Toxic pollution and employment dynamics: uncovering Europe's left-behind places

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La transizione ecologica: un'opportunità di sviluppo per l'Italia

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Introduction

- Dark sides of economic activity, e.g., pollution, are still relatively understudied by the economic literature. More attention has been devoted to health-related effects, fewer investigations have been conducted in terms of the negative effects propagating from pollution to socio-economic deprivation.
- Emergence of toxic pollution as a cause and consequence of growing regional inequalities adds a new dimension to recent geography studies.
- Look at nexus between long-term exposure to toxic industrial pollution, and the spillovers from the plant's production activities in terms of employment, wages and demographic dynamics.
- **We investigate the environmental dimension of left-behind places, proposing toxic pollution as structural socio-economic driver.**

What are left-behind places?

- The literature on left-behind places

  Focus on the geography of discontent leading to populist policy platforms, i.e. investigating social, cultural, political dimensions. [e.g., MacKinnon et al., 2022; Rodríguez-Pose, 2018; Dijkstra et al., 2020]

  So far has remained silent on the environmental dimension, even though:

  - **spatiality of power**: rural areas are extraction sites for natural resources, raw materials to support urban areas (McKinney, 2016);
  - **Stratification of inequality**: environmental policies have strong implications for left-behind places where emission-intense/extractive industries are located (compound disadvantage, globalization and deindustrialization).

  Hence: Need to understand the **political economy of toxic industries** and their interaction with the geography of left-behind places.

Propagation channels

- Path dependence and regional lock-ins (Grabher, 1993; Boschma, 2007; Frenken and Boschma, 2007; Cecere et al., 2014);
- environmental technology in toxic industries and its effect on labour (Vivarelli et al., 2022; Violante, 2008);
- spatial inequality feedback loops (Pinheiro et al., 2022) and spatiality of power (Lerner, 2012; Freudenburg, 2005; Massey, 2009).

Industrial Facilities, sourced from E-PRTR

- Source: European Pollutant Release and Transfer Register (E-PRTR) provided by the European Environment Agency (EEA).
- The E-PRTR contains environmental data from over 24,000 georeferenced industrial facilities in Europe, with information on quantities of 91 key pollutants released to air, water and land.
- Facility-level pollution used to calculate annual chemical-specific air pollution of continuous polluters aggregated by sector at NUTS-3 level.
- Coverage:
    - in space: 15 European countries, approx. 1200 NUTS-3 regions
    - in time: yearly data, 2007 - 2018
    - sectoral: 7 different activities: Agriculture and leather, chemicals, energy, metals, minerals, paper and wood, waste

List of Facility Names: top 10

Name of Facility	*Industry*	*City*	*Log Poll.*
Germany			
LEAG, Kraftwerk Jänschwalde	Energy	Teichland	26.90181
RWE Power AG	Energy	Eschweiler	26.57141
RWE Power AG Kraftwerk Niederaußem	Energy	Bergheim	26.43846
RWE Power AG - Kraftwerk Neurath	Energy	Grevenbroich	26.35705
Kraftwerk Boxberg	Energy	Boxberg/O.L.	26.06029
LEAG, Kraftwerk Schwarze Pumpe	Energy	Spremberg	26.02941
LEAG Lausitz Energie AG Kraftwerk Lippendorf	Energy	Neukieritzsch	25.6448
RWE Power AG - Kraftwerk Frimmersdorf	Energy	Grevenbroich	25.61316
Uniper Kraftwerke GmbH Kraftwerk Scholven	Energy	Gelsenkirchen	25.25633
BASF SE	Chemicals	Ludwigshafen	25.21908
France			
Arcelormittal France Site De Dunkerque	Metals	Dunkerque	25.58061
Arcelormittal Fos	Metals	Fos Sur Mer	25.01067
Edf - Up Cordemais	Energy	Cordemais	24.46878
Gazel Energie - Centrale Emile Huchet	Energy	St Avold	24.29204
Raffinerie De Normandie	Energy	Harfleur	24.27969
Engie Thermique France - Centrale Dk6	Energy	Dunkerque	24.07337
Edf Unite De Production Thermique Du Havre	Energy	Le Havre	24.03441
Raffinerie De Port-Jérome / Gravenchon	Energy	Notre Dame De Gr.	23.86249
Edf - Cycle Combiné Gaz De Blénod	Energy	Blenod Les Pont	23.66699
Gazel Energie - Centrale De Provence	Energy	Meyreuil	23.63564

