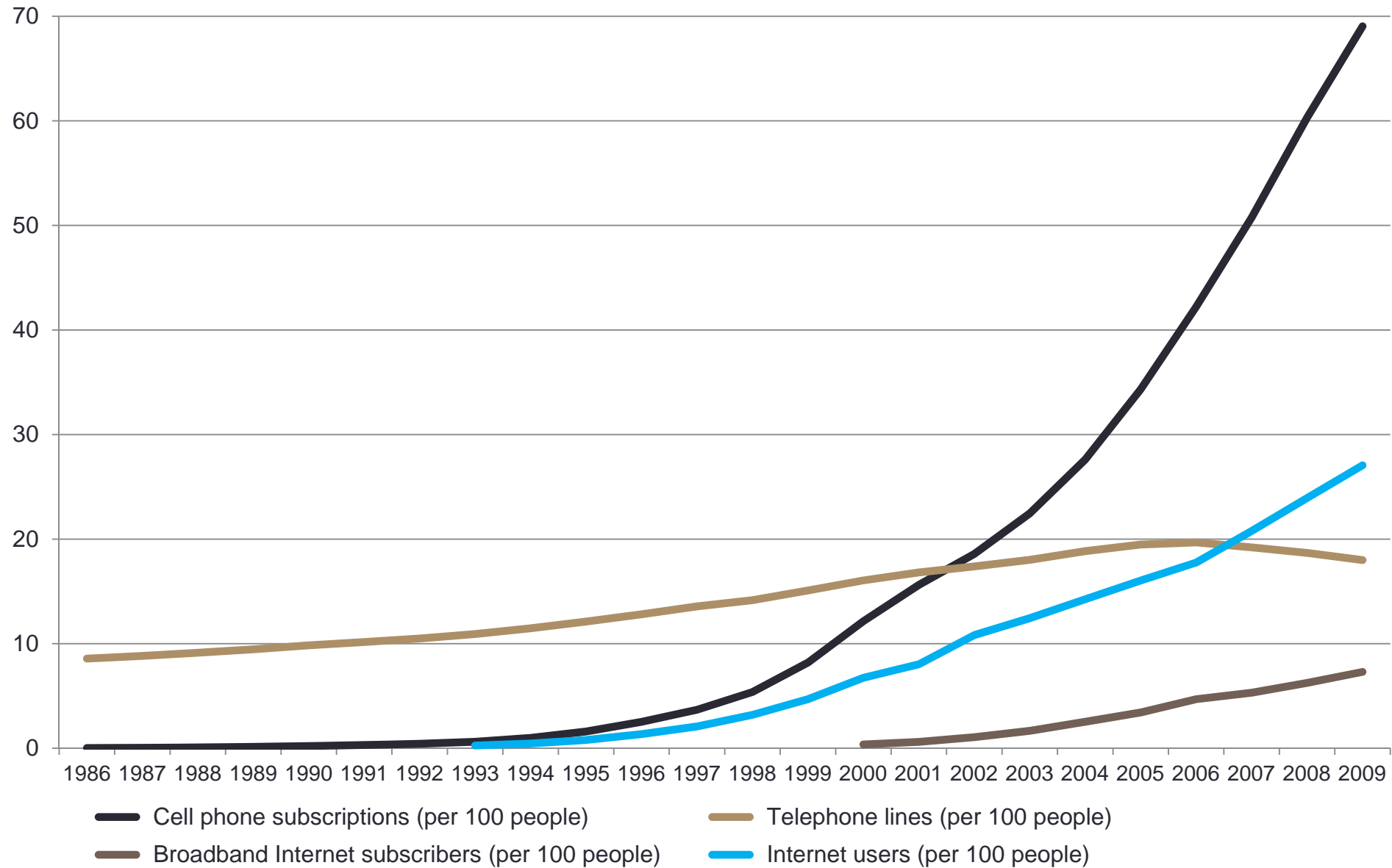… a laptop like this…

…and Al Gore had not yet created the internet

An ICT Revolution!

Microprocessor Transistor Counts 1971-2011 & Moore's Law

Significant Effect on Society

Legend:
- Cell phone subscriptions (per 100 people)
- Telephone lines (per 100 people)
- Broadband Internet subscribers (per 100 people)
- Internet users (per 100 people)

Source: World Development Indicators

Large Impact on International Trade Flows

It's not wine for cloth anymore…
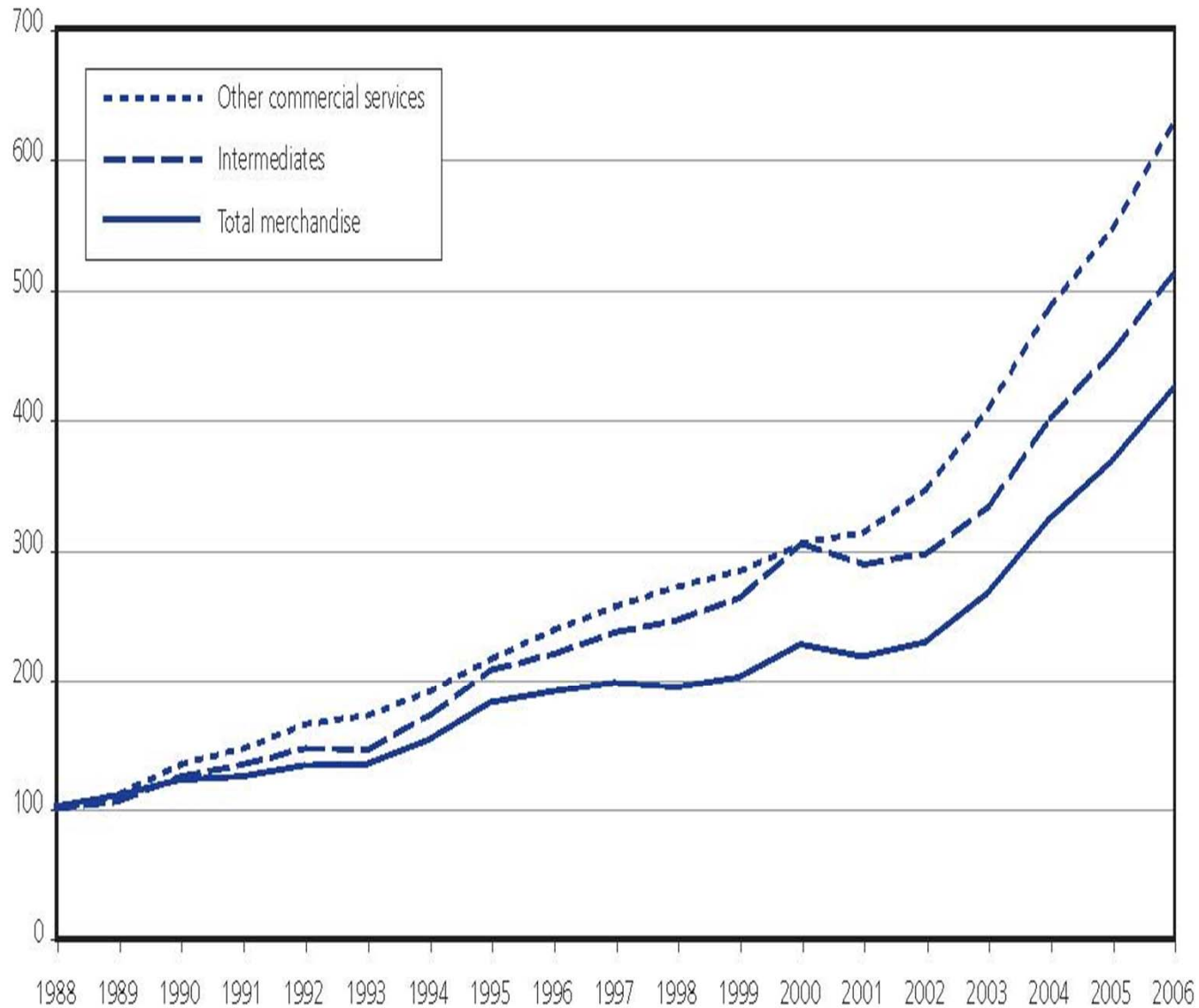
Source: World Trade Report (2008) using Yeats' (2001) methodology

- Assembled in China (and soon in Brazil) by Taiwan-based Foxconn

Apple iPad 2 32GB (Wi-Fi + 3G)

iSuppli®

Exploded View

Teardown Analysis

Touchscreen Assembly

LG Display, Samsung
(Korea, China)

TPK, now Wintek
(China, Taiwan, India)

Display Module

Catcher Tech. (case)
(Taiwan, China)

Rear Camera Module

Front Camera Module

Battery Pack

Simplo Tech, Dynapack
(Taiwan)

SIM Card PCB

Infineon, Qualcomm
(Germany, US, Singapore, Malaysia…)

Sensor PCB

STMicroelectronics, AKM, TAOS
(Italy-France, Japan, U.S)

3G Module

Loudspeaker Assembly

We're not done yet…

Main PCB

WLAN PCB

Main Connector PCB

Firms with R&D centers in developed countries and manufacturing plants worldwide

Samsung Semiconductor
APL0498
Applications Processor - 45nm, PoP

Broadcom
BCM5974CKFBGH
Multitouch Controller

WLAN PCB

Elpida
B4064B2PF-8D-F
SDRAM - Mobile DDR, 4Gb, PoP

Power Management
IC

Samsung Semiconductor
K9HDG08U5A-LCB0
Flash - NAND, 16GB, MLC
(x2)

