Globalization’s Direct and Indirect Impacts on the Environment

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Direct Effects
- Transport emissions
- Biological Invasions

Indirect Effects
- Scale, Composition & Technique Effects
Liberalization’s Indirect Effects

- **Liberalization changes relative prices:**
  - for example, the price of labor-intensive goods fall in labor-scarce countries
- **Composition**
  - When relative prices change, countries change their production mixes to take advantage of their comparative advantage
    - if comparative advantage lies in producing dirty goods, domestic emissions rise
- **Scale**
  - With everyone specializing in what they are best at, total production and emissions both rise
- **Technique Effects**
  - Globalization can change the *way we produce/consume goods*
  - emission intensity may rise or fall
Who has a comparative advantage in dirty goods?

- Pollution Haven Hypothesis/Effect
  - countries with weak environmental regulation
    - low per capita income
    - government non-responsive to citizen demands
Factor Endowments Hypothesis

- many pollution intensive industries are also capital intensive
- At the same time, capital rich-countries tend to be high-income, strict-regulation countries.
- Which dominates?
Interact openness index with quadratic measures of *relative* capital abundance and *relative* income

- *for statistically average country in sample*
  - Antweiler, Copeland & Taylor (2001)
    - $\text{SO}_2$ between -0.4 and -0.9
      (i.e. a 10% increase in trade intensity corresponds to reduction in $\text{SO}_2$ concentrations of between 4% and 9%)
  - Santos-Pinto (2002)
    - $\text{CO}_2$: -0.1
All good news?

- No. *For sample-mean country*,
  - Cole & Elliot (2003)
    - SO$_2$: 0.3
    - BOD: 0.049
    - SO$_2$: 0.05
  - Shen (2007)
    - SO$_2$: 1.566
    - Dust fall: 1.962
    - COD: -2.148
    - Arsenic: -0.236
    - Cadmium: -3.884
Liberalization will lead some countries to produce dirtier goods, and others to produce cleaner goods.

On its own, the Composition effect benefits environment in some countries at expense of others.
Technique Effects

how does liberalization change the way we produce things?
Trade raises incomes

- (Frankel & Rose 2002, Frankel & Romer 1999)
  - a 1% increase in ratio of (instrumented) trade volume to GDP raises income 1.6% to 2.0%
Income effects

- ample evidence that willingness to pay for environmental amenities rise with income
  - income elasticity of WTP >1
  - income elasticity of WTP <1 but >0
Direct Estimates of Trade’s Environmental Income Effects

- **Antweiler, Copeland and Taylor (2001)**
  - “if trade raises incomes by 1%, the technique effect will lead to a reduction of SO2 concentrations of approximately **0.9 to 1.6** percent.”

- **Dean (2002)**
  - “1 per cent reduction in the level of trade restrictiveness produces an increase of 0.09 per cent in the growth rate of income...[which] causes a decline in the growth rate of emissions by **0.03** per cent.” (p. 834)
Trade’s scale effects are theoretically straightforward: more production = more emissions

Most empirical studies use GDP/capita as proxy for scale

Scale effect is unambiguously bad for the environment
What’s the net effect?

- Cole and Elliot (2003)
  - for a statistically median country, a 1% increase in national output/income through trade lowers SO2 and BOD by 1.7% and 0.06%, respectively

- In terms of elasticities:

- Antweiler, Copeland & Taylor (2001):
  - SO\(_2\): -1.0.

- Shen (2007):
  - SO\(_2\): 4.0
  - Dust fall: 2.4
  - COD: -0.982
  - Arsenic: -1.659
  - Cadmium: -3.039
Other “Technique Effects”: Technology Transfer

- Inward FDI is often more fuel efficient, (and potentially greener) technology
- Eskeland and Harrison (2003)
  - Using the ratio of energy inputs to output (both measured in value), find foreign ownership is associated with lower levels of energy use in Mexico, Venezuela, and Côte d’Ivoire.
Changes in Political Economy of Environmental Policy

- Opening to trade changes how regulatory costs are distributed across consumers and producers (McAusland 2003, 2008)
- Trade liberalization can reduce industry opposition to regulation if domestic firms have cost-advantage in complying (Gulati & Roy 2007)
- Even in some cases where regulation doesn’t bind foreign competitors de jure (McAusland 2004)
So where do we stand on the indirect effects?

