NAFTA and Mexican Industrial Development

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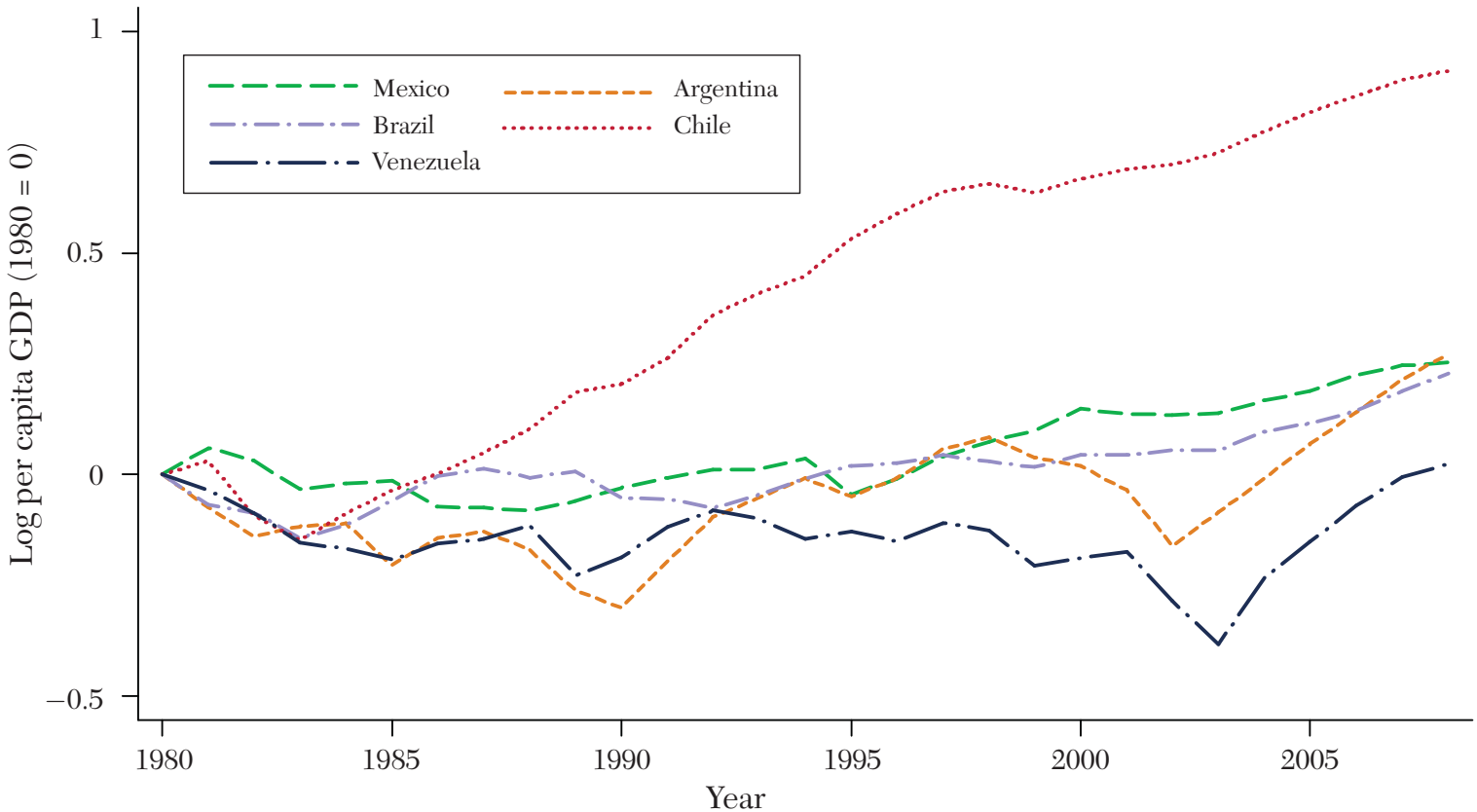
Mexico's Disappointing Growth Performance

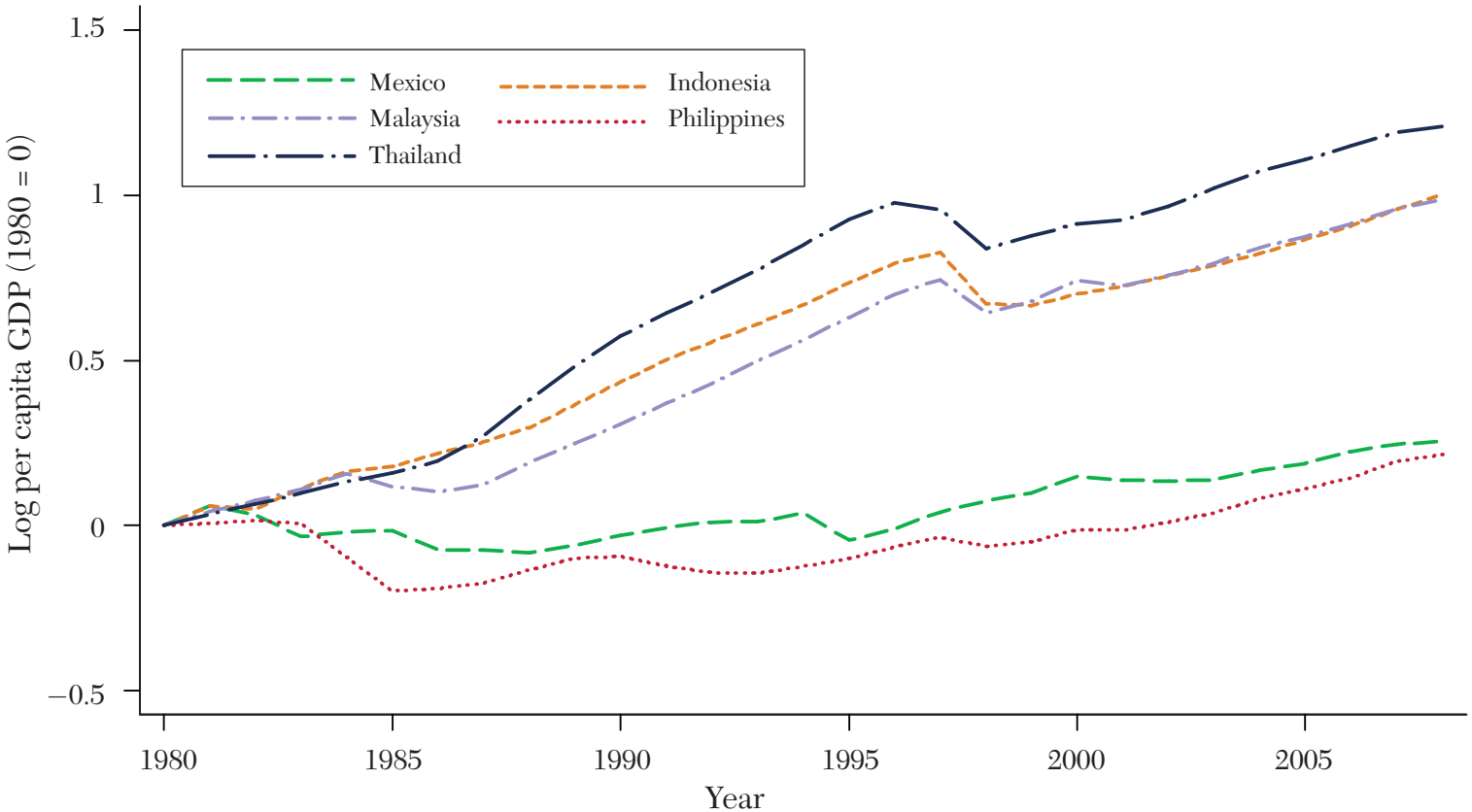
- Despite concerted efforts at market-oriented reforms since the mid-1980s, Mexico's growth has underperformed that of other middle-income countries.

vs. Latin-American Countries



Source: Hanson (2010).

