Firms in International Trade

(with an Application to Spain)

Pol Antràs Puchal (Harvard University)
Rubén Segura-Cayuela (Banco de España)

with
Diego Rodríguez Rodríguez (U. Complutense)

Overview of Recent Developments

Neoclassical Trade Theory

- Firms are treated as a black box (supply side = production set)
  - Often assume constant returns to scale, so firm size is indeterminate
- General equilibrium only pins down the size of the sector or industry to which the firm belongs
- Very powerful theory, but of limited use when studying firm-level issues in international trade

New Trade Theory

- Introduced increasing returns, imperfect competition and product differentiation
- This helped resolve the indeterminacy of firm size
  - With product differentiation, firms face downward sloping demand curves and there exists an optimal firm size
- Free entry (and general equilibrium) then pins down industry size and also the number of firms within an industry
- New Trade Theory rationalized two-way trade flows in similar products across countries

Some Problematic Predictions

- As insightful as New Trade Theory is, it delivers some counterfactual predictions
- Because all firms within a sector are treated symmetrically, either all firms within an industry export or none does (and they always do with CES)
- Trade liberalization generally affects all firms within an industry symmetrically (and when it doesn't, there is no way to predict these asymmetries)
- These predictions are problematic because they **do not provide a good description of reality**

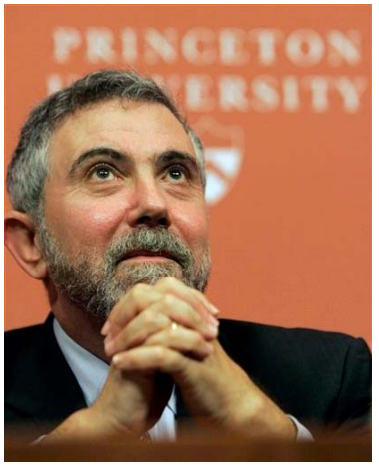
"Evidence"

- "*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*."

"Evidence"

- "*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



Real Evidence: Heterogeneity in Data

- Standard deviation of log sales

Country	# of producers	Overall	Within Sector (52 Manufacturing Sectors)
France	76,456	1.82	1.70
Italy	39,704	1.33	1.29
Spain	31,446	1.26	1.18
U.S. (plants)	224,009	1.67	

- Productivity: Standard deviation of log value added per worker for U.S. plants:
  - Overall: 0.75
  - Within 4-digit sectors (450 sectors): 0.66

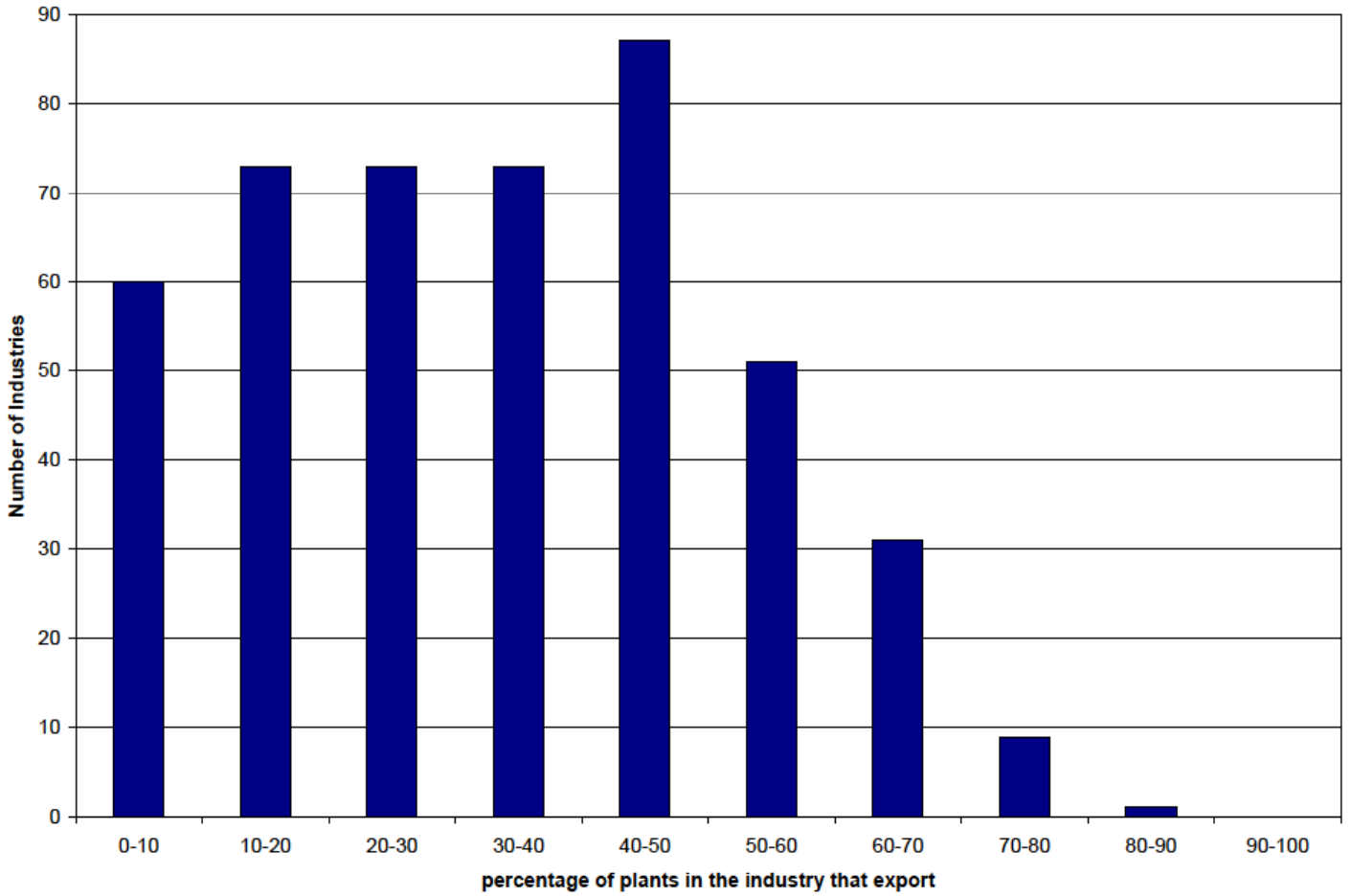
Exporters are in the Minority

Table 2
Exporting By U.S. Manufacturing Firms, 2002

NAICS industry	*Percent of firms*	*Percent of firms that export*	*Mean exports as a percent of total shipments*
311 Food Manufacturing	6.8	12	15
312 Beverage and Tobacco Product	0.7	23	7
313 Textile Mills	1.0	25	13
314 Textile Product Mills	1.9	12	12
315 Apparel Manufacturing	3.2	8	14
316 Leather and Allied Product	0.4	24	13
321 Wood Product Manufacturing	5.5	8	19
322 Paper Manufacturing	1.4	24	9
323 Printing and Related Support	11.9	5	14
324 Petroleum and Coal Products	0.4	18	12
325 Chemical Manufacturing	3.1	36	14
326 Plastics and Rubber Products	4.4	28	10
327 Nonmetallic Mineral Product	4.0	9	12
331 Primary Metal Manufacturing	1.5	30	10
332 Fabricated Metal Product	19.9	14	12
333 Machinery Manufacturing	9.0	33	16
334 Computer and Electronic Product	4.5	38	21
335 Electrical Equipment, Appliance	1.7	38	13
336 Transportation Equipment	3.4	28	13
337 Furniture and Related Product	6.4	7	10
339 Miscellaneous Manufacturing	9.1	2	15
Aggregate manufacturing	**100**	**18**	**14**

Sources: Data are from the 2002 U.S. Census of Manufactures.
Notes: The first column of numbers summarizes the distribution of manufacturing firms across three-digit NAICS manufacturing industries. The second reports the share of firms in each industry that export. The final column reports mean exports as a percent of total shipments across all firms that export in the noted industry.

Exporters in the U.S. (4-digit)



Exporters Are Different than Non-Exporters

Table 3

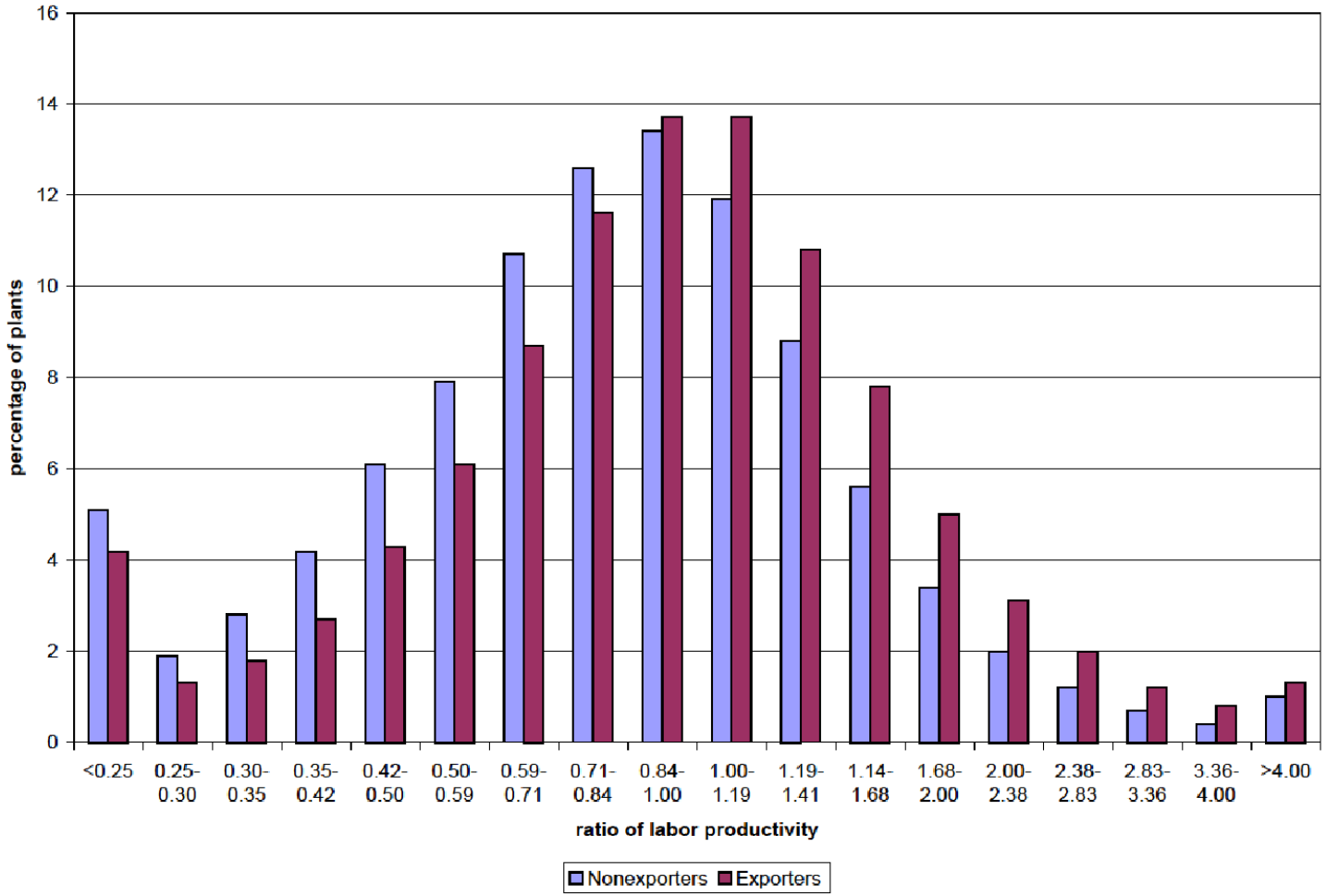
Exporter Premia in U.S. Manufacturing, 2002

	Exporter premia		
	(1)	*(2)*	*(3)*
Log employment	1.19	0.97	
Log shipments	1.48	1.08	0.08
Log value-added per worker	0.26	0.11	0.10
Log TFP	0.02	0.03	0.05
Log wage	0.17	0.06	0.06
Log capital per worker	0.32	0.12	0.04
Log skill per worker	0.19	0.11	0.19
Additional covariates	None	Industry fixed effects	Industry fixed effects, log employment

Sources: Data are for 2002 and are from the U.S. Census of Manufactures.

Notes: All results are from bivariate ordinary least squares regressions of the firm characteristic in the first column on a dummy variable indicating firm's export status. Regressions in column 2 include industry fixed effects. Regressions in column 3 include industry fixed effects and log firm employment as controls. Total factor productivity (TFP) is computed as in Caves, Christensen, and Diewert (1982). "Capital per worker" refers to capital stock per worker. "Skill per worker" is nonproduction workers per total employment. All results are significant at the 1 percent level.

Exporters Are Different than Non-Exporters



Interpreting the Evidence

- An obvious question at this point is: Do differences in performance generate selection into exporting, or does exporting generate differences in performance?
- Not straightforward to tease out empirically:
  - One can look at the timing of productivity changes and exporting (does exporting lag productivity improvements or vice versa)
  - But notice that firms can select into exporting because they anticipate that their productivity is in an upward trend (Costantini and Melitz, 2008)

Empirical Tests

- Strong evidence for self-selection of more productive firms into exporting
  - Colombia, Mexico, and Morocco: Clerides, Lach, and Tybout (1998, QJE)
  - U.S.: Bernard and Jensen (1999, JIE)
  - Taiwan: Aw, Chen, and Roberts (2001, JDE)
- Mixed evidence for "learning-by-exporting"
  - Some evidence in growing, developing countries (India, Slovenia) – see De Loecker (2007, JIE)

Caveats

- Exogenous causality from either export status or productivity is suspect
- New evidence shows that firms make **joint decisions** concerning both export status and technology choice:
  - Verhoogen (2009, QJE): quality upgrade and exports in Mexico
  - Bustos (2010, AER): new exporters in Argentina spend more on technological upgrades
  - Lileeva and Trefler (2010, QJE): similar for Canada

Effects of Trade Liberalization

- There is now mounting evidence that trade liberalization induces important reallocation effects
- Exporters expand, non-exporters contract, and this raises industry productivity
- Chile: trade liberalization in 1979-85 led to 19% productivity increase (of which 2/3 is explained by reallocation effects)
- Similarly for Canadian firms after U.S.-Canada free trade agreement (Trefler, 2004)

Plant Death and Exporting

- Bernard and Jensen (ReStat, 2007):
  - Unconditionally, they find that in the U.S. export status is associated with 12.6% reduction in probability of death (this is large, overall probability is 27%).
- Is it just that low-productivity firms are more likely to die and these tend to be non-exporters?
- No. Conditional on a full set of industry and firm controls (productivity, size, capital-labor ratio, ...), export status is still associated with a significant 5-6% reduction in probability of death

Why Do We See These Effects?

- "*It is a capital mistake to theorize before one has all the evidence. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts*"

Why Do We See These Effects?

