CREI Lectures in Macroeconomics

Contracts and the Global Organization of Production

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Why Me?

- I am not much of a macroeconomist
- My reservation price for spending a few days at CREI is way lower than the honor of giving these distinguished lectures

- So why me?
- Hard to believe that being a UPF and BGSE alumnus is not part of the reason
- So let's go back to 1994, when I began my undergraduate studies here

Experiencing Globalization in 1994

- The music I listened to and the movies I watched were mostly British or American
- Most of the clothes I wore were manufactured abroad (some in exotic places such as Morocco or Taiwan)
- My favorite beer was Dutch
- At UPF:
  - about half of my teachers were foreign
  - a third of the classes were taught in English
  - most of the textbooks were the same ones used in universities around the globe
- And yet, the world had not yet witnessed the full advent of globalization

What Has Happened Since 1994?

- I would highlight three major developments in the world economy

1. Information and communication technology (ICT) revolution
2. Deepening of trade liberalization and continuing transportation cost reduction
3. Political developments expanding the reach of globalization

The ICT Revolution

- Processing power and memory capacity of computers have doubled approximately every two years (Moore's law)
- Cost of transmitting a bit of information over an optical network has decreased by half roughly every nine months (Butter's law)
- Number of internet users has increased by a factor of 100, growing from around 20 million users in 1994 to more than 2,000 million users in 2010

Illustrative Example: My Favorite Movie of 1994

- Today, one can download *Pulp Fiction* from Amazon.com in about 11 minutes and 16 seconds using a standard broadband connection
  - at download speed of 5 megabits per second
- In 1994, downloading that same 3.3GB file would have kept your phone line busy for at least 33 hours and 23 minutes!
  - at maximum download speed of 28.8 kilobits per second

Or in the Words of Jules Winnfield

Download speed today and in 1994 "ain't the same [freaking] ballpark. They ain't the same league.They ain't even the same [freaking] sport."

Deepening Trade Liberalization

- Gradual dismantling of man-made barriers during the 1990s and 2000s
  - gradual expansion of the European Union
  - NAFTA (1994)
  - Mercosur (1991-94)
  - ASEAN FTA (1992-2003)
  - multitude of smaller PTAs under the umbrella of GATT's Article XXIV
  - China's accession to the WTO (2001)
  - expiration of the Multifiber Agreement (2005)
- World's weighted average tariff applied on traded manufactured goods fell from 5.14% in 1996 to 3.03% in 2010
- Technological developments since 1994 have also reduced quality- (or time-) adjusted costs of transporting goods across countries
- Investments in infrastructure in LDCs have also contributed to the spread of globalization

Political Developments

- Fall of communism brought about a remarkable increase in the share of world population actively participating in the process of globalization
- Ensuing ideological shift to the right in large parts of the globe
- Mainstream capitalist policies became more friendly towards globalization
  - trade liberalization
  - relaxation of currency convertibility and balance of payments restrictions

An Implication of These Three Developments

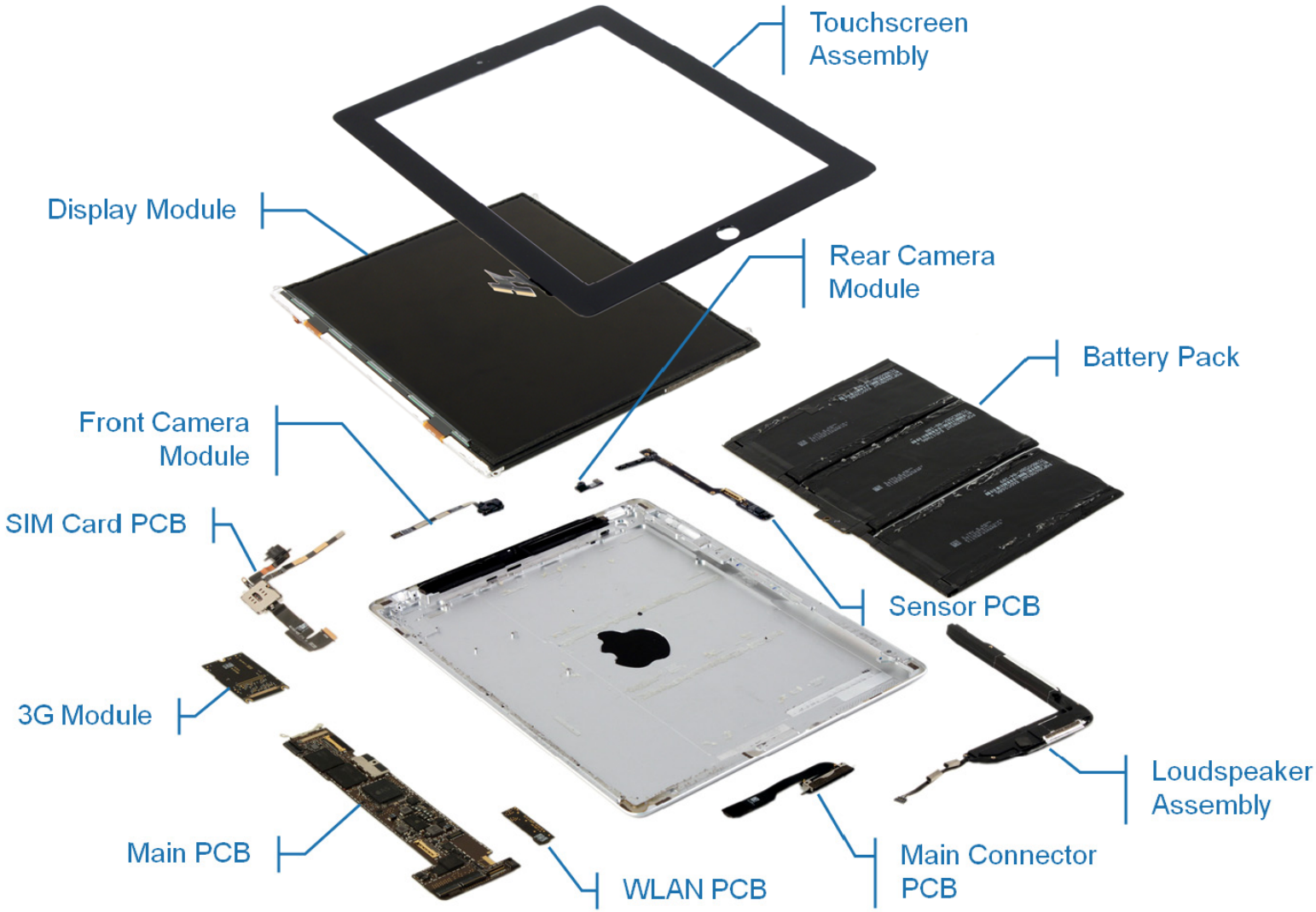
- Gradual disintegration of production processes across borders
- "Made in" labels should now read "Made in the World"
- Every author has his/her pet word to describe this phenomenon:
  - "slicing of the value chain"
  - "fragmentation of the production process"
  - "disintegration of production"
  - "delocalization"
  - "vertical specialization"
  - "global production sharing"
  - "unbundling"
  - "offshoring"
  - "flattening of the world"

An Example: the iPad 3

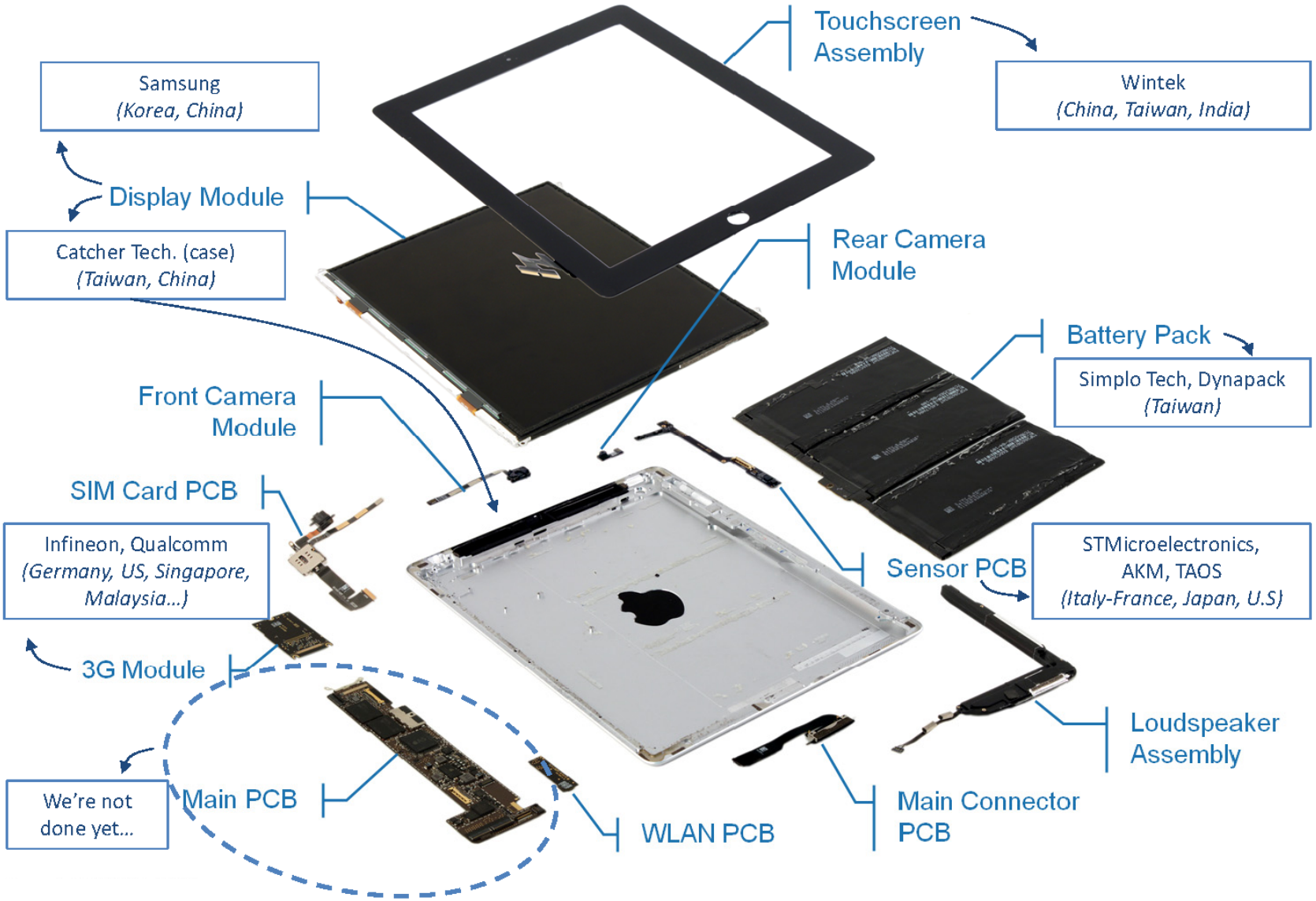
Designed by Apple in California, Assembled in China

