AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Environmental Quality in a Differentiated Duopoly

Y. Hossein Farzin and Ken-Ichi Akao

NOTA DI LAVORO 138.2006

NOVEMBER 2006

ETA – Economic Theory and Applications
--

Y. Hossein Farzin, *Department of Agricultural and Resource Economics,
University of California*

Ken-Ichi Akao, *School of Social Sciences, Waseda University, Tokyo*

This paper can be downloaded without charge at:

The Fondazione Eni Enrico Mattei Note di Lavoro Series Index:
<http://www.feem.it/Feem/Pub/Publications/WPapers/default.htm>

Social Science Research Network Electronic Paper Collection:
<http://ssrn.com/abstract=945047>

The opinions expressed in this paper do not necessarily reflect the position of
Fondazione Eni Enrico Mattei
Corso Magenta, 63, 20123 Milano (I), web site: www.feem.it, e-mail: working.papers@feem.it

Environmental Quality in a Differentiated Duopoly

Summary

In a duopoly industry with environmentally differentiated products, we examine the effects of introducing a mandatory environmental quality standard on firms' environmental quality choices, profits, and the average environmental quality offered by the industry. We show that at low standard levels, both firms choose to overcomply regardless of the standard level. At intermediate levels, the mandatory standard can reduce the profit of the low-cost firm while increasing that of the high-cost firm, and that it can lower the industry's average environmental quality below what it would be without the standard.

Keywords: Duopoly, Environmental Quality, Mandatory Environmental Standard, Overcompliance, Product Differentiation

JEL Classification: Q58, L13, I51, D43

Address for correspondence:

Y. Hossein Farzin
Department of Agricultural and Resource Economics
University of California
Davis, CA 95616
USA
E-mail: farzin@primal.ucdavis.edu

Environmental Quality in a Differentiated Duopoly

1. Introduction

The past three decades have witnessed two broad trends in concerns about environmental quality. On the one hand, consumers have become increasingly concerned about the environmental quality and impact of products they consume. They have often expressed these concerns both by showing willingness to pay a price premium for the so called “green” or environmentally-friendly products and by pressuring policymakers to subject the polluting industries to environmental quality standards. On the other hand, responding to the consumers’ preferences and public pressure for environmental regulations, producers have more than ever become environmentally proactive.¹ At the same time, firms have been increasingly competing with one another on the basis of environmental quality either directly, by adopting more environmentally friendly technologies to improve the environmental quality of their production processes and products, or indirectly, by engaging in, or supporting, pro-environment activities in general to enhance their environmental image or reputation (see, for example, Videras and Alberini (2000) and Antona *et al.* (2004)). In these fashions, firms have been increasingly tending to environmentally differentiate their brands and public image from those of their rivals. Examples indicating these trends abound and include agricultural products differentiated by the degree of their genetically modified (GM) content, or by the degree of their organic content (organic versus conventionally produced product), or the extent of their bio-degradability (recyclability). Gasolines of different octane or lead content, electricity generated by different processes (fossil fuel-based, solar based, hydro or thermal based) or inputs (coal, oil, natural gas, biomass), and cars driving on different mixes of bio-fuel (ethanol) and gasoline, or electricity, are all few among numerous other examples. In this last respect, it is perhaps interesting to note that to further differentiate itself environmentally from its rival auto companies such as Toyota,

¹ For an interesting historical account of corporate environmentalism, see Hoffman (1997). For an economic and financial view of corporations’ environmental pro-activism, see Heal (2005), who presents several interesting examples of the corporations (such as British Petroleum (BP), Dow Chemical, and Heniz) whose pro-environment actions have benefited them both financially and in reputation, thereby giving them a competitive edge over their rivals, and those (such as Shell oil company, McDonalds, and Monsanto) whose less environmental-friendly approaches have harmed their public image and profitability.

Honda Motor Co. has just announced that it “is to mass-produce compact cars that run solely on bioethanol, becoming the first Japanese automaker to do so.” Bioethanol has attracted attention as a carbon-neutral fuel that does not contribute to global warming. Furthermore, Honda R&D Co. and Japan’s Research Institute of Innovative Technology for the Earth “have developed a new process to efficiently produce ethanol fuel from soft biomass, a renewable resource derived from plants” (*The Daily Yomiuri*, Tokyo, Friday, September 15, 2006, p.8).

The trends noted above raise several important questions. For example, what factors determine the firms’ choice of environmental quality of their brands if they are left to freely compete by differentiating their products? More importantly, faced with a mandatory quality standard, do firms have an incentive to overcomply? How does the introduction of a mandatory standard affect the firms’ degree of environmental differentiation, their profitability, and the average environmental quality provided by the industry? This paper explores these questions by adopting a simple differentiated duopolistic model of a polluting industry that faces a mandatory standard set exogenously by a regulating agency. We take a purely positive approach and as such do not deal with social welfare effects of either the regulator’s choice of the standard level or the industry’s choice of environmental quality. The two firms are assumed to differ only with respect to their costs of environmental quality, perhaps due to having access to different pollution abating technologies. Each of the firms produces a brand of a commodity that consumers deem to be different only in their environmental quality attribute.

Although there is an extensive literature dealing with various aspects of interaction between corporations and environmental regulations [see, for example, one or two references here], rather few theoretical economic research have explored the specific question of firms’ environmental quality choice in a differentiated industry facing a mandatory standard. Maloney and McCormick (1982) study the effect of a mandatory environmental quality regulation on profits in an atomistic competitive industry where the regulation increases a typical firm’s costs but has no direct effect on industry demand. They show that with restricted entry to the industry, the regulation can result in increased profits for all firms in the industry creating a scarcity rent from the right to use the environmental assets. Further, they show that when the firms differ in

their production costs, the environmental regulation may increase the profits of the low-cost firms while lowering those of the high-cost firms, and that this intraindustry transfer can happen even if entry is not restricted. Farzin (2003) examines the effect of a mandatory pollution standard on a polluting oligopolistic industry with identical firms where a higher environmental quality standard raises both the firms' compliance costs and the demand for the industry's output. He shows the conditions under which a stricter standard leads to a larger profit in the industry, a larger number of firms, a greater industry output, and a lower total pollution in the long run. However, none of these studies considers strategic environmental quality differentiation and possibility of voluntary overcompliance with the standard. On the other hand, Arora and Gangopadhyay (1995) analyze a model in which firms overcomply in order to attract high-income consumers, and thereby raise consumers' welfare.² As such, in their model overcompliance derives from the demand side due the heterogeneity of consumers' willingness to pay for environmental quality, which arises from differences in income levels. In contrast, our model explains overcompliance from the supply side by considering heterogeneity of firms' pollution control technologies, which lead to differences in their unit costs of environmental quality improvement.

Salop and Scheffman (1983) (1987) consider a dominant firm-competitive fringe model of an industry where a lower-cost dominant firm acts as price leader. They show that a cost-raising action controlled by the dominant firm, which could be interpreted as controlling product standards or other government regulations, or expenditures on advertising or research and development, can increase the dominant firm's profit at the expense of the fringe's profit and possibly consumer welfare.³ Interestingly, however, in our model of environmental-quality differentiated duopoly, raising the mandatory quality standard can increase the profits of the

² A strand of literature on motives for corporate environmentalism has emphasized self-regulation as a strategic means of preempting otherwise higher future government regulations. For a survey of this literature, see Lyon and Maxwell (2000).

³ For a review of the literature on the use of regulation as a cost-raising strategy, see McCormick (1984). In a related but different model, Lutz *et al.* (2000) consider situations where a high quality firm in the industry takes the role of quality leader by credibly committing to a quality level that is higher than the anticipated standard to be set by the regulator. They show that by such a strategic action, the high-quality firm can influence the regulator to set lower standards, thereby leading to a *lower* social welfare than would be the case if the regulator were to lead in setting the industry standard.

high-cost firm while lowering those of the low-cost one.

The rest of the paper proceeds as follows. In section 2 we set out the model and present the firms' equilibrium choices of environmental quality of their products in the absence of regulation. Section 3 examines the effect of introducing a mandatory environmental quality standard on the firms' quality choices, where we show that depending on the level of the standard, either both, or only one, or none of the firms may overcomply with the standard. Sections 4.1 and 4.2 respectively examine the effects of the mandatory standard on the firms' profits and the average environmental quality offered by the industry. We show that for intermediate levels of the standard the mandatory standard can reduce the profits of the low-cost firm while increasing those of the high-cost firm, and that it can lower the industry's average environmental quality below what it would be without regulation. Concluding remarks are presented in section 5.

2. The Model: Environmental Quality in the Absence of Regulation

Consider an industry consisting of two firms, labeled $i = 1$ and 2 , each producing a brand of a product. From consumers' perspective, the products are different only with respect to their environmental quality attributes but are identical in all other respects. Let $\alpha_i \geq 0$ denote the environmental quality and $q_i \geq 0$ the quantity of firm i 's product.

In general, each firm's revenue is a function of the quantity demanded of the firm's own product and that of its rival firm's product. It also is a function of both firms' choices of environmental quality. Formally, the revenue function of firm i can generally be represented by $R_i = R_i(q_i, q_j, \alpha_i, \alpha_j) = p_i(q_i, q_j, \alpha_i, \alpha_j)q_i$. To concentrate on firms strategic behavior with regard to the choice of environmental quality, and their responses to the environmental standard set by an environmental regulatory agency, we abstract from firms' strategic behavior with regard to the choice of output quantity. This simplification can be justified, for example, by considering situations where consumers' aggregate income spent on the products is large enough and the firms make short-run decisions, so that consumers' demand for each product is determined by the

firm's available output capacity, which is assumed to be fixed at $\bar{q}$ in the short run. Thus, the revenue function of each simplifies to $R_i = R_i(\bar{q}_i, \bar{q}_j, \alpha_i, \alpha_j) = p_i(\alpha_i, \alpha_j) \bar{q}_i = R_i(\alpha_i, \alpha_j)$.

