The Environmental Kuznets Curve in Small Geographies

Dakshina G. De Silva
Lancaster University

Robert P. McComb
Texas Tech University

Anita R. Schiller
University of Dundee

Aurelie Slechten
Lancaster University

February 2018

Motivation

- Considerable interest in examining the relationship between environmental quality and income
  $\Rightarrow$ Grossman and Krueger (1993), ..., De Silva, Hubbard, and Schiller (2016), ...
- Most analyses are conducted for large geographies or national economies
- However, pollution is not evenly spread within a country/region
- Firms choose where to produce (and to pollute) depending on local areas' characteristics.
  $\Rightarrow$ Important to understand the distributional impacts of pollution within a region

What we do

1. We investigate (theoretically and empirically) the existence of a **local EKC-type relationship** by considering:
   - Small geographies (census tracts in Texas)
   - Local pollutants (toxic chemical releases reported in the TRI Program)

2. Additionally, we explain the **patterns of entry and exit in the waste management/remediation industry** as a function of income and industrial agglomeration
   $\Rightarrow$ If waste management activity is due to localized demand for environmental quality, it should also be related to income and to the presence of polluting firms

Our setting (1)

- We take a firm-level perspective: How do firms approach production and pollution decisions? Our setting is motivated by Hamilton (1995) who hypothesized regarding polluting firms' location decisions
  1. The plant location decision will depend on the valuation of residential characteristics that influence the compensation the firm will have to pay in case of damages (Coase, 1960)
  2. Potentially polluting firms will choose locations where the probability of the pursuit of collective action by residents and other businesses is lower
     $\Rightarrow$ This probability will depend on local income levels (Olson, 1965)
- We also take into account the fact that the number of potential polluters in a given location may depend on income (e.g. agglomeration effects)

In our model, we incorporate these factors to demonstrate the conditions on the drivers of local economic activity and on the costs of release that are necessary to generate a local EKC-type relationship

Our setting (2)

- A local EKC-type relationship implies that polluting firms invest in abatement/prevention activities as local income increases, which are provided by the remediation industry
- What is the structure (entry and exit patterns at the tract level) of this remediation industry? More specifically: Does the decision to enter a specific tract or exit depend on local residents' income, even after accounting for variables that should drive entry/exit decisions?
- To answer this question, we write down a profit maximization problem that leads to a conditional logit framework which can be taken to data.

Contribution

- To date, empirical studies have addressed both local and global pollutants (air quality, water quality, waste, city sanitation, energy use...), but most of these studies are conducted on large geographies or national economies
  $\Rightarrow$ Grossman and Krueger (1993), Shafik (1994),... Dasgupta et al. (2002)...
  $\Rightarrow$ Here we focus on small geographies (using a very detailed dataset from Texas) and we analyze the remediation industry

- de Bruyn and Heintz (2002) notes that theoretical approaches to explain the EKC fall within the range of five factors:
  1. behavioral change and preference (Andreoni and Levinson, 2001; Lieb, 2002)
  2. institutional changes (Jones and Manuelli, 2001; Egli and Steger, 2007)
  3. technological and organizational changes (Selden and Song, 1995; Stokey, 1998)
  4. structural changes (Marsiglio et al., 2016)
  5. international reallocation (Rothman, 1998; Shafik and Bandyopadhyay, 1992)

  $\Rightarrow$ These models typically use the representative agent or social welfare framework
  $\Rightarrow$ Here we look at the EKC from a firm-level production point of view

A local EKC-type relationship

Theoretical Analysis

- We look at the production and pollution decisions of a representative firm:
  - Producing output x, which generates a gross profit $\pi(x)$;
  - and releasing some toxic waste into the environment with a probability $p(x, e)$
    $\Rightarrow$ where e is the investment in prevention technologies, which reduces the probability that a release occurs.
    $$p_x(x, e) > 0 \text{ and } p_e(x, e) < 0$$
    we also assume that $p_{xe}(x, e) \geqslant 0$: increasing output reduces the marginal "productivity" of investment in prevention technology
- Prevention technologies can be purchased from remediation firms at a unit price w
- Locations differ in terms of median income (same environmental policy)
- Let's first look at production and prevention decisions of a firm in a location with income level $m \in [0, \bar{m}]$