Assembled in China (and now also in Brazil) by Taiwan-based Foxconn and Pegatron

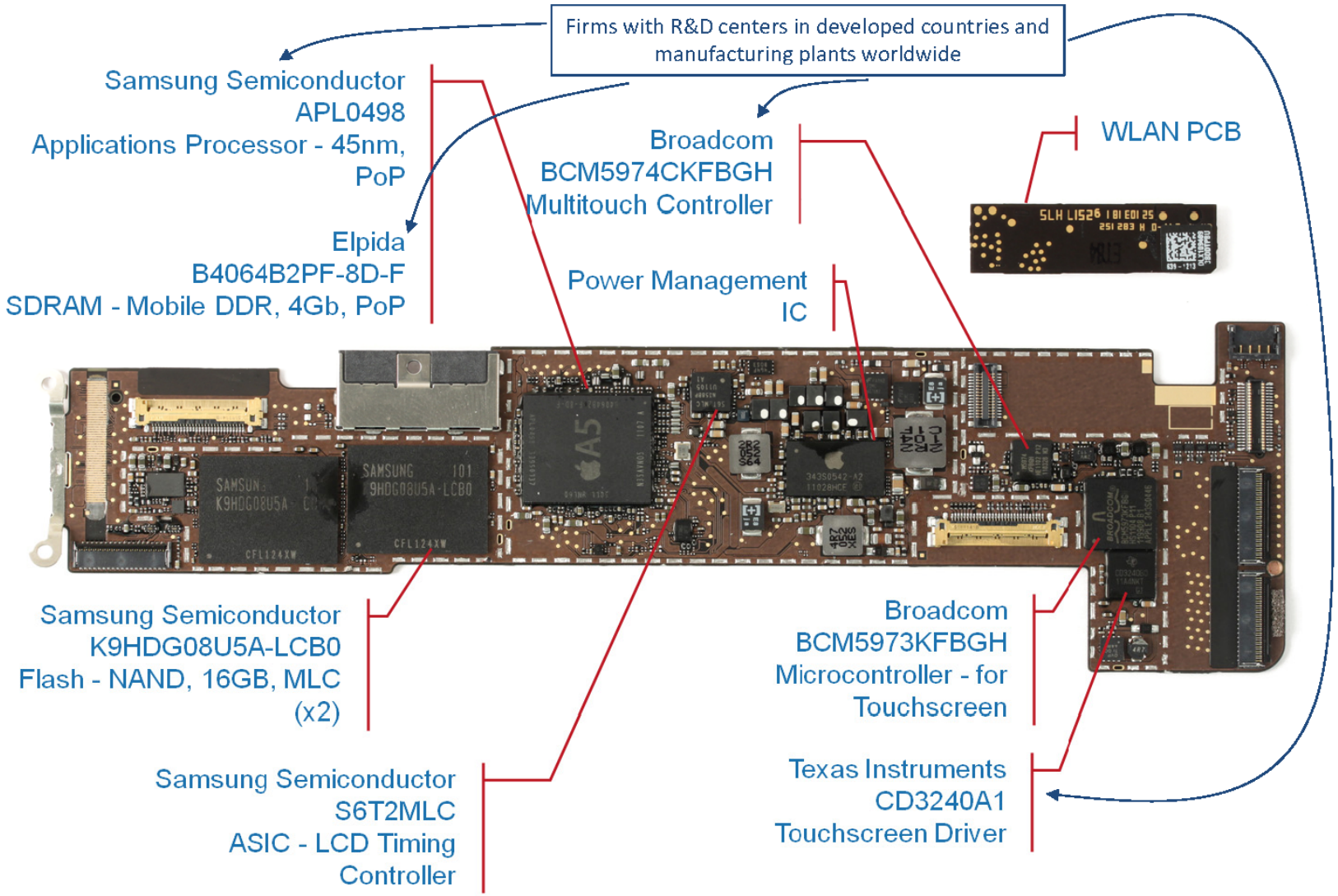
Tearing Down an iPad 3



Tearing Down an iPad 3



An Even Closer Look



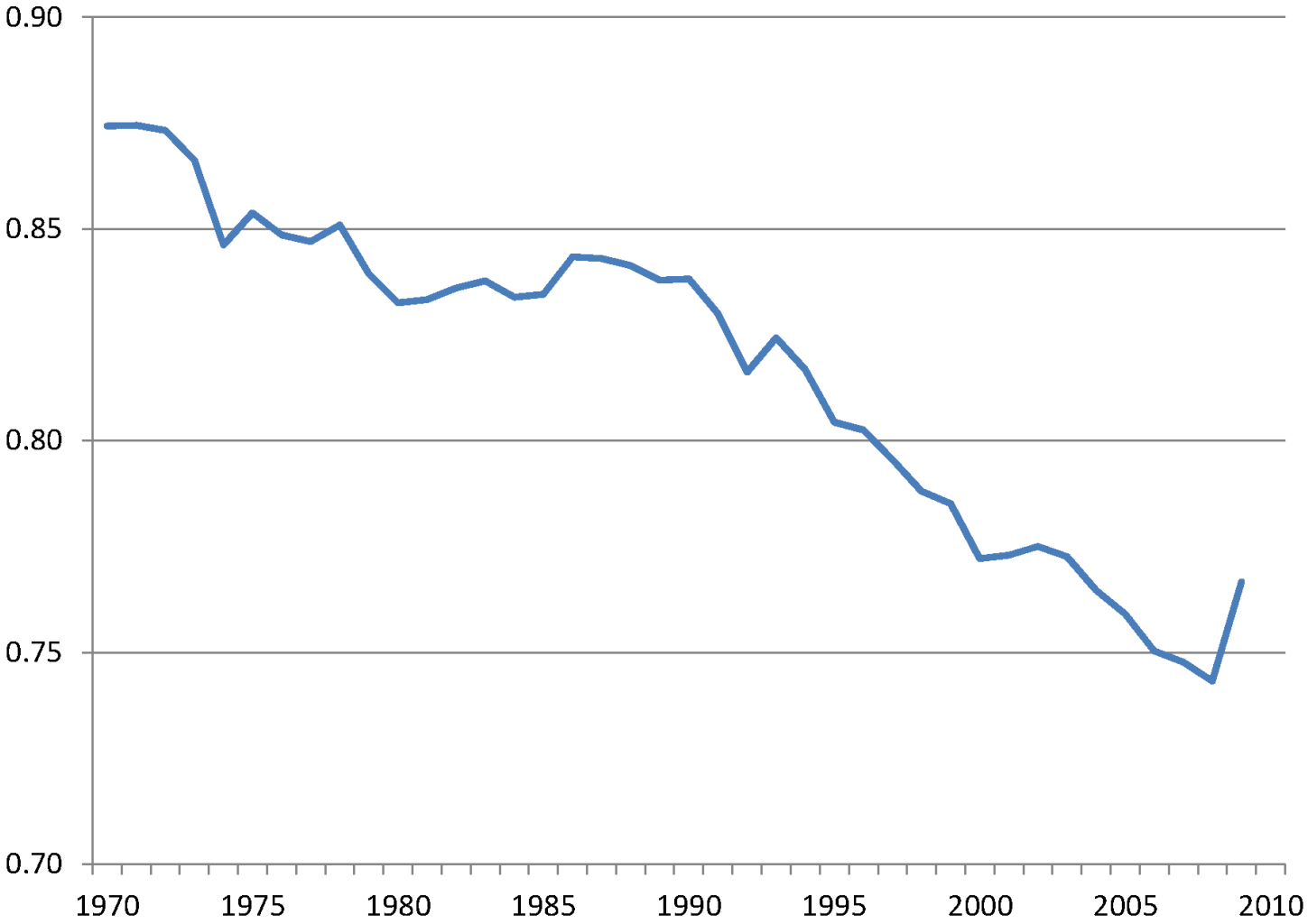
Quantifying Global Production Sharing

- Phenomenon large enough to be salient in aggregate statistics
- Feenstra and Hanson (1996) used U.S. I-O tables to infer the share of imported inputs in total U.S. input purchases
  - this share had already increased from 5.3% in 1972 to 11.6% in 1990
- Campa and Goldberg (1997) provided similar evidence for Canada and U.K. (but not Japan)
- Hummels et al. (2001) constructed a measure of vertical specialization capturing the value of imported inputs embodied in exported goods
  - this accounted for up to 30% of world exports in 1995, having grown by as much as 40% since 1970

Quantifying Global Production Sharing

- Recently, Johnson and Noguera (2012) have computed a *global* Input-Output table from which one can back out the value-added and intermediate input contents of gross trade flows
- Their *VAX* ratio (the value-added to gross-value ratio of exports) is an appealing inverse measure of the importance of vertical specialization in the world production
  - *VAX* ratio has declined significantly since 1970 with about 2/3 of the decline occuring after 1990
  - decline is concentrated in manufacturing

Ratio of Value Added to Gross Exports (VAX), 1970-2009

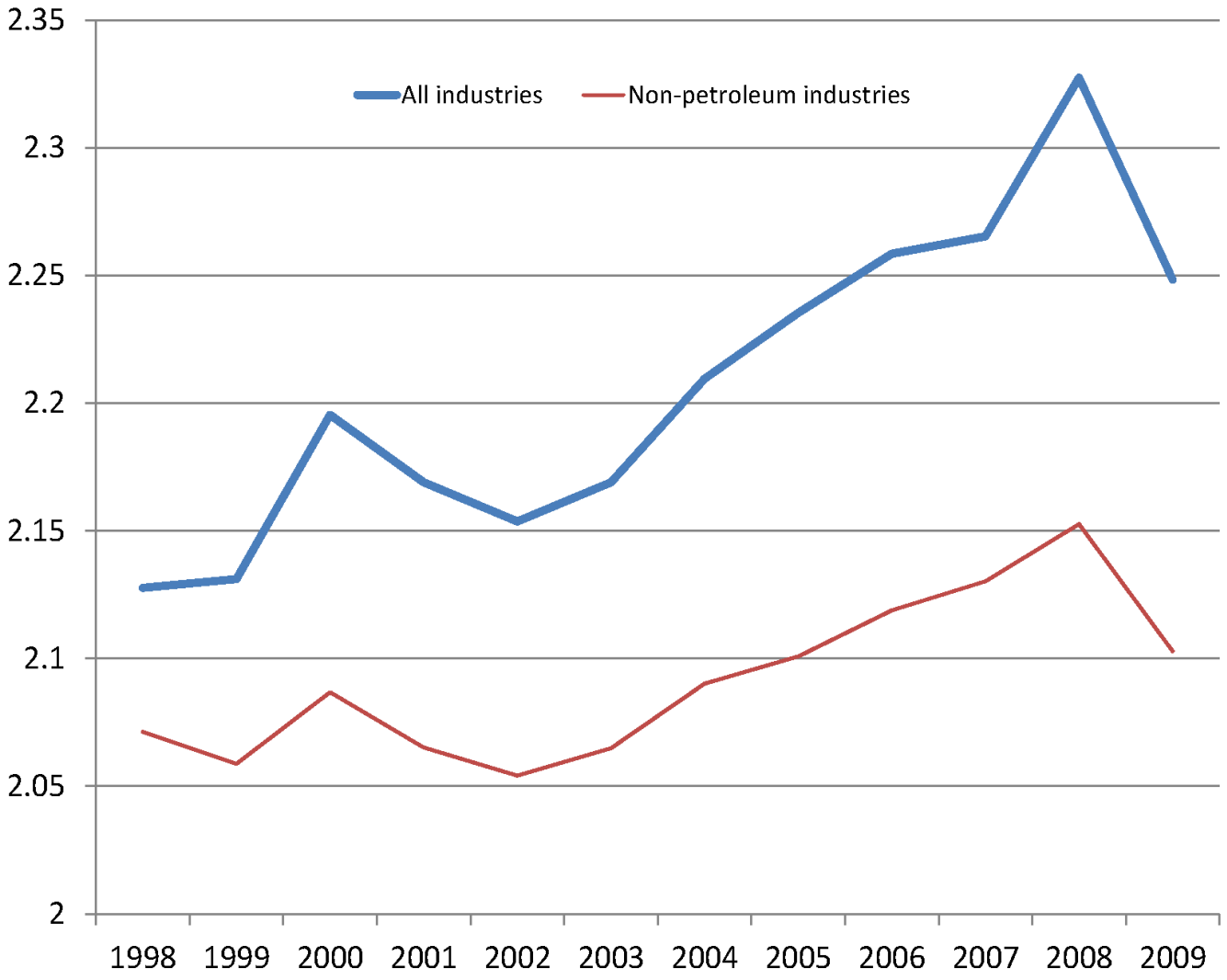


Source: Johnson and Noguera (2012b)

Quantifying Global Production Sharing: Alternatives

- Yeats (2001) suggests computing the share of trade flows accounted for by industry categories that can be safely assumed to contain *only* intermediate inputs
  - as reflected by the use of the word "Parts of" at the beginning of their SITC Rev.2 category description
  - these categories accounted for about 30% of OECD merchandise exports of machinery and transport equipment in 1995
  - and this share had steadily increased from 26.1% in 1978
- Caveat: using his methodology, one finds little evidence of a further increase in this share since 1995
- Antràs et al. (2012) develop a more continuous measure of the "upstreamness" of the goods being traded
  - weighted index of the average position in the value chain at which an industry's output is used, as inferred from I-O tables
  - world exports have become more upstream in recent years (before the recent crisis)

Average Upstreamness of World Exports



Source: Own calculations based on Antràs et al. (2012) and BACI data on world exports