vs. Asian Countries



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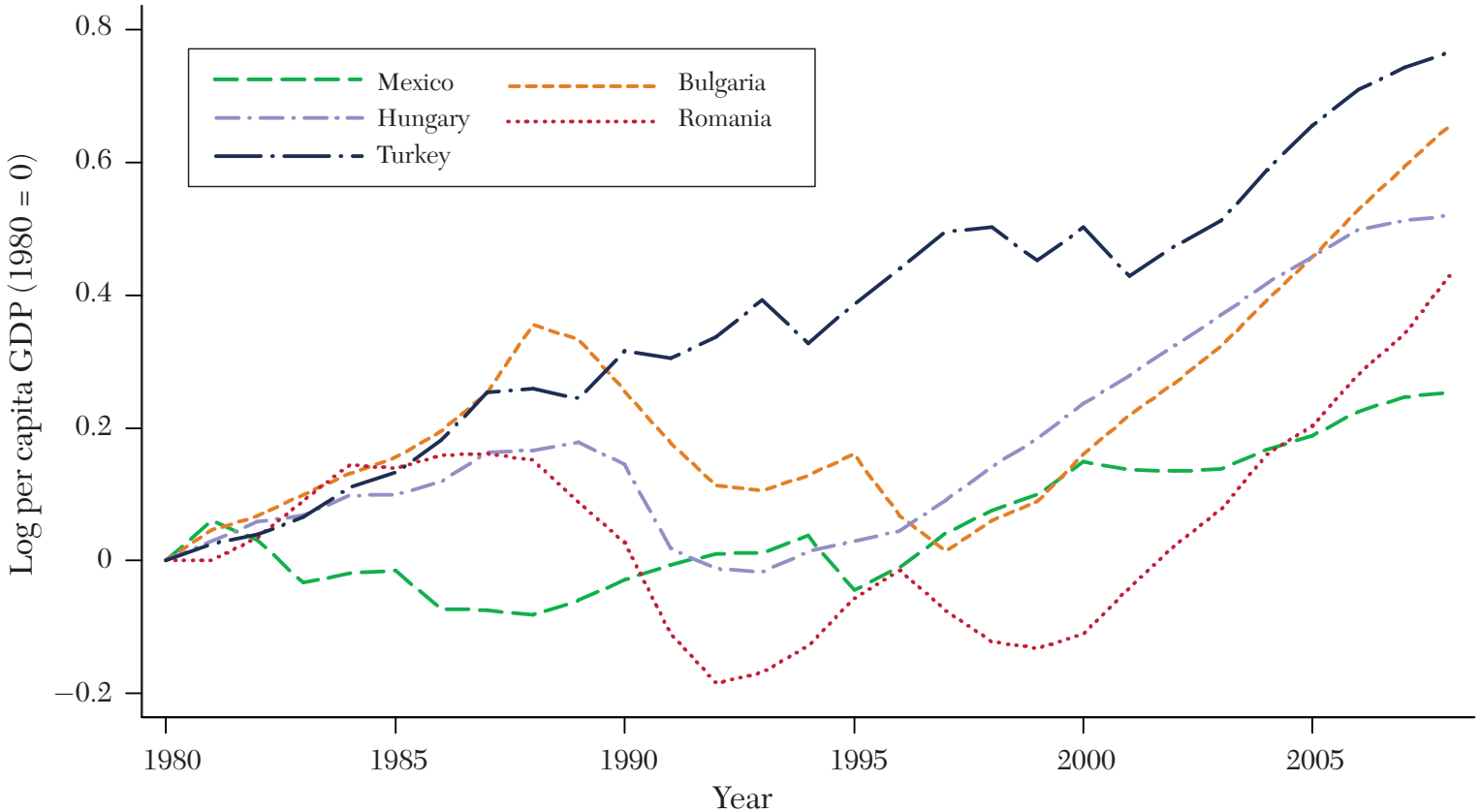

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- There are a number of plausible alternative factors that have contributed to the disappointing performance (Hanson, 2010; Kehoe and Ruhl, 2010):
  - Monopolies and inefficient regulation (Arias et al., 2010).
  - Underdeveloped credit markets (Haber, 2004).
  - Informality and evasion (Levy, 2008).
  - Corruption and, more recently, violence.
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  All of these likely played a role.
- But let's focus for now on trade/integration.

Plan of Talk

- Introduction
- Some Observations about Existing Approaches
- Sectoral Shifts and Innovation
- Conclusion

The Empirical Challenge

- As many others have noted, evaluating NAFTA is difficult because other things changed at the same time:
  - Trade liberalization of mid-1980s.
    - Events in 1990s may have been delayed reaction.
  - Peso crisis.
    - As Krueger (2000) and others have noted, devaluation was much larger (50% nominal devaluation) than tariff changes (10% reductions in Mexico, 3-5% in US).

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    - As Krueger (2000) and others have noted, devaluation was much larger (50% nominal devaluation) than tariff changes (10% reductions in Mexico, 3-5% in US).
- Two broad categories of approaches to evaluating the effects of NAFTA:
  - Applied general equilibrium modeling.
  - Reduced-form, typically difference-in-differences.

  I will argue that there is something missing from each.

Applied General Equilibrium Modeling

- Ably reviewed by Kehoe (2005), and yesterday's keynote.

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- Issue: Valid only if the model is right. (A big "if.")
- My reading of Tim's reading:
  - Applied GE models did not perform particularly well in predicting the effects of NAFTA.
  - One issue is new goods margin.
  - Aggregate changes seem to be driven largely by TFP changes. But models for the most part do not endogenize TFP.

    "It may be that we applied GE modelers eventually decide that the biggest effect of liberalization of trade and capital flows is on productivity — through changing the distribution of firms and encouraging technology adoption — rather than the effects emphasized by the models used to analyze the impact of NAFTA." (Kehoe, 2005, p. 372)

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- Advantage: Require weaker assumptions ex ante.
- Issue: generally have to give up on making statements about general equilibrium effects, welfare.
- De la Cruz et al. (2013) provide a nice review. Here I'll make a few observations, with a focus on effects on productivity in Mexico.

Lopez Cordova (2003)

- Emphasizes 3 channels:
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- Then regresses TFP on tariffs, controlling for plant, industry, geographical characteristics.

Lopez Cordova (2003) (cont.)

TABLE 4. Total Factor Productivity and Integration in Mexico: Regression Results[a]

	Log TFP					*Change in log TFP*
Explanatory variable	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Competition from imports						
Log imports/industry output	0.5053 (0.0433)***	0.5057 (0.0430)***	0.2088 (0.0513)***	0.2082 (0.0508)***	0.2088 (0.0514)***	0.2159 (0.0521)***
Mexican tariff on total imports[b]	−0.0026 (0.0009)***	−0.0026 (0.0009)***	−0.0031 (0.0013)**	−0.0030 (0.0013)**	−0.0031 (0.0013)**	−0.0040 (0.0012)***
FDI spillovers[c]						
Intraindustry FDI	−0.2626 (0.0477)***	−0.0119 (0.1063)	0.0533 (0.0477)	0.1146 (0.1013)	0.0532 (0.0477)	0.0139 (0.0454)
FDI-forward linkages	0.9116 (0.1035)***	1.2049 (0.1899)***	0.4160 (0.1146)***	0.4443 (0.1773)**	0.4160 (0.1146)***	0.4184 (0.1132)***
FDI-backward linkages	0.9489 (0.1185)***	0.5387 (0.2907)*	1.1690 (0.1157)***	0.9479 (0.2832)***	1.1691 (0.1157)***	1.1363 (0.1104)***
Intraindustry FDI*local firm		−0.3098 (0.1171)***		−0.0742 (0.1123)		
FDI-forward linkages*local firm		−0.3199 (0.1824)*		−0.0341 (0.1699)		
FDI-backward linkages*local firm		0.4509 (0.3011)		0.2466 (0.2908)		
Exporting activity						
U.S. tariff (Mx − RofW)[d]	−0.0336 (0.0037)***	−0.0335 (0.0036)***	−0.0113 (0.0044)**	−0.0111 (0.0044)**	−0.0113 (0.0044)**	−0.0105 (0.0044)**
Exporter					−0.0002 (0.0047)	
Exports/sales						0.0119 (0.0137)
Exporter*local firm						

Lopez Cordova (2003) (cont.)

- Findings:
  - Mexican tariffs $\downarrow \Rightarrow$ TFP $\uparrow$
  - U.S. tariffs $\downarrow \Rightarrow$ TFP $\uparrow$
  - Use of imported inputs does not seem to have robust positive effect on TFP.

Lopez Cordova (2003) (cont.)