Theoretical Analysis: production and prevention

In a location with income m, the representative firm chooses output x^* and investment in prevention e^* in order to maximize its profit:

$$\Pi(x, e) = \pi(x) - p(x, e)h(m) - we$$

$\Rightarrow$ Local income affects a firm's decision through $h(m)$ (Hamilton, 1995): higher local income is associated with higher local housing values and higher probability of collective actions (because of higher willingness to pay for better environmental quality)

Theoretical Analysis: production and prevention

The first-order conditions are given by:

$$\begin{aligned} \pi_x(x^*) - p_x(x^*, e^*)h(m) &= 0 \\ -p_e(x^*, e^*)h(m) - w &= 0 \end{aligned}$$

Optimal output will decrease and prevention will increase in local income

Therefore, the individual probability of release, $p(x^*, e^*)$ will decrease at high income levels $\rightarrow$ Environmental justice (Hamilton, 1995)

Richer tracts are less polluted because cleaning costs are higher, so a firm uses a combination of its two options to reduce these costs:

1. Firm invests in prevention technologies;
2. Firm also reduces output

But this assumes that the number of firms in a tract does not depend on residents' income...

Theoretical Analysis: production and prevention

Let N be the total number of potential polluters in a tract. We show that if:

1. $h(m)$ is increasing and convex
   $\Rightarrow$ checked by looking at the relationship between housing prices and median income

2. N is strictly increasing in income up to some income level $\hat{m} < \bar{m}$, and then it either flattens out or decreases
   - higher-income tracts tend to have better infrastructure and workers with better human capital $\rightarrow$ this should attract firms
   - When income is too high, these positive agglomeration effects may disappear as a result of negative externalities (e.g. congestion, land price...)

   $\Rightarrow$ checked in the empirical analysis by looking at the relationship between total number of polluting firms and median income

Then total level of toxic releases in a tract, $Np(x^*, e^*)$, will exhibit a $\bigcap$-shape (EKC)

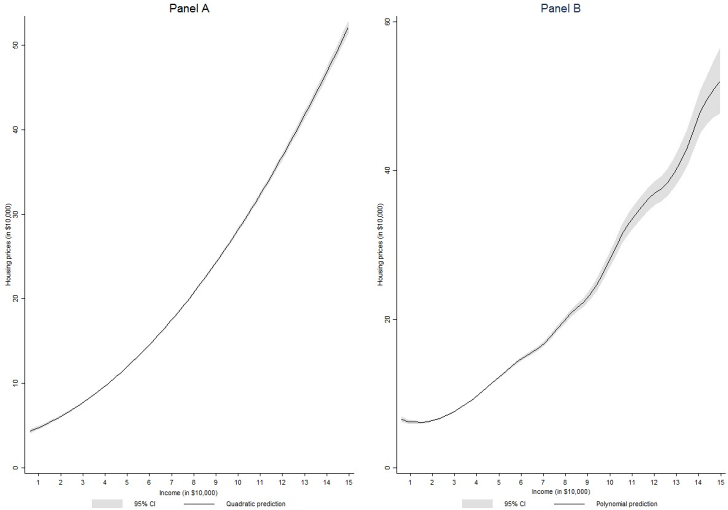
Theoretical Analysis: EKC - interpretation

Under conditions 1 and 2, toxic release $Np(x^*, e^*)$ will exhibit a $\bigcap$-shape (EKC):

- Higher income tracts will attract cleaner firms: i.e., firms with combinations of output and level of prevention technologies, such that their **individual probability of releasing toxic waste** is lower
- As income increases, tracts will also attract **potential polluters**. Hence, pollution will first increase with the level of income in a tract.
- But, from some income threshold ($\hat{m}$), agglomeration economies are not strong enough to compensate for negative externalities and higher cleaning costs...

