

Climate Policy, Industry Concentration and Technology Adoption:
Taxes, Subsidies and Rebates

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Discussion by

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This paper

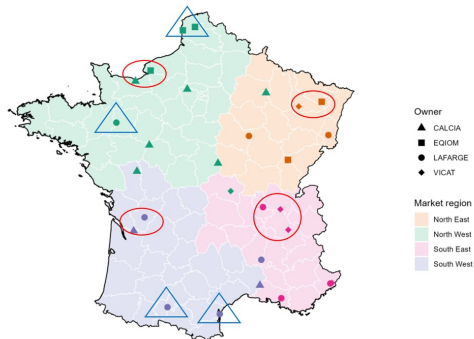
- Empirical context: oligopolistic industry (cement) subject to a carbon tax (EU ETS)
 - Cement: Concentrated and heavily polluting
 - Given a carbon tax: competition and innovation (adoption of available abatement technology)
 - Varying carbon tax: marginal return from innovation
- Optimal carbon tax balances two externalities
 - Market power: output has already been suppressed ($\tau \downarrow$)
 - Carbon emissions: less production and **more investment to reduce emission intensity** ($\tau \uparrow$)
- Policy combinations: You can't kill two birds with one stone
 - Tax + adoption subsidies/output-based rebate

Contribution

- A clean empirical context
 - Variations in market structure, carbon price, and technology adoption
 - Key is the abatement technology is **directly observed** and **cleverly measured**
- Estimate a dynamic game
 - Production and continuous investment
 - Application of cutting-edge tools (Gowrisankaran and Schmidt-Dengler, 2024)
- Multiple externalities call for multiple policy instruments

Comment 1. Distance

- Distance provides rich variations across plants about competition
 - Some plants face head-by-head competition while others are almost local monopolist



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- Distance provides rich variations across plants about competition
 - Some plants face head-by-head competition while others are almost local monopolist
- Different ways to measure competition through distance
 - Number of competitors within a radius of 150km
 - Inverse distance weighted average of competitor capacity
- Reduced-form evidence: carbon tax $\times$ competition $\rightarrow$ green investment?
 - Richer (cross-sectional) variations provide better identification for dynamic estimation

Comment 1. Distance

- Aggregating to 4 markets and to firms may understate actual firm-level market power
 - It looks that carbon tax itself already works pretty well (3.9% $\uparrow$ from policy combinations)
 - The paper's contribution shines even further with higher market power
 - Cement paper taking distance seriously: Miller et al. (2025)¹ and the follow up paper²
 - Whether distance matters for market power: exploiting plant-level prices
 - Lack of county level demand: proxy by construction activities then aggregate?

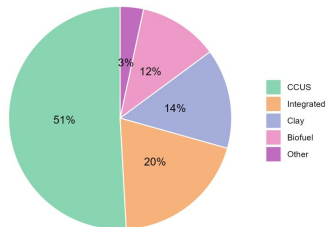
¹ Miller, Osborne, Sheu and Sileo, "Technology and Market Power in the Cement Industry", 2025, Working Paper

² Armitage, Miller, Osborne and Sileo, "The Dynamics of Emissions Pricing and Technology Adoption", 2025

Comment 2. Adoption as One Continuous Choice

- Rich menu of abatement technologies, each scalable independently
- Harmonize them with a scalar measure based on ex-post efficiency reduction

$$\underbrace{\eta_i}_{\text{Ex-post intensity}} = \frac{100 - \theta_i}{100} \times \underbrace{\bar{\eta}}_{\text{Baseline intensity}}$$

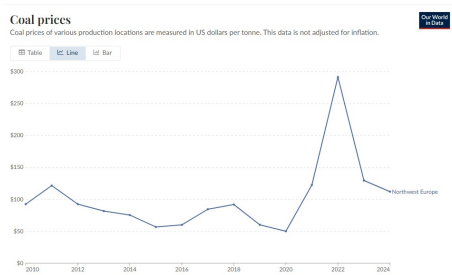
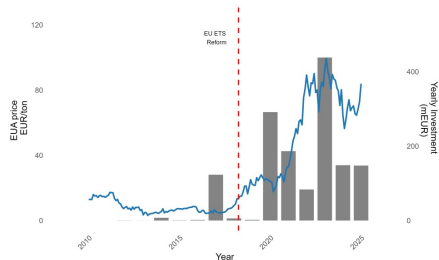


Comment 2. Adoption as One Continuous Choice

- I very much like this smart idea! But...
- Better separate CCUS from Biofuel and Coal
 - One motivation to adopt abatement technology is to reduce marginal costs
 - Biofuel and Coal both reduce energy cost significantly, but CCUS has no implication for MC
 - This is important as energy price also increases sharply after 2020
- Getting both discrete and continuous choice in investment is hard
 - Robustness: CCUS (with average efficiency reduction) as a separate discrete choice
- Empirical: exploit heterogeneity for CCUS adoptions

Comment 3. Energy Crisis (and Identification)

- Main identification variation comes from time series of carbon prices
- But the energy crisis also raised coal prices in the same period as carbon prices
 - Parameterize energy costs in the marginal cost specification
 - Firms hold static expectations about future energy prices?



Comment 4. Estimation and Model Fit

- More transparency in the estimation procedure would strengthen the paper
 - My understanding is that the current version is still BBL
 - 4 independent markets with 55 observations may not work well (How well it fits investment?)
 - How is the full solution implemented with some, but not heavy, reliance on first-stage policy?
 - Multiple equilibria?
- Important to show how model fits investment across time and markets
 - Investment spikes when carbon price surge (2020) and peak (2023)
 - Not clear how the model rationalizes the two spikes

Conclusion

- Important and timely question with a clean empirical setup
- Novel data and careful measurement
- Heavy lifting on estimating a dynamic game, well executed
- Very high potential with further polishing
- JMP → Best of luck on the job market!