

**ENVIRONMENTAL REGULATION AND  
PRODUCTIVITY : NEW FINDINGS ON THE  
PORTER HYPOTHESIS USING CANADIAN**

**OECD June 15 2005**

**PAUL LANOIE  
MICHEL PATRY  
RICHARD LAJEUNESSE  
HEC – Montréal**

# OUTLINE OF THE PRESENTATION

1. Introduction / the Porter hypothesis
2. Literature survey
3. Methodology and data
4. Empirical results
5. Conclusion

# 1. THE PORTER HYPOTHESIS

- Common wisdom:

There is always a trade-off between environmental protection and competitiveness.

- This view is challenged by Porter:

«Properly designed environmental standards can trigger innovation that may partially or more than fully offset the costs of complying with them».

# 1. THE PORTER HYPOTHESIS

AT THE HEART OF THIS HYPOTHESIS:

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- «Pollution is a manifestation of economic waste and involves unnecessary and incomplete utilization of resources »
- «Reducing pollution is often coincident with improving the productivity with which resources are used»

# 1. THE PORTER HYPOTHESIS

In the 2001 report by Baxter International, the company detailed how reductions in energy and water use and improved waste disposal and recycling over the past seven years cut costs by \$53 million last year. That savings amounted to nearly 10% of its 2001 net income.

Source : Time, August 26, 2002

# 1. THE PORTER HYPOTHESIS

## CONTRIBUTION OF THE PAPER:

- Impact of lagged regulation on productivity; to capture the dynamics of the Porter hypothesis
- Porter's argument suggests that firms with high loads of polluting emissions may have more opportunities to eliminate inefficiencies
- Porter's argument suggests that firms more highly exposed to competition are more likely to reduce costs (Brunnermeier and Cohen, 2003)

## 2. LITERATURE SURVEY

- A series of papers on the impact of environmental regulation on productivity and competitiveness,
  - Most show a negative relationship. One exception : Berman and Bui (2001). Positive impact in the U.S. oil refineries
- PALMER ET AL. (1995) : Arguments against the Porter hypothesis
  - Empirical evidence is anecdotal
  - No « low-hanging fruits »
  - The studies mentioned above

## 2. LITERATURE SURVEY

- **JAFFE AND PALMER (1997)**
  - They look at the impact of lag environmental regulation on innovations (patents, R&D expenditures)
  - Evidence is mixed : no impact on patenting activity, but a significant impact on R&D expenditures
- **BRUNNERMEIER and COHEN (2003)**
  - Environmental innovation (number of successful environmental patent applications) responds to increases in pollution abatement expenditures
  - Does not respond to increased monitoring and enforcement activities

# 3. METHODOLOGY AND DATA

- Look at the impact of CONTEMPORANEOUS and LAGGED environmental regulation on productivity growth.
  - If the Porter hypothesis is supported, we expect the impact to be negative in the short run, but positive in the long run.
- Is this pattern different across sectors with different loads of polluting emissions (cross-terms)?
- Is this pattern different across sectors with different exposure to competition?

# 3. METHODOLOGY AND DATA

## DATA

- Panel of 17 manufacturing sectors in Quebec for the period 1985-1994 inclusively.

## THE ESTIMATED MODEL

$$\begin{aligned} TFP = & \alpha_0 + \alpha_1 \cdot ENVIRONMENT_{it} + \alpha_2 ENVIRONMENT_{it-1} + \alpha_3 ENVIRONMENT_{it-2} + \\ & \alpha_4 ENVIRONMENT_{it-3} + \alpha_5 OSH_{it} + \alpha_6 \cdot SCALE_{it} + \\ & \alpha_7 \cdot CYCLE_{it} + \sum_i \mu_i + \sum_t \varphi_t + e_{it} \end{aligned}$$

# 3. METHODOLOGY AND DATA

Standard Törnqvist index

$$TFP = \log(Y_{it} - \log Y_{it-1}) - \sum_j [(\alpha_{jit} + \alpha_{jit-1}) / 2 \times (\log X_{jit} - \log X_{jit-1})]$$

Y: Output

X: Input

$\alpha$ : Input cost shares

Five inputs are considered: K, prod.workers, non-prod.workers, energy, material.