The environmental quality of the firm in our model can be interpreted broadly so that it not only can represent the environmental quality associated with any stage of production of the final products (that is, from input acquirement to production processing, packaging, and distribution). It can also represent a firm's environmental activities which may not necessarily be related to its product *per se*, but could be pro-environment activities which, for example, improve the firm's environmental reputation in general. The firm's incentive to engage in such activities is to attract consumers who support its pro-environment stance by their willingness to pay a premium price for the firm's product. In other words, α_i in our model can be interpreted broadly enough to encompass the notion of firm's environmental responsibility. We are thus treating α_i in our model as firm's environmental reputation which can from consumers' perspective be distinct from how much of the firm's product they may consume. Accordingly, our notion of the environmental standard set by the regulator may also be interpreted broadly. It may not only represent the environmental standard that firms have to observe in production of their products. It can more generally be viewed as a composite index of a firm's environmental friendliness.

To simplify the model, and without much loss of generality, we make two further assumptions. First, we assume that the choice of environmental quality by a firm does not affect its output level. That is, the firm's environmental quality activity is like end-of-pipe pollution abatement and as such is separate from the firm's production process, so that there is no spillover effect from environmental quality activity into the production activity and vice versa. An implication of this assumption is that the production cost is not affected by choice of environmental quality. This is consistent with the assumption of constant unit production costs of the products that we shall also be making shortly. Second, we assume that inputs employed in production and environmental activities are specific to each activity. An implication of this

assumption is that a firm can not by reallocating some of the inputs from production into environmental quality activity reduce the level of its output to improve the environmental quality of its product, thereby obtaining a higher price for its product.

To be able to proceed analytically, we assume the following quadratic revenue functions:

$$R^i(\alpha_i, \alpha_j) = -\frac{1}{2}a\alpha_i^2 - b\alpha_i\alpha_j + r\alpha_i, \quad i = 1, 2, j \neq i, \quad a, b, r > 0, \quad (1)$$

where $\partial^2 R^i(\alpha_i, \alpha_j) / \partial \alpha_i^2 = -a < 0$ and $\partial^2 R^i(\alpha_i, \alpha_j) / \partial \alpha_i \partial \alpha_j = -b < 0$. The first inequality indicates that for each firm there are diminishing marginal returns from choosing higher environmental quality levels. The second inequality indicates that an increase in one firm's environmental quality lowers the rival firm's marginal revenue, implying that from firms' perspectives the environmental qualities are strategic substitutes.

It is plausible to assume that a firm's marginal revenue is more sensitive to a change in its own environmental quality than to a change in the rival's; that is

$$a > b \quad (2)$$

In fact, for a given value of a , the magnitude of b indicates the degree to which the consumers' perceive the two products are differentiated, or inversely, how close strategic substitutes the two products are from the firms' perspectives. In the extreme case of $b = a > 0$ (*i.e.*, $a - b = 0$) the two products become homogeneous (zero degree of differentiation or strategically perfect substitutes) and the firms' profits would drop to the lowest level. In the other extreme case, when $b = 0$ (*i.e.*, $a - b = a$), the degree of product differentiation is the highest, and the two products become independent of each other. In this case, each firm behaves like a monopolist in choosing its level of environmental quality. As such, one could consider $(a - b)$ as an index of product differentiation or the inverse of it as a degree to which the two products are strategic substitutes.

To focus on the role of environmental quality differentiation, we assume that the unit production costs of products are the same, and normalize them to be zero. Let A_i be the

constant unit cost of achieving environmental quality α_i .⁴ We assume that the two firms differ only with respect to this cost, for example, due to differences in their pollution abatement technologies. More specifically, we assume that firm 1 has an advantage over firm 2 in cost of environmental quality, *i.e.*,

$$A_2 > A_1 > 0. \quad (3)$$

Then, the profit functions are expressed as^{5, 6}

$$\pi^i(\alpha_i, \alpha_j) = \left(-\frac{1}{2}a\alpha_i^2 - b\alpha_i\alpha_j + r\alpha_i \right) - A_i\alpha_i \quad (i, j = 1, 2, \quad i \neq j) \quad (4)$$

To ensure that both firms can coexist in the market, we need to assume that

$$r > A_2. \quad (5)$$

Otherwise, the profit of firm 2 will always be negative and thus not entering the market.

The two firms play a Nash-Cournot game in environmental qualities of their products.

The problem of firm $i = 1, 2$ is

$$\begin{aligned} \max_{\alpha_i} \pi^i(\alpha_i, \alpha_j) &= -\frac{1}{2}a\alpha_i^2 - b\alpha_i\alpha_j + r\alpha_i - A_i\alpha_i, \\ \alpha_j \quad (j \neq i) &\text{ given.} \end{aligned} \quad (6)$$

Suppose that in the absence of any environmental regulation, there exists an equilibrium (α_1^*, α_2^*) .⁷ At equilibrium, the following equation holds:

$$\begin{bmatrix} a & b \\ b & a \end{bmatrix} \begin{pmatrix} \alpha_1^* \\ \alpha_2^* \end{pmatrix} = \begin{pmatrix} r - A_1 \\ r - A_2 \end{pmatrix}. \quad (7)$$

With condition (2) one has $a^2 - b^2 > 0$, which ensures that a Nash equilibrium is unique and

⁴ A_i can also be interpreted, for example, as a constant unit cost of pollution abatement.

⁵ Strictly speaking, π^i represents the profit margin (price minus unit cost) for each firm. To simplify the analysis, we focus on the profit margin, instead of profit levels, which depend on $\bar{q}_i$, $i = 1, 2$.

⁶ We could more generally write the profit function to include a constant term c_i , as

$\pi^i(\alpha_i, \alpha_j) = R^i(\alpha_i, \alpha_j) - A_i\alpha_i - c_i$, where c_i can be interpreted either as a unit cost of production or as a tax or subsidy per unit of output respectively when c_i is positive or negative. This generalization would not affect the results as long as both firms remain in the market.

⁷ It is shown below (see (10)) that the firms' profits at equilibrium are positive. Therefore, both firms can coexist under *laissez faire*.

stable.⁸ The firms' equilibrium choices of environmental quality are

$$\alpha_1^* = \frac{a(r - A_1) - b(r - A_2)}{a^2 - b^2} > 0 \quad (\text{by (2) and (3)}), \quad (8.a)$$

$$\alpha_2^* = \frac{a(r - A_2) - b(r - A_1)}{a^2 - b^2} \quad (8.b)$$

Notice that whereas α_1^* is always positive, to ensure that α_2^* is positive we need the condition

$$\frac{b}{a} < \frac{r - A_2}{r - A_1} < 1, \quad (9)$$

that is, the adverse effect of an increase in the rival's quality on the firm's marginal revenue should not be too large, or, equivalently, the two products should be sufficiently differentiated.

As to be expected, from (8.a) and (8.b) it is seen that the equilibrium choice of the quality by each firm varies inversely with its own cost of environmental quality and directly with that of its opponent.

The associated profits at the equilibrium are calculated as

$$\pi^i(\alpha_i^*, \alpha_j^*) = \frac{a}{2} \left(\frac{a(r - A_i) - b(r - A_j)}{(a^2 - b^2)} \right)^2 > 0, \quad i = 1, 2, \quad j \neq i, \quad (10)$$

which ensures that both firms will coexist in the market.

An interesting finding here is (from (8.a) and (8.b))

$$\alpha_1^* - \alpha_2^* = \frac{A_2 - A_1}{a - b} > 0 \quad (11)$$

which enables us to state the following proposition:

Proposition 1: *In the absence of any environmental quality regulation, in a differentiated duopoly, (i) the firm with the lower environmental quality cost ($A_1 < A_2$) adopts a higher environmental quality than that chosen by its high-cost rival ($\alpha_1^* > \alpha_2^*$), and (ii) the extent of environmental quality differentiation in the market varies directly with the environmental cost differential and the degree to which the products are strategic substitutes.*

This result parallels that of output quantity choices in a differentiated duopoly (see, for example, Dixit, 1979, Singh and Vives, 1984, and Shy 1995.) As we shall see in the next

⁸ See Dixit (1986).

section, when a mandatory environmental standard is introduced, the asymmetric equilibrium quality choices, (8.a) and (8.b), give rise to a situation where one of the firms complies with the standard whereas the other overcomplies.

3. Mandatory Standard and Duopoly Choices of Environmental Quality

In this section we analyze the equilibrium quality choices of the duopoly facing an environmental quality standard. Let $\hat{\alpha} > 0$ denote the minimum environmental quality standard mandated by the environmental regulatory agency. Taking this standard and the rival firm's choice of environmental quality as given, the profit maximization problem for firm i is written as

$$\begin{aligned} \max_{\alpha_i} & \left(\frac{-1}{2} a\alpha_i - b\alpha_j + r - A_i \right) \alpha_i, \\ \text{subject to } & \alpha_i \geq \hat{\alpha}, \quad \alpha_j (j \neq i) \text{ given.} \end{aligned} \quad (12)$$

At equilibrium $(\alpha_1(\hat{\alpha}), \alpha_2(\hat{\alpha}))$, it holds that

$$\begin{aligned} - \begin{bmatrix} a & b \\ b & a \end{bmatrix} \begin{pmatrix} \alpha_1(\hat{\alpha}) \\ \alpha_2(\hat{\alpha}) \end{pmatrix} + \begin{pmatrix} \mu_1 \\ \mu_2 \end{pmatrix} &= - \begin{pmatrix} r - A_1 \\ r - A_2 \end{pmatrix}, \\ (\alpha_1(\hat{\alpha}) - \hat{\alpha}) \mu_1 &= 0, \quad (\alpha_2(\hat{\alpha}) - \hat{\alpha}) \mu_2 = 0 \end{aligned} \quad (13)$$

where $\mu_1, \mu_2 \geq 0$ are the Lagrange multipliers. Notice that for now we have left aside the possibility that the standard may render production by one or both firms unprofitable. Later, we will take this possibility into account and analyze how the standard affects the market structure.

