

Deissenberg, Christophe; Dawid, Herbert; Sevcik, Pavel

Working Paper

Cheap Talk, Gullibility, and Welfare in an Environmental Taxation Game

Nota di Lavoro, No. 137.2004

Provided in Cooperation with:

Fondazione Eni Enrico Mattei (FEEM)

Suggested Citation: Deissenberg, Christophe; Dawid, Herbert; Sevcik, Pavel (2004) : Cheap Talk, Gullibility, and Welfare in an Environmental Taxation Game, Nota di Lavoro, No. 137.2004, Fondazione Eni Enrico Mattei (FEEM), Milano

This Version is available at:

<https://hdl.handle.net/10419/118009>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

**Cheap Talk, Gullibility, and
Welfare in an Environmental
Taxation Game**

Herbert Dawid, Christophe Deissenberg
and Pavel Ševčík

NOTA DI LAVORO 137.2004

NOVEMBER 2004

ETA – Economic Theory and Applications

Herbert Dawid, *Department of Business Administration and Economics,
University of Bielefeld*
Christophe Deissenberg and Pavel Ševčík, *GREQAM and University of Aix-Marseille II*

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=615666>

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

Cheap Talk, Gullibility, and Welfare in an Environmental Taxation Game

Summary

We consider a simple dynamic model of environmental taxation that exhibits time inconsistency. There are two categories of firms, Believers, who take the tax announcements made by the Regulator to face value, and Non-Believers, who perfectly anticipate the Regulator's decisions, albeit at a cost. The proportion of Believers and Non-Believers changes over time depending on the relative profits of both groups. We show that the Regulator can use misleading tax announcements to steer the economy to an equilibrium that is Pareto superior to the solutions usually suggested in the literature. Depending upon the initial proportion of Believers, the Regulator may prefer a fast or a low speed of reaction of the firms to differences in Believers/Non-Believers profits.

Keywords: Environmental policy, Emissions taxes, Time inconsistency, Heterogeneous agents, Bounded rationality, Learning, Multiple equilibria, Stackelberg games

JEL Classification: H23, H3, Q5, C69, C79, D62

Address for correspondence:

Christophe Deissenberg
University of Aix-Marseille II
58, Bd Charles Livon
13284 Marseille Cedex 07
France
E-mail: deissenb@univ-aix.fr

1 Introduction

The use of taxes as a Regulatory instrument in environmental economics is a classic topic. In a nutshell, the need for regulation usually arises because producing causes detrimental emissions. Due to the lack of a proper market, the firms do not internalize the impact of these emissions on the utility of other agents. Thus, they take their decisions on the basis of prices that do not reflect the true social costs of their production. Taxes can be used to modify the prices confronting the firms so that the socially desirable decisions are taken.

The problem has been exhaustively investigated in static settings where there is no room for strategic interaction between the Regulator and the firms. Consider, however, the following situation: (a) The emission taxes have a dual effect, they incite the firms to reduce production *and* to undertake investments in abatement technology. This is typically the case when the emissions are increasing in the output and decreasing in the abatement technology; (b) Emission reduction is socially desirable, the reduction of production is not; and (c) The investments are irreversible. In that case, the Regulator must find an optimal compromise between implementing high taxes to motivate high investments, and keeping the taxes low to encourage production. The fact that the investments are irreversible introduces a strategic element in the problem. If the firms are naive and believe his announcements, the Regulator can insure high production *and* important investments by first declaring high taxes and reducing them once the corresponding investments have been realized. More sophisticated firms, however, recognize that the initially high taxes will not be implemented, and are reluctant to invest in the first place. In other words, one is confronted with a typical time inconsistency problem, which has been extensively treated in the monetary policy literature following Kydland and Prescott (1977) and Barro and Gordon (1983)). In environmental economics, the time inconsistency problem has received yet only limited attention, although it frequently occurs. See among others Gersbach and Glazer (1999) for a number of examples and for an interesting model, Abrego and Perroni (1999)), Batabyal (1996a)), Batabyal (1996b)), Dijkstra (2002)), Marsiliani and Renstr}om (2000)), Petrakis and Xepapadeas (2003)).

The time inconsistency is directly related to the fact that the situation described above defines a Stackelberg game between the Regulator (the leader) and the firms (the followers). As noted in the seminal work of Simaan and Cruz (1973a,b), inconsistency arises because the Stackelberg equilibrium is not defined by mutual best responses. It implies that the follower uses a best response in reaction the leader's action, but not that the leader's action is itself a best response to the follower's. This opens the door to a re-optimization by the leader once the follower has played. Thus, a Regulator who announces that he will implement the Stackelberg solution is not credible.

An usual conclusion is that, in the absence of additional mechanisms, the economy is doomed to converge towards the less desirable Nash

other agents. Thus, they take their decisions on the basis of prices that do not reflect the true social costs of their production. Taxes can be used to modify the prices confronting the firms so that the socially desirable decisions are taken.

The problem has been exhaustively investigated in static settings where there is no room for strategic interaction between the Regulator and the firms. Consider, however, the following situation: (a) The emission taxes have a dual effect, they incite the firms to reduce production *and* to undertake investments in abatement technology. This is typically the case when the emissions are increasing in the output and decreasing in the abatement technology; (b) Emission reduction is socially desirable, the reduction of production is not; and (c) The investments are irreversible. In that case, the Regulator must find an optimal compromise between implementing high taxes to motivate high investments, and keeping the taxes low to encourage production. The fact that the investments are irreversible introduces a strategic element in the problem. If the firms are naive and believe his announcements, the Regulator can insure high production *and* important investments by first declaring high taxes and reducing them once the corresponding investments have been realized. More sophisticated firms, however, recognize that the initially high taxes will not be implemented, and are reluctant to invest in the first place. In other words, one is confronted with a typical time inconsistency problem, which has been extensively treated in the monetary policy literature following Kydland and Prescott (1977) and Barro and Gordon (1983)). In environmental economics, the time inconsistency problem has received yet only limited attention, although it frequently occurs. See among others Gersbach and Glazer (1999) for a number of examples and for an interesting model, Abrego and Perroni (1999), Batabyal (1996a)), Batabyal (1996b)), Dijkstra (2002)), Marsiliani and Rensström (2000)), Petrakis and Xepapadeas (2003)).

The time inconsistency is directly related to the fact that the situation described above defines a Stackelberg game between the Regulator (the leader) and the firms (the followers). As noted in the seminal work of Simaan and Cruz (1973a,b), inconsistency arises because the Stackelberg equilibrium is not defined by mutual best responses. It implies that the follower uses a best response in reaction the leader's action, but not that the leader's action is itself a best response to the follower's. This opens the door to a re-optimization by the leader once the follower has played. Thus, a Regulator who announces that he will implement the Stackelberg solution is not credible. An usual conclusion is that, in the absence of additional mechanisms, the economy is doomed to converge towards the less desirable Nash

solution.

A number of options to insure credible solutions have been considered in the literature – credible binding commitments by the Stackelberg leader, reputation building, use of trigger strategies by the followers, etc. See McCallum (1997) for a review in a monetary policy context. Schematically, these solutions aim at assuring the time consistency of Stackelberg solution with either the Regulator or the firms as a leader. Usually, these solutions are not efficient and can be Pareto-improved.

In this paper, we suggest a new solution to the time inconsistency problem in environmental policy. We show that non-binding tax announcements can increase the payoff not only of the Regulator, but also of all firms, if these include any number of naive *Believers* who take the announcements at face value. Moreover, if firms tend to adopt the behavior of the most successful ones, a stable equilibrium may exist where a positive fraction of firms are Believers. This equilibrium Pareto-dominates the one where all firms anticipate perfectly the Regulator's action. To attain the superior equilibrium, the Regulator builds reputation and leadership by making announcements and implementing taxes in a way that generates good results for the Believers, rather than by pre-committing to his announcements.

This Pareto-superior equilibrium does not always exist. Depending upon the model parameters (most crucially: upon the speed with which the firms that follow different strategies react to differences in their respective profits, i.e., upon the *flexibility* of the firms) it may be rational for the Regulator to steer the Pareto-inferior fully rational equilibrium. This paper, thus, stresses the importance of the flexibility in explaining the policies followed by a Regulator, the welfare level realized, and the persistence or decay of private confidence in the Regulator's announcements.

The potential usefulness of employing misleading announcements to Pareto-improve upon standard game-theoretic equilibrium solutions was suggested for the case of general linear-quadratic dynamic games in Vallée et al. (1999) and developed by the same authors in subsequent papers. An early application to environmental economics is Vallée (1998). The Believers/Non-Believers dichotomy was introduced in Deissenberg and Alvarez Gonzalez (2002), who study the credibility problem in monetary economics in a discrete-time framework with reinforcement learning. A similar monetary policy problem has been investigated in Dawid and Deissenberg (2004) in a continuous-time setting akin to the one used in the present work.

The paper is organized as follows. In Section 2, we present the model of environmental taxation, introduce the imitation-type dynamics that determine the evolution of the number of Believers in the economy, and derive

the optimal reaction functions of the firms. In Section 3, we discuss the solution of the static problem one obtains by assuming a constant proportion of Believers. Section 4 is devoted to the analysis of the dynamic problem and to the presentation of the main results. Section 5 concludes.

2 The Model

We consider an economy consisting of a Regulator R and of a continuum of atomistic, profit-maximizing firms i with identical production technology. Time τ is continuous. To keep notation simple, we do not index the variables with either i or τ , unless useful for a better understanding.

In a nutshell, the situation we consider is the following. The Regulator can tax the firms in order to incite them to reduce their emissions. Taxes, however, have a negative impact on the employment. Thus, R has to choose them in order to achieve an optimal compromise between emissions reduction and employment. The following sequence of events occurs in every τ :

- R makes a non-binding announcement $t^a \geq 0$ about the tax level he will implement. The tax level is defined as the amount each firm has to pay per unit of its emissions.
- Given t^a , the firms form expectations t^e about the actual level of the environmental tax. As will be described in more detail later, there are two different ways for an individual firm to form its expectations. Each firm i decides about its level of emission reduction v_i based on its expectation t_i^e and makes the necessary investments.
- R chooses the actual level of tax $t \geq 0$.
- Each firm i produces a quantity x_i generating emissions $x_i - v_i$.
- The individual firms revise the way they form their expectations (that is, revise their beliefs) depending on the profits they have realized.

The Firms

Each firm produces the same homogenous good using a linear production technology: The production of x units of output requires x units of labor and generates x units of environmentally damaging emissions. The production costs are given by:

$$c(x) = wx + c_x x^2, \quad (1)$$

where x is the output, $w > 0$ the fixed wage rate, and $c_x > 0$ a parameter. For simplicity's sake, the demand is assumed infinitely elastic at the given price $\tilde{p} > w$. Let $p := \tilde{p} - w > 0$.

At each point of time, each firm can spend an additional amount of money γ in order to reduce its current emissions. The investment

$$\gamma(v) = c_v v^2, \quad (2)$$

with $c_v > 0$ a given parameter, is needed in order to reduce the firm's current emissions by $v \in [0, x]$. The investment in one period has no impact on the emissions in future periods. Rather than expenditures in emission-reducing capital, γ can therefore be interpreted as the additional costs resulting of a temporary switch to a cleaner resource – say, of a switch from coal to natural gas.

Depending on the way they form their expectations t^e , we consider two types of firms, Believers B and Non-Believers NB . The fraction of Believers in the population is denoted by $\pi \in [0, 1]$. Believers consider the Regulator's announcement to be truthful and set $t^e = t^a$. Non-Believers disregard the announcement and anticipate perfectly the actual tax level, $t^e = t$. Making perfect anticipations at any point of time, however, is costly. Thus, Non-Believers incur costs of $\delta > 0$ per unit of time.

The firms are profit-maximizers. As will become apparent in the following, one can assume without loss of substance that they are myopic, that is, maximize in every τ their current profit.

The Regulator R

The Regulator's goal is to maximize over an infinite horizon the cumulated discounted value of an objective function with the employment, the emissions, and the tax revenue as arguments. In order to realize this objective, it has two instruments at his disposal, the announced instantaneous tax level t^a , and the actually realized level t .