# 3. METHODOLOGY AND DATA

- ENVIRONMENT :  $\Delta$  ratio :

Investments in pollution–control equipment to the total cost of the industry (from a Stat Can Survey).

- ENVIRONMENT<sub>i,t-j</sub> up to t-3, or a three years moving average as in Jaffe and Palmer (1997)

# 3. METHODOLOGY AND DATA

- CONTROL for OSH regulation, SCALE, BUSINESS CYCLE
- Distinction between LESS and MORE POLLUTING sectors using data from StatCan on emissions of regulated pollutants.
- Distinction between sectors which are MORE OR LESS EXPOSED to COMPETITION using a standard measure of outside competition:  
(exports + imports / total shipments)

## 4. EMPIRICAL RESULTS

- GLS estimates based on the cross-sectionally heteroskedastic and time-wise autoregressive model developed by Kmenta. Fixed effects model
- Three sets of estimates :
  - One without cross-terms
  - One with cross-terms distinguishing the impact in LESS and MORE POLLUTING sectors
  - One with cross-terms distinguishing the impact on sectors which are LESS or MORE EXPOSED TO COMPETITION.

## 4. EMPIRICAL RESULTS

- As in Jaffe and Palmer (1997) in each set of estimates, we use TWO MEASURES OF ENVIRONMENTAL REGULATION.
  - One with simple lags
  - One with moving average lags
- THE RESULTS WITHOUT CROSS-TERMS
  - ENVIRONMENT<sub>it</sub> : Negative and significant
  - ENVIRONMENT<sub>i,t-l</sub> is POSITIVE and NOT SIGNIFICANT
  - ENVIRONMENT<sub>i,t-2</sub> and ENVIRONMENT<sub>i,t-3</sub> are positive and significant

## 4. EMPIRICAL RESULTS

- As in Gray (1987), we define the short-run contribution of independent  $X$  on the instantaneous rate of growth of productivity as the product of  $X$ 's estimated coeff. and  $X$ 's sample means
- SHORT RUN effect of ENVIRONMENT on TFP growth :  $-0.007 \approx 14\%$  of the mean decline in TFP
- The LONG-RUN effect (the sum of contemporaneous and lagged coef.) :  $+0,001 \approx 24\%$  of the observed  $\Delta$

## 4. EMPIRICAL RESULTS

- RESULTS WITH CROSS TERMS TO DISTINGUISH BETWEEN MORE AND LESS POLLUTING SECTORS
  - The pattern of NEGATIVE short-term effect and POSITIVE long-term effect is observed for LESS polluting sectors, contrary to our expectations.
    - 0,006 short run
    - 0,001

## 4. EMPIRICAL RESULTS

- FOR MORE polluting sectors, the long run impact is strongly NEGATIVE
  - 0,005 short run
  - 0,013 long run
- RESULTS WITH CROSS TERMS TO DISTINGUISH BETWEEN LESS AND MORE EXPOSED TO COMPETITION.
  - The ORIGINAL PATTEERN is observed for SECTORS WHICH ARE MORE EXPOSED to COMPETITION, as we conjectured.
    - 0,001 long run

## 4. EMPIRICAL RESULTS

- OSH: small negative impact and not significant
- SCALE and CYCLE : small positive and significant impact

## 5. CONCLUSION

- OUR RESULTS SUPPORT PORTER'S HYPOTHESIS, especially in sectors which are more exposed to outside competition.
- STRONG COMPETITION SEEMS GOOD for the ENVIRONMENT!!
- POTENTIAL CAVEATS :
  - Measure of environmental regulation may be IMPRECISE.
  - Can these results be generalized to other sectors in other regions??