- "*It is a capital mistake to theorize before one has all the evidence. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts*"

- Sherlock Holmes (1891)

Towards Succesful Theories

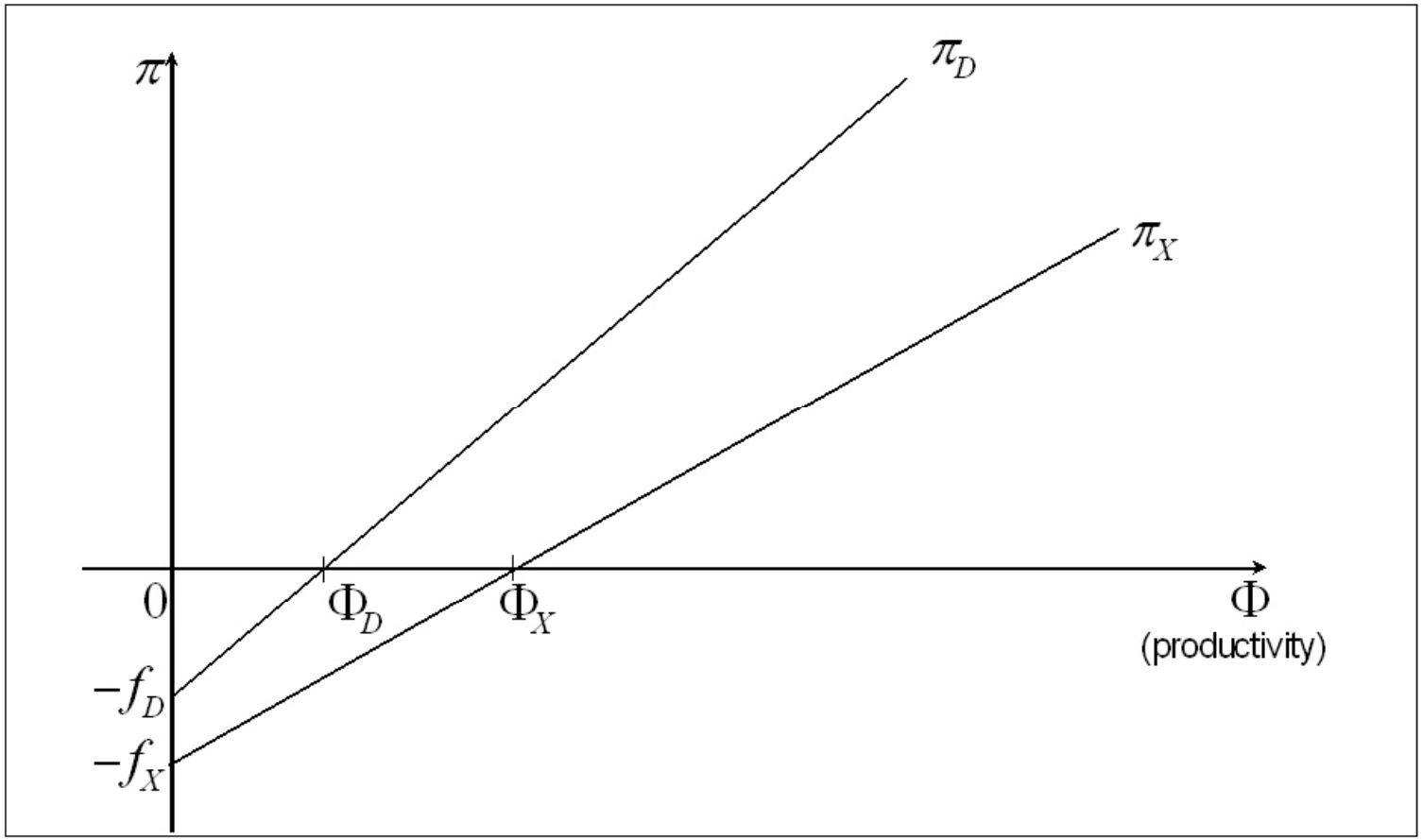
- Evidence suggests that successful theoretical frameworks for studying firms and the decision to export should include two features:

1. Within sectoral heterogeneity in size and productivity
2. A feature that leads only the most productive firms to engage in foreign trade:
   - fixed cost of exporting (Melitz, 2003)
   - variable markups (BEJK, 2002, Melitz and Ottaviano, 2008)

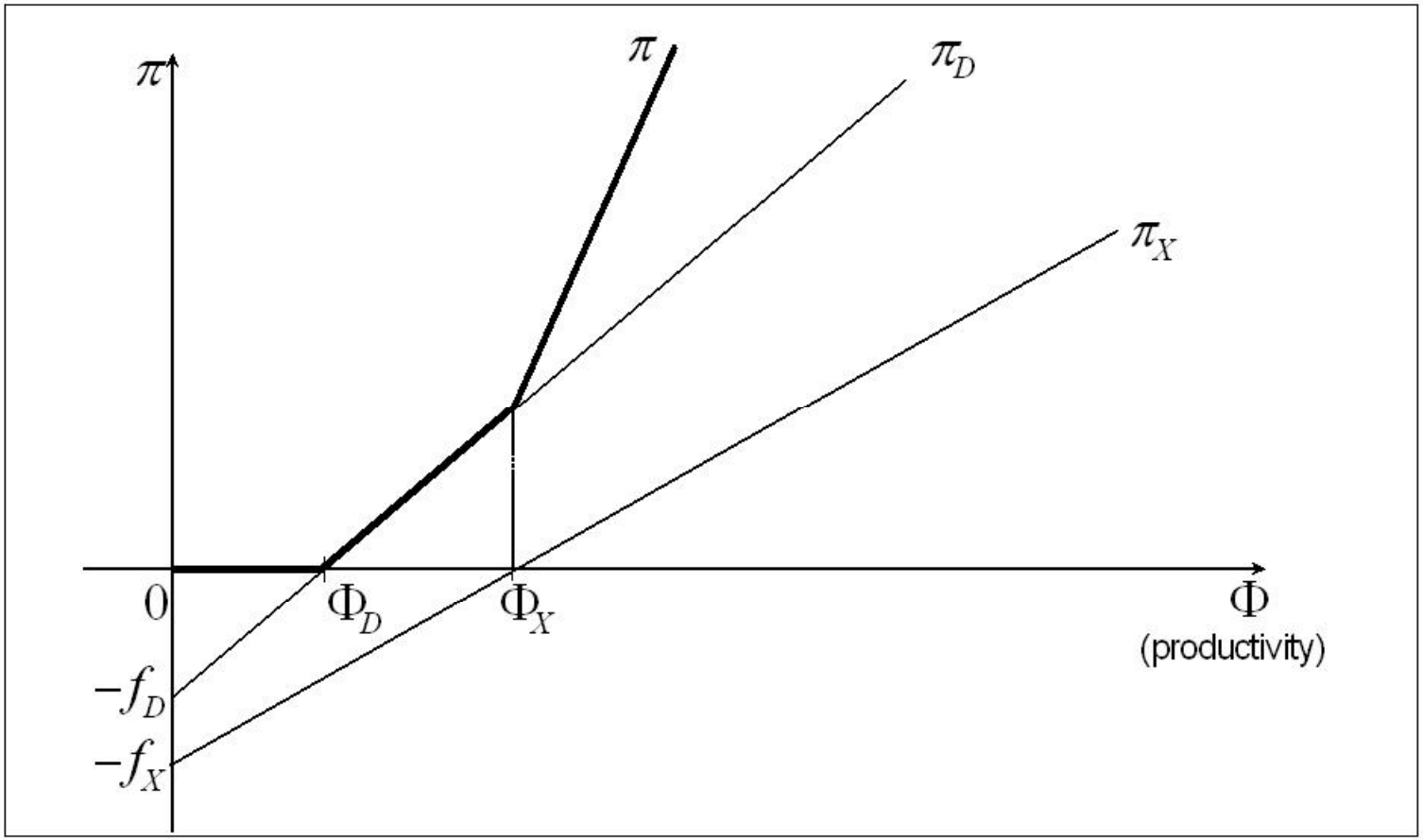
Melitz (2003)

- Each firm produces its own "variety" of a good (CES)
- Developing this variety entails a sunk entry cost
- Following entry, firms observe their productivity
- Prior to entry, only distribution of potential productivity levels is known (common for all firms)
- Firms also face a fixed overhead production cost
- Exporting involves both a standard "per-unit" trade cost as well as a fixed export cost
- An entering firm decides whether to produce (or exit) and then whether to export (or only serve home market)

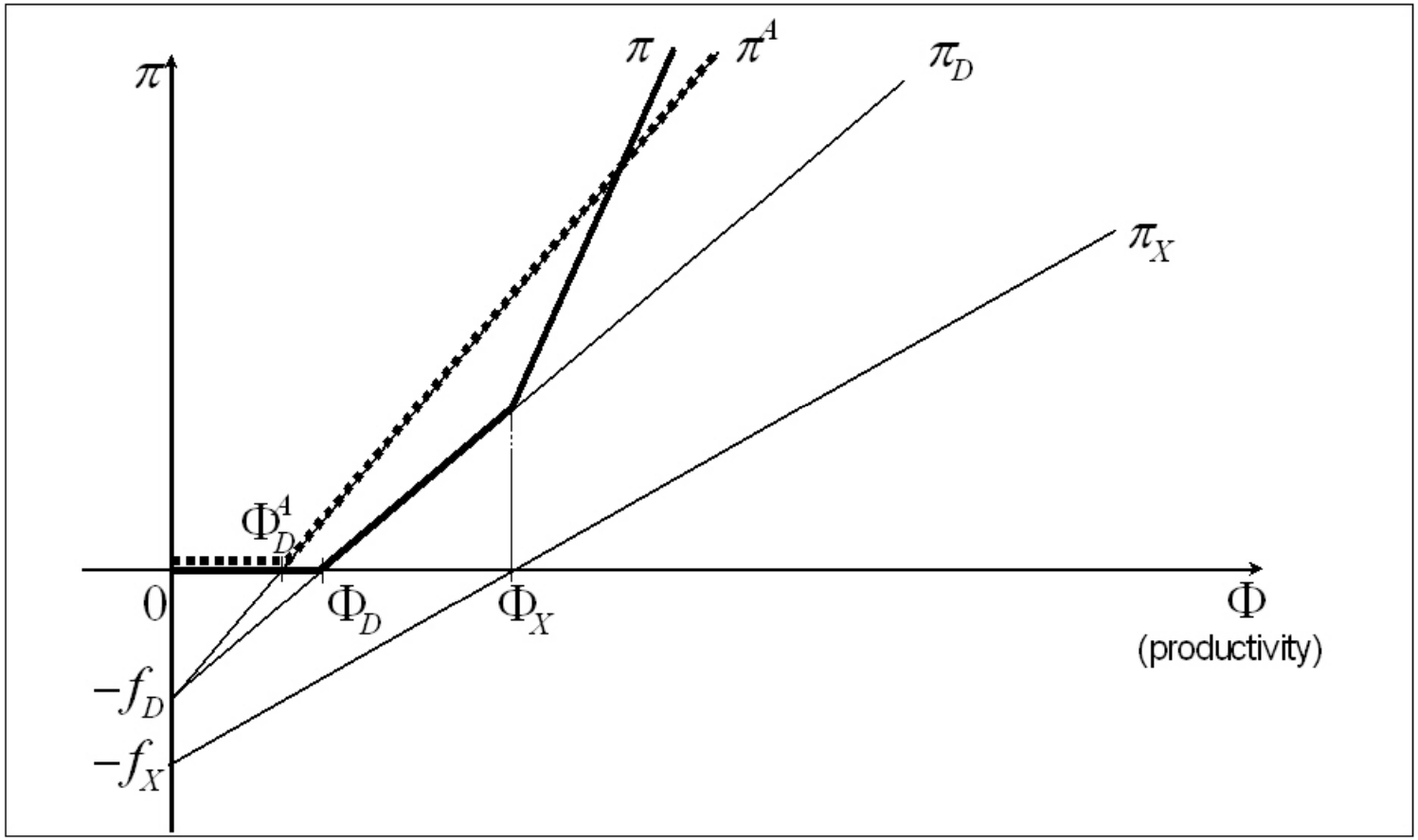
Melitz (2003): Equilibrium



Melitz (2003): Equilibrium



Melitz (2003): Reallocation Effects



Trade Liberalization

- Forces least productive firms to exit (competitive pressure)
- Re-allocates market shares towards more productive firms
  - Resulting in higher average productivity
- Welfare gains: combination of higher average productivity and ambiguous effect of product variety
  - But quantitatively, not clear there are additional gains from trade given certain observable variables (Arkolakis et al., 2010)

Aggregate Implications

- Melitz (2003) model is successful in accounting for several micro facts in the data
- More importantly, this micro-founded model of industry equilibrium has generated important new insights for the aggregate response of exports to shocks
- The increase in aggregate productivity is just one example, but many others have been highlighted

Chaney (2007)

- Develops multi-sector, multi-country Melitz model with Pareto distribution of productivity
- Shows that model predicts **modified** gravity equation
- Standard gravity

$$T_{ij} = \mu \frac{Y_i Y_j}{Y} \left(\frac{\tau_{ij}}{\theta_j} \right)^{-(\sigma-1)}$$

- Gravity with heterogeneous firms

$$T_{ij} = \mu \frac{Y_i Y_j}{Y} \left(\frac{\tau_{ij}}{\tilde{\theta}_j} \right)^{-\gamma} (f_{ij})^{-(\gamma/(\sigma-1)-1)}$$

Chaney (2007)

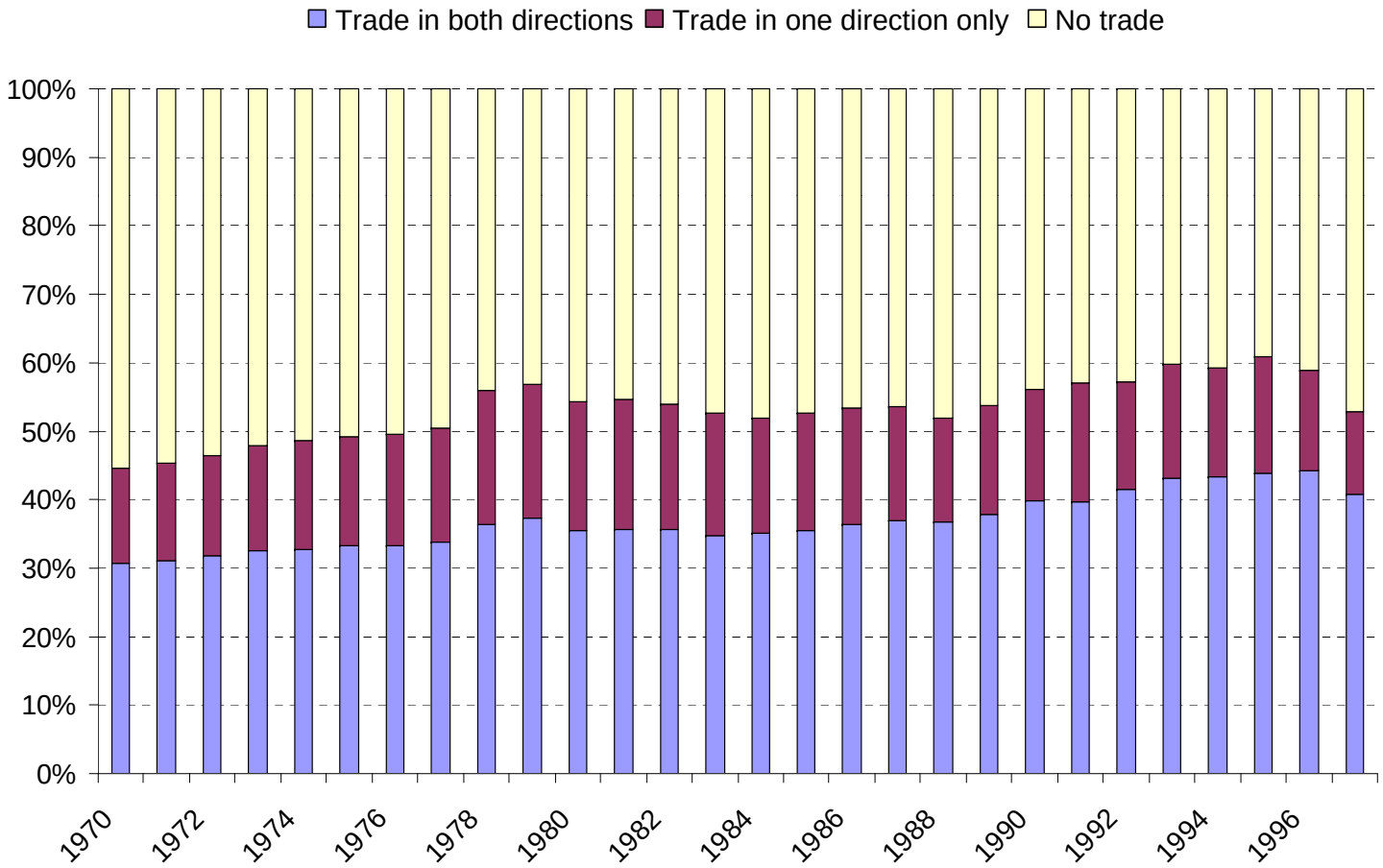
$$T_{ij} = \mu \frac{Y_i Y_j}{Y} \left(\frac{\tau_{ij}}{\tilde{\theta}_j} \right)^{-\gamma} (f_{ij})^{-(\gamma/(\sigma-1)-1)}$$

- A larger γ denotes a smaller right-tail of the Pareto distribution
- Thus, the elasticity of trade flows to changes in trade frictions is a function of characteristics of the size distribution of firms
- This elasticity is lower in sectors/countries with high dispersion in firm size (**Key:** extensive margin)

Helpman, Melitz & Rubinstein (08)

- Also demonstrate that firm-level models of exporting can have important implications for aggregate bilateral trade flows
- In particular, they can easily explain the large number of zeros observed in these flows
- Similar to Chaney (2007) but they develop an econometric approach for estimating trade flows
- Is being widely used in several applications

