The environmental goods and services industry (and the energy sector)

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The Eco-industry

A new subject !!


“The domestic industry that provides environmental products and services is one of the least understood sectors within American industry, despite its size and economic importance.”

► David and Sinclair-Desgagné (JRE, 2005):

“Someone will hardly find in the environmental economics literature an acknowledgement that there even exists such an industry: pollution abatement is consistently assumed to be set only by polluters, based in turn on relevant technological, regulatory or output market considerations, but absent any explicit market or bilateral relationship with actual suppliers.”
THE AIR POLLUTION ABATEMENT PUZZLE

- The 1990 Clean Air Act Amendments introduced tradable permits for controlling sulfur dioxide emissions from coal-burning power plants and forced scrubbers to compete with other abatement technologies.

- Most studies have found reduced or lower than expected compliance costs. Yet, contrary to the predictions of theoretical models, this does not imply that scrubber technology has advanced.

- No increase in SO$_2$ control patent applications.
- Both operating and capital costs took a discrete fall with the CAAA of 1990, but there was no difference in the annual rate of change subsequently.


Greater competition among scrubber manufacturers?
If anything, the market for scrubbers has become more concentrated in the 1990s.

"The greater flexibility allowed by the 1990 CAAA has enabled firms to minimize costs with existing technology."

What about greater demand elasticity?

A. Pollution Management
1. Air pollution control
2. Wastewater management
3. Solid waste management
4. Remediation and cleanup
5. Noise and vibration abatement
6. Environmental monitoring, analysis and assessment

B. Cleaner Technologies and Products
7. Remediation/cleanup
8. Solid/hazardous waste
9. Waste water management

C. Resources Management Group
10. Renewable energy plant
11. Indoor air pollution control
12. Water supply
13. Recycled materials
14. Renewable energy plant
15. Heat/energy...
16. Sustainable agriculture and fisheries
17. Sustainable forestry
18. Natural risk management
19. Eco-tourism
20. Other

* APEC and OECD lists

Operating Expenditure
Capital Expenditure
The Eco-industry

Air pollution control – An informative website

- Go to the Institute of Clean Air Companies: www.icac.com (Notice, in passing, the “Antitrust & Privacy Statement”)
- Click on “Buyers Guide.” You are offered:
  - a list of pollution control technologies

If you click instead on “Diesel Particulate Control” in the menu of abatement technologies, then on “Find Suppliers,” then again on “Find Suppliers” for “All Diesel Particulate Control,” you end up with a choice of four suppliers:

- BASF Catalysts LLC
- CSM Worlwide Inc.
- Johnson Matthey Stationary Source Emissions Control
- Sud-Chemie

The German companies are the only ones supplying “Diesel Particulate Filters.”
Overview of the UK’s EG&S industry

- Considerable growth over the last 30 years. Employs about 170,000 people. Relatively research intensive.

- Total turnover of £25 billion in 2005, roughly the same as the aerospace and pharmaceutical sectors and 8.2% of world market. By comparison, the U.S. holds 38.5% of the world’s market, the EU 38.3%, Japan 17%, China 3.2% and India 2.5%. Market will double over the next 10 years.

- Main driver is regulation: for example, Large Combustion Plant Directive or Landfill Directives.
Env. goods compared to other sectors

A bar chart showing the comparison of different sectors in terms of billions of dollars. The sectors include APEC Env. Goods, Chemicals, Textiles, and Machinery & Transport Equipment. Machinary & Transport Equipment has the highest value, reaching up to 2,250 billion dollars.
Growth of environmental goods trade, 1990-2002
Trade by categories of (OECD) environmental goods

- Waste water management: 34%
- Environmental monitoring analysis and assessment: 15%
- Noise and vibration abatement: 12%
- Remediation and clean-up: 5%
- Solid waste management: 13%
- Air pollution control: 10%
- Resource Management: 10%
- Cleaner Technologies: 1%

The pie chart shows the proportional distribution of trade by categories of environmental goods.
Results and qualifications
(Bora and Teh, 2004)

- **Equation:** \( Q_i = \alpha_0 + \alpha_1(GDP/Cap)_i + \alpha_2(GDP/Cap)_i^2 + \alpha_3(GDP/Cap)_i^3 + \alpha_4(Envtrade)_i + \alpha_5Z_i + u_i \)

- **Explanatory Variables:** GDP per capita (following Grossman and Krueger), value of environmental goods trade, land area, OPEC membership, etc.

- **Conclusion:** There is a negative (i.e., \( \alpha_4 < 0 \)) and statistically significant link between trade and environment. Countries which trade more environmental goods have less pollution or consume energy more efficiently. This holds whether the OECD or APEC list is chosen as the explanatory variable in the regressions.