- Findings:
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  - U.S. tariffs $\downarrow \Rightarrow$ TFP $\uparrow$
  - Use of imported inputs does not seem to have robust positive effect on TFP.
- There are things to criticize here:
  - TFP lumps mark-ups, measurment error, possibly output and input quality with technical efficiency.
  - Did not include plant effects. Are results driven by cross-sectional variation?

  but overall the results are credible that NAFTA had positive within-sector effects on productivity.

De Hoyos and Iacovone (2013)

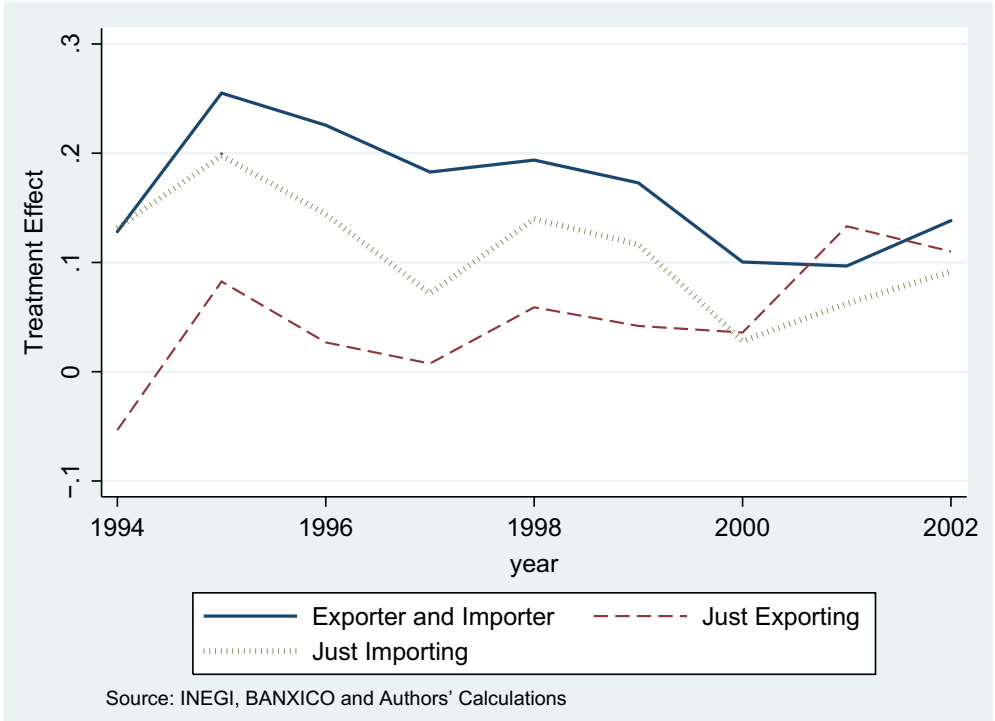


Figure 5. *Impact of NAFTA on productivity by integration status for all firms.*

- Figure plots coefficients from regression of log value-added per worker on time * dummies for importer/exporter/both.
- Results robust to throwing out switchers.

Iacovone (2012)

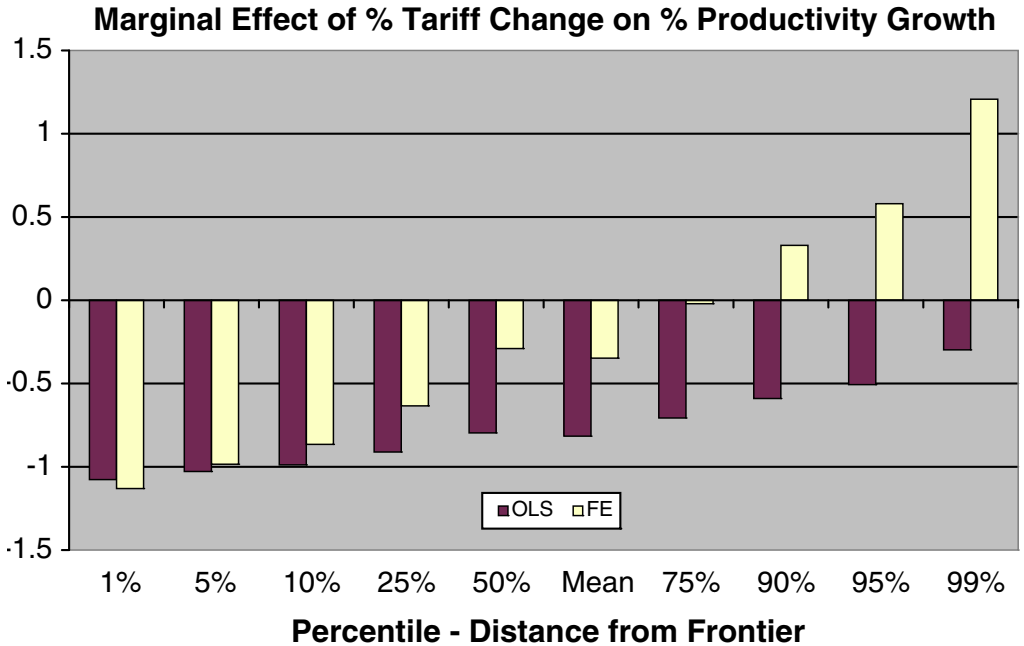
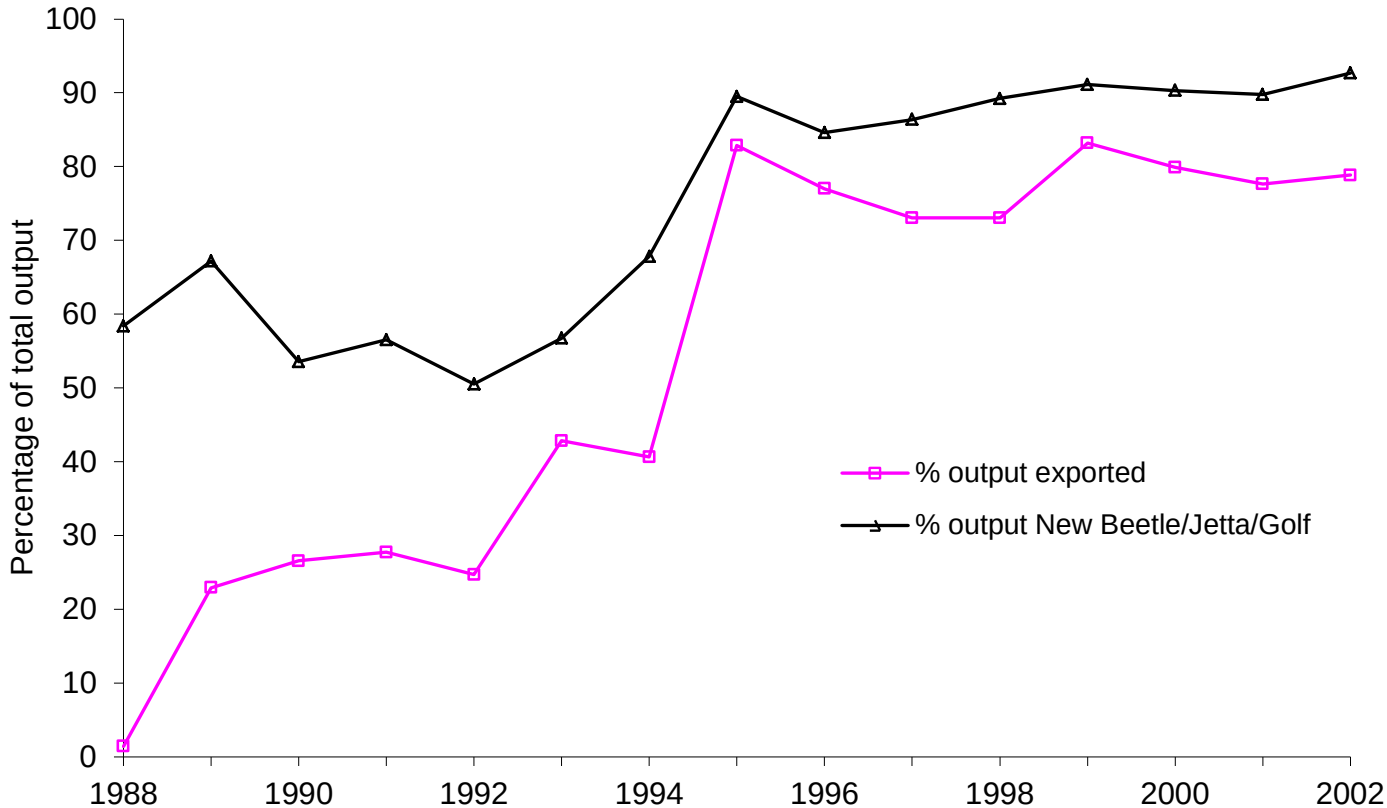


Fig. 3. Marginal effect of tariffs on productivity growth.