Broadcom
BCM5973KFBGH
Microcontroller - for
Touchscreen

Samsung Semiconductor
S6T2MLC
ASIC - LCD Timing
Controller

Texas Instruments
CD3240A1
Touchscreen Driver

Heterogeneity in Contracting Environments

Total Duration (Days) of Legal Process to Collect a Bounced Check

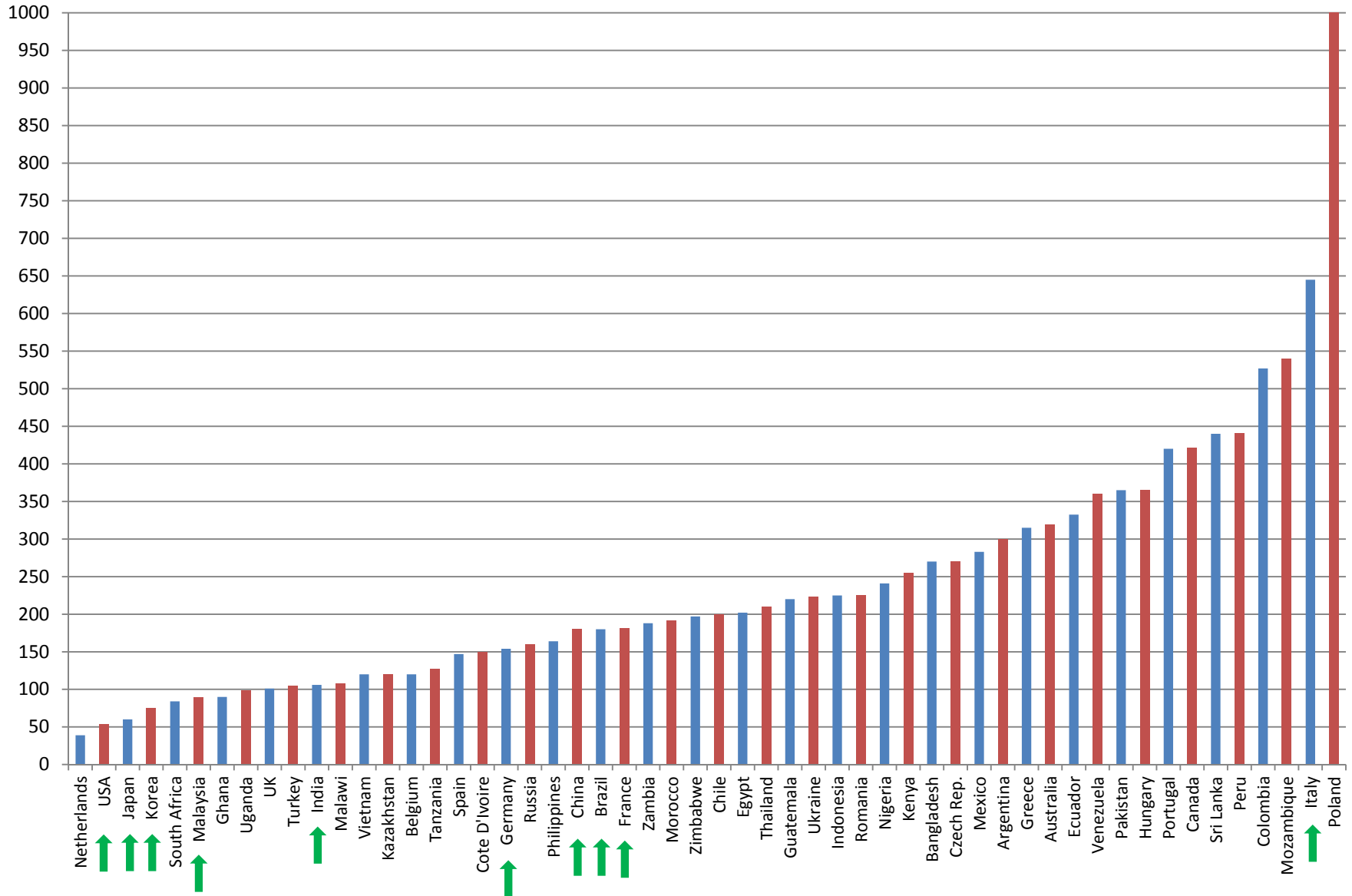**Source:** Djankov et al. (QJE, 2003)

→ iPad 2 producing countries

- Contract disputes in international trade: which country's laws apply?
  - Local courts may be unwilling to enforce a contract signed between residents of two different countries

- Attempts to resolve this issue – United Nations Convention on Contracts for the International Sale of Goods (CISG)
  - But not universally ratified and many parties opt out via Article 6

- There exist other forms of arbitration (e.g., ICC in Paris), but not widely used in practice

- Implicit contracts may be harder to sustain too due to limited repeated interactions and lack of collective punishment

- Rodrik (2000): *"Ultimately, [international] contracts are often neither explicit nor implicit; **they simply remain incomplete**"*

Example: "Price Go Up!"

- In "*Poorly Made in China,*" Paul Midler describes his (mis)adventures as an offshoring consultant

- Describes the last-minute pricing maneuvers and clever manipulation of quality of Chinese suppliers
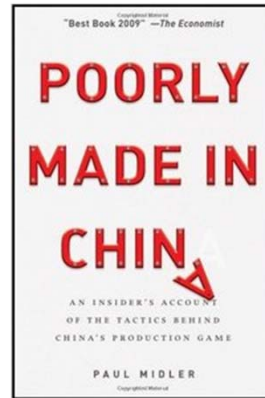
  "'Price go up!' was the resounding chorus heard across the manufacturing sector" (p. 184)

- Also describes the ineffectiveness of typical solutions:
  - Relational contracting ("Reverse Frequent Flyer" effect)
  - Foreign ownership (no "Joint Venture Panacea")

- Chinese saying: "Signing a contract is simply a first step in the negotiations"

GROSSMAN AND HART (1986) GOES GLOBAL

A Stylized Property-Rights Model

- Consider a situation in which the manager of a firm *F* has a access to a technology for converting a specialized intermediate input or component *m* into a final good

- The manager *F* is also in charge of providing "headquarter services" *h*, which raise the marginal product of *m*

- Given an amount *m* of components and *h* of headquarter services, sale revenue is given by

$$R(h,m) \text{ with } R_h>0;\ R_m>0;\ R_{hh}<0;\ R_{mm}<0;\ R_{hm}>0$$

- F needs to contract with an operator of a manufacturing plant (denoted by *M*) for the provision of *m*.

- *F* can produce *h* at a constant marginal cost c_h; M produces *m* at marginal cost c_m

- Contractual structure: before investments in 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 symmetric Nash bargaining: ½ , ½

- Distribution of surplus is sensitive to the mode of organization because the outside option of F is naturally higher when it owns M than when it does not

- Ownership entails residual rights of control over input m:
  - under outsourcing, contractual breach gives 0 to both agents (relaxable)
  - under integration of M, F can selectively fire M and seize input m (because it has property rights over it), but incurs productivity loss equal to a share $1-\delta$ of revenue

Discussion of Assumptions

- **Simpler than G-H 1986 in that:**
  - Ownership of asset = Ownership of input produced with asset
  - Effectively, only one form of integration is relevant (F is essential for final good production)
  - More structure on how investments affect inside and outside options (payoffs are proportional to an aggregator of h and m regardless of ownership structure)

- **Richer than G-H 1986 in that:**
  - More general production technology that allows for complementary investments
  - Investments affect each other's disagreement payoffs (no need to stick to interpretation of human capital investments)

- The (jointly) optimal ownership structure $k^* \in \{V, O\}$ is the solution to the following program:

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

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

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

where

$$\beta_k = \begin{cases} \beta_O = \frac{1}{2} & \text{if } F \text{ outsources to } M \\ \beta_V = \delta + \frac{1}{2}(1 - \delta) & \text{if } F \text{ integrates } M \end{cases}$$

- Suppose that instead of choosing $k \in \{V, O\}$, *F* could choose the joint profit-maximizing β

- Optimal β satisfies:

$$\frac{\beta^*}{1 - \beta^*} = \frac{\eta_{R,h} \cdot \xi_{h,\beta}}{\eta_{R,m} \cdot (-\xi_{m,\beta})} \qquad (1)$$

where for *j = h, m*

$$\eta_{R,j} \equiv \frac{jR_j(h,m)}{R(h,m)}$$

$$\xi_{j,\beta} \equiv \frac{dj}{d\beta} \frac{\beta}{j}$$

- Optimal to allocate bargaining power to *F* whenever his investment has a (relatively) large impact on revenue or is (relatively) more responsive to changes in bargaining power

- Most applications of the property-rights approach to international trade further assume

$$R(h,m) = Ah^{\eta_h}m^{\eta_m}$$

- This is often obtained by assuming:
  1. Cobb-Douglas production technology in h and m
  2. Constant-elasticity of demand system (Dixit-Stiglitz preferences in GE)

- In such case, (1) reduces to

$$\frac{\beta^*}{1-\beta^*} = \sqrt{\frac{\eta_h/(1-\eta_h)}{\eta_m/(1-\eta_m)}}$$

- **Proposition:** There exists a unique threshold $\hat{\eta}_h \in (0,1)$ such that for all $\eta_h > \hat{\eta}_h$ integration dominates outsourcing, while for $\eta_h < \hat{\eta}_h$ outsourcing dominates integration.