Helpman, Melitz & Rubinstein (08)



Di Giovanni & Levchenko (2010)

- They note that if the slope of the Pareto distribution is close to 1, then aggregate exports closely track those of the largest firms in an economy
- **Implication:** if productivity or costs evolve differently for large and small firms, the evolution of large firms may be particularly relevant
  - Simple price indices might not capture this correctly
- They estimate the slope for several countries and find an estimate very close to 1 in most countries

Policy Implications

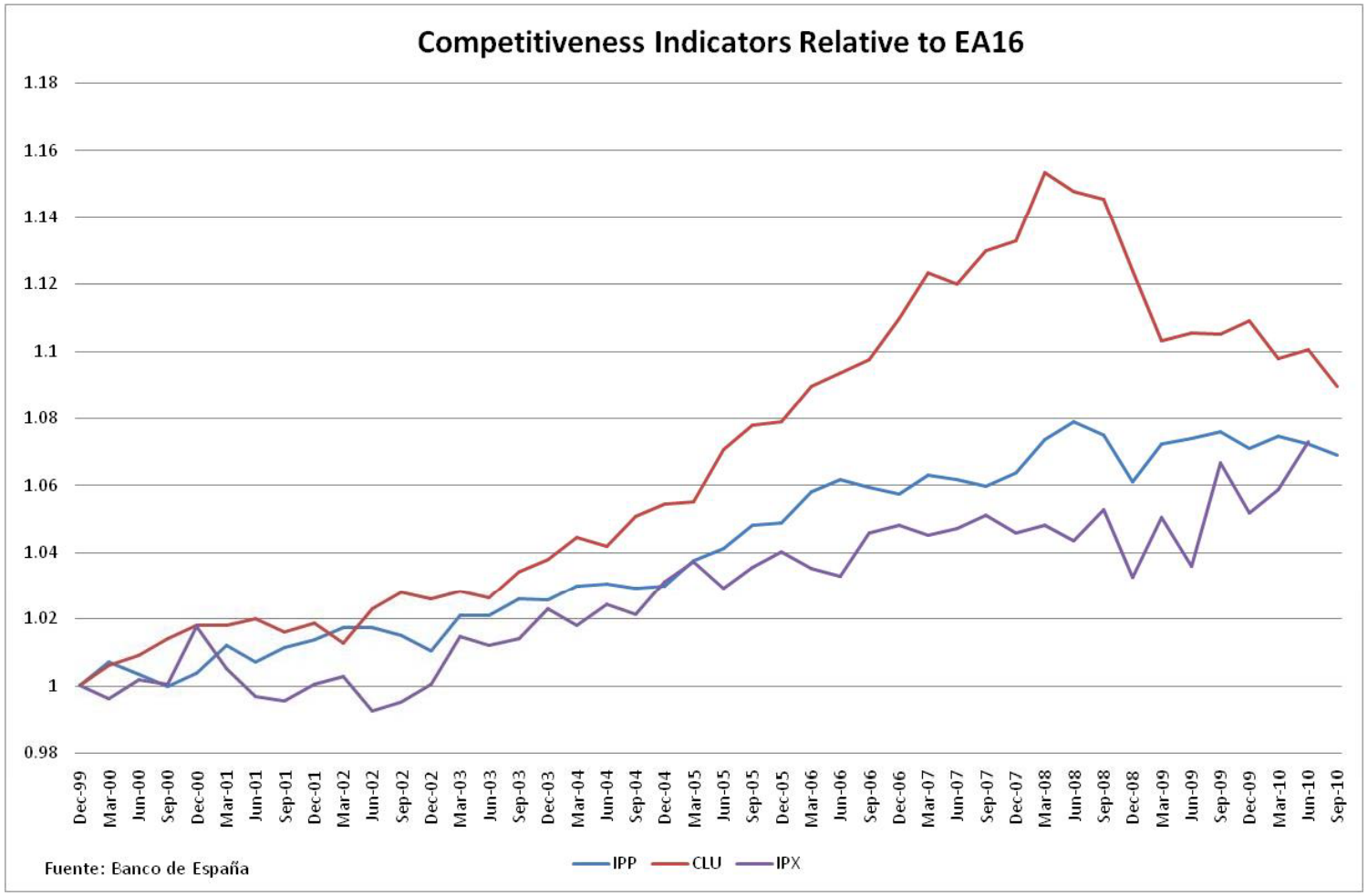
- Interesting question: conditional on some average level of productivity, is there a socially optimal size distribution of firms?
- Still very underdeveloped area – results seem very model specific

An Application to Spain

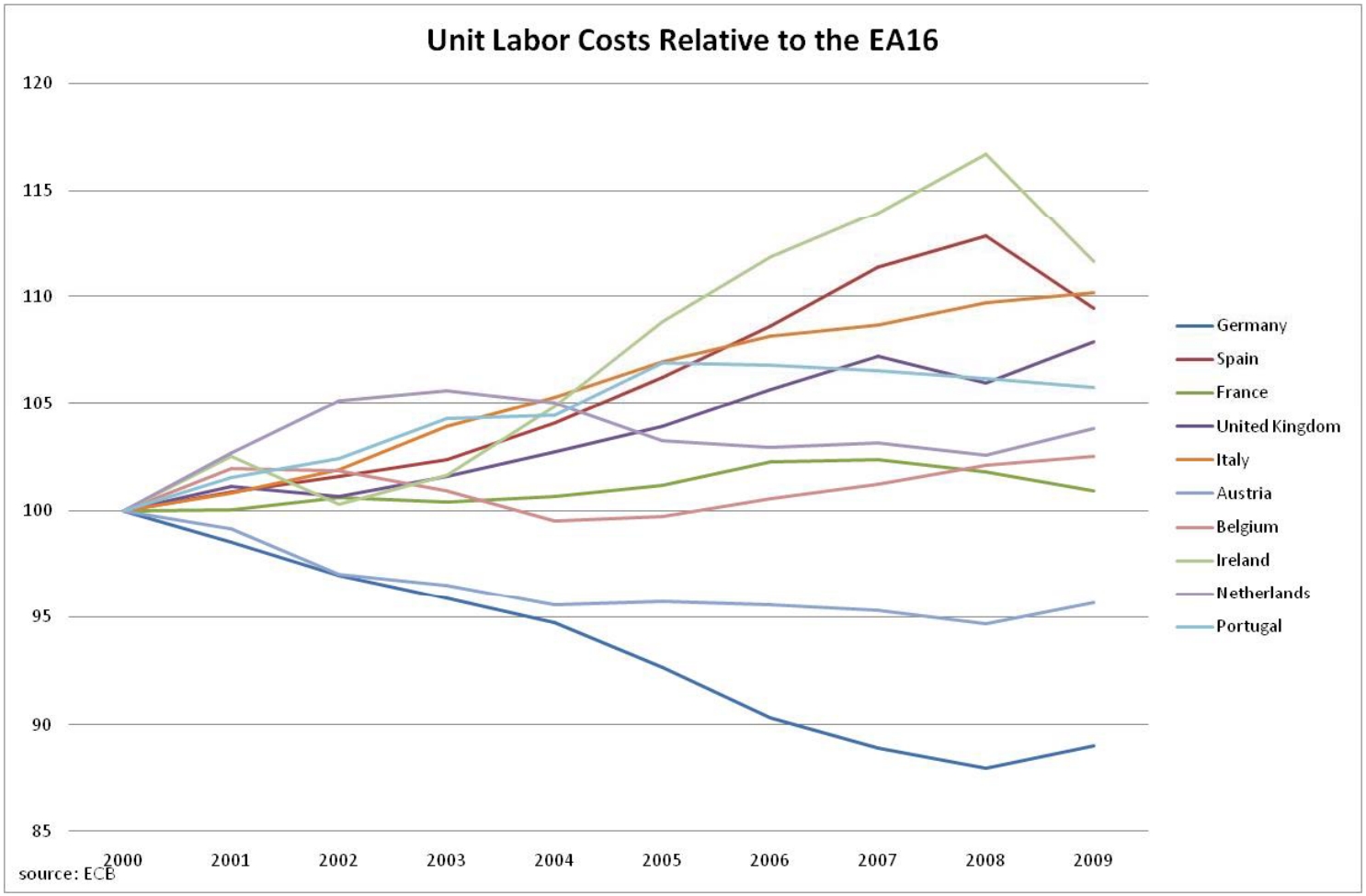
Road Map

- Can these new approaches shed light on the behavior of aggregate Spanish exports during the 2000s?
- We will argue that this behavior is puzzling from the point of view of homogenous firms models
- A more micro-founded investigation provides new insights that bring us closer to explaining the puzzle
- Still, we will see that the stylized models developed so far are too basic to account for all the patterns we observe