Old and New Theories

- First wave of work: fragmentation in otherwise neoclassical models
  - Feenstra and Hanson (1996), Jones (2000), Deardorff (2001), Grossman and Rossi-Hansberg (2008)
- Common theme: fragmentation generates nontrivial effects on productivity
  - novel predictions for the effects of reductions in trade costs on patterns of specialization and factor prices
- Insightful body of work, but in my view, misses (at least) two important characteristics of intermediate input trade

Some Limitations of Neoclassical Models of Fragmentation

1. Parts and components are frequently customized to the needs of their intended buyers (iPad 3 example)
   - growth of trade in *differentiated* (rather than homogeneous) intermediate inputs
2. Global production networks necessarily entail intensive *contracting* between parties located in different countries and thus subject to distinct legal systems
   - in a world with perfect (or complete) contracting across borders, this of course would be of little relevance
   - real-world commercial contracts are incomplete: they cannot possibly specify a course of action for *any* contingency that could arise during the course of a business relationship

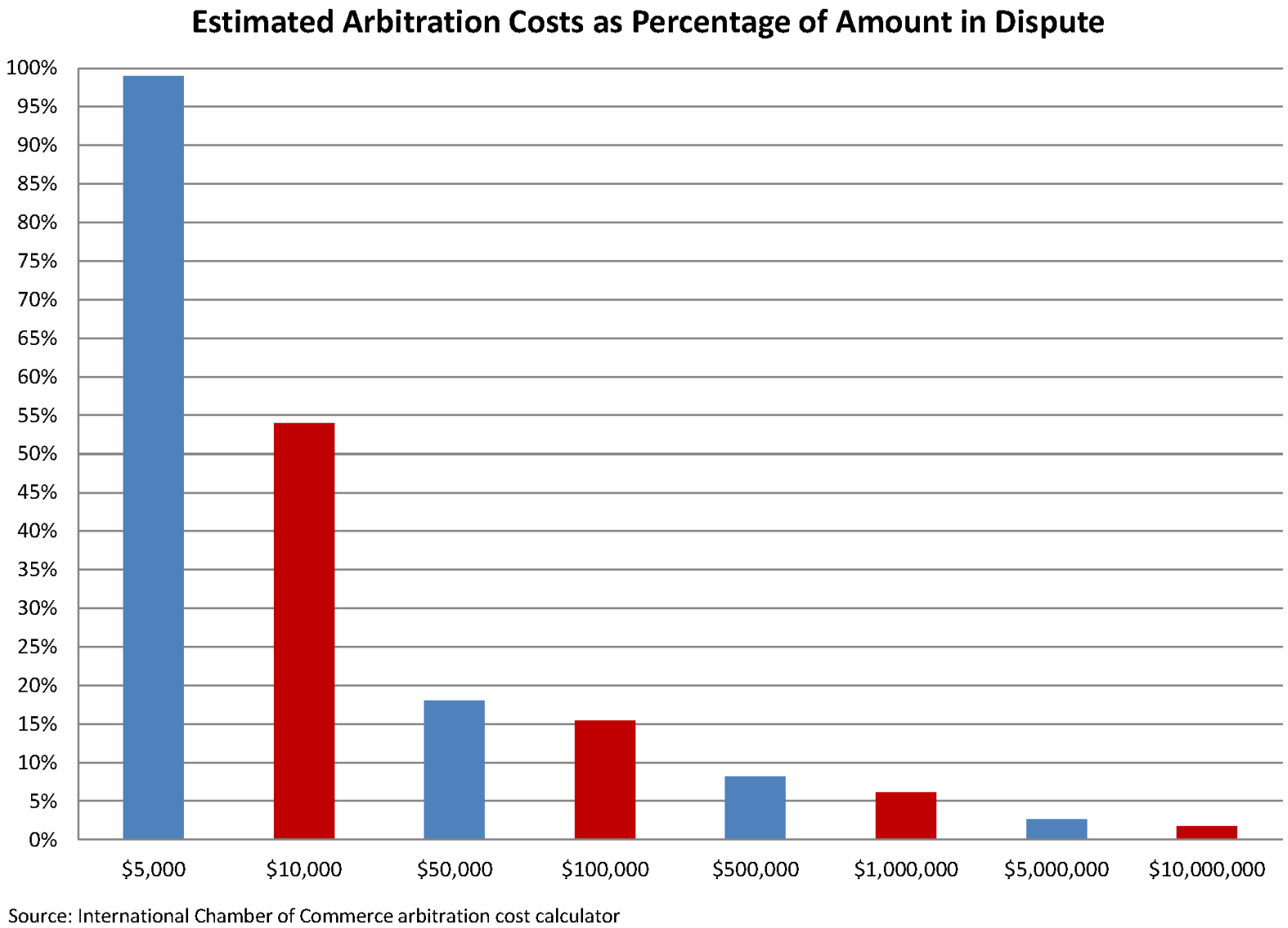
Contract Difficulties in International Trade

- Contract disputes in international trade: which country's laws apply?
  - *choice-of-law* clause is not often included and, when it is included, adjudicating courts may not uphold it
- Local courts may be unwilling to enforce a contract signed between residents of two different countries
  - particularly, if unfavorable outcome for local residents
- Complication with enforcement of remedies stipulated in verdicts
  - what if the party having to pay damages does not have any assets in the court's country?
- Detrimental effects of imperfect contract enforcement are particularly acute for transactions involving intermediate inputs
  - longer time lags between order and delivery
  - more relationship-specific investments and other sources of lock-in

Attempts to Reduce Contractual Insecurity

1. United Nations Convention on Contracts for the International Sale of Goods (CISG) or Vienna Convention
   - uniform rules to govern contracts for the international sale of goods
   - but...
     - several countries (e.g., Brazil, India, the UK) have yet to sign it
     - other countries do not apply certain parts of the agreement
     - private parties can opt out of it via Article 6
2. Use of International Arbitration (e.g., Int'l Chamber of Commerce)
   - can be invoked via a *forum-of-law* clause in a contract
   - appealing because
     - lower uncertainty as to which law will be applied
     - arbitrators tend to have more commercial expertise and rule faster
     - arbitration rulings are confidential and are generally perceived to be more enforceable (New York Convention)
   - But international arbitration is rarely used because it is **very costly**

International Arbitration Costs



Attempts to Reduce Contractual Insecurity

3. Resort to implicit contracting to sustain 'cooperation'
   - implicit contracts may be harder to sustain due to limited repeated interactions (e.g., exchange rate shocks)
   - collective or community enforcement hampered by long distance and differences in cultural and societal values

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

Firm Responses to Contractual Insecurity

- Two key organizational decisions of firms:

1. *Location* of different stages in the value chain
   - R&D and product development, parts and components production, assembly, and so on
2. Extent of *control* that firms exert over these different production stages
   - should these production stages be kept within firm boundaries or should they be contracted out to suppliers or assemblers

- Neoclassical models of fragmentation are all about location
  - firms fragment to achieve unit cost reductions (thanks to differences in relative factor endowments or technologies across countries)
  - but these models have **nothing** to say about control or the firm boundary decision

The Firm Boundary Decision under Complete Contracts

- Neoclassical models assume complete contracting, which makes the concept of control 'vacuous'
- Indeed, if firms could foresee all possible future contingencies...
- ... and if they could costlessly write contracts that specify in an enforceable manner the course of action to be taken in all of these possible contingencies...
- then firms would no longer need to worry about 'controlling' the workers, internal divisions and supplying firms with whom they interact in production
- Real world: contracts are very much incomplete and firms spend a substantial amount of time and resources figuring out the best possible way to organize production in the global economy

The Firm Boundary Decision under Incomplete Contracts

- Firms contemplating doing business in a country with weak contracting institutions might decide to do so within firm boundaries to have more 'control'
  - either by setting up a new, wholly- or partially-owned affiliate or by acquiring a controlling stake in an existing firm in that country
- But lack of contract enforceability might also turn firms to independent suppliers
  - because such an arrangement might elicit the best performance from the foreign plant producing the parts
- Important theme of these lectures: internalization is a **double-edged sword**
  - it may partly protect the integrating party from the vagaries of international contracting...
  - but it might dilute the integrated party's incentives to produce efficiently

Studying the Firm Boundary Decision

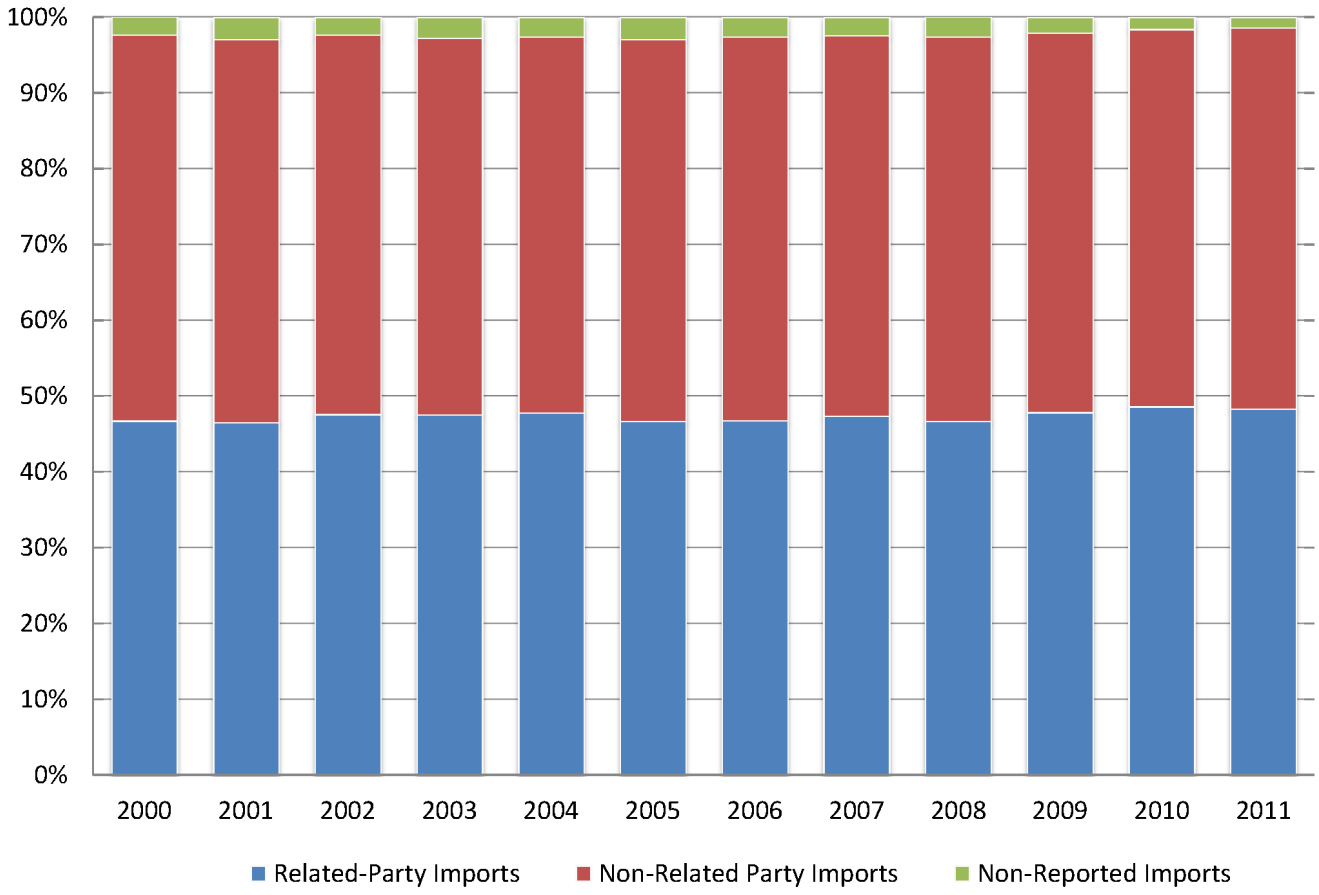
- In these lectures, I will argue that much can be learned from a theoretical and empirical study of the **fundamental** forces that shape this decision (regardless of sector or firm)
- Some might react skeptically to the idea that low-dimensional models can capture complex and idiosyncratic decisions of firms in the world economy
- Belief compounded by the fact that:
  - comprehensive datasets on the integration decisions of firms are not available
  - business school cases often highlight the peculiarities of particular organizational decisions
  - formal empirical studies of firm boundaries rely on data from specific industries or firms (see, Baker and Hubbard, 2003, for instance)