Name of Facility	*Industry*	*City*	*Log Poll.*
Great Britain			
Drax Power Station EPR	Energy	SELBY	26.58055
Longannet Power Station	Energy	Kincardine	25.37915
Eggborough Power Station	Energy	Eggborough	25.33629
Aberthaw Power Station	Energy	Aberthaw	25.29912
Cottam Ash Disposal Site	Waste	Cottam	25.25431
West Burton Power Station	Energy	Retford	25.20857
Fiddlers Ferry Power Station EPR	Energy	WARRINGTON	25.19221
Ferrybridge C Power Station EPR	Energy	Knottingley	25.15118
Ratcliffe-On-Soar Power Station EPR	Energy	NOTTINGHAM	25.08509
Port Talbot Steelworks Tata Steel	Metals	PORT TALBOT	24.96971
Italy			
Enel Produzione S.p.A. Brindisi	Energy	Brindisi	25.57953
ILVA S.p.A.	Metals	Taranto	25.24196
Enel Produzione S.p.A. - Torrevaldaliga Nord	Energy	Civitavecchia	25.11516
Sarlux srl	Energy	Sarroch	24.92747
CENTRALE TERMOELETTRICA DI TARANTO	Energy	Taranto	24.83107
Enel Produzione S.p.A. Venezia	Energy	Venezia	24.56382
Fiume Santo S.p.A.	Energy	Porto Torres	24.38021
TIRRENO POWER S.p.A.	Energy	Quiliano	24.21185
Enel Produzione S.p.A. La Spezia	Energy	La Spezia	24.17314
Enipower S.p.A.	Energy	Ferrera Erbognone	24.05704

Table: Names of top-polluting facilities by country, showing top-10 polluting facilities for a selection of four countries (Germany, Great Britain, France, Italy). The column ''*Log Poll.*'' refers to total facility pollution across all years.

Measuring toxic pollution

Different pollutants have different toxicities. We account for the variation of toxicity by multiplying the quantity (mass in kilogram per year) of each pollutant by a toxicity weight that we source from the USEtox 2.12 data base.

At sectoral-regional level, toxic pollution can be written as:

$$Tox\ Poll_{srt} = \sum_{i=1}^{N} \sum_{p=1}^{P} Tox\ Weight_p * Quantity_{ipsrt} \tag{1}$$

- i are facilities
- p are the 42 different pollutants, each with a distinct weight
- s indexes sectors, r NUTS-3 regions, and t years

Toxic pollution is an indicator for the scale or **intensity effect**.

Toxic pollution by industry

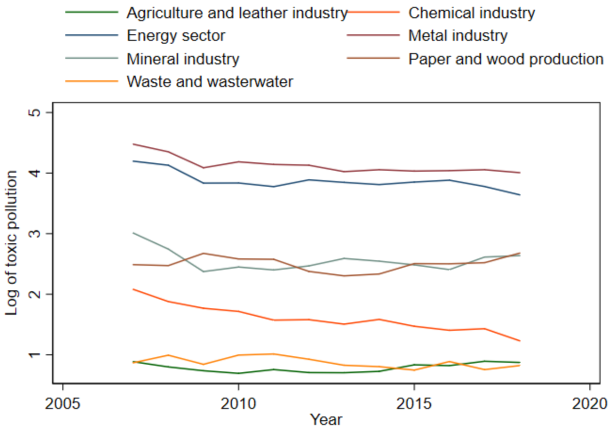


Figure: Mean toxic pollution by industry from 2007 to 2018. Source: Own calculation based on E-PRTR.