- Suppose that we can write

$$R(h, m) = A(q(h, m))^{\alpha}$$

and *q(h,m)* is linearly homogeneous. Then

$$\frac{\beta^*}{1 - \beta^*} = \sqrt{\frac{\eta/(1 - \alpha\eta + (\sigma - 1)(1 - \eta))}{(1 - \eta)/(1 - \alpha(1 - \eta) + (\sigma - 1)\eta)}}$$

- β^* increases in the output elasticity of *h* <u>for any</u> elasticity of substitution between *h* and *m*

- Effect of α *and* σ depends crucially on whether η is higher or lower than 1/2 (negative if η < *1/2*)

- Consider a multi-country version of the above model in which firms are allowed to locate different parts of the production process in different countries
  - denote by *L* the set of possible location decisions (a mapping from production processes to locations) and by $\ell \in L$ a particular one.

- Location decisions naturally affect marginal and fixed costs of production, and possibly revenue and ex-post division of surplus

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

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

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

- Fixed costs might also be affected by the ownership decision

An Application: The Role of Capital Intensity

- In Antràs (2003), I interpreted F's investment in h as being capital intensive relative to M's investment
  - can be boiled down to transferability of capital investments

- Proposition 1 then predicts a higher propensity to integrate suppliers in capital-intensive sectors

- I then embedded the model in a general equilibrium, factor proportions model of trade à la Helpman-Krugman
  - See also Grossman and Helpman (2002)

- Capital intensity not only affects the location of suppliers (or where M is produced), but also whether those sourcing decisions are integrated or not

- I showed how this had implications for how the share of intrafirm imports should correlate with capital intensity across industries and relative capital abundance across countries

- In Antràs and Helpman (2004) we embed the framework in a Melitz (2003) style model with intraindustry heterogeneity

- Choice of organizational form faces two types of tensions:
  1. Location: South offers relatively low variable costs, but relatively higher fixed costs (e.g., harder to find a supplier)
  2. Control: integration improves efficiency of variable production when η is high (Proposition 1), but involves higher fixed costs

- We show that equilibrium can feature multiple organizational forms within an industry and study the determinants of the relative prevalence of these different organizational forms
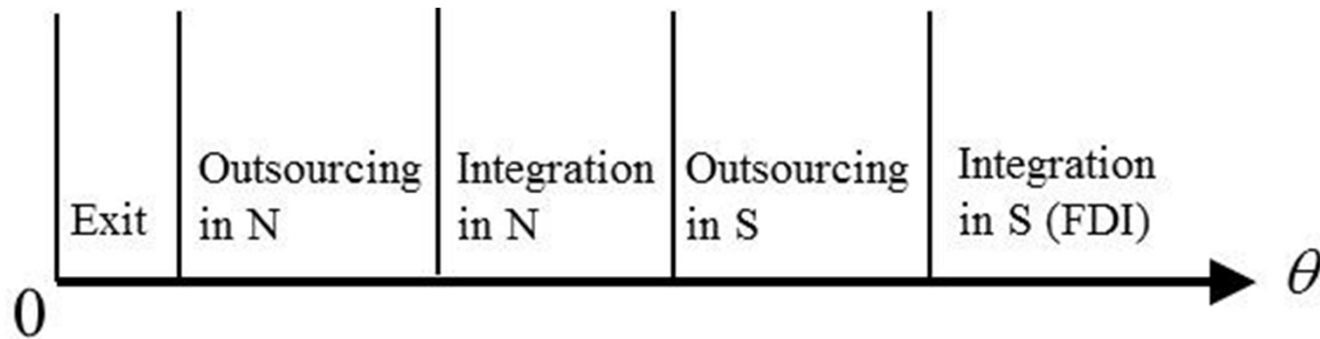
- Effect of headquarter intensity, but also of relative factor costs, trade frictions, or productivity dispersion

- Framework has been extended in several directions:
  - Partial contractibility (Antràs and Helpman, 2008)
  - Multiple suppliers (Acemoglu et al., 2006, Antràs and Chor, 2011)
  - Financial frictions (Carluccio and Fally, 2010, Basco, 2010, Conconi et al., 2010)

- Model has served as springboard for extensive empirical literature

Brief Review of Other Related Theoretical Work

- Earlier work following the transaction-cost approach
  - Ethier (1986), Ethier and Markusen (1998), McLaren (2000), Grossman and Helpman (2002, 03, 05)

- Work adopting organizational theories inspired by G-H' 86
  - Authority: Marin and Verdier (2008, 09), Puga and Trefler (2002, 10)
  - Relational Contracting: Corcos (2006)

- Implications of incomplete contracting for international trade flows even in the absence of intermediate input trade
  - Acemoglu et al. (2006), Levchenko (2007), Nunn (2007), Costinot (2009)

- Welfare implications of incomplete contracting in trade models
  - Antràs (2005), Levchenko (2007)

- Interaction with trade policy choices
  - Antràs-Staiger (2010), Díez (2010), Conconi et al. (2010, 2011)

CONFRONTING THE MODEL WITH INTERNATIONAL TRADE DATA

Challenges and Opportunities

- Empirically validating the property-rights theory poses at least two important challenges

  1. Data on integration decisions is not readily available
  2. Predictions are associated with marginal returns to investments that are generally unobservable in the data

- Admittedly, we have not made a lot of progress on point 2

- But data on international transactions is particularly accessible due to official records of goods crossing borders

- Fairly detailed data on U.S. intrafirm trade at the sector level (HS6; over 4000 of these) and origin/destination country level

- Also a few international firm-level datasets with detailed information on the sourcing strategies of firms
  - for example, the Spanish ESEE has data on domestic insourcing and outsourcing and foreign insourcing and outsourcing at the firm level

Pros and Cons of Using Intrafirm Trade Data

- **Some pros:**
  - Compiled from administrative records from official import and export merchandise trade statistics
  - There is plenty of variation in the data (more on this later)
  - Easier to spot "fundamental" forces that appear to shape whether international transactions are internalized or not
  - Potential to exploit 'exogenous' changes in sector characteristics or in institutional features of importing/exporting countries

- **Some cons:**
  - Aggregates firm decisions; can't control for firm-level determinants
  - Information only on the sector of the good being transacted
    - Not always clear which sector is buying on the import or export side
    - Not always clear whether inputs or final goods are traded
  - Not always clear who is integrating whom (backward vs. forward integration) and how large is the ownership stake
  - U.S. firm level sourcing decisions might not be reflected in U.S. trade data (remember the iPad 2 example) – affiliates as intermediaries

Variation in the Share of Intrafirm Trade across Countries

Share of U.S. Intrafirm Imports for Top 50 Exporters in 2010
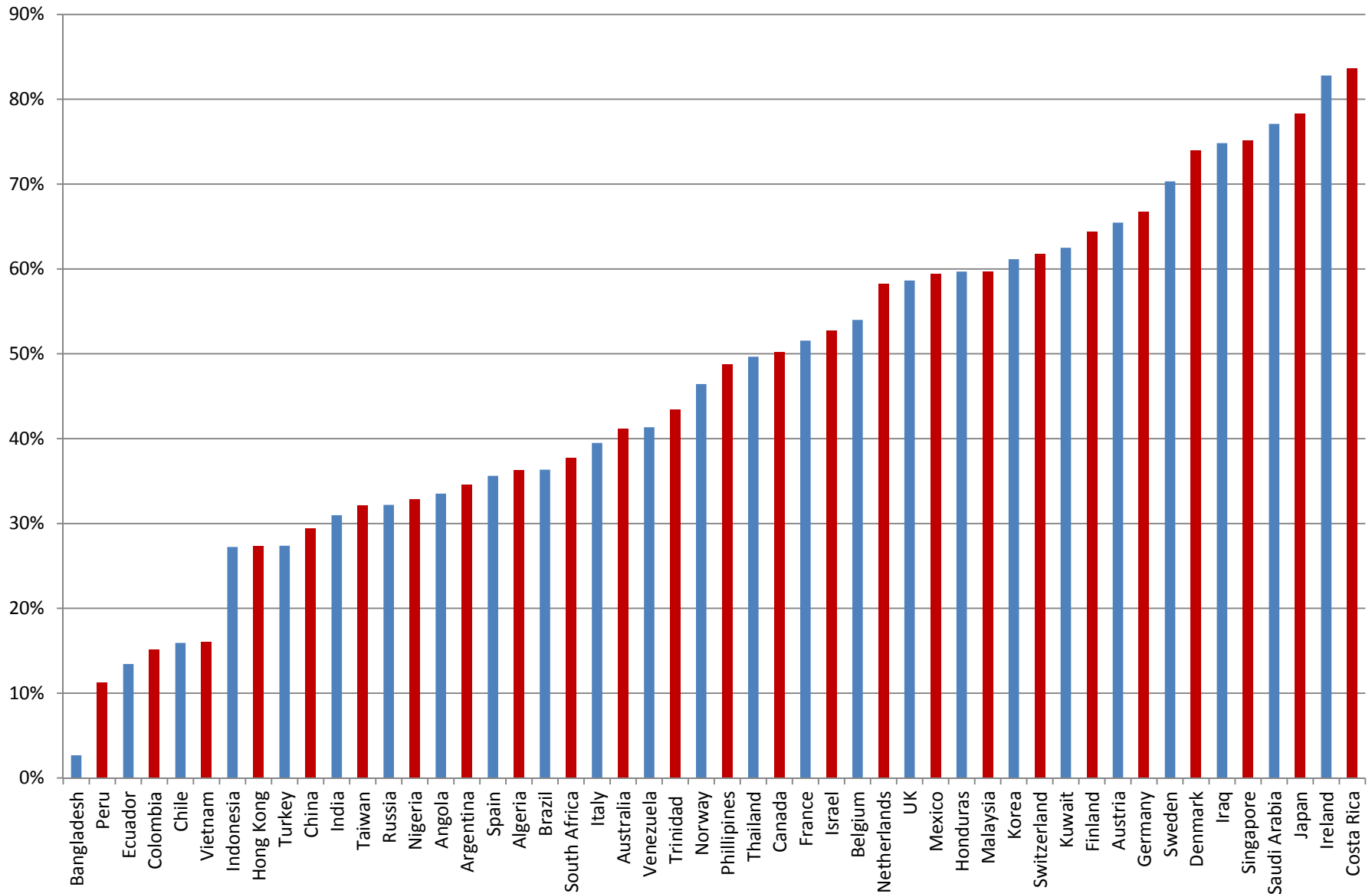
Aggregate Share of Intrafirm Trade: 48.57%