A Comparative Advantage of Trade Statistics

- Data on international transactions are particularly accessible (official records of goods and services crossing borders)
  - e.g., data on U.S. imports from all countries of the world at the remarkably detailed ten-digit Harmonized Tariff Schedule classification system, which consists of around 17,000 categories
- Some of these same detailed country- and product-level data also contain information on the extent to which trade flows involve related parties or non-related parties
- U.S. Related Party Trade database contains information on U.S. intrafirm imports and exports for all countries at the six-digit Harmonized System (HS) classification (which consists of over 5,000 categories)
  - so hundreds of thousands of observations *per year* on the relative prevalence of integration across products and countries

Some Features of the U.S. Intrafirm Trade Data

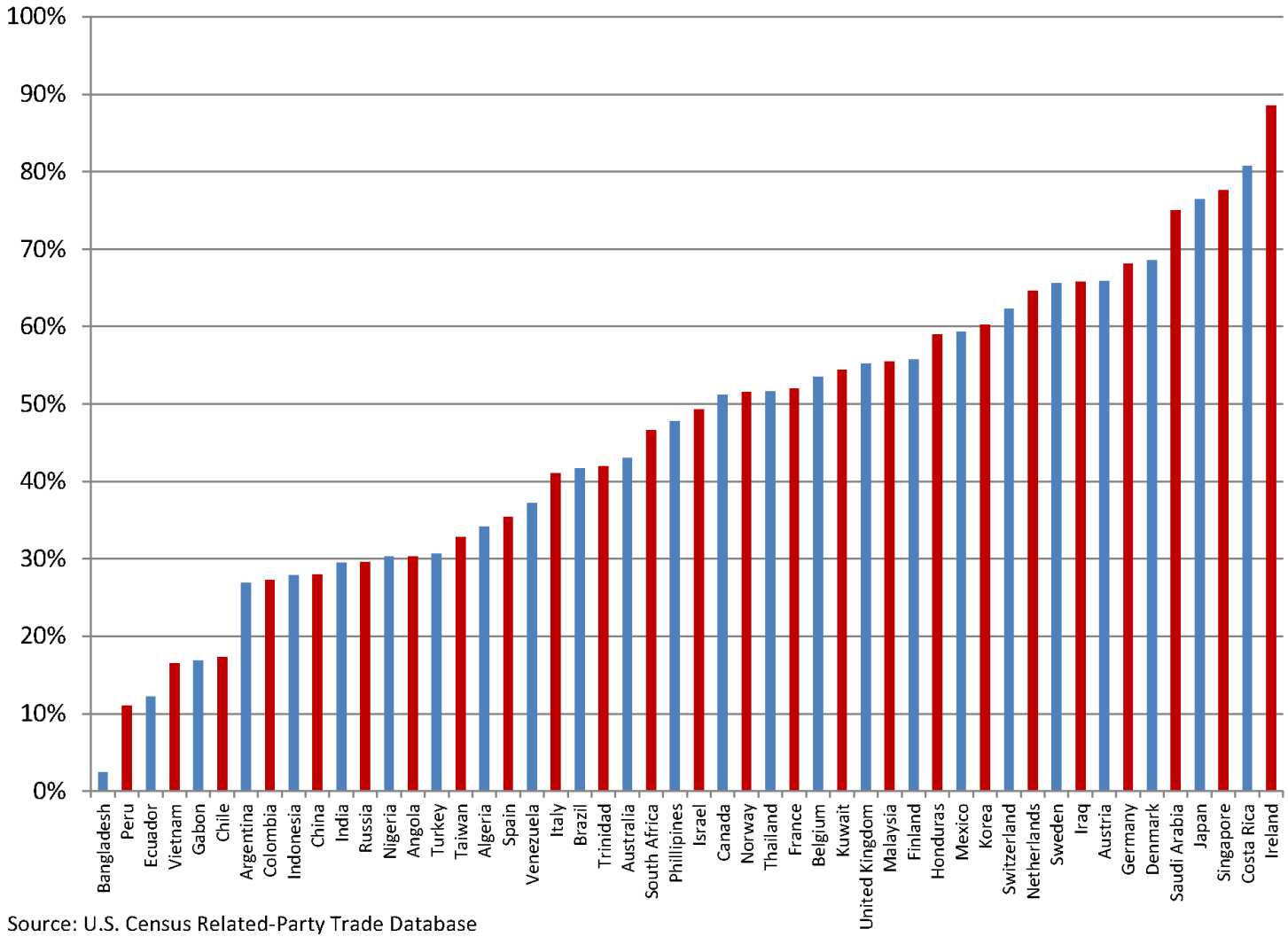
1. Intrafirm transactions are remarkably **prevalent** in U.S. trade (close to 50% of imports and around 30% of exports)



Source: U.S. Census Related-Party Trade Database

Some Features of the U.S. Intrafirm Trade Data

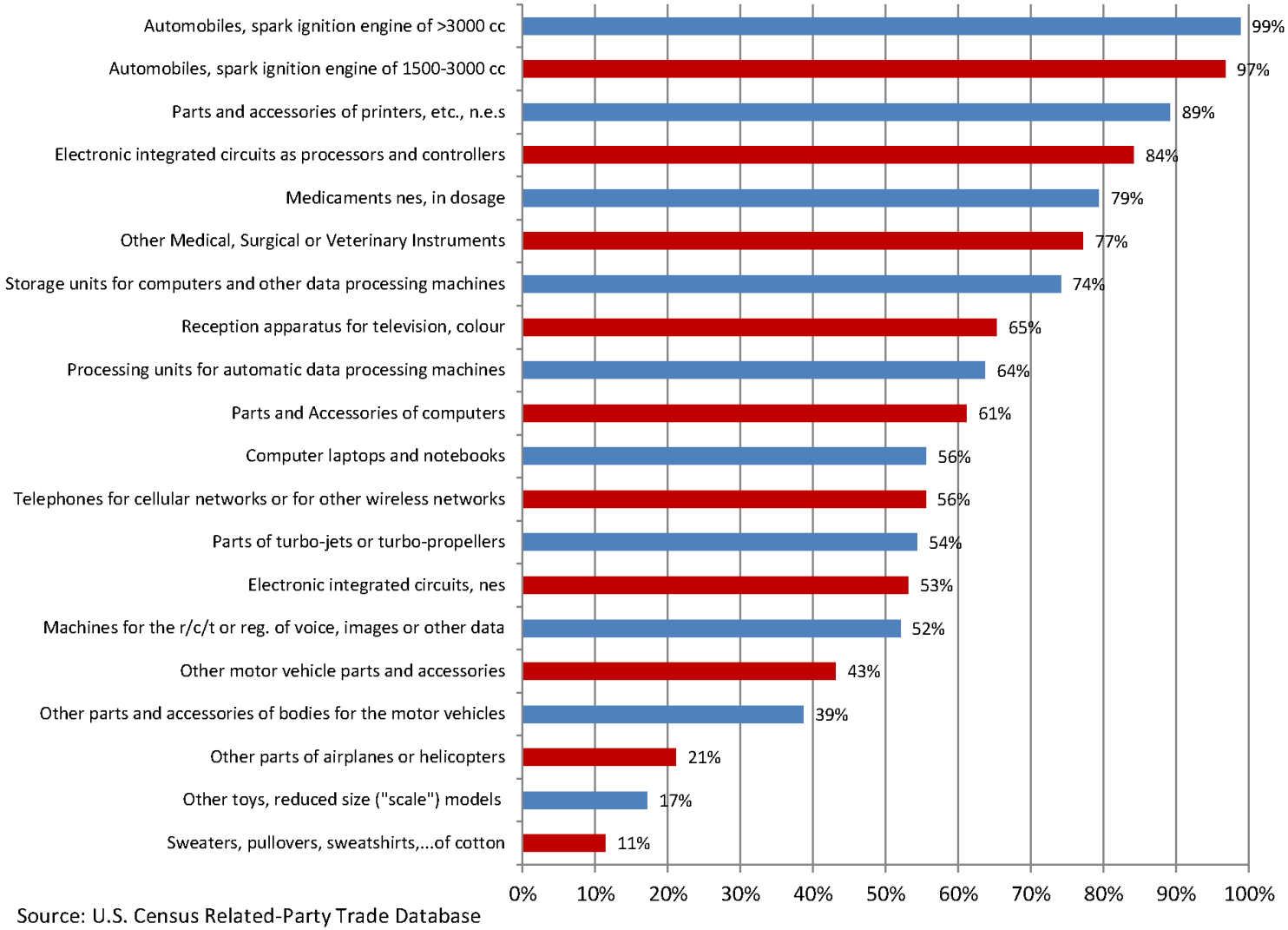
2. The share of U.S. intrafirm imports varies widely across countries



Source: U.S. Census Related-Party Trade Database

Some Features of the U.S. Intrafirm Trade Data

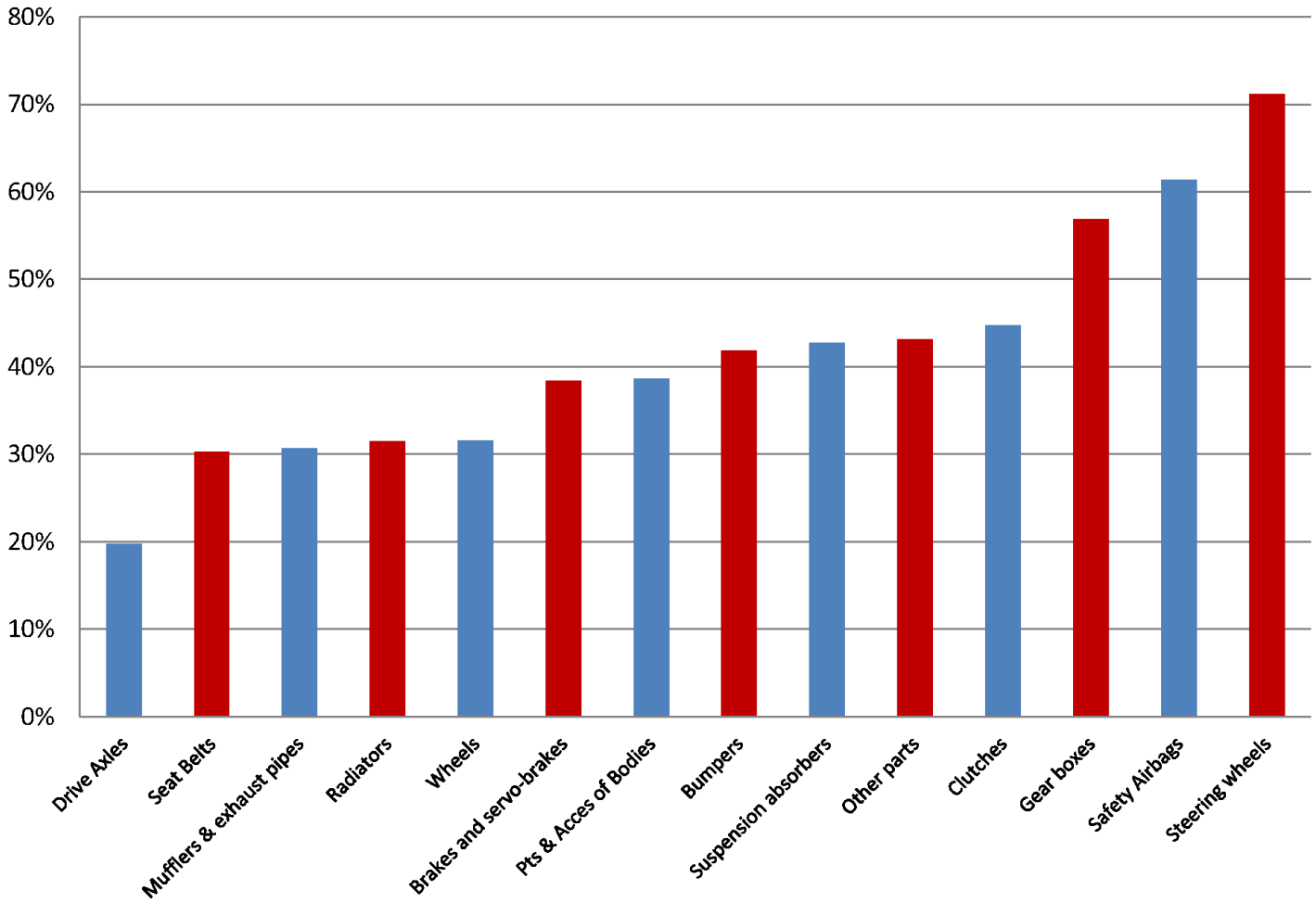
3. The share of U.S. intrafirm imports varies widely *across* sectors