Why industries matter

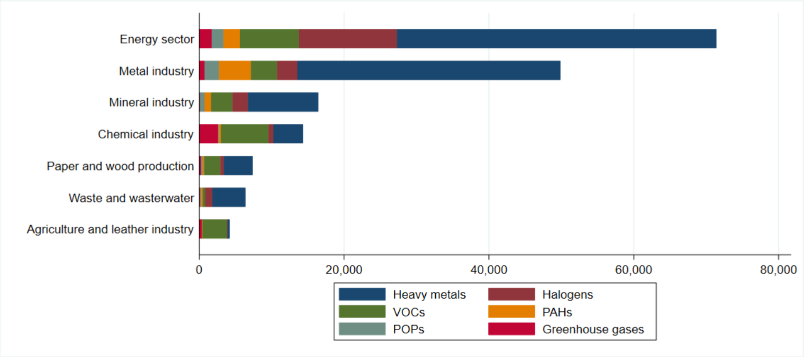


Figure: Toxic pollution industry, disaggregated by pollutant groups, ranked by share of toxic pollution, over 2007–2018. Source: Own calculation based on E-PRTR. (P)AHs: (polycyclic) aromatic hydrocarbons; POPs persistent organic pollutants; VOCs volatile organic compounds.

Concentration index of pollutants

Besides the level of toxic pollution, we are interested in the pollution portfolio, i.e., in the composition of toxins, as we observe a great level of heterogeneity with respect to the number of distinct pollutants emitted at facility level.

To capture this heterogeneity, we construct a Herfindahl-Hirschman Index (HHI) of the concentration of share of distinct pollutants at facility-year level aggregated across regions and sectors:

$$HHI_{srt} = \frac{\sum_{i=1}^{N} \sum_{\tilde{p}=1}^{\tilde{P}} \tilde{p_{it}}^2}{N_{srt}} * \frac{Tox\ Poll_{srt}}{Tox\ Poll_{rt}} \tag{2}$$

where

$$\tilde{p} = \frac{p}{\sum_p} \tag{3}$$

Pollutant concentration allows us to investigate a possible **composition effect**.

Concentration index of pollutants

This concentration index can approximate **efficiency**:

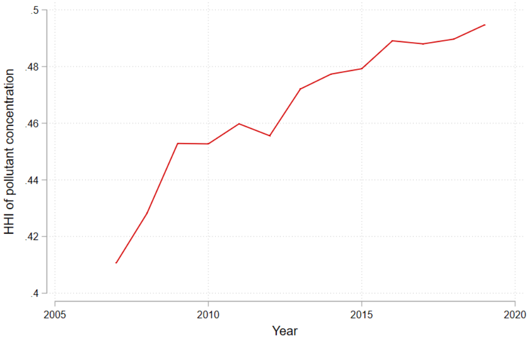


Figure: HHI of pollutant concentration, 2007-2019.

- We observe a reduction of toxic emissions of 0.3 per cent, comparing 2019 to 2007.
- This trend is mirrored by the increase of the concentration index, i.e. facilities on average reduce their number of pollutants.
- The graph on the left illustrates this as HHI increased from 0.41 in 2007 to 0.49 in 2019.

Concentration index of pollutants, by industry

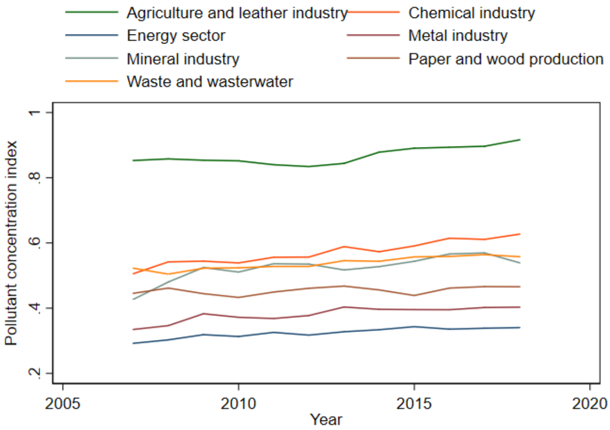


Figure: Mean concentration index of pollutants by industry from 2007 to 2018.
Source: Own calculation based on E-PRTR.