Source: U.S. Census

Variation in the Share of Intrafirm Trade across Industries

Share of U.S. Intrafirm Imports for Top 25 Importing Industries (NAICS6) in 2010

Source: U.S. Census
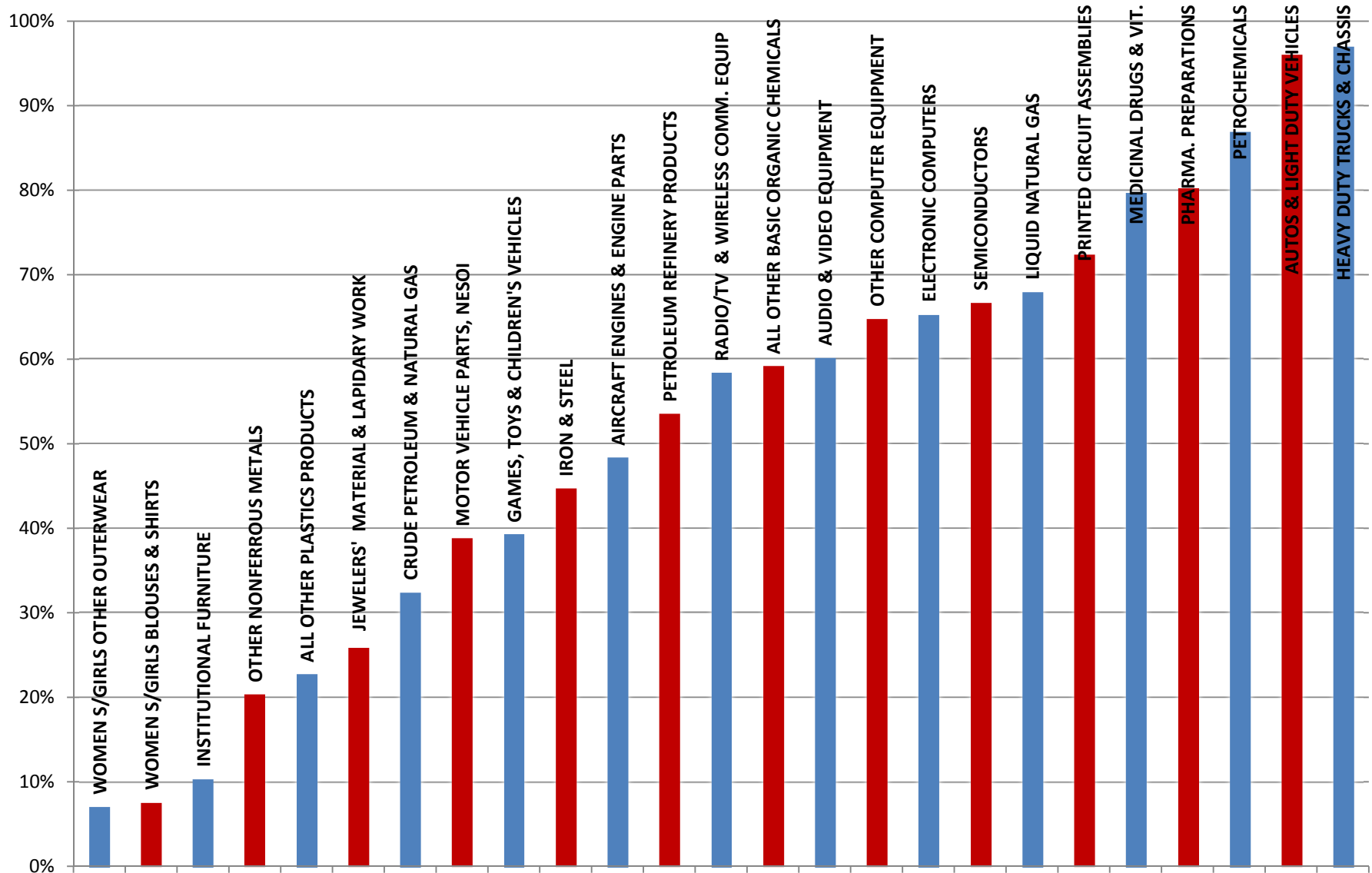
Large Variation in the Share of Intrafirm Trade within Sectors

Variation in the Share of U.S. Intrafirm Imports within HS2 sector 87
(Vehicles, except Railway or Tramway, and Parts)
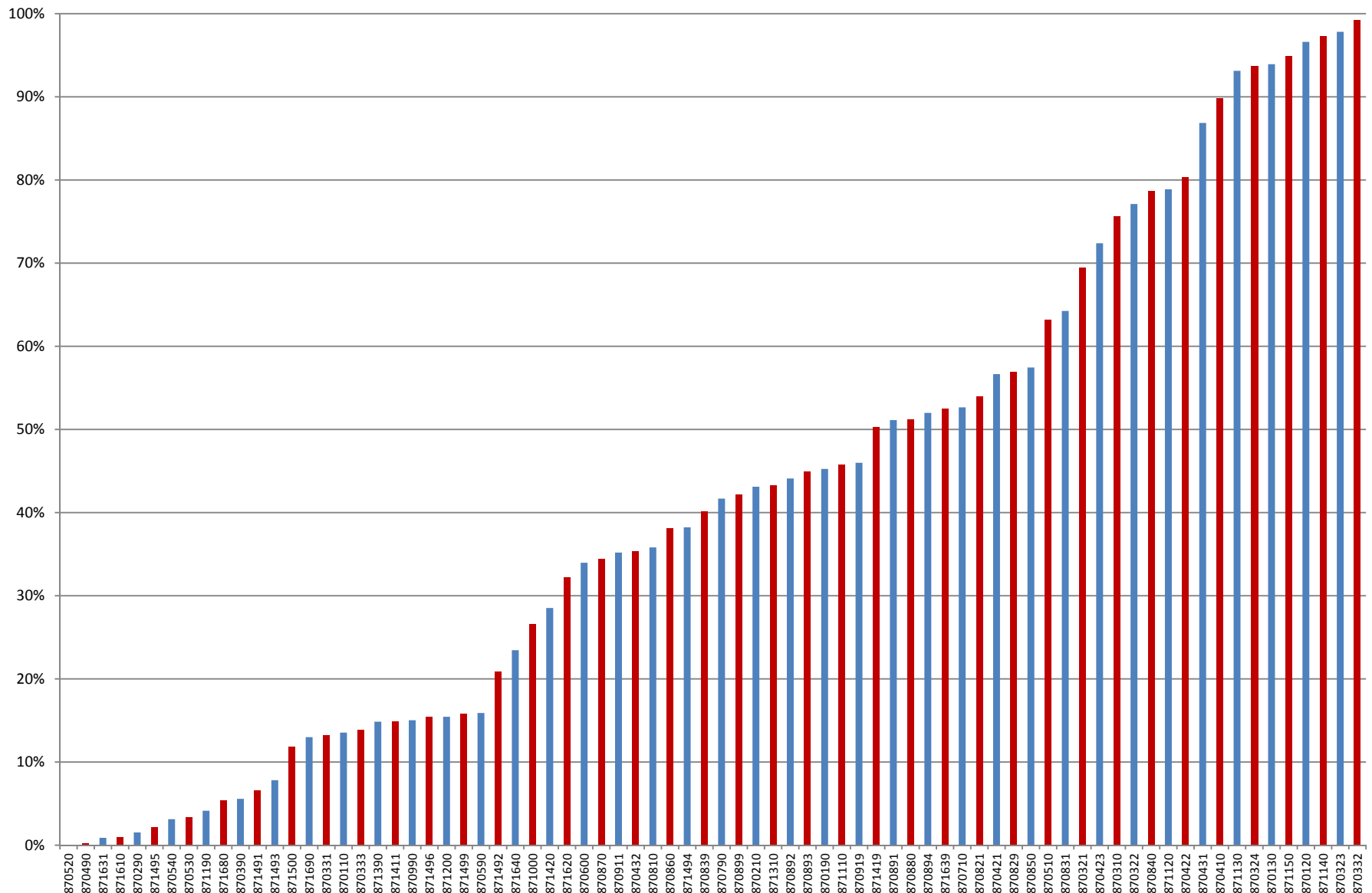
Source: Nunn and Trefler's dataset