Source: U.S. Census Related-Party Trade Database

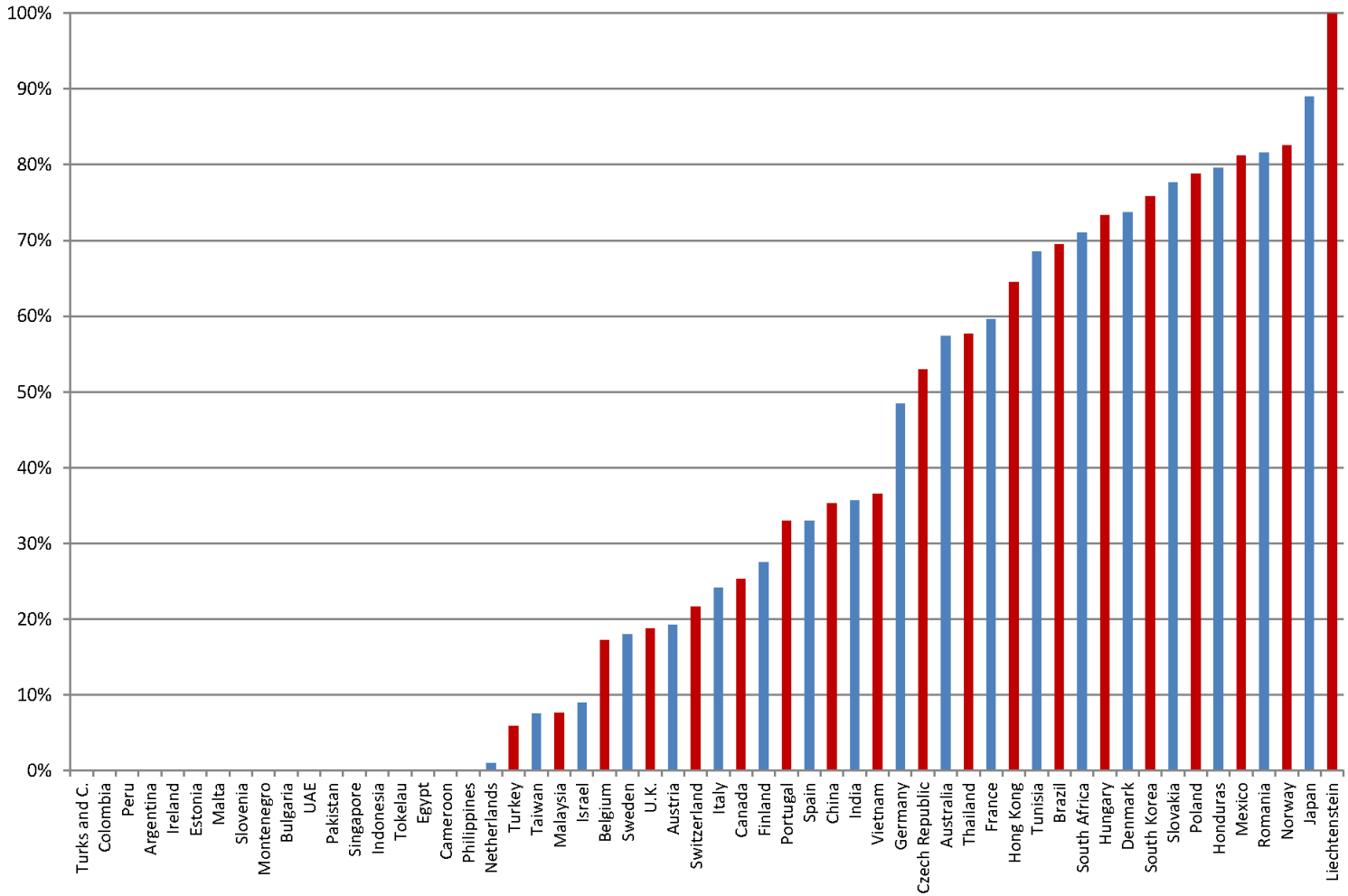
Some Features of the U.S. Intrafirm Trade Data

4. The share of U.S. intrafirm imports varies widely *within* sectors, say Auto Parts (NAICS 8708)



Some Features of the U.S. Intrafirm Trade Data

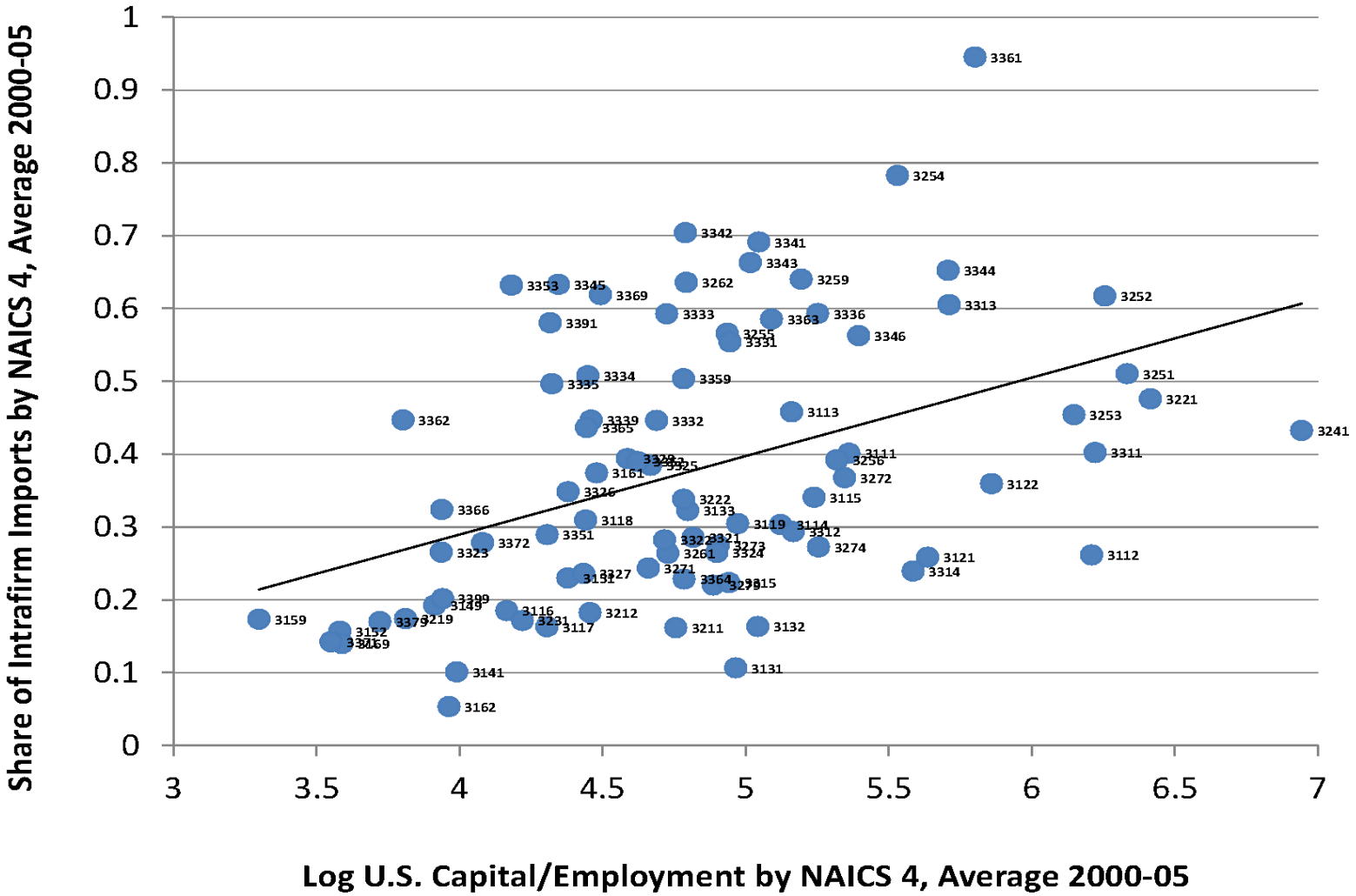
5. The share of U.S. intrafirm imports varies widely across countries within narrowly defined sectors, say Steering Wheels (NAICS 870894)



Is This Variation Random?

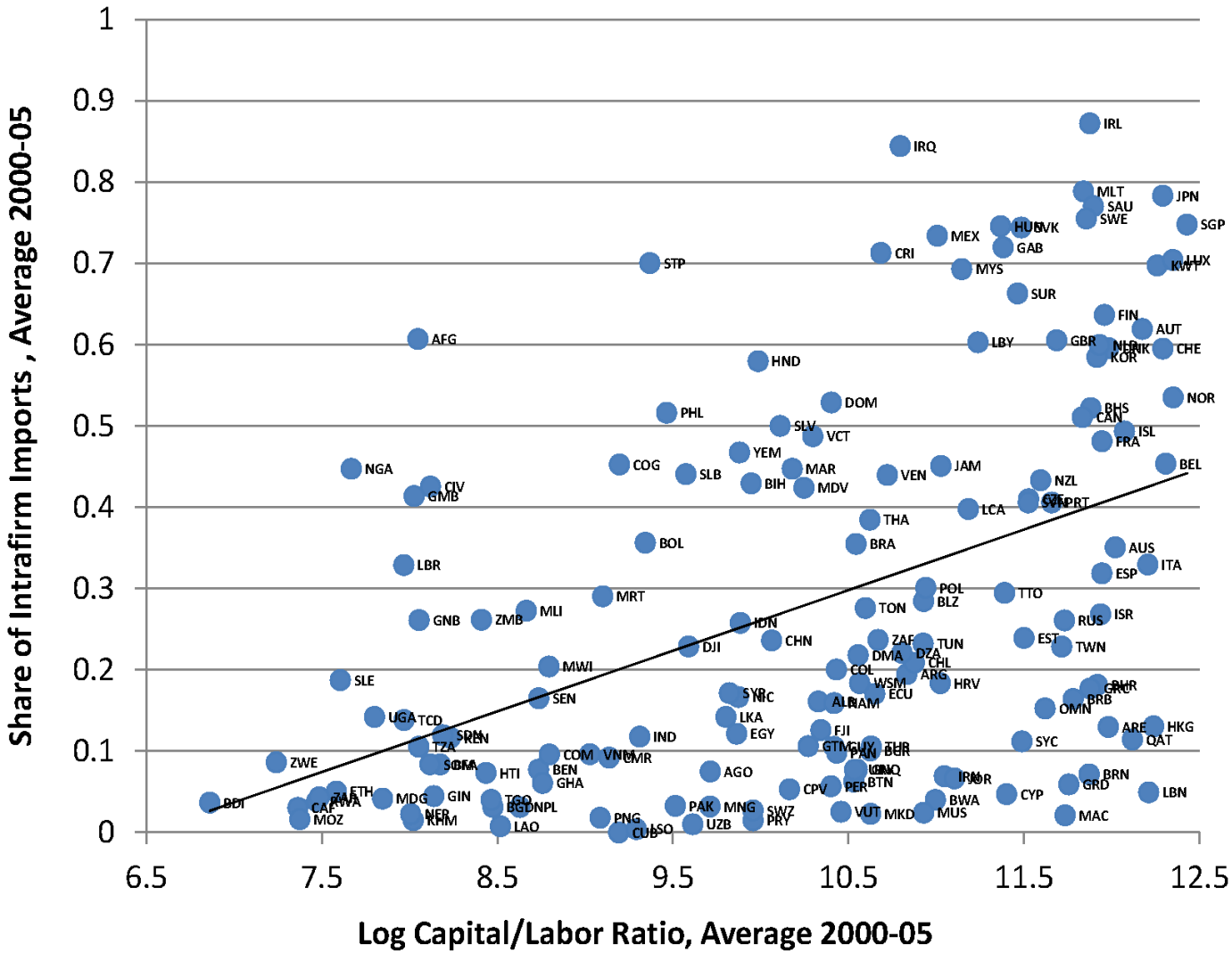
- Large variation might seem to validate the skeptics' view that the decision to integrate foreign production processes is largely driven by idiosyncratic factors
- But if that were the case, we would also expect this variation to be uncorrelated with simple industry or country-level variables
- The evidence, however, suggests otherwise