Scatterplot of pollutant concentration and toxic pollution

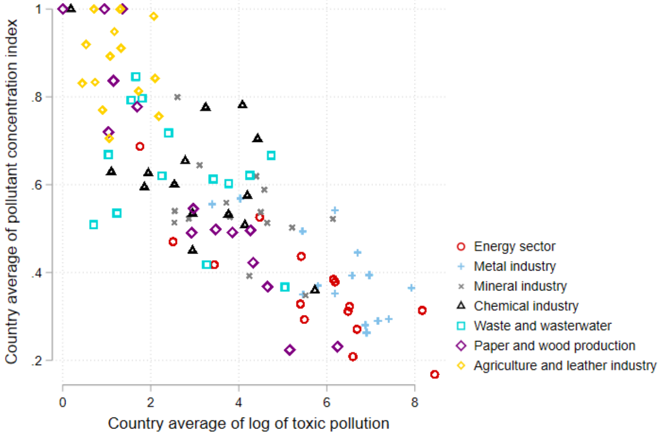


Figure: Scatterplot of country averages of pollutant concentration (y-axis) and toxic pollution (x-axis) across 2007-2018. Source: Own calculation based on E-PRTR.

Mapping the Facilities

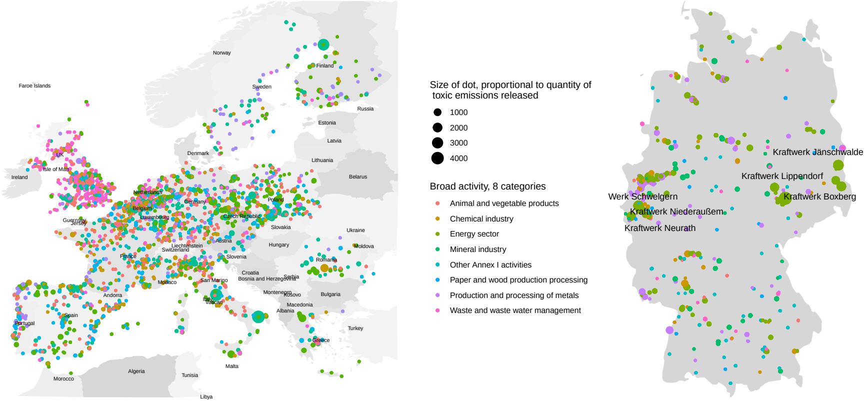


Figure: Spatial distribution of industrial facilities in 15 European countries (left panel) and of Germany (right panel) over 2007 - 2018. Color of the dots indicates industry, size of the dot indicates quantity of toxic pollution. Source: Own calculation based on E-PRTR.

Mapping the facilities

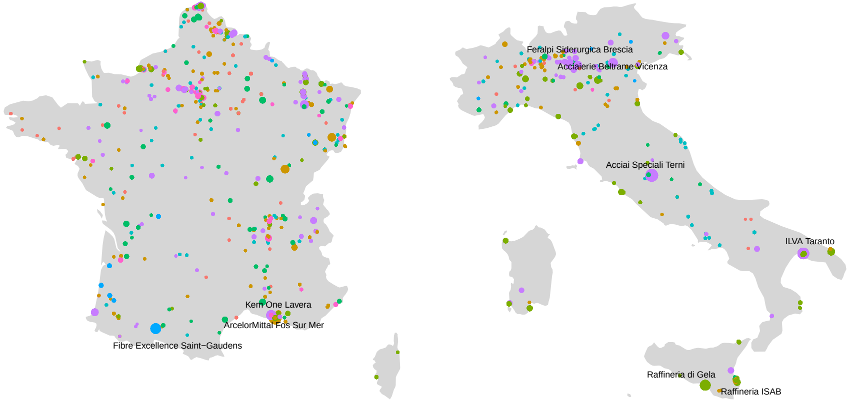


Figure: Spatial distribution of industrial facilities in France (left panel) and of Italy (right panel) Color of the dots indicates industry, size of the dot indicates quantity of toxic pollution. Source: Own calculation based on E-PRTR..

