

Rotillon, Gilles; Jovet, Pierre-André; Michel, Philippe

Working Paper

Equilibrium with a Market of Permits

Nota di Lavoro, No. 94.2004

Provided in Cooperation with:

Fondazione Eni Enrico Mattei (FEEM)

Suggested Citation: Rotillon, Gilles; Jovet, Pierre-André; Michel, Philippe (2004) : Equilibrium with a Market of Permits, Nota di Lavoro, No. 94.2004, Fondazione Eni Enrico Mattei (FEEM), Milano

This Version is available at:

<https://hdl.handle.net/10419/117967>

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.

Equilibrium with a Market of Permits

Pierre-André Jouvet, Philippe Michel
and Gilles Rotillon

NOTA DI LAVORO 94.2004

JUNE 2004

CCMP – Climate Change Modelling and Policy
--

Pierre-André Jouvet, *GREQAM, Université de la Méditerranée and GAINS, Université du Maine*
Philippe Michel, *GREQAM, Université de la Méditerranée et EUREQua, Université Paris I*
Gilles Rotillon, *THEMA, Université Paris X-Nanterre*

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=XXXXXX>

The opinions expressed in this paper do not necessarily reflect the position of
Fondazione Eni Enrico Mattei

Equilibrium with a Market of Permits

Summary

In this paper we present the main results of three original studies on the equilibrium with a market of tradeable permits in a static framework. In first study, we have considered an international equilibrium of two countries which depend on the quantity of permits to each country. The allocation is efficient if and only if it is proportional to efficient labor. A redistribution in favor of the less developed country implies a redistribution to this country but leads to a dilemma with efficiency. In the second study, we analyze the consequences of the choice between giving free permits to firms and other possibilities. We show that for equalizing incomes of production factors with their marginal productivities, each factor should receive a quantity of free permits proportional to its contribution to production. In the third study, we consider the partial equilibrium of an industry where each firm is characterized by a parameter combining production efficiency and pollution effect. We define a theoretical indicator of environmental efficiency and we analyze its properties.

Keywords: Pollution permits, Capital allocation, International equilibrium, Factor income, Environmental efficiency

JEL Classification: D50, F02, F18

Address for correspondence:

Gilles Rotillon
SEGMI
Université Paris X-Nanterre
200 Avenue de la République
92001 Nanterre cedex
France
Phone: 01 40 97 78 19
Fax: 01 40 97 78 19
E-mail: gilles.rotillon@u-paris10.fr

1 General introduction

Since the Kyoto agreement of 1997, the idea of setting up pollution rights as an instrument of environmental policy for the reduction of greenhouse gases has progressed. Tradeable permits were first brought into use in 1975 by the US Environmental Protection Agency (EPA) to reduce air pollution. In 1995, an emission trading programme started in the United States to reduce sulphur dioxide (SO₂). In Denmark, an emission trading system for electricity generators was established by the Danish CO₂ *Quota Act* passed by the Danish Parliament in 1999. Other markets of permits have been experimented (tradeable quotas are used to regulate fisheries in New Zealand and in the European Union (EU))(see Noll 1982, Hahn 1989, Kete 1992, Stavins and Hahn (1993), Tietenberg (2003)) . All these experiences use grandfathering to distribute permits to polluters with an exception for the sulphur reduction programme, in which 2.8% of the permits are auctioned each year.

Recently, a study by the Congressional Budget Office (2000) suggests that if grandfathered permits were used to reduce carbone emissions, low-income households might “loose” several hundred dollars per year while wealthy households could be better-off by “gaining” some \$1,500 per year. As shown by Parry (2002), “grandfathered permits create windfall gains for shareholders, who are concentrated in high-income groups, because such policies hand out a valuable asset to firms for free. There is no windfall gain to wealthy households under auctioned permits or emissions taxes ; instead, the government obtains revenues that can be recycled in tax reductions that benefit everyone or disproportionately favor the poor”.

One of the most interesting developments in environmental policy in recent years has been the emergence of global environment as a North-South issue. The close link between global environment and development calls for new insights. In a world of global externalities, national policies have important international repercussions through trade and factor mobility. To be sure that the full impact of environmental policies can be analyzed through to its ultimate effects on factor markets, income and pollution, a general equilibrium approach is needed.

Since Dales (1968), the literature (see for example Baumol and Oates 1998, Pearce and Turner (1990), Cropper and Oates 1992, Tietenberg (1999), Pezzey (2002), Schneider and Wager (2003)) on pollution permits system underline several questions on distribution scheme, on the definition of an international allocation rule for the initial distribution of permits, on the efficiency in the international context, *i.e.* How much does the point of acquittal matter? Do free permits distort competition by creating barriers to entry? Are free permits assigned to sectors or firms? Initial allocation should be based on per capita emission, relative historical responsibility, Size

of population,...? What should be the interaction between international and domestic policies?...

Among these questions, we consider in this paper the three following: Which are the consequences of different allocation rules of permits? Which are the redistribution effects on income distribution of the policy choice of the initial allocation of permits; grandfathering *versus* auctioneering? Does the efficiency of a permit market allow to define the environmental efficiency of different technologies?

In this paper, we refer to three studies on equilibrium with permit market (Jouvet, Michel, and Rotillon (JMR) (2002, 2003 a, 2003 b). These papers analyze important consequences of the attribution of permits to firms, studying capital movements, income distributions and technologies efficiency. We present here the main conclusions of these papers and make a special section of political application. Capital movement and income distributions are studied in a model of international equilibrium. The efficiency is analyzed in a partial equilibrium framework considering an industry (given the wage and the demand function).

