Heterogeneous Firms, Trade, and Links to Growth

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Introduction

- Two questions for presentation:
  - What can policy-makers learn from recent research in international trade?
  - What can researchers learn from the concerns of policy-makers?
- The animating idea of IGC is that in each group we have something to learn from the other. This talk will try to be in that spirit.

Introduction (cont.)

Plan of presentation:

1. What can policy-makers learn from recent research?
   - 1.1 Brief pre-history: traditional thinking and "new" trade theory
   - 1.2 Heterogeneous firms and "new new" trade theory
   - 1.3 New frontiers:
     - 1.3.1 Multi-product firms
     - 1.3.2 Product quality
2. What can researchers learn from the concerns of policy-makers?
   - 2.1 Case study: Mexico's disappointing growth
   - 2.2 Links between product specialization and innovation
3. Conclusion: Working Toward a Synthesis

1.1. Brief pre-history: traditional thinking and "new" trade theory

- Traditionally, the field of international trade was about sectors.
  - Data on trade flows, production only available at sector level.
  - Theories focused on how differences between countries would give rise to trade:
    - Productivity differences: Ricardo
    - Endowment differences: Heckscher-Ohlin
  - Puzzle for this literature: why is so much trade intra-industry, and between similar countries?

1.1. Brief pre-history: traditional thinking and "new" trade theory (cont.)

- Paul Krugman (1979, 1980) developed a tractable approach to modeling trade under monopolistic competition: "new" trade theory.
  - Each firm has its own differentiated brand.
  - Firms and products are homogeneous: distinct but symmetric.
  - Competition among brands drives profits to zero.
  - Representative consumer in each country has a "taste for variety," purchases all available varieties.
- Model proved extremely useful in understanding why, for instance, the US and Germany export cars to one another.
- Data were still only available at the sector level.
  - A typical goal for economic theory, appropriately, is the simplest model consistent with established facts.
  - Given the facts, trade economists were willing to live with the homogeneity assumptions.

1.2. Heterogeneous firms and "new new" trade theory

- Beginning in early 1990s, researchers gained access to data on individual firms/plants (Roberts and Tybout, eds, 1996; Bernard and Jensen, 1995).
  - Documented tremendous heterogeneity across firms, even within narrowly defined sectors.
  - Within narrow sectors,
    - A minority of firms export.
    - Exporters are larger, more productive, and pay higher wages than non-exporters.
  - In response to trade liberalization, sector-level productivity rises, but (at least initially) this appeared to be mainly because more-productive firms grow and less-productive firms shrink or die, not because trade raises productivity within a particular firm (Clerides et al., 1998; Bernard and Jensen, 1999; Pavcnik, 2002).
- Krugman-style theory couldn't account for the new facts.

1.2. Heterogeneous firms and "new new" trade theory (cont.)

- Marc Melitz (2003) extended the Krugman framework to incorporate heterogeneous firms.
  - Potential entrepreneurs initially do not know their productivity. Have to pay a fixed cost to get a productivity draw, φ.
  - There is a fixed cost for producing. If productivity is sufficiently high, they stay in market and produce.
  - There is also a fixed cost for exporting. Only firms above a higher cut-off enter export market.
  - In response to reductions in trade costs, higher-φ firms increase exports, lower-φ firms contract (because of greater competition in domestic market.)
- Model has become the standard framework for analyzing the behavior of heterogeneous firms.

1.2. Heterogeneous firms and "new new" trade theory (cont.)

- Model imposes a number of stark simplifications:
  - Each firm produces one product.
  - Products enter symmetrically in consumer's utility function.
  - Single input, labor, is homogeneous.
  - Firms export to all other countries or none.
- First generation of firm-level datasets lacked information on:
  - export destinations
  - products
  - individual workers
- Again, given the available facts, researchers were willing to live with the simplifying assumptions.

1.3. New frontiers

- Recently, several types of even more detailed data have started to become available:
  - Trade-transactions data from firms' customs declarations: include destination (or origin) and unit value (price) of every export (or import) transaction.
  - Data on all products produced (outputs) or consumed (inputs) by firms, in some cases with unit values.
  - Employer-employee data: wages of all individuals in a firm, with individual identifiers that allow one to follow workers across firms.
- A surge of recent work in empirical trade has explored these new datasets and established new facts.
  - The new facts have in turn led to a round of modifications/extensions of Melitz-type models to account for the new patterns.

1.3.1. Multi-product firms

- There is a strong correlation between the number of products that firms export and the number of destination countries they sell to.
- Value of trade is concentrated among multi-product, multi-destination firms.

Table 4 of Bernard, Jensen, Redding and Schott (2007)

Table 4

Distribution of Exporters and Export Value by Number of Products and Export Destinations, 2000

A: Share of Exporting Firms

Number of products	*Number of countries*					
	1	*2*	*3*	*4*	*5+*	*All*
1	40.4	1.2	0.3	0.1	0.2	**42.2**
2	10.4	4.7	0.8	0.3	0.4	**16.4**
3	4.7	2.3	1.3	0.4	0.5	**9.3**
4	2.5	1.3	1.0	0.6	0.7	**6.2**
5+	6.0	3.0	2.7	2.3	11.9	**25.9**
All	**64.0**	**12.6**	**6.1**	**3.6**	**13.7**	**100**

B: Share of Export Value

Number of products	*Number of countries*					
	1	*2*	*3*	*4*	*5+*	*All*
1	0.20	0.06	0.02	0.02	0.07	**0.4**
2	0.19	0.12	0.04	0.03	0.15	**0.5**
3	0.19	0.07	0.05	0.03	0.19	**0.5**
4	0.12	0.08	0.08	0.04	0.27	**0.6**
5+	2.63	1.23	1.02	0.89	92.2	**98.0**
All	**3.3**	**1.5**	**1.2**	**1.0**	**92.9**	**100**

1.3.1. Multi-product firms (cont.)

- In response to a bilateral trade liberalization (U.S. and Canada), U.S. firms reduced the number of different products they produced (Bernard et al., 2011).

TABLE I

U.S. MANUFACTURING FIRM SCOPE DURING THE CANADA–U.S. FREE TRADE AGREEMENT

	[1]	[2]	[3]
Change in products	−0.059	−0.624	−0.572
	0.015	0.101	0.096
Change in entropy	0.011	0.156	0.153
	0.003	0.026	0.026
Firm observations	66,472	66,472	66,472
Major industry dummy variables	No	Yes	Yes
Log 1987 employment	No	No	Yes

Notes. Table reports mean difference in noted variable between surviving firms experiencing above- and below-median changes in Canadian export opportunities between 1987 and 1992. Each cell reports the mean difference and associated standard error from a separate OLS regression. Change in products refers to change in number of five-digit SIC categories produced in the United States. Change in entropy is defined in the text. Change in export opportunities refers to the output-weighted average change in Canadian tariffs across the four-digit SIC industries produced by the firm. Robust standard errors are clustered according to firms' main four-digit SIC industry. Additional covariates are included as noted.

1.3.1. Multi-product firms (cont.)

- Bernard, Redding and Schott (2011) develop an extension of Melitz (2003) that is consistent with these facts:
  - In addition to firm-specific productivity draw (à la Melitz), firms get a product-specific productivity (or profitability/demand) draw.
  - In firms with high firm-specific draws, more products make the cut and are produced.
  - With trade liberalization, just as there is a reallocation from lower-productivity to higher-productivity firms, there is a reallocation from lower-productivity to higher-productivity products with firms.
- Alternative formalization, in context of oligopoly: Eckel and Neary (2010).
  - Can account for "cannibalization" effects.

1.3.1. Multi-product firms (cont.)

- Goldberg, Khandelwal, Pavcnik and Topalova (2010):
  - Trade liberalization in India led to expansion in the availability of imported inputs.
  - Using changes in import tariffs as an instrument, and input-output tables to determine which sectors use which inputs, authors show that greater input availability led to the introduction of new products by Indian firms.

Table IVa of Goldberg et al. (2010)

TABLE IVa
PRODUCT SCOPE AND INPUT TARIFFS

	(1)	(2)	(3)	(4)
Input tariff	−0.323**	−0.310**	−0.327**	−0.281**
	(0.139)	(0.150)	(0.150)	(0.125)
Output tariff		−0.013	−0.014	−0.010
		(0.043)	(0.041)	(0.041)
Delicensed			−0.032	−0.026
			(0.023)	(0.021)
FDI liberalized				0.037
				(0.024)
Year effects	Yes	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes	Yes
R^2	.90	.90	.90	.90
Observations	14,882	14,864	13,435	11,135

Notes. The dependent variable in each regression is (log) number of products manufactured by the firm. The delicensed variable is an indicator variable obtained from Aghion et al. (2008) that switches to one in the year that the industry becomes delicensed. The FDI variable is a continuous variable obtained from Topalova and Khandelwal (2011), with higher values indicating a more liberal FDI policy. As with the tariffs, the licensed and FDI policy variables are lagged. All regressions include firm and year fixed effects and are run from 1989 to 1997. Standard errors (in parentheses) clustered at the industry level.

*10%, **5%, and ***1% significance level.

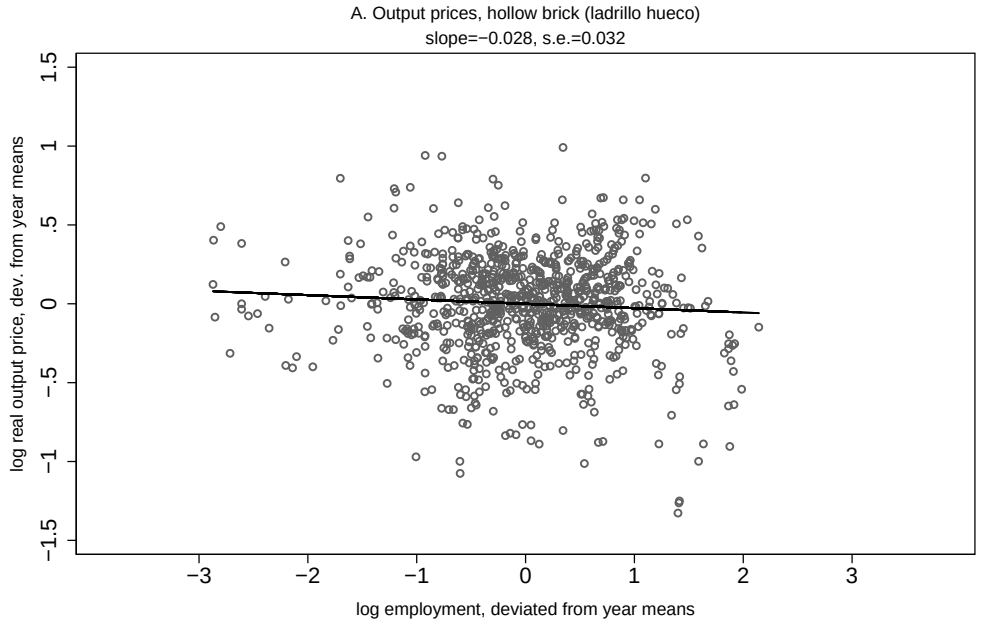
1.3.2. Product quality

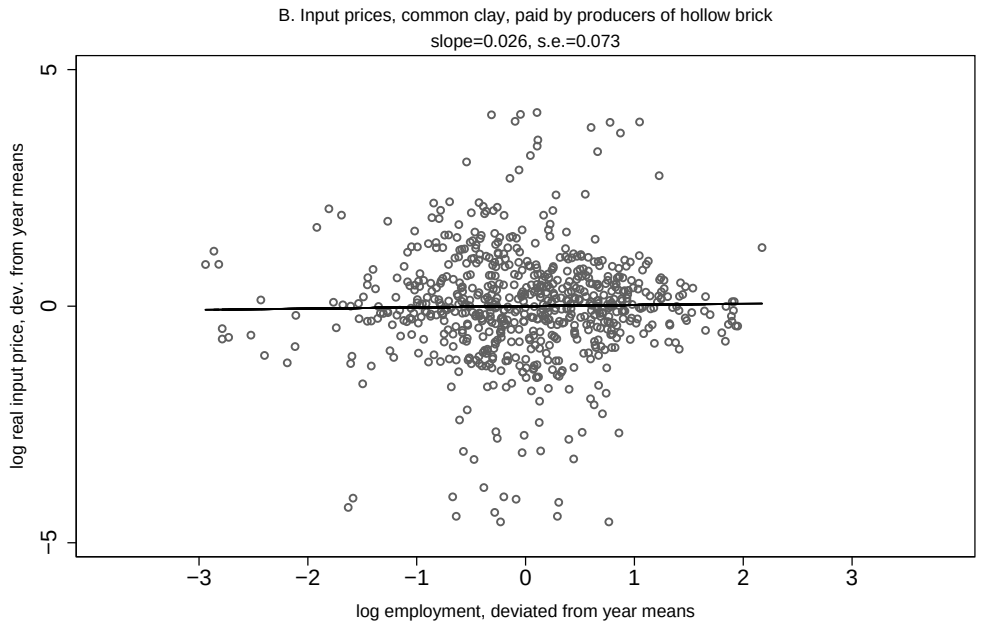
- Using U.S. trade flow data at the 10-digit level, Schott (2004) showed that unit values (prices) of U.S. imports vary widely within narrow categories.
  - Prices are systematically related to origin-country characteristics, with richer, more-capital- and skill-abundant countries charging higher prices.
- Hummels and Klenow (2005), Khandelwal (2010), and Hallak and Schott (2011) use fact that some origin country-sectors have both high prices and high quantities to make inferences about product quality.

