Energy prices, competition, and environment-related innovation

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Leon Bremer
l.bremer@vu.nl

Vrije Universiteit Amsterdam & Tinbergen Institute

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Research idea

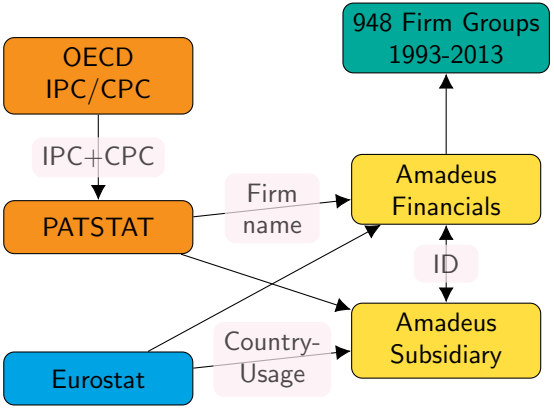
Motivation

Directed innovation can promote economic growth and environmental preservation.

Two hypotheses

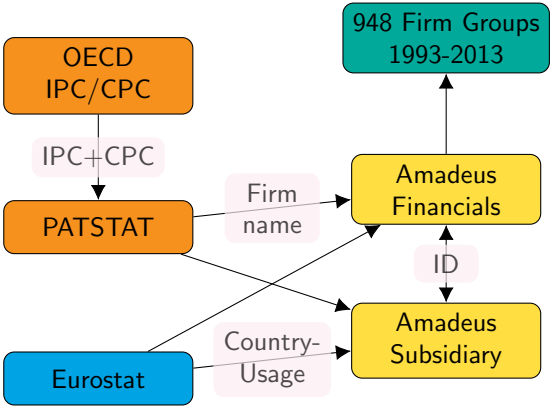
1. Induced Innovation: Do energy prices induce environment-related innovation?
2. Inverted-U: Is there an inverted-U relationship between competition and environment-related innovation?

Sample construction



Amadeus Financials	Fin. data of large EU firms
Amadeus Subsidiary	Ownership links
PATSTAT (Autumn 2018)	Worldwide data Patent-level
OECD, IPC, CPC	(Env.) patent classification
EUROSTAT	EU energy prices Country-usage-level

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Work-in-progress:

1. Fuzzy firm name matching
   - TF-IDF vectorization & Cosine Similarity
   - $\underbrace{\cos(\theta)}_{1\times 1} = \vec{a}\cdot\vec{b} \Rightarrow \underbrace{\cos(\theta)}_{m_1\times m_2} = \underbrace{\hat{A}}_{m_1\times n}\underbrace{\hat{B}'}_{n\times m_2}$
2. Group types of Env patents

Estimation equation

$$\mathbb{E}[PAT_{jt}^{ENV}|\cdot] = \exp\{g(EP_{jt-1}, COMP_{it-1})\beta + X_{jt-1}\gamma + W_{jt-1}\delta + \eta_i\} \quad (1)$$

- Fit (zero-inflated) Poisson or Negative Binomial model
- Lagged indep. vars and exogeneity of energy prices and industry-level market competition

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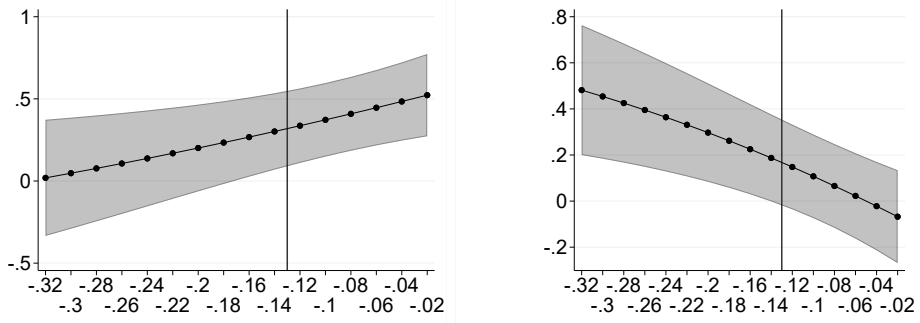
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PAT	No. of successful patent applications (fam level)	
EP	Electricity and gas prices	logs
$COMP$	Competition	logs
$g(\cdot)$	Interactions of EP with $COMP$ and $COMP^2$	
X	$PS_{i\|j}^{z}$, population, GDP per capita	logs
	energy tax	
W	Number of employees, total assets	logs
	cash flow, cash holdings, debt, stock issues	changes

j, i, c, t denote firm, industry, country, year.

Poisson margin plots – Energy prices



(a) Y: Electricity price, X: Competition

(b) Y: Gas price, X: Competition

Figure 1: Elasticities of env patents w.r.t. Y for values of X ($n = 9,516$, $N = 776$).

Further, strong path dependence wrt firms' own patent stocks, especially env. No industry path dependence. GDP per capita promotes env patenting.

Poisson margin plots – Competition

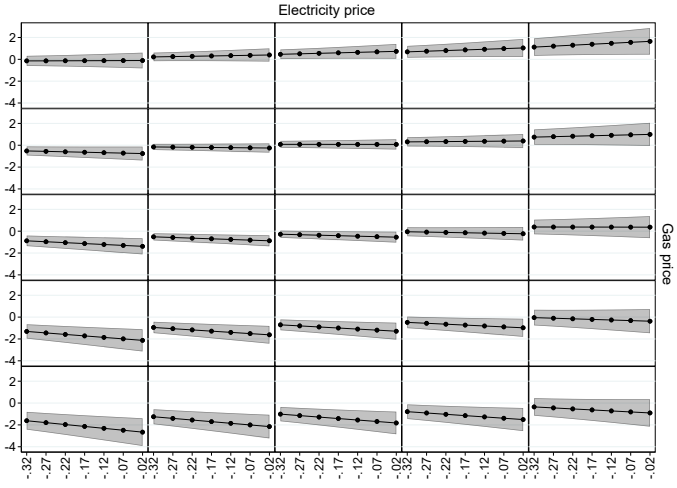


Figure 2: Elasticities of env patents w.r.t. *COMP* for values of *COMP* ($n = 9,516$, $N = 776$).

Main regression outcomes

Induced innovation

- Positive elasticity between energy prices and innovation
- Elasticity for elec (gas) prices strengthens (weakens) with competition intensity

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Inverted-U

- Relationship competition-innovation fairly linear. Sometimes quadratic but rarely inverted-U within plausible values

Way forward

- Fuzzy firm name matching to increase sample size
- Group types of environment-related patents
- Feedback, suggestions, comments?

Contact details

Leon Bremer
PhD candidate @ Department of Spatial Economics
Vrije Universiteit Amsterdam

l.bremer@vu.nl
leonbremer.nl
@leon_bremer
bremerleon