Climate Policy and Firm Efficiency: Lessons From the Trucking Industry

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Do more stringent climate policies come at the expense of productivity?

- Why it matters?
  - Decoupling of economic growth from emission growth
  - Short-term trade-offs between carbon pricing and economic performance (& welfare)
- Laboratory: Swedish trucking sector between 2007 and 2020
  - Fantastic microdata
- Climate policy of interest: A form of carbon tax on diesel
  - Biofuel blending mandates

Kaya identity: Can we decouple emissions from economic growth?

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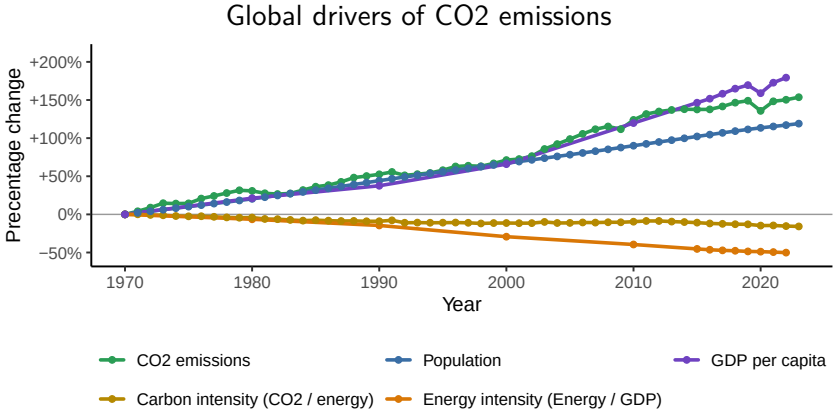

Source: OurWorldinData.org/co2-and-greenhouse-gas-emissions

Kaya identity in the Swedish trucking industry

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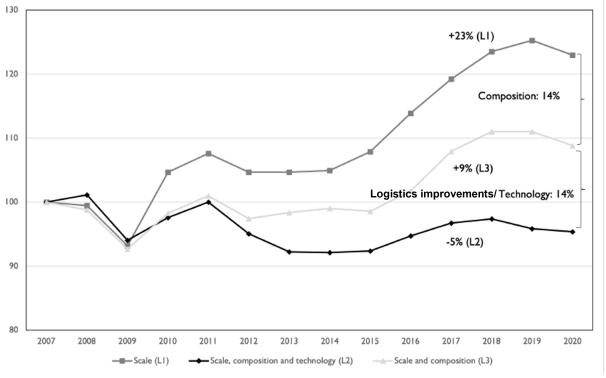
Figure 8: Grossman-Krueger Decomposition of Trucking CO_2 Emissions



This discussion in three parts

- Carefully executed study with a clear conceptual framing, excellent data, and rigorous empirics at vehicle/firm/industry level

1. How does carbon pricing impact trucking compared to other sectors?
2. Why do firms realise productivity gains only upon cost pressure?
3. What does the identification strategy assume?

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- Manufacturing & trucking: ↑ carbon prices → ↓ emision and ∼ output

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Manufacturing (Colmer et al., 2024, Martinsson et al., 2024):

- ↑ carbon prices ⇒ abatement investments (tech. upgrades) ⇒ $\downarrow \frac{\text{CO}_2}{\text{Fuel}}$ & $\frac{\text{Fuel}}{\text{Output}}$

Trucking (this paper):

- ↑ fuel prices ⇒ logistics optimization (better capital utilization) ⇒ $\downarrow \frac{\text{Fuel}}{\text{Output}}$
- Composition effects: Larger firms gain share over smaller ⇒ change in $\sum_i s_i$

1. For carbon pricing: When do which channels matter?

- *Suggestion*: Highlight conditions under which different adjustment channels dominate?
  - Technological upgrades
  - Organizational/logistics improvements
  - Competition dimension
- Contextual factors to consider:
  - Role of spare capacity
  - Role of capital intensity / availability of alternative technologies
  - Role of the policy design - biofuel mandate vs. carbon tax