- **Qualifications:** This is an ongoing exercise. Need to expand the range of environmental indicators beyond those indicated. There is a need to look at more recent international data.
Environmental regulation and horizontal mergers in the eco-industry

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Background

○ **Stylized facts:**
  - 1998: *Lhoist Group*, Europe’s leading lime producer, gets full ownership of *Chemical Lime Company*
  - 2006: *DuPont Chemical Solutions Enterprise* buys *BELCO*
  - 2006: *BASF Catalysts* buys *Engelhard* ($5 billions)

○ **Literature on mergers:**
  - Williamson (1968)
  - Farrel and Shapiro (1990)
  - McAfee and Williams (1992)
  - Salant et al. (1983)
  - Perry and Porter (1985)

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**BASF Catalysts buys Engelhard**

- BASF provides carmakers with tools to meet **increasingly stringent standards** for evaporative emissions.
- Engelhard also makes catalytic converters.
- The biggest transaction in BASF’s 140-year history.
- “Our customers will benefit from the accelerated development of products with superior performance through the **combined R&D capabilities** of our companies.” [Jurgen Hambrecht, CEO of BASF]
The model (1/2)

x - consumption good
P - unit price of consumption good
c - unit production cost
A - pollution abatement
p - unit price of abatement goods and services

- Emission function: \( e(x,A) = \frac{(x - A)^2}{2} \)

t - tax per unit of polluting emission
The model (2/2)

- **The eco-industry**

Cournot competition
n initially identical firms

\[ p(A) \] - inverse demand function

\[ a_i^2 / 2k_i \] - environment firm i’s production cost

\[ A = \text{sum } a_i \]

Merger = summation of capital
Polluting firms’ behavior

- **Maximizes** \( P_x - c_x - pA - te(x,A) \)
  
  Let \( P = 1 - x \)

- **FOC:** \( x = 1 - c - p \); \( A = 1 - c - (1+t)p/t \)
  
  Let \( p(A) = \alpha_1 - \alpha_2 A \)

  where \( \alpha_1 = (1-c)t/(1+t) \)

  \( \alpha_2 = t/(1+t) \)
Environment firms’ behavior

Let $\beta_i = \frac{\alpha_2 k_i}{(\alpha_2 k_i + 1)}$ and $B = \sum \beta_i$

- **Before merging:**
  
  $a = \frac{\alpha_1 \beta}{(\alpha_2 (1+B))}$
  $A = \frac{\alpha_1 B}{(\alpha_2 (1+B))}$
  $p = \frac{\alpha_1}{(1+B)}$

- **After an s-firm merger:**
  
  $B_m < B$
  
  $a_0 = \frac{\alpha_1 \beta_0}{(\alpha_2 (1+B_m))}$
  $A_m = \frac{\alpha_1 B_m}{(\alpha_2 (1+B_m))}$
  $p_m = \frac{\alpha_1}{(1+B_m)}$

  and $A > A_m$, $p < p_m$
Incentives to merge

Lemma 1 (Allain and Souam 2004): There is a minimal threshold $\hat{s}$ at which an $\hat{s}$-firm merger is profitable.

Proposition 1: $d\hat{s}/dt > 0$

That is: A stricter environmental policy reduces incentives to merge.

Intuition: higher $t$ => lower demand elasticity => higher positive externality on outsiders
Welfare analysis

- **Impact of an s-firm merger:**
  - End-consumer surplus and pollution surplus decrease.
  - New firm’s cost decreases, while outsiders have a higher cost.
  - Polluting emissions increase because \( p_m > p \) entails lower purchases of abatement goods and services.

**Proposition 2:** An s-firm merger is welfare enhancing if and only if

\[
B(1-Bh)(1+B_m)^2 - B_m(1-B_m h_m)(1+B)^2 > \frac{\nu + t^2}{(1+B)^2 - (1+B_m)^2} \frac{t(1+t)}{}
\]

where \( h \) is the Herfindhal index and \( \nu \) the marginal environmental damage from pollution.
Conflicts between jurisdiction – the two-firm merger case

Profits

Consumer surpluses

Welfare
Policy implications and possible extensions

○ Steps from present work:
  ● What is the optimal tax?
  ● Check robustness of results under Bertrand or monopolistic competition, and with an imperfectly competitive polluting industry.
  ● Desperately seeking empirical work

○ Beware of the effect of regulation on the eco-industry’s structure (and ensuing market power)

○ Review current wisdom on environmental R&D and innovation.
  Stress “environmental entrepreneurship.”