The Geographical Leakage of Environmental Regulation

Curtis, Miao, Soliman, Suárez Serrato, & Xu (2024)

Levi Crews (UCLA)

February 2025

A clear, important paper

- **research question**:

  How large is geographic leakage resulting from place-based environmental policy?

A clear, important paper

- **research question**:

  How large is geographic leakage resulting from place-based environmental policy?

- in the context of the **US Clean Air Act Amendments** (1963–87)...
  1. updated **reduced-form results** w/ event study design identify the **relative effect** of CAAA on plants/firms/counties in treated vs. control areas (**$\sim$30% decline** in emp., sales)

A clear, important paper

- **research question**:

  How large is geographic leakage resulting from place-based environmental policy?

- in the context of the **US Clean Air Act Amendments** (1963–87)...

  1. updated **reduced-form results** w/ event study design identify the **relative effect** of CAAA on plants/firms/counties in treated vs. control areas (**∼30% decline** in emp., sales)

     → **BUT** maybe production **shifted** from treated to control areas to escape CAAA...

A clear, important paper

- **research question**:

  How large is geographic leakage resulting from place-based environmental policy?

- in the context of the **US Clean Air Act Amendments** (1963–87)...

  1. updated **reduced-form results** w/ event study design identify the **relative effect** of CAAA on plants/firms/counties in treated vs. control areas (**$\sim$30% decline** in emp., sales)

     $\rightarrow$ **BUT** maybe production **shifted** from treated to control areas to escape CAAA...

  2. industry equilibrium model w/ **regional trade** and **multi-unit firms** used to **decompose** into the **change in treated** (-19.9%) vs. "**geographic leakage**" ($+17.6\%$)

A clear, important paper

- **research question**:

  How large is geographic leakage resulting from place-based environmental policy?

- in the context of the **US Clean Air Act Amendments** (1963–87)...

  1. updated **reduced-form results** w/ event study design identify the **relative effect** of CAAA on plants/firms/counties in treated vs. control areas (**$\sim$30% decline** in emp., sales)

     $\rightarrow$ **BUT** maybe production **shifted** from treated to control areas to escape CAAA...

  2. industry equilibrium model w/ **regional trade** and **multi-unit firms** used to **decompose** into the **change in treated** (-19.9%) vs. "**geographic leakage**" ($+17.6\%$)

- **punchline**: w/ trade + multi-unit firms, production shifts to regional **pollution havens**

A clear, important paper

- **research question**:

  How large is geographic leakage resulting from place-based environmental policy?

- in the context of the **US Clean Air Act Amendments** (1963–87)...
  1. updated **reduced-form results** w/ event study design identify the **relative effect** of CAAA on plants/firms/counties in treated vs. control areas (**$\sim$30% decline** in emp., sales)

     $\rightarrow$ **BUT** maybe production **shifted** from treated to control areas to escape CAAA...
  2. industry equilibrium model w/ **regional trade** and **multi-unit firms** used to **decompose** into the **change in treated** (-19.9%) vs. "**geographic leakage**" ($+17.6\%$)

- **punchline**: w/ trade + multi-unit firms, production shifts to regional **pollution havens**

- great example of **micro-to-macro** approach!

Testing re: pollution havens can be hard. . . (Copeland, Shapiro, and Taylor, 2022)

- **weak sense** ("pollution haven effect"):

  environmental regulation has a negative effect on competitiveness in affected industries

- **strong sense** ("pollution haven hypothesis"):

  the location with the weakest regulation will export the pollution-intensive good

Testing re: pollution havens can be hard. . . (Copeland, Shapiro, and Taylor, 2022)

☑ **weak sense** ("pollution haven effect"): the **relative effect** (**−30%**) is sufficient. . .

environmental regulation has a negative effect on competitiveness in affected industries

. . . but we had **strong evidence** already (Hanna, 2010; Cherniwchan, Copeland, and Taylor, 2017)

☐ **strong sense** ("pollution haven hypothesis"):

the location with the weakest regulation will export the pollution-intensive good

Testing re: pollution havens can be hard... (Copeland, Shapiro, and Taylor, 2022)

☑ **weak sense** ("pollution haven effect"): the **relative effect** (-30%) is sufficient...

environmental regulation has a negative effect on competitiveness in affected industries

...but we had **strong evidence** already (Hanna, 2010; Cherniwchan, Copeland, and Taylor, 2017)

☐ **strong sense** ("pollution haven hypothesis"): want to see **leakage** ($+17.6\%$)...

the location with the weakest regulation will export the pollution-intensive good

...but **other sources of comparative advantage** may dominate the diff. regulation

- factor abundance, local productivity, ...
- Carleton, Crews, and Nath (2023, 2024): location of water-intensive production determined more by local ag. productivity than by property rights or even (absolute) water abundance