Lower quartiles of industry empl. and left-behind regions

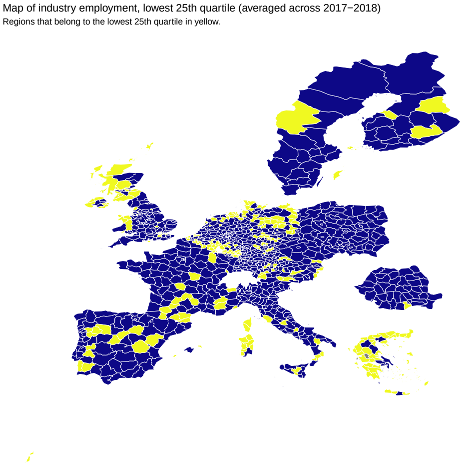
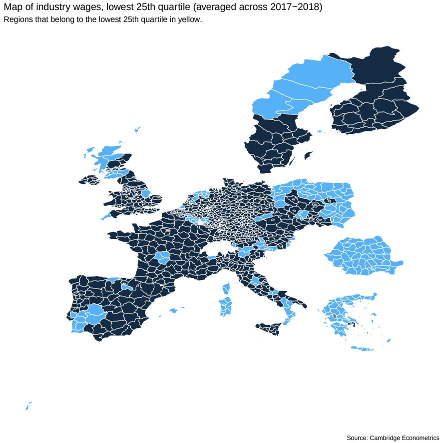


Figure: NUTS-3 map of 25th quartiles of industry employment, averaged across all years. In yellow are the so-called left-behind regions.

25th quartiles are clustered in:

- Scotland, Wales, Highlands
- South West France
- Central Spain
- East Portugal
- East Germany, Pfalz
- South Italy plus islands
- Western Austria
- Greece

Coincidence of regions?



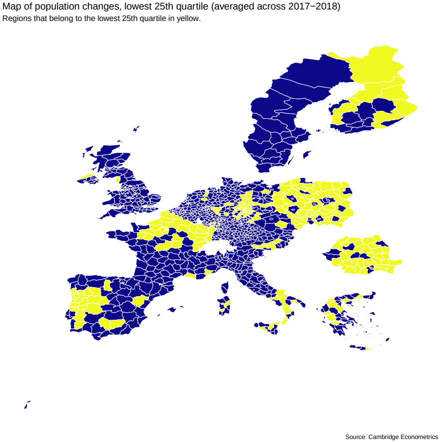


Figure: NUTS-3 map of 25th quartiles of industry wages (left panel) and population changes (right panel), averaged across all years.

Conclusion

- We conceptualize left-behind regions through economic deprivation and demographic loss and explore their environmental dimension.
- (via Quantile regression estimation) We find opposing effects for left-behind places vis-à-vis the rest:
  - $+$ in terms of toxic pollution, signalling material dependence of left-behind places
  - - in terms of pollutant concentration, signalling LS effects of environmental technologies,

  for employment, wages, demographic losses in left-behind places.
- Contemporary crises overlapping across social, economic and ecological spheres are creating systemic inequalities across space and maintain the status quo of reproductive injustices.

Policy Implications

- In order for environmental and climate policies to even out territorial inequalities, policy-makers have to take into account local contexts in terms of industrial specialization, technological lock-ins, employment segregation as well as the material dependence on highly toxic industries.
- Strong need for a place-sensitive regional policy, with an urgent focus on left-behind places, that connects to the broader concept of the geography of discontent, i.e., see rise of populism. Left-behind places would have reason to become subjects in environmental struggles and the green transition.
- It is crucial to understand the policy implications of a labour-saving effect of environmental technology in polluting industries, i.e., skill and task mismatch vis-à-vis green jobs leading to a compound disadvantage of those left-behind.