Housing prices and median income

$h(m)$ is increasing and convex (condition 1)



Theoretical analysis: remediation firms

If we assume that remediation is a local service, we expect that remediation firms will locate close to polluting firms, which generate their revenues:

1. clean-up programs in case of toxic release: $\underbrace{Np(x^*, e^*)}_{EKC} h(m)$
2. sale of prevention technologies: Nwe^*

Differentiating this revenue with respect to income yields:

$$\underbrace{\frac{dEKC}{dm} h(m)}_{\text{inverted } \bigcap -shape} + \underbrace{Np(x^*, e^*) h'(m) + \frac{d(Nwe^*)}{dm}}_{>0 \text{ but converging to } 0}$$

$\Rightarrow$ Revenues of remediation firms will not exhibit a $\bigcap$-shape, but follow the same pattern as the number of potential polluting firms

Data description (sample period 2000-2006)

Establishment-level information for Texas from the Quarterly Census of Employment and Wages (QCEW) data from the Texas Workforce Commission. We collapse quarterly data ($>$ 12 million obs.) to yearly data

- Firm name, geo-coded address, entry, & exit dates
- Also have information about the monthly number of employees, quarterly wage bill, & six-digit NAICS code

TRI data from EPA – yearly

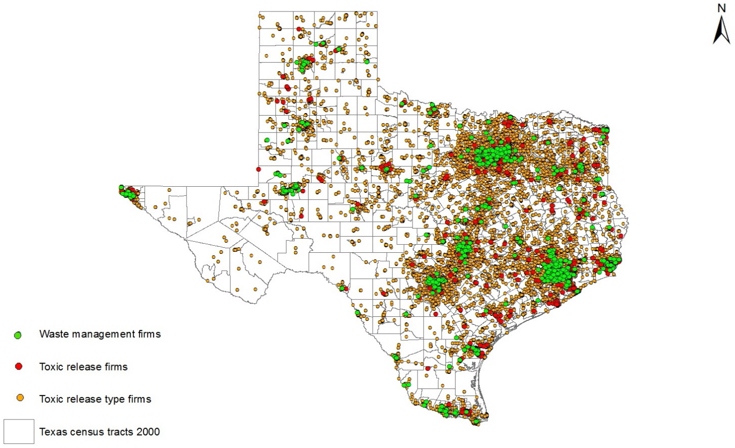
- Firm name, address, toxicity in pounds, industry NAICS codes, and polluting year
- Use these industry NAICS codes to identify TRI and TRI-type, non-TRI, and remediation (NAICS codes: 562112, 562211, 562910, & 562920) firms
  $\Rightarrow$ TRI: 795 TRI-type: 258,128 non-TRI: 321,128 Remediation: 598

Tract-level data (2000 & 2010) from U.S. Census

- Demographics data, number (and miles) of roads & rail roads
- Expand demographics data between 2000 & 2010

Road construction expenditures from TxDOT

Locations of waste remediation and TRI firms



Summary statistics by tract

Variable	Mean (Standard deviation)
Average toxicity in pounds$_{l,t}$ (in millions)	0.010
	(0.180)
Average number of environmental remediation employees$_{l,t}$	2.162
	(18.588)
Average number of TRI type employees$_{l,t}$	53.810
	(318.620)
Average number of environmental remediation firms$_{l,t}$	0.084
	(0.342)
Average number of TRI type firms$_{l,t}$	4.018
	(9.994)
Median household income (in \$10,000)$_{l,t}$	4.393
	(2.278)
Average wage (in \$10,000)$_{l,t}$	3.825
	(4.470)

Summary statistics by tract (cont.)

Variable	Mean (Standard deviation)
College ratio$_{l,t}$	0.094
	(0.078)
Number of amenity establishments$_{l,t}$	5.478
	(12.878)
Number of roads$_{l}$	13.150
	(12.022)
Number of rail roads$_{l}$	2.153
	(4.154)
Population (in 1,000)$_{l,t}$	5.088
	(2.884)
Unemployment rate$_{l,t}$	4.468
	(3.204)
Land area (in 100 in square miles)$_{l}$	0.622
	(2.200)
Housing rental ratio$_{l,t}$	0.315
	(0.201)
TxDOT expenditures (in \$1,000,000)$_{l,t}$	9.068
	(23.076)
Average house value (in \$10,000)$_{l,t}$	11.423
	(9.619)