Using the Kuhn-Tucker conditions (13), the equilibria are classified into three types:

(a) *Both firms overcomply*: In this case, $\mu_1 = \mu_2 = 0$, implying that $\alpha_1(\hat{\alpha}) = \alpha_1^* > \hat{\alpha}$ and $\alpha_2(\hat{\alpha}) = \alpha_2^* > \hat{\alpha}$, where, as before, α_1^* and α_2^* are given by (8.a) and (8.b). The equilibrium exists if $\min[\alpha_1^*, \alpha_2^*] = \alpha_2^* \geq \hat{\alpha}$. We term the interval $[0, \alpha_2^*)$ as *Interval I*. Thus,

Proposition 2: *Over Interval I, (i) both firms overcomply, (ii) they choose equilibrium quality levels that are the same as those in the absence of any standard, implying that within this interval the mandatory standard has no effect on the firms' voluntary choices of environmental quality, and (iii) the low-cost firm overcomplies by a larger extent than the high-cost firm does. (See Figure 1).*

An important implication of (ii) is that since the mandatory standard does not affect the firms' laissez faire choices of environmental quality of their products, to the extent that monitoring the firms' environmental quality levels and enforcing the standard involve social costs, zero mandatory standard should be preferred to weak standards (*i.e.*, $\hat{\alpha} < \alpha_2^* = [a(r - A_2) - b(r - A_1)] / (a^2 - b^2)$).⁹

(b) *Only one of the firms overcomplies*: In this case $\mu_1 = 0$ and $\mu_2 > 0$, so that $\hat{\alpha} < \alpha_1(\hat{\alpha}) = (-b\hat{\alpha} + r - A_1) / a$ and $\alpha_2(\hat{\alpha}) = \hat{\alpha}$.¹⁰ This equilibrium exists if $\alpha_2^* \leq \hat{\alpha} \leq \hat{\alpha}^U$, where $\hat{\alpha}^U$ is defined by

$$\hat{\alpha}^U = \frac{r - A_1}{a + b} > \alpha_2^*. \quad (14)$$

So, calling $[\alpha_2^*, \hat{\alpha}^U)$ as *Interval II*, we have

Proposition 3: *If the environmental quality standard lies within the Interval II, then whereas the high-cost firm just complies with the standard, the low-cost firm still chooses to overcomply, although by a lesser extent than if the standard was lower. As a result, the standard reduces the quality differentiation in the market. (See Figure 2).*

The economic reason for firm 2 refraining from overcompliance is clear. Being the high-cost firm, at higher standard levels (*i.e.*, higher than α_2^*), the cost of overcomplying would be too high for firm 2 to afford it. On the other hand, the low-cost firm 1 still continues to overcomply, but as the mandatory standard is raised over Interval II, it *lowers* its environmental quality, and does so at the rate of $b/a < 1$, which is smaller the more strongly the two products are strategic substitutes (or, equivalently, the less differentiated they are). The reason for this behavior of firm 1 is simple: since its rival now adopts, and sticks to, a higher standard than it would over Interval

⁹ Also, see Farzin (2004) who analyzes the social welfare effects of a stricter environmental standard and identifies situations in which the regulator may prefer no standard to weak ones.

¹⁰ The other overcompliance case where $\mu_1 > 0$, $\mu_2 = 0$ implying that $\alpha_1(\hat{\alpha}) = \hat{\alpha}$, $\alpha_2(\hat{\alpha}) > \hat{\alpha}$ can never happen because otherwise one would have $a\hat{\alpha} + b\alpha_2(\hat{\alpha}) = r - A_1$, $b\hat{\alpha} + a\alpha_2(\hat{\alpha}) > r - A_2$. By (2), this implies that $a\hat{\alpha} + b\alpha_2(\hat{\alpha}) > b\hat{\alpha} + a\alpha_2(\hat{\alpha})$. Since $a - b > 0$, we have a contradiction: $\alpha_2(\hat{\alpha}) < \hat{\alpha}$.

¹¹ $\hat{\alpha}^U - \alpha_2^* = \frac{r - A_1}{a + b} - \frac{a(r - A_2) - b(r - A_1)}{a^2 - b^2} = \frac{a(A_2 - A_1)}{a^2 - b^2} > 0$ (since $A_1 < A_2$ and $a > b$).

I (i.e., $\alpha_2(\hat{\alpha}) = \hat{\alpha} > \alpha_2^*$), and since the best response of firm 1 is negatively related to firm 2's choice of environmental quality (recall that $\alpha_1(\alpha_2) = (-b\alpha_2 + r - A_1)/a$), it follows that the best strategy of firm 1 is to still overcomply but to reduce its environmental quality below the level it would choose over Interval I. As such, by mandating a sufficiently high standard, the regulatory agency also causes the environmental quality differentiation in the market to narrow. At the limit when $\hat{\alpha} = \hat{\alpha}^U$, even for the low-cost firm 1 the cost of overcomplying becomes so large that environmental differentiation no longer pays off and therefore both firms just comply with the minimum standard.

(c) *None of the firms overcomplies:* In this case, $\mu_1 > 0, \mu_2 > 0$, implying that $\alpha_1(\hat{\alpha}) = \hat{\alpha}$ and $\alpha_2(\hat{\alpha}) = \hat{\alpha}$. This equilibrium occurs on *Interval III*, defined as $[\hat{\alpha}^U, \infty)$. We therefore have:

Proposition 4: *At sufficiently high environmental standards ($\hat{\alpha} > \hat{\alpha}^U = (r - A_1)/(a + b)$), none of the firms has an incentive to environmentally differentiate itself by overcomplying. Therefore both firms choose to comply with the minimum standard. (See Figure 1).*

The economic explanation of this result is simple. As noted before, when the environmental standard is too high, it becomes too costly even for the low-cost firm 1 to differentiate itself through overcompliance as a strategic means of competition.

Figure 1. Firms' equilibrium quality responses to environmental standard $\hat{\alpha}$

4. Profits and average environmental quality under the mandatory standard

4.1 Profits under the mandatory standard

It would be interesting to examine the corresponding behavior of the duopoly profits in response to the mandatory standard over the three intervals.

Over Interval I, the mandatory standard is ineffective, so the firms' profits remain constant at the laissez fair levels, given by (10), regardless of the standard level. It is easy to verify from (10) that $\pi^{*1} > \pi^{*2}$. (See Figure 2).

Over Interval II, the profits of the two firms, denoted by $\pi_{II}^{*1}(\hat{\alpha})$ and $\pi_{II}^{*2}(\hat{\alpha})$ and illustrated by solid and dashed lines in Figure 2, are calculated as.

$$\pi_{II}^{*1}(\hat{\alpha}) = \frac{-1}{2} a [\alpha_1(\hat{\alpha})]^2 + (-b\hat{\alpha} + r - A_1) \alpha_1(\hat{\alpha}) \quad (15.a)$$

$$\pi_{II}^{*2}(\hat{\alpha}) = \frac{2b^2 - a^2}{2a} \hat{\alpha}^2 + \frac{a(r - A_2) - b(r - A_1)}{a} \hat{\alpha} \quad (15.b)$$

Using (15.a) and the envelop theorem, we have for Firm 1's profit

$$\frac{d\pi_{II}^{*1}(\hat{\alpha})}{d\hat{\alpha}} = -b\alpha_1(\hat{\alpha}) < 0. \quad (16)$$

That is, the low-cost firm 1's profit monotonically *declines* as the standard is tightened over interval II, although the profit always remains positive over this interval. (See Appendix 1)

The response of firm 2's profit to the standard over this interval is more complicated and, as shown formally in Appendix 2, it depends on b/a , the degree to which the products are strategic substitutes, on $(r - A_1)/(r - A_2)$, the degree of the cost differential of the two firms, and on the sign of the expression $2b^2 - a^2$, which determines the curvature of firm 2's profit function. Figure 2 illustrates possible responses of firm 2's profit to the level of the standard in Interval II. As can be seen, there are four possible cases, labeled A, B, C, and D. Figure 3 shows the sets of combinations of b/a and $(r - A_1)/(r - A_2)$ values that correspond to each of the four cases (see Appendix 2 for derivations).¹²

One notable result of our analysis can be stated as

Proposition 5: *There is always a sub-range of the mandatory standard level in Interval II for which as the standard is tightened the profit of the high-cost firm 2 increases while that of the low-cost firm 1 always decreases.*

¹² Notice that the relevant values of b/a and $(r - A_1)/(r - A_2)$ are those to the left of the 45-degree line to ensure positive α_2^* as well as positive corresponding firm 2's profit.

Figure 2. Firms' profit responses to the environmental standard $\hat{\alpha}$

Figure 3: Classification of the response of firm 2's profit to the standard level in Interval II

That by raising the environmental standard, the regulator causes the profit of the high-cost firm to increase but that of the low-cost firm to decrease is both interesting and counter intuitive for two reasons. First, it shows that the industrialists' claim that a higher environmental standard reduces a firm's profit is not generally true. Second, following Salop and Shceffman's (1983) argument of "raising the rivals' cost", one may have expected that by raising the environmental cost of the high-cost firm, a more stringent standard should benefit the low-cost firm and not the high-cost one. The explanation for our counter-intuitive and contrasting result is as follows. By mandating a high enough standard ($\hat{\alpha} > \alpha_2^*$), the regulator sends the credible signals to the low-cost firm 1 that the high-cost firm 2 has to, at least, comply with this higher standard. Therefore, contrary to the equilibrium choices over Interval I (or the laissez-fair equilibrium), the low-cost firm 1 can no longer by choosing a much higher standard (and hence a greater environmental differentiation) disadvantage firm 2 to lower its quality below $\hat{\alpha}$ ($> \alpha_2^*$) and thereby increase its own profit at the expense of firm 2's. In fact, the introduction of a relatively high mandatory standard in Interval II alters the nature of the strategic game of environmental quality competition from a Nash-Cournot one to a game akin to the Stackleberg's leader-follower game in that, by complying with the regulator's standard, firm 2 sets its quality choice at the standard level ($\alpha_2(\hat{\alpha}) = \hat{\alpha}$) and lets firm 1 react to this strategy. As such, firm 1's cost advantage no longer gives it an incentive to choose as high an environmental quality as it would have chosen in the absence of the standard. Consequently, we see that over Interval II, the mandatory standard lowers the degree of environmental differentiation in the market relative to that over Interval I (or the laissez-fair equilibrium) and raises profits of firm 2 while lowering those of firm 1.