1.3.2. Product quality (cont.)

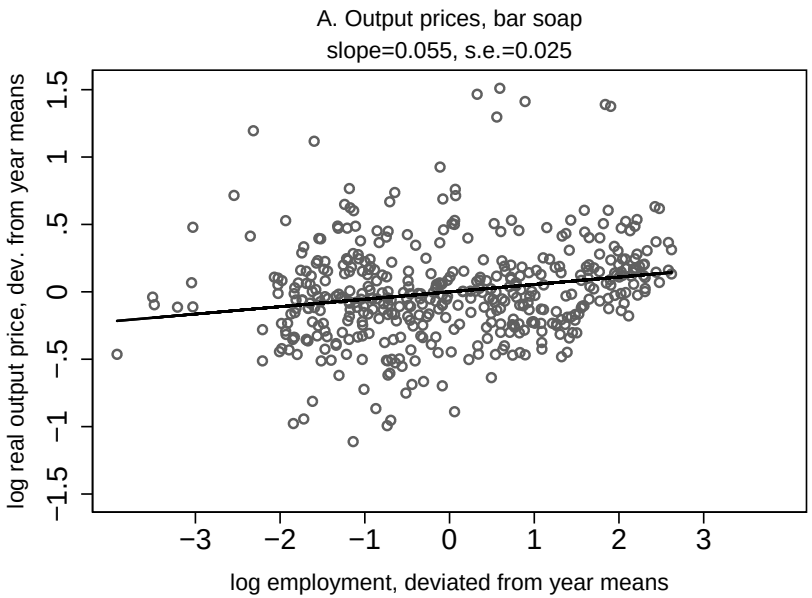
- Using detailed data on prices of both outputs and inputs from the Colombian manufacturing census, Kugler and Verhoogen (2012) show that, within narrow industries:
  - Larger plants charge higher prices for their outputs.
    - Plant-level analogue of correlation used to infer quality in sector-level studies.
  - Larger plants pay higher prices for their inputs.
  - Both of the above correlations are more positive in sectors with greater scope for quality differentiation, as measured by R&D and advertising intensity (following Sutton (1998)).

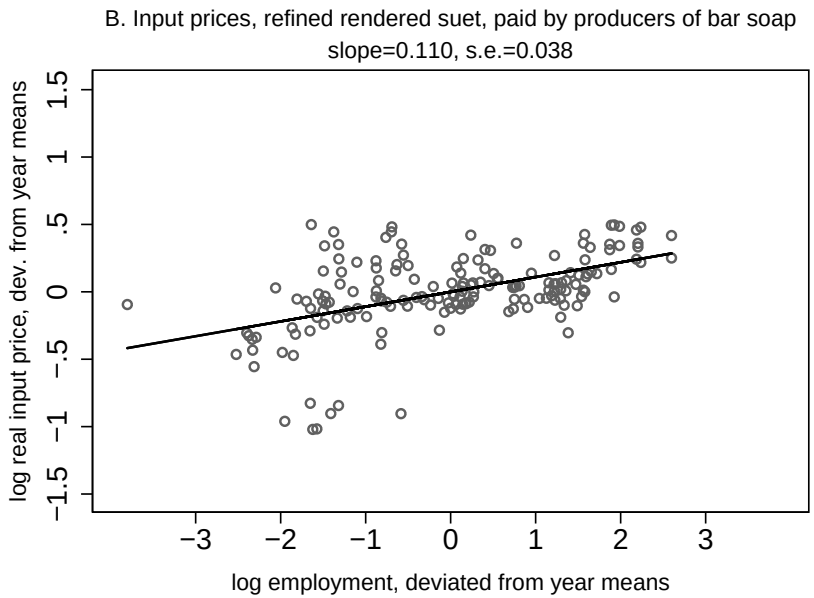
Example: Hollow Brick





Example: Bar Soap (for Washing)





1.3.2. Product quality (cont.)

- On average, Colombian sectors are more like bar soap than like hollow bricks.
- Patterns consistent with extension of Melitz (2003) in which better firms endogenously choose higher-quality inputs to produce higher-quality outputs.
  - Technical note: Melitz (2003) model itself has a quality interpretation, but cannot account for patterns in input prices.

1.3.2. Product quality (cont.)

- Related studies:
  - Using direct quality ratings of French wines, Crozet, Head and Mayer (2012) show that patterns are consistent with "quality Melitz" model.
    - Higher-rated wines are produced by larger firms and shipped to more destinations.
  - Hallak and Sivadasan (2011): exporters have higher output prices, input prices, capital intensity, ISO 9000 adoption *conditional on size.*
    - Requires model with more than one dimension of heterogeneity.

1.3.2. Product quality (cont.)

- This literature is particularly relevant to developing countries because it suggests that firms need to *upgrade quality* in order to be successful in selling to rich countries.
  - Verhoogen (2008): exogenous increase in incentive to export led Mexican plants increased exports, ISO 9000 certification, capital intensity and wages.
  - Bastos and Silva (2010): using trade-transactions data from Portugal, show that firms charge higher prices in rich destinations, for the same product in the same year. See table.
  - Manova and Zhang (2012) show similar pattern for China.
    - Also show that firms that charge on average high prices for exports also on average pay high prices for imported inputs.
  - Pattern also holds for Hungary (Görg et al., 2010) and France (Martin, forthcoming).
  - Brambilla, Lederman and Porto (forthcoming): exogenous increases in exports of Argentinian firms to rich countries lead to wage increases; exogenous increases in exports *per se* (i.e. to Brazil) do not.

Table 6 of Bastos and Silva (2010)

	Full sample					
	(1)	(2)	(3)	(4)	(5)	(6)
ln Y	0.026	0.024	0.012	0.007	0.006	0.005
	(3.99)***	(2.48)**	(2.48)**	(1.08)	(1.23)	(0.95)
ln Y/L	0.042	0.051	0.038	0.043	0.039	0.039
	(1.75)*	(2.61)***	(2.58)**	(3.01)***	(1.90)*	(2.06)**
EU	−0.011	−0.029	0.023	0.024	−0.056	−0.075
	(0.33)	(0.71)	(0.82)	(0.66)	(1.45)	(1.67)*
LANDL	0.137	0.117	0.120	0.113	0.077	0.066
	(3.40)***	(3.28)***	(3.58)***	(3.49)***	(1.86)*	(2.00)**
ln DIST	0.094		0.086		0.053	
	(6.95)***		(7.06)***		(4.00)***	
1<km≤4000		0.135		0.093		0.073
		(5.13)***		(5.84)***		(3.39)***
4000<km≤7800		0.265		0.223		0.114
		(5.86)***		(5.83)***		(2.78)***
7800<km≤14000		0.168		0.204		0.109
		(3.62)***		(4.52)***		(2.34)**
14000<km		0.271		0.254		0.184
		(5.74)***		(5.55)***		(3.56)***
Product fixed-effects	Yes					
Firm fixed-effects			Yes			
Firm-product fixed-effects					Yes	
R^2	0.55	0.55	0.56	0.56	0.94	0.94
F-statistic	25.06	28.90	15.46	15.56	7.94	9.34
P-value	0.000	0.000	0.000	0.000	0.000	0.000
Observations	247,269					
Products	7553					
Firms	16,366					
Product-firm groups	161,166					
Destinations	199					

1.3.2. Product quality (cont.)

- Caveat: product quality is almost never directly observed. But the accumulation of more and more consistent results from more and more datasets points strongly toward a quality interpretation.

1.3. New frontiers (cont.)

- Important stuff I am not saying anything about:
  - Recent work on trade and labor markets, using employer-employee data.
    - Verhoogen (2008); Bustos (2011); Frías et al. (2011); Helpman et al. (2012); Hummels et al. (2011); Krishna et al. (2011); Davidson et al. (2011).
  - Recent work on export dynamics.
    - Eaton et al. (2009); Albornoz et al. (2012)
  - Quantitative modeling of trade flows based on Eaton and Kortum (2002).

Plan of presentation:

1. What can policy-makers learn from recent research?
   - 1.1 Brief pre-history: traditional thinking and "new" trade theory
   - 1.2 Heterogeneous firms and "new new" trade theory
   - 1.3 New frontiers:
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2. What can researchers learn from the concerns of policy-makers?
   - 2.1 Case study: Mexico's disappointing growth
   - 2.2 Links between product specialization and innovation
3. Conclusion

2. What can researchers learn from the concerns of policy-makers?

- At past Growth Weeks, I have been struck by the attention by policy-makers to a set of issues I would put under the heading of links between the pattern of specialization and growth.
  - Does what a country produces affect how fast it grows?
- This concern has not been central to the mainstream academic literature in trade.
- It should be.

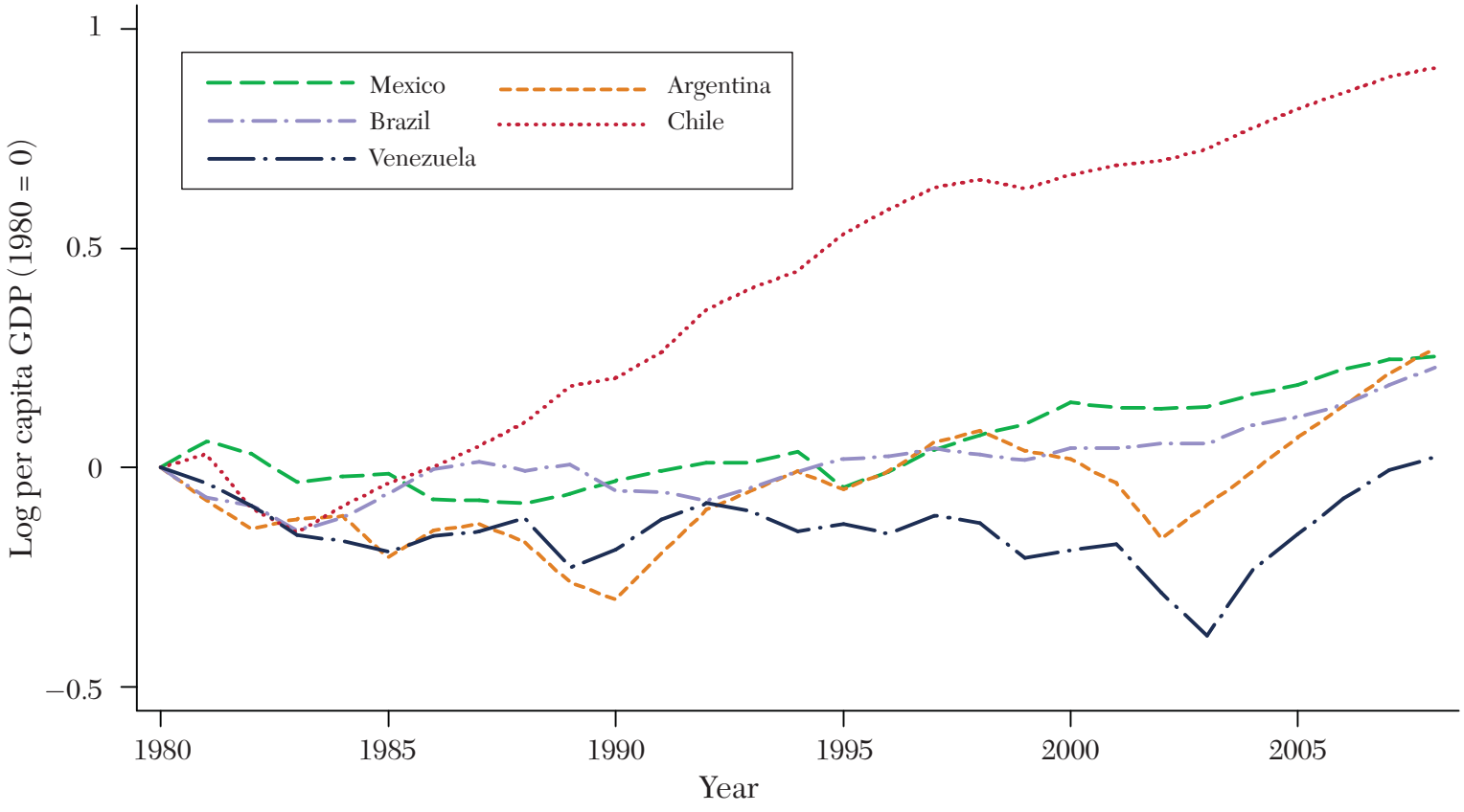
2.1. Case study: Mexico's disappointing growth

- To ground the discussion, I will focus on a particular country, Mexico.
  - Although not an IGC country, many IGC countries are facing (or will face) similar issues.
  - It also happens to be the country that I know best and am most qualified to talk about.