Intrafirm Trade and Capital Intensity



Sources: U.S. Census Related-Party Trade Database and NBER-CES Manufacturing Industry Database

Intrafirm Trade and Capital Abundance



Sources: U.S. Census Related-Party Trade Database and Penn World Tables (using perpetual inventory method of Caselli, 2005)

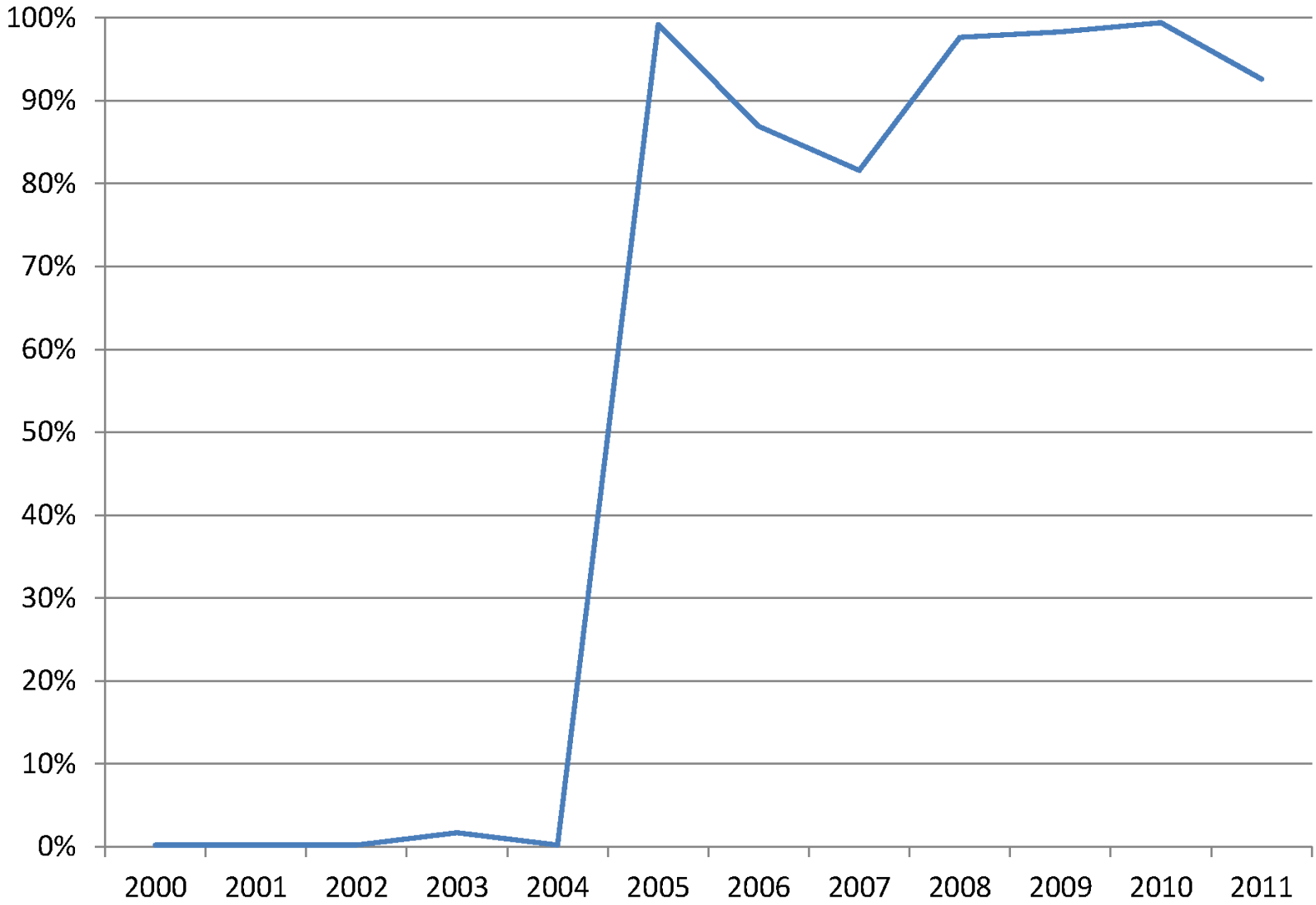
Some Concerns with U.S. Intrafirm Trade Data

1. Related-party: "any person directly or indirectly, owning, controlling or holding power to vote, 6 percent of the outstanding voting stock or shares of any organization."
   - Natural concern: 6 percent threshold might be too low for that 'relatedness' to have any significant economic meaning
   - But intrafirm trade is generally associated with one of the entities having a **majority-ownership** stake in the other entity (around 95% as indicated by BEA data)
2. Overall quality of the data: importers and exporters not always report that information in their shipment documents
   - but this only accounts for 1-2% of U.S. imports (see Figure above)
   - still room for non-sampling errors (e.g., imputed values for undocumented shipments)
   - but no reason to believe that data are any less reliable than U.S. customs data on trade flows

A Reassuring Example

- 2005: Boston-based Gillette Company completed the construction of a 120 million-euro plant in Łódź (Poland)
  - manufacturing of disposable razors and other shaving products.
- Production was mostly directed to the European market, but some of the products produced in the plant were shipped back to the U.S.
- One would expect that these transactions would naturally occur within firm boundaries
- Do we see any spike in the share of intrafirm trade of NAICS code 332211 (dominated by razors) around 2005?

Gillete's Investment in Poland in 2005

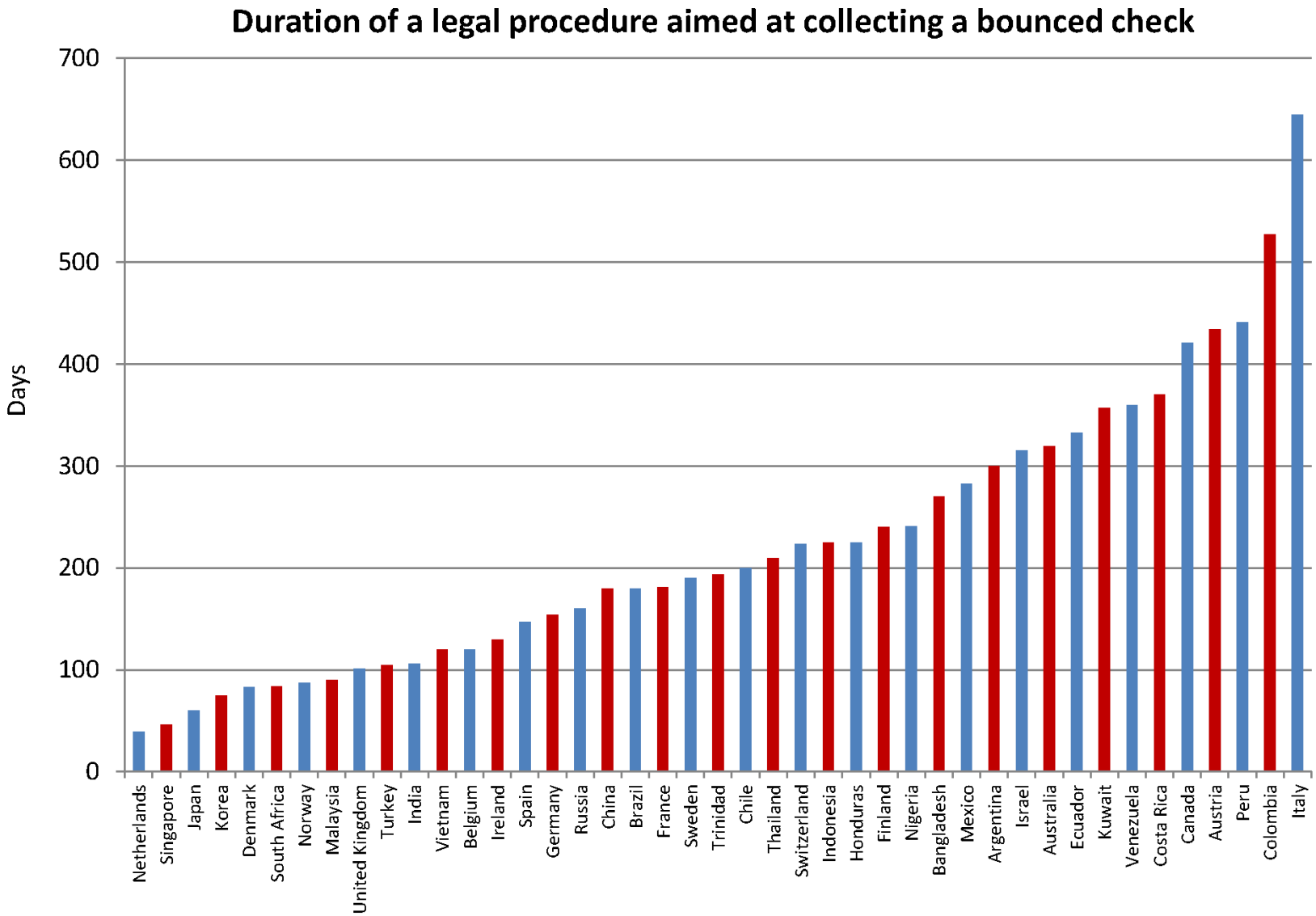


Source: U.S. Census Related-Party Trade Database

Back to the Location Decision

- It is clear that contractual frictions are key to understanding the internalization decisions of firms
- It seems natural that imperfect contracting might also influence firms' geographical location decisions
- Cost-minimizing behavior but **effective costs** of doing international business are not solely explained by the factors highlighted by neoclassical theory
- Unappealing to offshore in:
  - low-wage countries where suppliers are unreliable and tend not respect contracts, and where local courts are unlikely to effectively enforce contracts
  - countries in which advanced technologies could be productively deployed (due to complementary factors), but in which the contractual environment might not provide enough security to firms

Heterogeneity in Contracting Environments



Source: Djankov et al. (2003)

A Brief Road Map

1. Overview of Complete-Contracting Benchmark Models
2. Contractual Frictions and the Location of Production
    1. Contracting Institutions and Trade Flows (Briefly)
    2. Contracting Institutions and Global Sourcing Strategies
3. Contractual Frictions and the Internalization Decision

Neoclassical Trade Theory (1817-today)

- Insightful models that still constitute the core of what we teach undergrads
- **Key Assumptions:** constant returns to scale, perfect competition, homogeneous goods and factors
- **Key Results:** cross-country differences (technology, endowments) drive trade ; emphasis on intersectoral trade flows; robust factor content predictions
- Useful tool to analyze certain aspects of fragmentation...
- ... but of limited use when studying firm-level issues in international trade

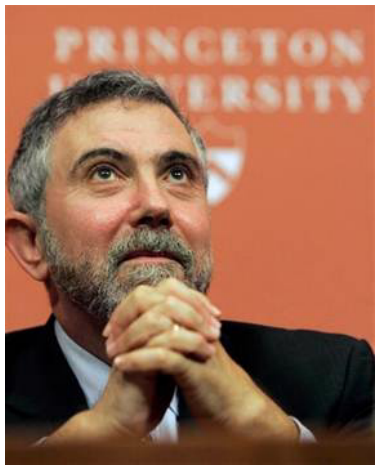
New Trade Theory (1979-today)

- First true revolution in the field, begins with Krugman (1979) and culminates with Helpman and Krugman (1985)
- **Key Assumptions:** increasing returns to scale, imperfect competition, product differentiation
- **Key Results:** intraindustry specialization and intraindustry trade flows; helps explain large volumes of trade between similar countries
- Preference, technology and market structure pin down size of the firm/plant...
- ... but all firms within a sector are treated symmetrically, so not great models for firm-level approaches to trade
- Furthermore: most New Trade Theory models make strong assumptions
  - on preferences (symmetric Dixit-Stiglitz CES aggregators)
  - on technology (positive fixed cost and common constant marginal cost)
  - on market structure (industries feature a continuum of firms with market power)

Wisdom After the Fact

"There is no good reason to believe that the assumptions of the Dixit-Stiglitz model – a continuum of goods that enter symmetrically into demand, with the same cost functions, and with the elasticity of substitution between any two goods both constant and the same for any pair you choose – are remotely true in reality."

