

Pollution Havens and the Trade in Toxic Chemicals: Evidence from US Trade Flows

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Motivation

- Relationship between environmental degradation and industrial activity
- Pollution haven phenomenon
 - environmental vs. commercial regulatory change
 - US EPA Toxic Release Inventory (TRI)
 - 45% decrease in toxic chemical emissions (1988-2008)
 - US foreign trade flows in chemicals
 - net exporter (1989) → net importer (2008)

Contributions

- Use of trade microdata in pollution haven hypotheses
 - correspondence between regulation and activity
 - panel data by chemical-country-year
 - direct measures
- Identification via differences-in-differences methodology
 - multiple sources of variation
- Separate results for competing PHHs
 - regulatory effect versus factor endowments

Preview of findings

Domestic regulation leads to production offshoring of toxic chemicals

- higher net imports during TRI-listing period

Production disproportionately offshored to countries with less stringent environmental regulation

- net imports negatively associated with interaction of TRI-listing change and trade partner income levels

Literature review and theory



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Literature review and theory



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Literature review and theory

“[S]houldn’t the World Bank be encouraging MORE migration of the dirty industries to the LDCs?...”

“I’ve always thought that under-populated countries in Africa are vastly UNDER-polluted...”

“The demand for a clean environment for aesthetic and health reasons is likely to have very high income elasticity...”

-Larry Summers

(1991)

Literature review and theory

Environmental Kuznets Curve (EKC)

- Grossman and Krueger (1993, 1995)
 - Mexico and NAFTA
 - scale, technique, composition effects
- Antweiler et al (2001), Frankel and Rose (2005)
- Ederington et al (2004, 2006), Levinson and Taylor (2008)
- Copeland and Taylor (2004)
 - multiple hypotheses

Testable hypotheses

Pollution haven effect (PHE)

All else equal, domestic regulation increases net imports.

Pollution haven hypothesis (PHH)

Increase in net imports disproportionately sourced from poorer countries.

Factor endowment hypothesis (FEH)

Chemicals disproportionately imported from high capital countries.

Toxic Release Inventory (TRI)

Emergency Planning and Community Right-to-Know Act (EPCRA)

- mandatory federal reporting
- market-oriented outcomes

Toxic Release Inventory (US EPA)

- chemicals: 332 (1988) → 666 (2008)
- facilities: 21,996 – 25,400
- thresholds: 10,000 lbs usage, 25,000 lbs other

Toxic Release Inventory (TRI)

Reporting concerns

- emissions for changing set of chemicals
 - variation in chemical toxicity per pound of release
- regulatory effect deduced from period of listing
- threshold-regarding
- attribution of emission decreases
 - reduced usage and production
 - improved management and chemical recycling
 - fewer reporting facilities

Foreign Merchandise Trade data

- universe of US trade transactions, 1992 to 2008
- variables: commodity tariffs paid
value freight costs
quantity related party
trade partner plant identifier
- additional: GDP, population, bilateral distance, OECD
- 14 TRI-change chemicals (exact name match):
 - [+] α -lindane, bromine, fluorine, formic acid, HCFC-22, lithium carbonate, vanadium oxide
 - [–] acetone, barium sulfate, hydrochloric acid, methyl ethyl ketone, n-dioctyl phthalate, phosphoric acid, sulfuric acid

Differences-in-differences model

- cf. Card & Krueger (1994), Hastings (2004)

$$y_{ijt} = \beta_0 + \beta_{1i} x_{1i} + \beta_{2j} x_{2j} + \beta_{3t} x_{3t} + \beta_{4it} x_{4it} + \beta_{5ijt} x_{5ijt} + \varepsilon_{ijt}$$