The objective function is given by:

$$\begin{aligned}
\Phi(t^a, t) &= \int_0^\infty e^{-\rho\tau} \phi(t^a, t) d\tau & (3) \\
&:= \int_0^\infty e^{-\rho\tau} \left[k(\pi x^b + (1-\pi)x^{nb}) - \kappa(\pi(x^b - v^b) \right. \\
&\quad \left. + (1-\pi)(x^{nb} - v^{nb})) + t(\pi(x^b - v^b) + (1-\pi)(x^{nb} - v^{nb})) \right] d\tau,
\end{aligned}$$

where x^b, x^{nb}, v^b, v^{nb} denote the optimal production respectively investment chosen by the Believers B and the Non-Believers NB , and where k and κ are strictly positive weights placed by R on the average employment respectively on the average emissions (remember that output and employment are in a one-to-one relationship in this economy). The strictly positive parameter ρ is a social discount factor.

Belief Dynamics

The firms' beliefs (B or NB) change according to a imitation-type dynamics, see Dawid (1999), Hofbauer and Sigmund (1998)). The firms meet randomly two-by-two, each pairing being equiprobable. At each encounter the firm with the lower current profit adopts the belief of the other firm with a probability proportional to the current difference between the individual profits. This gives rise to the dynamics:

$$\dot{\pi} = \beta\pi(1-\pi)(g^b - g^{nb}), \quad (4)$$

where g^b and g^{nb} denote the profits of a Believer and of a Non-Believer:

$$\begin{aligned}
g^b &= px^b - c_x(x^b)^2 - t(x^b - v^b) - c_v(v^b)^2, \\
g^{nb} &= px^{nb} - c_x(x^{nb})^2 - t(x^{nb} - v^{nb}) - c_v(v^{nb})^2 - \delta.
\end{aligned}$$

Notice that $\pi(1-\pi)$ reaches its maximum for $\pi = \frac{1}{2}$ (the value of π for which the probability of encounter between firms with different profits is maximized), and tends towards 0 for $\pi \rightarrow 0$ and $\pi \rightarrow 1$ (for extreme values of π , almost all firms have the same profits). The parameter $\beta \geq 0$, that depends on the adoption probability of the other's strategy may be interpreted as a measure of the willingness to change strategies, that is, of the flexibility of the firms.

Equation (4) implies that by choosing the value of (t^a, t) at time τ , the Regulator not only influences its instantaneous objective but also the future

proportion of B s in the economy. This, in turn, has an impact on the values of its objective function. Hence, although there are no explicit dynamics for the economic variables v and x , the R faces a non-trivial inter-temporal optimization problem.

Optimal Decisions of the Firms

Since the firms are atomistic, each single producer is too small to influence the dynamics of π . Thus, the single firm does not take into account any inter-temporal effect and, independently of its true planning horizon, *de facto* maximizes its current profit in every τ . Each firm chooses its investment v after it has learned t^a but *before* t has been made public. However, it fixes its production level x *after* v and t are known. The firms being price takers, the optimal production decision is:

$$x = \frac{p - t}{2c_x}. \quad (5)$$

The thus defined optimal x does not depend upon t^a , neither directly nor indirectly. As a consequence, both B s and NB s choose the same production level (5) as a function of the realized tax t alone, $x^b = x^{nb} = x$.

The profit of a firm given that an investment v has been realized is:

$$g(v; t) = \frac{(p - t)^2}{4c_x} + tv.$$

When the firms determine their investment v , the actual tax rate is not known. Therefore, they solve:

$$\max_v [g(v; t^e) - c_v v^2],$$

with $t^e = t$ if the firm is a NB and $t^e = t^a$ if the firm is a B . The interior solution to this problem is:

$$v^b = \frac{t^a}{2c_v}, \quad v^{nb} = \frac{t}{2c_v}. \quad (6)$$

The net emissions $x - v$ of any firm will remain non-negative after the investment, i.e., $v \in [0, x]$ will hold, if:

$$p \geq \frac{c_v + c_x}{c_v} \max[t, t^a]. \quad (7)$$

Given above expressions (5) for x and (6) for v , it is straightforward to see that the belief dynamics can be written as:

$$\dot{\pi} = \beta\pi(1 - \pi) \left(\frac{-(t^a - t)^2}{4c_v} + \delta \right). \quad (8)$$

The two effects that govern the evolution of π become now apparent. Large deviations of the realized tax level t from t^a induce a decrease in the stock of believers, whereas the stock of believers tends to grow if the cost δ necessary to form rational expectations is high.

Using (5) and (6), the instantaneous objective function ϕ of the Regulator becomes:

$$\phi(t^a, t) = (k - \kappa + t) \frac{p - t}{2c_x} + \frac{\kappa - t}{2c_v} (\pi t^a + (1 - \pi)t). \quad (9)$$

3 The static problem

In the model, there is only one source of dynamics, the beliefs updating (4). Before investigating the dynamic problem, it is instructive to cursorily consider the solution § of the static case in which R maximizes the integrand in (3) for a given value of π .

From (9), one recognizes easily that at the optimum t^a will either take its highest possible value or be zero, depending on whether $\kappa - t^{\S}$ is positive or negative. The case $\kappa - t^{\S} < 0$ corresponds to the uninteresting situation where the regulator values tax income more than emissions reduction and thus tries to increase the volume of emissions. We therefore restrict our analysis to the environmentally friendly case $t^{\S} < \kappa$. Note that (7) provides a natural upper bound \bar{t}^a for t , namely:

$$\bar{t}^a = \frac{pc_v}{c_v + c_x}. \quad (10)$$

Assuming that the optimal takes the upper value \bar{t}^a just defined (the choice of another bound is inconsequential for the qualitative results), the optimal tax t^{\S} is:

$$t^{\S} = \frac{1}{2} \left(\kappa + \bar{t}^a - \frac{c_v k}{c_v + c_x - c_x \pi} \right). \quad (11)$$

Note that t^{\S} is decreasing in π . (As π increases, the announcement t^a becomes a more powerful instrument, making a recourse to t less necessary). The requirement $\kappa > t^{\S}$ is fulfilled for all π iff:

$$c_v(k + \kappa - p) + c_x\kappa > 0. \quad (12)$$

In the remainder of this paper, we assume that (12) holds.

Turning to the firms profits, one recognizes the difference $g^{nb} - g^b$ between the *NB*'s and *B*'s profits is increasing in $|t^{\$} - t^{a\$}|$:

$$g^{nb} - g^b = \frac{(t^{\$} - t^{a\$})^2}{4c_v} - \delta. \quad (13)$$

For $\delta = 0$, the profit of the *NBs* is always higher than the profit of the *Bs* whenever $t^a \neq t$, reflecting the fact the latter make a systematic error about the true value of t . The profit of the *Bs*, however, can exceed the one of the *NBs* if the learning cost δ is high enough. Since $t^{a\$}$ is constant and $t^{\$}$ decreasing in π , and since $t^{\$} < t^{a\$}$, the difference $t^{a\$} - t^{\$}$ increases in π . Therefore, the difference between the profits of the *NBs* and *Bs*, (13), is increasing in π .

Further analytical insights are exceedingly cumbersome to present due to the complexity of the functions involved. We therefore illustrate a remarkable, generic feature of the solution with the help of Figure 1¹. Not only the Regulator's utility ϕ increases with π , so do also the profits of the *Bs* and *NBs*. For $\pi = 0$, the outcome is the Nash solution of a game between the *NBs* and the Regulator. This outcome is not efficient, leaving room for Pareto-improvement. As π increases, the *Bs* enjoy the benefits of a decreasing t , while their investment remains fixed at $v(\bar{t}^a)$. Likewise, the *NBs* benefit from the decrease in taxation. The lowering of the taxation is made rational by the existence of the Believers, who are led by the *R*'s announcements to invest more than they would otherwise, and to subsequently emit less. Accordingly, the marginal tax income goes down as π increases and therefore *R* is induced to reduce taxation if the proportion of believers goes up.

The only motive that could lead *R* to reduce the spread between t and t^a , and in particular to choose $t^a < \bar{t}^a$, lies in the impact of the tax announcements on the beliefs dynamics. Ceteris paribus, *R* prefers a high proportion of *Bs* to a low one, since it has one more instrument (that is, t^a) to influence the *Bs* than to control the *NBs*. A high spread $t^a - t$, however, implies that the profits of the *Bs* will be low compared to those of the *NBs*. This, by (4), reduces the value of $\hat{\pi}$ and leads over time to a lower proportion of *Bs*,

¹The parameter values underlying the figure are $c_v = 5$, $c_x = 3$, $\delta = 0$, $p = 6$, $k = 4$, $\kappa = 3$. The figure is qualitatively robust with respect to changes in these values.

diminishing the instantaneous utility of R . Therefore, in the dynamic problem, R will have to find an optimal compromise between choosing a high value of t^a , which allows a low value of t and insures the Regulator a high instantaneous utility, and choosing a lower one, leading to a more favorable proportion of B s in the future.

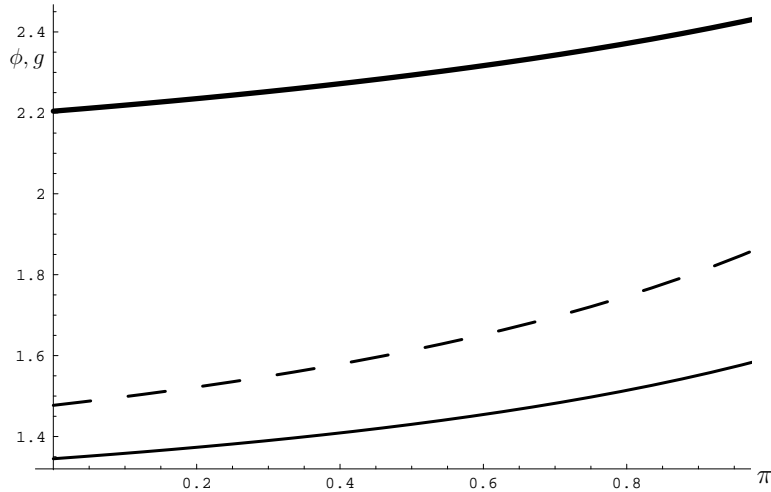


Figure 1: Profits of the believers (solid line), of the non-believers (dashed line), and Regulator's utility (bold-line) as a function of π .

4 Dynamic Analysis

4.1 Characterization of the optimal paths

As pointed out earlier, the Regulator faces a dynamic optimization problem because of the effect of his current action on the future stock of believers. This problem is given by:

$$\max_{0 \leq t^a(\tau), t(\tau)} \Phi(t^a, t) \quad \text{subject to (8).}$$

The Hamiltonian of the problem is given by:

$$\begin{aligned} H(t^a, t, \pi, \lambda) &= (k - \kappa + t) \frac{p - t}{2c_x} + \frac{\kappa - t}{2c_v} (\pi t^a + (1 - \pi)t) \\ &\quad + \lambda \beta \pi (1 - \pi) \left(-\frac{1}{4c_v} (t^a - t)^2 + \delta \right), \end{aligned}$$

where λ denotes the co-state variable. The Hamiltonian is concave in (t, t^a) iff:

$$2\lambda\beta(1-\pi)(c_v + c_x) - \pi c_x > 0. \quad (14)$$

The optimal controls t^* are then given by:

$$t^*(\pi, \lambda) = \frac{\lambda\beta(1-\pi)(c_v(\hat{p} - k + \kappa) + c_x\kappa) - c_x\kappa\pi}{2\lambda\beta(1-\pi)(c_v + c_x) - c_x\pi} \quad (15)$$

$$t^{a*}(\pi, \lambda) = \frac{1}{2\lambda\beta(1-\pi)(c_v + c_x) - c_x\pi} [c_x\kappa(1-\pi) + \lambda\beta(1-\pi)(c_v(\hat{p} - k + \kappa) + c_x\kappa) - c_v(\hat{p} - k - \kappa)] \quad (16)$$

Otherwise, there are no interior optimal controls. In what follows we assume that (14) is satisfied along the optimal path. It can be easily checked that this is the case at the equilibrium discussed below.