… And Also Within More Narrowly Defined Sectors

Variation in the Share of U.S. Intrafirm Imports within HS4 Sector 8708 (Auto Parts)
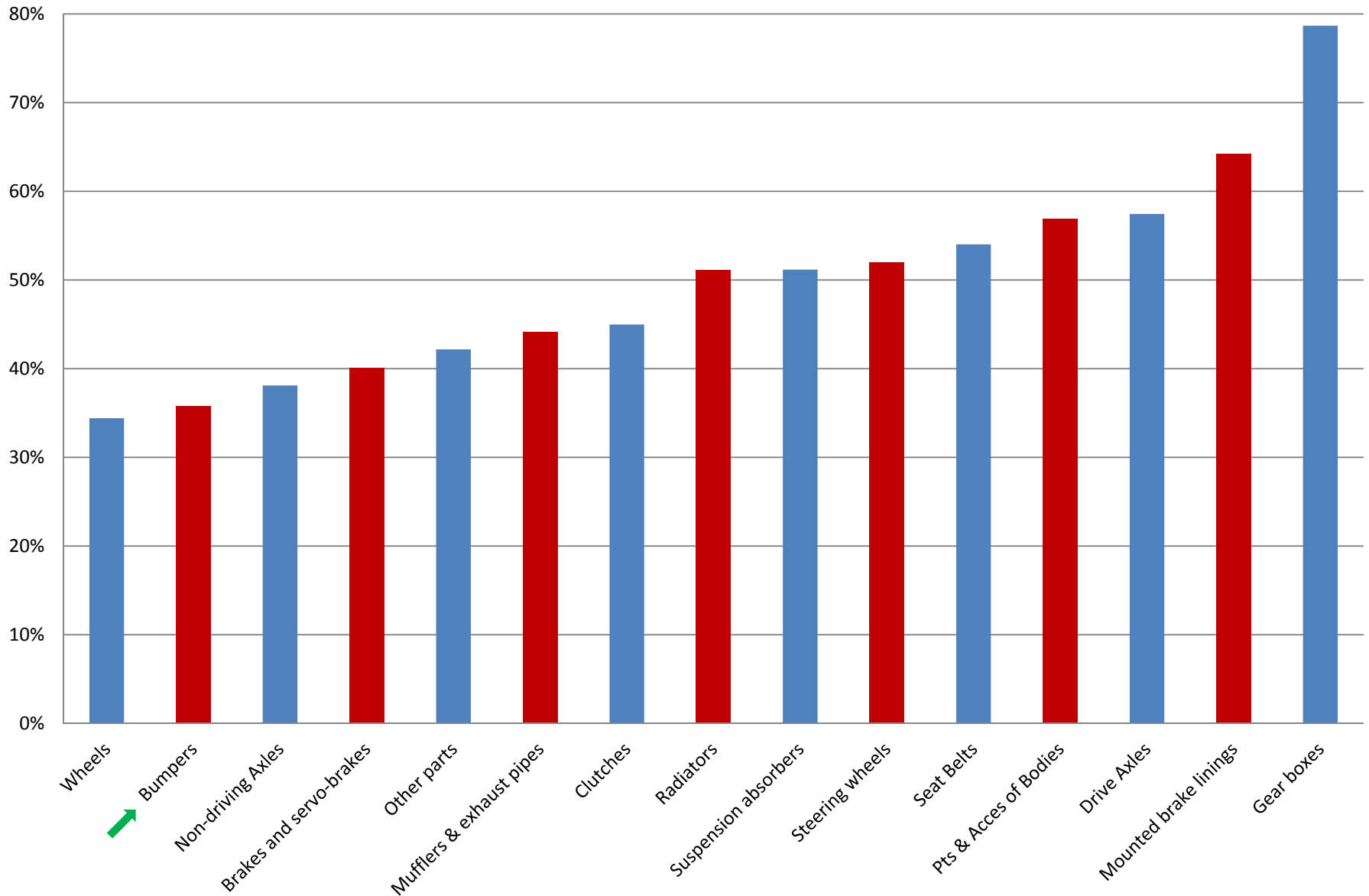
Source: Nunn and Trefler's dataset

... And Across Countries Within HS6 Sectors

Variation in the Share of U.S. Intrafirm Imports within HS6 Sector 870810 (Bumpers)
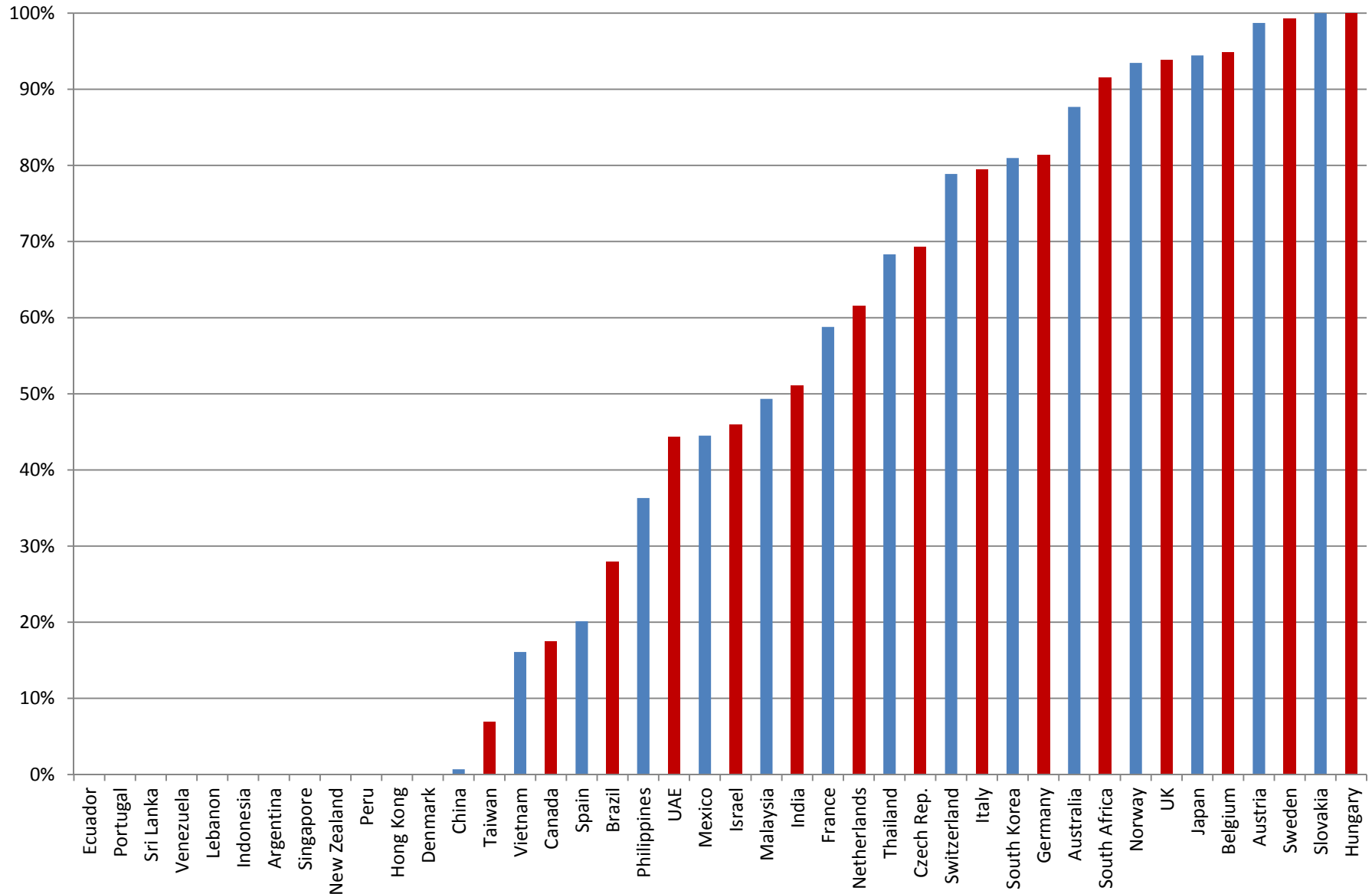
Source: Nunn and Trefler's dataset

Using Intrafirm Trade Data

- Several studies have made use of U.S. intrafirm trade data
  - Antràs (2003), Yeaple (2006), Nunn and Trefler (2008a,b), Bernard et al. (2010), Antràs and Chor (2011)

- There also exists work using detailed Chinese trade data
  - Feenstra and Hanson (2005), Fernandes and Tang (2010)

- Results are generally supportive of the predictions of the model though, admittedly, one might worry about the power of some of these tests

- I will next illustrate some of the results for U.S. imports through correlations (which also hold conditional on wide set of covariates)