2. Why do firms realise productivity gains only upon cost pressure?

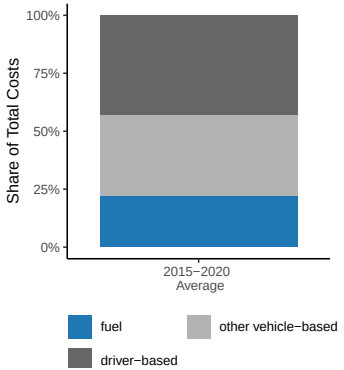
- Firms seem to have **latent efficiency margins**, e.g.routing, load factors, eco-driving, hub-an-spoke investments
- These margins do not just improve emission intensity, but also enable growth
- Gains are not realized under low fuel prices $\rightarrow$ fuel efficiency **and** output growth left on the table?

$\Rightarrow$ Why do firms not exploit efficiency gains that enable growth?

2. Why do firms realise productivity gains only upon cost pressure?

What is the NPV calculation of firms?

Average Marginal Costs per Mile



Source: American Transportation Research Institute

- Fuel $\approx 20\%$ of US marginal trucking costs
- Cost share possibly low enough to not matter without fuel price increase, but high enough once fuel price increases
- Can you elaborate on the key drivers and constraints behind firms' investment decisions?

2. Why do firms realise productivity gains only upon cost pressure?

What is the NPV calculation of firms?

Suggestions to shed light on drivers and constraints behind firms' investment decisions:

- Translate fuel-cost elasticities into implied effects on total trucking cost/km
- Benchmark the magnitude of cost shocks to average sector margins
- What may hinder firms to invest?
  - Financial constraints
  - Time horizon of investment
  - Salience of costs $\Rightarrow$ higher upon biofuel mandate
- New result in line: Large-fleet firms show strong investment to fuel cost sensitivity

3. What does the identification strategy assume?

Goal: Isolate year-over-year changes in fuel cost from time-series changes in other variables that also affect output

Core Idea:

- Fuel price shocks affect per unit costs of all firms equally in a given year
- But the **cost exposure** differs by firm based on fleet:

$$\underbrace{FC_{i,t}}_{\substack{\text{Fuel costs per transport} \\ \text{work for firm } i \text{ in year } t}} = \sum_{v \in V_{i,t-1}} \underbrace{\phi_v}_{\substack{\text{Fuel consumption per} \\ \text{ton-km (exposure)}}} \times \underbrace{c_t}_{\text{Fuel price}}$$

- Cross-sectional heterogeneity:
  Firms with higher ex-ante vehicle fuel intensity face larger cost shocks

3. Zooming in on the identification assumption

Does ex-ante fuel intensity act as quasi-random exposure to fuel prices?

Assumption: Ex-ante differences in fuel efficiency are unrelated to outcome trends

Why it may hold:

- Firm fixed effects control for time-invariant selection
- Truck fleets are long-term investments with slow turnover

Why it may not hold:

- Fuel efficiency reflects past choices
- Older/weaker firms may systematically run less efficient trucks
- Low fuel-efficiency firms may be on a faster improvement path
- Efficiency differences may capture both **exposure** and **selection**

3. Zooming in on the identification assumption

Suggestion to further strengthen identification assumption:

- Test whether high- and low-efficiency firms look different in other ways
  - Do they differ in size, age, constraints, growth?
  - Do they differ in fleet turnover rate?
  - Do they differ in profit margins / business models (quality vs quantity)?
- Estimate responses separately for quartiles of fuel intensity
  - Understand who drives the effect

Question: What does the elasticity you measure capture?

- Paper estimates a relative elasticity measure: More-exposed relative to less-exposed firms
  - If efficiency correlates with capabilities/constraints, this may represent a lower bound

Good luck with the paper

- Fantastic paper: rich data, careful execution, and compelling results
- Highlights logistics optimization and industry composition as an important channel of carbon pricing
- Open questions:
  - When do logistics vs technology vs competition channels dominate?
  - Why are efficiency gains realized only under cost pressure?
  - Can you provide further clarification/ evidence to support the identification assumption?