The contrast between Salop and Shceffman's (1983) argument and our result derives from the fact that whereas they model the game of quality competition as the Stackleberg's leader-follower variety in which a *low-cost* dominant firm raises the costs for a high-cost competitive fringe, our model characterizes the market as a Nash-Cournot differentiated duopoly in Interval I, and a kind of leader-follower game in interval II *but* with the difference that over

Interval II it is the high-cost, and not the low-cost firm that leads by setting its quality choice at the mandatory standard level and letting the low-cost firm react to it.

Another notable result of our analysis is that

Proposition 6: *The situations where the mandatory standard raises the profits of the high-cost firm 2 over the entire Interval II (Case A and Case B) occur when the two products are highly strategic substitutes (or nearly homogenous, b/a large) and the cost differential between the two firms is very small $((r - A_1)/(r - A_2)$ close to one). (See Figure 3)*

The intuition behind this proposition is straightforward: it is precisely under those conditions that the beneficial effect on Firm 2's profits of tightening the standard is the strongest. In the extreme opposite Case D, where the two products are highly differentiated and the cost differential is very large, the favorable effect of a higher standard on firm 2's profit is very weak, thus leading to the possibility of firm 2's profit eventually declining to zero as the standard is raised. Between these extremes is Case C, representing moderate degrees of product differentiation and cost differentials.

Over Interval III, the profits of both firms monotonically decrease as the standard is strengthened, although firm 1's profit always exceed firm 2's profit and eventually falls to zero within the interval (See Appendixes 1 and 3 and Figure 2). This case represents the situation where the environmental pollution caused by the industry is deemed too serious to be left to the firms' voluntary choices of environmental quality levels. As such, by mandating a sufficiently high standard, the regulator trades off the firms' profits for higher environmental quality and hence social welfare. In extremely harmful cases of environmental pollution, the regulator may in fact sets the standard so high as to make the high-cost firm 2 unprofitable or even so high as to force both of the polluting firms out of the market. In such extreme cases, the regulator believes that the social gain from improving environmental quality exceeds the resulting losses of firms' profits and consumers' surplus.

4.2 Average environmental quality under the mandatory standard

Of particular interest is the effect of a mandatory environmental standard on the average environmental quality enjoyed by consumers. To examine this effect, we define the actual (or realized) environmental quality as the weighted average of the firms' choices of environmental quality of the products $(\alpha_1(\hat{\alpha}), \alpha_2(\hat{\alpha}))$ under the regulated regime, where the weights are the shares of firms' outputs in total quantity of the products consumed $(\bar{q}_1, \bar{q}_2)$, *i.e.*,

$$\bar{\alpha}(\hat{\alpha}) = \frac{\bar{q}_1 \alpha_1(\hat{\alpha}) + \bar{q}_2 \alpha_2(\hat{\alpha})}{\bar{q}_1 + \bar{q}_2}.$$

We then compare this average with the average quality which would have prevailed in the absence of any standard (*i.e.*, the laissez fair average quality), which is calculated as:

$$\bar{\alpha}_{LF} = \frac{(\bar{q}_1 - \bar{q}_2)(a - b)r - (a\bar{q}_1 - b\bar{q}_2)A_1 + (b\bar{q}_1 - a\bar{q}_2)A_2}{(\bar{q}_1 + \bar{q}_2)(a^2 - b^2)}.$$

Figure 4 presents this comparison for different intervals of the mandatory standard.

Figure 4: Average environmental quality with and without standard

As can be seen from Figure 4, over Interval I where the environmental standard is relatively weak, the actual average quality in the absence of any regulation would exceed that the mandatory standard. The extent to which the actual average quality would differ from the benchmark (laissez fair) quality depends on whether $\bar{q}_1 > \bar{q}_2$ as well as on the ratio of b/a . In Figure 4, $\bar{\alpha}_{LF}'$ represents the former possibility whereas $\bar{\alpha}_{LF}''$ denotes the latter case. The solid lines present the actual (or realized) average quality over different intervals of the standard level. In any case, a potential policy implication is that when environmental pollution is not too serious a problem to necessitate very stringent standards, then, as far as average environmental quality is concerned, having no standard at all may serve the society better than imposing a weak standard.

Interestingly, over Interval II, it is ambiguous whether the mandatory standard leads to a higher actual average quality than would be the case under the laissez fair. In fact, it would lead to a *lower* average quality if $\bar{\alpha}_{LF}' > \hat{\alpha}^U$ (or equivalently, $b/a > \bar{q}_2/\bar{q}_1$). Inversely, it would lead to higher average if $\bar{\alpha}_{LF}'' < \hat{\alpha}^U$. Over Interval III, the comparison of the average quality with and without standard is ambiguous too. As long as $\bar{\alpha}_{LF}' > \hat{\alpha}^U$ and $\hat{\alpha} < \bar{\alpha}_{LF}'$, imposing a mandatory standard would *lower* the average environmental quality relative to that under the laissez fair. Together with the similar effect over the interval II, this result cautions the regulator against selecting an environmental standard in the range of

$$[\alpha_2^*, \bar{\alpha}_{LF}'] = \left[\frac{a(r - A_2) - b(r - A_1)}{a^2 - b^2}, \frac{(\bar{q}_1 - \bar{q}_2)(a - b)r - (a\bar{q}_1 - b\bar{q}_2)A_1 + (b\bar{q}_1 - a\bar{q}_2)A_2}{(\bar{q}_1 + \bar{q}_2)(a^2 - b^2)} \right]$$

However, in Interval III, any standard level such that $\hat{\alpha} > \bar{\alpha}_{LF}' > \hat{\alpha}^U$ or $\hat{\alpha} > \hat{\alpha}^U > \bar{\alpha}_{LF}''$ would lead to a higher average environmental quality than would prevail under the laissez fair.

Thus, the behavior of the average environmental quality over Intervals I and II enables us to state the following proposition:

Proposition 7: *In a differentiated duopoly, (i) too weak standards will be overridden by the industry's voluntary quality choices, and (ii) for intermediate ranges of the standard, a mandatory standard can lower the average quality below the level that would be voluntarily*

offered by the industry without regulation.

Finally, regardless of the size of b/a and whether $\bar{q}_1 \gtrless \bar{q}_2$, any mandatory standard exceeding $\alpha_1^* = [a(r - A_1) - b(r - A_2)]/(a^2 - b^2)$ improves the average environmental quality relative to the quality under no standard at all. This explains situations where environmental pollution can be socially a serious problem necessitating sufficiently stringent standards that otherwise firms would not volunteer to adopt.

5. Conclusions

In a simple model of a differentiated duopoly industry, we have examined the effects of introducing a mandatory environmental quality standard on the firms' choices of the environmental quality of their products, the firms' profits, and the average environmental quality offered by the industry. We have shown that the effects depend on the degree to which the two products are strategic substitutes, on the firms' environmental costs differential, and critically on the level of the mandatory quality standard.

Specifically, we have shown that at too low standard levels both firms voluntarily overcomply, thus rendering the mandatory standard ineffective and implying that no standard can be better than too weak standards. Interestingly, and contrary to common intuition, we have shown that at the intermediate levels, the mandatory standard can benefit the *high-cost* firm and hurt the *low-cost* one and that it can also lower the average environmental quality offered by the industry. Thus, we have identified the conditions regarding the degrees of product differentiation, the industry's environmental costs differential, and, most importantly, the level of standard setting, under which the regulation of the industry by introducing a mandatory quality standard can result in some unintended effects. Besides alerting regulators to exercise caution in setting the standard level, our results can explain (i) why in situations where environmental quality and reputation of firms matter to consumers, the "greener" firms may prefer voluntary pollution control to a mandatory environmental regulation, and (ii) why environmental advocacy groups cry for strict environmental regulations, fearing that weak standards can alter the behavior of an

otherwise more environmental friendly firm (motivated, of course, to outcompete its rivals) to become less environmental friendly by becoming content with merely complying with the standard.

Obviously, our analysis and the results have been based on a simplified model of the industry, thus suggesting extensions and further research in several important respects. As a natural and straightforward extension, it would be interesting to see whether the main results derived here for a duopoly industry would significantly change if the model is generalized to a differentiated oligopoly. A more important extension will be to allow the environmental-brand producing firms to compete not only by environmental quality differentiation but also in output quantities. The interplay of the firms' quantity and quality strategies could lead to interesting equilibrium possibilities. For example, firms may choose to lower their market share but intensify their environmental quality differentiation or vice versa. Further more, in this paper we have restricted ourselves to a positive analysis of the response of the duopoly to a mandatory environmental standard. In an extension of the model, we introduce social welfare and investigate the regulator's trading off the social welfare gain from a more competitive market with that from a higher quality standard. In such a setting, we investigate the conditions under which the regulator may prefer a low-cost monopoly operating under a relatively high environmental quality to a duopoly industry surviving under a low standard. Another direction for further research would be to combine a model of heterogeneous consumers with different willingness to pay for environmental quality (along the work of Arora and Gangopadhyay (1995)) with the present model of environmental differentiation to examine situations in which each firm may produce both a low and a high quality product to attract both segments of the market, or one in which firms specialize either in low or in high quality product to appeal only to one segment of the market. Finally, of particular value will be to empirically test firms' environmental differentiation as implied by the present analysis.