- **Composition effect:**
  - ambiguous: depends on a country’s comparative advantage

- **Income + scale effect:** likely positive

- **Other technique effects:**
  - tech transfer: benign to positive
  - politics: ambiguous
So if we knew a country had a comparative advantage in clean goods and its regulators were not captured by interest groups, should we conclude trade is necessarily good for its environment?
Econometric Problem: Contemporaneous Correlation

- Capital abundant & democratic countries tend to trade more
- Any empirical test of liberalization’s environmental impacts needs to control for endogeneity of trade volumes

- use 1st-stage gravity model to generate instruments for national trade intensity
- fixes endogeneity problem
- find beneficial impact (i.e. lower concentrations) on SO\(_2\) and NO\(_2\), but no statistically significant impact on particulate matter (PM).
Problem

- Gravity models use geographic data to predict trade flows
- Geographic variables don’t vary over observed time periods
- Must rely on cross-sectional variation
- Data drawn from cross-section of countries may not be truly comparable
Solution: Chintrakarn and Millimet (2006)

- use gravity model to predict trade within a single country
- specifically, predict trade between US states
- measure of pollution/emissions: toxic releases
- results: find trade intensity increases land releases, but either reduces or has no statistically significant effect on air, water and underground releases.
Problem

- Most of us aren’t really concerned about increased trade within countries.
- How do we know we can extrapolate from results drawn from within-country trade to international trade?
Solution: McAusland and Millimet (2008)

- use 1\textsuperscript{st}-stage gravity model to construct instrument for trade volumes
- compare environmental impacts of trade depending on whether it is between countries (US-Canada) or within country (within US or within Canada)
- toxic releases as dependent variable

Results:
- a 10\% increase in trade intensity lowers average state/provinces total toxic releases by roughly 9\% 
- changes in sub-national trade intensity do not have a statistically meaningful effect on total toxic releases.
Conclusion

- Even after controlling for endogeneity of trade volumes, more trade appears to have at worst a benign impact on emissions of localized pollutants.
Caveat

- Trade’s beneficial effects don’t always generalize to global pollutants such as CO$_2$

- My reading: trade will not serve as a substitute for global cooperation on global pollutants
Indirect Impacts
Biological Invasions

- Pimental *et al.* (2005)
  - annual cost of dealing with invasive species currently present in the United States is > $120 billion per year

- Invasive species are implicated in 458 of the 900 species currently listed as either threatened or endangered in the United States.
Trade in goods and services (tourism) is primary vector for introductions of exotic species

- intentional introductions: nursery & pet trade

- unintentional introductions: stowaways in trade goods, packaging, transport
Costello, Springborn, McAusland & Solow (2007)

- data:
  - import (by ship) volume & species counts in San Francisco Bay
- estimate rate at which new introductions arise as a result of trade.
- calculate marginal invasion risk (MIR) from imports from different regions.
Atlantic & Mediterranean (ATM) and West Pacific (WPC) regions responsible for most SF invasions:
- ATM: 74 NIS introduced to date
- WPC: 43 NIS introduced to date

MIR from *future* imports:
- WPC: 0.38 additional introductions per additional million short tons imported
- ATM: 0.11
Projection:
- business-as-usual imports from ATM and WPC will lead to 1.4 and 52.4 introductions of new exotic species into SF bay by 2020

Should we restrict trade?

Probably not: deadweight loss from crude trade restrictions swamp measured costs from invasives except for worst offenders (zebra mussels)