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Trade Liberalization and the Environment: Evidence from NAFTA

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Introduction

Research Question:

How did bilateral trade liberalization between the US and Mexico following NAFTA affect pollution from US manufacturing plants?

Motivation

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Figure: The Debate Before NAFTA: Gore vs. Perot

Motivation

Figure: The Battle in Seattle: WTO Protests in 1999

Motivation

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Figure: The 2008 Democratic Primaries: Obama vs. Clinton

Existing Evidence

- Cross-country studies:
  - Antweiler, Copeland, and Taylor (2001), Frankel and Rose (2005) and Managi et al. (2009)
- The composition of imports:
  - Ederington et al. (2004), Levinson and Taylor (2008)
  - Levinson (2009)
- Episode of trade liberalization:
  - Martin (2012)

Method

- My approach: Employ a novel dataset and estimate the effect of trade liberalization between the US and Mexico on emissions of four pollutants from the US manufacturing sector.

- Key empirical issue: Isolating the causal effect of trade liberalization from other confounding factors.

- Treat NAFTA as a quasi-experiment and exploit variation in protection across time, industries and geographic regions to isolate the causal effect.

Contribution

- First study to estimate the causal effect of trade liberalization on plant pollution emissions.
- Identify whether changes in pollution emissions are being driven by changes in the level of production or by changes in the methods of production.

Research Design

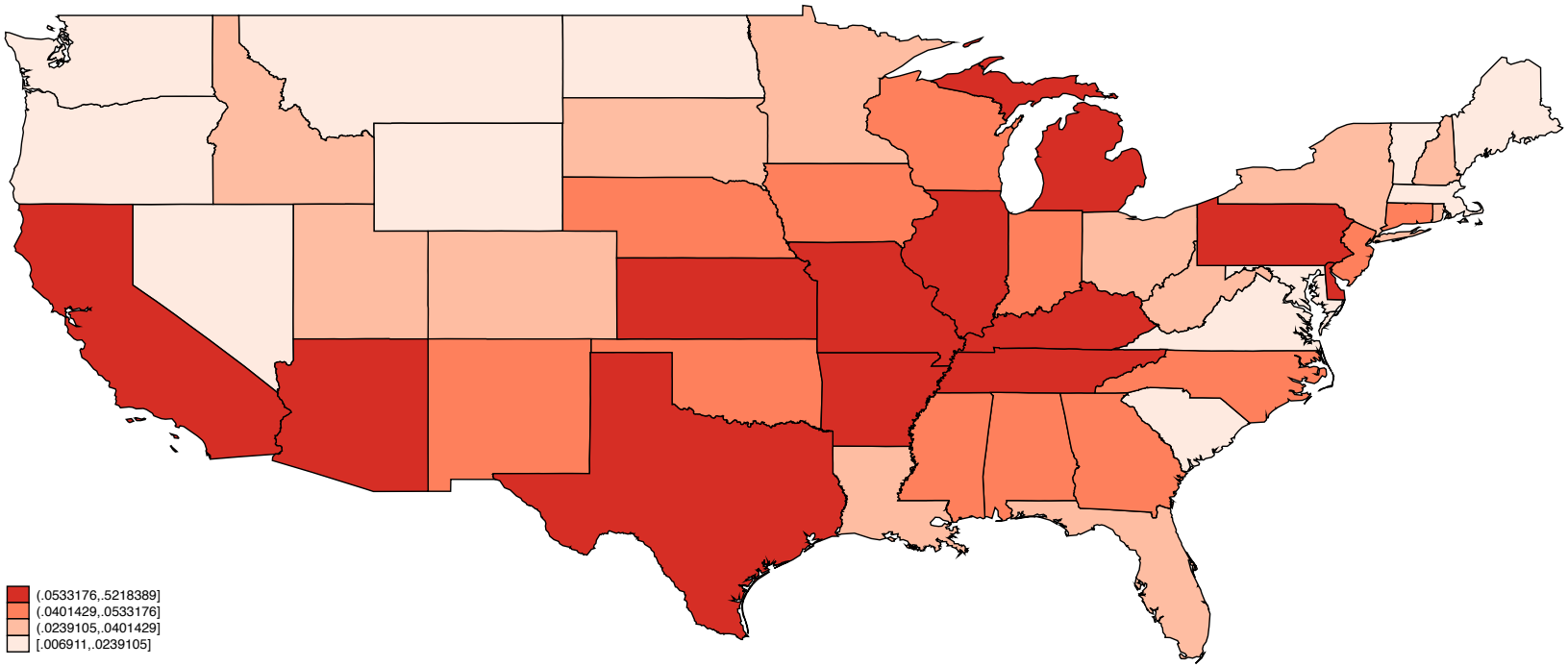
- Empirical challenge:
  - Isolating the causal effect of trade liberalization.
- Typical approach:
  - Differences-in-Differences
  - Treat trade liberalization as a quasi-experiment and compare outcomes of liberalized (treated) and unliberalized (control) industries.
- Key Issue:
  - Level of protection is correlated with (unobservable) industry characteristics at any point in time.