- Effects calculated from regression of $\triangle$log value-added/worker on interaction of distance to frontier and level of tariff (and industry or plant effects).
- Distance is ratio of value-added/worker to avg value-added/worker of 5 leading firms in each sector.

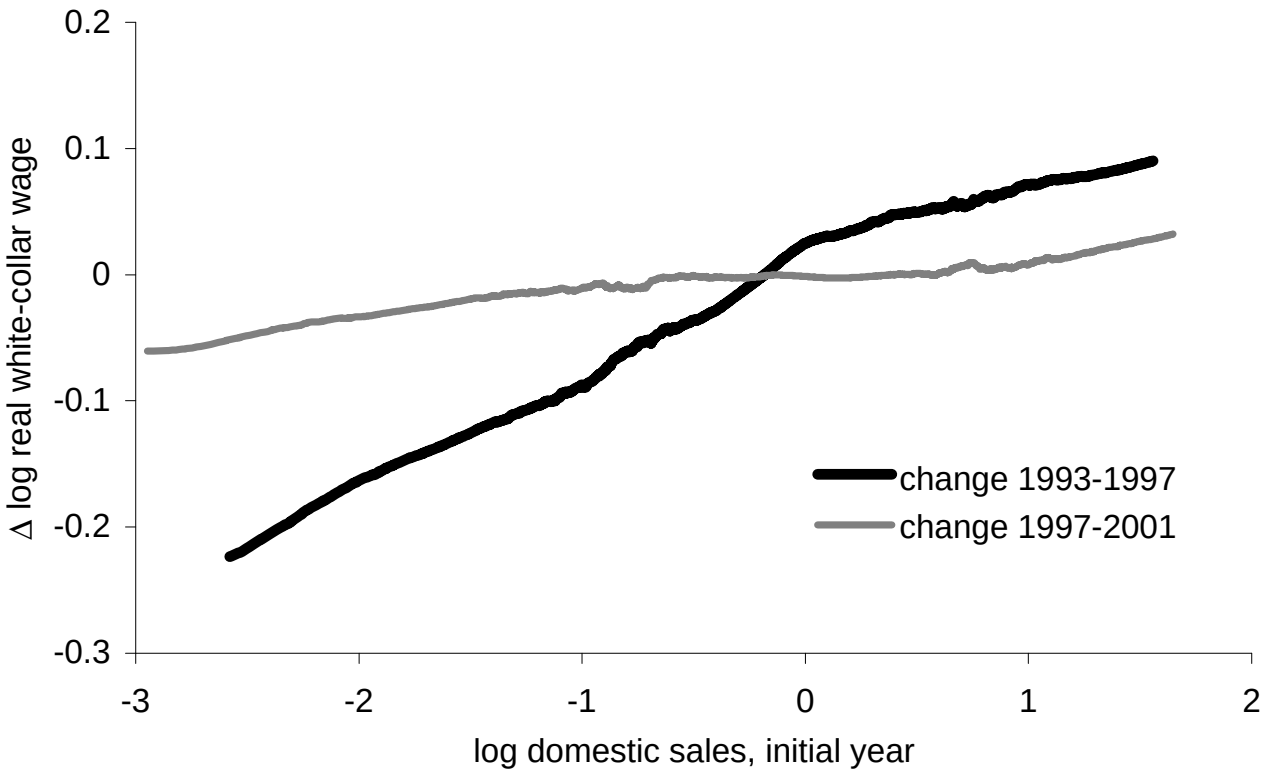
Verhoogen (2008)



Notes: Uses data from the Bulletins of the Asociación Mexicana de la Industria Automotriz (AMIA). Production measured in number of vehicles.

Verhoogen (2008) (cont.)

App. Fig. Vb: Changes in log white-collar wage



Notes: Uses data from balanced panel of non-maquiladora plants from the Encuesta Industrial Anual (EIA).

Existing Approaches: Summary

- Both approaches have made progress, but both also seem to me to be missing something important.

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- Reduced-form:
  - Documents productivity changes.
  - But relatively little attention to effects of sectoral shifts on ongoing productivity growth.

Sectoral Shifts and Innovation

- Old-fashioned idea (Prebisch, 1950; Matsuyama, 1992):
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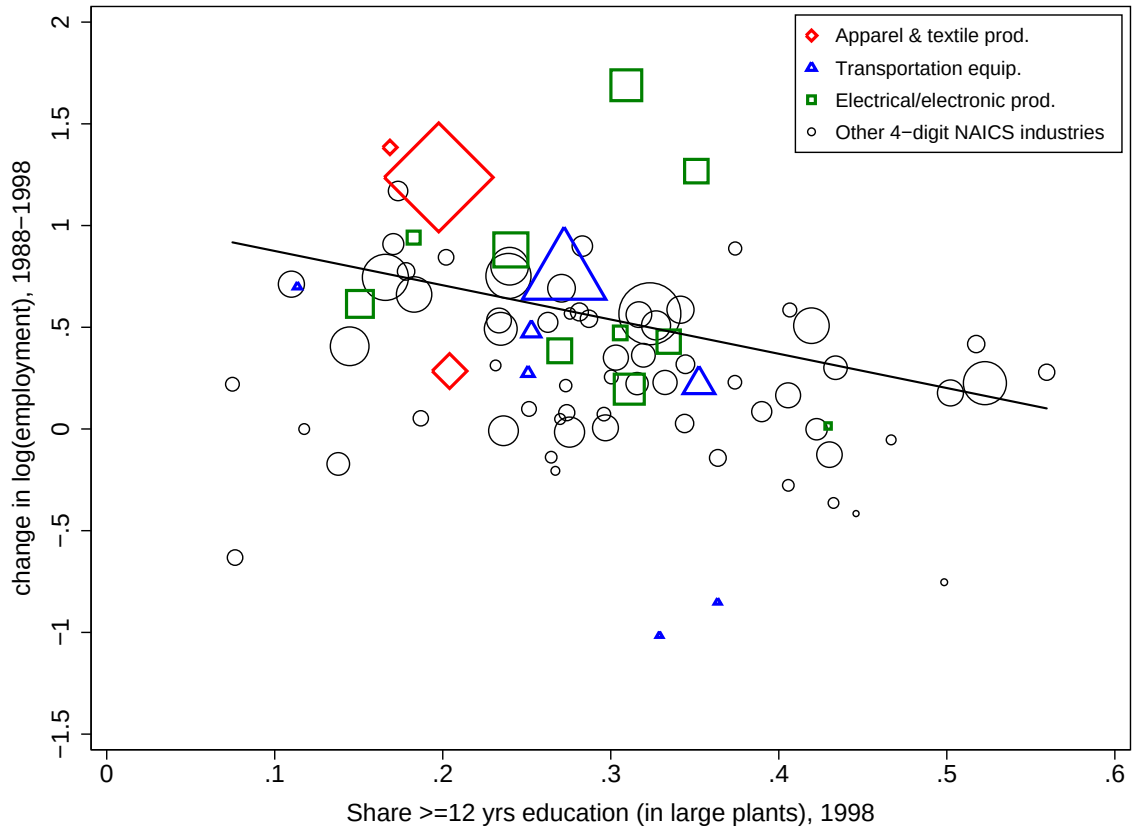
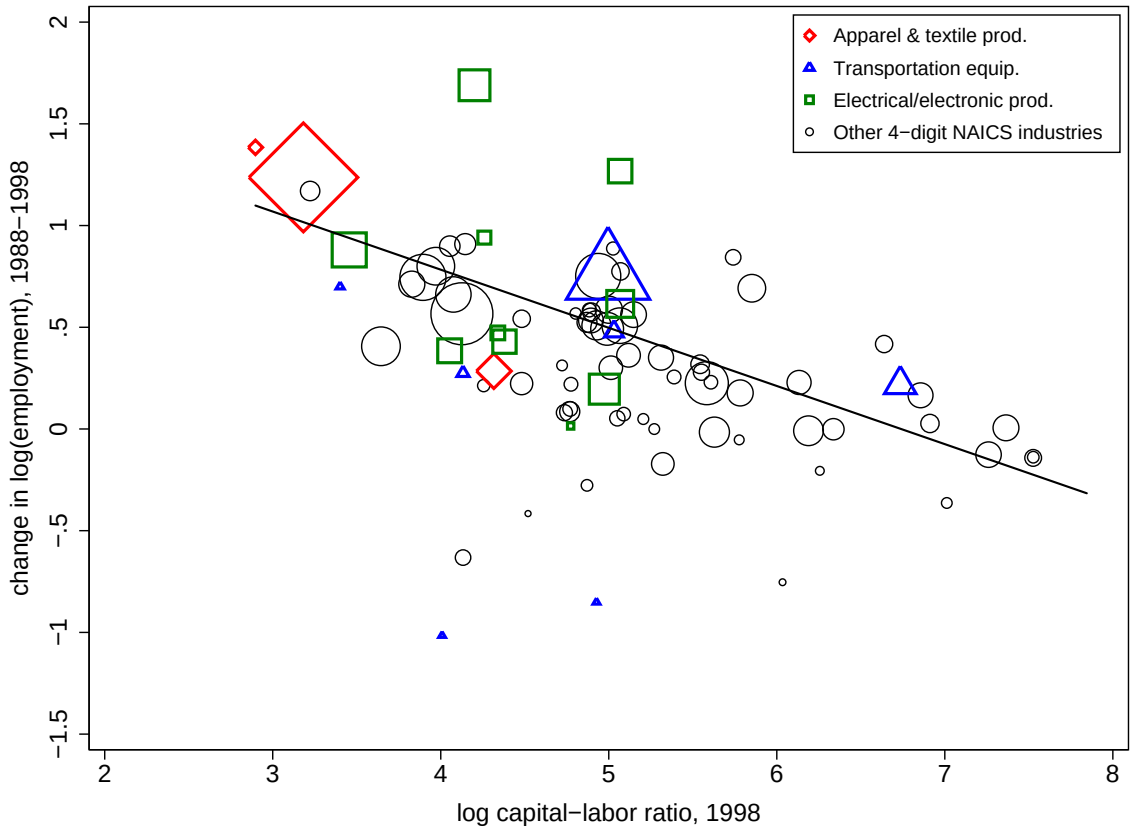
- More details on my website (text of a talk I gave in Monterrey, published in *Boletin Informativo Techint*.)