2.1. Case study: Mexico's disappointing growth (cont.)

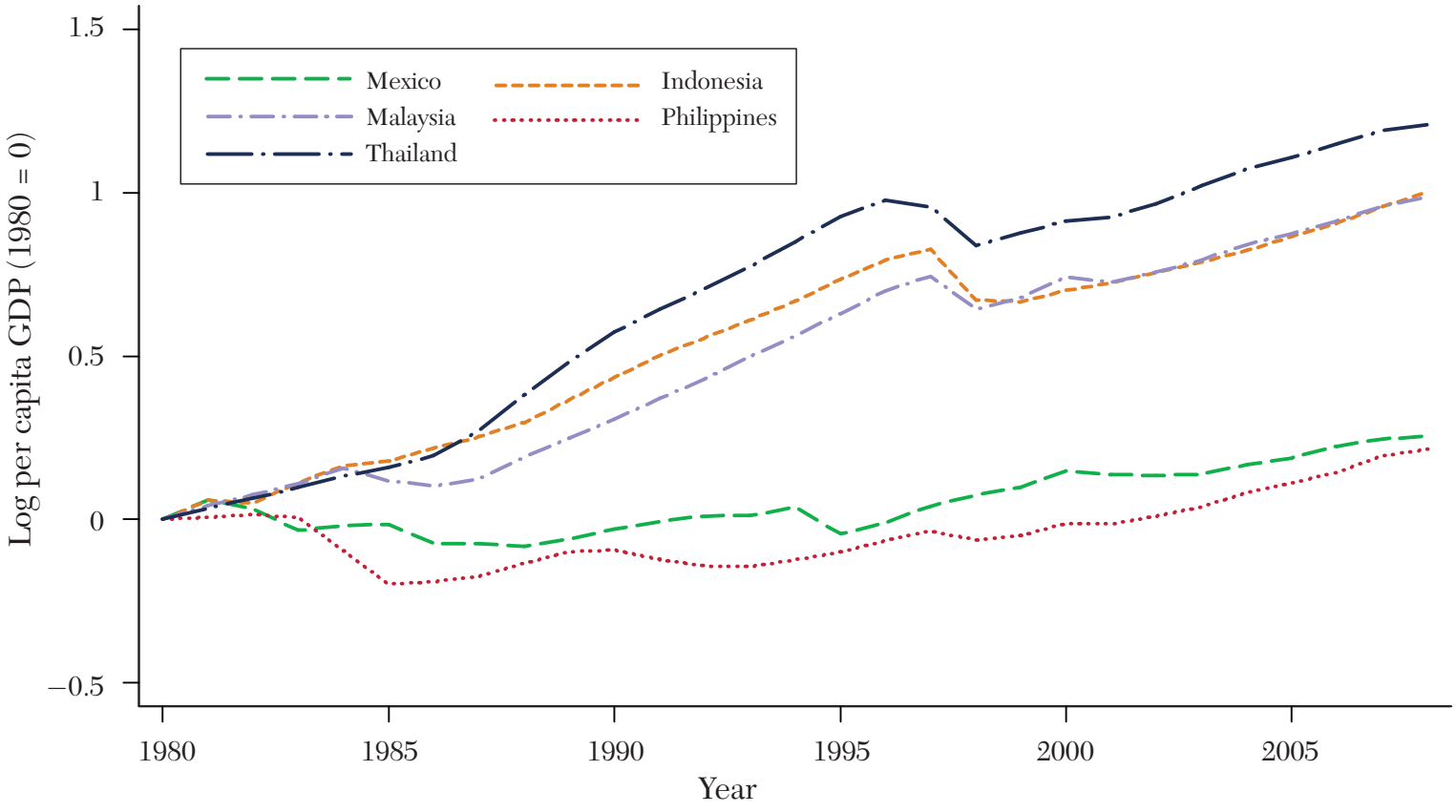
- Between 1985 and 1994, Mexico implemented an ambitious program of reforms, in line with recommendations from international institutions (IMF, World Bank etc.):
  - Trade liberalization
  - Privatization of state-owned enterprises
  - Liberalization of investment regime
  - General reduction of role of state in economy
- Advocates of reform were confident that rising average incomes would follow.
- But despite a very recent uptick, Mexico's growth performance has been disappointing.

2.1. Case study: Mexico's disappointing growth (cont.)



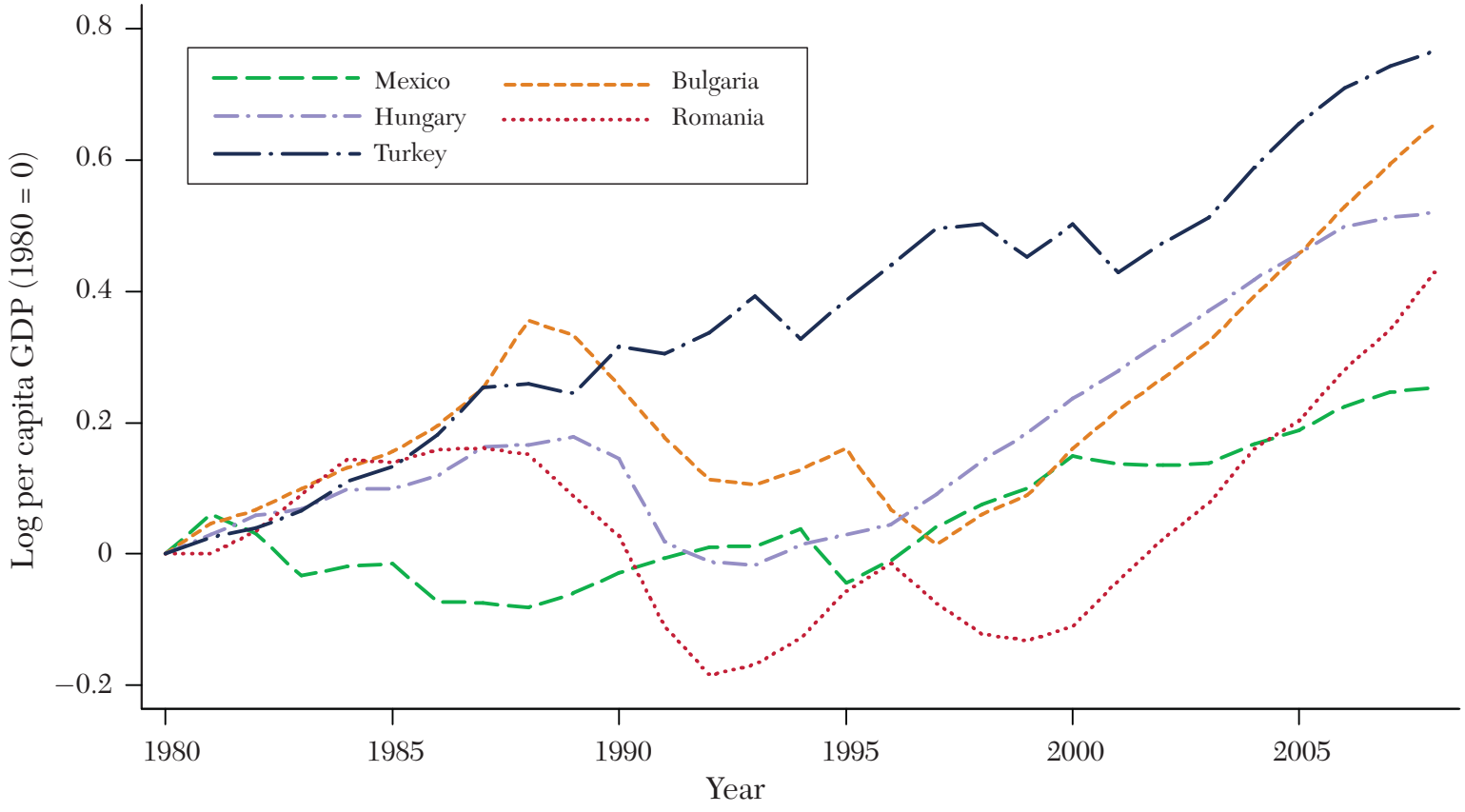
Source: Hanson (2010), Fig. 1A.

2.1. Case study: Mexico's disappointing growth (cont.)



Source: Hanson (2010), Fig 1B.

2.1. Case study: Mexico's disappointing growth (cont.)

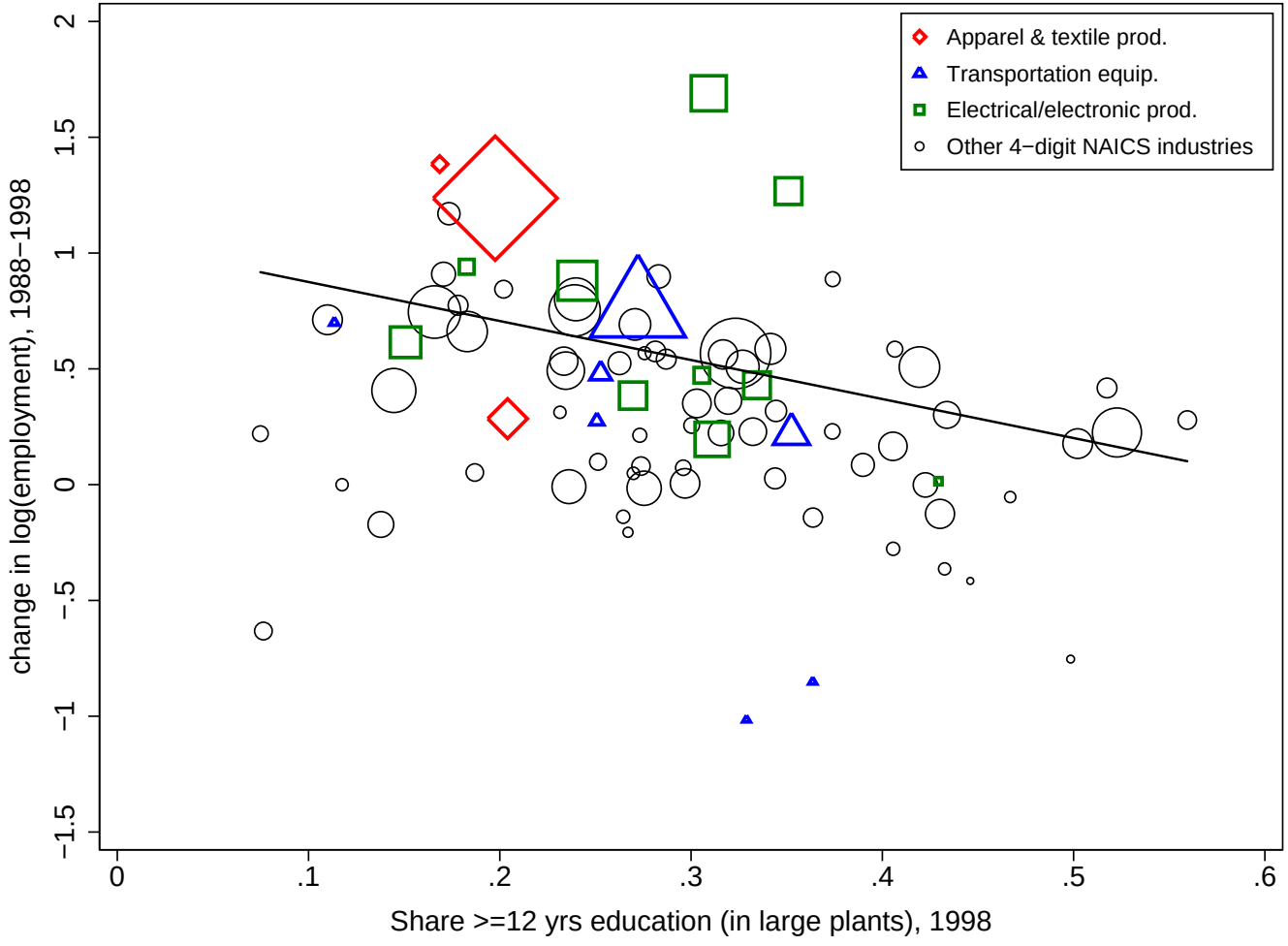


Source: Hanson (2010), Fig. 1C.

