

# The Effect of Carbon Pricing on Firm Performance: Worldwide Evidence

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# Summary

- The authors use carbon pricing to refer to carbon taxing or trading.
- The authors examine how firms' profitability and operations change upon the staggered adoption of carbon pricing => they attempt to argue a causal impact.
- They examine 104,100 firm-year observations covering 16,222 unique firms across 52 countries from 2002 to 2019.
- In the sample period, 32 countries/provinces have adopted some form of carbon pricing initiatives.
- The authors show that firms with higher emissions lose profits (ROE and ROA), incur higher production costs, suffer slower growth, and have lower market valuations – these results are more pronounced in some countries

# The scope

- The results presented in the current version seem fairly intuitive and straightforward...  
(Yes, I understand that the analyses are done at the firm level and the use of firm-level variables provide more micro-evidence)
- However, I kinda feel a lack of “exciting surprises” to raise the scope of this paper.
- I have two suggestions:
  1. Cross-border spillovers of carbon tax/price
  2. Relocation or offshoring of carbon-emissions

# Cross-border spillovers of carbon tax/price

- My cousin working in a petro-chemical company in Taiwan said that the executives of the company have been very concerned about the implementation of carbon tax in EU in 2026. Why?
- Carbon Border Adjustment Mechanism (CBAM) will be fully implemented in 2026. It is the EU's tool to put a fair price on the carbon emitted during the production of carbon intensive goods that are entering the EU.
- CBAM was proposed on July 14, 2021 (in the Fit for 55 Package). Thus, foreign manufacturers would have form some expectation in 2021.
- Cross-border spillovers of carbon tax and ETS may offer some interesting angle to enhance this paper (when Norway/Sweden acted in 1991, other European countries are under pressure)

# Relocation or offshoring of carbon-emissions

- The authors may examine if firms move out their emitting facilities
- In one of their current table, they exclude firms with “foreign assets” as these firms may have overseas facilities
- Following this logic, the authors may examine if treated firms increase their foreign assets after carbon tax/price => This will suggest that the treated firms move carbon-emissions overseas
- I am not sure if there are more data that can capture the geographic information of production sites for international firms in Worldscope.
- On supplier side: The author may also consider the switch of suppliers – Bisetti, She, and Zaldokas (2023 “ESG Shocks in Global Supply Chains”)

# Regression design

- The 3<sup>rd</sup> layer of difference,  $\text{Log}(\text{Intensity}1+1)$ , is defined in year t:

$$Y_{i,c,t} = \beta_0 + \beta_1 \text{Log}(\text{Intensity}1 + 1)_{i,c,t} + \beta_2 \text{Post}_{c,t} + \beta_3 \text{Post}_{c,t} \times \text{Log}(\text{Intensity}1 + 1)_{i,c,t} + \gamma' \mathbf{X}_{i,c,t} + k' \mathbf{Z}_{c,t} + \varepsilon_{i,c,t} \quad (2)$$