. . . but the current draft may have made it *too* easy

- **this draft**: common $\boldsymbol{T_j = T}$ across all regions (before CAAA)

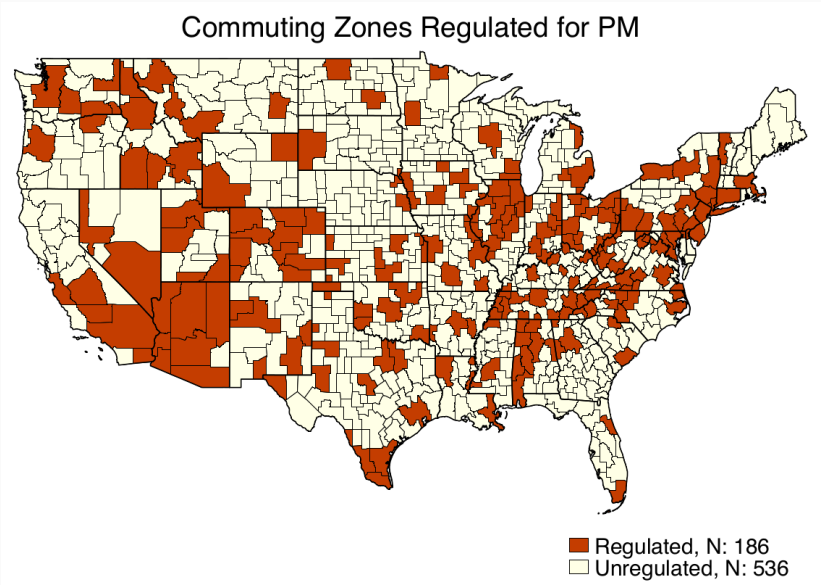
. . . but the current draft may have made it *too* easy

- **this draft**: common $T_j = T$ across all regions (before CAAA)
- but if T_j is **heterogeneous** and, in particular, **positively correlated** w/ treatment. . .
  - in the extreme with $T_{na} >> T_a$, could be still better to produce in **treated areas**
  - the **relative effect** would just be the **change in treated** $\rightarrow$ no **geographic leakage**
  - assuming common $T_j = T$ is just dropping an omitted variable ad hoc

. . . but the current draft may have made it *too* easy

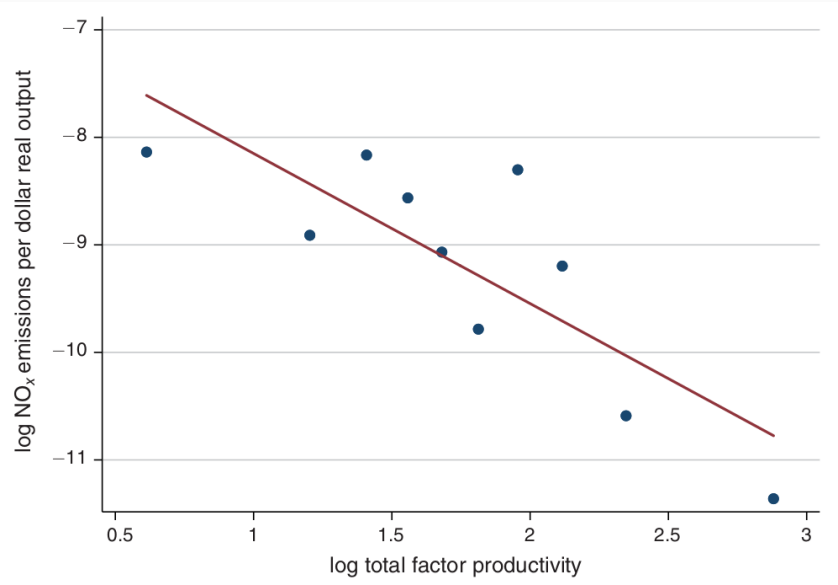
- **this draft**: common $\boldsymbol{T_j} = \boldsymbol{T}$ across all regions (before CAAA)
- but if $\boldsymbol{T_j}$ is **heterogeneous** and, in particular, **positively correlated** w/ treatment. . .
  - in the extreme with $\boldsymbol{T}_{\text{na}} >> \boldsymbol{T}_{\text{a}}$, could be still better to produce in **treated areas**
  - the **relative effect** would just be the **change in treated** $\rightarrow$ no **geographic leakage**
  - assuming common $\boldsymbol{T_j} = \boldsymbol{T}$ is just dropping an omitted variable ad hoc
- seems like the usual model inversion of local production data should identify $\{\boldsymbol{T_j}\}$

Where would we expect T_j to be highest?