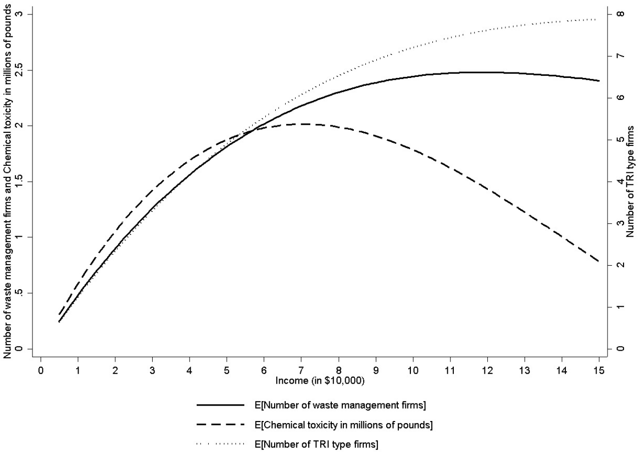
Tobit results for EKC: toxic pounds and number of firms

Variable	Toxicity in pounds$_{l,t}$	Number of firms in TRI type$_{l,t}$	Number of firms in Remediation$_{l,t}$	
	(1)	(2)	(3)	(4)
Median income (in \$10,000)$_{l,t}$	0.642***	1.091***	0.515***	0.464***
Median income (in \$10,000)$^2_{l,t}$	-0.060***	-0.071***	-0.034***	-0.031***
Median income (in \$10,000)$^3_{l,t}$	0.001***	0.001*	0.001*	0.001*
Number of TRI type incumbents$_{l,t}$				0.027***
Average wage (in \$10,000)$_{l,t}$	0.033***	0.079***	0.024***	0.021***
College ratio$_{l,t}$	-5.773***	-10.447***	-3.989***	-3.437***
Number of amenity establishments$_{l,t}$	-0.008**	0.110***	0.011***	0.007***
Number of roads$_l$	0.014***	0.167***	0.024***	0.015***
Number of rail roads$_l$	0.071***	0.402***	0.058***	0.043***
Population (in 1,000)$_{l,t}$	0.004	0.113***	0.034***	0.032***
Unemployment rate$_{l,t}$	0.016***	0.010	0.021***	0.023***
Land area (in 100 in square miles)$_l$	-0.045***	-0.335***	-0.110***	-0.082***
Housing rental ratio$_{l,t}$	0.387***	2.803***	1.216***	1.045***
Border county effects$_l$	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Number of observations	30,114	30,114	30,114	30,114
Log likelihood	-3,302.000	-109,680.000	-9,644.000	-9,517.000
Uncensored observations	833	29,968	2,104	2,104

Robust standard errors are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Estimated cubic functions relating firms to median income

N is strictly increasing in income up to some income $\hat{m} < \bar{m}$ (condition 2)

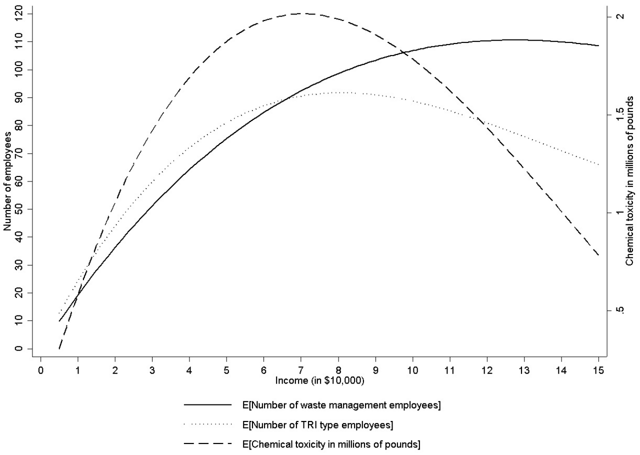


Tobit results for EKC: toxic pounds and number of employees

Variable	Toxicity in pounds$_{l,t}$	Number of employees in TRI type$_{l,t}$	Number of employees in Remediation$_{l,t}$	
	(1)	(2)	(3)	(4)
Median income (in \$10,000)$_{l,t}$	0.642***	26.381***	20.371***	19.702***
Median income (in \$10,000)$^2_{l,t}$	-0.060***	-2.323***	-1.154**	-1.091**
Median income (in \$10,000)$^3_{l,t}$	0.001***	0.057***	0.019	0.017
Number of TRI type incumbent employees$_{l,t}$				0.011***
Average wage (in \$10,000)$_{l,t}$	0.033***	3.546***	0.913***	0.862***
College ratio$_{l,t}$	-5.773***	-96.515**	-175.229***	-173.329***
Number of amenity establishments$_{l,t}$	-0.008**	0.601***	0.392***	0.385***
Number of roads$_{l}$	0.014***	0.688**	0.876***	0.863***
Number of rail roads$_{l}$	0.071***	9.955***	2.235***	2.091***
Population (in 1,000)$_{l,t}$	0.004	-0.909	1.374***	1.393***
Unemployment rate$_{l,t}$	0.016***	-0.959**	0.630**	0.662***
Land area (in 100 in square miles)$_{l}$	-0.045***	-5.182***	-2.632**	-2.523**
Housing rental ratio$_{l,t}$	0.387***	94.129***	56.586***	54.659***
Border county effects$_{l}$	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Number of observations	30,114	30,114	30,114	30,114
Log likelihood	-3,302.000	-210,064.000	-17,091.000	-17,080.000
Uncensored observations	833	29,968	2,104	2,104