- Positively correlation with alternative measures of "headquarter intensity"

Intrafirm and Headquarter Intensity

- Positively correlation with alternative measures of "headquarter intensity"

- Robust to various controls and to country fixed effects in country/industry regressions
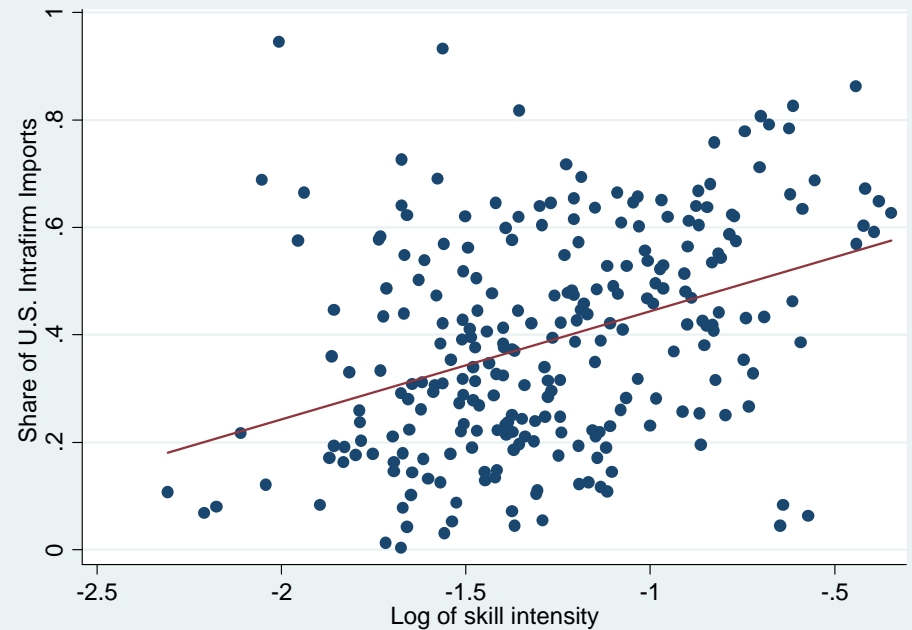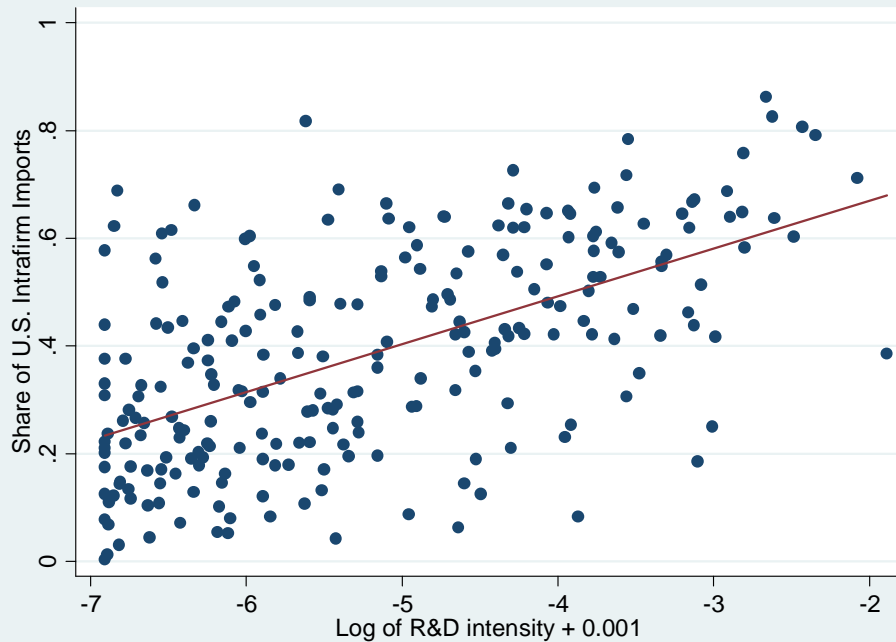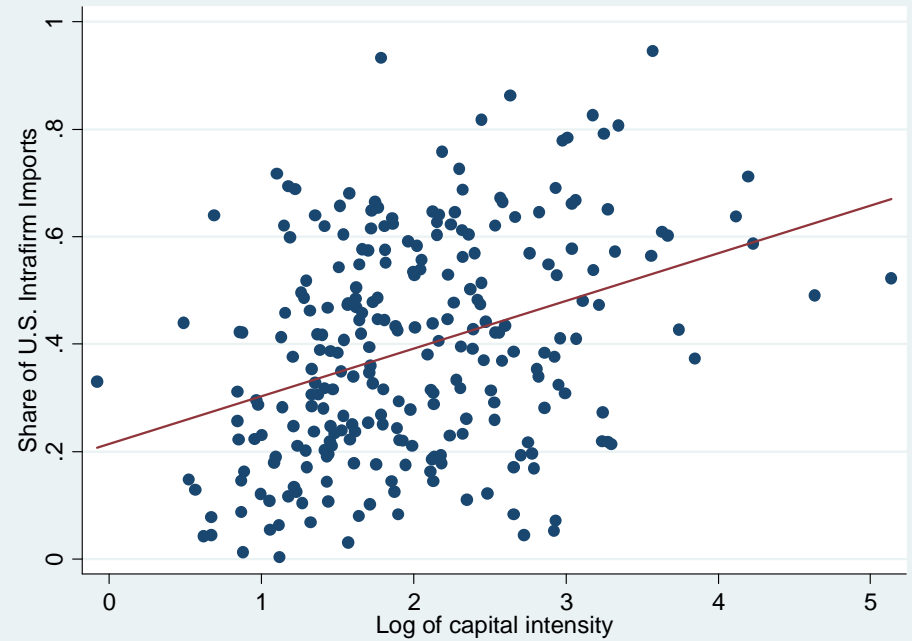
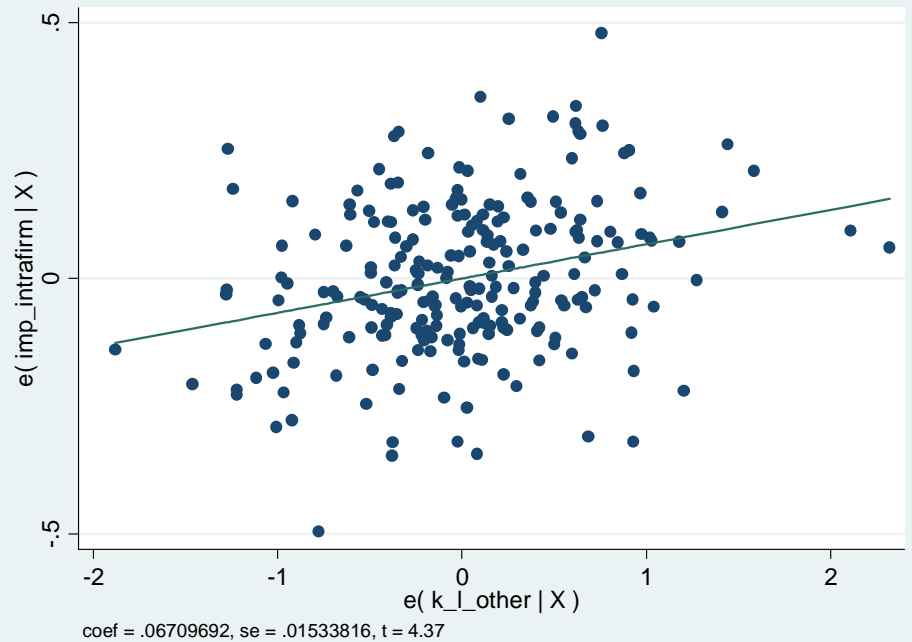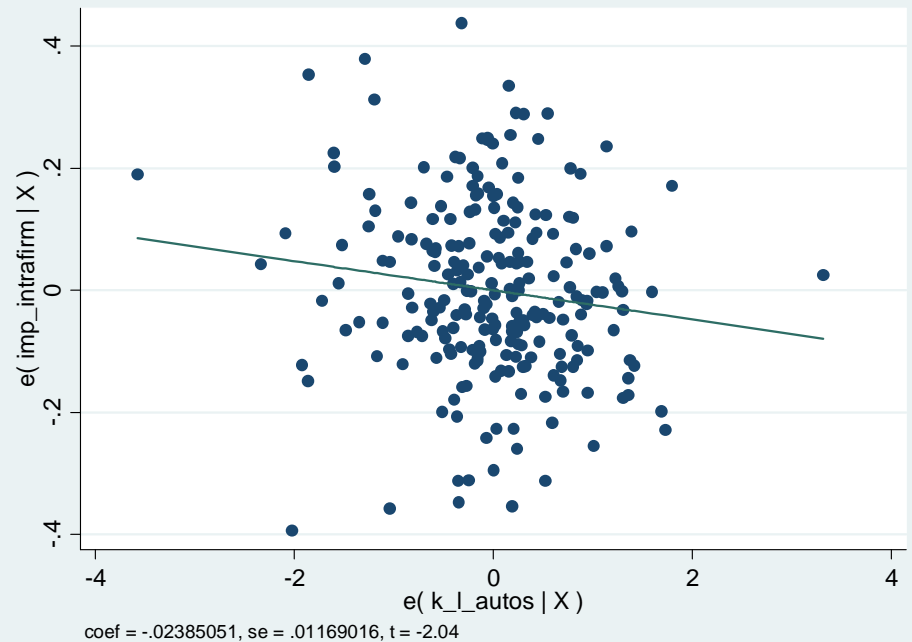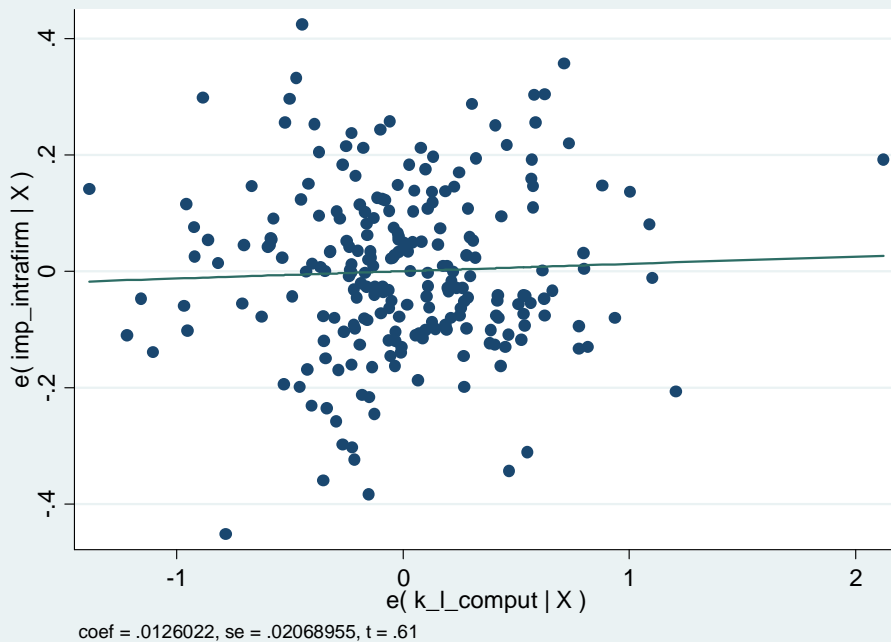# What is Behind the Effect of Capital Intensity?