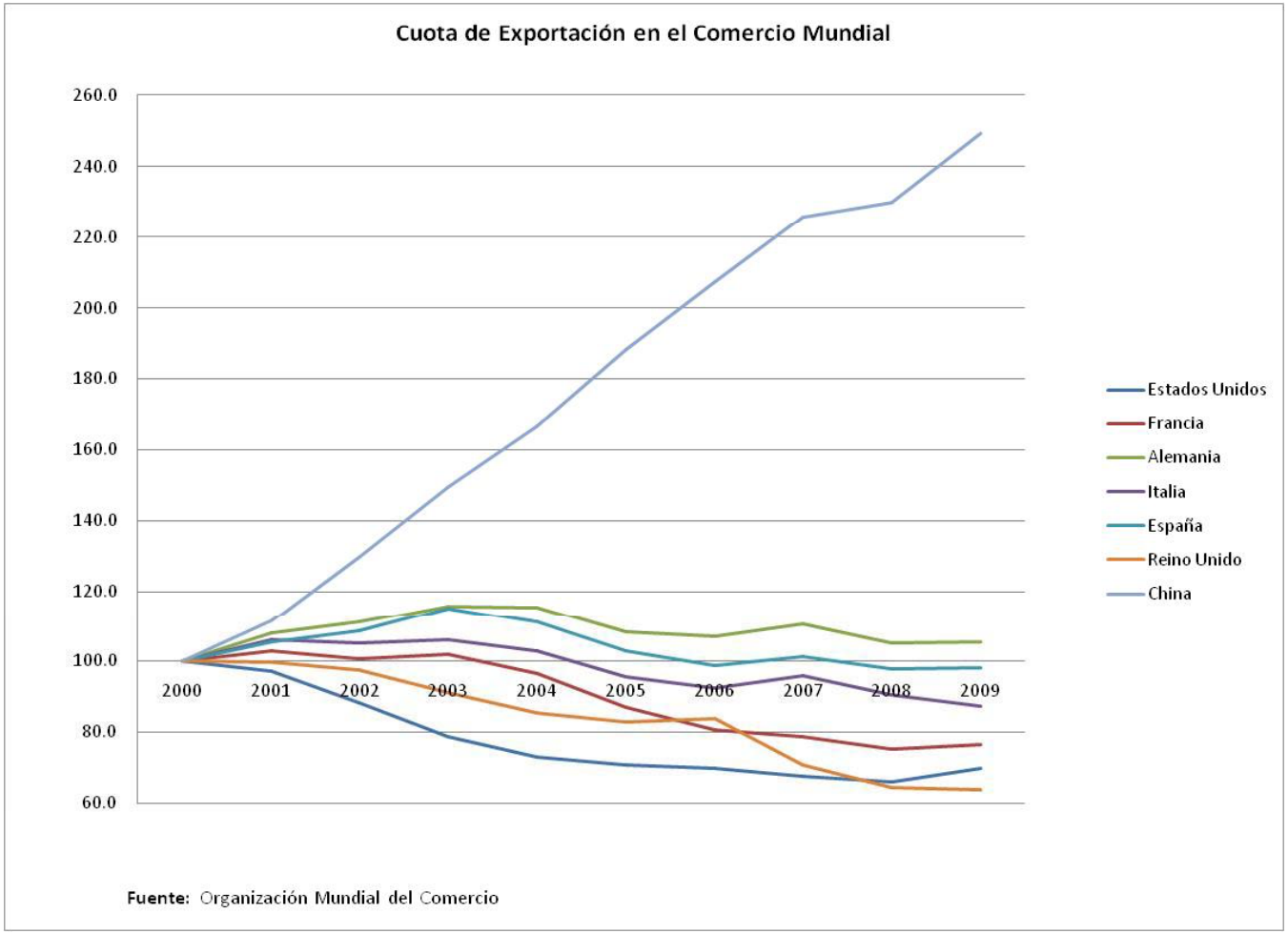
Puzzle: Competitiveness Falls…



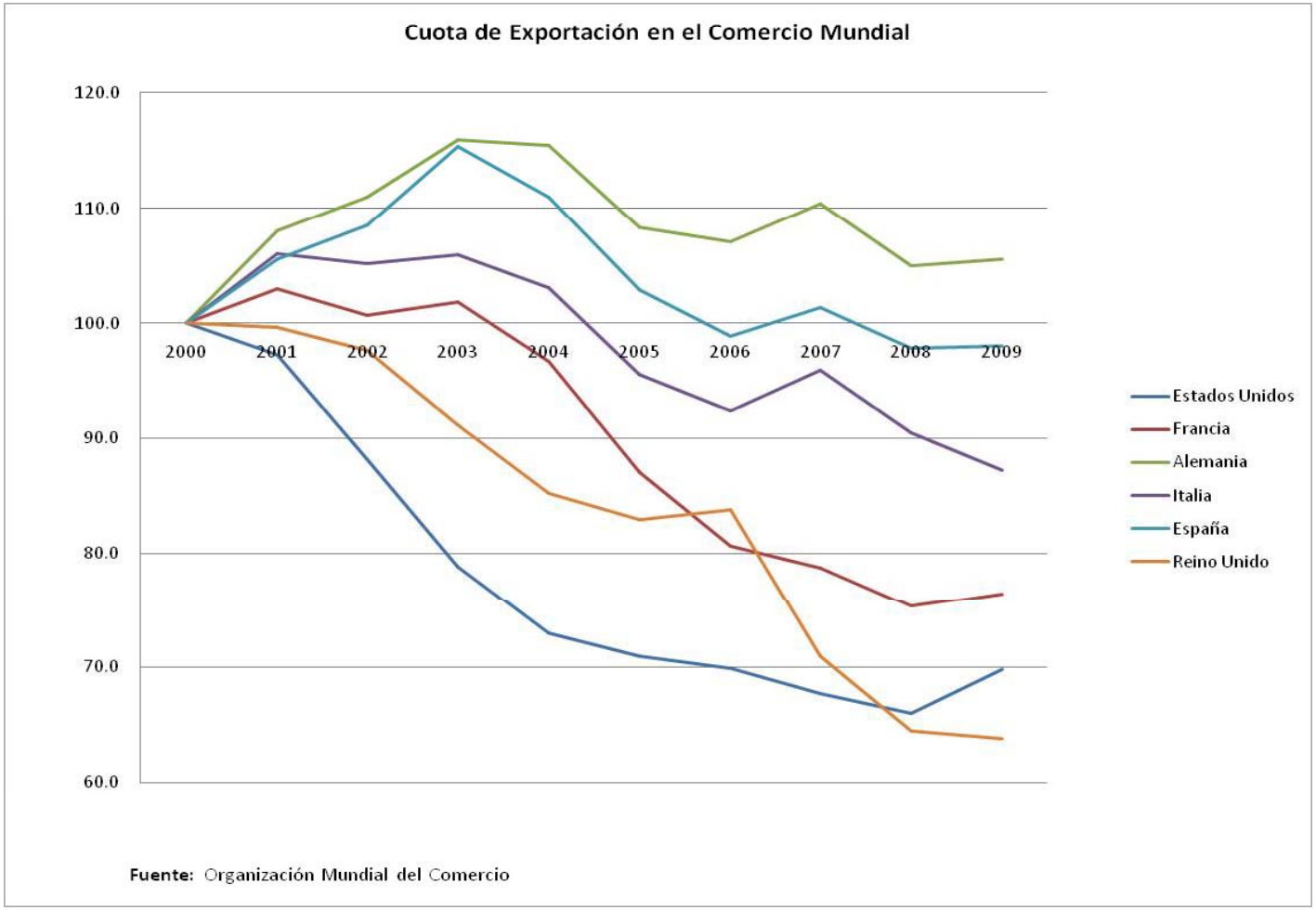
Puzzle: Competitiveness Falls…



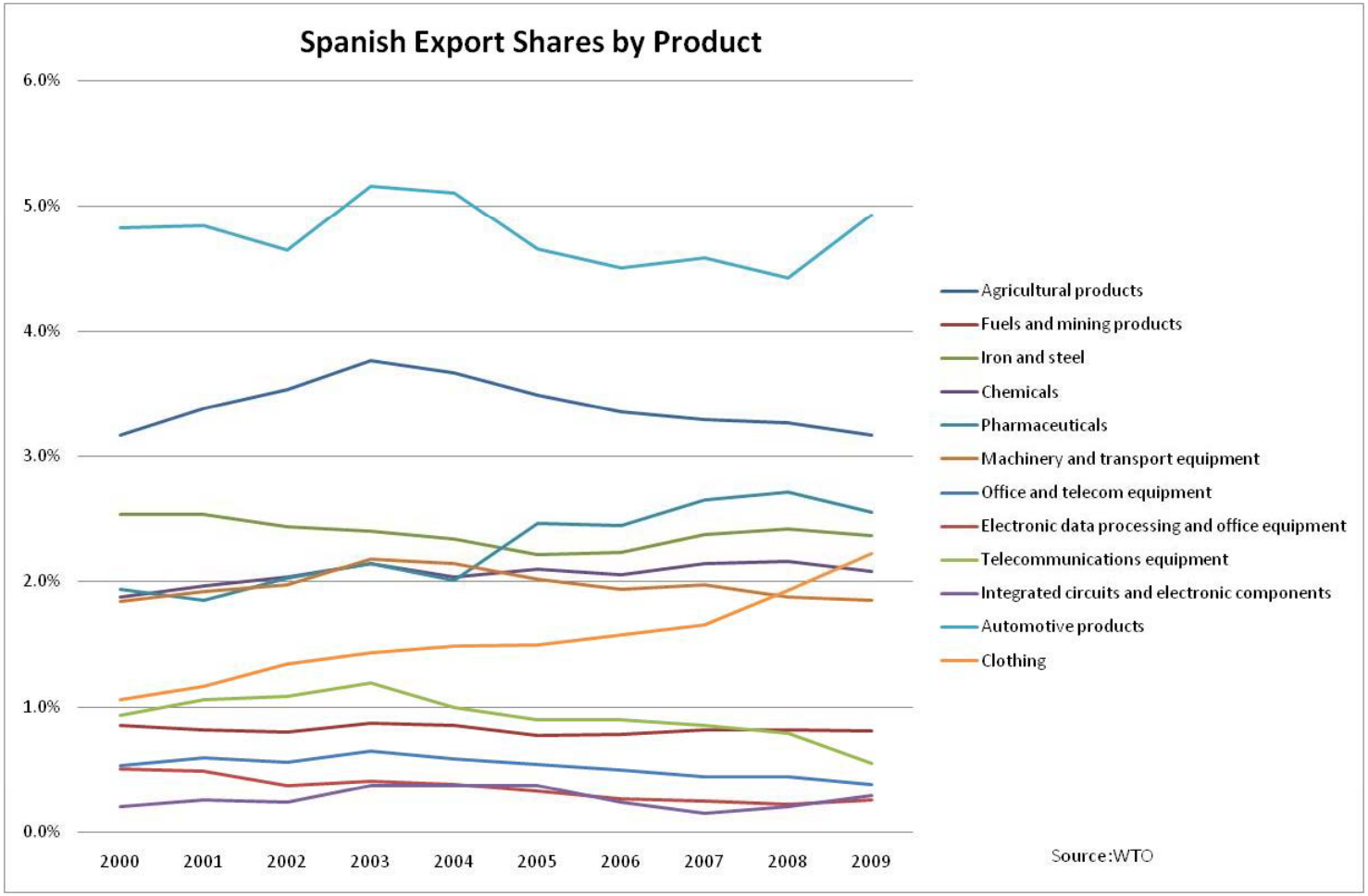
The Puzzle: but Market Share is Flat



The Puzzle: but Market Share is Flat



Market Share is Flat in Most Sectors



Puzzle: Homogenous Firm Models

- Relative exports should be decreasing in relative export prices (and, in turn, in relative costs)

$$\frac{X^{SPAIN}}{X^{OTHER}} = \frac{D_X^{SPAIN}\left(P_X^{SPAIN}\left(C_X^{SPAIN}\right)\right)}{D_X^{OTHER}\left(P_X^{OTHER}\left(C_X^{OTHER}\right)\right)}$$

- With CES preferences, this looks

$$\frac{X^{SPAIN}}{X^{OTHER}} = \frac{\psi_X^{SPAIN}}{\psi_X^{OTHER}} \times \left(\frac{C_X^{SPAIN}}{C_X^{OTHER}}\right)^{-\rho}$$

where $\psi_X^{SPAIN} / \psi_X^{OTHER}$ is a relative demand shifter

Explanations for Puzzle

1. Relative Demand Shifts
   a. Increase in relative quality of Spanish exports
   b. Higher income growth in predominant Spanish importers
2. Relative Supply Shifts
   a. Effects of heterogeneity
   b. Markup adjustment (though relative prices are going up)
3. Capital Flows, FDI, and Current Account Dynamics

We will focus on 2.a., but will say a word about the others

Heterogeneity in Spanish Exporters

Spanish Exporters Also Perform Better

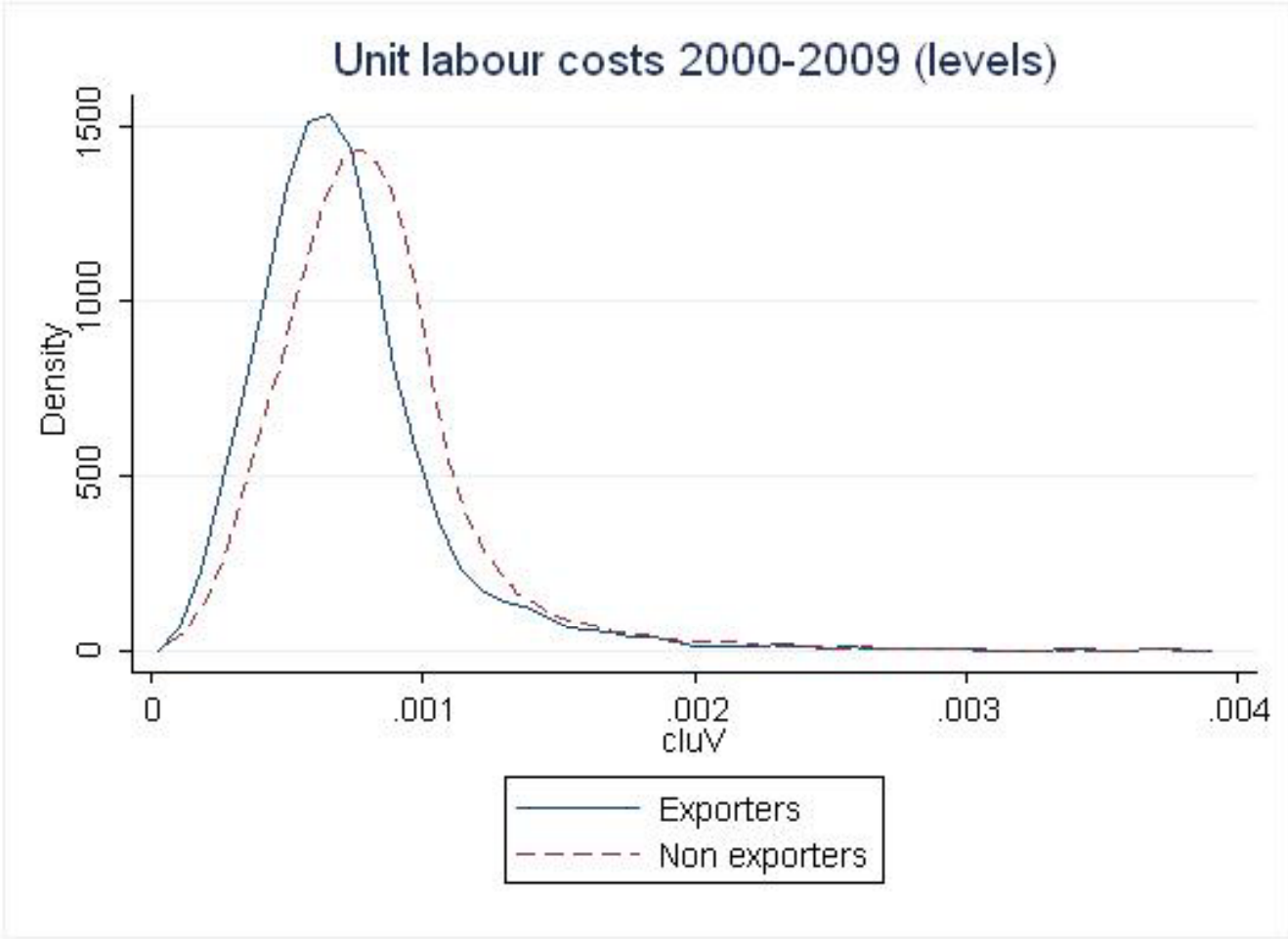
$$\ln X_{it} = \alpha + \beta D\exp_{it} + \gamma Ind_{it} + \eta Year_{it} + \lambda Size_{it} + \varepsilon_{it}$$

Exporting *Premia*

Dependent Variable (X):	*All firms*	*Firms with 200 or fewer workers*	*Firms with more than 200 workers*
Output	0.479	1.233	0.222
	(33.74)	(57.47)	(4.26)
Employment	0.086	0.692	0.195
	(14.9)	(44.66)	(6.00)
Capital per worker	0,253	0,496	0,122
	(18,2)	(32,7)	(3,6)
Capital per hour	0,255	0,503	0,118
	(17,9)	(32,5)	(3,4)
Results:			
Wage per worker	0.106	0.190	0.035
	(18.91)	(32.37)	(2.26)
Output per worker	0.385	0.536	0.022
	(30.53)	(43.41)	(0.56)
Output per hour	0.386	0.539	0.022
	(30.61)	(43.66)	(0.57)
N. of observations	17,740	12,589	5,151