Robust standard errors are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Estimated cubic functions relating employment to median income



EKC – alternate spline specification

Variable	Toxicity in pounds$_{l,t}$	Number of firms in TRI type$_{l,t}$	Number of firms in Remediation$_{l,t}$	
	(1)	(2)	(3)	(4)
Median income \$0 – \$66,700$_{l,t}$	0.206***	0.566***	0.308***	0.278***
Median income >\$66,700 – \$100,000$_{l,t}$	0.013	0.107	-0.040	-0.054
Median income >\$100,000$_{l,t}$	-0.679*	-0.093	0.025	0.035
Number of TRI type incumbents$_{l,t}$				0.027***
Average wage (in \$10,000)$_{l,t}$	0.033***	0.079***	0.024***	0.021***
College ratio$_{l,t}$	-6.062***	-10.477***	-4.118***	-3.566***
Number of amenity establishments$_{l,t}$	-0.008**	0.110***	0.011***	0.007***
Number of roads$_{l}$	0.015***	0.168***	0.024***	0.015***
Number of rail roads$_{l}$	0.070***	0.400***	0.057***	0.043***
Population (in 1,000)$_{l,t}$	0.001	0.114***	0.033***	0.031***
Unemployment rate$_{l,t}$	0.014***	0.004	0.020***	0.022***
Land area (in 100 in square miles)$_{l}$	-0.040***	-0.332***	-0.108***	-0.080***
Housing rental ratio$_{l,t}$	0.358**	2.753***	1.229***	1.061***
Border county effects$_{l}$	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Number of observations	30,114	30,114	30,114	30,114
Log likelihood	-3,312.000	-109,684.000	-9,636.000	-9,508.000
Uncensored observations	833	29,968	2,104	2,104

Robust standard errors are in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Similar patterns are observed for number of employees

Entry and exit patterns in the remediation industry

Plant Location Choice

We empirically model a firm's (i) location (l - tract) choice of entry in order to maximize expected profits using a conditional Logit model (see McFadden, 1974).

Each firm's after-entry profit from location l, $\pi_{i,l}$, can be written as follows:

$$\pi_{i,l,t} = A'_{l,w,t}\gamma + A'_{l,p,t}\lambda + X'_{l,t}\beta + \epsilon_{i,l,t}$$

$A_{l,w,t}$ is the number of waste remediation incumbents that are in a tract l. $A_{l,p,t}$ is the number of incumbents that are TRI-type in a tract l, and X_l is the tract l specific characteristics.

Note that these TRI-type firms are in the NAICS codes identifying TRI firms for EPA reporting requirements –*potentially* polluting firms.

Plant Location Choice

These two variables, $A_{l,w,t}$ and $A_{l,p,t}$, together capture the agglomeration effects in tract l.

We assume that the disturbance, $\epsilon_{i,l,t}$, is independent and identically distributed. In order to have a closed form expression for a firm's choice probabilities, as in Green (2008), we also assume that $\epsilon_{i,l,t}$ are distributed with a Type 1 extreme value distribution.

We further assume that each firm knows its private costs and expected profits. This asymmetric information assumption enables us to convert the discrete actions of competitors into continuous location choice probabilities.

Then, we can specify the conditional logit model as follows:

$$Pr(E_{i,l,t} = 1 | A_{l,w,t}, A_{l,p,t}, X_{l,t}) = Pr(\pi_{i,l,t} > \pi_{i,k,t} \text{ for all } l \neq k)$$

Plant Location Choice

The dependent variable $E_{i,l,t}$ equals 1 if a firm i chooses location l and 0 otherwise. A Firm i will choose location l as far as $\pi_{i,l} > \pi_{i,k}$ for all $k \neq l$.