2.1. Case study: Mexico's disappointing growth (cont.)

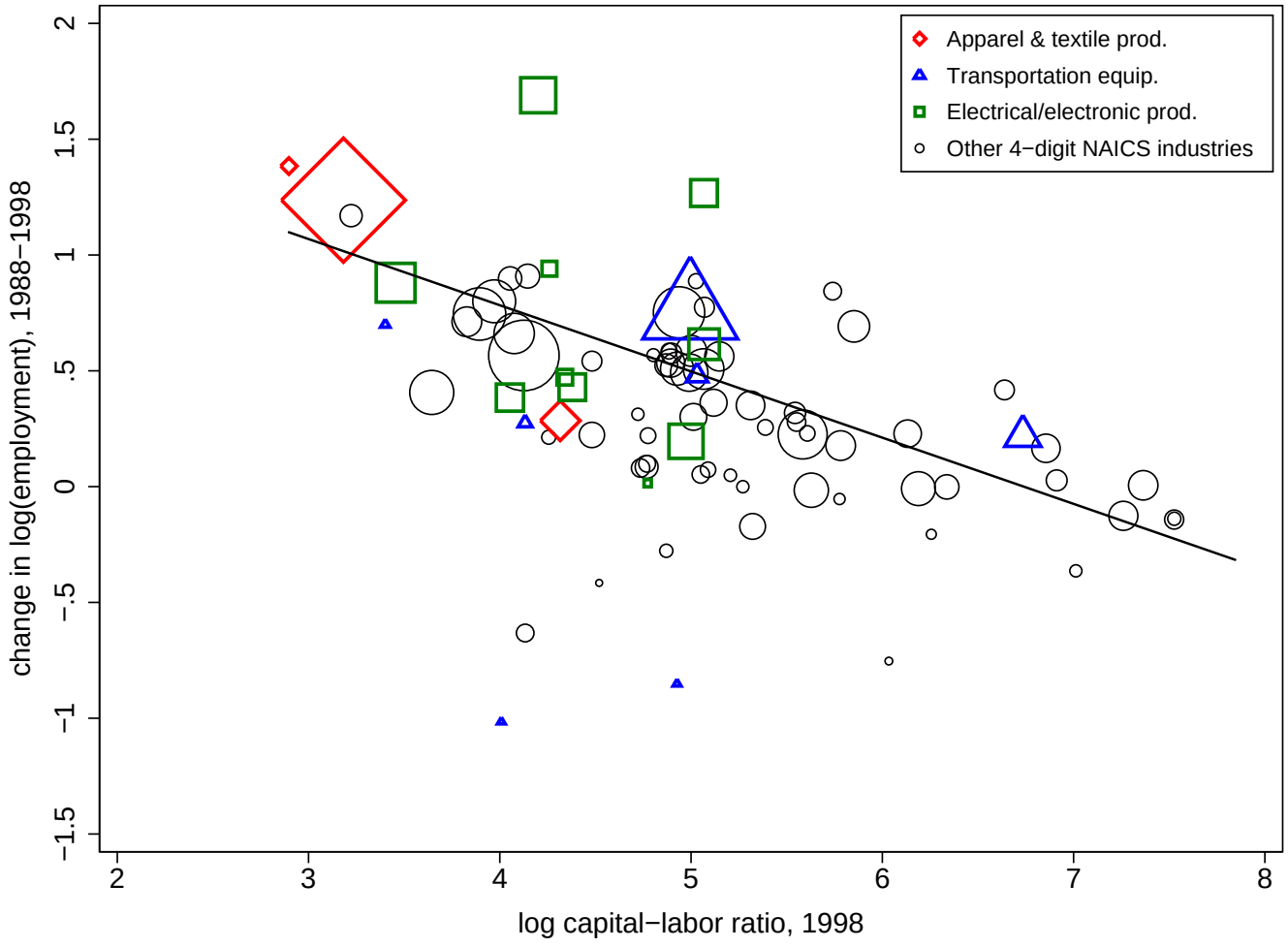
- There are many potentially valid explanations:
  - Monopolies and inefficient regulation (Arias, Azuara, Bernal, Heckman and Villarreal, 2010).
  - Underdeveloped credit markets (Haber, 2004).
  - Informality and tax evasion (Levy, 2008).
  - Corruption and, more recently, drug violence.
  - ...
- Without discounting these possibilities, here I would like to suggest that links between the pattern of specialization and innovation also played an important role.

2.1. Case study (cont.)



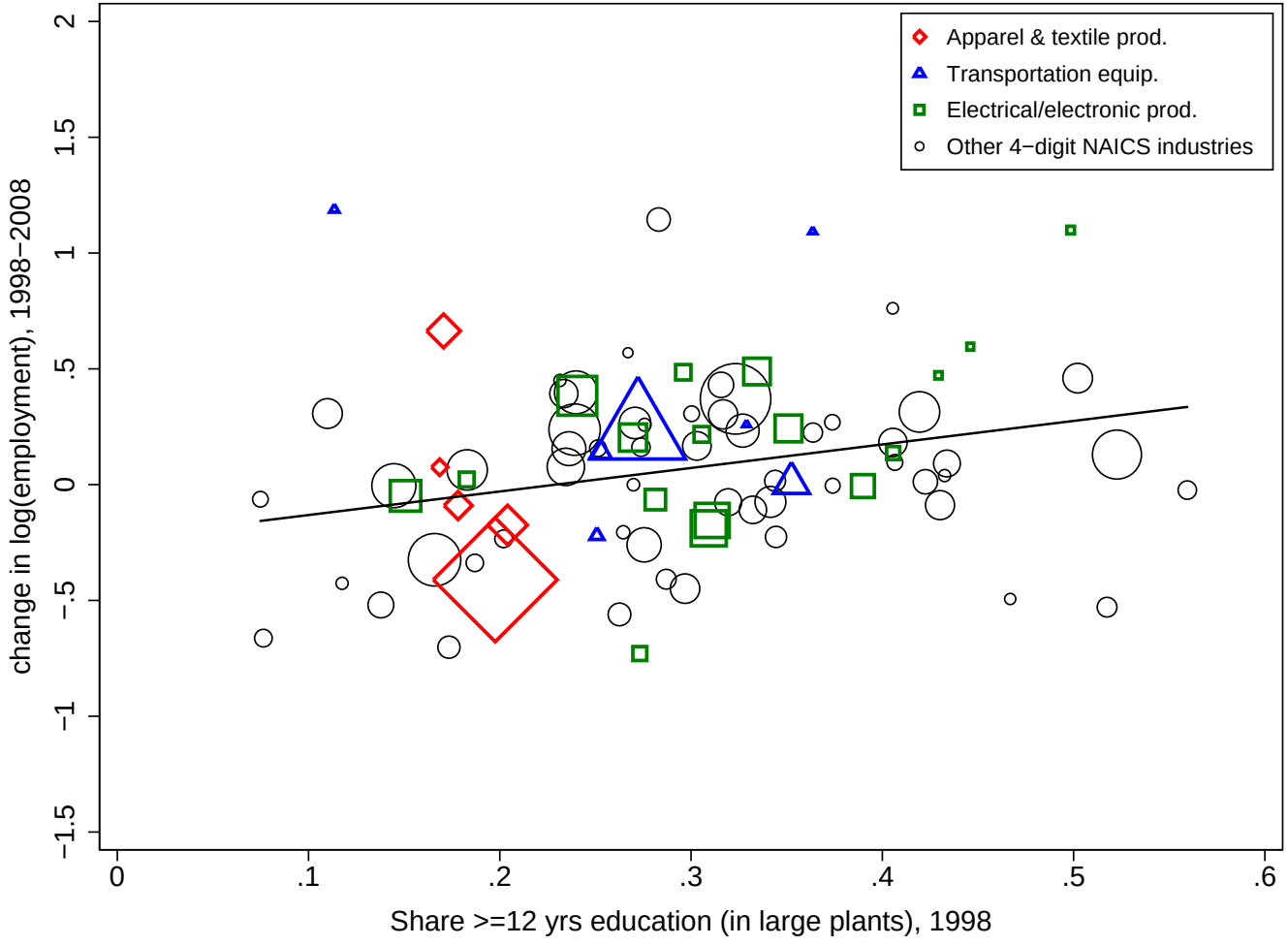
Source: Economic Censuses 1989, 1999 (employment) and ENESTyC 1999 (schooling). Each symbol represents a 4-digit NAICS industry; size reflects employment in industry in 1998.

2.1. Case study (cont.)



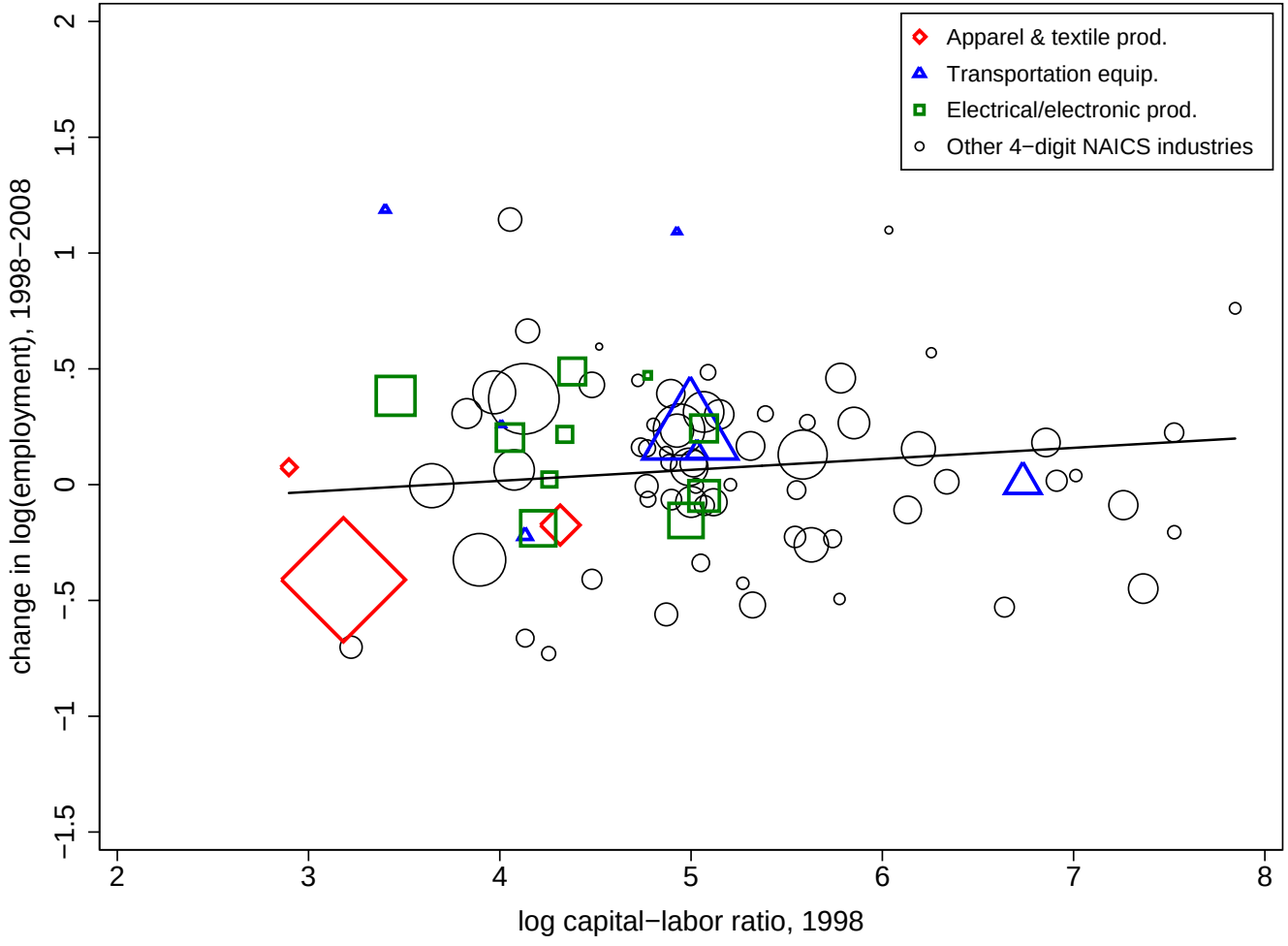
Source: Economic Censuses 1989, 1999 (employment and capital stock). Each symbol represents a 4-digit NAICS industry; size reflects employment in industry in 1998.

