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

Source: Hanson (2010).
vs. Eastern Europe

Figure 1: Economic Growth in Comparison Countries (continued)

Source: Hanson (2010).
Big question: What role has NAFTA (or integration more broadly) played in this growth experience?
Mexico’s Disappointing Growth Performance (cont.)

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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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► But let’s focus for now on trade/integration.
Plan of Talk

- Introduction
- Some Observations about Existing Approaches
- Sectoral Shifts and Innovation
- Conclusion
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).
The Empirical Challenge

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  ▶ 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).

▶ 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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- Advantage: Can make theoretically well-grounded statements about general-equilibrium effects, welfare.
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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)
Reduced-Form Approaches

- A number of authors have followed what De la Cruz et al. (2013) call “econometric” approaches, e.g. difference-in-differences.
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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:
  - Import-discipline effect.
  - Improved access to intermediate inputs, machinery.
  - Reallocation toward more productive plants.
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  - Import-discipline effect.
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  - Reallocation toward more productive plants.


- 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$^a$ |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Explanatory variable | Log TFP | \( (1) \) | Log TFP | \( (2) \) | Log TFP | \( (3) \) | Log TFP | \( (4) \) | Log TFP | \( (5) \) | Log TFP | \( (6) \) |
| 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 – RoW)$^d$ | -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 |  |  |  |  |  |  |  |  |  |  |  |  |
| Exports/sales |  |  |  |  |  |  |  |  |  |  |  |  |
| Exporter*local firm |  |  |  |  |  |  |  |  |  |  |  |  |
Lopez Cordova (2003) (cont.)

Findings:

- Mexican tariffs ↓ ⇒ TFP ↑
- U.S. tariffs ↓ ⇒ TFP ↑
- Use of imported inputs does not seem to have robust positive effect on TFP.
Lopez Cordova (2003) (cont.)

Findings:
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There are things to criticize here:
- TFP lumps mark-ups, measurement 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)

Effects calculated from regression of $\Delta \log$ 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.

Fig. 3. Marginal effect of tariffs on productivity growth.
Notes: Uses data from the Bulletins of the Asociación Mexicana de la Industria Automotriz (AMIA). Production measured in number of vehicles.
Verhoogen (2008) (cont.)

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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  - Sectoral shifts central to analysis.
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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):
  - Different activities are associated with different inherent rates of innovation, productivity growth.
  - Liberalization changes to pattern of specialization, may lead to specialization in non-dynamic activities.
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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).
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).
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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).

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

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.
Role of China

- A common explanation: Mexico had bad luck.
  - Just as Mexico was poised to grow, China entered.
  - China had similar pattern of specialization in exports to U.S.
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▶ There is definitely evidence to support the China story:
  ▶ Utar and Torres Ruiz (2013) yesterday.
  ▶ 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

<table>
<thead>
<tr>
<th>Sector</th>
<th>non-exporters</th>
<th>exporters</th>
<th>maquiladoras</th>
</tr>
</thead>
<tbody>
<tr>
<td>All manufacturing</td>
<td>0.36</td>
<td>0.50</td>
<td>0.41</td>
</tr>
<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.02)</td>
</tr>
<tr>
<td>Apparel</td>
<td>0.19</td>
<td>0.33</td>
<td>0.34</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.04)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>Electrical and Electronic Products</td>
<td>0.35</td>
<td>0.54</td>
<td>0.45</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td>(0.04)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>Transportation Equipment</td>
<td>0.40</td>
<td>0.62</td>
<td>0.54</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td>(0.04)</td>
<td>(0.10)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Country</th>
<th>R&amp;D spending/GDP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexico</td>
<td>.38</td>
</tr>
<tr>
<td>Chile</td>
<td>.65</td>
</tr>
<tr>
<td>China</td>
<td>.65</td>
</tr>
<tr>
<td>Korea</td>
<td>2.34</td>
</tr>
<tr>
<td>U.S.</td>
<td>2.59</td>
</tr>
<tr>
<td>Canada</td>
<td>1.76</td>
</tr>
</tbody>
</table>

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

Integration led Mexico to specialize in less capital- and skill-intensive activities, both across and within sectors.
Introduction
Existing Approaches
Sectoral Shifts and Innovation
Conclusion

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- These sectors that Mexico tended to be less innovative.
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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.
▶ 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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- But patterns suggest that there may be a trade-off between static allocative efficiency and long-term productivity growth.
  - Liberalization alone may not be enough to bring about sustained growth.
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- But patterns suggest that there may be a trade-off between static allocative efficiency and long-term productivity growth.
  - Liberalization alone may not 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)
I do not want to argue that such interventions need to happen at the border, in the form of tariffs or other trade barriers.
Further Thoughts (cont.)

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- And it is true that governments have no special knowledge about which sectors/firms/ideas/technologies are going to be successful in the future.
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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.


References II


References


# Means by Sub-Sector: Apparel

<table>
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<th>non-exporters (1)</th>
<th>exporters (2)</th>
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## Means by Sub-Sector: Transportation Equipment

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## Means by Sub-Sector: Electrical/Electronic Equipment

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<td>(0.78)</td>
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<td>0.29</td>
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<td>0.22</td>
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<td>39.68</td>
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<td>(5.52)</td>
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US Import Shares from China, Mexico

Source: Hanson (2010).
Export Similarity between Mexico and China

The increasing similarity between the Chinese and Latin America export baskets is not unlike the growth in the similarity between East Asia (China excluded) and Latin America. Figure 5.2 shows the ESI values between selected Latin American countries and regions and East Asia. The similarity of exports between Latin America (particularly Brazil and Mexico) and East Asian economies was relatively pronounced in the early-1990s; this similarity has increased during the same period, particularly for Mexico and Latin America as a whole.

Figure 5.2: Export Similarity between Selected Latin American Countries and East Asia in the US Market, 1992-2002

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

Within manufacturing product categories, moreover, China's export prices (measured in unit values) are generally lower than the prices received by other developing economies in Latin America and Asia. The premium received by those countries over China is highest in machinery and lowest in apparel. One explanation for this differential is that products from those regions offer higher quality or have more attributes than products from China, thereby raising their value. This would be consistent with differences in comparative advantage: countries that are relatively abundant in human and physical capital can improve quality or add product features. A competing explanation is that the difference in prices reflects greater product efficiency in China, the result of very low labor costs. This explanation is also consistent with China's explosive export growth, and it raises questions about the share of the manufacturing market that Latin American and other Asian countries can retain as China's capacity and access to foreign markets increases.

What are the future prospects for those Latin America countries whose export structures most resembling that of China? China has significant comparative advantages in the product categories that are crucial to Mexico and countries in Central America (textiles, apparel, and electronics), in particular because these countries specialize in the labor-intensive parts of the production chain in which China has an important edge. The current and relatively high overlap in miscellaneous

Note that the two sets of figures (5.1 and 5.2) are not immediately comparable, given the different levels of aggregation of the data in computing the indices.