- As pointed out by Nunn and Trefler (2009), effect of capital intensity is driven by capital equipment intensity, not structures

coef = -.03425467, se = .01541797, t = -2.22

coef = .08361554, se = .01623926, t = 5.15
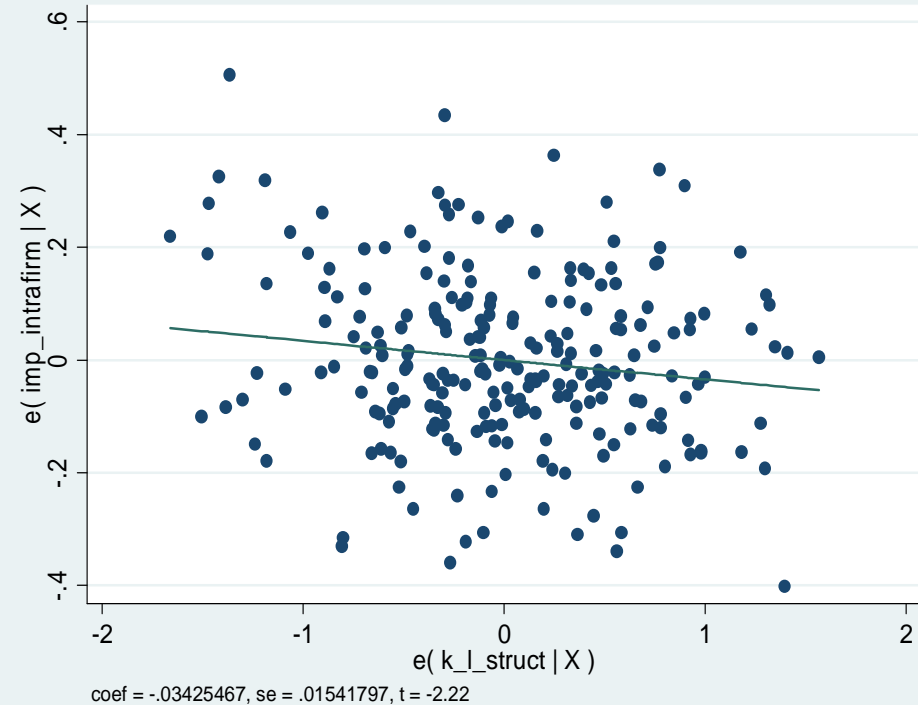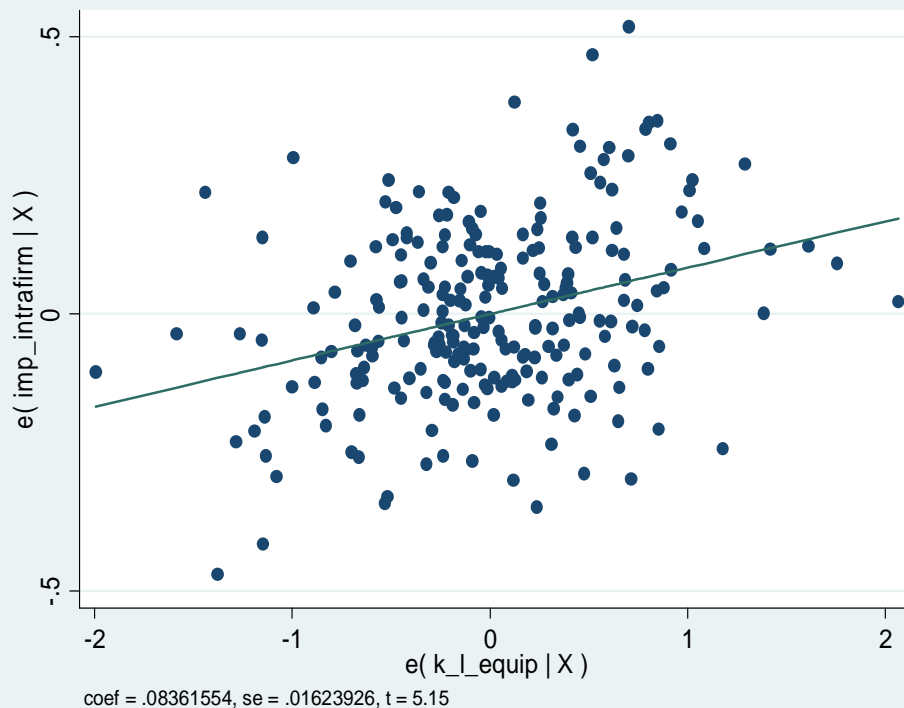
- Graphs plots partial effect of the log capital intensity of a particular type of capital
- Regressions controls for R&D intensity and skill intensity

What is Behind the Effect of Capital Intensity?

- And within capital equipment, the correlation is not driven by spending on autos or computers (see Nunn and Trefler, 2009)

coef = -.02385051, se = .01169016, t = -2.04

coef = .0126022, se = .02068955, t = .61

coef = .06709692, se = .01533816, t = 4.37

Contractibility

- Some evidence of a negative correlation between intrafirm trade and contractibility