Appendix 1. Firm 1's profit in Interval II

Firm 1's profit in Interval II, $\pi_{II}^{*1}(\hat{\alpha})$, is

$$\pi_{II}^{*1}(\hat{\alpha}) = \max_{\alpha_1 \geq \hat{\alpha}} \pi^1(\alpha_1; \hat{\alpha}) = \pi^1(\alpha_1(\hat{\alpha}), \hat{\alpha}) = \left(\frac{-1}{2} a \alpha_1(\hat{\alpha}) - b \hat{\alpha} + r - A_1 \right) \alpha_1(\hat{\alpha}). \quad (\text{A.1})$$

Applying the envelop theorem, we have

$$\frac{d\pi_{II}^{*1}(\hat{\alpha})}{d\hat{\alpha}} = \frac{\partial \pi^1(\alpha_1(\hat{\alpha}), \hat{\alpha})}{\partial \hat{\alpha}} = -b \alpha_1(\hat{\alpha}) < 0. \quad (\text{A.2})$$

That is, the low-cost firm 1's profit monotonically decreases as the standard is raised.

The minimum profit is attained at $\hat{\alpha} = \hat{\alpha}^U$. Since

$$\pi_{II}^{*1}(\hat{\alpha}^U) = \frac{a(r - A_1)}{a + b} \frac{\alpha_1(\hat{\alpha})}{2} > 0, \quad (\text{A.3})$$

we conclude that Firm 1's profit remains positive over Interval II.

Appendix 2. Firm 2's profit in Interval II

Interval II is defined as $[\alpha_2^*, \hat{\alpha}^U]$, where

$$\alpha_2^* = \frac{a(r - A_2) - b(r - A_1)}{a^2 - b^2},$$

and
$$\hat{\alpha}^U = \frac{r - A_1}{a + b} > \alpha_2^*$$

α_2^* is positive if and only if

$$\frac{b}{a} < \frac{r - A_2}{r - A_1} < 1. \quad (\text{A.4})$$

The firm 2's profit in Interval II, $\pi_{II}^{*2}(\hat{\alpha})$, is given by

$$\pi_{II}^{*2}(\hat{\alpha}) = \max_{\alpha_2 \geq \hat{\alpha}} \pi(\alpha_2; \alpha_1(\hat{\alpha})) = \pi^2(\hat{\alpha}, \alpha_1(\hat{\alpha})) = \left(\frac{-1}{2} a \hat{\alpha} - b \alpha_1(\hat{\alpha}) + r - A_2 \right) \hat{\alpha} \quad (\text{A.5})$$

By substituting $\alpha_1(\hat{\alpha}) = \frac{-b\hat{\alpha} + r - A_1}{a}$, we have

$$\pi_{II}^{*2}(\hat{\alpha}) = \frac{2b^2 - a^2}{2a} \hat{\alpha}^2 + \frac{a(r - A_2) - b(r - A_1)}{a} \hat{\alpha}. \quad (\text{A.6})$$

The second term on the right hand side is always positive by (A.4). Therefore, we have the following four cases:

$$\text{If } 2b^2 - a^2 \geq 0,$$

(Case A): $\pi_{II}^{*2}(\hat{\alpha}) > 0$ over Interval II. Furthermore, the profit is monotonically increasing in the standard ($d\pi_{II}^{*2}(\hat{\alpha})/d\hat{\alpha} > 0$).

If $2b^2 - a^2 < 0$, we classify the following three cases:

(Case B): $\pi_{II}^{*2}(\hat{\alpha}) > 0$ and $d\pi_{II}^{*2}(\hat{\alpha})/d\hat{\alpha} > 0$ over Interval II.

(Case C): $\pi_{II}^{*2}(\hat{\alpha}) > 0$ over Interval II. There is $\tilde{\alpha}$ in the interval such that

$$d\pi_{II}^{*2}(\hat{\alpha})/d\hat{\alpha} > (<)0 \text{ if } \hat{\alpha} < (>)\tilde{\alpha}.$$

(Case D): There is $\hat{\alpha}_{II}$ in the interval such that $\pi_{II}^{*2}(\hat{\alpha}) > 0$ if and only if $\alpha_2^* \leq \hat{\alpha} < \hat{\alpha}_{II}$. In this interval, there is $\tilde{\alpha}$ such that $d\pi_{II}^{*2}(\hat{\alpha})/d\hat{\alpha} > (<)0$ if $\hat{\alpha} < (>)\tilde{\alpha}$.

We next derive the conditions under which each of the four cases occurs. The condition for Case B is

$$0 \leq \frac{d\pi_{II}^{*2}(\hat{\alpha}^U)}{d\hat{\alpha}} = \frac{(a^2 + ab)(r - A_2) - (a^2 + ab - b^2)(r - A_1)}{a}. \quad (\text{A.7})$$

That is, Case B happens if

$$\frac{r - A_2}{r - A_1} \geq \frac{a^2 + ab - b^2}{a^2 + ab} > \frac{b}{a}. \quad (\text{A.8})$$

Notice that the last inequality in (A.8) is equivalent to $2b^2 - a^2 < 0$, which is the case we are considering.

The conditions for Case C are

$$\frac{a^2 + ab - b^2}{a^2 + ab} > \frac{r - A_2}{r - A_1} > \frac{b}{a}, \quad (\text{A.9})$$

and

$$\frac{r - A_2}{r - A_1} \geq \frac{a + 2b}{2(a + b)}. \quad (\text{A.10})$$

The latter condition follows from

$$0 \leq \pi_{II}^{*2}(\hat{\alpha}^U) = \left(\frac{2a(a + b)(r - A_2) - (a^2 + 2ab)(r - A_1)}{2(a + b)} \right) \frac{\hat{\alpha}^U}{a}. \quad (\text{A.11})$$

Putting (A.9) and (A.10) together, Case C occurs if

$$\frac{a^2 + ab - b^2}{a^2 + ab} > \frac{r - A_2}{r - A_1} \geq \frac{a + 2b}{2(a + b)} > \frac{b}{a}. \quad (\text{A.12})$$

Notice that the last inequality in (A.4) is equivalent to $2b^2 - a^2 < 0$, which holds for the case under consideration.

Finally, Case D happens if

$$\frac{a+2b}{2(a+b)} > \frac{r-A_2}{r-A_1} > \frac{b}{a}. \quad (\text{A.13})$$

$$\hat{\alpha}_{II} = \frac{a(r-A_2)-b(r-A_1)}{(1/2)a^2-b^2} \left(< \hat{\alpha}^U = \frac{r-A_1}{a+b} \text{ if } \frac{r-A_2}{r-A_1} < \frac{a+2b}{2(a+b)} \right) \quad (\text{A.14})$$

Appendix 3. Firms' profits in Interval III

In Interval III, firm i 's profit is

$$\pi_{III}^{*i}(\hat{\alpha}) = \max_{\alpha_i \geq \hat{\alpha}} \pi^i(\alpha_i; \hat{\alpha}) = -\frac{1}{2}a(\hat{\alpha})^2 - b(\hat{\alpha})^2 + (r-A_i)\hat{\alpha}, \quad \hat{\alpha} \geq \hat{\alpha}^U. \quad (\text{A.15})$$

Since $\pi_{III}^{*i}(\hat{\alpha})$ is a concave function,

$$\frac{d\pi_{III}^{*1}(\hat{\alpha}^U)}{d\hat{\alpha}} = -\frac{a+2b}{a+b}(r-A_1) + (r-A_1) = \frac{-b(r-A_1)}{a+b} < 0,$$

and

$$\frac{d\pi_{III}^{*2}(\hat{\alpha}^U)}{d\hat{\alpha}} = -\frac{a+2b}{a+b}(r-A_1) + (r-A_2) = \frac{(a+b)(r-A_2) - (a+2b)(r-A_1)}{a+b} \hat{\alpha}^U < 0,$$

imply that both firms' profits are monotonically decreasing over Interval III. Notice that before firm 1's profit goes to zero, the rival's profit has already dropped to zero, since $A_1 < A_2$.

For Firm 2 to be operative over Interval III its profit at the standard level $\hat{\alpha}^U$ has to be nonnegative:

$$\pi_{III}^{*2}(\hat{\alpha}^U) = \left[-\frac{a+2b}{2} \frac{r-A_1}{a+b} + (r-A_2) \right] \hat{\alpha}^U = \frac{2(a+b)(r-A_2) - (a+2b)(r-A_1)}{2(a+b)} \hat{\alpha}^U \geq 0.$$

Combining this condition with the positivity condition of α_2^* ((A.4)), we have

$$\frac{r-A_2}{r-A_1} \geq \max \left[\frac{a+2b}{2(a+b)}, \frac{b}{a} \right]. \quad (\text{A.16})$$

Under condition (A.16), there is a unique ceiling of the standard on Interval III, at which Firm 2's profit is zero. This ceiling, denoted by $\hat{\alpha}_{III}$, is given by

$$\hat{\alpha}_{III} = \frac{r-A_2}{(1/2)a+b} \left(\geq \hat{\alpha}^U = \frac{r-A_1}{a+b} \text{ if } \frac{r-A_2}{r-A_1} \geq \frac{a+2b}{2(a+b)} \right). \quad (\text{A.17})$$

References:

- Antona, W. R. Q., G. Deltasb and M. Khanna (2004), "Incentives for Environmental Self-regulation and Implications for Environmental Performance", *Journal of Environmental Economics and Management*, Vol. 48, Issue 1, 632-654.
- Arora, S. and S. Gangopadhyay (1995), "Toward a Theoretical Model of Voluntary Overcompliance", *Journal of Economic Behavior and Organization*, 28, 289-309.
- Dixit, A. (1979), "A Model of Duopoly Suggesting an Entry Barrier", *Bell Journal of Economics*, 10, 22-32.
- Dixit, A. (1986), "Comparative Statics for Oligopoly", *International Economic Review*, 27, 107-122.
- Farzin, Y. H. (2004), "Can Stricter Environmental Standards Benefit Industry and Enhance Welfare?", *Annales D'Economie et de Statistique*, Vol. 75-76, 223-255.
- Farzin, Y. H. (2003), "The Effects of Emissions Standards on Industry", *Journal of Regulatory Economics*, Vol. 24, No.3, 315-327.
- Heal, G. M., (2005), "Corporate Social Responsibility: An Economic and Financial Framework", *The Geneva Papers on Risk and Insurance: Issues and Practice*; 30 (3), 387-409.
- Hoffman, A. (1997), *From Heresy to Dogma: An Institutional History of Corporate Environmentalism*, New Lexington Press, San Francisco.
- Lutz, S., Lyon, T. P. and J. W. Maxwell (2000), "Quality Leadership When Regulatory Standards Are Forthcoming", *Journal of Industrial Economics*, Vol. 47, No.3, 331-347.
- Lyon, T. P. and J. W. Maxwell (2000), "Voluntary Approaches to Environmental Regulation", in Franzini, M. and A. Nicita (eds.), *Economic Institutions and Environmental Policy*, Ashgate Publishing, Aldershot.
- Maloney, M. T. and R. E. McCormick (1982), "A Positive Theory of Environmental Quality Regulation", *Journal of Law and Economics*, Vol. XXV, 99-123.
- McCormick, R. E. (1984), "The Strategic Use of Regulation: A Review of the Literature", in *The Political Economy of Regulation: Private Interests in the Regulatory Process*, R. A. Rogowsky and B. Yandle (Eds.), Federal Trade Commission, Washington D.C., (1984).
- Salop, S. C. and D. T. Scheffman (1983), "Raising Rivals' Costs", *American Economic Review*, Vol. 73, No. 2, 267-271.
- Salop, S. C. and D. T. Scheffman (1987), "Cost-raising Strategies", *Journal of Industrial Economics*, 36 (1): 19-34.
- Shy, O. (1995), *Industrial Organization*, MIT Press.
- Singh, N. and X. Vives (1984), "Price and Quantity Competition in a Differentiated Duopoly", *Rand Journal of Economics*, 15, 546-554.
- Videras, J. and A. Alberini (2000), "The Appeal of Voluntary Environmental Programs: Which Firms Participate and Why?", *Contemporary Economic Policy*, Vol. 18, No.4, 449-461.

NOTE DI LAVORO DELLA FONDAZIONE ENI ENRICO MATTEI

Fondazione Eni Enrico Mattei Working Paper Series

Our Note di Lavoro are available on the Internet at the following addresses:

<http://www.feem.it/Feem/Pub/Publications/WPapers/default.html>

<http://www.ssrn.com/link/feem.html>

<http://www.repec.org>

<http://agecon.lib.umn.edu>

NOTE DI LAVORO PUBLISHED IN 2006

SIEV	1.2006	<i>Anna ALBERINI</i> : <u>Determinants and Effects on Property Values of Participation in Voluntary Cleanup Programs: The Case of Colorado</u>
CCMP	2.2006	<i>Valentina BOSETTI, Carlo CARRARO and Marzio GALEOTTI</i> : <u>Stabilisation Targets, Technical Change and the Macroeconomic Costs of Climate Change Control</u>
CCMP	3.2006	<i>Roberto ROSON</i> : <u>Introducing Imperfect Competition in CGE Models: Technical Aspects and Implications</u>
KTHC	4.2006	<i>Sergio VERGALLI</i> : <u>The Role of Community in Migration Dynamics</u>
SIEV	5.2006	<i>Fabio GRAZI, Jeroen C.J.M. van den BERGH and Piet RIETVELD</i> : <u>Modeling Spatial Sustainability: Spatial Welfare Economics versus Ecological Footprint</u>
CCMP	6.2006	<i>Olivier DESCHENES and Michael GREENSTONE</i> : <u>The Economic Impacts of Climate Change: Evidence from Agricultural Profits and Random Fluctuations in Weather</u>
PRCG	7.2006	<i>Michele MORETTO and Paola VALBONESE</i> : <u>Firm Regulation and Profit-Sharing: A Real Option Approach</u>
SIEV	8.2006	<i>Anna ALBERINI and Aline CHIABAI</i> : <u>Discount Rates in Risk v. Money and Money v. Money Tradeoffs</u>
CTN	9.2006	<i>Jon X. EGUIA</i> : <u>United We Vote</u>
CTN	10.2006	<i>Shao CHIN SUNG and Dinko DIMITRO</i> : <u>A Taxonomy of Myopic Stability Concepts for Hedonic Games</u>
NRM	11.2006	<i>Fabio CERINA</i> (lxxviii): <u>Tourism Specialization and Sustainability: A Long-Run Policy Analysis</u>
NRM	12.2006	<i>Valentina BOSETTI, Mariaester CASSINELLI and Alessandro LANZA</i> (lxxviii): <u>Benchmarking in Tourism Destination, Keeping in Mind the Sustainable Paradigm</u>
CCMP	13.2006	<i>Jens HORBACH</i> : <u>Determinants of Environmental Innovation – New Evidence from German Panel Data Sources</u>
KTHC	14.2006	<i>Fabio SABATINI</i> : <u>Social Capital, Public Spending and the Quality of Economic Development: The Case of Italy</u>
KTHC	15.2006	<i>Fabio SABATINI</i> : <u>The Empirics of Social Capital and Economic Development: A Critical Perspective</u>
CSRM	16.2006	<i>Giuseppe DI VITA</i> : <u>Corruption, Exogenous Changes in Incentives and Deterrence</u>
CCMP	17.2006	<i>Rob B. DELLINK and Marjan W. HOFKES</i> : <u>The Timing of National Greenhouse Gas Emission Reductions in the Presence of Other Environmental Policies</u>
IEM	18.2006	<i>Philippe QUIRION</i> : <u>Distributional Impacts of Energy-Efficiency Certificates Vs. Taxes and Standards</u>
CTN	19.2006	<i>Somdeb LAHIRI</i> : <u>A Weak Bargaining Set for Contract Choice Problems</u>
CCMP	20.2006	<i>Massimiliano MAZZANTI and Roberto ZOBOLI</i> : <u>Examining the Factors Influencing Environmental Innovations</u>
SIEV	21.2006	<i>Y. Hossein FARZIN and Ken-ICHI AKAO</i> : <u>Non-pecuniary Work Incentive and Labor Supply</u>
CCMP	22.2006	<i>Marzio GALEOTTI, Matteo MANERA and Alessandro LANZA</i> : <u>On the Robustness of Robustness Checks of the Environmental Kuznets Curve</u>
NRM	23.2006	<i>Y. Hossein FARZIN and Ken-ICHI AKAO</i> : <u>When is it Optimal to Exhaust a Resource in a Finite Time?</u>
NRM	24.2006	<i>Y. Hossein FARZIN and Ken-ICHI AKAO</i> : <u>Non-pecuniary Value of Employment and Natural Resource Extinction</u>
SIEV	25.2006	<i>Lucia VERGANO and Paulo A.L.D. NUNES</i> : <u>Analysis and Evaluation of Ecosystem Resilience: An Economic Perspective</u>
SIEV	26.2006	<i>Danny CAMPBELL, W. George HUTCHINSON and Riccardo SCARPA</i> : <u>Using Discrete Choice Experiments to Derive Individual-Specific WTP Estimates for Landscape Improvements under Agri-Environmental Schemes: Evidence from the Rural Environment Protection Scheme in Ireland</u>
KTHC	27.2006	<i>Vincent M. OTTO, Timo KUOSMANEN and Ekko C. van IERLAND</i> : <u>Estimating Feedback Effect in Technical Change: A Frontier Approach</u>
CCMP	28.2006	<i>Giovanni BELLA</i> : <u>Uniqueness and Indeterminacy of Equilibria in a Model with Polluting Emissions</u>
IEM	29.2006	<i>Alessandro COLOGNI and Matteo MANERA</i> : <u>The Asymmetric Effects of Oil Shocks on Output Growth: A Markov-Switching Analysis for the G-7 Countries</u>
KTHC	30.2006	<i>Fabio SABATINI</i> : <u>Social Capital and Labour Productivity in Italy</u>
ETA	31.2006	<i>Andrea GALLICE</i> (lxxix): <u>Predicting one Shot Play in 2x2 Games Using Beliefs Based on Minimax Regret</u>
IEM	32.2006	<i>Andrea BIGANO and Paul SHEEHAN</i> : <u>Assessing the Risk of Oil Spills in the Mediterranean: the Case of the Route from the Black Sea to Italy</u>
NRM	33.2006	<i>Rinaldo BRAU and Davide CAO</i> (lxxviii): <u>Uncovering the Macrostructure of Tourists' Preferences. A Choice Experiment Analysis of Tourism Demand to Sardinia</u>
CTN	34.2006	<i>Parkash CHANDER and Henry TULKENS</i> : <u>Cooperation, Stability and Self-Enforcement in International Environmental Agreements: A Conceptual Discussion</u>
IEM	35.2006	<i>Valeria COSTANTINI and Salvatore MONNI</i> : <u>Environment, Human Development and Economic Growth</u>
ETA	36.2006	<i>Ariel RUBINSTEIN</i> (lxxix): <u>Instinctive and Cognitive Reasoning: A Study of Response Times</u>