Employment Growth vs. Skill Intensity, 1988-1998



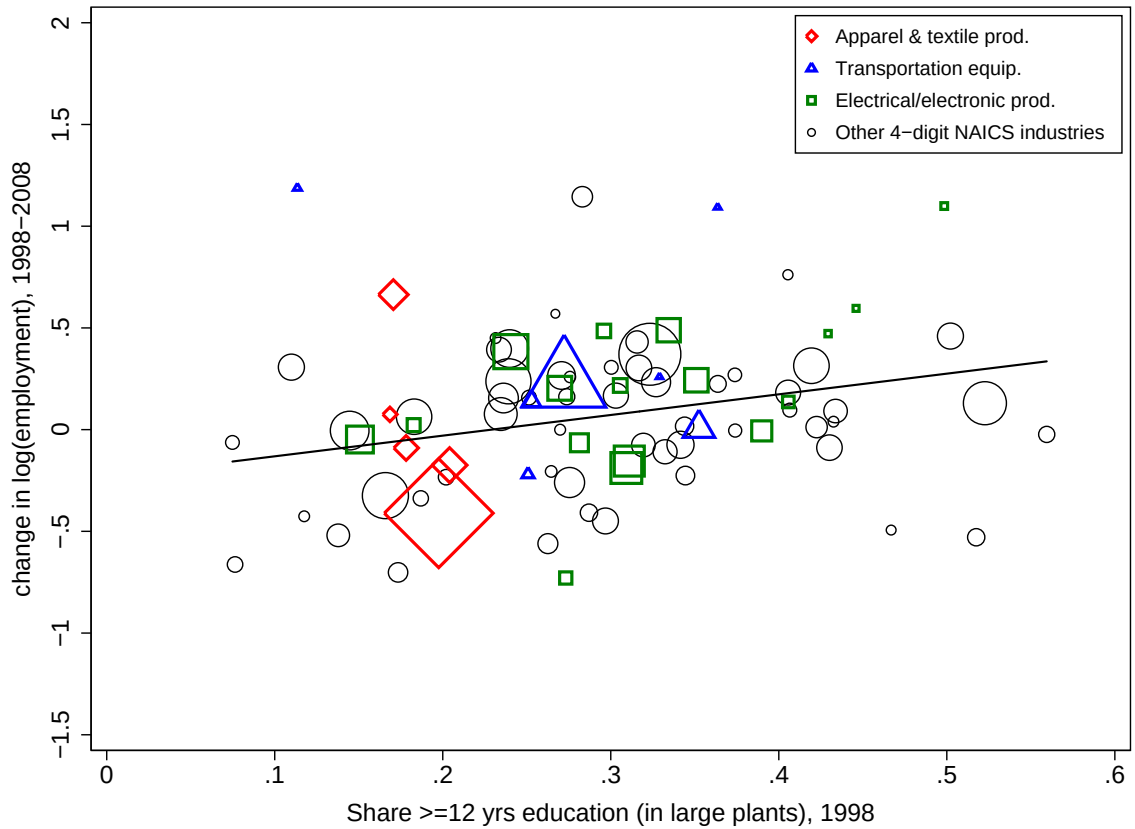
Notes: Data on employment growth are from the INEGI Economic Censuses from 1989 and 1999 (containing information from previous year). Data on schooling are from 1999 ENESTyC. Each symbol represents a 4-digit industry in the North American Industrial Classification System (NAICS). The size of the symbols reflect employment in the industry in 1998. The fitted regression line is weighted by employment in 1998. See Figure A1 of Verhoogen (2008).

Employment Growth vs. Capital Intensity, 1988-1998



Notes: Data on employment growth and capital-labor ratio are from the INEGI Economic Censuses from 1989 and 1999 (containing information from previous year). Each symbol represents a 4-digit industry in the North American Industrial Classification System (NAICS). The size of the symbols reflect employment in the industry in 1998. The fitted regression line is weighted by employment in 1998. A similar graph (using a different industry classification) appeared as Figure A2 of Verhoogen (2008).

Employment Growth vs. Skill Intensity, 1998-2008



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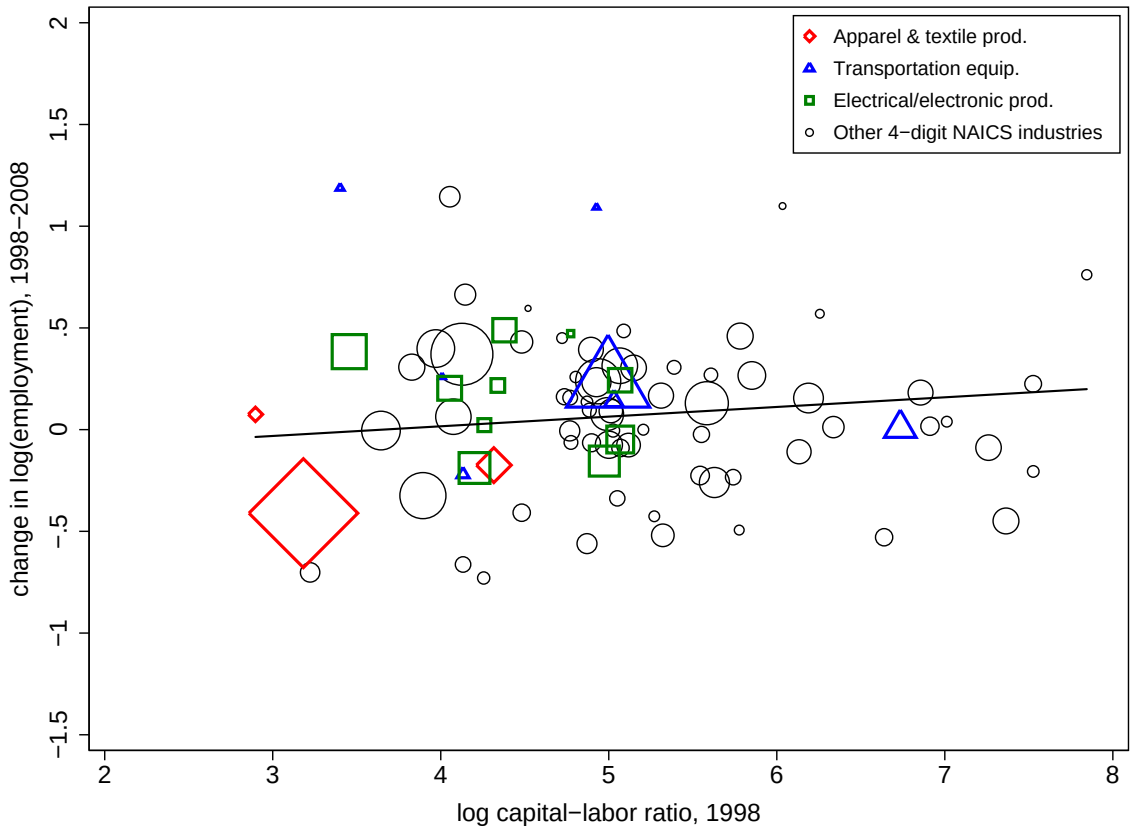