The difference between the optimal announced and realized tax levels is given by:

$$t^{a*} - t^* = \frac{\kappa - t^*}{\lambda\beta(1-\pi)}. \quad (17)$$

Hence the optimal announced tax exceeds the realized one if and only if $t^* < \kappa$. As in the static case, we restrict the analysis to the environmentally friendly case $t^* < \kappa$ and assume that (12) holds.

According to Pontriagins' Maximum Principle, an optimal solution $(\pi(\tau), \lambda(\tau))$ has to satisfy the state dynamics (8) plus:

$$\dot{\lambda} = \rho\lambda - \frac{\partial H(t^{a*}(\pi, \lambda), t^*(\pi, \lambda), \pi, \lambda)}{\partial \pi}, \quad (18)$$

$$\lim_{\tau \rightarrow \infty} e^{-\rho\tau} \lambda(\tau) = 0. \quad (19)$$

In our case the co-state dynamics are given by:

$$\dot{\lambda} = \rho\lambda - \frac{\kappa - t}{2c_v}(t^a - t) - \lambda\beta(1-2\pi) \left(-\frac{1}{4c_v}(t^a - t)^2 + \delta \right). \quad (20)$$

In order to analyze the long run behavior of the system we now provide a characterization of the steady states for different values of the public flexibility parameter β . Due to the structure of the state dynamics there are always trivial steady states for $\pi = 0$ and $\pi = 1$. For $\pi = 0$ the announcement is irrelevant. Its optimal value is therefore indeterminate. The optimal tax level is $t = \kappa$. For $\pi = 1$, the concavity condition (14) is violated

and the optimal controls are like in the static case. In the following, we restrict our attention to $\pi < 1$. In Proposition 1, we first show under which conditions there exists an interior steady state where Believers coexist with Non-Believers. Furthermore, we discuss the stability of the steady states.

Proposition 1 *Steady states and their stability:*

(i) For $0 < \beta \leq \frac{\rho}{2\delta}$ there exists no interior steady state. The steady state at $\pi = 0$ is stable.

(ii) For $\beta > \frac{\rho}{2\delta}$ there exists a unique stable interior steady state π^+ with:

$$\pi^+ = 1 - \frac{\rho}{2\beta\delta}. \quad (21)$$

The steady state at $\pi = 0$ is unstable.

Proof: We prove the existence and the stability of the interior steady state. The claims about the boundary steady state at $\pi = 0$ follow directly.

Equation (8) implies that, in order for $\dot{\pi} = 0$, to hold one must have:

$$(t^{a*} - t^*)^2 = 4c_v\delta. \quad (22)$$

That is, taking into account (17):

$$t^* = \kappa - 2\lambda^+\beta(1 - \pi^+)\sqrt{c_v\delta}. \quad (23)$$

Equation (22) implies that $\dot{\lambda} = 0$ is satisfied iff:

$$\rho\lambda - \frac{\kappa - t^*}{2c_v}(t^{a*} - t^*) = 0. \quad (24)$$

Using (17) for $t^{a*} - t^*$ in (24) we obtain the condition:

$$t^* = \kappa - \sqrt{2\rho\beta(1 - \pi^+)c_v}. \quad (25)$$

Combining (23) and (25) shows that

$$2\lambda^+\beta(1 - \pi^+)\sqrt{c_v\delta} = \sqrt{2\rho\beta(1 - \pi^+)c_v}$$

must hold at an interior steady state. This condition is equivalent to (21). For $\beta \leq \frac{\rho}{2\delta}$, (21) becomes smaller or equal zero. Therefore, an interior steady state is only possible for $\beta > \frac{\rho}{2\delta}$.

Using (21, 15, 23), one obtains for the value of the co-state at the steady state:

$$\lambda^+ = \frac{\delta\beta(c_x(2\sqrt{c_v\delta} + \kappa) + c_v(k + \kappa - p)) - \rho c_x\sqrt{c_v\delta}}{2\rho\beta\sqrt{c_v\delta}(c_v + c_x)}. \quad (26)$$

To determine the stability of the interior steady state we investigate the Jacobian matrix J of the canonical system (8, 20) at the steady state. The eigenvalues of J are given by:

$$e_{1,2} = \frac{\text{tr}(J) \pm \sqrt{\text{tr}(J)^2 - 4\det(J)}}{2}.$$

Therefore, the steady state is saddle point stable if and only if the determinant of J is negative. Inserting (15, 16) into the canonical system (8, 20), taking the derivatives with respect to (π, λ) and then inserting (21, 26) gives the matrix J . Tedious calculations show that its determinant is given by:

$$\det(j) = C \left(-\sqrt{\delta\beta}(c_v(k + \kappa - p) + c_x\kappa) - c_x\sqrt{c_v}(2\beta\delta - \rho) \right),$$

where C is a positive constant. The first of the two terms in the bracket is negative due to the assumption (12), the second is negative whenever $\beta > \frac{\rho}{2\delta}$. Hence, $\det(J) < 0$ whenever an interior steady state exists, implying that the interior steady state is always stable. For $\beta = \frac{\rho}{2\delta}$ this stable steady state collides with the unstable one at $\pi = 0$. The steady state at $\pi = 0$ therefore becomes stable for $\beta \leq \frac{\rho}{2\delta}$. \square

Since there is always only one stable steady state and since cycles are impossible in a control problem with a one-dimensional state, we can conclude from Proposition 1 that the stable steady state is always a global attractor. Convergence to the unique steady state is always monotone. The long run fraction of believers in the population is independent from the original level of trust. From (21) one recognizes that it decreases with ρ . An impatient Regulator will not attempt to build up a large proportion of B s since the time and efforts needed now for an additional increase of π weighs heavily compared to the future benefits. By contrast, π^+ is increasing in β and δ . A high flexibility β of the firms means that the cumulated loss of potential utility occurred by the Regulator *en route* to π^+ will be small and easily compensated by the gains in the vicinity of and at π^+ . Reinforcing this, the Regulator does not have to make B s much better off than N Bs in order to insure a fast reaction. As a result, for β large, the equilibrium π^+ is characterized by a large proportion of B s and provide high profits respectively

utility to all players. A high learning cost δ means that the Regulator can make the B s better off than the NB s at low or no cost, implying again a high value of π at the steady state.

Note that it is never optimal for the Regulator to follow a policy that would ultimately insure that all firms are Believers, $\pi^+ = 1$. There are two concurrent reasons for that. On the one hand, as π increases, the Regulator has to deviate more and more from the statically optimal solution $t^{a^s}(\pi)$, $t^s(\pi)$ to make believing more profitable than non-believing. On the other hand, the beliefs dynamics slow down. Thus, the discounted benefits from increasing π decrease.

For $\rho = 0.8$, $c_v = 5$, $c_x = 3$, $\delta = 0.15$, $p = 6$, $k = 4$, $\kappa = 3$ e.g., the profits and utility at the steady state $\pi^+ = 0.733333$ are $g^b = g^{nb} = 1.43785$, $\phi = 2.33043$. This steady state Pareto-dominates the fully rational equilibrium with $\pi = 0$, where $g^{nb} = 1.32708$, $\phi = 2.30844$. It also dominates the equilibrium attained when the belief dynamics (8) holds but the Regulator maximizes in each period his instantaneous utility ϕ instead of Φ . At this last equilibrium, $\pi = 0.21036$, $g^b = g^{nb} = 1.375$, $\phi = 2.23689$. Note that the last two equilibria cannot be compared, since the latter provides a higher profit to the firms but a lower utility to the Regulator.

This ranking of equilibria is robust with respect to parameter variations. A clear message emerges. As we contended at the beginning of this paper the suggested solution Pareto-improves on the static Nash equilibrium. This solution implies both a beliefs dynamics among the firms and a farsighted Regulator. A farsighted Regulator without beliefs dynamics is pointless. Beliefs dynamics with a myopic Regulator lead to a more modest Pareto-improvement. But it is the combination of beliefs dynamics and farsightedness that Pareto-dominates all other solutions.

4.2 The Influence of Public Flexibility

An interesting question is whether the Regulator would prefer a population that reacts quickly to profit differences, shifting from Believing to Non-Believing or vice versa in a short time, or if it would prefer a less reactive population. In other words, would the Regulator prefer a high or a low value of β ?

From Proposition 1 we know that the long run fraction of Believers is given by:

$$\pi^+ = \max \left[0, 1 - \frac{\rho}{2\beta\delta} \right].$$

A minimum level $\beta > \frac{\rho}{2\delta}$ of flexibility is necessary for the system to converge

towards an interior steady state with a positive fraction of B s. For β greater than $\frac{\rho}{2\delta}$, the fraction of B s at the steady state increases with β , converging towards $\pi = 1$ as β goes to infinity. One might think that, since the Regulator always prefers a high proportion of B s at equilibrium, he would also prefer a high value of β . Stated in a more formal manner, one might expect that the value function of the Regulator, $V^R(\pi_0)$, increases with β regardless of π_0 . This, however, is not the case. The dependence of $V^R(\pi_0)$ on β is non-monotone and depends crucially on π_0 . An analytical characterization of $V^R(\pi_0)$ being impossible, we use a numerical example to illustrate that point. The results are very robust with respect to parameter variations.

Figure 2 shows the steady state value $\pi^+ = \pi^+(\beta)$ of π for $\beta \in [1, 30]$. Figure 3 compares² $V^R(0.2)$ and $V^R(0.8)$ for the same values of β . The other parameter values are as before $\rho = 0.8$, $c_v = 5$, $c_x = 3$, $\delta = 0.15$, $p = 6$, $k = 4$, $\kappa = 3$ in both cases.

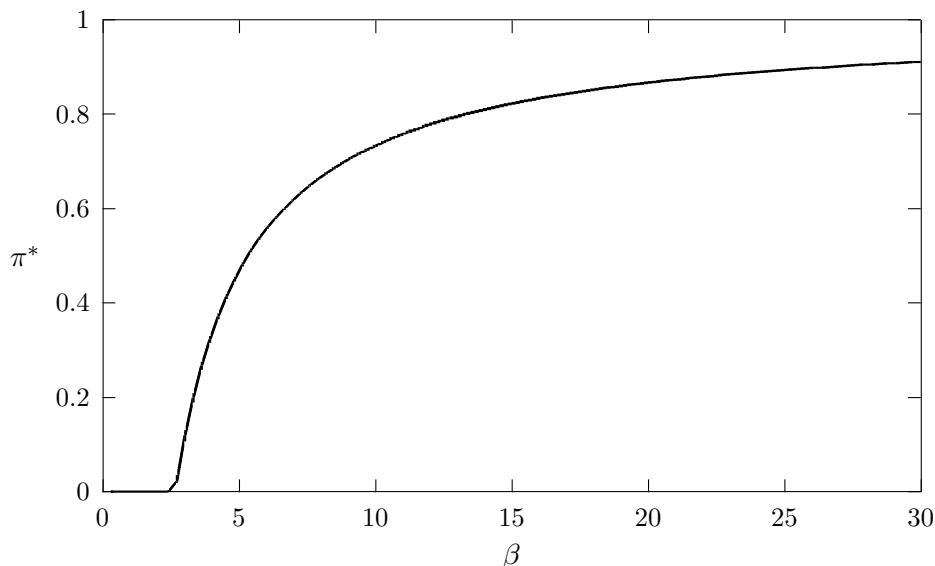


Figure 2: The proportion believers at the steady state for $\beta \in [1, 30]$.

Figure 3 reveals that one always has $V^R(0.8) > V^R(0.2)$, reflecting the

²The numerical calculations underlying this figure were carried out using a powerful proprietary computer program for the treatment of optimal control problems graciously provided by Lars Grüne, whose support is most gratefully acknowledged. See Grüne and Semmler (2002).