ETA	37.2006	<i>Maria SALGADEO</i> (lxxx): <u>Choosing to Have Less Choice</u>
ETA	38.2006	<i>Justina A.V. FISCHER and Benno TORGLER</i> : <u>Does Envy Destroy Social Fundamentals? The Impact of Relative Income Position on Social Capital</u>
ETA	39.2006	<i>Benno TORGLER, Sascha L. SCHMIDT and Bruno S. FREY</i> : <u>Relative Income Position and Performance: An Empirical Panel Analysis</u>
CCMP	40.2006	<i>Alberto GAGO, Xavier LABANDEIRA, Fidel PICOS And Miguel RODRÍGUEZ</i> : <u>Taxing Tourism In Spain: Results and Recommendations</u>
IEM	41.2006	<i>Karl van BIERVLIET, Dirk Le ROY and Paulo A.L.D. NUNES</i> : <u>An Accidental Oil Spill Along the Belgian Coast: Results from a CV Study</u>
CCMP	42.2006	<i>Rolf GOLOMBEK and Michael HOEL</i> : <u>Endogenous Technology and Tradable Emission Quotas</u>
KTHC	43.2006	<i>Giulio CAINELLI and Donato IACOBUCCI</i> : <u>The Role of Agglomeration and Technology in Shaping Firm Strategy and Organization</u>
CCMP	44.2006	<i>Alvaro CALZADILLA, Francesco PAULI and Roberto ROSON</i> : <u>Climate Change and Extreme Events: An Assessment of Economic Implications</u>
SIEV	45.2006	<i>M.E. KRAGT, P.C. ROEBELING and A. RUIJS</i> : <u>Effects of Great Barrier Reef Degradation on Recreational Demand: A Contingent Behaviour Approach</u>
NRM	46.2006	<i>C. GIUPPONI, R. CAMERA, A. FASSIO, A. LASUT, J. MYSLIAK and A. SGOBBI</i> : <u>Network Analysis, Creative System Modelling and DecisionSupport: The NetSyMoD Approach</u>
KTHC	47.2006	<i>Walter F. LALICH</i> (lxxx): <u>Measurement and Spatial Effects of the Immigrant Created Cultural Diversity in Sydney</u>
KTHC	48.2006	<i>Elena PASPALANOVA</i> (lxxx): <u>Cultural Diversity Determining the Memory of a Controversial Social Event</u>
KTHC	49.2006	<i>Ugo GASPARINO, Barbara DEL CORPO and Dino PINELLI</i> (lxxx): <u>Perceived Diversity of Complex Environmental Systems: Multidimensional Measurement and Synthetic Indicators</u>
KTHC	50.2006	<i>Aleksandra HAUKE</i> (lxxx): <u>Impact of Cultural Differences on Knowledge Transfer in British, Hungarian and Polish Enterprises</u>
KTHC	51.2006	<i>Katherine MARQUAND FORSYTH and Vanja M. K. STENIUS</i> (lxxx): <u>The Challenges of Data Comparison and Varied European Concepts of Diversity</u>
KTHC	52.2006	<i>Gianmarco I.P. OTTAVIANO and Giovanni PERI</i> (lxxx): <u>Rethinking the Gains from Immigration: Theory and Evidence from the U.S.</u>
KTHC	53.2006	<i>Monica BARNI</i> (lxxx): <u>From Statistical to Geolinguistic Data: Mapping and Measuring Linguistic Diversity</u>
KTHC	54.2006	<i>Lucia TAJOLI and Lucia DE BENEDICTIS</i> (lxxx): <u>Economic Integration and Similarity in Trade Structures</u>
KTHC	55.2006	<i>Suzanna CHAN</i> (lxxx): <u>"God's Little Acre" and "Belfast Chinatown": Diversity and Ethnic Place Identity in Belfast</u>
KTHC	56.2006	<i>Diana PETKOVA</i> (lxxx): <u>Cultural Diversity in People's Attitudes and Perceptions</u>
KTHC	57.2006	<i>John J. BETANCUR</i> (lxxx): <u>From Outsiders to On-Paper Equals to Cultural Curiosities? The Trajectory of Diversity in the USA</u>
KTHC	58.2006	<i>Kiflemariam HAMDE</i> (lxxx): <u>Cultural Diversity A Glimpse Over the Current Debate in Sweden</u>
KTHC	59.2006	<i>Emilio GREGORI</i> (lxxx): <u>Indicators of Migrants' Socio-Professional Integration</u>
KTHC	60.2006	<i>Christa-Maria LERM HAYES</i> (lxxx): <u>Unity in Diversity Through Art? Joseph Beuys' Models of Cultural Dialogue</u>
KTHC	61.2006	<i>Sara VERTOMMEN and Albert MARTENS</i> (lxxx): <u>Ethnic Minorities Rewarded: Ethnostratification on the Wage Market in Belgium</u>
KTHC	62.2006	<i>Nicola GENOVESE and Maria Grazia LA SPADA</i> (lxxx): <u>Diversity and Pluralism: An Economist's View</u>
KTHC	63.2006	<i>Carla BAGNA</i> (lxxx): <u>Italian Schools and New Linguistic Minorities: Nationality Vs. Plurilingualism. Which Ways and Methodologies for Mapping these Contexts?</u>
KTHC	64.2006	<i>Vedran OMANOVIĆ</i> (lxxx): <u>Understanding "Diversity in Organizations" Paradigmatically and Methodologically</u>
KTHC	65.2006	<i>Mila PASPALANOVA</i> (lxxx): <u>Identifying and Assessing the Development of Populations of Undocumented Migrants: The Case of Undocumented Poles and Bulgarians in Brussels</u>
KTHC	66.2006	<i>Roberto ALZETTA</i> (lxxx): <u>Diversities in Diversity: Exploring Moroccan Migrants' Livelihood in Genoa</u>
KTHC	67.2006	<i>Monika SEDENKOVA and Jiri HORAK</i> (lxxx): <u>Multivariate and Multicriteria Evaluation of Labour Market Situation</u>
KTHC	68.2006	<i>Dirk JACOBS and Andrea REA</i> (lxxx): <u>Construction and Import of Ethnic Categorisations: "Allochthones" in The Netherlands and Belgium</u>
KTHC	69.2006	<i>Eric M. USLANER</i> (lxxx): <u>Does Diversity Drive Down Trust?</u>
KTHC	70.2006	<i>Paula MOTA SANTOS and João BORGES DE SOUSA</i> (lxxx): <u>Visibility & Invisibility of Communities in Urban Systems</u>
ETA	71.2006	<i>Rinaldo BRAU and Matteo LIPPI BRUNI</i> : <u>Eliciting the Demand for Long Term Care Coverage: A Discrete Choice Modelling Analysis</u>
CTN	72.2006	<i>Dinko DIMITROV and Claus-JOCHEN HAAKE</i> : <u>Coalition Formation in Simple Games: The Semistrict Core</u>
CTN	73.2006	<i>Ottorino CHILLEM, Benedetto GUI and Lorenzo ROCCO</i> : <u>On The Economic Value of Repeated Interactions Under Adverse Selection</u>
CTN	74.2006	<i>Sylvain BEAL and Nicolas QUÉROU</i> : <u>Bounded Rationality and Repeated Network Formation</u>
CTN	75.2006	<i>Sophie BADE, Guillaume HAERINGER and Ludovic RENOU</i> : <u>Bilateral Commitment</u>
CTN	76.2006	<i>Andranik TANGIAN</i> : <u>Evaluation of Parties and Coalitions After Parliamentary Elections</u>
CTN	77.2006	<i>Rudolf BERGHAMMER, Agnieszka RUSINOWSKA and Harrie de SWART</i> : <u>Applications of Relations and Graphs to Coalition Formation</u>
CTN	78.2006	<i>Paolo PIN</i> : <u>Eight Degrees of Separation</u>
CTN	79.2006	<i>Roland AMANN and Thomas GALL</i> : <u>How (not) to Choose Peers in Studying Groups</u>