2.1. Case study (cont.)



Source: Economic Censuses 1999, 2009 (employment) and ENESTyC 1999 (schooling). Each symbol represents a 4-digit NAICS industry; size reflects employment in industry in 1998.

2.1. Case study (cont.)



Source: Economic Censuses 1999, 2009 (employment and capital stock). Each symbol represents a 4-digit NAICS industry; size reflects employment in industry in 1998.

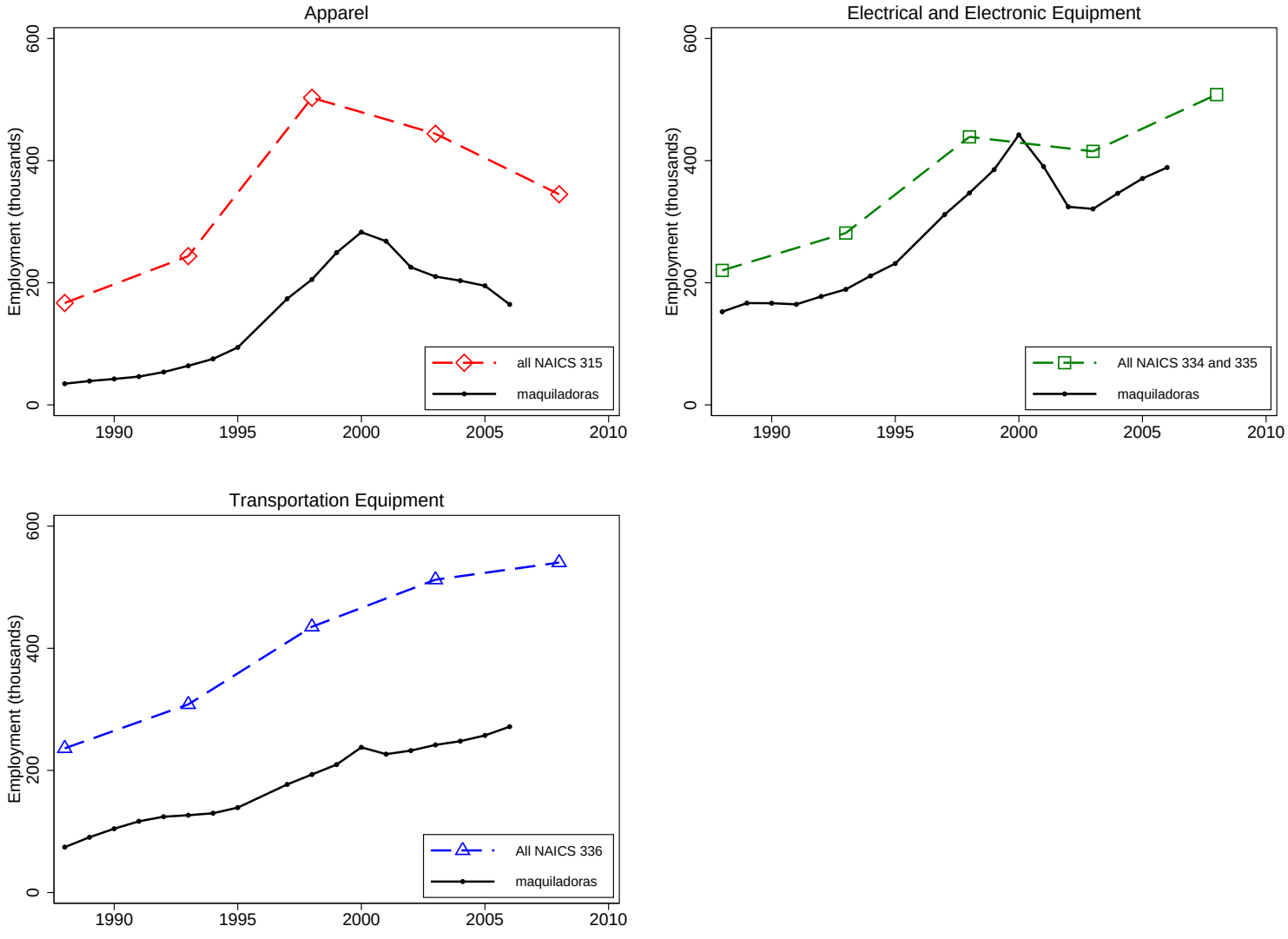
2.1. Case study (cont.)

	non-maquiladoras		
	non-exporters	exporters	maquiladoras
	(1)	(2)	(3)
Employment	315.43	438.97	969.67
	(8.23)	(11.07)	(30.02)
Export percentage of sales		30.81	96.52
		(0.72)	(0.63)
Foreign ownership indicator	0.08	0.29	0.84
	(0.01)	(0.01)	(0.02)
Capital-labor ratio	254.26	309.07	54.87
	(19.11)	(14.45)	(7.18)
Share with $>=$ 12 years schooling	0.28	0.32	0.19
	(0.01)	(0.01)	(0.01)
Percentage blue-collar	70.18	70.75	83.04
	(0.56)	(0.46)	(0.63)
Years of schooling, blue-collar	7.86	8.15	7.37
	(0.04)	(0.04)	(0.06)
Blue-collar hourly wage	3.59	3.92	3.83
	(0.06)	(0.05)	(0.10)
White-collar hourly wage	7.45	9.32	9.33
	(0.14)	(0.15)	(0.27)
Turnover rate	41.47	40.54	72.37
	(1.22)	(1.06)	(2.66)
Tenure (years)	6.25	6.59	3.53
	(0.09)	(0.08)	(0.08)
N	1423	1774	557

Source: ENESTyC 1999. Standard errors of means in parentheses. Sample is plants with $\geq$ 100 employees in 1999 ENESTyC. Capital-labor ratio measured in thousands of 1998 pesos; blue-collar and white-collar hourly wage in 1998 pesos. Foreign ownership indicator is 1 if foreign share of capital $>$ 0, 0 otherwise. Turnover is annual percentage turnover, defined as 100*[.5 * (new hires + separations)/employment]. Average 1998 nominal exchange rate: 9.1 pesos/dollar. Maquiladoras are *maquiladoras de exportación*, registered in Mexican government maquiladora program.

▸ Apparel ▸ Transportation equipment ▸ Electical/electronic equipment

2.1. Case study (cont.)



Source: Economic Censuses 1989, 1994, 1999, 2004, 2009 and EMIME 1988-2006.

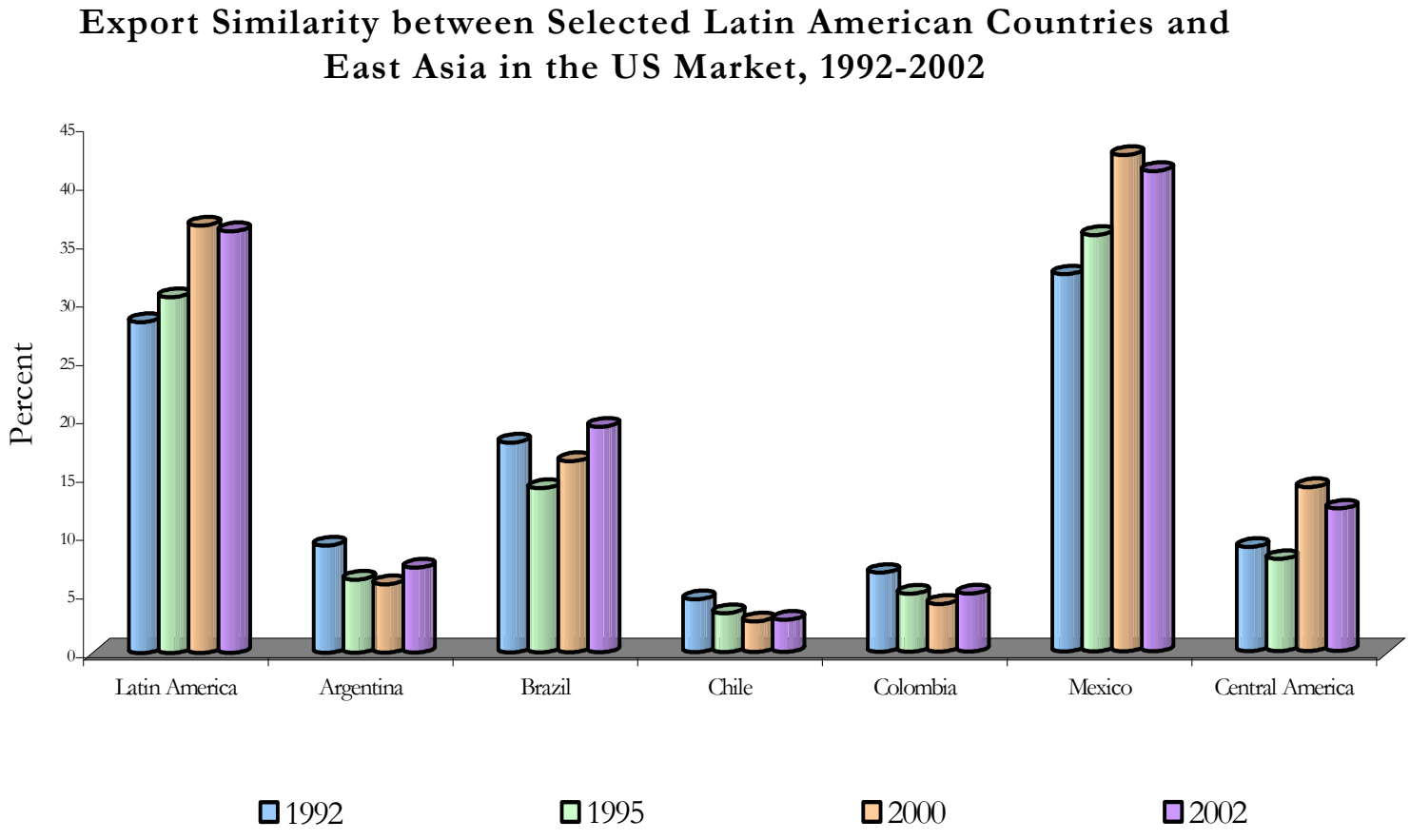
2.1. Case study (cont.)

- The story so far:
  - Between 1988 and 1998, the Mexican manufacturing sector specialized in less-skill-intensive and less-capital-intensive activities, both across and within sectors.
  - Between 1998 and 2008, employment growth was meager in manufacturing.
  - To the extent that there was a pattern, it appears that employment growth was low particularly in those less-skill and capital-intensive activities in which the economy specialized in the previous decade.
- More details in paper on my website (Verhoogen, forthcoming).

2.1. Case study (cont.)

- A common explanation for Mexico's disappointing performance is that it has been a victim of bad luck:
  - Liberalization was paying dividends and underlay the growth of manufacturing employment in the latter half of the 1990s, helping the economy to recover from the 1994-95 peso crisis.
  - The economy was hit by an unexpected shock — the expansion of China — and has been undergoing a period of adjustment.
  - Once the manufacturing sector readjusts to its new comparative advantage, growth will resume.
- There is little doubt that China's expansion has had a important effect on Mexican manufacturing.
  - Mexico produces many of the products that China produces, and few of the products that it consumes.