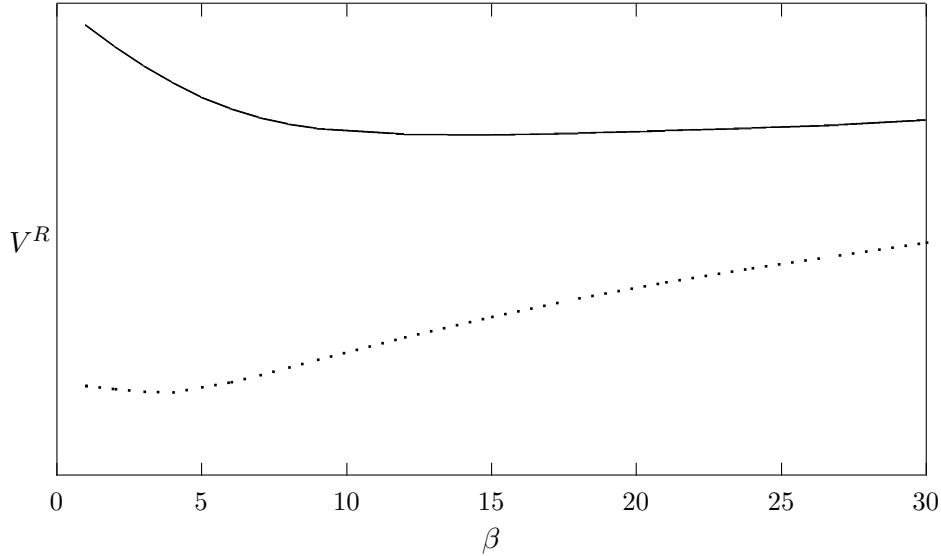


Figure 3: The value function of the Regulator for $\pi = 0.2$ (dotted line) and $\pi = 0.8$ (solid line) for $\beta \in [1, 30]$.

general result that $V^R(\pi_0)$ is increasing in π_0 for any β . Both value functions are not monotone in β but U-shaped. Combining Figure 2 and Figure 3 shows that the minimum of $V^R(\pi_0)$ is always attained for the value of β at which the steady state value $\pi^+(\beta)$ coincides with the initial fraction of Believers π_0 . This result is quite intuitive. If $\pi^+(\beta) < \pi_0$, it is optimal for the Regulator to reduce π over time. The Regulator does it by announcing a tax t^a much greater than the tax t he will implement, making the B s worse off than the N Bs, but also increasing his own instantaneous benefits ϕ . Thus, R prefers that the convergence towards the steady state be as slow as possible. That is, V^R is decreasing in β . On the other hand, if $\pi^+ > \pi_0$, it is optimal for R to increase π over time. To do so, he must follow a policy that makes the B s better off than the N Bs, but this is costly in terms of his instantaneous objective function ϕ . It is therefore better for R if the firms react fast to the profit difference. The value function V^R increases with β . Summarizing, the Regulator prefers (depending on π_0) to be confronted with *either* very flexible *or* very inflexible firms. In-between values of β provide him smaller discounted benefit streams.

Whether a low or a high flexibility is preferable for R depends on the

initial fraction π_0 of Believers. Our numerical analysis suggests that a Regulator facing a small π_0 prefer large values of β , whereas he prefers a low value of β when π_0 is large. This result may follow from the specific functional form used in the model rather than reflect any fundamental property of the solution.

If $\beta = 0$, the proportion of B s remains fixed over time at π_0 – any initial value of $\pi_0 \in (0, 1)$ corresponds to a stable equilibrium. The Pareto-improving character of the inner equilibrium then disappears. Given $\beta = 0$, condition (14) is violated. The Regulator can announce any tax level without having to fear negative long term consequences. Thus, it is in his interest to exploit the gullibility of the B s to the maximum. To obtain a meaningful, Pareto-improving solution, some flexibility is necessary that assures that the firms are not kept captive of beliefs that penalize them. Only then will the Regulator be led to take into account the B s interest.

5 Conclusions

The starting point of this paper is a situation frequently encountered in environmental economics (and similarly in other economic contexts as well): If all firms are perfectly rational Non-Believers who make perfect predictions of the Regulator's actions and discard the Regulators announcements as cheap talk, standard optimizing behavior leads to a Pareto-inferior outcome, although there are no conflicts of interest between the different firms and although the objectives of the firms and of the Regulator largely concur. We show that, in a static world, the existence of a positive fraction of Believers who take the Regulator's announcement at face value Pareto-improves the economic outcome. This property crucially hinges on the fact that the firms are atomistic and thus do not anticipate the collective impact of their individual decisions.

The static model is extended by assuming that the proportion of Believers and Non-Believers changes over time depending on the difference in the profits made by the two types of firms. The Regulator is assumed to recognize his ability to influence the evolution of the proportion of Believers by his choice of announced and realized taxes, and to be interested not only in his instantaneous but also in his future utility. It is shown that a rational Regulator will never steer the economy towards a Pareto-optimal equilibrium. However, his optimal policy may lead to a stable steady state with a strictly positive proportion of Believers that is Pareto-superior to the equilibrium where all agents perfectly anticipate his actions. Prereq-

uisites therefore are a sufficiently patient Regulator and firms that occur sufficiently high costs for building perfect anticipations of the government actions and/or are suitably flexible, i.e., switch adequately fast between Believing and Non-Believing. The conjunction of beliefs dynamics for the firms *and* of a farsighted Regulator allows for a larger Pareto-improvement than either only beliefs dynamics or only farsightedness. Depending upon the initial proportion of Believers, the Regulator is better off if the firms are very flexible or very inflexible. Intermediate values of the flexibility parameter are never optimal for the Regulator.

References

- Abrego, L. and Perroni, C. *Investment Subsidies and Time-Consistent Environmental Policy*. Discussion paper, University of Warwick, U.K., 1999.
- Barro, R. and D. Gordon. Rules, discretion and reputation in a model of monetary policy. *Journal of Monetary Economics*, 12:101–122, 1983.
- Batabyal, A. Consistency and optimality in a dynamic game of pollution control I: Competition. *Environmental and Resource Economics*, 8:205–220, 1996.
- Batabyal, A. Consistency and optimality in a dynamic game of pollution control II: Monopoly. *Environmental and Resource Economics*, 8:315–330, 1996.
- Biglaiser, G., Horowitz, J., and Quiggin, J. Dynamic pollution regulation. *Journal of Regulatory Economics*, 8:33–44, 1995.
- Dawid, H. On the Dynamics of Word of Mouth Learning with and without Anticipations. *Annals of Operations Research*, 89:273 - 295, 1999.
- Dawid, H. and Deissenberg, C. On the Efficiency-Effects of Private (Dis-)Trust in the Government. Forthcoming, *Journal of Economic Behavior and Organization*, 2004.
- Deissenberg, C. and Alvarez Gonzalez, F. Pareto-improving cheating in a monetary policy game. *Journal of Economic Dynamics and Control*, 26:1457–1479, 2002.
- Dijkstra, B. *Time Consistency and Investment Incentives in Environmental Policy*. Discussion paper 02/12, School of Economics, University of Nottingham, U.K., 2002.

- Gersbach, H., and Glazer, A. (1999). Markets and Regulatory Hold-Up Problems. *Journal of Environmental Economics and Management*, 37:151-64, 1999.
- Grüne, L., and Semmler, W. *Using dynamic programming with adaptive grid scheme for optimal control problems in economics*. Working paper, Center for Empirical Macroeconomics, University of Bielefeld, Germany, 2002. Forthcoming, *Journal of Economic Dynamics and Control*.
- Hofbauer, J. and Sigmund, K. *Evolutionary Games and Population Dynamics*, Cambridge University Press, 1998.
- Kydland, F. and Prescott, E. Rules Rather than Discretion: the Inconsistency of Optimal Plans. *Journal of Political Economy* 85:473-491, 1977.
- McCallum, B. Critical issues concerning central bank independence. *Journal of Monetary Economics*, 39:99-112, 1997.
- Marsiliani, L. and Renström, T. Time inconsistency in environmental policy: tax earmarking as a commitment solution. *Economic Journal*, 110:C123–C138, 2000.
- Petrakis, E. and Xepapadeas, A. Location Decisions of a Polluting Firm and the Time Consistency of Environmental Policy. *Resource and Energy Economics*, 25:197-214, 2003.
- Simaan, M. and Cruz, J.B. On the Stackelberg strategy in nonzero-sum games. *Journal of Optimization Theory and Applications*, 11:533–555, 1973a.
- Simaan, M. and Cruz, J.B. Additional aspects of the Stackelberg strategy in nonzero-sum games. *Journal of Optimization Theory and Applications*, 11:613–626, 1973b.
- Vallée, T., Deissenberg, C. and Başar, T. Optimal open loop cheating in dynamic reversed Linear-Quadratic Stackelberg games. *Annals of Operations Research* 88:247-266, 1999.
- Vallée, T. (1998), Comparison of different Stackelberg solutions in a deterministic dynamic pollution control problem, Discussion Paper, LEN-C3E, University of Nantes, France, 1998.