y_{ijt} = net import value for chemical i from country j in year t

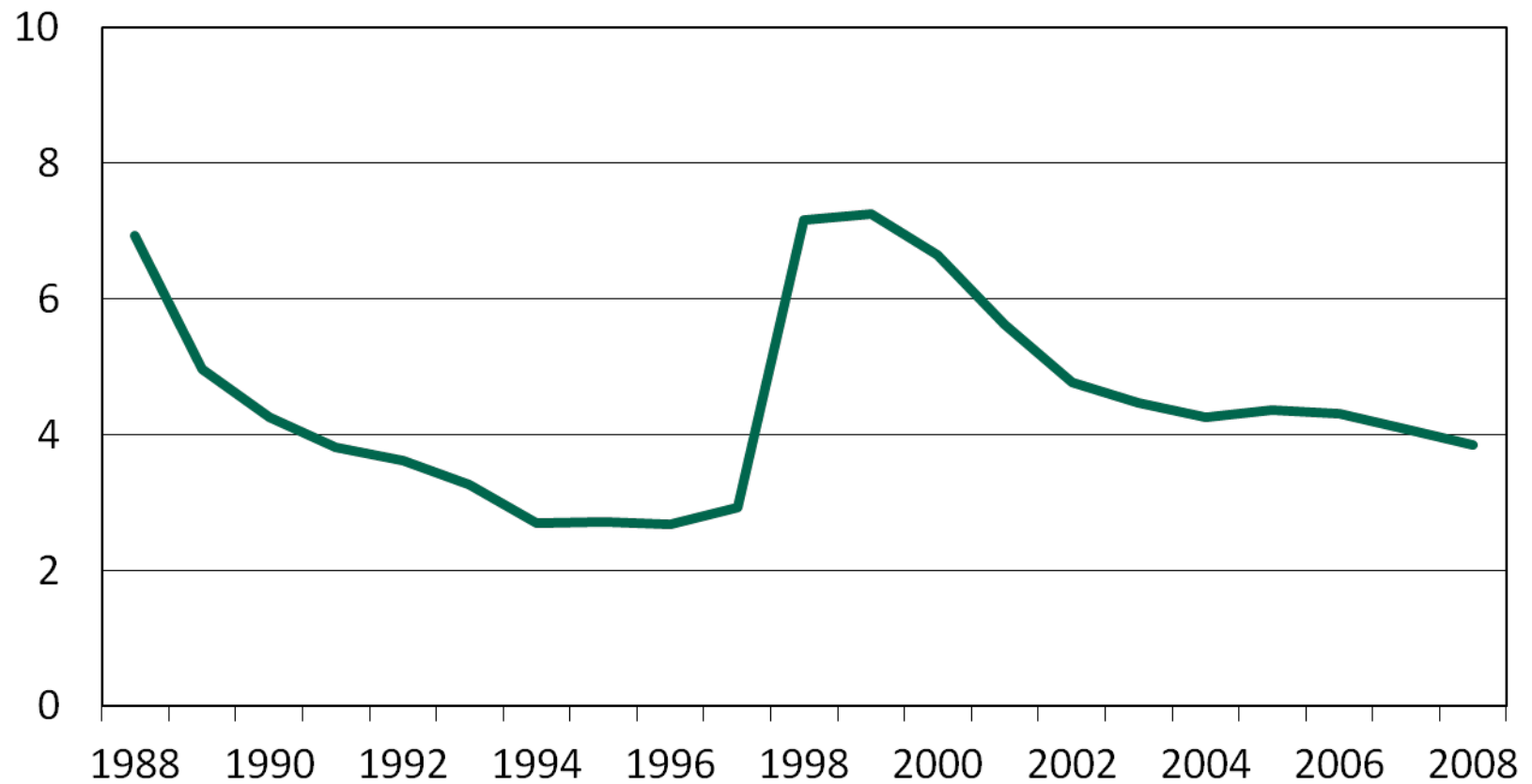
x_{1i}, x_{2j}, x_{3t} = dummy variables