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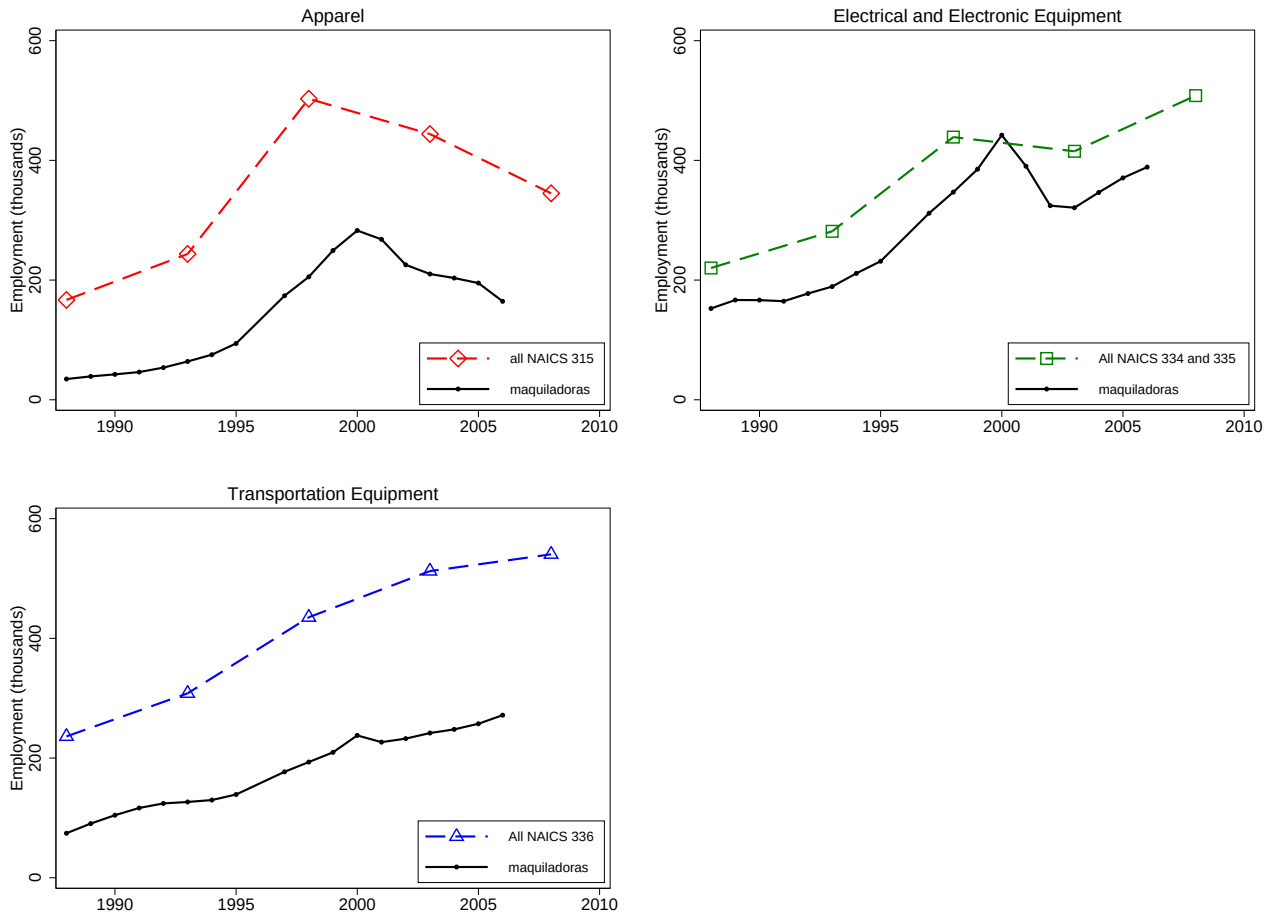
Maquiladora and Total Industry Employment



Notes: Maquiladora employment from EMIME for 1988-2006; total industry employment from Economic Censuses of 1989, 1994, 1999, 2004, and 2009. Apparel and textile products (maquila group 2) mapped to NAICS 315 (apparel manufacturing); transportation equipment (maquila group 6) to NAICS 336 (transportation equipment manufacturing); electrical and electronic equipment (maquila groups 8 and 9) to NAICS 334 and 335 (computer and electronic equipment; and electrical equipment, appliances, and components).

Means by Sub-Sector: Apparel, Elect. & Trans. Equip.

	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

Notes: 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.
Average 1998 nominal exchange rate: 9.1 pesos/dollar.

▸ Apparel ▸ Transport Equip. ▸ Electronics

The Story So Far

- From 1988-1998, manufacturing sector specialized in less capital- and skill-intensive activities, both across sectors and within sectors (i.e. to maquilas).

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- From 1998-2008, these sectors/subsectors tended to stagnate.

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  - Kumler (2014): applies approach of Autor, Dorn and Hanson (2013) in Mexico.
  - Lopez Cordova, Micco and Molina (2008), Hanson and Robertson (2010), Hsieh and Ossa (2011).

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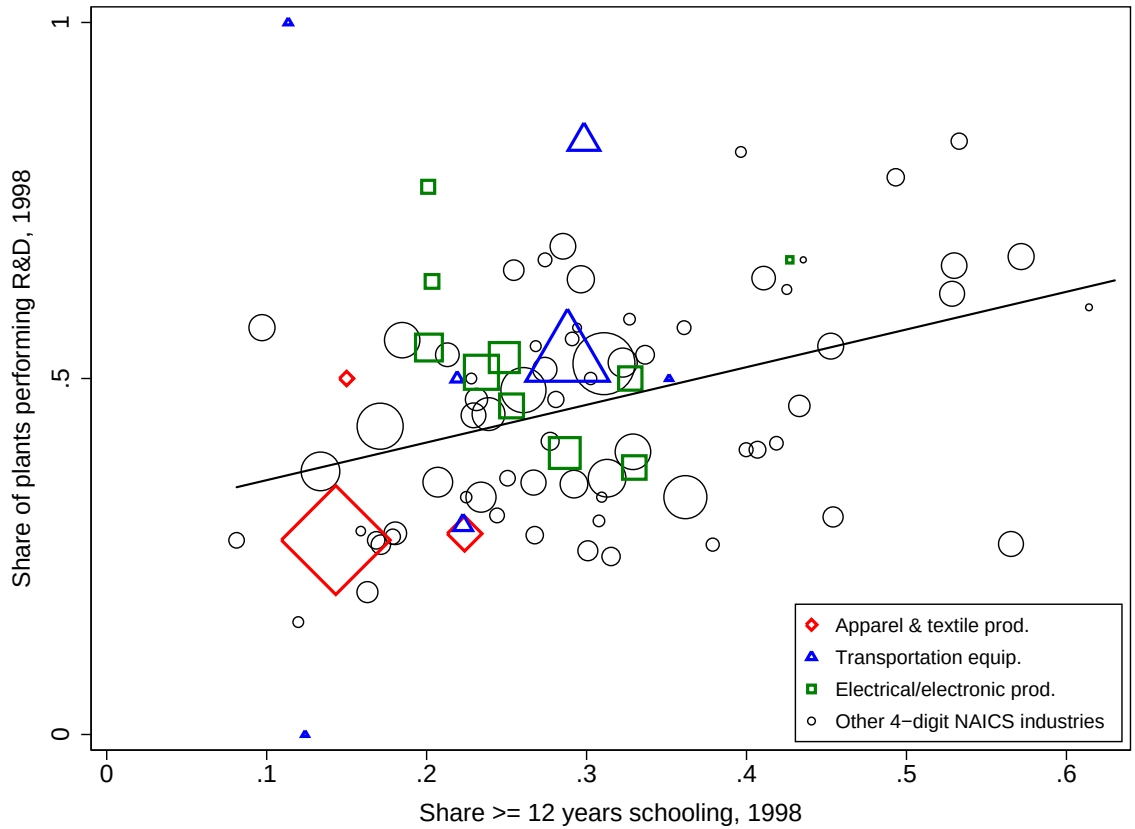
- But here I would like to argue that China is not the whole story, that Mexico would have had problems even if China had not entered.