Research Design (Cont'd)

- My approach:
  - Redefine the quasi-experiment to also exploit geographic variation in protection.

Geographic Variation

Figure: Trade With Mexico by State: 1991



Research Design (Cont'd)

- Geographic variation in trade costs means only a subset of plants in each industry will be affected by trade liberalization.
  - Treated groups:
    - Plants in liberalized industries located in exposed states.

- Compare treated groups with plants that are unaffected by trade liberalization.
  - Control groups:
    - Plants in liberalized industries in protected states.
    - Plants in unliberalized industries in exposed states.
    - Plants in unliberalized industries in protected states.

Research Design (Cont'd)

- This amounts to a triple difference approach.
- Three comparisons:
  - Before v. After
  - Liberalized Industries v. Unliberalized Industries
  - Exposed States v. Protected States
- Three sources of variation allow me to control for time-invariant industry and region characteristics, as well as trends in industry, regional and national outcomes.

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Data Sources

1. Plant Pollution Data:
   - Plant level pollution data from the Toxic Release Inventory.
   - Employ data on chemicals that can be classified as VOCs, PM, Pb or Other using classification from Greenstone (2003).
2. Plant Characteristics:
   - Data from the National Establishment Time Series.
3. Trade Data:
   - Tariff data from Feenstra, Romalis and Schott (2002), and Romails (2007).
   - State export data from Feenstra (1997).

- Data for VOCs: 3082 plants in 210 industries and 48 states over years 1991-1996.

Summary Statistics

Table: Summary Statistics: Pre-NAFTA

	Liberalized		Unliberalized	
	Exposed	Protected	Exposed	Protected
	(1)	(2)	(3)	(4)
VOCs:				
Emissions	183711	132797	118973.2	156809
	(1393803)	(526064.3)	(338113.4)	(749655.1)
Employment	424.6	431.4	383.7	381.6
	(920.4)	(854.2)	(1388.6)	(1060.5)
Sales	62285.2	57727.9	46214.1	47585.1
	(128478.3)	(115056.8)	(155682.0)	(122888.7)
No. of Plants	1027	1148	435	472

Notes: Standard deviations reported in parentheses. Emissions reported in pounds. Sales reported in 1000s of 1987 US dollars. Plants are classified as liberalized if they are in industries that experienced an increase in tariff preferences following NAFTA and unliberalized if they did not. Plants are classified as exposed if they are located in states with trade exposure that is higher than the median level, and classified as protected if it is less.

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Estimation Framework

- Benchmark model:

$$\ln Z_{ijst} = \beta_0 + \beta_1[\tau_{jt}^U \times I_s] + \beta_2[\tau_{jt}^M \times I_s] + \rho_i + \mu_{jt} + \delta_{st} + \lambda_t + \varepsilon_{ijst}$$

- Coefficients of interest: β_1 and β_2

- To deal with serial correlation issues use solution from Bertrand et al. (2004) and estimate:

$$\Delta \ln Z_{ijst} = \beta_1[\Delta\tau_j^U \times I_s] + \beta_2[\Delta\tau_j^M \times I_s] + \mu_j + \delta_s + \lambda + \Delta\varepsilon_{ijs}$$

- Identifying assumption: No time-varying industry$\times$state shocks.

Main Results

Table: Emission Levels: VOCs

	(1)	(2)	(3)
$\Delta\tau_j^U \times I_s$	-0.052	-0.391^c	-0.663^b
	(0.187)	(0.234)	(0.297)
$\Delta\tau_j^M \times I_s$	0.011	0.033	-0.161^c
	(0.019)	(0.024)	(0.087)
Industry Dummies	No	Yes	Yes
State Dummies	No	No	Yes
Observations	3082	3082	3082
R^2	0.00	0.13	0.15

Notes: Standard errors clustered by industry and state are reported in parentheses. ^{a}, ^{b}, and ^{c} denote significance at the 1%, 5% and 10% levels, respectively.

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Why Do Emissions Fall?

- The quantity of pollution emitted by plant i in industry j and state s, Z_{ijs}, can be written as:

$$Z_{ijs} = \underbrace{E_{ijs}}_{\text{Techniques}} \times \underbrace{X_{ijs}}_{\text{Scale}}$$

- To differentiate between the two, can examine the effect of trade liberalization on emission intensity:

$$E_{ijs} = Z_{ijs}/X_{ijs}$$

Mechanism

Table: Emission Intensity: VOCs

	(1)	(2)	(3)
$\Delta\tau_j^U \times I_s$	-0.085	-0.441^c	-0.728^b
	(0.202)	(0.239)	(0.314)
$\Delta\tau_j^M \times I_s$	0.006	0.038	-0.165^c
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Conclusion

- Trade liberalization decreased pollution emissions in plants that were exposed to trade with Mexico.
  - Driven by a technique effect.
- Things to do:
  - Firm heterogeneity.
  - Placebo tests.