x_{4it} = TRI listing status dummy variable

x_{5ijt} = interaction and control variables

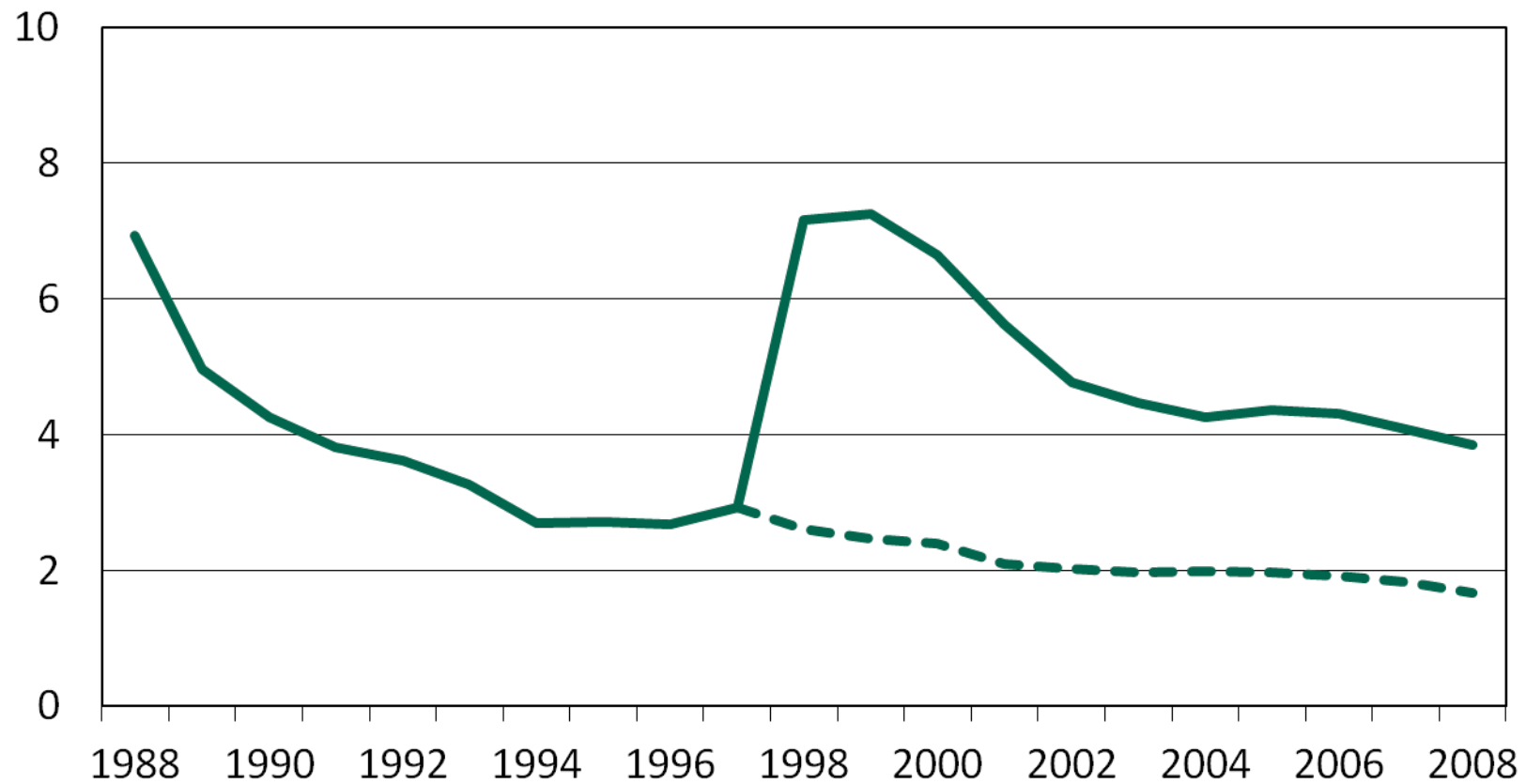
ε_{ijt} = error term

Aggregate TRI emissions (billion lbs)