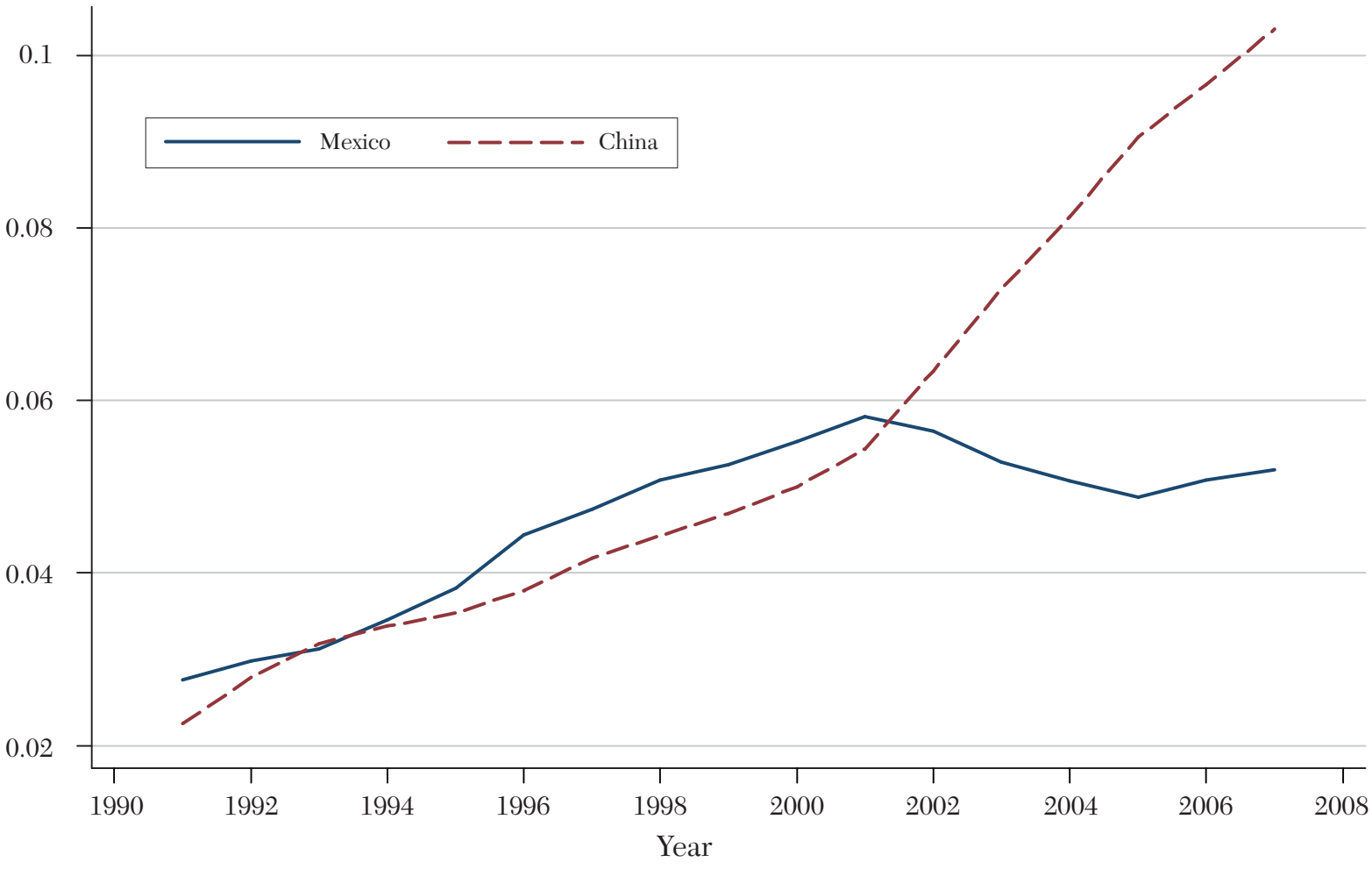
2.1. Case study (cont.)



Source: IDB-INT calculations based on UN/Comtrade data.

Source: Devlin, Estevadeordal and Rodriguez-Clare (2006). Based on Finger-Kreinin export similarity index.

2.1. Case study (cont.)

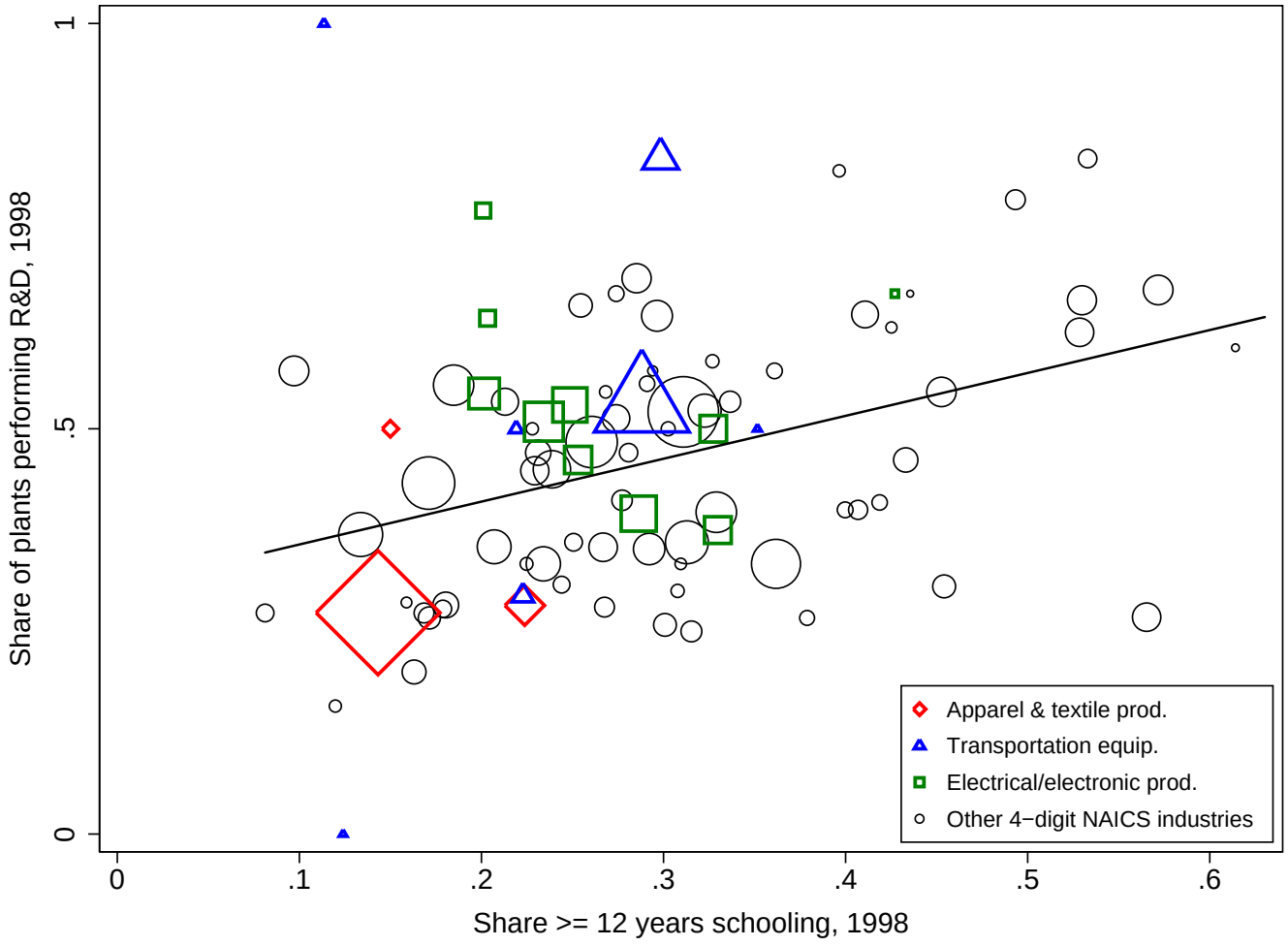


Source: Hanson (2010). Y-axis is share of total U.S. imports.

2.1. Case study (cont.)

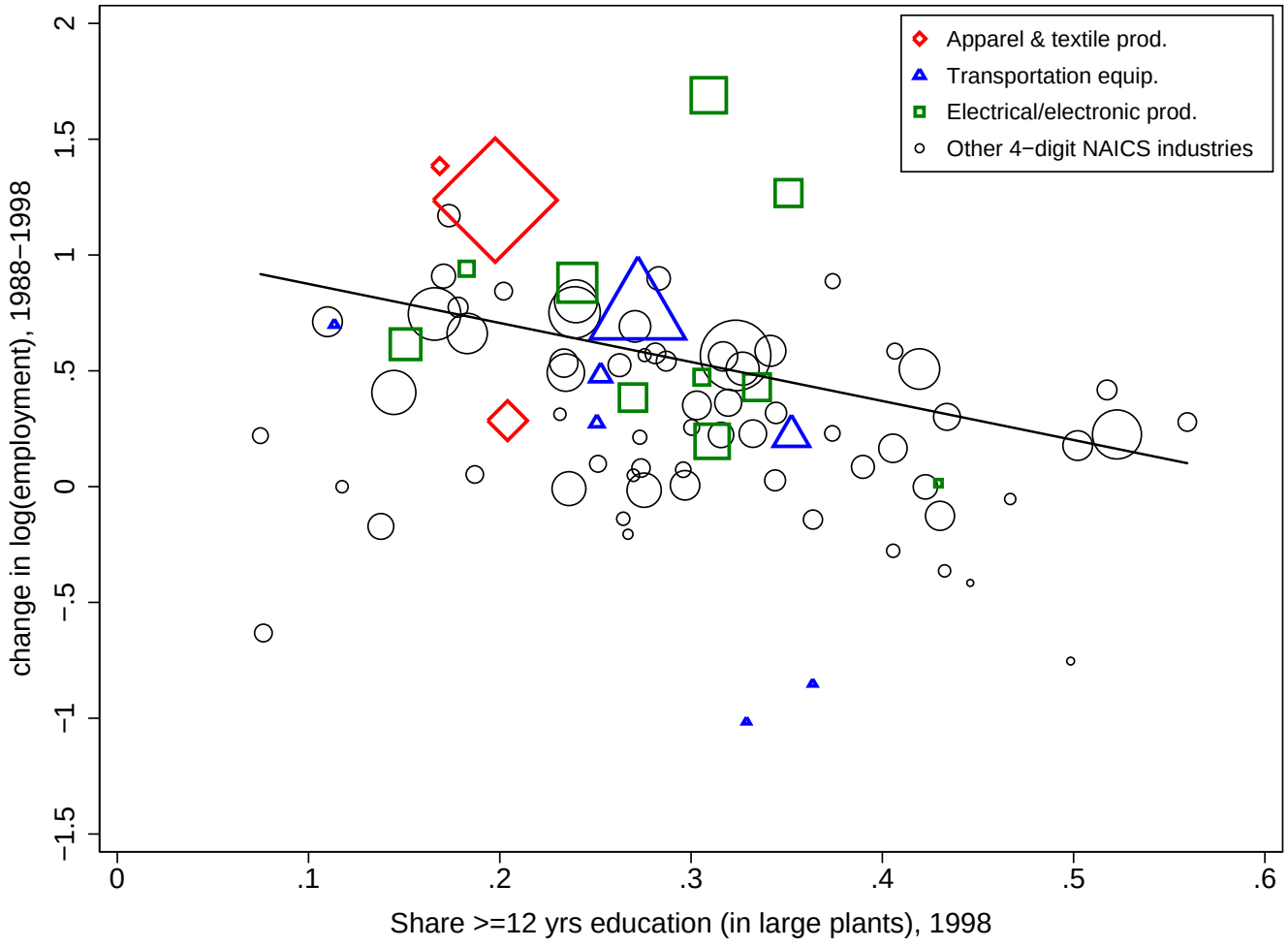
- But Mexico's disappointing performance may not solely be a case of bad luck.
- High-quality microdata in Mexico allow us to examine in more detail the links between product specialization and innovation.
- In 1999, the ENESTyC survey asked:
  - Since 1997, has the establishment engaged in R&D activity?
  - (If yes) What did the R&D activity mainly consist of?
    - Design of new products.
    - Process improvements.
    - Product quality improvements.
    - Design/improvement/production of machinery and/or equipment.
    - Other
- This is by no means an ideal measure. But it is useful as a first pass.
  - Note that the (implicit) definition of R&D is quite broad, includes broad range of upgrading/cost reduction efforts.