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>

NOTE DI LAVORO PUBLISHED IN 2003

PRIV	1.2003	<i>Gabriella CHIESA and Giovanna NICODANO: <u>Privatization and Financial Market Development: Theoretical Issues</u></i>
PRIV	2.2003	<i>Ibolya SCHINDELE: <u>Theory of Privatization in Eastern Europe: Literature Review</u></i>
PRIV	3.2003	<i>Wietze LISE, Claudia KEMFERT and Richard S.J. TOL: <u>Strategic Action in the Liberalised German Electricity Market</u></i>
CLIM	4.2003	<i>Laura MARSILIANI and Thomas I. RENSTRÖM: <u>Environmental Policy and Capital Movements: The Role of Government Commitment</u></i>
KNOW	5.2003	<i>Reyer GERLAGH: <u>Induced Technological Change under Technological Competition</u></i>
ETA	6.2003	<i>Efrem CASTELNUOVO: <u>Squeezing the Interest Rate Smoothing Weight with a Hybrid Expectations Model</u></i>
SIEV	7.2003	<i>Anna ALBERINI, Alberto LONGO, Stefania TONIN, Francesco TROMBETTA and Margherita TURVANI: <u>The Role of Liability, Regulation and Economic Incentives in Brownfield Remediation and Redevelopment: Evidence from Surveys of Developers</u></i>
NRM	8.2003	<i>Elissaios POPYRAKIS and Reyser GERLAGH: <u>Natural Resources: A Blessing or a Curse?</u></i>
CLIM	9.2003	<i>A. CAPARRÓS, J.-C. PEREAU and T. TAZDAÏT: <u>North-South Climate Change Negotiations: a Sequential Game with Asymmetric Information</u></i>
KNOW	10.2003	<i>Giorgio BRUNELLO and Daniele CHECCHI: <u>School Quality and Family Background in Italy</u></i>
CLIM	11.2003	<i>Efrem CASTELNUOVO and Marzio GALEOTTI: <u>Learning By Doing vs Learning By Researching in a Model of Climate Change Policy Analysis</u></i>
KNOW	12.2003	<i>Carole MAIGNAN, Gianmarco OTTAVIANO and Dino PINELLI (eds.): <u>Economic Growth, Innovation, Cultural Diversity: What are we all talking about? A critical survey of the state-of-the-art</u></i>
KNOW	13.2003	<i>Carole MAIGNAN, Gianmarco OTTAVIANO, Dino PINELLI and Francesco RULLANI (lix): <u>Bio-Ecological Diversity vs. Socio-Economic Diversity. A Comparison of Existing Measures</u></i>
KNOW	14.2003	<i>Maddy JANSSENS and Chris STEYAERT (lix): <u>Theories of Diversity within Organisation Studies: Debates and Future Trajectories</u></i>
KNOW	15.2003	<i>Tuzin BAYCAN LEVENT, Enno MASUREL and Peter NIJKAMP (lix): <u>Diversity in Entrepreneurship: Ethnic and Female Roles in Urban Economic Life</u></i>
KNOW	16.2003	<i>Alexandra BITUSIKOVA (lix): <u>Post-Communist City on its Way from Grey to Colourful: The Case Study from Slovakia</u></i>
KNOW	17.2003	<i>Billy E. VAUGHN and Katarina MLEKOV (lix): <u>A Stage Model of Developing an Inclusive Community</u></i>
KNOW	18.2003	<i>Selma van LONDEN and Arie de RUIJTER (lix): <u>Managing Diversity in a Globalizing World</u></i>
Coalition		
Theory	19.2003	<i>Sergio CURRARINI: <u>On the Stability of Hierarchies in Games with Externalities</u></i>
Network		
PRIV	20.2003	<i>Giacomo CALZOLARI and Alessandro PAVAN (lx): <u>Monopoly with Resale</u></i>
PRIV	21.2003	<i>Claudio MEZZETTI (lx): <u>Auction Design with Interdependent Valuations: The Generalized Revelation Principle, Efficiency, Full Surplus Extraction and Information Acquisition</u></i>
PRIV	22.2003	<i>Marco LiCalzi and Alessandro PAVAN (lx): <u>Tilting the Supply Schedule to Enhance Competition in Uniform-Price Auctions</u></i>
PRIV	23.2003	<i>David ETTINGER (lx): <u>Bidding among Friends and Enemies</u></i>
PRIV	24.2003	<i>Hannu VARTIAINEN (lx): <u>Auction Design without Commitment</u></i>
PRIV	25.2003	<i>Matti KELOHARJU, Kjell G. NYBORG and Kristian RYDQVIST (lx): <u>Strategic Behavior and Underpricing in Uniform Price Auctions: Evidence from Finnish Treasury Auctions</u></i>
PRIV	26.2003	<i>Christine A. PARLOUR and Uday RAJAN (lx): <u>Rationing in IPOs</u></i>
PRIV	27.2003	<i>Kjell G. NYBORG and Ilya A. STREBULAIEV (lx): <u>Multiple Unit Auctions and Short Squeezes</u></i>
PRIV	28.2003	<i>Anders LUNANDER and Jan-Eric NILSSON (lx): <u>Taking the Lab to the Field: Experimental Tests of Alternative Mechanisms to Procure Multiple Contracts</u></i>
PRIV	29.2003	<i>TangaMcDANIEL and Karsten NEUHOFF (lx): <u>Use of Long-term Auctions for Network Investment</u></i>
PRIV	30.2003	<i>Emiel MAASLAND and Sander ONDERSTAL (lx): <u>Auctions with Financial Externalities</u></i>
ETA	31.2003	<i>Michael FINUS and Bianca RUNDSHAGEN: <u>A Non-cooperative Foundation of Core-Stability in Positive Externality NTU-Coalition Games</u></i>
KNOW	32.2003	<i>Michele MORETTO: <u>Competition and Irreversible Investments under Uncertainty</u></i>
PRIV	33.2003	<i>Philippe QUIRION: <u>Relative Quotas: Correct Answer to Uncertainty or Case of Regulatory Capture?</u></i>
KNOW	34.2003	<i>Giuseppe MEDA, Claudio PIGA and Donald SIEGEL: <u>On the Relationship between R&D and Productivity: A Treatment Effect Analysis</u></i>
ETA	35.2003	<i>Alessandra DEL BOCA, Marzio GALEOTTI and Paola ROTA: <u>Non-convexities in the Adjustment of Different Capital Inputs: A Firm-level Investigation</u></i>

GG	36.2003	<i>Matthieu GLACHANT</i> : <u>Voluntary Agreements under Endogenous Legislative Threats</u>
PRIV	37.2003	<i>Narjess BOUBAKRI, Jean-Claude COSSET and Omrane GUEDHAMI</i> : <u>Postprivatization Corporate Governance: the Role of Ownership Structure and Investor Protection</u>
CLIM	38.2003	<i>Rolf GOLOMBEK and Michael HOEL</i> : <u>Climate Policy under Technology Spillovers</u>
KNOW	39.2003	<i>Slim BEN YOUSSEF</i> : <u>Transboundary Pollution, R&D Spillovers and International Trade</u>
CTN	40.2003	<i>Carlo CARRARO and Carmen MARCHIORI</i> : <u>Endogenous Strategic Issue Linkage in International Negotiations</u>
KNOW	41.2003	<i>Sonia OREFFICE</i> : <u>Abortion and Female Power in the Household: Evidence from Labor Supply</u>
KNOW	42.2003	<i>Timo GOESCHL and Timothy SWANSON</i> : <u>On Biology and Technology: The Economics of Managing Biotechnologies</u>
ETA	43.2003	<i>Giorgio Busetti and Matteo MANERA</i> : <u>STAR-GARCH Models for Stock Market Interactions in the Pacific Basin Region, Japan and US</u>
CLIM	44.2003	<i>Katrin MILLOCK and Céline NAUGES</i> : <u>The French Tax on Air Pollution: Some Preliminary Results on its Effectiveness</u>
PRIV	45.2003	<i>Bernardo BORTOLOTTI and Paolo PINOTTI</i> : <u>The Political Economy of Privatization</u>
SIEV	46.2003	<i>Elbert DIJKGRAAF and Herman R.J. VOLLEBERGH</i> : <u>Burn or Bury? A Social Cost Comparison of Final Waste Disposal Methods</u>
ETA	47.2003	<i>Jens HORBACH</i> : <u>Employment and Innovations in the Environmental Sector: Determinants and Econometrical Results for Germany</u>
CLIM	48.2003	<i>Lori SNYDER, Nolan MILLER and Robert STAVINS</i> : <u>The Effects of Environmental Regulation on Technology Diffusion: The Case of Chlorine Manufacturing</u>
CLIM	49.2003	<i>Lori SNYDER, Robert STAVINS and Alexander F. WAGNER</i> : <u>Private Options to Use Public Goods. Exploiting Revealed Preferences to Estimate Environmental Benefits</u>
CTN	50.2003	<i>László Á. KÓCZY and Luc LAUWERS</i> (Ixi): <u>The Minimal Dominant Set is a Non-Empty Core-Extension</u>
CTN	51.2003	<i>Matthew O. JACKSON</i> (Ixi): <u>Allocation Rules for Network Games</u>
CTN	52.2003	<i>Ana MAULEON and Vincent VANNETELBOSCH</i> (Ixi): <u>Farsightedness and Cautiousness in Coalition Formation</u>
CTN	53.2003	<i>Fernando VEGA-REDONDO</i> (Ixi): <u>Building Up Social Capital in a Changing World: a network approach</u>
CTN	54.2003	<i>Matthew HAAG and Roger LAGUNOFF</i> (Ixi): <u>On the Size and Structure of Group Cooperation</u>
CTN	55.2003	<i>Tajji FURUSAWA and Hideo KONISHI</i> (Ixi): <u>Free Trade Networks</u>
CTN	56.2003	<i>Halis Murat YILDIZ</i> (Ixi): <u>National Versus International Mergers and Trade Liberalization</u>
CTN	57.2003	<i>Santiago RUBIO and Alistair ULPH</i> (Ixi): <u>An Infinite-Horizon Model of Dynamic Membership of International Environmental Agreements</u>
KNOW	58.2003	<i>Carole MAIGNAN, Dino PINELLI and Gianmarco I.P. OTTAVIANO</i> : <u>ICT, Clusters and Regional Cohesion: A Summary of Theoretical and Empirical Research</u>
KNOW	59.2003	<i>Giorgio BELLETTINI and Gianmarco I.P. OTTAVIANO</i> : <u>Special Interests and Technological Change</u>
ETA	60.2003	<i>Ronnie SCHÖB</i> : <u>The Double Dividend Hypothesis of Environmental Taxes: A Survey</u>
CLIM	61.2003	<i>Michael FINUS, Ekko van IERLAND and Robert DELLINK</i> : <u>Stability of Climate Coalitions in a Cartel Formation Game</u>
GG	62.2003	<i>Michael FINUS and Bianca RUNDSHAGEN</i> : <u>How the Rules of Coalition Formation Affect Stability of International Environmental Agreements</u>
SIEV	63.2003	<i>Alberto PETRUCCI</i> : <u>Taxing Land Rent in an Open Economy</u>
CLIM	64.2003	<i>Joseph E. ALDY, Scott BARRETT and Robert N. STAVINS</i> : <u>Thirteen Plus One: A Comparison of Global Climate Policy Architectures</u>
SIEV	65.2003	<i>Edi DEFRANCESCO</i> : <u>The Beginning of Organic Fish Farming in Italy</u>
SIEV	66.2003	<i>Klaus CONRAD</i> : <u>Price Competition and Product Differentiation when Consumers Care for the Environment</u>
SIEV	67.2003	<i>Paulo A.L.D. NUNES, Luca ROSSETTO, Arianne DE BLAEIJ</i> : <u>Monetary Value Assessment of Clam Fishing Management Practices in the Venice Lagoon: Results from a Stated Choice Exercise</u>
CLIM	68.2003	<i>ZhongXiang ZHANG</i> : <u>Open Trade with the U.S. Without Compromising Canada's Ability to Comply with its Kyoto Target</u>
KNOW	69.2003	<i>David FRANTZ</i> (Iix): <u>Lorenzo Market between Diversity and Mutation</u>
KNOW	70.2003	<i>Ercole SORI</i> (Iix): <u>Mapping Diversity in Social History</u>
KNOW	71.2003	<i>Ljiljana DERU SIMIC</i> (Ixi): <u>What is Specific about Art/Cultural Projects?</u>
KNOW	72.2003	<i>Natalya V. TARANOVA</i> (Ixi): <u>The Role of the City in Fostering Intergroup Communication in a Multicultural Environment: Saint-Petersburg's Case</u>
KNOW	73.2003	<i>Kristine CRANE</i> (Ixi): <u>The City as an Arena for the Expression of Multiple Identities in the Age of Globalisation and Migration</u>
KNOW	74.2003	<i>Kazuma MATOBA</i> (Ixi): <u>Glocal Dialogue- Transformation through Transcultural Communication</u>
KNOW	75.2003	<i>Catarina REIS OLIVEIRA</i> (Ixi): <u>Immigrants' Entrepreneurial Opportunities: The Case of the Chinese in Portugal</u>
KNOW	76.2003	<i>Sandra WALLMAN</i> (Ixi): <u>The Diversity of Diversity - towards a typology of urban systems</u>
KNOW	77.2003	<i>Richard PEARCE</i> (Ixi): <u>A Biologist's View of Individual Cultural Identity for the Study of Cities</u>
KNOW	78.2003	<i>Vincent MERK</i> (Ixi): <u>Communication Across Cultures: from Cultural Awareness to Reconciliation of the Dilemmas</u>
KNOW	79.2003	<i>Giorgio BELLETTINI, Carlotta BERTI CERONI and Gianmarco I.P. OTTAVIANO</i> : <u>Child Labor and Resistance to Change</u>
ETA	80.2003	<i>Michele MORETTO, Paolo M. PANTEGHINI and Carlo SCARPA</i> : <u>Investment Size and Firm's Value under Profit Sharing Regulation</u>