- What are these measures capturing and are these patterns consistent with theory?
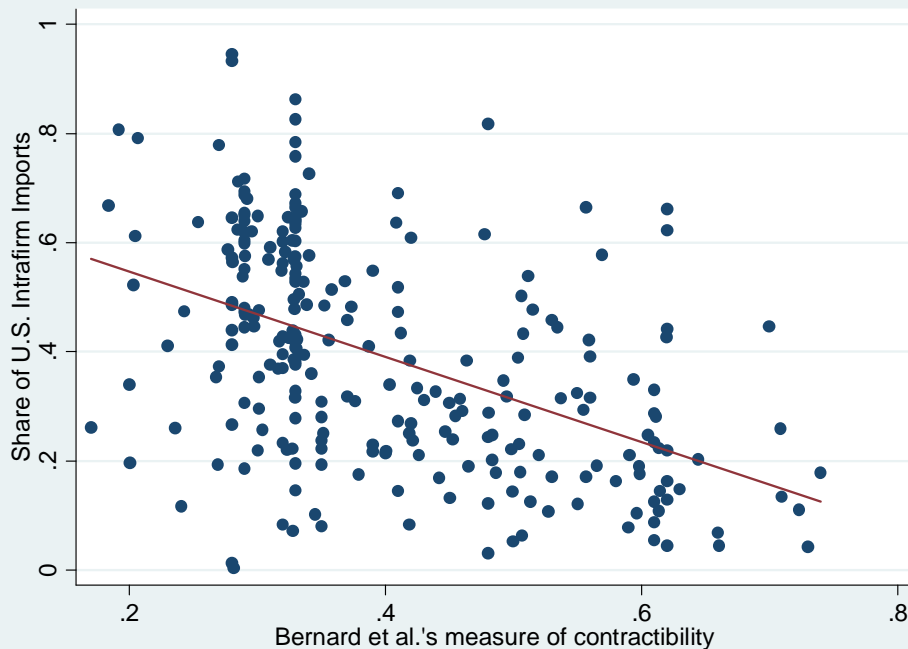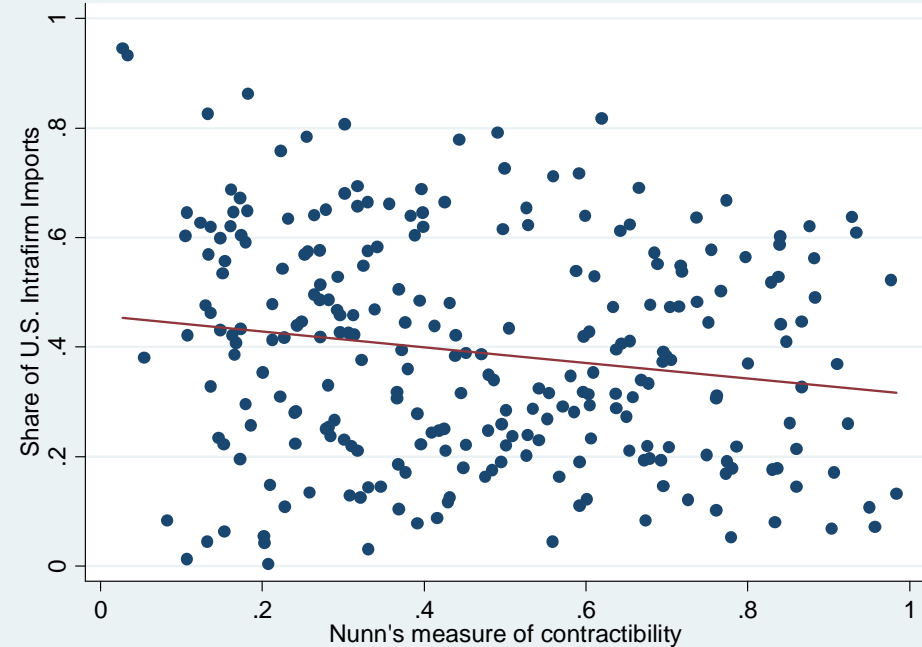
- Antràs and Helpman (2008): key is whether contractibility is low in headquarter services or in the provision of the input
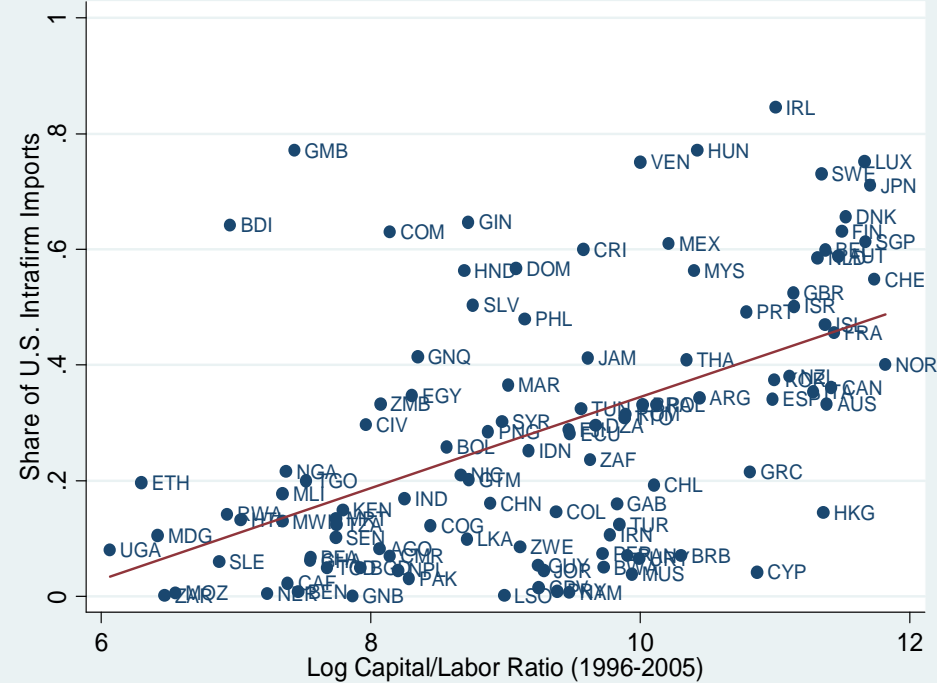
- Some evidence of a positive correlation with productivity dispersion

- Consistent with Antràs and Helpman (2004)
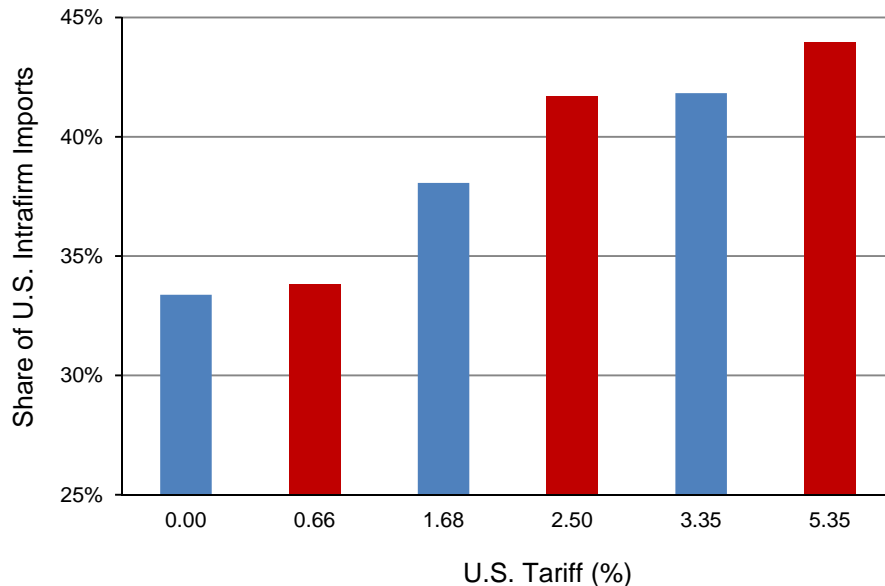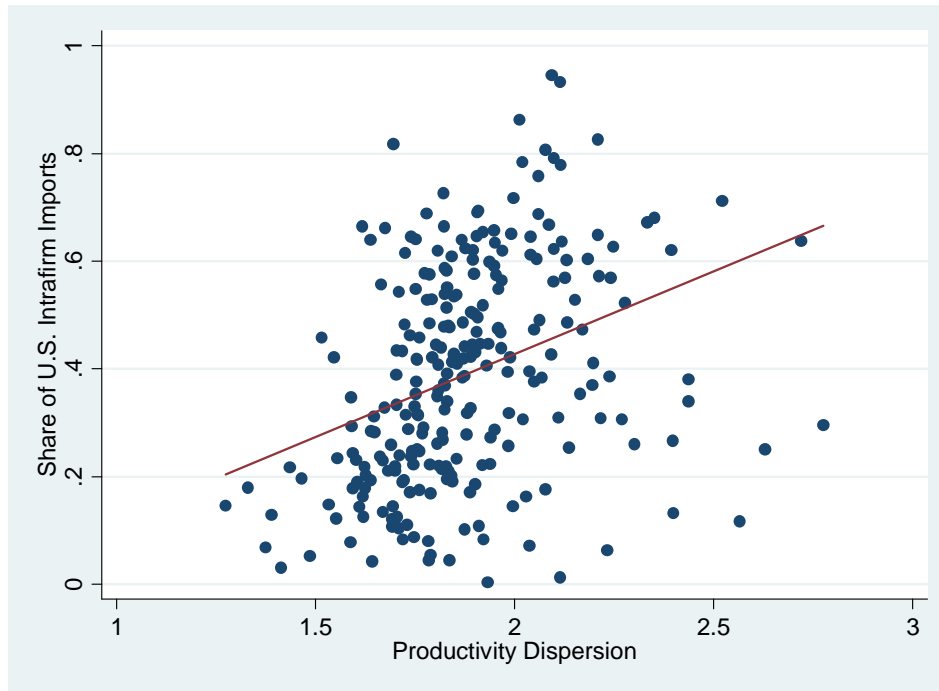
- Díez (2010) finds a positive correlation with U.S. tariffs

- Again consistent with A-H' 04

Cross-Country Variation

- Positive correlation between physical capital abundance and the share of intrafirm trade (see Antràs, 2003)

- Positive correlation between rule and law and the share of intrafirm trade

- Holds for various institutional variables

Firm-Level Studies

- Tomiura (2007) uses a rich sample of 118,300 Japanese manufacturing firms in 1998
  - Foreign outsourcing versus foreign integration

- Corcos et al. (2009) and Defever and Toubal (2009) use French data from a survey conducted in 1999 by SESSI (Service des Études Statistiques Industrielles)
  - Again foreign outsourcing versus foreign integration

- Kohler and Smolka (2009) use data from the Spanish Survey on Business Strategies (ESEE)
  - Data on both domestic and foreign outsourcing and integration

- Availability of these datasets opens the door for more structural tests of the model and might allow to circumvent some of the obvious "observability" issues in the literature

- Institutions and comparative advantage
  - Contracting institutions, financial institutions, labor institutions

- Understanding the financial structure of multinational firms
  - Implications for aggregate capital flows across countries

- Effects from trade when power matters in market (and nonmarket) transactions
  - Intermediaries, government pressures

- Trade Policy when power matters in market and (nonmarket) transactions
  - Implications for effectiveness of WTO rules