

Carbon Footprints of European Manufacturing Jobs: Stylized Facts and Implications for Climate Policy

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Motivation

- ▶ Reducing greenhouse gas emissions from manufacturing is a key objective of climate policy.
- ▶ The manufacturing sector is the main driver of economic growth as well as one of the main sources of carbon emissions.
- ▶ Challenges include leakages and concerns about competitiveness of regulated firms.
- ▶ This has implications beyond the geography of one economy and any evaluation of such climate policies needs to take that into account, especially in a context such as Europe.

This Paper

- ▶ New pan-European data from the EPREE Network.
- ▶ Greater agenda: provide comprehensive and consistent evidence on climate policy with a European geographic scope.
- ▶ Today: stylized facts about carbon emissions in European manufacturing, with largely descriptive results, and discuss policy implications

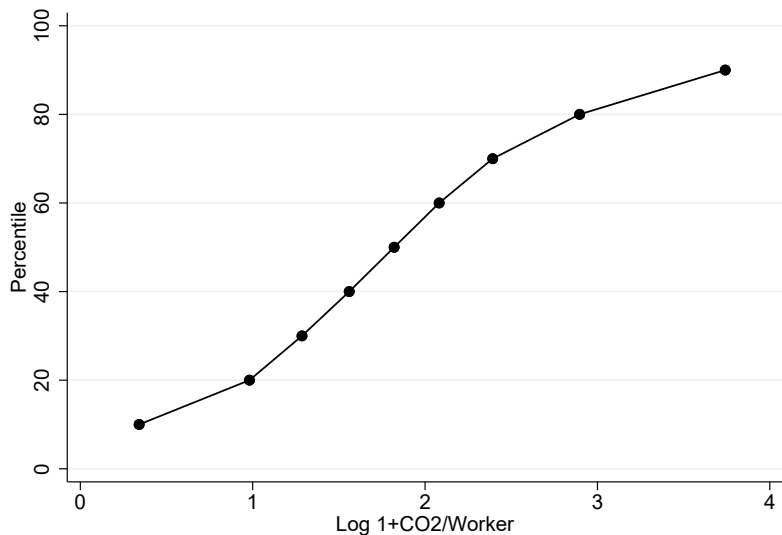
Data

- ▶ Source: official census of manufacturing in each of Denmark, Finland, France, Germany, Lithuania, Norway, and Sweden
- ▶ Outcome of interest: direct CO_2 emissions per worker
- ▶ For consistency (and convenience) we have from each country:
 - ▶ deciles of the outcome variable for each 2-digit sector
 - ▶ Years: 2004, 2007, 2012
 - ▶ number of plants in each sector and year by EU Emissions Trading Scheme (ETS) status

Aggregation

- ▶ To approximate the aggregate distribution of emissions per worker in Europe, we proceed as follows:
 - ▶ unit of observation: decile d of a 2-digit sector-country-year
 - ▶ assume a step function where we assign the value of every decile to 10% of the firms in that sector and year
 - ▶ We treat the top and bottom 5% as missing (data protection).