IEM	81.2003	<i>Alessandro LANZA, Matteo MANERA and Massimo GIOVANNINI: <u>Oil and Product Dynamics in International Petroleum Markets</u></i>
CLIM	82.2003	<i>Y. Hossein FARZIN and Jinhua ZHAO: <u>Pollution Abatement Investment When Firms Lobby Against Environmental Regulation</u></i>
CLIM	83.2003	<i>Giuseppe DI VITA: <u>Is the Discount Rate Relevant in Explaining the Environmental Kuznets Curve?</u></i>
CLIM	84.2003	<i>Reyer GERLAGH and Wietze LISE: <u>Induced Technological Change Under Carbon Taxes</u></i>
NRM	85.2003	<i>Rinaldo BRAU, Alessandro LANZA and Francesco PIGLIARU: <u>How Fast are the Tourism Countries Growing? The cross-country evidence</u></i>
KNOW	86.2003	<i>Elena BELLINI, Gianmarco I.P. OTTAVIANO and Dino PINELLI: <u>The ICT Revolution: opportunities and risks for the Mezzogiorno</u></i>
SIEV	87.2003	<i>Lucas BRETSCGHER and Sjak SMULDERS: <u>Sustainability and Substitution of Exhaustible Natural Resources. How resource prices affect long-term R&D investments</u></i>
CLIM	88.2003	<i>Johan EYCKMANS and Michael FINUS: <u>New Roads to International Environmental Agreements: The Case of Global Warming</u></i>
CLIM	89.2003	<i>Marzio GALEOTTI: <u>Economic Development and Environmental Protection</u></i>
CLIM	90.2003	<i>Marzio GALEOTTI: <u>Environment and Economic Growth: Is Technical Change the Key to Decoupling?</u></i>
CLIM	91.2003	<i>Marzio GALEOTTI and Barbara BUCHNER: <u>Climate Policy and Economic Growth in Developing Countries</u></i>
IEM	92.2003	<i>A. MARKANDYA, A. GOLUB and E. STRUKOVA: <u>The Influence of Climate Change Considerations on Energy Policy: The Case of Russia</u></i>
ETA	93.2003	<i>Andrea BELTRATTI: <u>Socially Responsible Investment in General Equilibrium</u></i>
CTN	94.2003	<i>Parkash CHANDER: <u>The γ-Core and Coalition Formation</u></i>
IEM	95.2003	<i>Matteo MANERA and Angelo MARZULLO: <u>Modelling the Load Curve of Aggregate Electricity Consumption Using Principal Components</u></i>
IEM	96.2003	<i>Alessandro LANZA, Matteo MANERA, Margherita GRASSO and Massimo GIOVANNINI: <u>Long-run Models of Oil Stock Prices</u></i>
CTN	97.2003	<i>Steven J. BRAMS, Michael A. JONES, and D. Marc KILGOUR: <u>Forming Stable Coalitions: The Process Matters</u></i>
KNOW	98.2003	<i>John CROWLEY, Marie-Cecile NAVES (Ixxiii): <u>Anti-Racist Policies in France. From Ideological and Historical Schemes to Socio-Political Realities</u></i>
KNOW	99.2003	<i>Richard THOMPSON FORD (Ixxiii): <u>Cultural Rights and Civic Virtue</u></i>
KNOW	100.2003	<i>Alaknanda PATEL (Ixxiii): <u>Cultural Diversity and Conflict in Multicultural Cities</u></i>
KNOW	101.2003	<i>David MAY (Ixxiii): <u>The Struggle of Becoming Established in a Deprived Inner-City Neighbourhood</u></i>
KNOW	102.2003	<i>Sébastien ARCAND, Danielle JUTEAU, Sirma BILGE, and Francine LEMIRE (Ixxiii) : <u>Municipal Reform on the Island of Montreal: Tensions Between Two Majority Groups in a Multicultural City</u></i>
CLIM	103.2003	<i>Barbara BUCHNER and Carlo CARRARO: <u>China and the Evolution of the Present Climate Regime</u></i>
CLIM	104.2003	<i>Barbara BUCHNER and Carlo CARRARO: <u>Emissions Trading Regimes and Incentives to Participate in International Climate Agreements</u></i>
CLIM	105.2003	<i>Anil MARKANDYA and Dirk T.G. RÜBBELKE: <u>Ancillary Benefits of Climate Policy</u></i>
NRM	106.2003	<i>Anne Sophie CRÉPIN (Ixiv): <u>Management Challenges for Multiple-Species Boreal Forests</u></i>
NRM	107.2003	<i>Anne Sophie CRÉPIN (Ixiv): <u>Threshold Effects in Coral Reef Fisheries</u></i>
SIEV	108.2003	<i>Sara ANIYAR (Ixiv): <u>Estimating the Value of Oil Capital in a Small Open Economy: The Venezuela's Example</u></i>
SIEV	109.2003	<i>Kenneth ARROW, Partha DASGUPTA and Karl-Göran MÄLER(Ixiv): <u>Evaluating Projects and Assessing Sustainable Development in Imperfect Economies</u></i>
NRM	110.2003	<i>Anastasios XEPAPADEAS and Catarina ROSETA-PALMA(Ixiv): <u>Instabilities and Robust Control in Fisheries</u></i>
NRM	111.2003	<i>Charles PERRINGS and Brian WALKER (Ixiv): <u>Conservation and Optimal Use of Rangelands</u></i>
ETA	112.2003	<i>Jack GOODY (Ixiv): <u>Globalisation, Population and Ecology</u></i>
CTN	113.2003	<i>Carlo CARRARO, Carmen MARCHIORI and Sonia OREFFICE: <u>Endogenous Minimum Participation in International Environmental Treaties</u></i>
CTN	114.2003	<i>Guillaume HAERINGER and Myrna WOODERS: <u>Decentralized Job Matching</u></i>
CTN	115.2003	<i>Hideo KONISHI and M. Utku UNVER: <u>Credible Group Stability in Multi-Partner Matching Problems</u></i>
CTN	116.2003	<i>Somdeb LAHIRI: <u>Stable Matchings for the Room-Mates Problem</u></i>
CTN	117.2003	<i>Somdeb LAHIRI: <u>Stable Matchings for a Generalized Marriage Problem</u></i>
CTN	118.2003	<i>Marita LAUKKANEN: <u>Transboundary Fisheries Management under Implementation Uncertainty</u></i>
CTN	119.2003	<i>Edward CARTWRIGHT and Myrna WOODERS: <u>Social Conformity and Bounded Rationality in Arbitrary Games with Incomplete Information: Some First Results</u></i>
CTN	120.2003	<i>Gianluigi VERNASCA: <u>Dynamic Price Competition with Price Adjustment Costs and Product Differentiation</u></i>
CTN	121.2003	<i>Myrna WOODERS, Edward CARTWRIGHT and Reinhard SELTEN: <u>Social Conformity in Games with Many Players</u></i>
CTN	122.2003	<i>Edward CARTWRIGHT and Myrna WOODERS: <u>On Equilibrium in Pure Strategies in Games with Many Players</u></i>
CTN	123.2003	<i>Edward CARTWRIGHT and Myrna WOODERS: <u>Conformity and Bounded Rationality in Games with Many Players</u></i>
	1000	Carlo CARRARO, Alessandro LANZA and Valeria PAPPONETTI: <u>One Thousand Working Papers</u>

NOTE DI LAVORO PUBLISHED IN 2004

IEM	1.2004	<i>Anil MARKANDYA, Suzette PEDROSO and Alexander GOLUB: <u>Empirical Analysis of National Income and So2 Emissions in Selected European Countries</u></i>
ETA	2.2004	<i>Masahisa FUJITA and Shlomo WEBER: <u>Strategic Immigration Policies and Welfare in Heterogeneous Countries</u></i>
PRA	3.2004	<i>Adolfo DI CARLUCCIO, Giovanni FERRI, Cecilia FRALE and Ottavio RICCHI: <u>Do Privatizations Boost Household Shareholding? Evidence from Italy</u></i>
ETA	4.2004	<i>Victor GINSBURGH and Shlomo WEBER: <u>Languages Disenfranchisement in the European Union</u></i>
ETA	5.2004	<i>Romano PIRAS: <u>Growth, Congestion of Public Goods, and Second-Best Optimal Policy</u></i>
CCMP	6.2004	<i>Herman R.J. VOLLEBERGH: <u>Lessons from the Polder: Is Dutch CO2-Taxation Optimal</u></i>
PRA	7.2004	<i>Sandro BRUSCO, Giuseppe LOPOMO and S. VISWANATHAN (lxv): <u>Merger Mechanisms</u></i>
PRA	8.2004	<i>Wolfgang AUSSENEGG, Pegaret PICHLER and Alex STOMPER (lxv): <u>IPO Pricing with Bookbuilding, and a When-Issued Market</u></i>
PRA	9.2004	<i>Pegaret PICHLER and Alex STOMPER (lxv): <u>Primary Market Design: Direct Mechanisms and Markets</u></i>
PRA	10.2004	<i>Florian ENGLMAIER, Pablo GUILLEN, Loreto LLORENTE, Sander ONDERSTAL and Rupert SAUSGRUBER (lxv): <u>The Chopstick Auction: A Study of the Exposure Problem in Multi-Unit Auctions</u></i>
PRA	11.2004	<i>Bjarne BRENDSTRUP and Harry J. PAARSCH (lxv): <u>Nonparametric Identification and Estimation of Multi-Unit, Sequential, Oral, Ascending-Price Auctions With Asymmetric Bidders</u></i>
PRA	12.2004	<i>Ohad KADAN (lxv): <u>Equilibrium in the Two Player, k-Double Auction with Affiliated Private Values</u></i>
PRA	13.2004	<i>Maarten C.W. JANSSEN (lxv): <u>Auctions as Coordination Devices</u></i>
PRA	14.2004	<i>Gadi FIBICH, Arieh GAVIOUS and Aner SELA (lxv): <u>All-Pay Auctions with Weakly Risk-Averse Buyers</u></i>
PRA	15.2004	<i>Orly SADE, Charles SCHNITZLEIN and Jaime F. ZENDER (lxv): <u>Competition and Cooperation in Divisible Good Auctions: An Experimental Examination</u></i>
PRA	16.2004	<i>Marta STRYSZOWSKA (lxv): <u>Late and Multiple Bidding in Competing Second Price Internet Auctions</u></i>
CCMP	17.2004	<i>Slim Ben YOUSSEF: <u>R&D in Cleaner Technology and International Trade</u></i>
NRM	18.2004	<i>Angelo ANTOCI, Simone BORGHESI and Paolo RUSSU (lxvi): <u>Biodiversity and Economic Growth: Stabilization Versus Preservation of the Ecological Dynamics</u></i>
SIEV	19.2004	<i>Anna ALBERINI, Paolo ROSATO, Alberto LONGO and Valentina ZANATTA: <u>Information and Willingness to Pay in a Contingent Valuation Study: The Value of S. Erasmo in the Lagoon of Venice</u></i>
NRM	20.2004	<i>Guido CANDELA and Roberto CELLINI (lxvii): <u>Investment in Tourism Market: A Dynamic Model of Differentiated Oligopoly</u></i>
NRM	21.2004	<i>Jacqueline M. HAMILTON (lxvii): <u>Climate and the Destination Choice of German Tourists</u></i>
NRM	22.2004	<i>Javier Rey-MAQUIEIRA PALMER, Javier LOZANO IBÁÑEZ and Carlos Mario GÓMEZ GÓMEZ (lxvii): <u>Land, Environmental Externalities and Tourism Development</u></i>
NRM	23.2004	<i>Pius ODUNGA and Henk FOLMER (lxvii): <u>Profiling Tourists for Balanced Utilization of Tourism-Based Resources in Kenya</u></i>
NRM	24.2004	<i>Jean-Jacques NOWAK, Mondher SAHLI and Pasquale M. SGRO (lxvii): <u>Tourism, Trade and Domestic Welfare</u></i>
NRM	25.2004	<i>Riaz SHAREEF (lxvii): <u>Country Risk Ratings of Small Island Tourism Economies</u></i>
NRM	26.2004	<i>Juan Luis EUGENIO-MARTÍN, Noelia MARTÍN MORALES and Riccardo SCARPA (lxvii): <u>Tourism and Economic Growth in Latin American Countries: A Panel Data Approach</u></i>
NRM	27.2004	<i>Raúl Hernández MARTÍN (lxvii): <u>Impact of Tourism Consumption on GDP. The Role of Imports</u></i>
CSRM	28.2004	<i>Nicoletta FERRO: <u>Cross-Country Ethical Dilemmas in Business: A Descriptive Framework</u></i>
NRM	29.2004	<i>Marian WEBER (lxvi): <u>Assessing the Effectiveness of Tradable Landuse Rights for Biodiversity Conservation: an Application to Canada's Boreal Mixedwood Forest</u></i>
NRM	30.2004	<i>Trond BJORN DAL, Phoebe KOUNDOURI and Sean PASCOE (lxvi): <u>Output Substitution in Multi-Species Trawl Fisheries: Implications for Quota Setting</u></i>
CCMP	31.2004	<i>Marzio GALEOTTI, Alessandra GORIA, Paolo MOMBRINI and Evi SPANTIDAKI: <u>Weather Impacts on Natural, Social and Economic Systems (WISE) Part I: Sectoral Analysis of Climate Impacts in Italy</u></i>
CCMP	32.2004	<i>Marzio GALEOTTI, Alessandra GORIA, Paolo MOMBRINI and Evi SPANTIDAKI: <u>Weather Impacts on Natural, Social and Economic Systems (WISE) Part II: Individual Perception of Climate Extremes in Italy</u></i>
CTN	33.2004	<i>Wilson PEREZ: <u>Divide and Conquer: Noisy Communication in Networks, Power, and Wealth Distribution</u></i>
KTHC	34.2004	<i>Gianmarco I.P. OTTAVIANO and Giovanni PERI (lxviii): <u>The Economic Value of Cultural Diversity: Evidence from US Cities</u></i>
KTHC	35.2004	<i>Linda CHAIB (lxviii): <u>Immigration and Local Urban Participatory Democracy: A Boston-Paris Comparison</u></i>
KTHC	36.2004	<i>Franca ECKERT COEN and Claudio ROSSI (lxviii): <u>Foreigners, Immigrants, Host Cities: The Policies of Multi-Ethnicity in Rome. Reading Governance in a Local Context</u></i>
KTHC	37.2004	<i>Kristine CRANE (lxviii): <u>Governing Migration: Immigrant Groups' Strategies in Three Italian Cities – Rome, Naples and Bari</u></i>
KTHC	38.2004	<i>Kiflemariam HAMDE (lxviii): <u>Mind in Africa, Body in Europe: The Struggle for Maintaining and Transforming Cultural Identity - A Note from the Experience of Eritrean Immigrants in Stockholm</u></i>
ETA	39.2004	<i>Alberto CAVALIERE: <u>Price Competition with Information Disparities in a Vertically Differentiated Duopoly</u></i>
PRA	40.2004	<i>Andrea BIGANO and Stef PROOST: <u>The Opening of the European Electricity Market and Environmental Policy: Does the Degree of Competition Matter?</u></i>
CCMP	41.2004	<i>Micheal FINUS (lxix): <u>International Cooperation to Resolve International Pollution Problems</u></i>
KTHC	42.2004	<i>Francesco CRESPI: <u>Notes on the Determinants of Innovation: A Multi-Perspective Analysis</u></i>