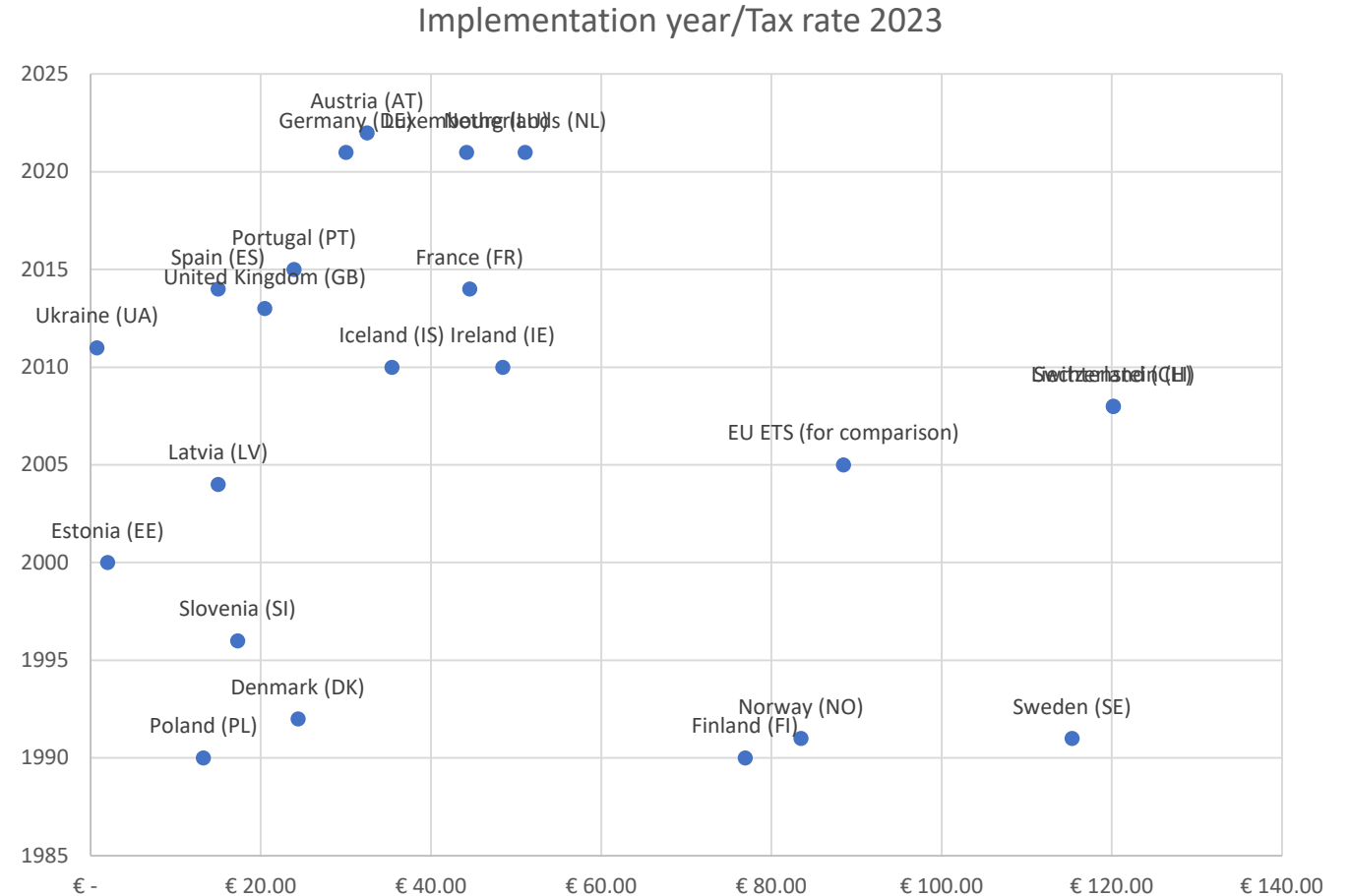
- I think that, to be valid for DDD, the third differencing condition should be pre-treatment (otherwise firms' post-event emissions are already affected by carbon pricing)
- Maybe the authors want to use  $\text{Log}(\text{Intensity}1+1)$  in the pre-event year or the average of all pre-event years?

# Treated firms are defined by HQ

- Like prior papers, the authors defined whether a firm is treated by its HQ province/country
- However, prior papers use HQ as they are information hubs or where top executives live or where most staff are located.
- However, I think more justifications are needed for two reasons:
  1. Here we are talking about production sites with carbon emissions.
  2. There are many carbon taxing/pricing imposed by provinces rather than nationwide policies => are carbon taxing/pricing determined by production provinces or HQ provinces?
- Is there any information about firms' within-country geographic distribution from Worldscope?