Paul Krugman, Nobel Lecture 2008



'New New' Trade Theory

- Second true revolution in the field, begins with Melitz (2003) and culminates with ....
- Motivated by firm-level empirical facts inconsistent with New Trade Theory models
  - Firms appear to be heterogeneous in productivity, factor inputs, and trade behavior
  - Only a small fraction of firms export
  - Most exporting firms sell only to few markets
  - Extensive margin of trade plays a significant role in shaping cross-sectional variation in aggregate exports
  - Exporters appear to be systematically different from non-exporters: larger, more productive, more skill intensive
  - Trade liberalization leads to market share reallocations towards more productive firms, thereby increasing aggregate productivity

'New New' Trade Theory

- **Key Assumptions:** same as New Trade Theory plus heterogeneity in (revenue-based) productivity across firms; fixed/sunk costs of exporting
- **Key Results:** able to account for firm-level facts and delivers interesting predictions for the importance of extensive margin for aggregate trade flows
- Benchmark models use strong functional form assumptions - no 'Helpman-Krugman (1985)'-equivalent yet (it's hard!)
- I will put a lot of structure on the models too, but will attempt to discuss how results (might) generalize
- Functional forms deliver qualitative and quantitative predictions of the model that line up well with data

A Multi-Sector Melitz Model

- The world consists of J countries that produce goods in $M+1$ sectors using a unique (composite) factor of production, labor
- One sector produces a homogenous good z, while the remaining M sectors produce a continuum of differentiated products
- Preferences are identical everywhere in the world and given by:

$$U = \beta_z \log z + \sum_{m=1}^{M} \beta_m \log Q_m, \tag{1}$$

with $\beta_z + \sum_{m=1}^{M} \beta_m = 1$ and

$$Q_m = \left(\int_{\omega \in \Omega_m} q_m(\omega)^{(\sigma_m - 1)/\sigma_m} d\omega \right)^{(\sigma_m/\sigma_m - 1)}, \quad \sigma > 1. \tag{2}$$

- Strict generalization of Krugman (1980) and Melitz (2003), where $\beta_z = 0$

Discussion

- We have already built in a few specific assumptions
  - Cobb-Douglas across sectors (will faciliate sector-by-sector analysis, so I will omit m subscripts below)
  - Constant-Elasticity-of-Substitution aggregator (convenient but not crucial)
  - Symmetry across varieties (easily relaxed)
  - Continuum of varieties (avoids complications from strategic interactions)
- Also, although the model features some dynamics, we will focus on stationary equilibria (so drop time subscripts)

Demand

- Given (1) and (2), the demand for variety ω in industry m (subscripted omitted) in country j is given by

$$q_j(\omega) = \frac{\beta w_j L_j}{P_j} \left(\frac{p_j(\omega)}{P_j} \right)^{-\sigma} \tag{3}$$

where $p_j(\omega)$ is the price of this variety and

$$P_j = \left[\int_{\omega \in \Omega_j} p_j(\omega)^{1-\sigma} d\omega \right]^{1/(1-\sigma)} \tag{4}$$

and Ω_j is the set of varieties available to consumers in j.

Technology

- The homogenous good is produced using labor according to a constant-returns-to-scale technology, $z_i = L_z / a_{zi}$, in country i
- The differentiated-good industries are monopolistically competitive
- Each variety is produced by a single firm under a technology featuring increasing returns to scale
- Firms in country i first need to incur an entry cost $f_{ei} w_i$
- Production of final-good varieties for the domestic market then involves an increasing returns to scale technology characterized by the following total cost function

$$C_i(q) = \left(f_{ii} + \frac{q}{\varphi} \right) w_i,$$

where f_{ii} is an overhead cost (for domestic production), and $1/\varphi$ is the marginal cost in terms of labor

Technology

- The parameters f_{ei} and f_{ii} are assumed to be common for all firms, while φ may vary across firms
- Following Melitz (2003), producers in the differentiated good sector learn their productivity only after incurring the fixed cost of entry
- This productivity level is drawn from a distribution $G(\varphi)$ which is assumed to be Pareto with shape $k > \sigma - 1$, so

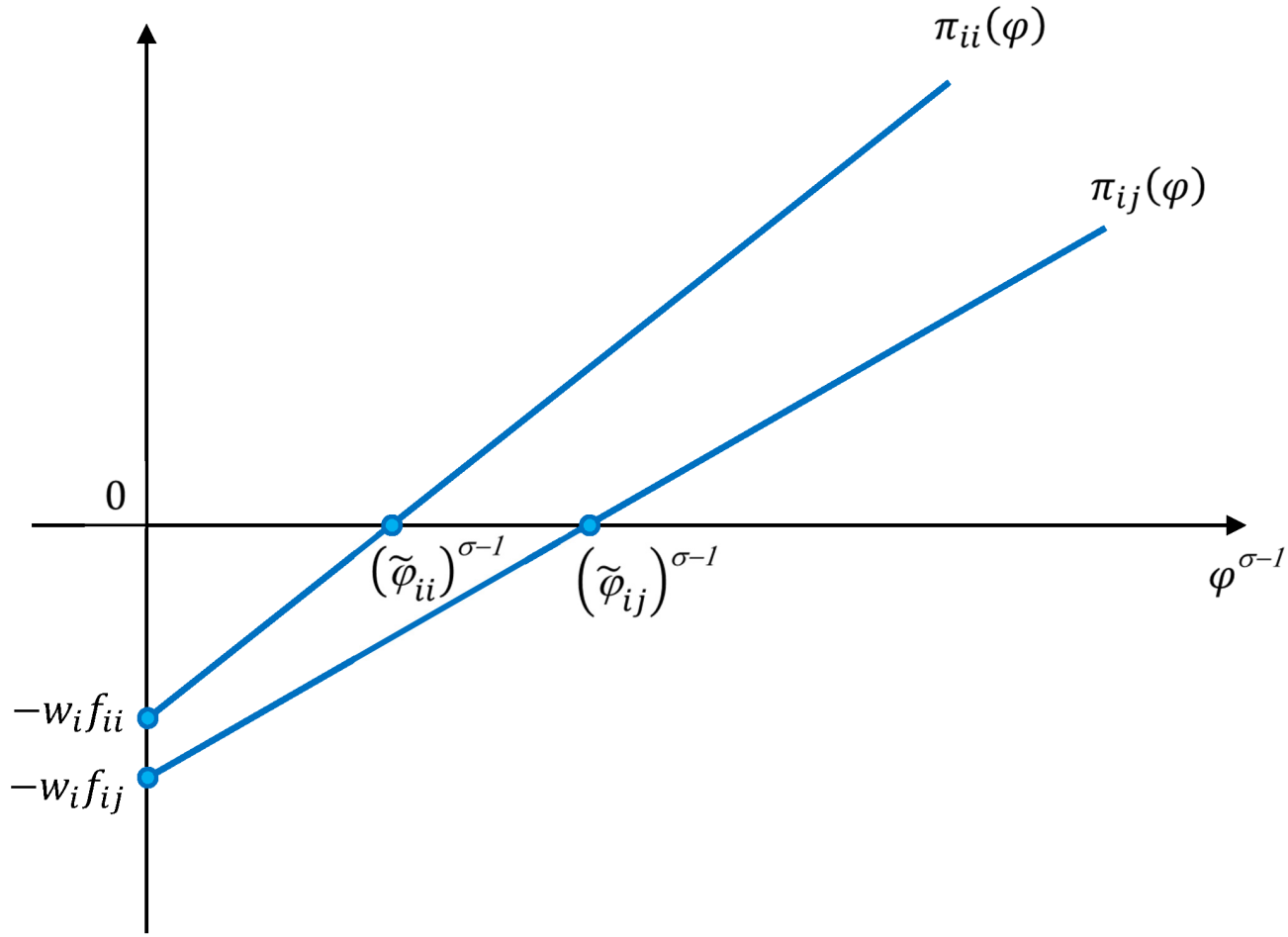
$$G(\varphi) = 1 - \left(\frac{b}{\varphi}\right)^k, \quad \text{for } \varphi \geq b > 0 \tag{5}$$

Costly Trade

- The homogeneous good is freely tradable and is used as the numeraire in the model
- It is very convenient to assume that it is produced everywhere
  - wage w_i in terms of good z is pinned down by productivity in that sector, regardless of labor-market clearing
  - this kills some interesting general-equilibrium effects, so I will relax it at times in the lectures
- If firms want to sell in foreign markets, they need to:
  1. incur an additional fixed cost of $f_{ij} - f_{ii}$ units of labor to start exporting (related to marketing, labeling, building a distribution network,...)
  2. incur an 'iceberg' trade cost such that τ_{ij} units of the good need to be shipped from i to j for 1 unit to make it to any foreign country (let $\tau_{ii} = 1$)
     - isomorphic to an ad valorem tariff, except for tariff revenue

A First Key Result: Selection into Exporting

- Within an industry, only a subset of firms from i (those with $\varphi \geq \varphi_{ij}$) will be able to profitably sell in country j



A First Key Result: Discussion

- The fact that the operating profit curves are linear follows from the fact that preferences are CES and the marginal cost is constant, so that prices are a constant markup over marginal cost, since

$$\pi_{ij}(\varphi) = \left[p_{ij}(\varphi) - \frac{\tau_{ij} w_i}{\varphi}\right] q(\varphi) - w_i f_{ij}$$

simplifies to

$$\pi_{ij}(\varphi) = (\tau_{ij} w_i)^{1-\sigma} B_j \varphi^{\sigma-1} - w_i f_{ij}$$

where

$$B_j = \frac{1}{\sigma}\left(\frac{\sigma}{(\sigma-1) P_j}\right)^{1-\sigma} \beta w_j L_j$$

- Exporters will appear to be relatively more productive (or more profitable) provided that differences in the B's don't undo the sorting generated by $\tau_{ij} > 1$ and $f_{ij} > f_{ii}$

Other Important Results (But Less So For These Lectures)

1. When aggregating over firm-level exports, the model delivers a gravity equation for bilateral trade flows
2. Variation in aggregate bilateral exports is shaped by both an intensive margin but also an **extensive margin**
   - nontrivial implications for elasticity of trade flows with respect to trade frictions (see, Chaney, 2008)
   - zeros in bilateral trade flows can easily be explained and corrected for (see, Helpman, Melitz and Rubinstein, 2009)
3. Reductions in trade frictions also affect firm survival (or the set of productivity levels φ for which $\pi_{ii}(\varphi) > 0$):
   - this is most elegantly derived in Melitz (2003), where no parametric assumptions on $G(\varphi)$ are imposed
   - this has implications for endogenous changes in industry-level aggregate productivity as a result of trade liberalization

Global Sourcing: General Structure

- Production of differentiated varieties now involves two stages, **headquarter services** and **plant production or assembly**, and these can be geographically separated
- For simplicity, headquarter services need to be produced in the same country in which the entry cost f_{ei} was incurred
- Key new firm-level decision is then whether to maintain plant production in the same country in which entry and headquarter service provision take place, or whether to offshore that stage
- Why would firms want to offshore manufacturing/assembly?
  - intensive use of a relatively abundant local factor (e.g., labor intensive manufacturing in relatively labor abundant countries)
  - productivity-based comparative advantage (**focus mostly on this**)
- Why would firms not want to always offshore?
  - comparative advantage of domestic economy in some production processes
  - additional fixed and variable costs associated with fragmentation

Global Sourcing: Specific Assumptions

- We maintain all the assumptions made above with the following simplifications:
  - assume there are only two countries: North and South
  - there are no costs, fixed or variable, of exporting final goods so as to isolate new elements here
  - good z is produced in both countries but with a higher labor productivity in the North, so $w^N = 1/a_{zN} > 1/a_{zS} = w^S$
  - the fixed costs of entry are prohibitively large in South so all entry occurs in the North
  - similarly, headquarter services are always produced in the North
  - plant production can be done with the same physical productivity in both North and South, so South has comparative advantage
  - as before, producers are heterogeneous in their productivity $\varphi \sim G(\varphi)$ in (5)

Global Sourcing: Specific Assumptions

- On the technology side, assume for simplicity that the total cost of production is given by

$$C_D(q,\varphi) = \left(f_D + \frac{q}{\varphi}\right) w_N,$$

in the absence of offshoring (i.e., with *D*omestic sourcing).