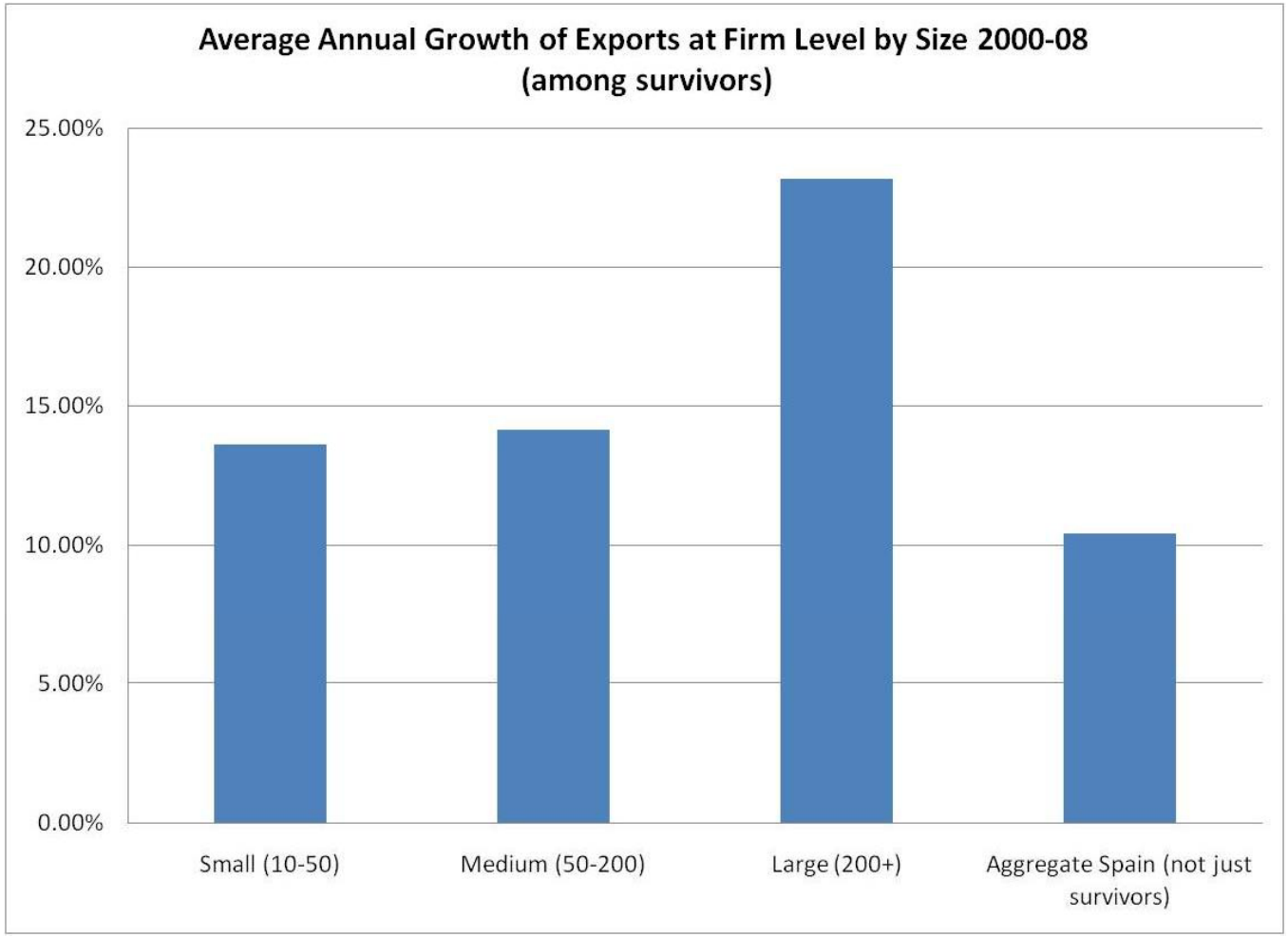
Source: ESEE

But There is Substantial Heterogeneity



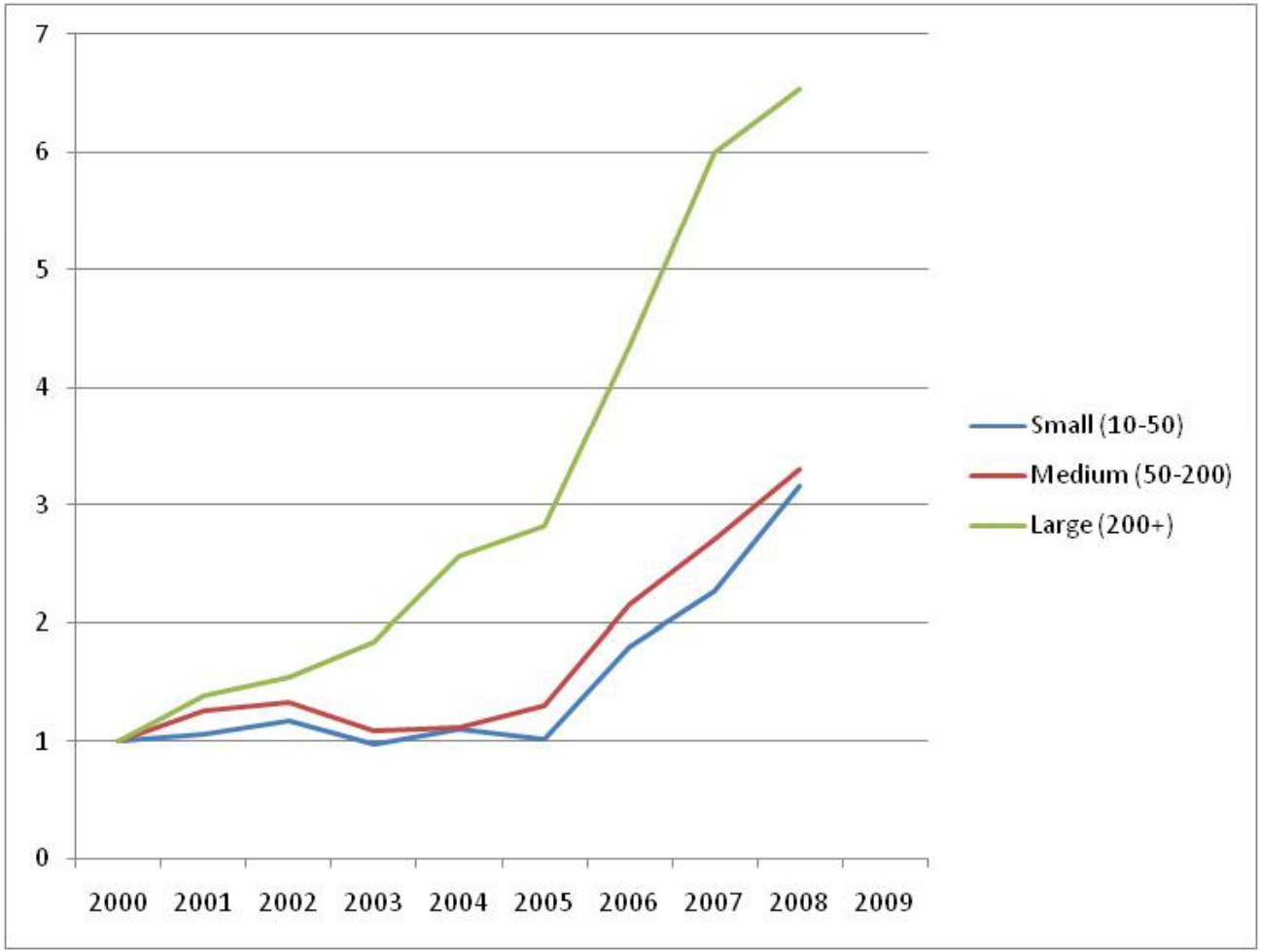
Source: ESEE

In 2000s, Large Exporters Grew More



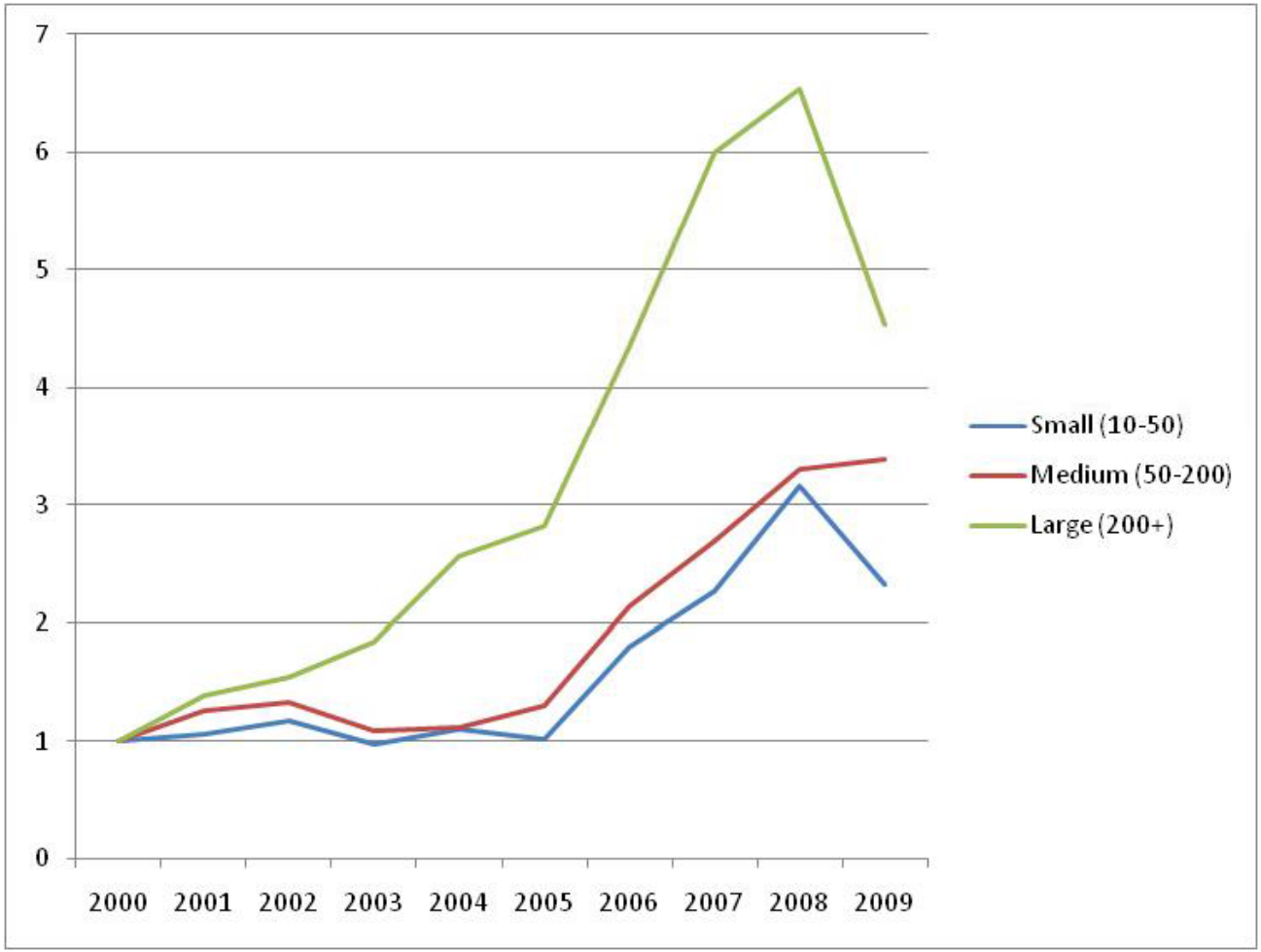
Source: ESEE

In 2000s, Large Exporters Grew More



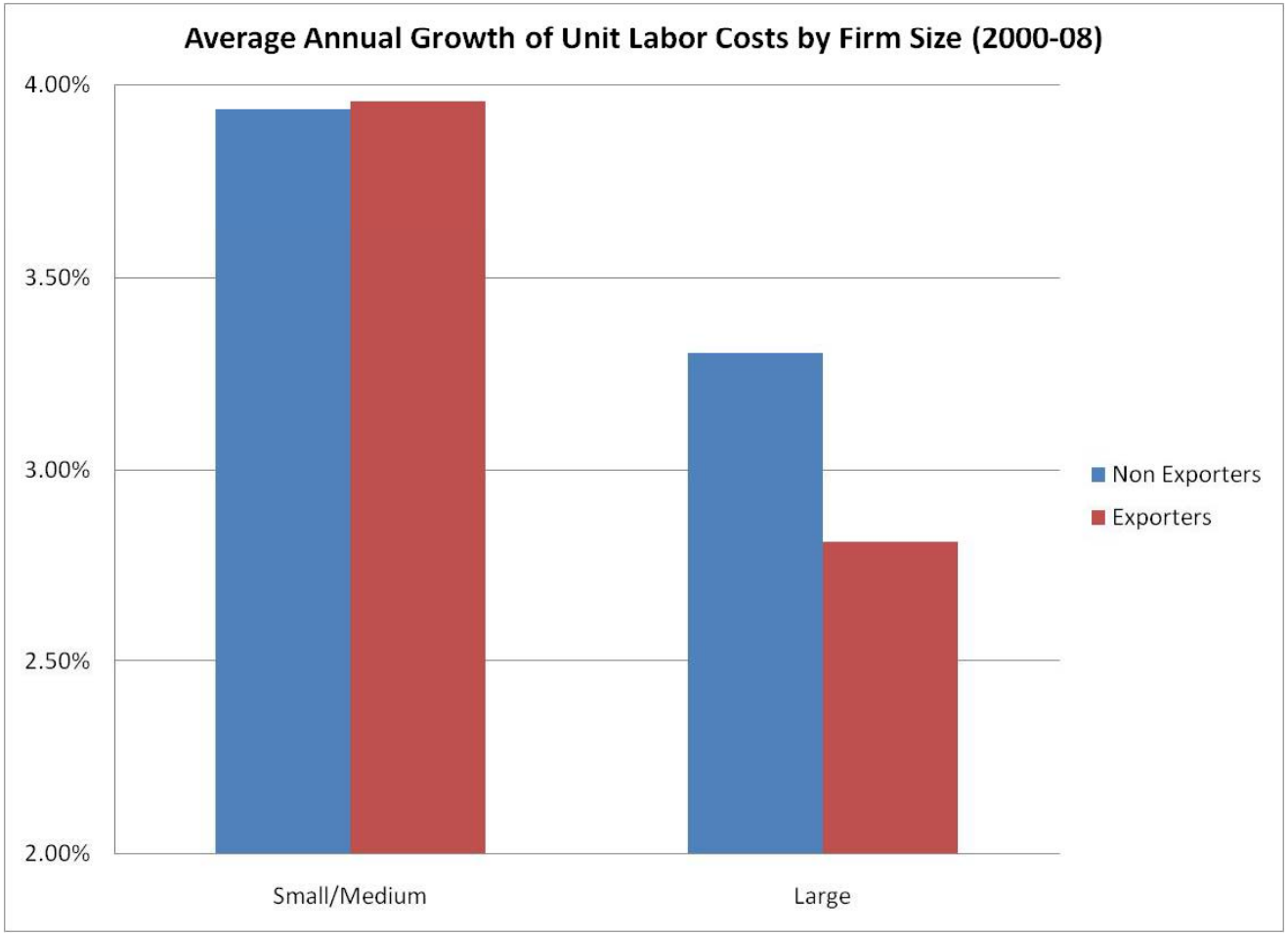
Source: ESEE

In 2000s, Large Exporters Grew More



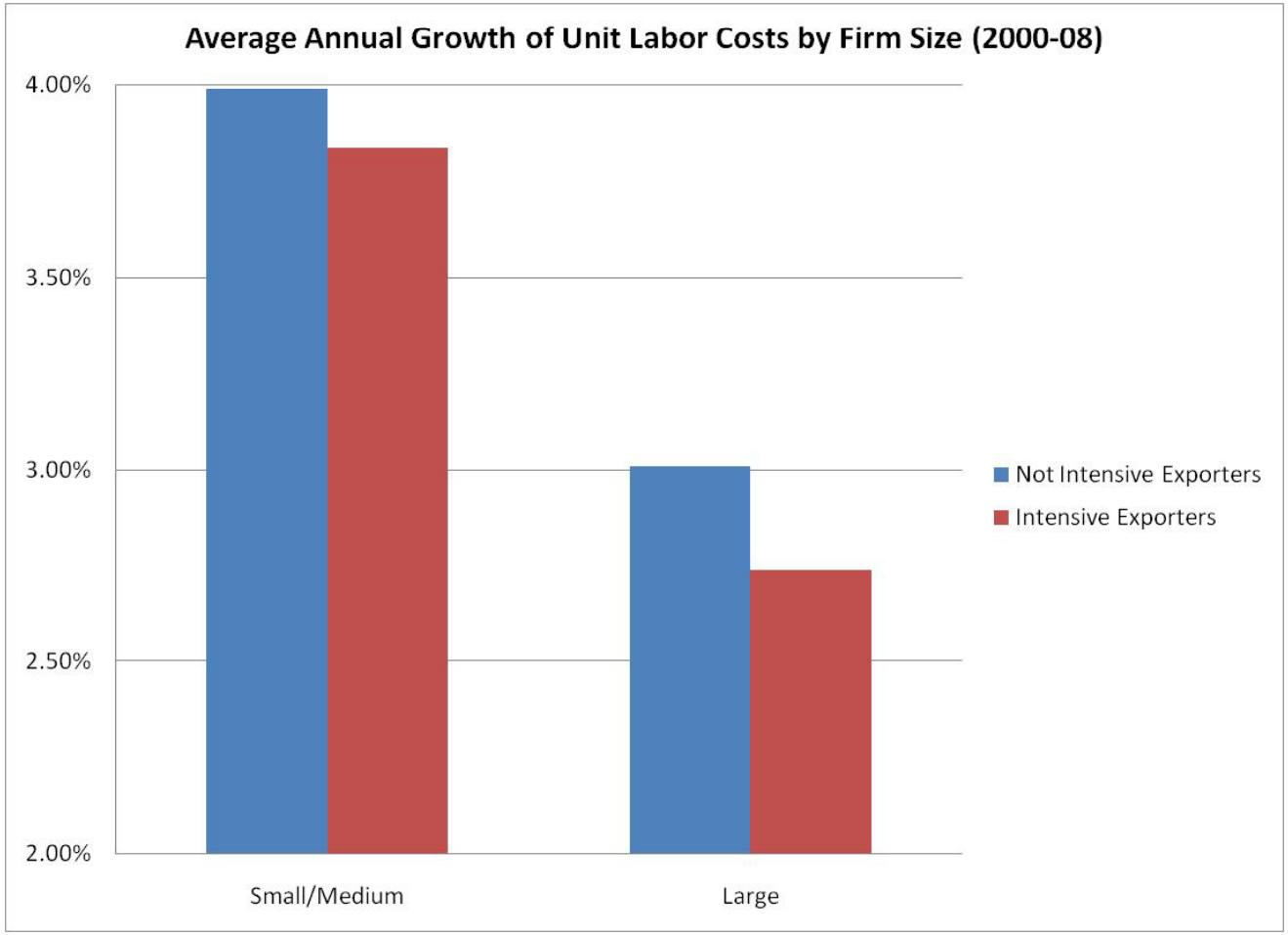
Source: ESEE

Why This Differential Growth?



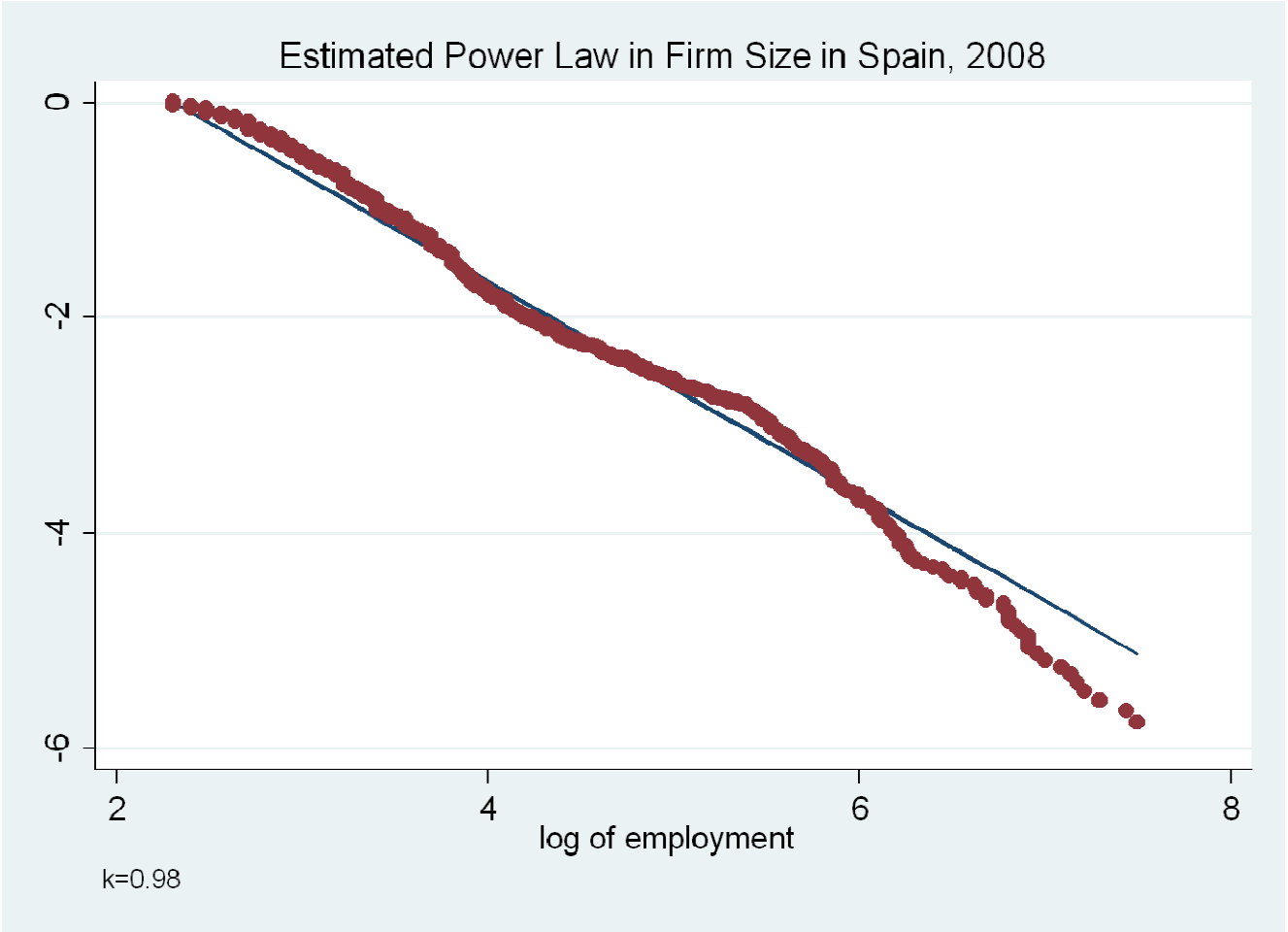
Source: ESEE

Why This Differential Growth?