R&D Measure, ENESTyC 1999

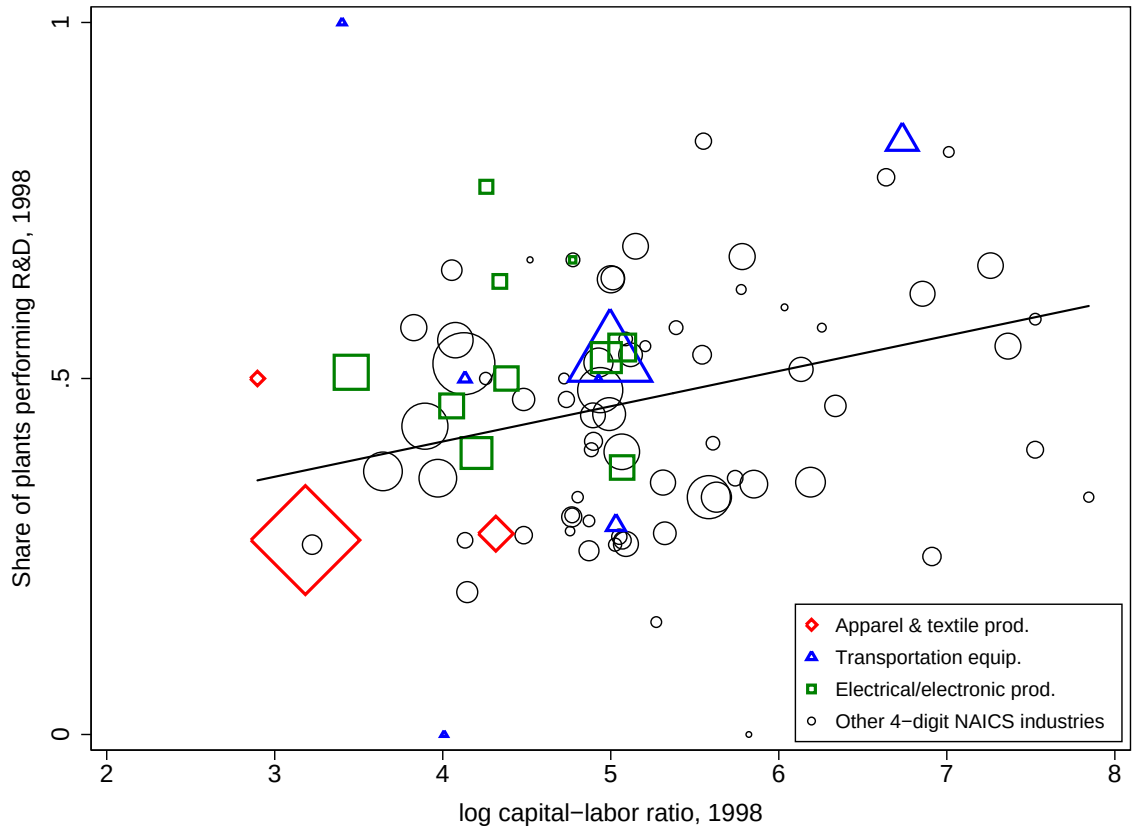
- Survey asked: "Since 1997, has the establishment undertaken R&D?"
- (If yes) "What did the R&D principally consist of?"
  - "Design of new products"
  - "Process improvements"
  - "Product quality improvements"
  - "Design/Improvement/Manufacture of machinery or equipment"
  - "Other"
- N.B.: This is a broad, inclusive definition of R&D, not just patents.
- Not perfect, but not bad as a first pass.
- Code as 0/1.

R&D Intensity vs Skill Intensity, 1998



Notes: Size of plotting symbols reflects employment in industry. The fitted regression line is weighted by employment. The estimated slope is 0.53 with standard error 0.13; the R^2 is 0.16. Industry-level averages are for large plants ($\geq$ 100 employees).

R&D Intensity vs Capital Intensity, 1998



Notes: Size of plotting symbols reflects employment in industry. The fitted regression line is weighted by employment. The estimated slope is 0.05 with standard error 0.01; the R^2 is 0.14. Industry-level averages are for large plants ($\geq$ 100 employees).

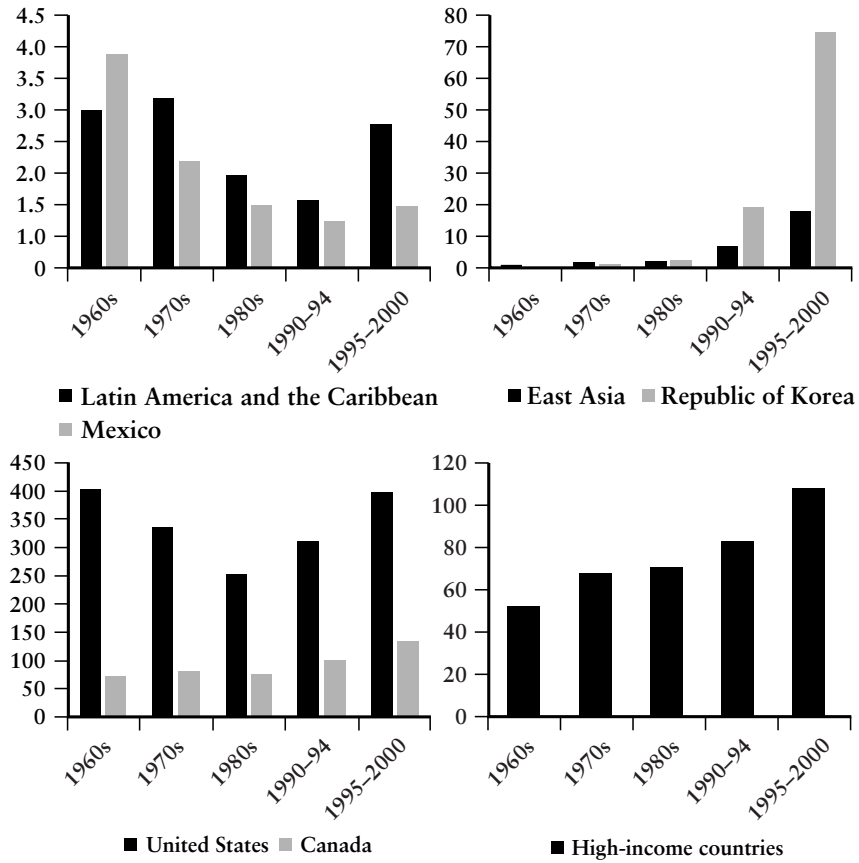
R&D Intensity by Sector

	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.

Alternative Innovation Measure I: Patents per Capita

Figure 6.2 Patents per Million Workers, 1960–2000



Notes: From Lederman, Maloney and Servén (2005), based on data from the U.S. Office of Patents and Trademarks.

Alternative Innovation Measure II: R&D Spending/GDP

Country	R&D spending/GDP (%)
Mexico	.38
Chile	.65
China	.65
Korea	2.34
U.S.	2.59
Canada	1.76

Notes: Data from World Bank World Development Indicators for 1998.

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- These sectors that Mexico tended to be less innovative.
  - This did not have to be true. But the correlation appears quite robust.
- The sectoral shifts thus tended to dampen the overall rate of innovation in the economy.

Summary

- Integration led Mexico to specialize in less capital- and skill-intensive activities, both across and within sectors.
- These sectors that Mexico tended to be less innovative.
  - This did not have to be true. But the correlation appears quite robust.
- The sectoral shifts thus tended to dampen the overall rate of innovation in the economy.
- What if China had not entered?
  - We don't observe the counterfactual, but my sense is that there would always be another country moving up the product ladder — Malaysia, Thailand, Indonesia, Vietnam, ...