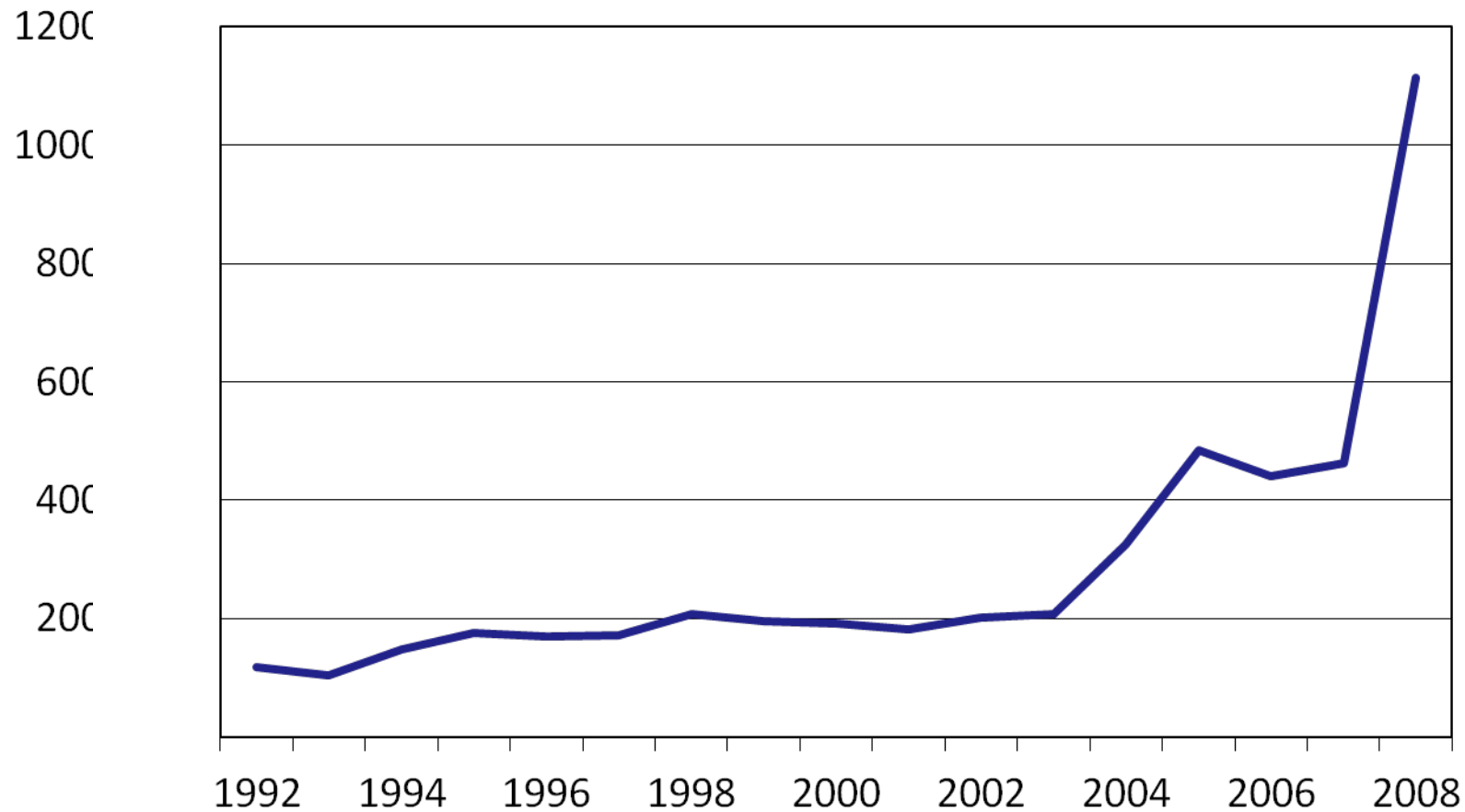
Source: US EPA (2009)

Aggregate TRI emissions (billion lbs)