Source: ESEE

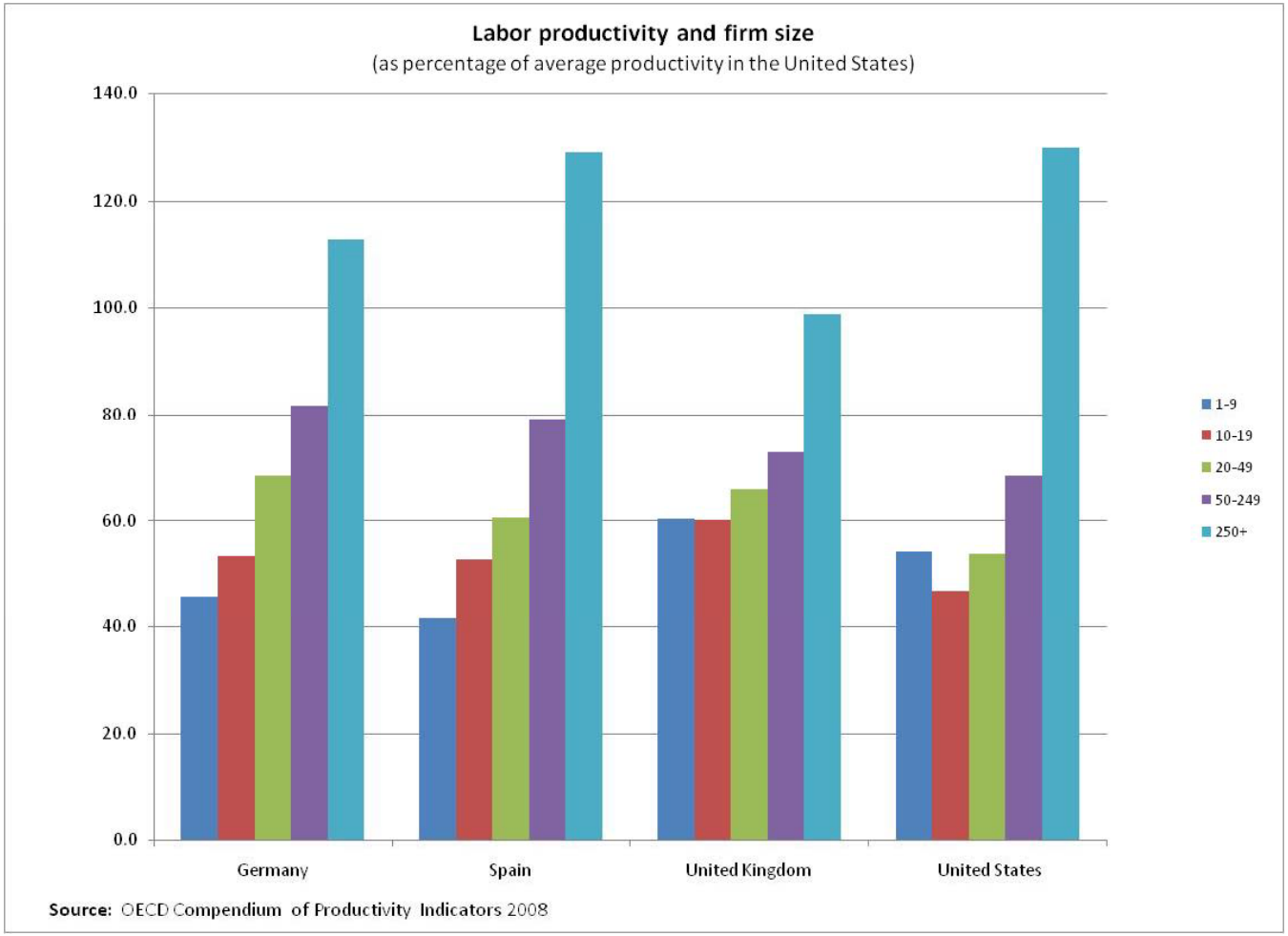
Why Might This Affect Aggregate Exports?



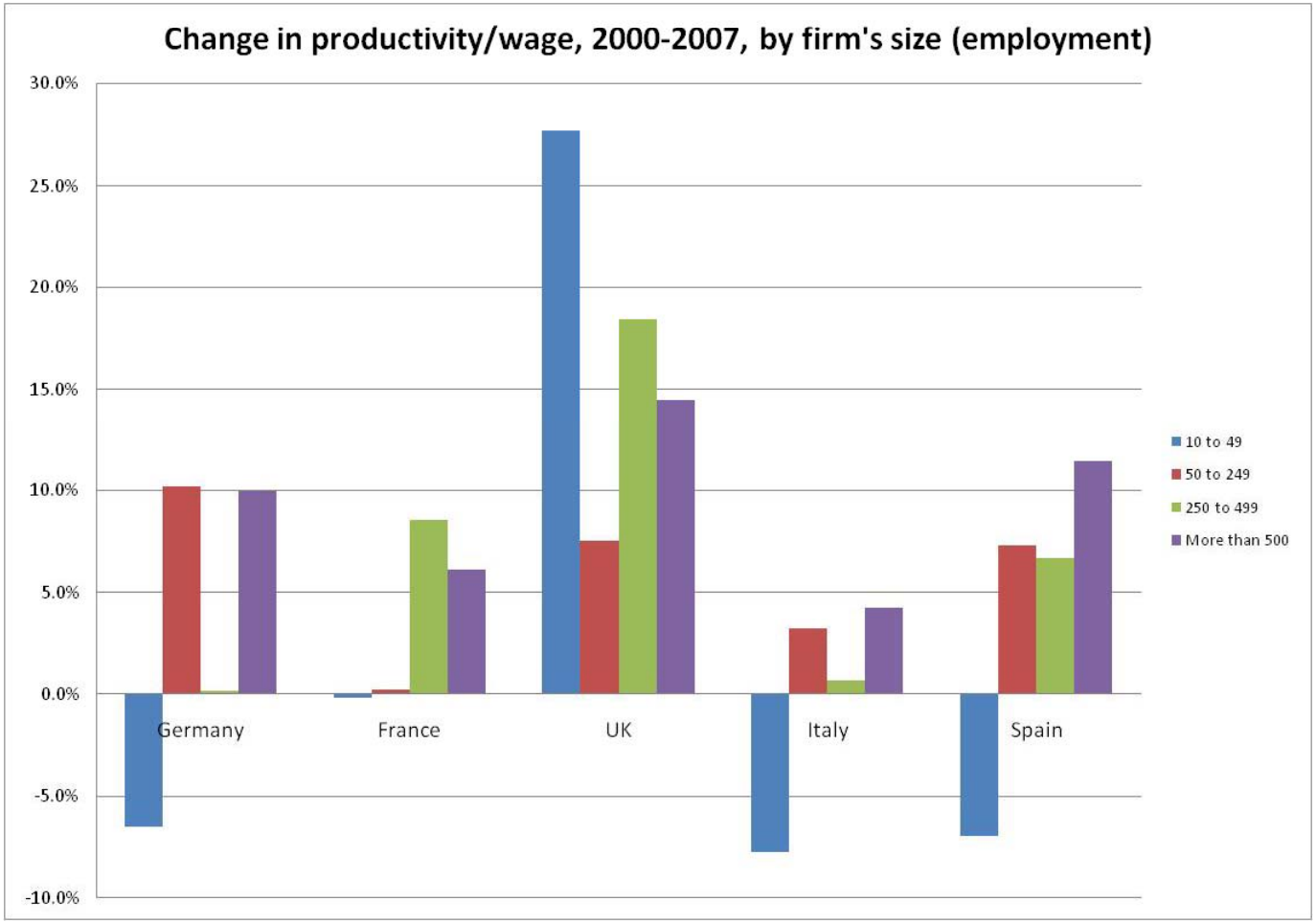
Is This Sufficient to Explain the Puzzle?

- No!
- We are not saying anything quantitative at this point
- More importantly, what matters is relative competitiveness
- What if large firms in other countries are seeing their competitiveness rise by even more?
- For this we need firm-level data from other countries
  - Homogenized dataset available in a few weeks
  - Next: preliminary evidence from OECD and Amadeus

Relative Competitiveness



Change in Relative Competitiveness



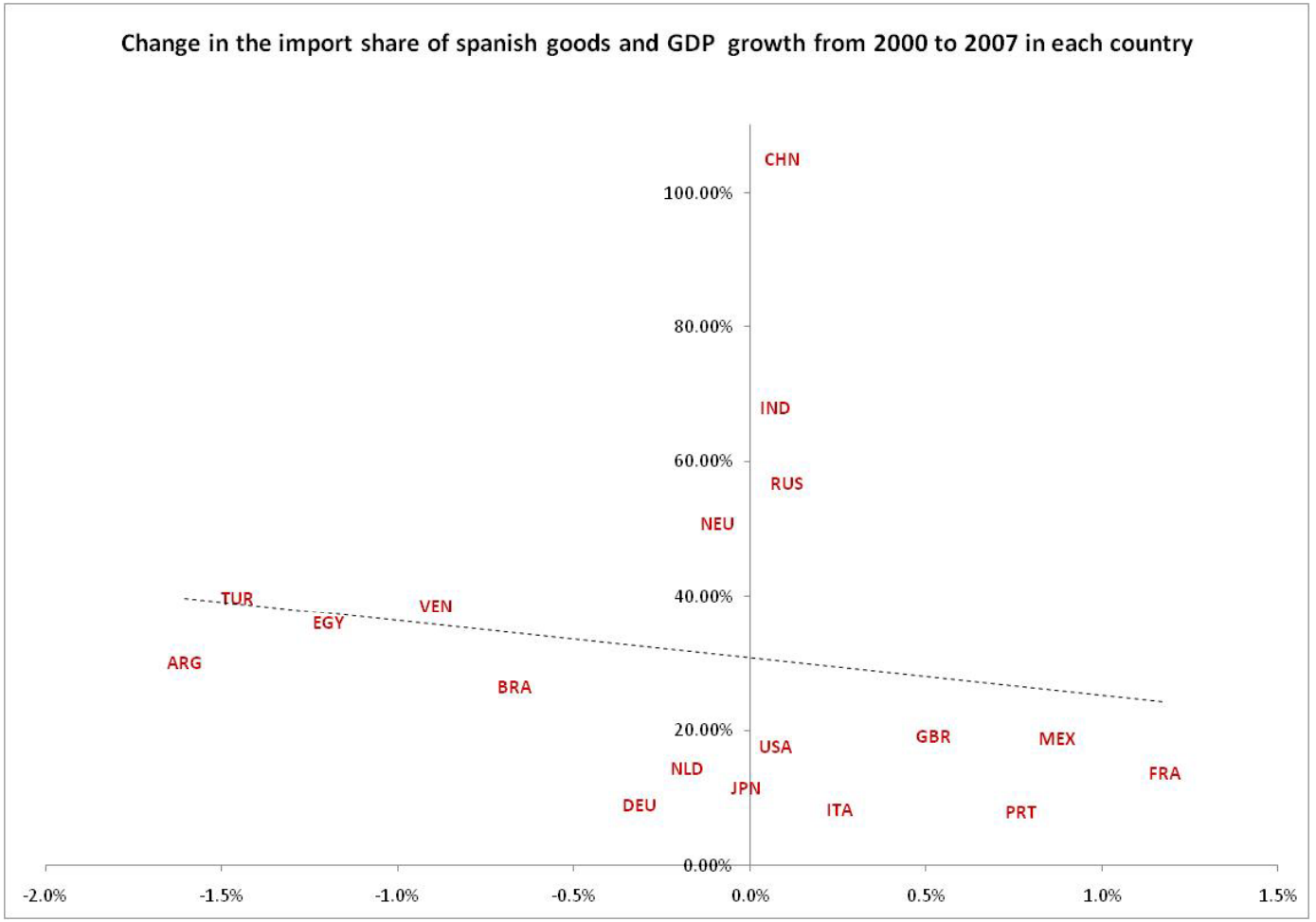
Source: Amadeus

Recap

- We observe heterogeneous performance of Spanish exporters
- Given thickness of right-tail, these changes in relative competitiveness have potential to explain **aggregate** export behavior
- But: why are price indices not capturing this?
  - Weighting does not seem to appropriately take into account for **intraindustry** heterogeneity

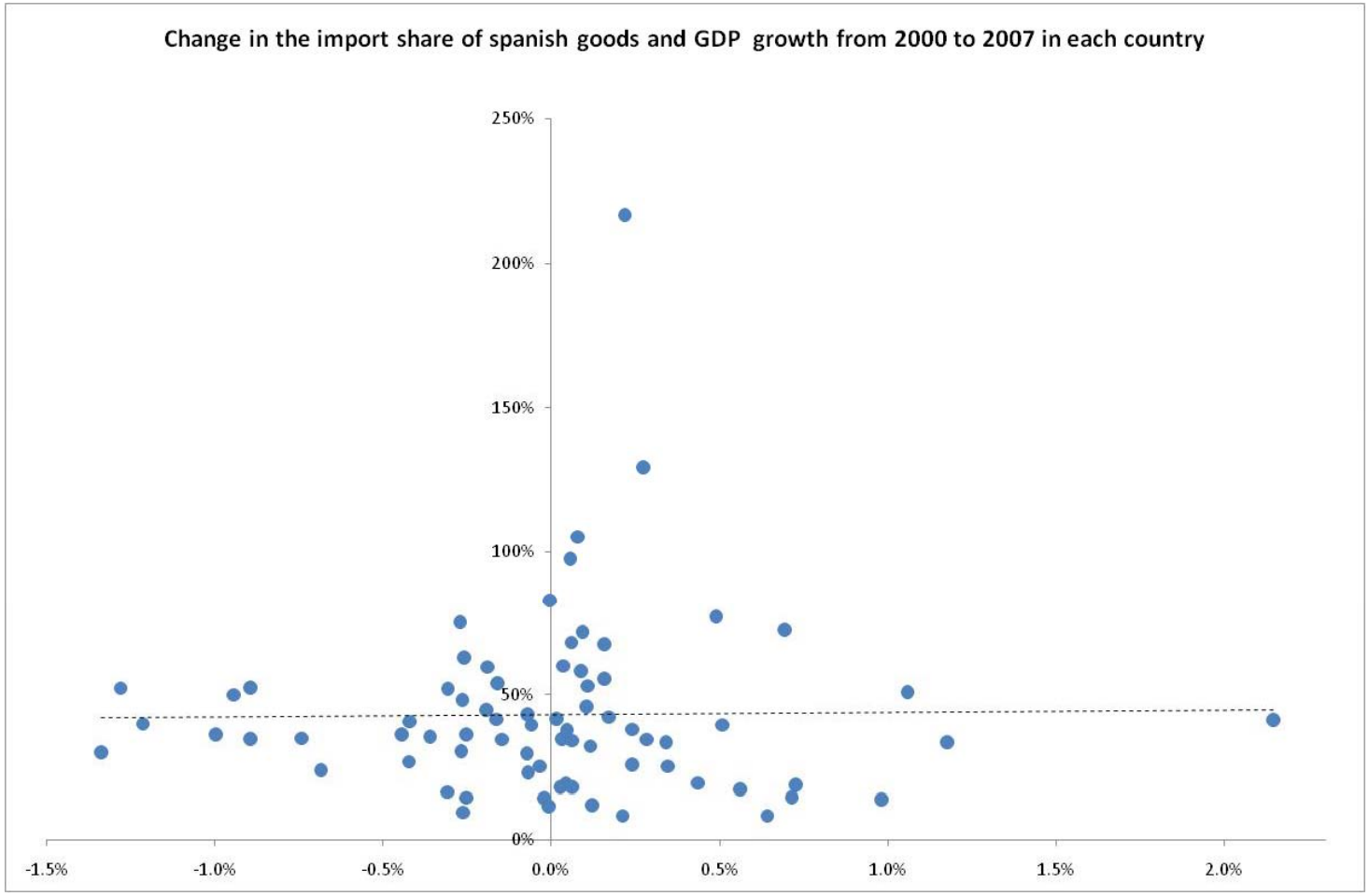
Some Notes on Alternative Explanations

A Relative Demand Shock?