# The heterogeneity of carbon taxing

- To my knowledge, there is no “template” or “guide” for carbon tax from EU or UN
- Thus, the tax rates can be anywhere (here is the 2023 rate)
- <https://taxfoundation.org/data/all/eu/carbon-taxes-in-europe-2023/#timeline>





# The unit for clustered standard errors

- The authors use standard errors clustered by firm in their main analysis
  - They do cluster by province/country in a robustness check
- However, given that the treatment mainly occur to province/country, they probably want to cluster standard errors accordingly
  - MacKinnon, Nielsen, and Webb has a nice users' guide paper "Cluster-robust inference: A guide to empirical practice" (forthcoming, J. Econometrics):  
"If treatment is assigned by cluster, whether for all observations in each cluster or just for some of them, as in the case of DiD models, then the scores will be correlated within the treated clusters whenever there is any intra-cluster correlation of the disturbances. Thus it never makes sense to cluster at a level finer than the one at which treatment is assigned.

# Some technical issues (1)

- Law/regulation vs. enforcement
  - The authors may provide some discussions for the enforcement issues of carbon tax and ETS.
- For early adaptors of carbon tax (Norway, Ireland, and Sweden), are firms double-taxed (i.e., double-treated) after entering into ETS? More discussions may be needed.
- According to World Bank, another important carbon pricing mechanism is crediting (many countries impose both, and some countries introduced only crediting: Thailand 2014 and Sri Lanka 2016): <https://carbonpricingdashboard.worldbank.org/>

# Some technical issues (2)

- The authors show: (1) COGS/Sales drop as increased production cost channel; and (2) Sales growth drops as the weak demand channel.
  - However, (2) is the denominator of (1)... empirically it is hard to estimate the production costs per unit as we do not know the units sold... so maybe just combine both as one channel?
- $D(\text{Intensity}1 > \text{Median})$  and  $D(\text{Intensity}1 = \text{Top Quartile})$  are not clearly defined in the text or table notes
  - Median and quartile are based on all firm-years, all firms in the same year, or all firms in the same industry in the same year?
- How about firms issuing ADRs and GDRs and thus listed in multiple markets? They will have more than one financial statement.

# Link to prior pollution literature

- The debate on whether pollution prevention/abatement policies work or not and hurt or not has been well-studied in the economics literature.
- Jaffe, Peterson, Portney, and Stavins (1995, JEL) and Currie and Walker (2019 JEP) offer review prior economics literature on the effect of environmental regulation on US manufacturers.
- Jaffe and Palmer (1997, REStat) show that firms spending more on environmental abatement also spent more on R&D.
- Greenstone (2002) show that the Clean Air Act led to loss of \$75 billion in output and \$37 billion in capital stock the regulated counties.

# Some thoughts on the write-up/structure (1)

- The transition from Eq (1) to Eq (2) can be improved:

$$\text{Log(Intensity)}_{i,c,t} = \beta_0 + \beta_1 \text{Post}_{c,t} + \gamma' \mathbf{X}_{i,c,t} + \mathbf{k}' \mathbf{Z}_{c,t} + \varepsilon_{i,t} \quad (1)$$

$$Y_{i,c,t} = \beta_0 + \beta_1 \text{Log(Intensity1 + 1)}_{i,c,t} + \beta_2 \text{Post}_{c,t} + \beta_3 \text{Post}_{c,t} \times \text{Log(Intensity1 + 1)}_{i,c,t} + \gamma' \mathbf{X}_{i,c,t} + \mathbf{k}' \mathbf{Z}_{c,t} + \varepsilon_{i,c,t} \quad (2)$$

1. *Intensity* in Eq (1) and *Intensity1* in Eq (2) => the latter scope 1-specific but was not defined on p.18
2. *Log(Intensity)* in Eq (1) and *Log(Intensity1+1)* in Eq (2) => why do you add 1 in Eq (2) but not Eq (1)?

## Some thoughts on the write-up/structure (2)

- Too many transitions in their discussion of the baseline results:
  1. On page 18, the authors discuss the results from *Post X*  
 $\text{Log}(\text{Intensity}_{1+1})$
  2. On pages 19-20, the authors discuss the results from *Post X*  
 $D(\text{Intensity}_1 \geq X)$
  3. On pages 20-21, the author present the dynamic effects from *Year dummies X*  
 $\text{Log}(\text{Intensity}_{1+1})$
- I got confused, so may be other readers