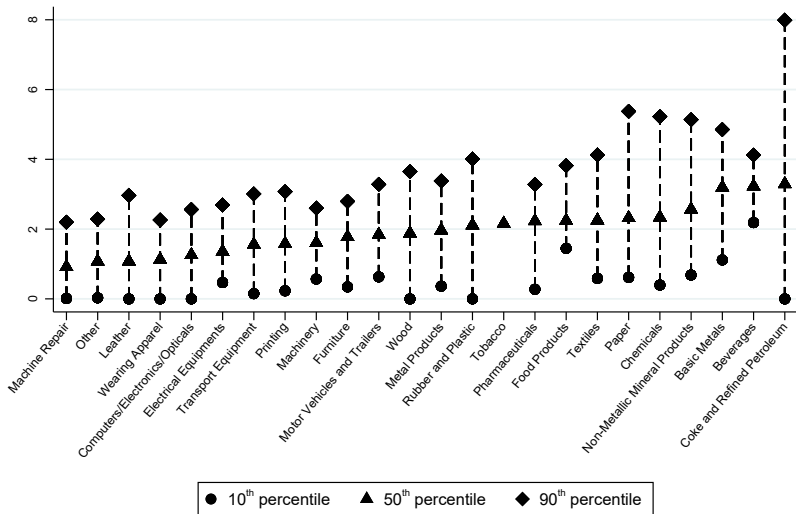
Distribution of Log CO₂ Per Worker



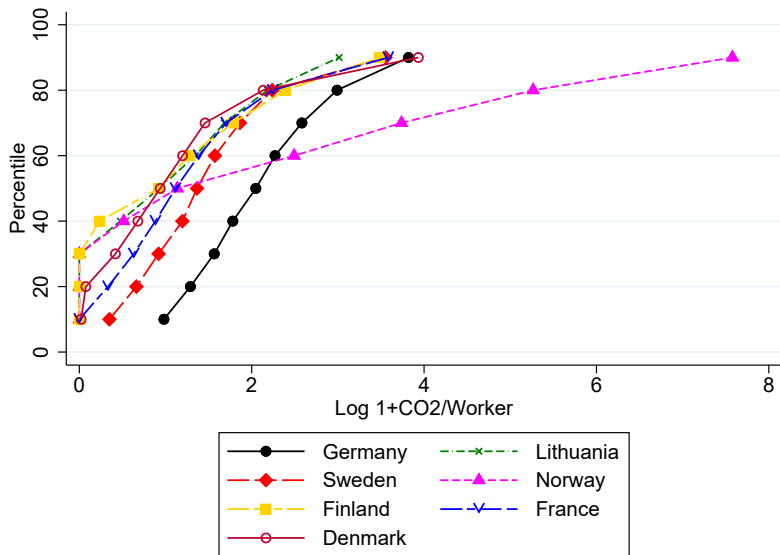
allcountries

Heterogeneity across Industries

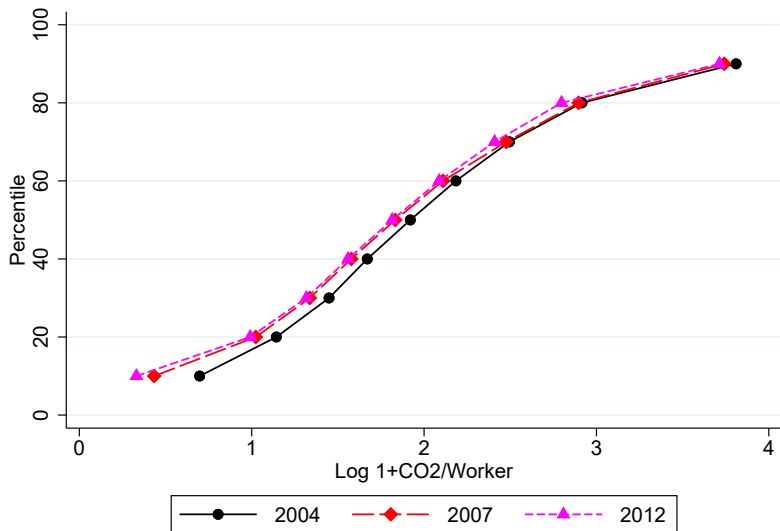
EU 2007



Heterogeneity by Country (2007)



Distribution of Log CO₂ Per Worker Over Time



Obs 2004 = 48627, 2007 = 51396, 2012 = 47529, balancedcountries

Carbon Intensity over Time

- ▶ To know which countries are driving this shift to the left, we estimate:

$$\left(\frac{CO_2}{L}\right)_{q,c,s,t} = \alpha + \sum_c \beta_c t \times D_c + \lambda_{c,s} + \eta_q + \epsilon_{q,c,s,t} \quad (1)$$

- ▶ where η_q denotes decile fixed effects, D_c is a dummy variable for country c , and β_c is the time trend of this country.

