Discussion of *"Environmental Taxation and Technological Choice under Cournot Competition"*

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Summary

- Cournot oligopoly with n firms; a homogeneous good and an emission tax.
  - Each firm chooses an emission intensity $x_i \in [0, 1]$, with emissions $e_i = (1 - x_i)q_i$.
  - A *cleaner* technology is *costlier*: $c(x_i)$ with $c' > 0$, $c'' \geq 0$ (cost-based, not end-of-pipe).
- A three-stage game (regulator $\longrightarrow$ technology $\longrightarrow$ output) delivers:
  - **First best:** output subsidy (for market power) + Pigouvian tax $t = D'(E)$.
  - **Second best** (no subsidy): tax *below* marginal damages.
- Linear-quadratic case ($P = a - Q$, $D = dE$, $c = cx_i^2/2$): $x_i^* = t/c$, and the tax *rises* with n.
  - $\Rightarrow$ **competition promotes green innovation**, lowers each firm's output and emissions ...
  - ... **but** numerically *total* emissions *rise* with n: the "paradox."

Comments

- Timing structure.
  - The unregulated equil. assumes every firm i chooses x_i and q_i simultaneously.
  - But under regulation, the model considers that x_i is chosen before q_i.
  - The difference in both could be partially due to the timing, not only to the gov. considering env. damages.
- Env. damages.
  - $D(E) = dE$ are linear in E.
  - Convex damages (more standard) could *attenuate or overturn* the "total emissions rise with n" result.

Comments

- Paradox/Conjecture 1.
  - This is done in section 5, linear demand, parametric expressions.
  - No subsidies, only emission fees.
  - The setting is, then, closer to Lambertini et al. (2017), including their timing,...
  - but they consider convex damages and abatement, not your costly x_i.
  - They obtain that Z first increases in n, but then decreases (free-riding dominates).
  - Only first segment here.

Comments

- Number of firms, n, is exogenous.
  - With free entry, n^* is an *equilibrium* outcome (zero-profit condition).
  - Comparing welfare across n then could mix:
    - the emission distortion and
    - the business-stealing / excess-entry distortion.
- Katsoulacos & Xepapadeas (1995), already cited, show that with endogenous market structure the optimal tax may *exceed* marginal damages, to curb excess entry.
  - This could *reverse* the sign in Proposition 4.