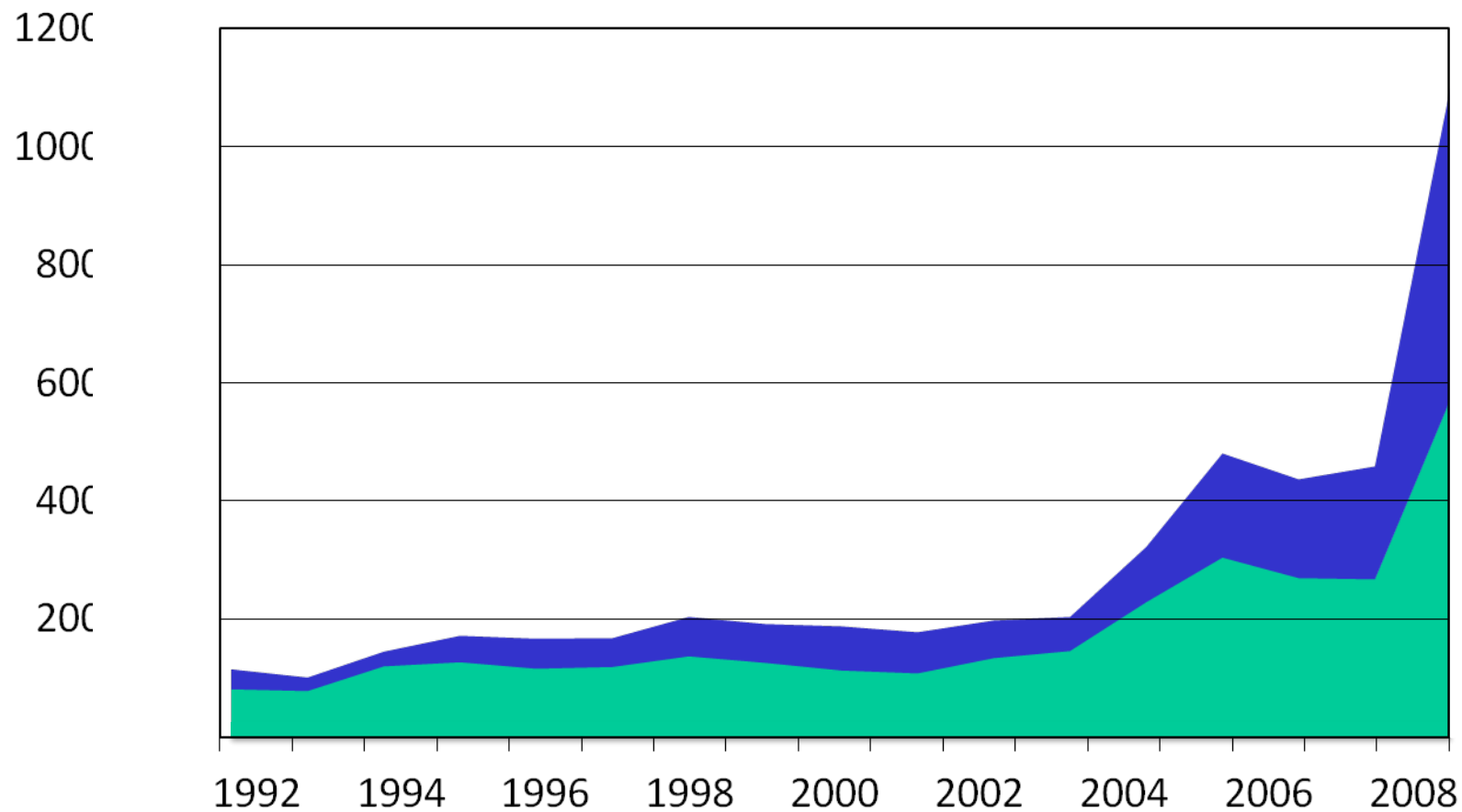
Source: US EPA (2009)

TRI panel: gross imports (\$ million)



Source: US Census Bureau (2009)

TRI panel: gross imports (\$ million)



Source: US Census Bureau (2009)

■ OECD ■ non-OECD

Table 2: Differences-in-differences regression results

DV: Net import (\$ mil)	[A]	[B]	[C]
Panel treatment/control	TRI Δ/other (19/1)	TRI Δ/other (19/1)	TRI add/other (9/1)
TRI listing	13.672*** (3.575)	10.176** (4.622)	65.822** (15.216)
GDP per capita (\$1,000)	2.802*** (0.252)	4.801*** (0.386)	18.458*** (1.081)
TRI listing · GDP pc	-0.960*** (0.196)	-0.716*** (0.256)	-7.768*** (0.665)
Control variables	No	Yes	Yes
Observations	25,431	18,569	8,651
R-squared	0.049	0.082	0.154

Significance level: *1% **5% ***1%

All specifications include chemical, country, and year indicators; standard errors in parentheses.

Table 3: Robustness checks

DV: Net import (\$ mil)	[Time Consistent Controls]		[Matched Pairs]
Panel treatment/control	TRI Δ/TRI never (19/1)	TRI Δ/TRI always (19/1)	TRI Δ/TRI always (19/18)
TRI listing	0.820 (0.862)	0.516 (0.515)	0.105** (0.048)
GDP per capita (\$1,000)	0.219*** (0.073)	0.266*** (0.043)	0.009*** (0.003)
TRI listing · GDP pc	-0.078* (0.048)	-0.056* (0.029)	-0.007** (0.003)
Control variables	Yes	Yes	Yes
Observations	18,489	18,553	31,337
R-squared	0.296	0.060	0.255

Significance level: *1% **5% ***1%

All specifications include chemical, country, and year indicators; standard errors in parentheses.

Summary of findings

Fail to reject pollution haven effect (PHE)

- higher net imports during TRI-listing period

Fail to reject pollution haven hypothesis (PHH)

- net imports negatively associated with the interaction of TRI-listing change and trade partner income levels

Fail to reject factor endowment hypothesis (FEH)

- net imports positively associated with trade partner income and OECD status

Discussion and extensions

- measurement in toxicity
- panel dataset expansion
- overlapping regulatory regimes
 - foreign: Montreal Protocol, pollution release and transfer registers (PRTRs)
 - domestic: OSHA, CERCLA, state-level
- firm-level analysis
 - multinational firm trade