Therefore, conditional on the decision to open a new plant, the probability that firm i will choose particular location l can be written as follows:

$$\Pr(E_{i,l,t} = 1) = \frac{\exp(A'_{l,w,t}\gamma + A'_{l,p,t}\lambda + X'_{l,t}\beta)}{\sum_{k=1}^{m} \exp(A'_{k,w,t}\gamma + A'_{k,p,t}\lambda + X'_{k,t}\beta)}$$

Entry patterns

- Use QCEW establishment level data
- Appearance of a new EIN number indicates establishment entry
  $\Rightarrow$ Dunne et al. (1989), De Silva et al. (2016)

Entry year	Remediation firm	
	Entrants	Incumbents
2000	43	203
2001	47	241
2002	98	277
2003	54	362
2004	58	367
2005	50	368
2006	45	375

Conditional logit results for remediation firm entry

Variable	Firm entry		
	(5)	(6)	(7)
Number of environmental remediation incumbents$_{l,t}$	0.960***	0.990***	1.019***
Number of TRI type establishments$_{i,l,t}$	0.004**	0.008***	0.004**
Median income \$0 – \$66,700$_{l,t}$	0.391***	0.376***	
Median income >\$66,700 – \$100,000$_{l,t}$	0.088	0.077	
Median income >\$100,000$_{l,t}$	-0.001	0.015	
Average wage (in \$10,000)$_{l,t}$	0.013*	0.014**	0.014**
College ratio$_{l,t}$	-5.050***	-5.307***	-0.444
Number of amenity establishments$_{l,t}$	0.003***	0.003***	0.003***
Number of roads$_{l}$	0.006		0.004
Number of rail roads$_{l}$	0.019**		0.020**
Population (in 1,000)$_{l,t}$	0.038**	0.044***	0.067***
Unemployment rate$_{l,t}$	0.013	0.013	0.021*
Land area (in 100 in square miles)$_{l}$	-0.052	-0.023	-0.076*
Housing rental ratio$_{l,t}$	1.211***	1.135***	-0.028
TxDOT expenditures (in \$1,000,000)$_{l,t}$		-0.004	
Average house value$_{l,t}$			0.010**
Border county effects$_{l}$	Yes	Yes	Yes
Number of entrants	395	395	395
Number of tratcs	4,302	4,302	4,302
Log likelihood	-3,137.000	-3,141.000	-3,155.000
χ^2	336.400	327.400	298.900

- Seems to cluster together
- Having TRI-type firms nearby matters
- Effect of income is similar to what we observed in siting

Conditional logit results for remediation firm entry

Variable	Firm entry		
	(5)	(6)	(7)
Number of environmental remediation incumbents$_{l,t}$	0.960***	0.990***	1.019***
Number of TRI type establishments$_{i,l,t}$	0.004**	0.008***	0.004**
Median income \$0 – \$66,700$_{l,t}$	0.391***	0.376***	
Median income >\$66,700 – \$100,000$_{l,t}$	0.088	0.077	
Median income >\$100,000$_{l,t}$	-0.001	0.015	
Average wage (in \$10,000)$_{l,t}$	0.013*	0.014**	0.014**
College ratio$_{l,t}$	-5.050***	-5.307***	-0.444
Number of amenity establishments$_{l,t}$	0.003***	0.003***	0.003***
Number of roads$_{l}$	0.006		0.004
Number of rail roads$_{l}$	0.019**		0.020**
Population (in 1,000)$_{l,t}$	0.038**	0.044***	0.067***
Unemployment rate$_{l,t}$	0.013	0.013	0.021*
Land area (in 100 in square miles)$_{l}$	-0.052	-0.023	-0.076*
Housing rental ratio$_{l,t}$	1.211***	1.135***	-0.028
TxDOT expenditures (in \$1,000,000)$_{l,t}$		-0.004	
Average house value$_{l,t}$			0.010**
Border county effects$_{l}$	Yes	Yes	Yes
Number of entrants	395	395	395
Number of tratcs	4,302	4,302	4,302
Log likelihood	-3,137.000	-3,141.000	-3,155.000
χ^2	336.400	327.400	298.900