- With *O*ffshoring, we have

$$C_O(q,\varphi) = f_O w_N + \frac{q}{\varphi}(w_N)^{\eta}(\tau w_S)^{1-\eta},$$

where $f_O > f_D$ and $\tau > 1$, reflecting fixed and variable costs of offshoring

Global Sourcing: Specific Assumptions

- This amounts to assuming that production combines headquarter services h and manufacturing m according to

$$q(\varphi) = \varphi \left(\frac{h(\omega)}{\eta} \right)^{\eta} \left(\frac{m(\omega)}{1-\eta} \right)^{1-\eta}, \quad 0 < \eta < 1$$

- $m(\omega)$ produced one-to-one with labor
- $h(\omega)$ produced one-to-one with labor in North; prohibitive cost in South
- Sectors may vary in the intensity with which headquarter services are used, as captured by η
- Within sectors, firms differ in productivity φ

Heterogeneity: Choice of Location

- Profit levels of each firm alternative (no offshoring vs. offshoring) continue to be linear in $\varphi^{\sigma-1}$:

$$\pi_D(\varphi) = (w_N)^{1-\sigma} B \varphi^{\sigma-1} - w_N f_D$$

and

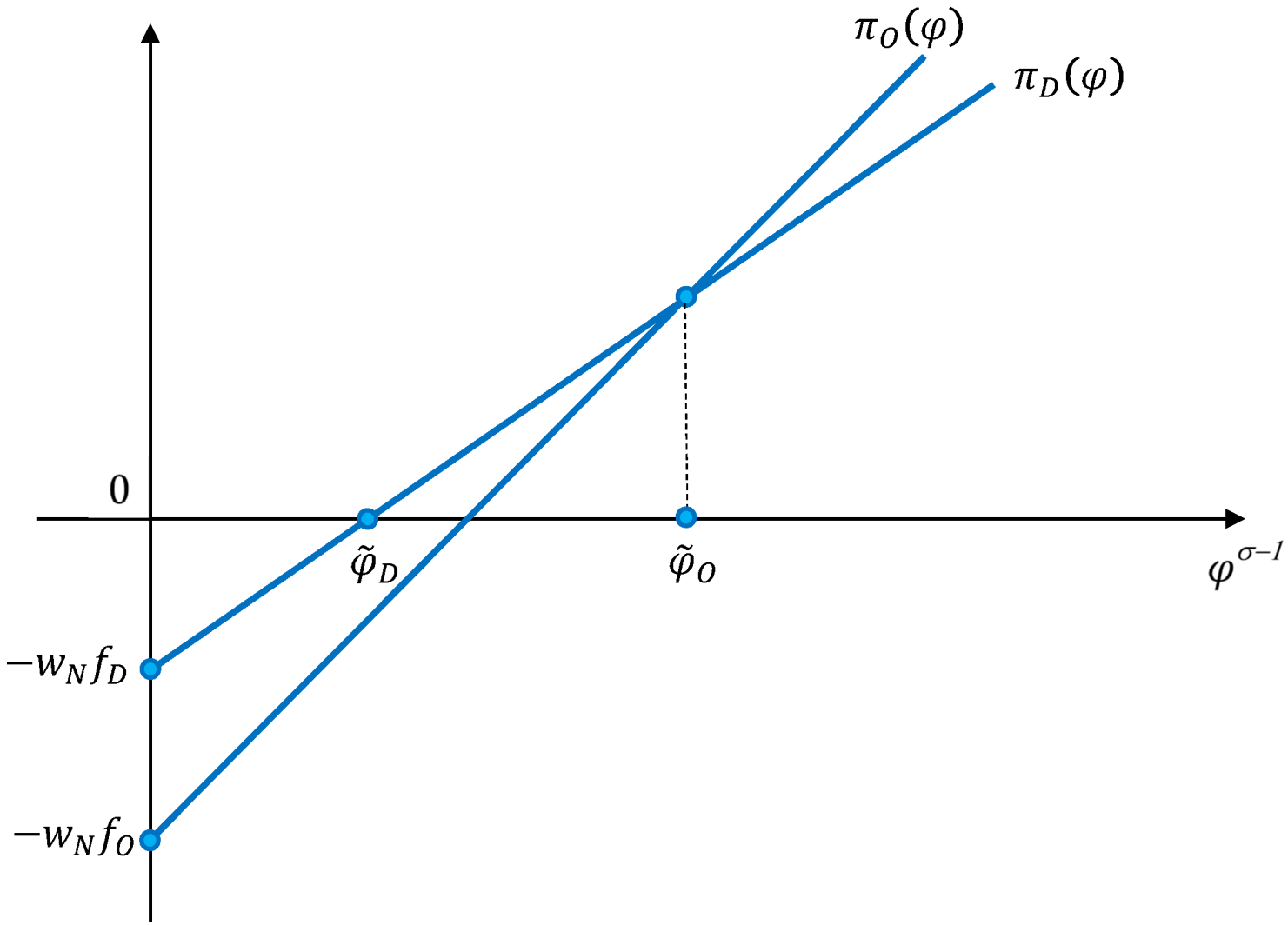
$$\pi_O(\varphi) = \left((w_N)^{\eta} (\tau w_S)^{1-\eta}\right)^{1-\sigma} B \varphi^{\sigma-1} - w_N f_O$$

- Note

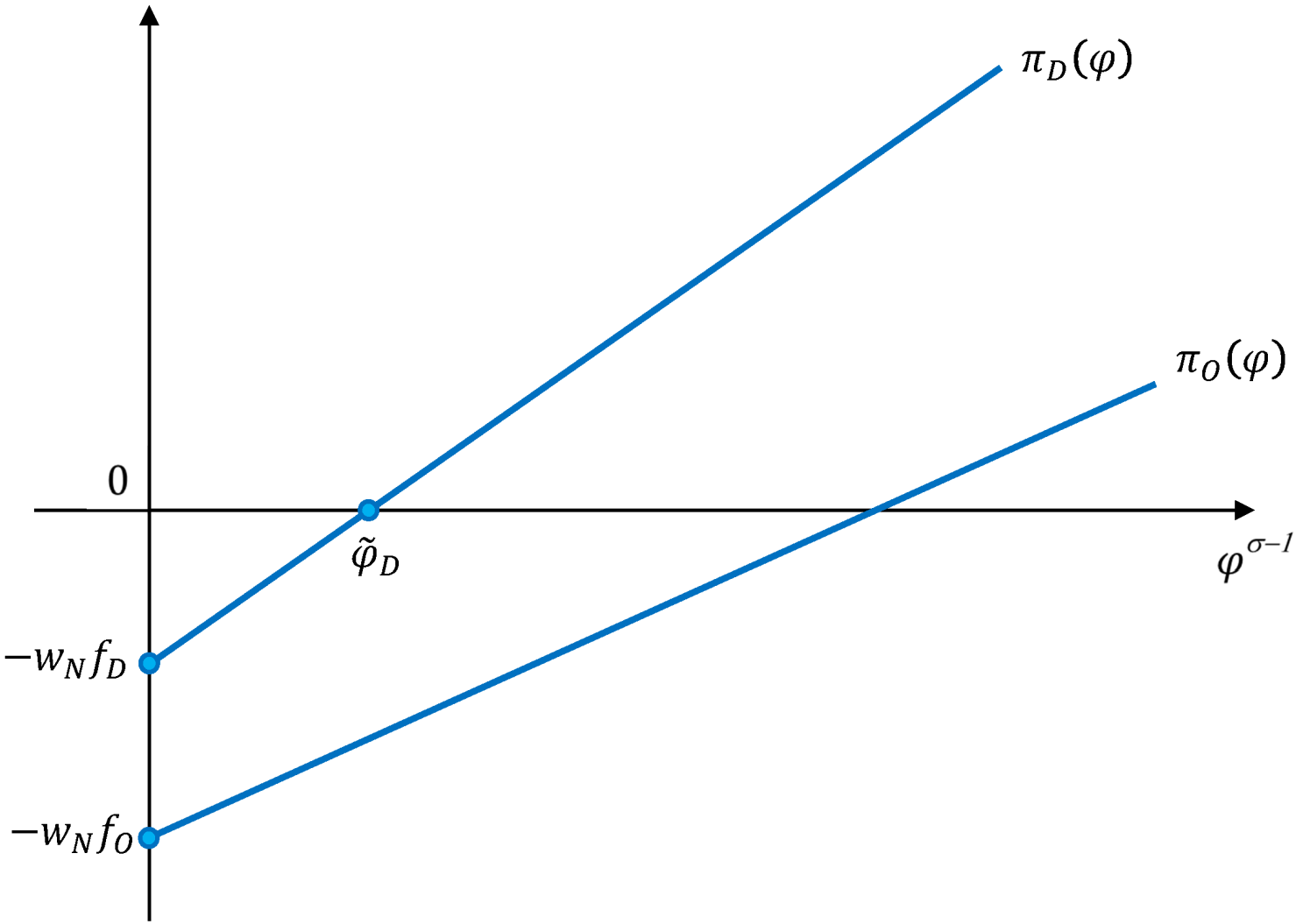
$$B = \frac{1}{\sigma}\left(\frac{\sigma}{(\sigma-1)P}\right)^{1-\sigma} \beta \left(w_N L_N + w_S L_S\right)$$

and P is the common price index in (4) in each country, given costless final-good trade

Equilibrium Sorting



Equilibrium Sorting with Low Wage Differences



Some Implications

- There exists selection into importing, as documented by Bernard et al. (2009, NBER book)

Trading Premia in U.S. Manufacturing, 1997

	(1) Exporter premia	*(2) Importer premia*	*(3) Exporter & importer premia*
Log employment	1.50	1.40	1.75
Log shipments	0.29	0.26	0.31
Log value-added per worker	0.23	0.23	0.25
Log TFP	0.07	0.12	0.07
Log wage	0.29	0.23	0.33
Log capital per worker	0.17	0.13	0.20
Log skill per worker	0.04	0.06	0.03

Sources: Data are for 1997 and are for firms that appear in both the U.S. Census of Manufacturers and the Linked-Longitudinal Firm Trade Transaction Database (LFTTD).
Notes: All results are from bivariate ordinary least squares regressions of the firm characteristic listed on the left on a dummy variable noted at the top of each column as well as industry fixed effects and firm employment as additional controls. Employment regressions omit firm employment as a covariate. Total factor productivity (TFP) is computed as in Caves, Christensen, and Diewert (1982).

Heterogeneity: Comparative Statics

- Given the Pareto distribution in (5), the ratio of firms engaged in offshoring to those that do not offshore is given by

$$\frac{\int_{\tilde{\varphi}_O}^{\infty} \varphi^{\sigma-1} dG(\varphi)}{\int_{\tilde{\varphi}_D}^{\tilde{\varphi}_O} \varphi^{\sigma-1} d\varphi} = \frac{kb^k \int_{\tilde{\varphi}_O}^{\infty} \varphi^{-(k-\sigma)} d\varphi}{kb^k \int_{\tilde{\varphi}_D}^{\tilde{\varphi}_O} \varphi^{-(k-\sigma)} d\varphi} = \frac{1}{\left(\frac{\tilde{\varphi}_O}{\tilde{\varphi}_D}\right)^{k-(\sigma-1)} - 1}$$

- Note that the ratio of thresholds satisfies

$$\left(\frac{\tilde{\varphi}_O}{\tilde{\varphi}_D}\right)^{\sigma-1} = \frac{f_O - f_D}{f_D} \frac{1}{\left(\frac{w_N}{\tau w_S}\right)^{(1-\eta)(\sigma-1)} - 1}.$$

- The prevalence of offshoring is thus increasing in the wage gap (w_N/w_S) and in dispersion (low k) and decreasing in headquarter intensity (η) and fragmentation barriers $(f_O - f_D, \tau)$
  - same comparative statics for ratio of sales of offshoring to non-offshoring firms

Relaxing Some Assumptions

- We can dispense of the outside sector and let relative wages adjust
  - if entry and headquarter service provision are prohibitively expensive in the South, then it necessarily holds that $\tau w_S < w_N$ by labor-market clearing (see Antràs, 2005)
- We can incorporate a second factor of production, physical capital or skilled labor and let headquarter services use this factor intensively
  - if North is capital or skill-abundant, it will naturally specialize in headquarter services, while South will have comparative advantage in manufacturing (similar to Helpman, 1984, or Antràs, 2003)
  - with frictions to fragmentation, no factor price equalization, and wages remain lower in the South

Preview of Next Time

- Introducing contractual frictions into the two complete-contracting frameworks developed above
  - particular emphasis on global sourcing
- Brief overview of empirical literature on the effects of contracting institutions on the location of production