R&D vs. Avg. Schooling, 1998



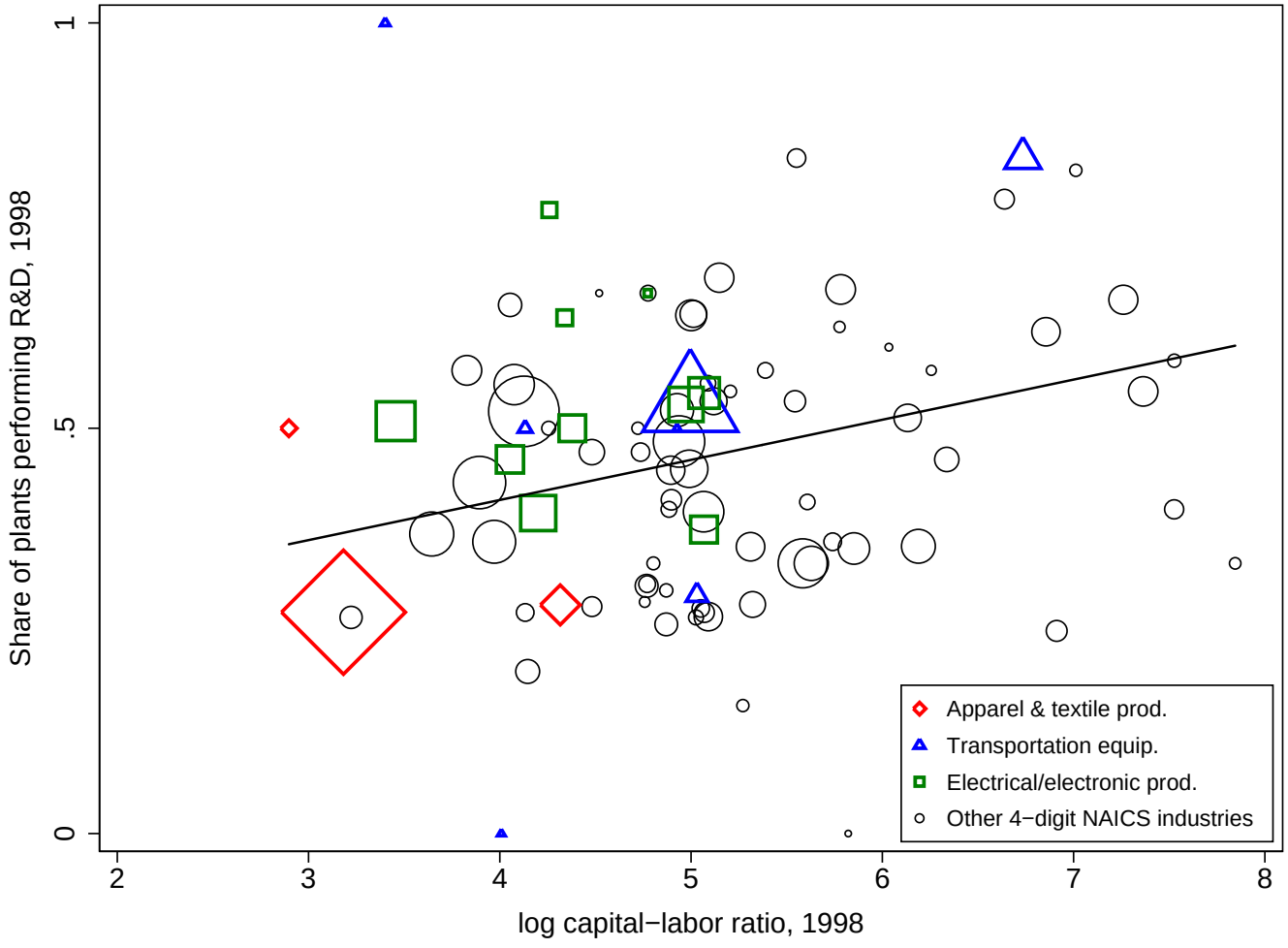
Source: ENESTyC 1999. The coefficient of the (employment-weighted) regression line is 0.53 with standard error 0.13 and R^2 0.16.

Employment Growth vs. Avg. Schooling, 1998



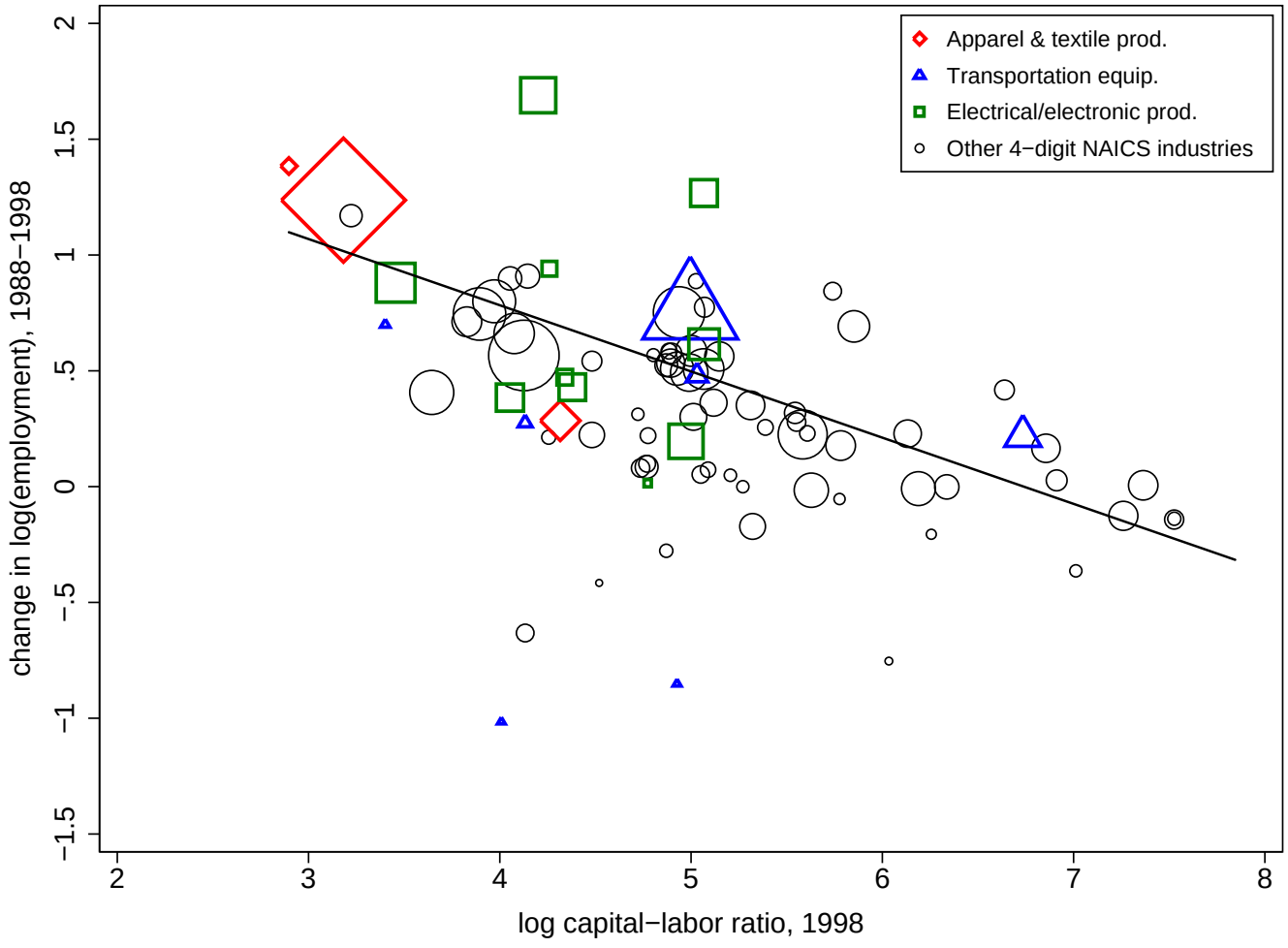
Source: Economic Censuses 1989, 1999 (employment) and ENESTyC 1999 (schooling). Each symbol represents a 4-digit NAICS industry; size reflects employment in industry in 1998.

R&D vs. Capital Intensity, 1998



Source: ENESTyC 1999 (R&D) and Economic Census 1999 (K/L ratio). The slope of the (employment-weighted) regression line is 0.05 with standard error 0.01 and R^2 0.14.

Employment Growth vs. Capital Intensity, 1998



Source: Economic Censuses 1989, 1999 (employment and capital stock). Each symbol represents a 4-digit NAICS industry; size reflects employment in industry in 1998.

R&D by Sector/Sub-sector

	non-maquiladoras		
	non-exporters	exporters	maquiladoras
	(1)	(2)	(3)
All manufacturing	0.36	0.50	0.41
	(0.01)	(0.01)	(0.02)
Apparel	0.19	0.33	0.34
	(0.03)	(0.04)	(0.05)
Electrical and Electronic Products	0.35	0.54	0.45
	(0.07)	(0.04)	(0.03)
Transportation Equipment	0.40	0.62	0.54
	(0.07)	(0.04)	(0.10)

Source: ENESTyC 1999.

2.1. Case study (cont.)

Summing up case study:

- Between 1988 and 1998, Mexico, apparently following its then-current comparative advantage, specialized in less-skill and capital-intensive activities, both across and within sectors.
- These activities displayed low rates of innovation.
- This suggests that the rate of innovation in 1998-2008 would have been low *even in the absence of the expansion by China.*
- It is very difficult to sustain robust growth without a robust rate of innovation.
- If not China, it seems likely that other lower-wage countries would have moved up the ladder of product sophistication to compete with Mexico.

2.2. Links between Specialization and Growth

- In Mexican case, it appears that there was a tension between Mexico's static (or short-term) comparative advantage and the rate of innovation and growth.
- This is essentially a restatement of a classic hypothesis of Raúl Prebisch (1950):
  - Comparative advantage leads developing countries to specialize in the production of primary products.
  - Primary products offer relatively few opportunities for technical innovation.
  - As a result, growth remains low.

  (Prebisch, along with Singer (1950), also worried that relative prices of primary products would fall over time.)
- The argument also applies to less-skill/capital/R&D-intensive activities within manufacturing, not just to primary products.

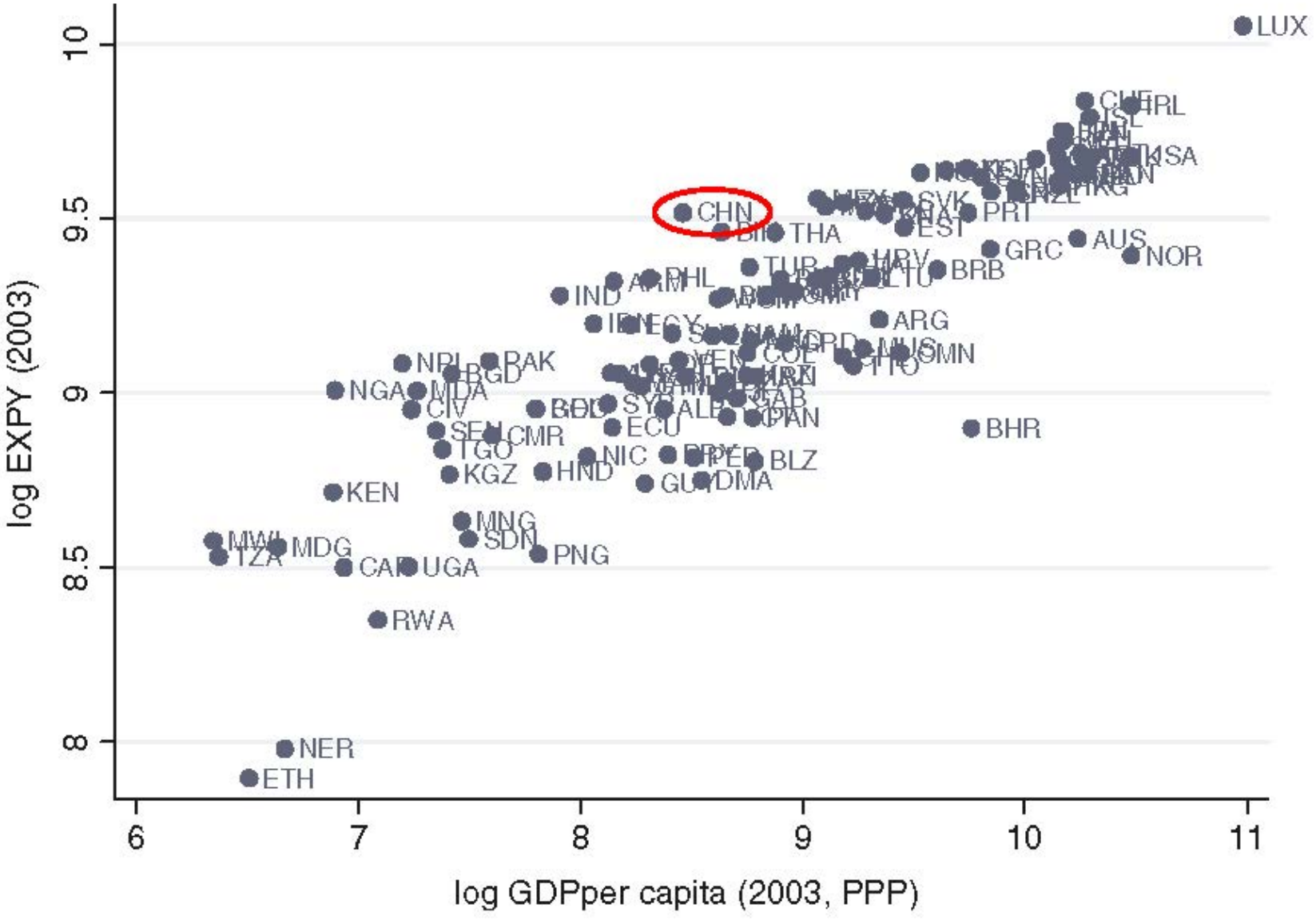
2.2. Links between Specialization and Growth (cont.)