CTN	80.2006	<i>Maria MONTERO</i> : <u>Inequity Aversion May Increase Inequity</u>
CCMP	81.2006	<i>Vincent M. OTTO, Andreas LÖSCHEL and John REILLY</i> : <u>Directed Technical Change and Climate Policy</u>
CSRM	82.2006	<i>Nicoletta FERRO</i> : <u>Riding the Waves of Reforms in Corporate Law, an Overview of Recent Improvements in Italian Corporate Codes of Conduct</u>
CTN	83.2006	<i>Siddhartha BANDYOPADHYAY and Mandar OAK</i> : <u>Coalition Governments in a Model of Parliamentary Democracy</u>
PRCG	84.2006	<i>Raphaël SOUBEYRAN</i> : <u>Valence Advantages and Public Goods Consumption: Does a Disadvantaged Candidate Choose an Extremist Position?</u>
CCMP	85.2006	<i>Eduardo L. GIMÉNEZ and Miguel RODRÍGUEZ</i> : <u>Pigou's Dividend versus Ramsey's Dividend in the Double Dividend Literature</u>
CCMP	86.2006	<i>Andrea BIGANO, Jacqueline M. HAMILTON and Richard S.J. TOL</i> : <u>The Impact of Climate Change on Domestic and International Tourism: A Simulation Study</u>
KTHC	87.2006	<i>Fabio SABATINI</i> : <u>Educational Qualification, Work Status and Entrepreneurship in Italy an Exploratory Analysis</u>
CCMP	88.2006	<i>Richard S.J. TOL</i> : <u>The Polluter Pays Principle and Cost-Benefit Analysis of Climate Change: An Application of Fund</u>
CCMP	89.2006	<i>Philippe TULKENS and Henry TULKENS</i> : <u>The White House and The Kyoto Protocol: Double Standards on Uncertainties and Their Consequences</u>
SIEV	90.2006	<i>Andrea M. LEITER and Gerald J. PRUCKNER</i> : <u>Proportionality of Willingness to Pay to Small Risk Changes – The Impact of Attitudinal Factors in Scope Tests</u>
PRCG	91.2006	<i>Raphaël SOUBEYRAN</i> : <u>When Inertia Generates Political Cycles</u>
CCMP	92.2006	<i>Alireza NAGHAVI</i> : <u>Can R&D-Inducing Green Tariffs Replace International Environmental Regulations?</u>
CCMP	93.2006	<i>Xavier PAUTREL</i> : <u>Reconsidering The Impact of Environment on Long-Run Growth When Pollution Influences Health and Agents Have Finite-Lifetime</u>
CCMP	94.2006	<i>Corrado Di MARIA and Edwin van der WERF</i> : <u>Carbon Leakage Revisited: Unilateral Climate Policy with Directed Technical Change</u>
CCMP	95.2006	<i>Paulo A.L.D. NUNES and Chiara M. TRAVISI</i> : <u>Comparing Tax and Tax Reallocations Payments in Financing Rail Noise Abatement Programs: Results from a CE valuation study in Italy</u>
CCMP	96.2006	<i>Timo KUOSMANEN and Mika KORTELAJINEN</i> : <u>Valuing Environmental Factors in Cost-Benefit Analysis Using Data Envelopment Analysis</u>
KTHC	97.2006	<i>Dermot LEAHY and Alireza NAGHAVI</i> : <u>Intellectual Property Rights and Entry into a Foreign Market: FDI vs. Joint Ventures</u>
CCMP	98.2006	<i>Inmaculada MARTÍNEZ-ZARZOSO, Aurelia BENGOCHEA-MORANCHO and Rafael MORALES LAGE</i> : <u>The Impact of Population on CO2 Emissions: Evidence from European Countries</u>
PRCG	99.2006	<i>Alberto CAVALIERE and Simona SCABROSETTI</i> : <u>Privatization and Efficiency: From Principals and Agents to Political Economy</u>
NRM	100.2006	<i>Khaled ABU-ZEID and Sameh AFIFI</i> : <u>Multi-Sectoral Uses of Water & Approaches to DSS in Water Management in the NOSTRUM Partner Countries of the Mediterranean</u>
NRM	101.2006	<i>Carlo GIUPPONI, Jaroslav MYSLAK and Jacopo CRIMI</i> : <u>Participatory Approach in Decision Making Processes for Water Resources Management in the Mediterranean Basin</u>
CCMP	102.2006	<i>Kerstin RONNEBERGER, Maria BERRITTELLA, Francesco BOSELLO and Richard S.J. TOL</i> : <u>Klum@Gtap: Introducing Biophysical Aspects of Land-Use Decisions Into a General Equilibrium Model A Coupling Experiment</u>
KTHC	103.2006	<i>Avner BEN-NER, Brian P. McCALL, Massoud STEPHANE, and Hua WANG</i> : <u>Identity and Self-Other Differentiation in Work and Giving Behaviors: Experimental Evidence</u>
SIEV	104.2006	<i>Aline CHIABAI and Paulo A.L.D. NUNES</i> : <u>Economic Valuation of Oceanographic Forecasting Services: A Cost-Benefit Exercise</u>
NRM	105.2006	<i>Paola MINOIA and Anna BRUSAROSCO</i> : <u>Water Infrastructures Facing Sustainable Development Challenges: Integrated Evaluation of Impacts of Dams on Regional Development in Morocco</u>
PRCG	106.2006	<i>Carmine GUERRIERO</i> : <u>Endogenous Price Mechanisms, Capture and Accountability Rules: Theory and Evidence</u>
CCMP	107.2006	<i>Richard S.J. TOL, Stephen W. PACALA and Robert SOCOLOW</i> : <u>Understanding Long-Term Energy Use and Carbon Dioxide Emissions in the Usa</u>
NRM	108.2006	<i>Carles MANERA and Jaume GARAU TABERNER</i> : <u>The Recent Evolution and Impact of Tourism in the Mediterranean: The Case of Island Regions, 1990-2002</u>
PRCG	109.2006	<i>Carmine GUERRIERO</i> : <u>Dependent Controllers and Regulation Policies: Theory and Evidence</u>
KTHC	110.2006	<i>John FOOT (lxxx)</i> : <u>Mapping Diversity in Milan. Historical Approaches to Urban Immigration</u>
KTHC	111.2006	<i>Donatella CALABI</i> : <u>Foreigners and the City: An Historiographical Exploration for the Early Modern Period</u>
IEM	112.2006	<i>Andrea BIGANO, Francesco BOSELLO and Giuseppe MARANO</i> : <u>Energy Demand and Temperature: A Dynamic Panel Analysis</u>
SIEV	113.2006	<i>Anna ALBERINI, Stefania TONIN, Margherita TURVANI and Aline CHIABAI</i> : <u>Paying for Permanence: Public Preferences for Contaminated Site Cleanup</u>
CCMP	114.2006	<i>Vivekananda MUKHERJEE and Dirk T.G. RÜBBELKE</i> : <u>Global Climate Change, Technology Transfer and Trade with Complete Specialization</u>
NRM	115.2006	<i>Clive LIPCHIN</i> : <u>A Future for the Dead Sea Basin: Water Culture among Israelis, Palestinians and Jordanians</u>
CCMP	116.2006	<i>Barbara BUCHNER, Carlo CARRARO and A. Denny ELLERMAN</i> : <u>The Allocation of European Union Allowances: Lessons, Unifying Themes and General Principles</u>
CCMP	117.2006	<i>Richard S.J. TOL</i> : <u>Carbon Dioxide Emission Scenarios for the Usa</u>

NRM	118.2006	<i>Isabel CORTÉS-JIMÉNEZ and Manuela PULINA: <u>A further step into the ELGH and TLGH for Spain and Italy</u></i>
SIEV	119.2006	<i>Beat HINTERMANN, Anna ALBERINI and Anil MARKANDYA: <u>Estimating the Value of Safety with Labor Market Data: Are the Results Trustworthy?</u></i>
SIEV	120.2006	<i>Elena STRUKOVA, Alexander GOLUB and Anil MARKANDYA: <u>Air Pollution Costs in Ukraine</u></i>
CCMP	121.2006	<i>Massimiliano MAZZANTI, Antonio MUSOLESI and Roberto ZOBOLI: <u>A Bayesian Approach to the Estimation of Environmental Kuznets Curves for CO₂ Emissions</u></i>
ETA	122.2006	<i>Jean-Marie GRETHER, Nicole A. MATHYS, and Jaime DE MELO: <u>Unraveling the World-Wide Pollution Haven Effect</u></i>
KTHC	123.2006	<i>Sergio VERGALLI: <u>Entry and Exit Strategies in Migration Dynamics</u></i>
PRCG	124.2006	<i>Bernardo BORTOLOTTI and Valentina MILELLA: <u>Privatization in Western Europe Stylized Facts, Outcomes and Open Issues</u></i>
SIEV	125.2006	<i>Pietro CARATTI, Ludovico FERRAGUTO and Chiara RIBOLDI: <u>Sustainable Development Data Availability on the Internet</u></i>
SIEV	126.2006	<i>S. SILVESTRI, M PELLIZZATO and V. BOATTO: <u>Fishing Across the Centuries: What Prospects for the Venice Lagoon?</u></i>
CTN	127.2006	<i>Alison WATTS: <u>Formation of Segregated and Integrated Groups</u></i>
SIEV	128.2006	<i>Danny CAMPBELL, W. George HUTCHINSON and Riccardo SCARPA: <u>Lexicographic Preferences in Discrete Choice Experiments: Consequences on Individual-Specific Willingness to Pay Estimates</u></i>
CCMP	129.2006	<i>Giovanni BELLA: <u>Transitional Dynamics Towards Sustainability: Reconsidering the EKC Hypothesis</u></i>
IEM	130.2006	<i>Elisa SCARPA and Matteo MANERA: <u>Pricing and Hedging Illiquid Energy Derivatives: an Application to the JCC Index</u></i>
PRCG	131.2006	<i>Andrea BELTRATTI and Bernardo BORTOLOTTI: <u>The Nontradable Share Reform in the Chinese Stock Market</u></i>
IEM	132.2006	<i>Alberto LONGO, Anil MARKANDYA and Marta PETRUCCI: <u>The Internalization of Externalities in The Production of Electricity: Willingness to Pay for the Attributes of a Policy for Renewable Energy</u></i>
ETA	133.2006	<i>Brighita BERCEA and Sonia OREFFICE: <u>Quality of Available Mates, Education and Intra-Household Bargaining Power</u></i>
KTHC	134.2006	<i>Antonia R. GURRIERI and Luca PETRUZZELLIS: <u>Local Networks to Compete in the Global Era. The Italian SMEs Experience</u></i>
CCMP	135.2006	<i>Andrea BIGANO, Francesco BOSELLO, Roberto ROSON and Richard S.J. TOL: <u>Economy-Wide Estimates of the Implications of Climate Change: A Joint Analysis for Sea Level Rise and Tourism</u></i>
CCMP	136.2006	<i>Richard S.J. TOL: <u>Why Worry About Climate Change? A Research Agenda</u></i>
SIEV	137.2006	<i>Anna ALBERINI, Alberto LONGO and Patrizia RIGANTI: <u>Using Surveys to Compare the Public's and Decisionmakers' Preferences for Urban Regeneration: The Venice Arsenale</u></i>
ETA	138.2006	<i>Y. Hossein FARZIN and Ken-Ichi AKAO: <u>Environmental Quality in a Differentiated Duopoly</u></i>

(lxxviii) This paper was presented at the Second International Conference on "Tourism and Sustainable Economic Development - Macro and Micro Economic Issues" jointly organised by CRENoS (Università di Cagliari and Sassari, Italy) and Fondazione Eni Enrico Mattei, Italy, and supported by the World Bank, Chia, Italy, 16-17 September 2005.

(lxxix) This paper was presented at the International Workshop on "Economic Theory and Experimental Economics" jointly organised by SET (Center for advanced Studies in Economic Theory, University of Milano-Bicocca) and Fondazione Eni Enrico Mattei, Italy, Milan, 20-23 November 2005. The Workshop was co-sponsored by CISEPS (Center for Interdisciplinary Studies in Economics and Social Sciences, University of Milan-Bicocca).

(lxxx) This paper was presented at the First EURODIV Conference "Understanding diversity: Mapping and measuring", held in Milan on 26-27 January 2006 and supported by the Marie Curie Series of Conferences "Cultural Diversity in Europe: a Series of Conferences.

2006 SERIES	
CCMP	<i>Climate Change Modelling and Policy</i> (Editor: Marzio Galeotti)
SIEV	<i>Sustainability Indicators and Environmental Valuation</i> (Editor: Anna Alberini)
NRM	<i>Natural Resources Management</i> (Editor: Carlo Giupponi)
KTHC	<i>Knowledge, Technology, Human Capital</i> (Editor: Gianmarco Ottaviano)
IEM	<i>International Energy Markets</i> (Editor: Matteo Manera)
CSR	<i>Corporate Social Responsibility and Sustainable Management</i> (Editor: Giulio Sapelli)
PRCG	<i>Privatisation Regulation Corporate Governance</i> (Editor: Bernardo Bortolotti)
ETA	<i>Economic Theory and Applications</i> (Editor: Carlo Carraro)
CTN	<i>Coalition Theory Network</i>