CTN	43.2004	<i>Sergio CURRARINI and Marco MARINI: <u>Coalition Formation in Games without Synergies</u></i>
CTN	44.2004	<i>Marc ESCRHUELA-VILLAR: <u>Cartel Sustainability and Cartel Stability</u></i>
NRM	45.2004	<i>Sebastian BERVOETS and Nicolas GRAVEL (lxvi): <u>Appraising Diversity with an Ordinal Notion of Similarity: An Axiomatic Approach</u></i>
NRM	46.2004	<i>Signe ANTHON and Bo JELLESMARK THORSEN (lxvi): <u>Optimal Afforestation Contracts with Asymmetric Information on Private Environmental Benefits</u></i>
NRM	47.2004	<i>John MBURU (lxvi): <u>Wildlife Conservation and Management in Kenya: Towards a Co-management Approach</u></i>
NRM	48.2004	<i>Ekin BIROL, Ágnes GYOVAI and Melinda SMALE (lxvi): <u>Using a Choice Experiment to Value Agricultural Biodiversity on Hungarian Small Farms: Agri-Environmental Policies in a Transitional Economy</u></i>
CCMP	49.2004	<i>Gernot KLEPPER and Sonja PETERSON: <u>The EU Emissions Trading Scheme. Allowance Prices, Trade Flows, Competitiveness Effects</u></i>
GG	50.2004	<i>Scott BARRETT and Michael HOEL: <u>Optimal Disease Eradication</u></i>
CTN	51.2004	<i>Dinko DIMITROV, Peter BORM, Ruud HENDRICKX and Shao CHIN SUNG: <u>Simple Priorities and Core Stability in Hedonic Games</u></i>
SIEV	52.2004	<i>Francesco RICCI: <u>Channels of Transmission of Environmental Policy to Economic Growth: A Survey of the Theory</u></i>
SIEV	53.2004	<i>Anna ALBERINI, Maureen CROPPER, Alan KRUPNICK and Nathalie B. SIMON: <u>Willingness to Pay for Mortality Risk Reductions: Does Latency Matter?</u></i>
NRM	54.2004	<i>Ingo BRÄUER and Rainer MARGGRAF (lxvi): <u>Valuation of Ecosystem Services Provided by Biodiversity Conservation: An Integrated Hydrological and Economic Model to Value the Enhanced Nitrogen Retention in Renaturated Streams</u></i>
NRM	55.2004	<i>Timo GOESCHL and Tun LIN (lxvi): <u>Biodiversity Conservation on Private Lands: Information Problems and Regulatory Choices</u></i>
NRM	56.2004	<i>Tom DEDEURWAERDERE (lxvi): <u>Bioprospection: From the Economics of Contracts to Reflexive Governance</u></i>
CCMP	57.2004	<i>Katrin REHDANZ and David MADDISON: <u>The Amenity Value of Climate to German Households</u></i>
CCMP	58.2004	<i>Koen SMEKENS and Bob VAN DER ZWAAN: <u>Environmental Externalities of Geological Carbon Sequestration Effects on Energy Scenarios</u></i>
NRM	59.2004	<i>Valentina BOSETTI, Mariaester CASSINELLI and Alessandro LANZA (lxvii): <u>Using Data Envelopment Analysis to Evaluate Environmentally Conscious Tourism Management</u></i>
NRM	60.2004	<i>Timo GOESCHL and Danilo CAMARGO IGLIORI (lxvi): <u>Property Rights Conservation and Development: An Analysis of Extractive Reserves in the Brazilian Amazon</u></i>
CCMP	61.2004	<i>Barbara BUCHNER and Carlo CARRARO: <u>Economic and Environmental Effectiveness of a Technology-based Climate Protocol</u></i>
NRM	62.2004	<i>Elissaios POPYRAKIS and Reyer GERLAGH: <u>Resource-Abundance and Economic Growth in the U.S.</u></i>
NRM	63.2004	<i>Györgyi BELA, György PATAKI, Melinda SMALE and Mariann HAJDÚ (lxvi): <u>Conserving Crop Genetic Resources on Smallholder Farms in Hungary: Institutional Analysis</u></i>
NRM	64.2004	<i>E.C.M. RUIJGROK and E.E.M. NILLESEN (lxvi): <u>The Socio-Economic Value of Natural Riverbanks in the Netherlands</u></i>
NRM	65.2004	<i>E.C.M. RUIJGROK (lxvi): <u>Reducing Acidification: The Benefits of Increased Nature Quality. Investigating the Possibilities of the Contingent Valuation Method</u></i>
ETA	66.2004	<i>Giannis VARDAS and Anastasios XEPAPADEAS: <u>Uncertainty Aversion, Robust Control and Asset Holdings</u></i>
GG	67.2004	<i>Anastasios XEPAPADEAS and Constadina PASSA: <u>Participation in and Compliance with Public Voluntary Environmental Programs: An Evolutionary Approach</u></i>
GG	68.2004	<i>Michael FINUS: <u>Modesty Pays: Sometimes!</u></i>
NRM	69.2004	<i>Trond BJØRNDAL and Ana BRASÃO: <u>The Northern Atlantic Bluefin Tuna Fisheries: Management and Policy Implications</u></i>
CTN	70.2004	<i>Alejandro CAPARRÓS, Abdelhakim HAMMOUDI and Tarik TAZDAÏT: <u>On Coalition Formation with Heterogeneous Agents</u></i>
IEM	71.2004	<i>Massimo GIOVANNINI, Margherita GRASSO, Alessandro LANZA and Matteo MANERA: <u>Conditional Correlations in the Returns on Oil Companies Stock Prices and Their Determinants</u></i>
IEM	72.2004	<i>Alessandro LANZA, Matteo MANERA and Michael MCALEER: <u>Modelling Dynamic Conditional Correlations in WTI Oil Forward and Futures Returns</u></i>
SIEV	73.2004	<i>Margarita GENIUS and Elisabetta STRAZZERA: <u>The Copula Approach to Sample Selection Modelling: An Application to the Recreational Value of Forests</u></i>
CCMP	74.2004	<i>Rob DELLINK and Ekko van IERLAND: <u>Pollution Abatement in the Netherlands: A Dynamic Applied General Equilibrium Assessment</u></i>
ETA	75.2004	<i>Rosella LEVAGGI and Michele MORETTO: <u>Investment in Hospital Care Technology under Different Purchasing Rules: A Real Option Approach</u></i>
CTN	76.2004	<i>Salvador BARBERÀ and Matthew O. JACKSON (lxx): <u>On the Weights of Nations: Assigning Voting Weights in a Heterogeneous Union</u></i>
CTN	77.2004	<i>Àlex ARENAS, Antonio CABRALES, Albert DÍAZ-GUILERA, Roger GUIMERA and Fernando VEGA-REDONDO (lxx): <u>Optimal Information Transmission in Organizations: Search and Congestion</u></i>
CTN	78.2004	<i>Francis BLOCH and Armando GOMES (lxx): <u>Contracting with Externalities and Outside Options</u></i>
CTN	79.2004	<i>Rabah AMIR, Effrosyni DIAMANTOUDI and Licun XUE (lxx): <u>Merger Performance under Uncertain Efficiency Gains</u></i>
CTN	80.2004	<i>Francis BLOCH and Matthew O. JACKSON (lxx): <u>The Formation of Networks with Transfers among Players</u></i>
CTN	81.2004	<i>Daniel DIERMEIER, Hülya ERASLAN and Antonio MERLO (lxx): <u>Bicameralism and Government Formation</u></i>