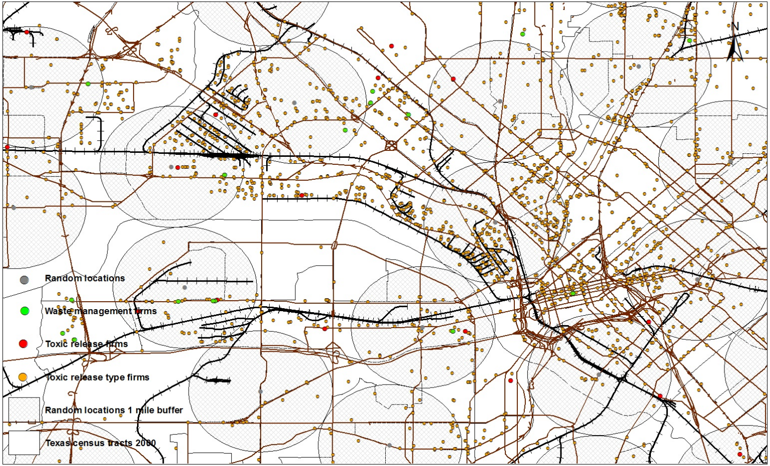
- Seems to cluster together
- Having TRI-type firms nearby matters
- Effect of income is similar to what we observed in siting
- We re-estimate with PPML and results are qualitatively similar

Robustness check

- We look at entry by establishment in the remediation industries into random locations that are not dependent on jurisdictional boundaries
- Identify all establishment locations other than remediation
- By doing so, we limit the analysis to areas where there is commercial activity
- Select locations that are defined as non-overlapping rings of one-mile radius centered on these establishments
  $\Rightarrow$ Establishment that existed at any point during the study time frame is a potential center point
- Select rings from West to East-sorted by latitudes and longitudes

Robustness check

Non-overlapping one-mile rings: Dallas area



Summary statistics for randomly chosen non-overlapping locations

Variable	Non-overlapping locations
Number of non-overlapping locations	8,142
Number of environmental remediation entrants	231
Average number of environmental remediation entrants$_{l,t}$	0.004
	(0.072)
Average number of environmental remediation incumbents$_{l,t}$	0.024
	(0.173)
Average number of TRI type firms$_{l,t}$	1.212
	(5.708)

Standard deviation are in parentheses.

Poisson results for randomly chosen non-overlapping locations

Variable	Number of entrants		
	(1)	(2)	(3)
Number of environmental remediation incumbents within 0-1 mile$_{l,t}$	1.142***	1.083***	1.138***
Number of TRI incumbents within 0-1 mile$_{l,t}$	0.012***	0.011***	0.012***
Median income \$0 – \$66,700$_{l,t}$	0.407***	0.309***	
Median income >\$66,700 – \$100,000$_{l,t}$	0.254**	0.193	
Median income >\$100,000$_{l,t}$	-0.075	-0.079	
Average wage(in \$10,000)$_{l,t}$	0.023***	0.022***	0.022***
College ratio$_{l,t}$	-1.753	-1.038	2.544*
Number of amenity establishments$_{l,t}$	0.004***	0.003**	0.004***
Number of roads$_{l}$	-0.009		-0.009
Number of rail roads$_{l}$	0.013		0.015
Population (in 1,000)$_{l,t}$	-0.009	0.002	0.030*
Unemployment rate$_{l,t}$	0.066***	0.065***	0.075***
Housing rental ratio$_{l,t}$	4.430***	3.799***	3.307***
TxDOT expenditures (in \$1,000,000)$_{l,t}$		-0.030**	
Average house value$_{l,t}$			0.020***
Border county effects$_{l}$	Yes	Yes	Yes
Year effects	Yes	Yes	Yes
Number of obs.	56,994	56,994	56,994
Log likelihood	-1,364.000	-1,351.000	-1,378.000

- Basic results are similar to what we observed in conditional logit models at tract level
- Effects of agglomeration and TRI-type firms seem to be stronger at random locations

Exit

- Consider the question of remediation industry establishment exit
- If firms do not make a sufficient level of profit, they choose to exit the industry
- Exit is identified as having taken place if the firm (EIN) disappears from the data set
  $\Rightarrow$ Dunne et al. (1989), De Silva (2016)
- Consider firms that enter during the time frame of the analysis, i.e., 2000–2006