Further Thoughts

- More research is needed, needless to say.

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- More research is needed, needless to say.
- But patterns suggest that there may be a trade-off between static allocative efficiency and long-term productivity growth.
  - Liberalization alone may not to be enough to bring about sustained growth.
- My own view is that policy-makers should consider interventions to promote the sorts of activities that generate innovation and productivity growth.
  - This argument relies on the idea that innovation generates positive externalities, which I am exploring empirically in other work with co-authors (Atkin et al., 2014)

Further Thoughts (cont.)

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Further Thoughts (cont.)

- I do not want to argue that such interventions need to happen at the border, in the form of tariffs or other trade barriers.
- And it is true that governments have no special knowledge about which sectors/firms/ideas/technologies are going to be successful in the future.
- But I think there is a strong case for policies that provide broad-based (sometimes called "horizontal" (Lederman and Maloney, 2012)) support for innovative activities.

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Means by Sub-Sector: 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

Notes: 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. Average 1998 nominal exchange rate: 9.1 pesos/dollar.

Return

Means by Sub-Sector: 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

Notes: 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. Average 1998 nominal exchange rate: 9.1 pesos/dollar.

Return

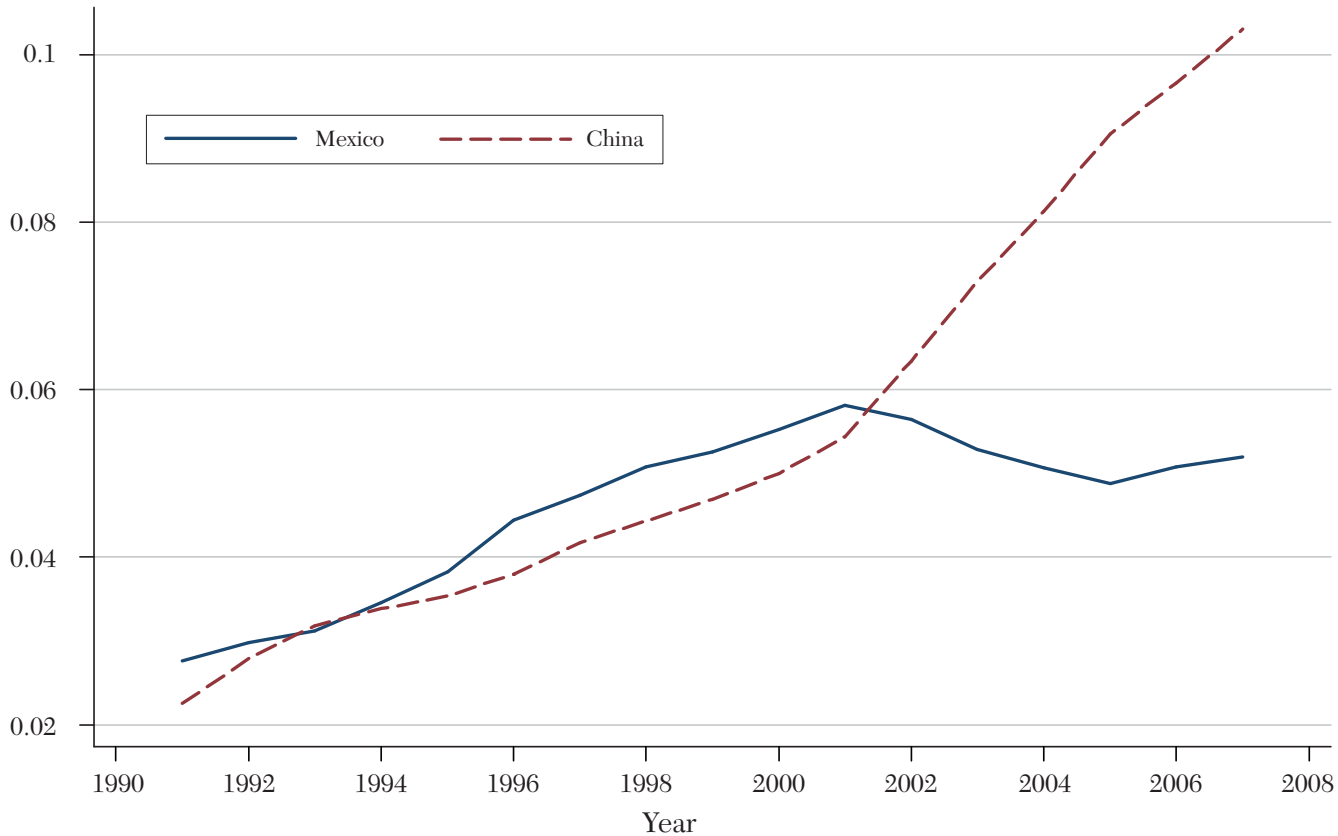
Means by Sub-Sector: Electrical/Electronic Equipment

	non-maquiladoras		
	non-exporters	exporters	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

Notes: 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. Average 1998 nominal exchange rate: 9.1 pesos/dollar.

Return

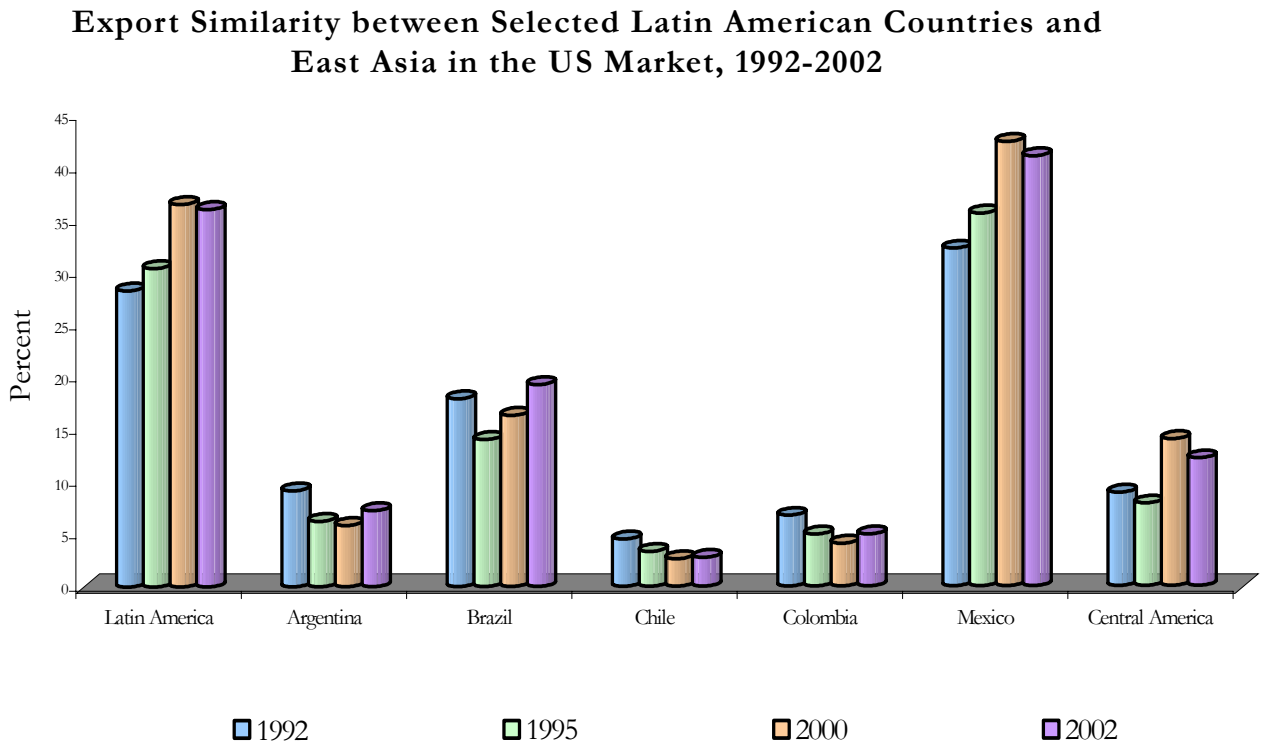
US Import Shares from China, Mexico



Source: Hanson (2010).

▸ Return

Export Similarity between Mexico and China



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

Source: Devlin, Estevadeordal and Rodriguez-Clare (2006).

▸ Return