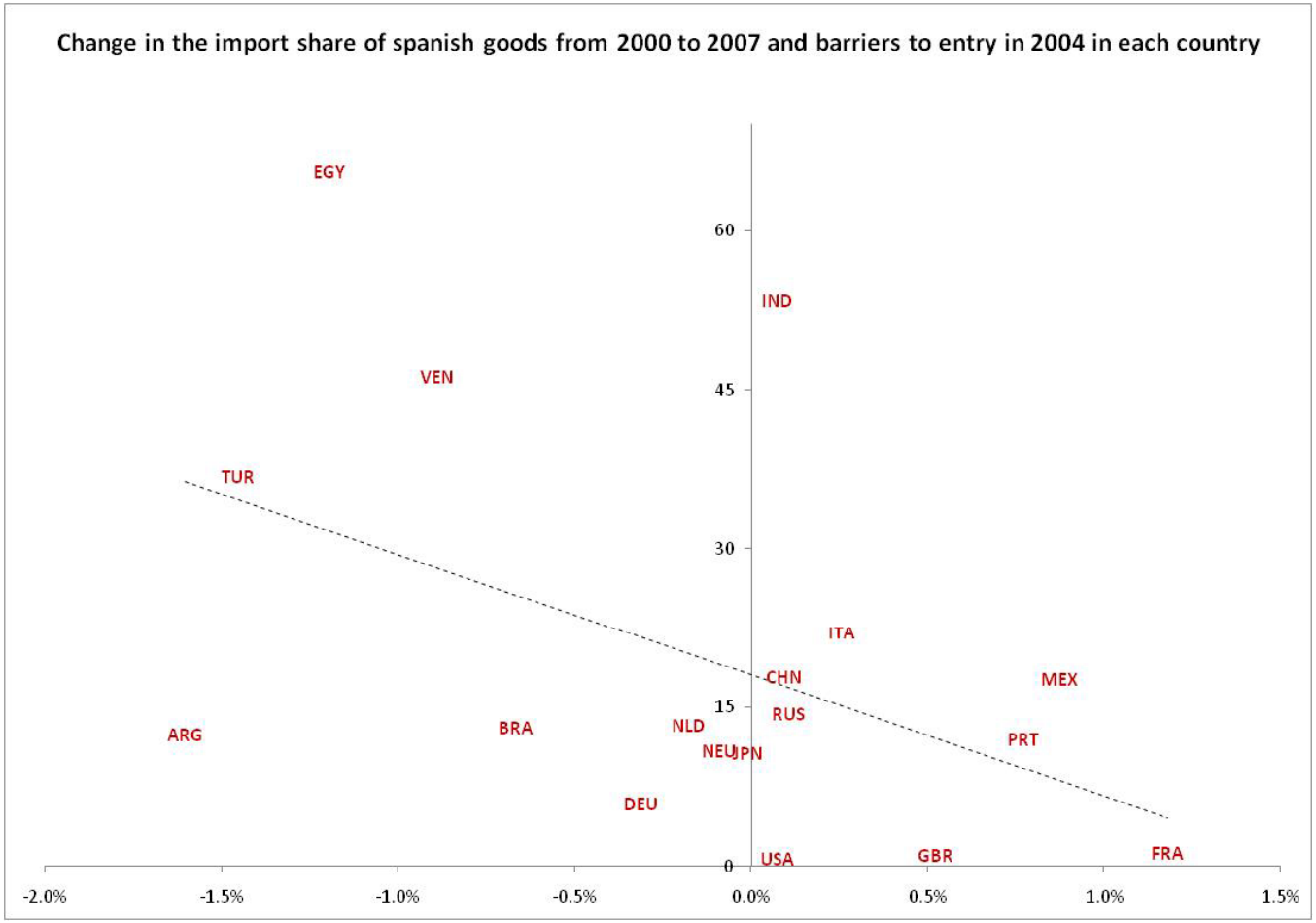
Sources: WB, ECB, WTO, and MEH

A Relative Demand Shock?



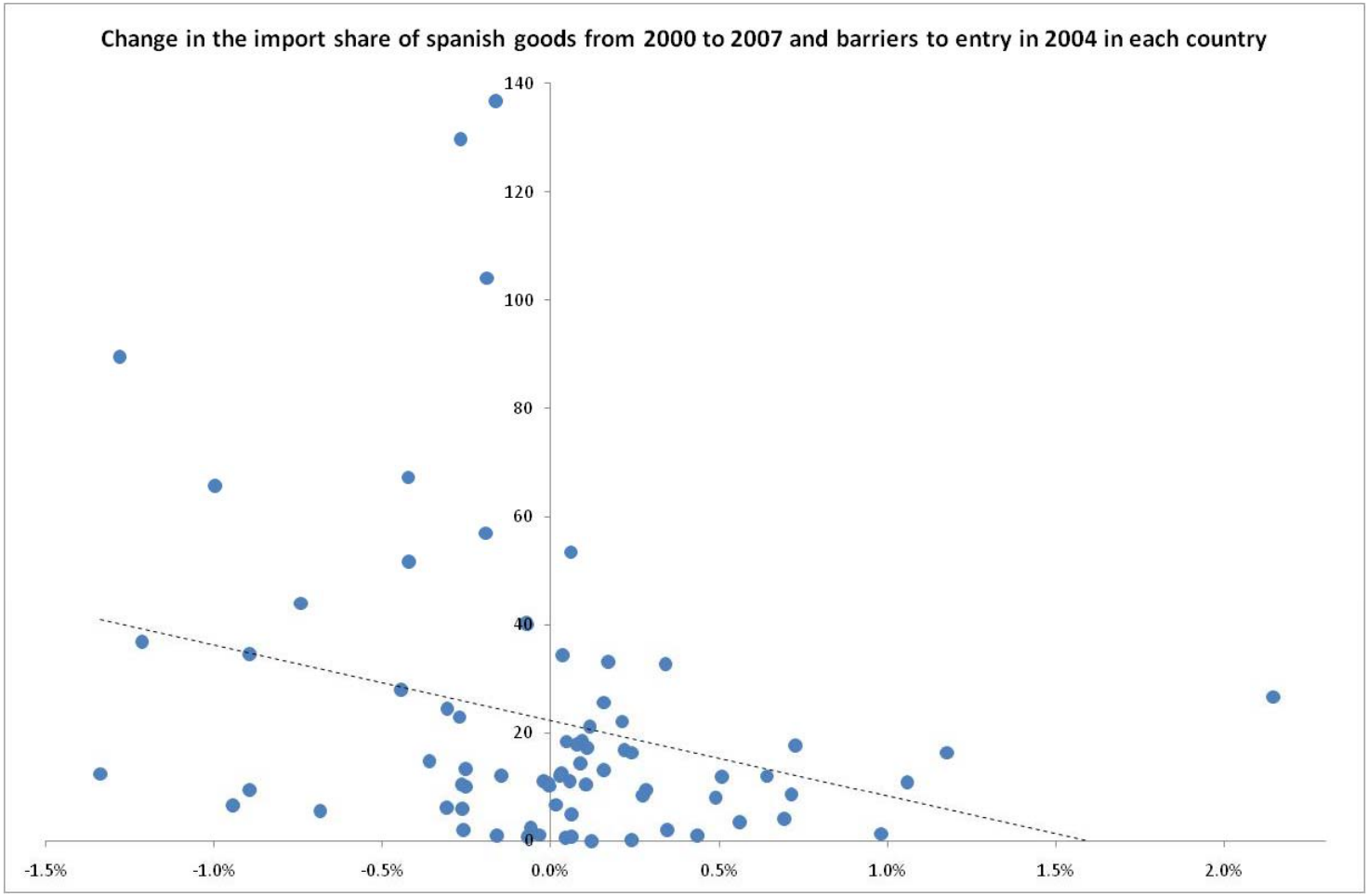
Sources: WB, ECB, WTO, and MEH

A Markup Adjustment?



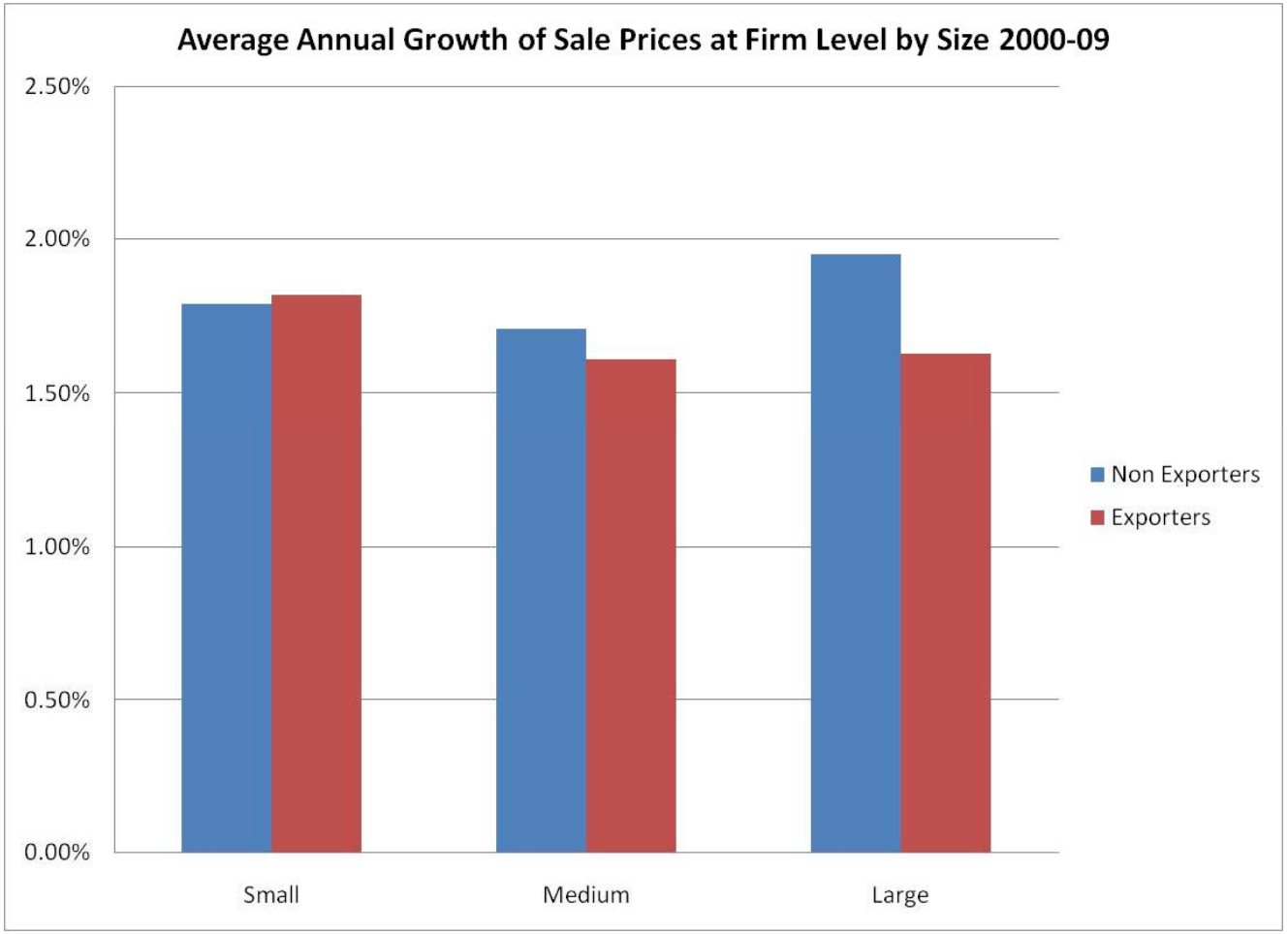
Sources: WB, ECB, WTO, and MEH

A Markup Adjustment?



Sources: WB, ECB, WTO, and MEH

A Markup Adjustment?



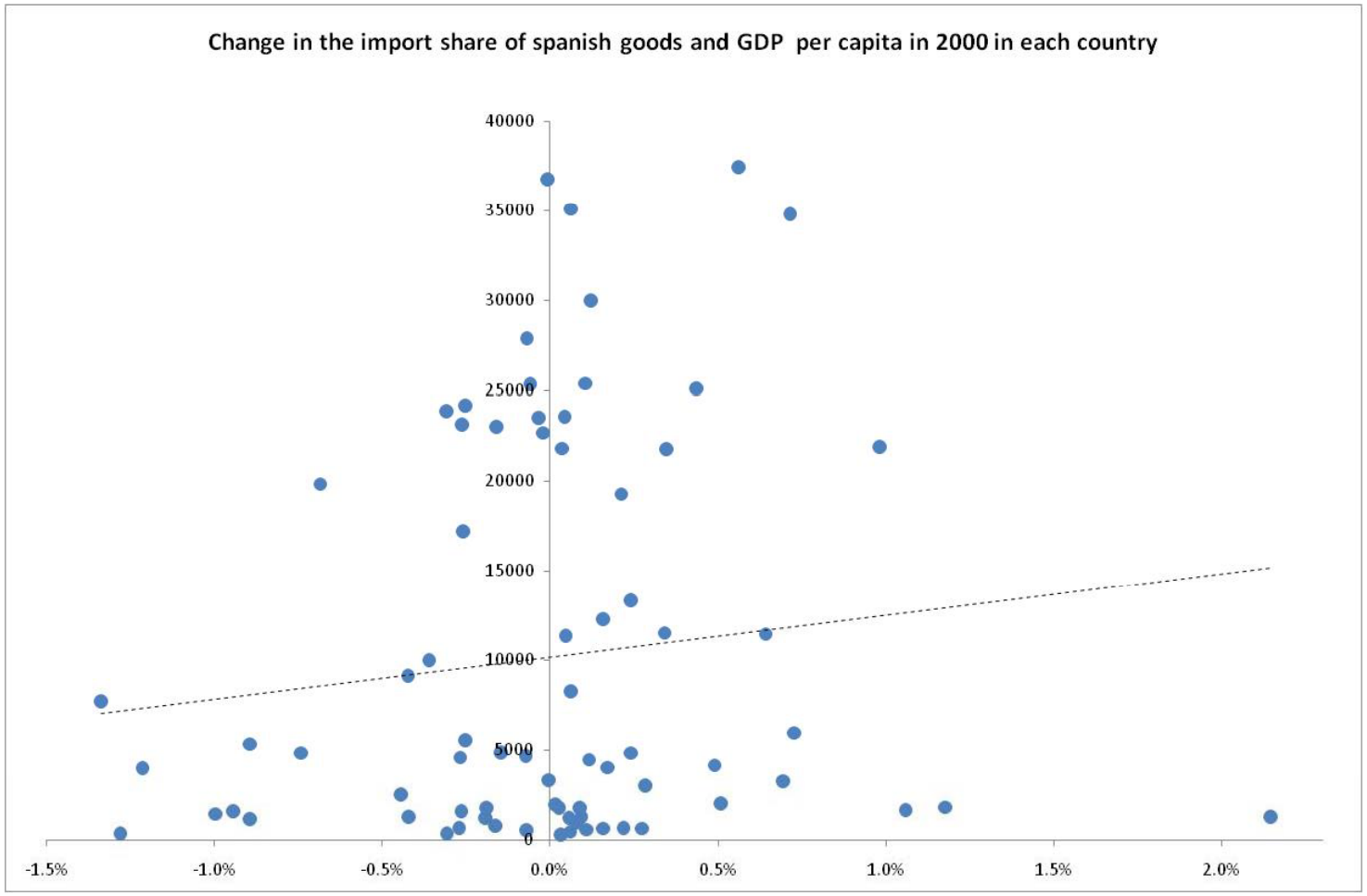
Source: ESEE

A Markup Adjustment?

