The impact of carbon emissions trading on industries

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Political economy of market-based climate policy

Economic instruments are often superior to command-and-control policies

- Carbon tax or emissions trading scheme (ETS)

Additional burden on industry can be a disadvantage

- How large is the profit impact?
- How can adverse impacts be alleviated?
    - Role of free emissions permits vs auctions

Political economy of market-based instruments is key to their success

Overview of modelling approach & results

Imperfect competition in product markets

- Generalized version of Cournot-Nash competition
  - Aluminium, aviation, cement, electricity, steel

Price-taking behaviour in carbon markets

- Individual sector within economy-wide trading scheme (e.g., EU ETS)

Key insight

- Under reasonable conditions, adverse profit impact of carbon pricing on industry is "modest"
  - ✓ Industry can be compensated ***and*** substantial government revenue raised from permit auctions

Profit-neutral permit allocations (PNA)

Definition of profit-neutrality at the industry-level

$$\Pi^*(T) + T\gamma(T)\zeta^*(0) = \Pi^*(0).$$

- Emissions price, *T*
- Industry profits, *π*
- Industry emissions, ζ
- Industry PNA, γ

Profit-neutral allocation based on initial (*T*=0) emissions

- e.g., grandfathering based on historical emissions

Industry profit impact is determined by its PNA

Core elements of the model setup

Generalized version of Cournot competition

- Industry conduct parameter $\theta \geq 0$

  e.g., Cournot-Nash (θ=1), perfect competition (θ=0)

Firms' production & emissions costs

- Emissions price t lies on interval $[0,T]$
- Marginal cost function $MC_i(q_i,t)$ is linear in output
- Firm chooses its emissions intensity z_i optimally
  - Cuts emissions intensity as t rises

Key feature

Emissions price raises MC_i by *optimal* emissions intensity

$$\frac{d}{dt} MC_i(q_i, t) = z_i(t)$$

Two sufficient conditions for the main results

A1. Industry demand curve is log-concave

=> Existence, uniqueness & stability of Cournot equilibrium

=> Rate of cost pass-through ≤ 100%

A2. Covariance (marginal costs, emissions intensities) ≥ 0

“Eco-efficiency”

- Firms which use fewer other inputs also produce less emissions (per unit of output)

Impact of carbon pricing on industry

Conditions A1 & A2 lead to “desirable” outcomes

① Product prices rise & industry output falls

② Market share shifts from high-cost to low-cost firms

③ Herfindahl index of concentration rises

④ Average emissions intensity of production falls

⑤ Industry-level emissions decline

NB. There are counterexamples to *all* of these outcomes!

Simple formulae for industry-level PNA

PNA is estimated via observable industry characteristics

Proposition 8. *Suppose ζ^* is decreasing in t. Then $\gamma(T) \leq \max_{0 \leq t \leq T} \tilde{\gamma}(t)$, where*

$$\tilde{\gamma}(t) = \frac{(2\theta + \bar{m})}{(\theta + \bar{m})} - \frac{[(\theta + \bar{m}) + \theta(1 - \theta HE)]}{(\theta + \bar{m})(N + \theta(1 - E) + \bar{m})} \frac{\sum_{j=1}^{N} z_j}{\sum_{i=1}^{N} \sigma_i z_i}. \quad (43)$$

- In some cases, PNA turns negative – or is above 100%

Key result: Under reasonable conditions, PNA is "low"

$$\gamma(T) \leq \theta H(T).$$

Illustration: UK cement industry in EU ETS

Cement PNA often ≤ 28% (HHI), almost always < 50%

- Large majority of emissions permits can be auctioned whilst preserving UK cement industry profits

Table 2
Upper bounds on PNA in terms of correlation (ρ) and variation (υ) of emissions intensities.

	Correlation ρ				
Variation υ	−1.0	−0.5	0	0.5	1.0
0.00 (uniform intensities)	0.28	0.28	0.28	0.28	0.28
0.05	0.18	0.23	0.28	0.33	0.37
0.10	0.06	0.18	0.28	0.37	0.45
0.15 (maximal variation)	−0.06	0.12	0.28	0.41	0.53

Some further issues for research

- Beyond homogenous-product Cournot competition
- Endogenous market structure & dynamics (entry & exit)
- International competition & carbon leakage
- *Good* empirical evidence on industry profit impacts

References

Thank you for listening!

Comments welcome:
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References

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