- In recent years, the most prominent advocates of this idea have been Dani Rodrik, Ricardo Hausmann and co-authors.
- Rodriguez and Rodrik (2001), building on Matsuyama (1992), provide a formalization:
  - In an open economy, if a sector has greater dynamic learning potential, it may be optimal, under certain circumstances, to impose a tax/subsidy to push resources toward that sector, at the cost of static inefficiency.
- At a theoretical level, this idea is widely accepted as sound.
- The key question, of course, is whether the "certain circumstances" hold in the world.

2.2. Links between Specialization and Growth (cont.)

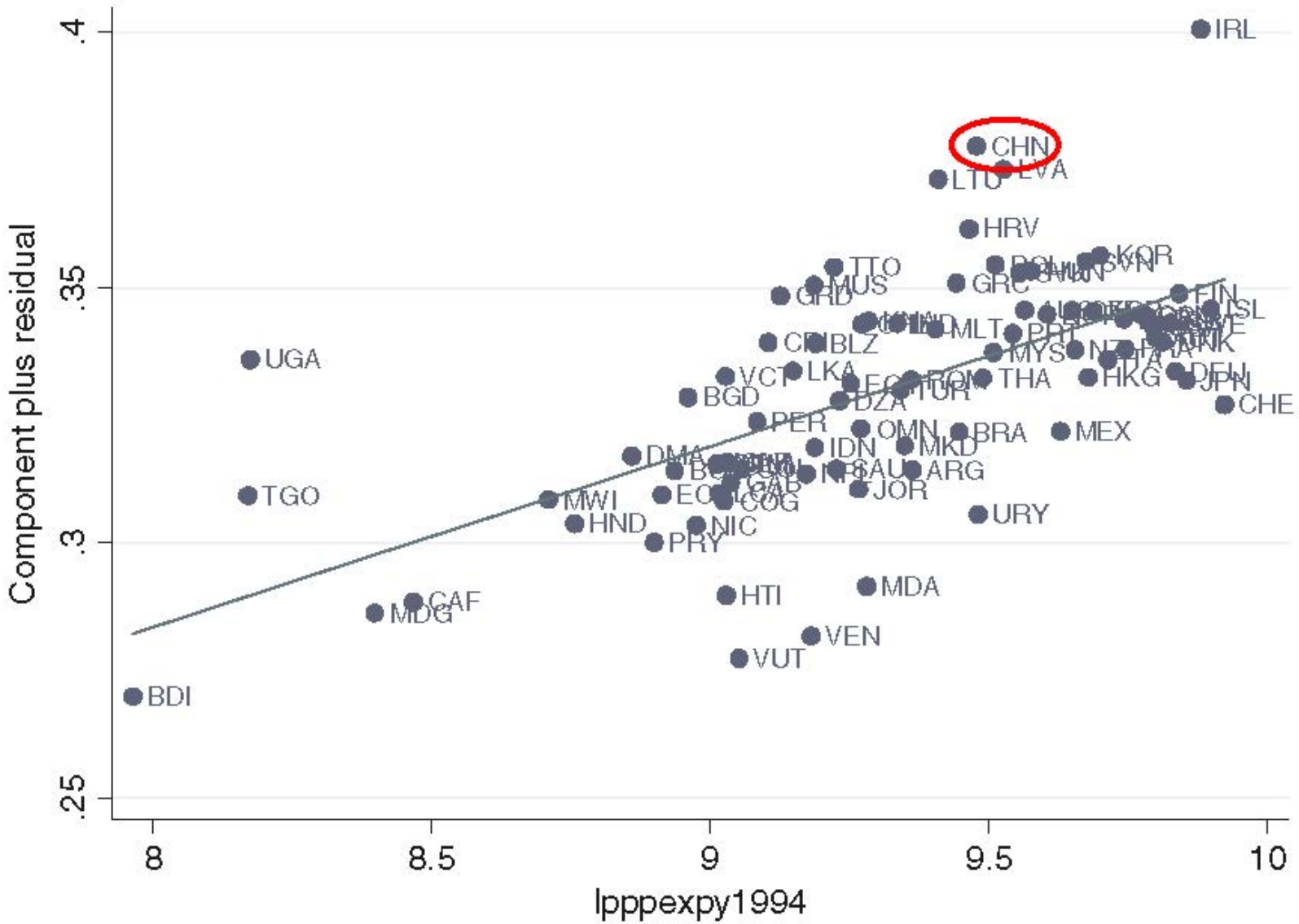
- Leading piece of empirical evidence: Hausmann, Hwang and Rodrik (2007):
  - Generate a measure of product sophistication, EXPY, using trade-flow data (HS 6-digits):
    - PRODY: weighted average income per capital of countries that produce a product.
    - EXPY: weighted average of PRODYs of products produced by a country.
  - EXPY predicts future growth, conditional on current income.

EXPY vs Income per Capita



Source: Hausmann, Hwang and Rodrik (2007).

Growth vs. Initial Level of EXPY



Source: Hausmann, Hwang and Rodrik (2007). On y-axis is $X_i\widehat{\beta} + \hat{\varepsilon}$ estimated from an instrumental variables regression $\triangle y_i = X_i\beta + Z_i\gamma + \varepsilon_i$ where $\triangle y$ is change in log GDP/capita from 1992-2003, X_i is EXPY in 1994, Z_i includes log initial GDP/capita and a measure of human capital in logs, and log population and log land area are used as instruments for EXPY.

2.2. Links between Specialization and Growth (cont.)

- This finding has been criticized:
  - Not clear it can be interpreted causally.
  - In countries with big assembly-for-export sectors, EXPY is likely to be oversated.
- I think it is fair to say that this finding has been more influential in policy circles than in mainstream academic ones.
- But the correlation is provocative and interesting, and we should take the hint from policy-makers that it is worth exploring further.

3. Conclusion: Working Toward a Synthesis

- Key lesson from research for policy community:
  - We should think about firms, and products within firms, and activities (tasks) that go into making products within firms, not just about sectors.
- Key lesson from policy community for researchers:
  - We should be examining the links between the pattern of specialization in products/tasks and innovation.

3. Conclusion: Working Toward a Synthesis (cont.)

- Key question for research: how does knowledge/productivity of firms evolve endogenously based on their investments in learning and on what they produce?
- In formal terms, we should not think of the "Melitz draw" φ as being fixed over time or simply being subject to random shocks.
  - It may evolve endogenously in a directed way, depending both on investments in learning and incidental learning-by-doing.
- Conjecture: producing high-quality goods tends to generate technological improvements.
  - High-quality goods often developed in rich countries, where capital and skill are abundant (Acemoglu and Zilibotti, 2001).
  - Richer consumers are more willing to pay both for high quality and for innovative goods.

3. Conclusion: Working Toward a Synthesis (cont.)

- There has been some work on the links between trade, specialization and innovation:
  - Theory: Atkeson and Burstein (2010).
  - Empirics: Bloom, Draca and Van Reenen (2011), Hanlon (2011), Teshima (2010).

  but we need more of it!

3. Conclusion: Working Toward a Synthesis (cont.)

- From perspective of policy, if there are externalities in the learning process, there is a potential case for industrial-policy interventions.
  - Caveat #1: governments are generally not better informed than firms.
  - Caveat #2: regulatory agencies may be captured by the firms/industries they are supposed to regulate.
- One lesson of the new work in trade is that interventions should not seek to provide blanket support for entire industries.
  - The key task is to find creative ways to promote innovative activities, without presuming to have knowledge about where in particular the next innovation will come from.

3. Conclusion: Working Toward a Synthesis (cont.)

- A lesson of the Mexican experience: exports *per se* should not necessarily be the target.
  - Asian tigers conditioned support on export performance, to positive effect.
  - But Mexican experience suggests export *value added* is a better metric than gross exports.
  - With appropriate caution, support should be targeted at the exporting activities most likely to generate learning.
- We clearly need more research on what works and what doesn't in promoting innovation.
  - For current state of knowledge, see Harrison and Rodríguez-Clare (2010), Lederman and Maloney (2012).

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Summary statistics, Apparel

	non-maquiladoras		
	non-exporters	exporters	maquiladoras
	(1)	(2)	(3)
Employment	260.19	460.66	813.88
	(17.90)	(39.51)	(57.79)
Export percentage of sales		46.93	97.40
		(3.53)	(1.13)
Foreign ownership indicator	0.02	0.05	0.60
	(0.01)	(0.02)	(0.05)
Capital-labor ratio	64.96	48.38	28.90
	(29.22)	(8.87)	(7.56)
Share with $>=$ 12 years schooling	0.15	0.18	0.14
	(0.02)	(0.02)	(0.01)
Percentage blue-collar	84.66	82.91	88.48
	(1.62)	(1.46)	(1.18)
Years of schooling, blue-collar	7.25	7.40	7.21
	(0.16)	(0.14)	(0.14)
Blue-collar hourly wage	2.34	2.43	3.03
	(0.13)	(0.11)	(0.17)
White-collar hourly wage	5.50	6.38	6.84
	(0.44)	(0.55)	(0.50)
Turnover rate	55.17	60.19	60.20
	(4.51)	(5.44)	(4.90)
Tenure (years)	4.91	4.45	3.29
	(0.31)	(0.29)	(0.16)
N	112	105	111

Return

Summary statistics, transportation equipment

	non-maquiladoras		
	non-exporters	exporters	maquiladoras
	(1)	(2)	(3)
Employment	344.24	637.01	1342.07
	(46.90)	(52.91)	(82.97)
Export percentage of sales		41.32	96.33
		(2.68)	(1.28)
Foreign ownership indicator	0.28	0.49	0.97
	(0.07)	(0.04)	(0.02)
Capital-labor ratio	212.92	294.49	57.30
	(90.57)	(46.77)	(22.49)
Share with $>=$ 12 years schooling	0.27	0.34	0.20
	(0.02)	(0.02)	(0.01)
Percentage blue-collar	75.35	73.40	84.29
	(1.89)	(1.01)	(1.48)
Years of schooling, blue-collar	7.79	8.60	7.43
	(0.19)	(0.12)	(0.14)
Blue-collar hourly wage	3.55	4.73	3.64
	(0.26)	(0.22)	(0.19)
White-collar hourly wage	7.24	11.17	9.81
	(0.61)	(0.52)	(0.65)
Turnover rate	45.99	33.11	69.47
	(7.59)	(3.18)	(6.74)
Tenure (years)	5.37	6.88	3.74
	(0.34)	(0.28)	(0.20)
N	46	141	92

Return

Summary statistics, electrical/electronic equipment

	no-maquiladoras		
	non-exportadores	exportadores	maquiladoras
	(1)	(2)	(3)
Employment	334.83	585.75	1081.90
	(105.70)	(56.59)	(51.35)
Export percentage of sales		39.94	98.24
		(3.33)	(0.78)
Foreign ownership indicator	0.25	0.52	0.92
	(0.09)	(0.05)	(0.02)
Capital-labor ratio	132.03	223.10	68.35
	(74.50)	(26.16)	(14.69)
Share with $>=$ 12 years schooling	0.29	0.31	0.22
	(0.04)	(0.02)	(0.01)
Percentage blue-collar	73.35	71.88	80.79
	(3.56)	(1.57)	(1.06)
Years of schooling, blue-collar	8.03	8.52	7.54
	(0.27)	(0.12)	(0.09)
Blue-collar hourly wage	3.04	3.84	4.15
	(0.25)	(0.17)	(0.17)
White-collar hourly wage	8.74	10.17	10.82
	(1.00)	(0.53)	(0.48)
Turnover rate	39.68	41.19	73.60
	(5.52)	(4.09)	(4.56)
Tenure (years)	6.18	6.21	3.50
	(0.64)	(0.29)	(0.12)
N	24	109	191

Return