Dependent variable: Growth of Sale Prices	Coefficient	t-statistic
Growth of Intermediate Input Prices	0.3168	39.81
Large Firms	0.1514	1.90

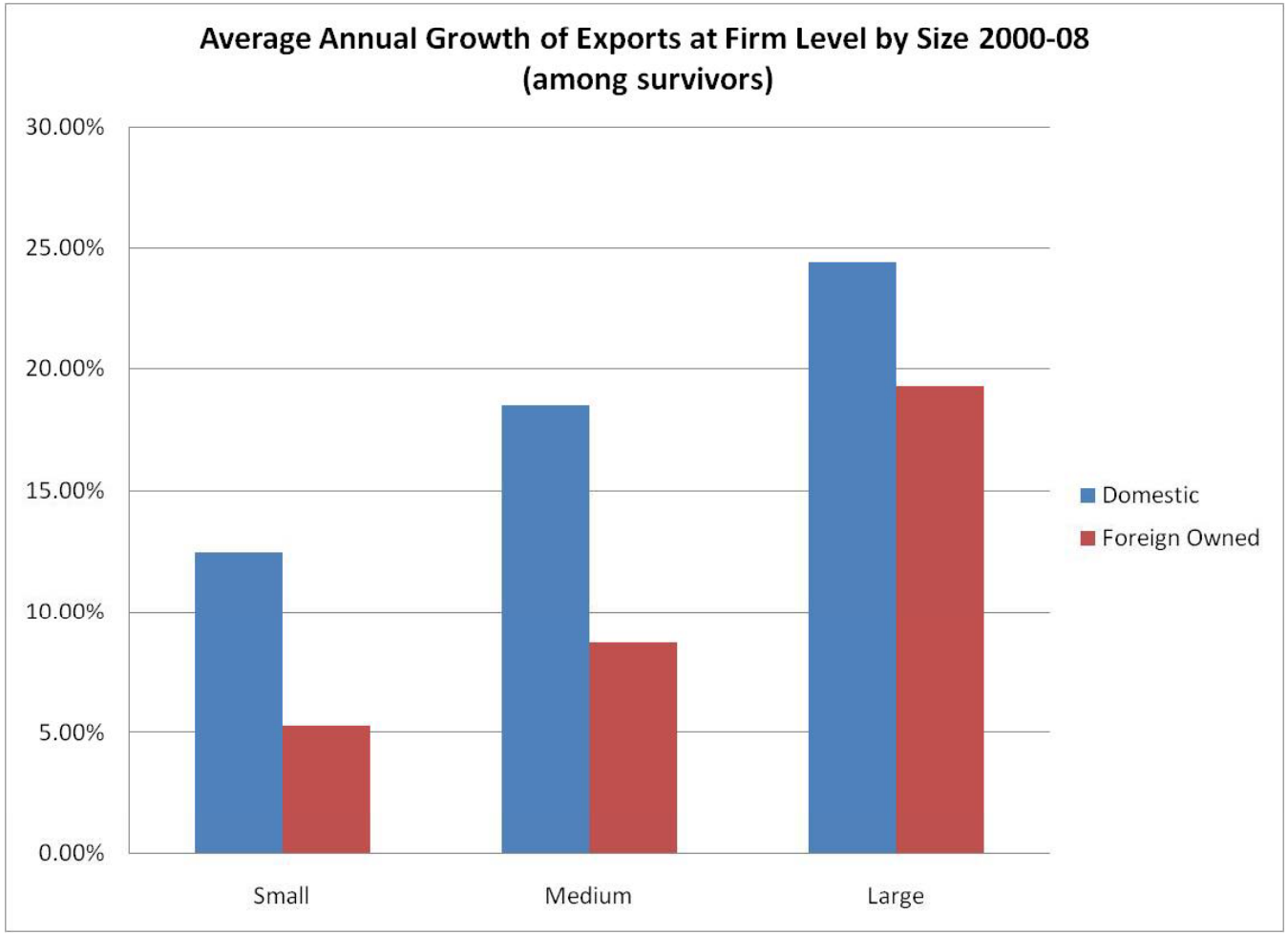
Source: ESEE

“Quality” Improvements?



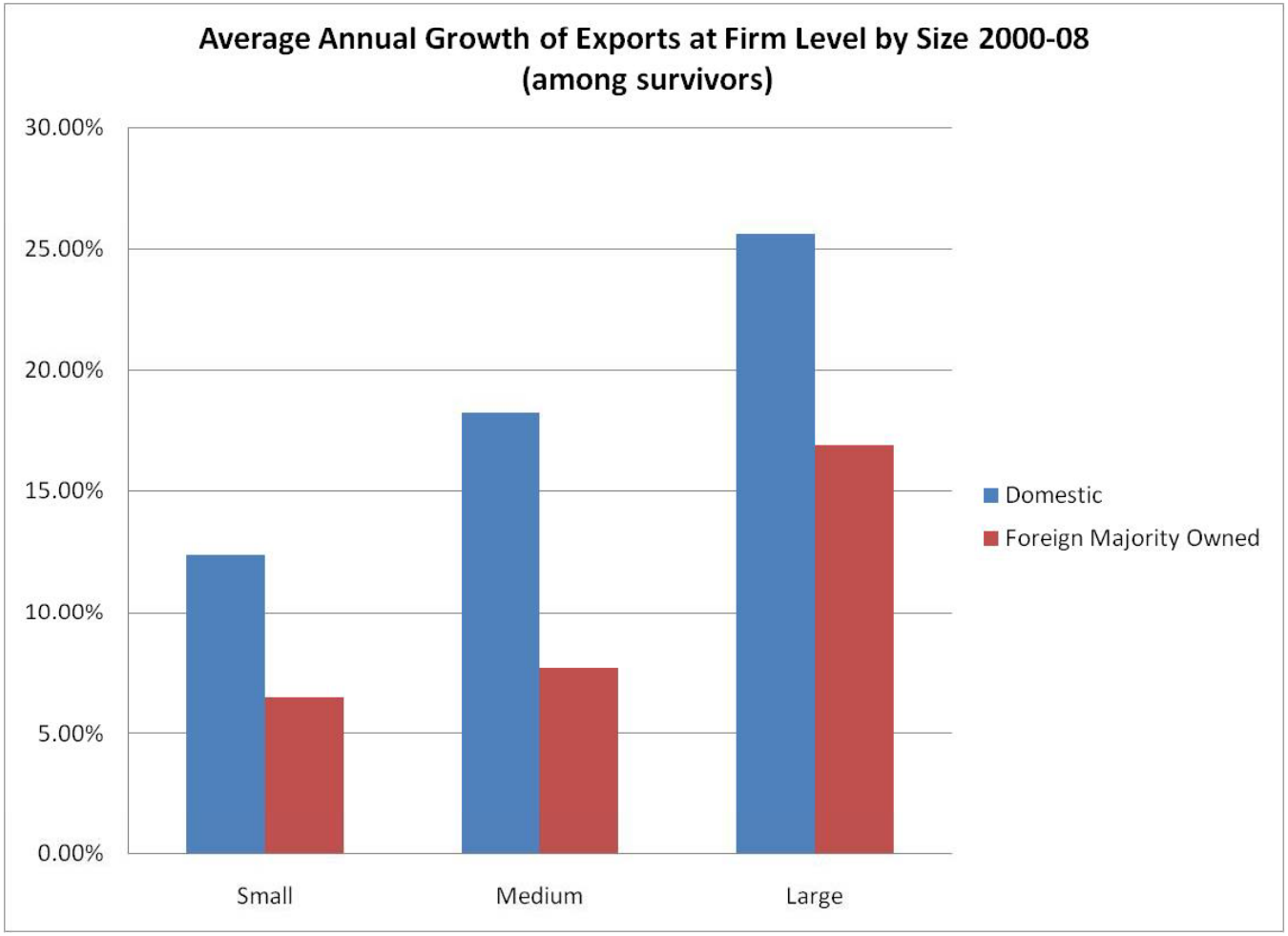
Sources: WB, ECB, WTO, and MEH

Is It Explained by Inward FDI?



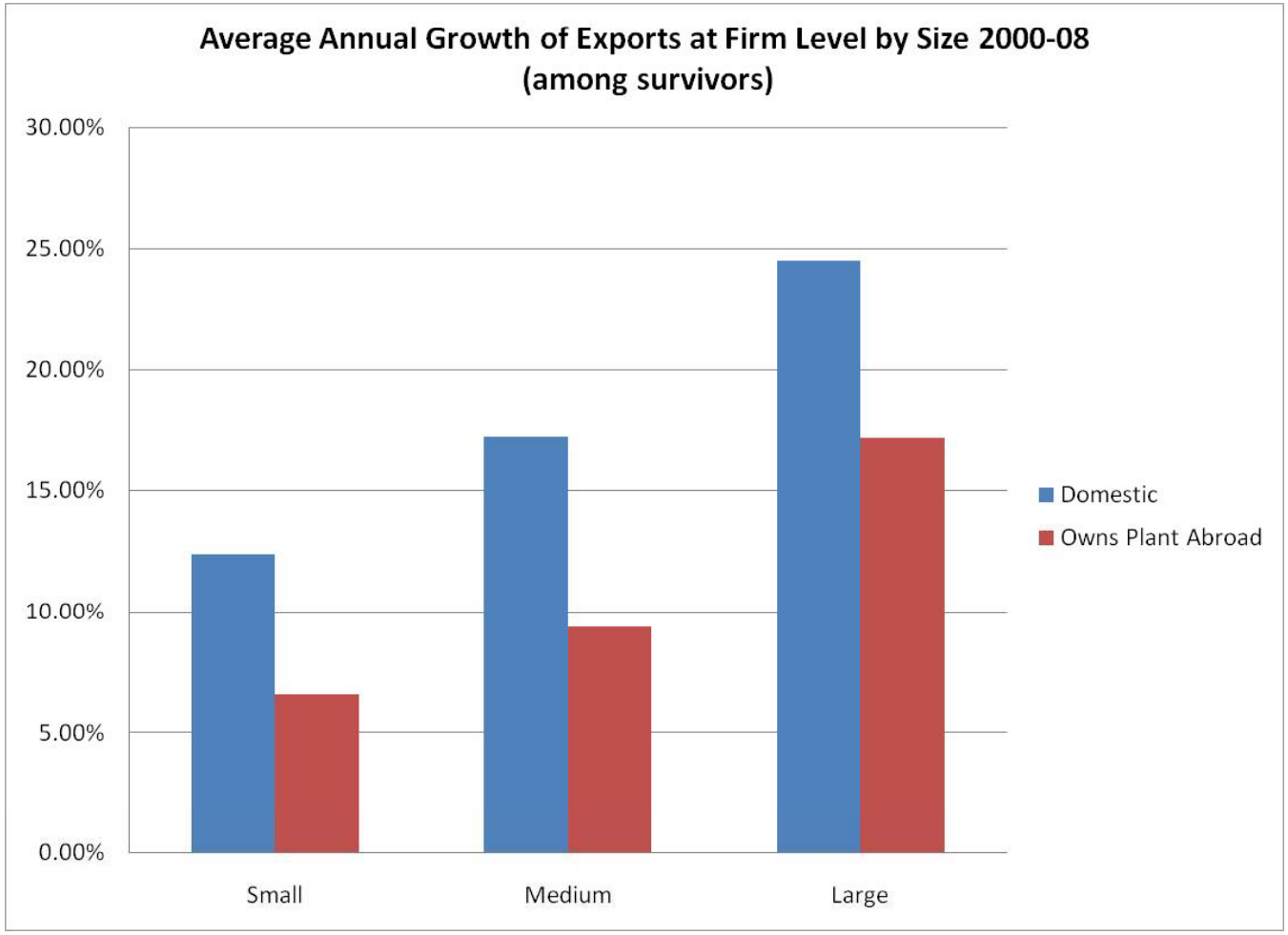
Source: ESEE

Is It Explained by Inward FDI?



Source: ESEE

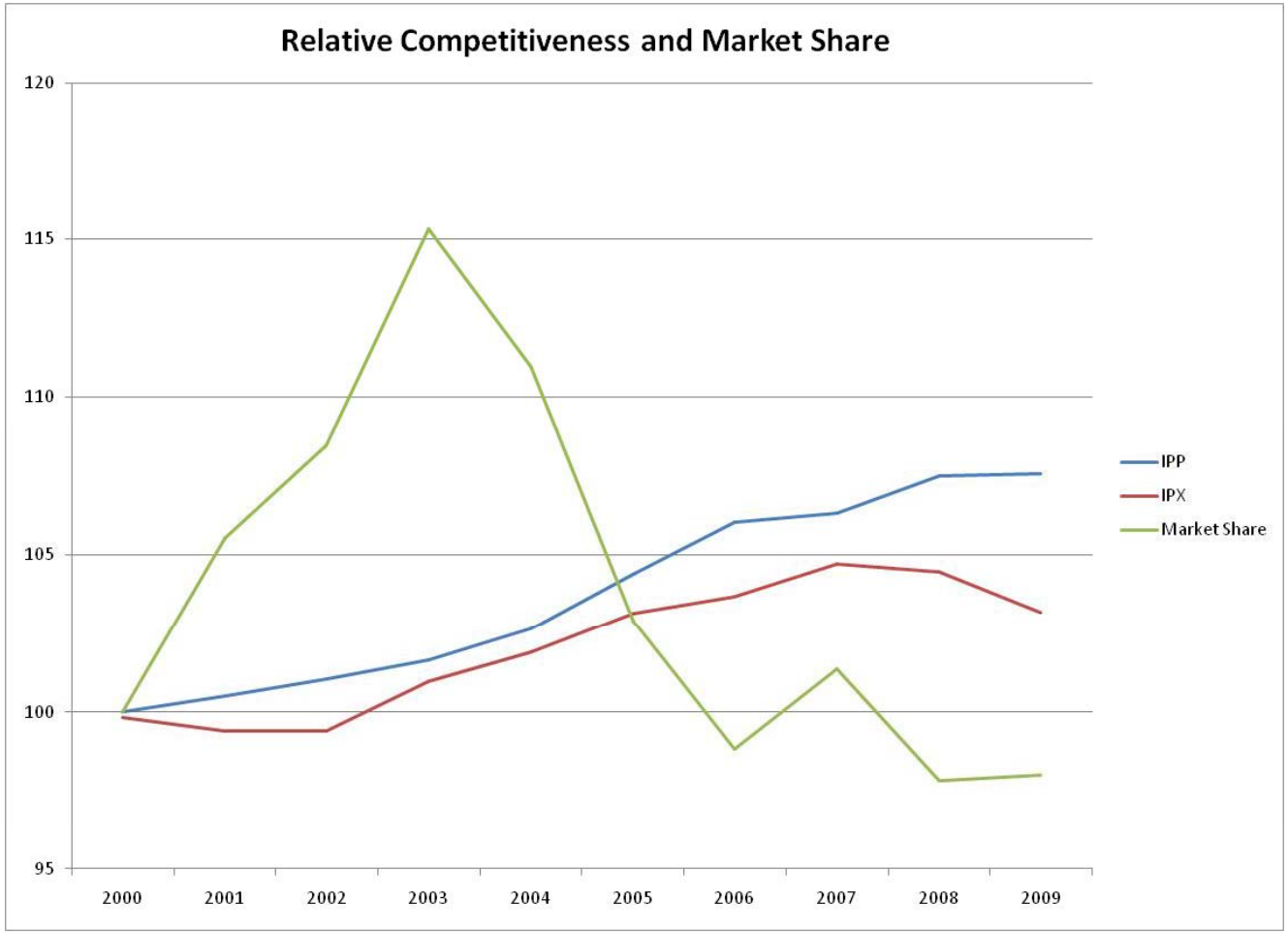
Is It Explained by Outward FDI?



Source: ESEE

Loose Ends

The Non-Monotonicity Around 2003



Sources: WTO and BdE

Recent Crisis

Changes in Labor Costs and Productivity (percentages)

	Firm Size (no. of employees)			
	200 or less		More than 200	
	2008	2009	2008	2009
Total Labor Costs	1,9	-8,7	3,3	-7,7
Average Total Employment	-5,3	-9,4	-2,6	-8,9
Real Ouput of Goods and Services	-5,0	-18,0	-8,4	-17,6
Real Value Added	-0,1	-6,1	-8,0	-9,6
Labor cost per worker	7,6	0,8	6,0	1,3
Productivity (Output based)	0,3	-9,5	-6,0	-9,6
Productivity (Value added based)	5,5	3,6	-5,5	-0,8

Source: ESEE

(In)Conclusions

(In)Conclusions

- Puzzling behavior of aggregate Spanish exports in light of apparent loss of competitiveness
- Models with firm heterogeneity appear promising in (partly) explaining this puzzle
  - Loss of competitiveness not homogenous across firms: large firms less affected
- Other simple explanations appear at odds with features of the data
- **Future work:** use of new homogenized dataset and quantification

(In)Conclusions

- *"Sorprenderse, extrañarse, es comenzar a entender"*
  ("To be surprised, to wonder, is to begin to understand.")

- José Ortega y Gasset