CTN	82.2004	<i>Rod GARRATT, James E. PARCO, Cheng-ZHONG QIN and Amnon RAPOPORT (lxx): <u>Potential Maximization and Coalition Government Formation</u></i>
CTN	83.2004	<i>Kfir ELIAZ, Debraj RAY and Ronny RAZIN (lxx): <u>Group Decision-Making in the Shadow of Disagreement</u></i>
CTN	84.2004	<i>Sanjeev GOYAL, Marco van der LEIJ and José Luis MORAGA-GONZÁLEZ (lxx): <u>Economics: An Emerging Small World?</u></i>
CTN	85.2004	<i>Edward CARTWRIGHT (lxx): <u>Learning to Play Approximate Nash Equilibria in Games with Many Players</u></i>
IEM	86.2004	<i>Finn R. FØRSUND and Michael HOEL: <u>Properties of a Non-Competitive Electricity Market Dominated by Hydroelectric Power</u></i>
KTHC	87.2004	<i>Elissaios POPYRAKIS and Reyer GERLAGH: <u>Natural Resources, Investment and Long-Term Income</u></i>
CCMP	88.2004	<i>Marzio GALEOTTI and Claudia KEMFERT: <u>Interactions between Climate and Trade Policies: A Survey</u></i>
IEM	89.2004	<i>A. MARKANDYA, S. PEDROSO and D. STREIMIKIENE: <u>Energy Efficiency in Transition Economies: Is There Convergence Towards the EU Average?</u></i>
GG	90.2004	<i>Rolf GOLOMBEK and Michael HOEL: <u>Climate Agreements and Technology Policy</u></i>
PRA	91.2004	<i>Sergei IZMALKOV (lxx): <u>Multi-Unit Open Ascending Price Efficient Auction</u></i>
KTHC	92.2004	<i>Gianmarco I.P. OTTAVIANO and Giovanni PERI: <u>Cities and Cultures</u></i>
KTHC	93.2004	<i>Massimo DEL GATTO: <u>Agglomeration, Integration, and Territorial Authority Scale in a System of Trading Cities. Centralisation versus devolution</u></i>
CCMP	94.2004	<i>Pierre-André JOUVET, Philippe MICHEL and Gilles ROTILLON: <u>Equilibrium with a Market of Permits</u></i>
CCMP	95.2004	<i>Bob van der ZWAAN and Reyer GERLAGH: <u>Climate Uncertainty and the Necessity to Transform Global Energy Supply</u></i>
CCMP	96.2004	<i>Francesco BOSELLO, Marco LAZZARIN, Roberto ROSON and Richard S.J. TOL: <u>Economy-Wide Estimates of the Implications of Climate Change: Sea Level Rise</u></i>
CTN	97.2004	<i>Gustavo BERGANTIÑOS and Juan J. VIDAL-PUGA: <u>Defining Rules in Cost Spanning Tree Problems Through the Canonical Form</u></i>
CTN	98.2004	<i>Siddhartha BANDYOPADHYAY and Mandar OAK: <u>Party Formation and Coalitional Bargaining in a Model of Proportional Representation</u></i>
GG	99.2004	<i>Hans-Peter WEIKARD, Michael FINUS and Juan-Carlos ALTAMIRANO-CABRERA: <u>The Impact of Surplus Sharing on the Stability of International Climate Agreements</u></i>
SIEV	100.2004	<i>Chiara M. TRAVISI and Peter NIJKAMP: <u>Willingness to Pay for Agricultural Environmental Safety: Evidence from a Survey of Milan, Italy, Residents</u></i>
SIEV	101.2004	<i>Chiara M. TRAVISI, Raymond J. G. M. FLORAX and Peter NIJKAMP: <u>A Meta-Analysis of the Willingness to Pay for Reductions in Pesticide Risk Exposure</u></i>
NRM	102.2004	<i>Valentina BOSETTI and David TOMBERLIN: <u>Real Options Analysis of Fishing Fleet Dynamics: A Test</u></i>
CCMP	103.2004	<i>Alessandra GORIA e Gretel GAMBARELLI: <u>Economic Evaluation of Climate Change Impacts and Adaptability in Italy</u></i>
PRA	104.2004	<i>Massimo FLORIO and Mara GRASSENTI: <u>The Missing Shock: The Macroeconomic Impact of British Privatisation</u></i>
PRA	105.2004	<i>John BENNETT, Saul ESTRIN, James MAW and Giovanni URGÀ: <u>Privatisation Methods and Economic Growth in Transition Economies</u></i>
PRA	106.2004	<i>Kira BÖRNER: <u>The Political Economy of Privatization: Why Do Governments Want Reforms?</u></i>
PRA	107.2004	<i>Pebr-Johan NORBÄCK and Lars PERSSON: <u>Privatization and Restructuring in Concentrated Markets</u></i>
SIEV	108.2004	<i>Angela GRANZOTTO, Fabio PRANOVI, Simone LIBRALATO, Patrizia TORRICELLI and Danilo MAINARDI: <u>Comparison between Artisanal Fishery and Manila Clam Harvesting in the Venice Lagoon by Using Ecosystem Indicators: An Ecological Economics Perspective</u></i>
CTN	109.2004	<i>Somdeb LAHIRI: <u>The Cooperative Theory of Two Sided Matching Problems: A Re-examination of Some Results</u></i>
NRM	110.2004	<i>Giuseppe DI VITA: <u>Natural Resources Dynamics: Another Look</u></i>
SIEV	111.2004	<i>Anna ALBERINI, Alistair HUNT and Anil MARKANDYA: <u>Willingness to Pay to Reduce Mortality Risks: Evidence from a Three-Country Contingent Valuation Study</u></i>
KTHC	112.2004	<i>Valeria PAPPONETTI and Dino PINELLI: <u>Scientific Advice to Public Policy-Making</u></i>
SIEV	113.2004	<i>Paulo A.L.D. NUNES and Laura ONOFRI: <u>The Economics of Warm Glow: A Note on Consumer's Behavior and Public Policy Implications</u></i>
IEM	114.2004	<i>Patrick CAYRADE: <u>Investments in Gas Pipelines and Liquefied Natural Gas Infrastructure What is the Impact on the Security of Supply?</u></i>
IEM	115.2004	<i>Valeria COSTANTINI and Francesco GRACCEVA: <u>Oil Security. Short- and Long-Term Policies</u></i>
IEM	116.2004	<i>Valeria COSTANTINI and Francesco GRACCEVA: <u>Social Costs of Energy Disruptions</u></i>
IEM	117.2004	<i>Christian EGENHOFER, Kyriakos GIALOGLOU, Giacomo LUCIANI, Maroeska BOOTS, Martin SCHEEPERS, Valeria COSTANTINI, Francesco GRACCEVA, Anil MARKANDYA and Giorgio VICINI: <u>Market-Based Options for Security of Energy Supply</u></i>
IEM	118.2004	<i>David FISK: <u>Transport Energy Security. The Unseen Risk?</u></i>
IEM	119.2004	<i>Giacomo LUCIANI: <u>Security of Supply for Natural Gas Markets. What is it and What is it not?</u></i>
IEM	120.2004	<i>L.J. de VRIES and R.A. HAKVOORT: <u>The Question of Generation Adequacy in Liberalised Electricity Markets</u></i>
KTHC	121.2004	<i>Alberto PETRUCCI: <u>Asset Accumulation, Fertility Choice and Nondegenerate Dynamics in a Small Open Economy</u></i>
NRM	122.2004	<i>Carlo GIUPPONI, Jaroslaw MYSLAK and Anita FASSIO: <u>An Integrated Assessment Framework for Water Resources Management: A DSS Tool and a Pilot Study Application</u></i>
NRM	123.2004	<i>Margaretha BREIL, Anita FASSIO, Carlo GIUPPONI and Paolo ROSATO: <u>Evaluation of Urban Improvement on the Islands of the Venice Lagoon: A Spatially-Distributed Hedonic-Hierarchical Approach</u></i>

ETA	124.2004	<i>Paul MENSINK: <u>Instant Efficient Pollution Abatement Under Non-Linear Taxation and Asymmetric Information: The Differential Tax Revisited</u></i>
NRM	125.2004	<i>Mauro FABIANO, Gabriella CAMARSA, Rosanna DURSI, Roberta IVALDI, Valentina MARIN and Francesca PALMISANI: <u>Integrated Environmental Study for Beach Management: A Methodological Approach</u></i>
PRA	126.2004	<i>Irena GROSFELD and Iraj HASHI: <u>The Emergence of Large Shareholders in Mass Privatized Firms: Evidence from Poland and the Czech Republic</u></i>
CCMP	127.2004	<i>Maria BERRITTELLA, Andrea BIGANO, Roberto ROSON and Richard S.J. TOL: <u>A General Equilibrium Analysis of Climate Change Impacts on Tourism</u></i>
CCMP	128.2004	<i>Reyer GERLAGH: <u>A Climate-Change Policy Induced Shift from Innovations in Energy Production to Energy Savings</u></i>
NRM	129.2004	<i>Elissaios PAPYRAKIS and Reyer GERLAGH: <u>Natural Resources, Innovation, and Growth</u></i>
PRA	130.2004	<i>Bernardo BORTOLOTTI and Mara FACCIO: <u>Reluctant Privatization</u></i>
SIEV	131.2004	<i>Riccardo SCARPA and Mara THIENE: <u>Destination Choice Models for Rock Climbing in the Northeast Alps: A Latent-Class Approach Based on Intensity of Participation</u></i>
SIEV	132.2004	<i>Riccardo SCARPA Kenneth G. WILLIS and Melinda ACUTT: <u>Comparing Individual-Specific Benefit Estimates for Public Goods: Finite Versus Continuous Mixing in Logit Models</u></i>
IEM	133.2004	<i>Santiago J. RUBIO: <u>On Capturing Oil Rents with a National Excise Tax Revisited</u></i>
ETA	134.2004	<i>Ascensión ANDINA DÍAZ: <u>Political Competition when Media Create Candidates' Charisma</u></i>
SIEV	135.2004	<i>Anna ALBERINI: <u>Robustness of VSL Values from Contingent Valuation Surveys</u></i>
CCMP	136.2004	<i>Gernot KLEPPER and Sonja PETERSON: <u>Marginal Abatement Cost Curves in General Equilibrium: The Influence of World Energy Prices</u></i>
ETA	137.2004	<i>Herbert DAWID, Christophe DEISSENBERG and Pavel ŠEVČIK: <u>Cheap Talk, Gullibility, and Welfare in an Environmental Taxation Game</u></i>

- (lix) This paper was presented at the ENGIME Workshop on “Mapping Diversity”, Leuven, May 16-17, 2002
- (lx) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications”, organised by the Fondazione Eni Enrico Mattei, Milan, September 26-28, 2002
- (lxi) This paper was presented at the Eighth Meeting of the Coalition Theory Network organised by the GREQAM, Aix-en-Provence, France, January 24-25, 2003
- (lxii) This paper was presented at the ENGIME Workshop on “Communication across Cultures in Multicultural Cities”, The Hague, November 7-8, 2002
- (lxiii) This paper was presented at the ENGIME Workshop on “Social dynamics and conflicts in multicultural cities”, Milan, March 20-21, 2003
- (lxiv) This paper was presented at the International Conference on “Theoretical Topics in Ecological Economics”, organised by the Abdus Salam International Centre for Theoretical Physics - ICTP, the Beijer International Institute of Ecological Economics, and Fondazione Eni Enrico Mattei – FEEM Trieste, February 10-21, 2003
- (lxv) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications” organised by Fondazione Eni Enrico Mattei and sponsored by the EU, Milan, September 25-27, 2003
- (lxvi) This paper has been presented at the 4th BioEcon Workshop on “Economic Analysis of Policies for Biodiversity Conservation” organised on behalf of the BIOECON Network by Fondazione Eni Enrico Mattei, Venice International University (VIU) and University College London (UCL), Venice, August 28-29, 2003
- (lxvii) This paper has been presented at the international conference on “Tourism and Sustainable Economic Development – Macro and Micro Economic Issues” jointly organised by CRENoS (Università di Cagliari e Sassari, Italy) and Fondazione Eni Enrico Mattei, and supported by the World Bank, Sardinia, September 19-20, 2003
- (lxviii) This paper was presented at the ENGIME Workshop on “Governance and Policies in Multicultural Cities”, Rome, June 5-6, 2003
- (lxix) This paper was presented at the Fourth EEP Plenary Workshop and EEP Conference “The Future of Climate Policy”, Cagliari, Italy, 27-28 March 2003
- (lxx) This paper was presented at the 9th Coalition Theory Workshop on "Collective Decisions and Institutional Design" organised by the Universitat Autònoma de Barcelona and held in Barcelona, Spain, January 30-31, 2004

2003 SERIES

CLIM	<i>Climate Change Modelling and Policy</i> (Editor: Marzio Galeotti)
GG	<i>Global Governance</i> (Editor: Carlo Carraro)
SIEV	<i>Sustainability Indicators and Environmental Valuation</i> (Editor: Anna Alberini)
NRM	<i>Natural Resources Management</i> (Editor: Carlo Giupponi)
KNOW	<i>Knowledge, Technology, Human Capital</i> (Editor: Gianmarco Ottaviano)
IEM	<i>International Energy Markets</i> (Editor: Anil Markandya)
CSR	<i>Corporate Social Responsibility and Management</i> (Editor: Sabina Ratti)
PRIV	<i>Privatisation, Regulation, Antitrust</i> (Editor: Bernardo Bortolotti)
ETA	<i>Economic Theory and Applications</i> (Editor: Carlo Carraro)
CTN	<i>Coalition Theory Network</i>

2004 SERIES

CCMP	<i>Climate Change Modelling and Policy</i> (Editor: Marzio Galeotti)
GG	<i>Global Governance</i> (Editor: Carlo Carraro)
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: Anil Markandya)
CSR	<i>Corporate Social Responsibility and Management</i> (Editor: Sabina Ratti)
PRA	<i>Privatisation, Regulation, Antitrust</i> (Editor: Bernardo Bortolotti)
ETA	<i>Economic Theory and Applications</i> (Editor: Carlo Carraro)
CTN	<i>Coalition Theory Network</i>