Exit patterns

Entry year	Total	Exit year							Total
	entrants	2000	2001	2002	2003	2004	2005	2006	
2000	43	0	2	2	5	6	3	2	20
2001	47		5	6	16	6	3	3	39
2002	98			4	29	18	11	7	69
2003	54				7	11	10	5	33
2004	58					13	10	9	33
2005	50						9	7	16
2006	45							5	5
Total	395	0	7	12	57	54	46	38	214

Establishment-level summary statistics for entrants

Variable	Mean (Standard deviation)
Establishments with past experience	0.364
	(0.481)
Average number of branches	1.021
	(2.334)
Age (in months)	42.702
	(22.532)
Average wage (in $10,000)	4.908
	(11.619)
Size	18.872
	(37.543)

Logit results for exit

Variable	Exit					
	(1)	(2)	(3)	(4)	(5)	(6)
Number of environmental remediation incumbents$_{i,l,t}$	0.076***	0.075***	0.077***	0.078***	0.078***	0.078***
Number of TRI type incumbents$_{i,l,t}$	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
Establishments with past experience$_{i}$	-0.016	-0.017	-0.016	-0.017	-0.018	-0.018
Number of branches$_{i,t}$	-0.002	-0.002	-0.002	-0.001	-0.001	-0.001
Age$_{i,t}$	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***
Median income \$0 – \$66,700$_{l,t}$	-0.005		-0.006	0.006	0.006	
Median income >\$66,700 – \$100,000$_{l,t}$	-0.003		-0.003	0.003	0.005	
Median income >\$100,000$_{l,t}$	0.015		0.015	0.016	0.016	
Average wage (in \$10,000)$_{l,t}$	-0.003	-0.003	-0.003	-0.002	-0.003	-0.003
Size$_{i,t}$	-0.001**	-0.001**	-0.001**	-0.001**	-0.001**	-0.001**
College ratio$_{l,t}$		-0.016	0.019	-0.204	-0.190	-0.260
Number of amenity establishments$_{l,t}$			-0.000	-0.000	-0.000	-0.000
Number of roads$_{l}$	-0.000	-0.000	-0.000	-0.000		-0.000
Number of rail roads$_{l}$	-0.002	-0.002	-0.002	-0.001		-0.001
Population (in 1,000)$_{l,t}$	0.002	0.001	0.002	0.001	0.001	0.001
Unemployment rate$_{l,t}$				-0.002	-0.002	-0.002
Land area (in 100 in square miles)$_{l}$				-0.009	-0.014	-0.009
Housing rental ratio$_{l,t}$				0.090	0.098*	0.106*
MSA	-0.005	-0.008	-0.004	-0.017	-0.001	-0.019
TxDOT expenditures (in \$1,000,000)$_{l,t}$					0.001	
Average house value$_{l,t}$						0.003
Border county effects$_{l}$	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	1,346	1,346	1,346	1,346	1,346	1,346
Log likelihood	-420.972	-422.477	-420.822	-419.178	-419.228	-419.759

*** denotes statistical significance at the 1 percent level, ** denotes statistical significance at the 5 percent level and *denotes statistical significance at the 10 percent level. The dependent variable takes the value of 1 for exit and 0 otherwise.

Conclusion

- We show that the EKC shape is consistent with patterns for economic activity and abatement expenditures that are increasing, but at a decreasing rate
- Results support the theoretical predictions and are consistent with the $\bigcap$–shaped relationship between income and emissions released at a given location
- Number of TRI-type establishments is significant in predicting the number of waste remediation firms
- Presence of polluting or TRI-type industries is a significant explanatory variable in modeling both entry probabilities and entry counts for the remediation industry
- Remediation industry localization is also one of the significant explanatory variables in all entry models

Conclusion

- We show that the EKC shape is consistent with patterns for economic activity and abatement expenditures that are increasing, but at a decreasing rate
- Results support the theoretical predictions and are consistent with the $\bigcap$–shaped relationship between income and emissions released at a given location
- Number of TRI-type establishments is significant in predicting the number of waste remediation firms
- Presence of polluting or TRI-type industries is a significant explanatory variable in modeling both entry probabilities and entry counts for the remediation industry
- Remediation industry localization is also one of the significant explanatory variables in all entry models

Thank you!