Table: Time Trend In CO₂ Per Worker By Country

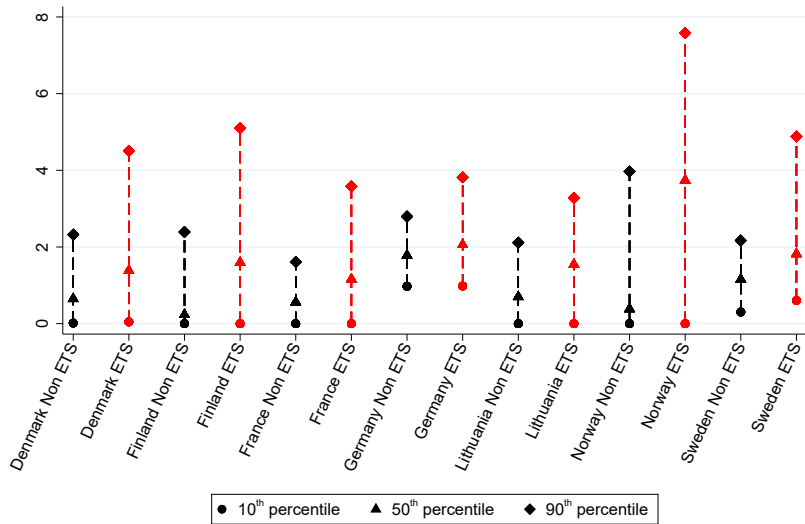
	(1)	(2)
t	-1.036** (0.494)	
$t \times$ Denmark		-0.236 (0.252)
$t \times$ Finland		1.452 (1.185)
$t \times$ France		-0.258*** (0.074)
$t \times$ Germany		0.826 (0.874)
$t \times$ Lithuania		-5.580 (5.676)
$t \times$ Norway		-4.065** (2.056)
$t \times$ Sweden		-1.882** (0.751)
R^2	0.5094	0.5102
Number of obs.	3,567	3,567
Number of country-sector pairs	151	151

Carbon Intensity over Time and Regulation

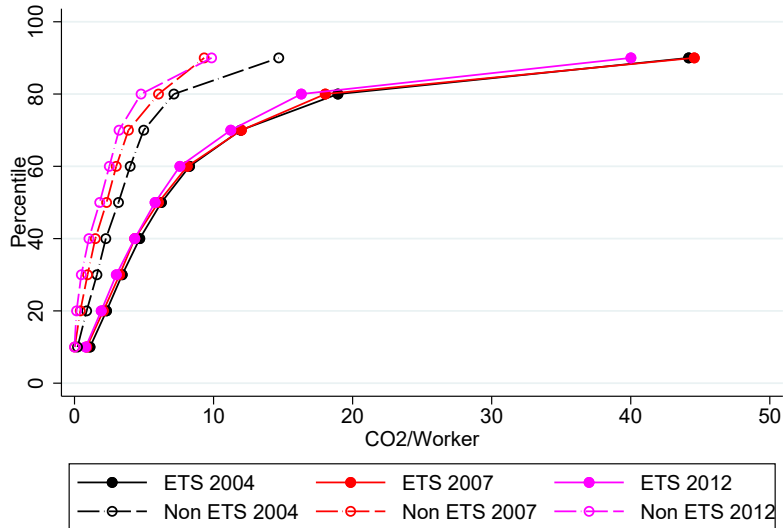
- ▶ We see the that the trend is driven by countries with more regulations (carbon tax in Sweden, Norway)
- ▶ Did the EU Emissions Trading Scheme (EU ETS) contribute to the reduction over time in CO_2 emissions per worker?

Log CO₂/Worker by Country and ETS Status

2007



Log CO₂/Worker by Year and ETS Status



balancedcountries

Table: Time Trend In CO₂ Per Worker By ETS Status

	(1)	(2)
t	-1.036** (0.494)	-0.159 (0.452)
$ETS_{c,s,t}$		1,229.305** (541.301)
$t \times ETS_{c,s,t}$		-0.611** (0.269)
R^2	0.5094	0.5184
Number of obs.	3,567	3,567
Number of country-sector pairs	151	151

Summary of Stylized Facts and Policy Implications

1. More than 80% of firms have direct CO_2 emissions, and there is a long right tail in the distribution. There is therefore still a large potential for CO_2 abatement in manufacturing
2. Variability in carbon intensity within sectors is greater than the variability across industries and countries. This could be due to productivity differences (target technology), or due to national exemptions (more comprehensive coverage of the ETS at the sector level)
3. Cross-country differences are not negligible, perhaps due to other policies such as carbon taxation
4. Substantial overlap in the carbon footprint of a job between regulated and unregulated firms. Therefore there is scope for efficiency improvements in the EU ETS.

Conclusion

- ▶ This paper presents the first cross-country comparison of CO_2 intensity of manufacturing from 7 European countries.
- ▶ The comprehensive and descriptive evidence and stylized facts uncover important patterns in the carbon footprint of manufacturing jobs in Europe
- ▶ These have important policy implications and are a step forward towards evidence-based climate policy.