More productive firms are cleaner

(Shapiro and Walker, 2018)



Another way for regulation to enter (Shapiro and Walker, 2018)

- **this draft**: CAAA regulation is a permanent drop in local productivity ($T_j \downarrow$)

Another way for regulation to enter (Shapiro and Walker, 2018)

- **this draft**: CAAA regulation is a permanent drop in local productivity ($\boldsymbol{T_j} \downarrow$)
- instead, let firms **choose abatement tech.** (a) to **avoid a tax** on pollution emissions (z):

$$q_{ij}(\phi) = [1 - a(\phi)]\phi\ell_{ij}(\phi) \text{ and } z_{ij}(\phi) = [1 - a(\phi)]^{\frac{1}{\varepsilon}}\phi\ell_{ij}(\phi)$$

$$\rightarrow \quad \boldsymbol{q_{ij}(\phi) = [z_{ij}(\phi)]^{\varepsilon}[\phi\ell_{ij}(\phi)]^{1-\varepsilon}}$$

- CAAA is then a **differential change** in the pollution tax across regions

Another way for regulation to enter (Shapiro and Walker, 2018)

- **this draft**: CAAA regulation is a permanent drop in local productivity ($\boldsymbol{T_j} \downarrow$)
- instead, let firms **choose abatement tech.** (a) to **avoid a tax** on pollution emissions (z):

$$q_{ij}(\phi) = [1 - a(\phi)]\phi\ell_{ij}(\phi) \text{ and } z_{ij}(\phi) = [1 - a(\phi)]^{\frac{1}{\varepsilon}}\phi\ell_{ij}(\phi)$$

$$\rightarrow \quad \boldsymbol{q_{ij}(\phi) = [z_{ij}(\phi)]^{\varepsilon}[\phi\ell_{ij}(\phi)]^{1-\varepsilon}}$$

- CAAA is then a **differential change** in the pollution tax across regions
- it's precisely the **more productive** firms that are...
  - ... more likely to be **multi-unit** $\rightarrow$ their **leakage** is **40%** of total
  - ... **cleaner** $\rightarrow$ different incidence of the tax

Another way for regulation to enter (Shapiro and Walker, 2018)

- **this draft**: CAAA regulation is a permanent drop in local productivity ($\boldsymbol{T_j} \downarrow$)
- instead, let firms **choose abatement tech.** (a) to **avoid a tax** on pollution emissions (z):

$$q_{ij}(\phi) = [1 - a(\phi)]\phi\ell_{ij}(\phi) \text{ and } z_{ij}(\phi) = [1 - a(\phi)]^{\frac{1}{\varepsilon}}\phi\ell_{ij}(\phi)$$

$$\rightarrow \quad \boldsymbol{q_{ij}(\phi) = [z_{ij}(\phi)]^{\varepsilon}[\phi\ell_{ij}(\phi)]^{1-\varepsilon}}$$

- CAAA is then a **differential change** in the pollution tax across regions
- it's precisely the **more productive** firms that are...
  - ... more likely to be **multi-unit** $\rightarrow$ their **leakage** is **40%** of total
  - ... **cleaner** $\rightarrow$ different incidence of the tax
- Shapiro and Walker (2018) based on Annual Survey of Manufactures (1990)...
  - firms behave as if they pay **1%** of their total production costs to pollution taxes
  - the implicit pollution tax that US manufacturers face **doubled** between 1990 and 2008 $\rightarrow$ accounts for most of the observed 60% drop in emissions

Recap

A clearly-motivated, micro-to-macro paper on **spatial effects of environmental regulation**

1. allow for heterogeneous T_j when decomposing **change in treated** vs. **leakage**
2. more agnostic modeling of CAAA + firm heterogeneity in pollution (Shapiro and Walker, 2018)

Recap

A clearly-motivated, micro-to-macro paper on **spatial effects of environmental regulation**

1. allow for heterogeneous T_j when decomposing **change in treated** vs. **leakage**
2. more agnostic modeling of CAAA + firm heterogeneity in pollution (Shapiro and Walker, 2018)

Thanks!

References

Carleton, Tamma, Levi Crews, and Ishan Nath. 2023. "Agriculture, trade, and the spatial efficiency of global water use."

———. 2024. "Is the world running out of fresh water?" *AEA Papers and Proceedings* 114:31–35.

Cherniwchan, Jevan, Brian R. Copeland, and M. Scott Taylor. 2017. "Trade and the environment: New methods, measurements, and results." *Annual Review of Economics* 9 (1):59–85.

Copeland, Brian R., Joseph S. Shapiro, and M. Scott Taylor. 2022. "Globalization and the environment." In *Handbook of International Economics*, vol. 5, edited by Gita Gopinath, Elhanan Helpman, and Kenneth Rogoff, chap. 2. Elsevier, 61–146.

Hanna, Rema. 2010. "Us environmental regulation and FDI: Evidence from a panel of US-based multinational firms." *American Economic Journal: Applied Economics* 2 (3):158–189.

Shapiro, Joseph S. and Reed Walker. 2018. "Why is pollution from US manufacturing declining? The roles of environmental regulation, productivity, and trade." *American Economic Review* 108 (12):3814–3854.