The paper is set out as follows. Section 2 presents the general framework. Section 3 study the capital allocation at the international equilibrium. In section 4, we analyze the factor income distribution. Section 5 studies the environmental efficiency and section 6 concludes.

2 General framework

Our three studies use the same basic framework, which we present now, for the definition of technologies, the behavior of firms and the equilibrium conditions on the capital market, labor markets and the permits market.

2.1 Production technology

A usual formulation of production with emission of pollutant assumes a neo-classical function homogeneous of degree one with respect to capital, K , labor, L , and emissions, E :

$$Y = G(K, L, E) \tag{1}$$

A typical problem results from the use of a free input when there is no restriction on it. In the literature there are some standard answers (see Turner and Pearce (1990), Baumol and Oates (1998)).

Sometimes one ignores the problem, assuming directly in the economy some quotas or taxes on the free input. In this kind of approach the competitive equilibrium without policy regulation is not defined (see for example Ono (2002)).

Another answer is to impose an upper-bound on emissions, often given exogenously (see for example Jouvét, Michel and Vidal (2000)).

A more technical answer considers a function $G(\cdot)$ non monotonic with respect to emissions (Montgomery (1972)).¹

¹Such a formulation with a negative effect of the stock of pollution on production is often used for dynamics studies (Howarth and Norgaard (1992)).

An interesting way to define a limit on emission is based on the notion of an index of technology used due to Stokey (1998). This index z satisfies $z \leq 1$ and is applied to potential output, $F(K, L)$. F is a standard neo-classical production function homogeneous of degree one with respect to capital, K , and labor, L . Production is

$$Y = zF(K, L) \tag{2}$$

The ratio of emissions on output is an increasing continuous function φ of z

$$\frac{E}{Y} = \varphi(z) \tag{3}$$

or equivalently

$$\frac{E}{F(K, L)} = \psi(z) \tag{4}$$

where $\psi(z) = z\varphi(z)$ is also increasing. Without loss of generality, we assume that $\psi(\cdot)$ is defined and invertible on \mathbf{R}^+ . Eliminating z between (2) and (4) allows to define the following production function homogeneous of degree one:

$$\Phi(K, L, E) = \psi^{-1}\left(\frac{E}{F(K, L)}\right)F(K, L) \tag{5}$$

Production is equal to this function if and only if the index is lower than 1, $z \leq 1$, *i.e.* $Y \leq F(K, L)$. Thus, the three factors production function corresponding to the formulation with an index of technology used is,

$$Y = G(K, L, E) = \min\{F(K, L), \Phi(K, L, E)\} \tag{6}$$

This gives production as a function homogeneous of degree one of capital, labor and emissions. This function is not differentiable at the points such

that the two terms $F(\cdot)$ and $\Phi(\cdot)$ are equal. In the papers [1] and [3], we use the following Cobb-Douglas formulation:

$$F(K, L) = AK^\alpha L^{1-\alpha} \quad (7)$$

and

$$\phi(z) = bz^\beta \quad (8)$$

with $A > 0$, $\alpha \in]0, 1[$, $b > 0$ and $\beta > 0$. Then, $\Phi(\cdot)$ is also a Cobb-Douglas function,

$$\Phi(K, L, E) = A^{\frac{\beta}{1+\beta}} b^{\frac{-1}{1+\beta}} K^{\frac{\alpha\beta}{1+\beta}} L^{\frac{(1-\alpha)\beta}{1+\beta}} E^{\frac{1}{1+\beta}} \quad (9)$$

2.2 Firms' behavior

Firms are perfectly competitive and produce an homogeneous good which is taken as numeraire. The competitive firm has a stock of installed capital K and a stock of permits \bar{E} . At given q , the price of permits and w , the wage rate, a firm chooses the index of technology, z , labor, L and emissions, E , in order to maximize its net revenue $zF(K, L) - wL - q(E - \bar{E})$ subject to emissions condition $E = \psi(z)F(K, L)$.

The optimal value of z is

$$z = \min\{1, \psi'^{-1}(1/q)\} \quad (10)$$

the solution of $\max_{0 \leq z \leq 1} z - q\psi(z) \equiv m(q)$. The optimal choice of labor satisfies,

$$w = m(q)F'_L(K, L) \quad (11)$$

and the corresponding net revenue is,

$$\pi = m(q)KF'_K(K, L) + q\bar{E} \quad (12)$$

This net revenue is distributed to shareholders, the owners of the capital stock. An important property is that return to capital does depend on the quantity of permits attributed to the firms and this property has an important consequence on the equilibrium.

2.3 Equilibrium conditions

The equilibrium in the labor market and in the permits markets implies the equality of demand and supply. The equality of return to capital in all firms results from the arbitrage property. It implies that the allocation of capital at equilibrium will depend on the attribution of permits to firms. In fact, if free permits are given to firms, at the equilibrium the return to capital is generally not equal to the marginal productivity of capital.

3 The capital allocation at the international equilibrium

JMR (2002) consider two countries producing the same good homogenous with the same Cobb-Douglas production technology of capital and labor, and an index of technology used.

For country i , with capital K_i , efficient labor H_i and index of technology $z_i \leq 1$, the production is defined by

$$Y_i = z_i AK_i^\alpha H_i^{1-\alpha} \quad (13)$$

with $A > 0$ and $\alpha \in]0, 1[$. The ratio of emissions E_i on production Y_i is

$$\frac{E_i}{Y_i} = bz_i^\beta \quad (14)$$

with $b > 0$ and $\beta > 0$.

The efficient labor supply and the quantity of permits \bar{E} are given for each country, $i = 1, 2$. The total world capital stock \bar{K} is given and assuming that there is not international mobility of labor, we study its allocation which equalizes the returns in the two countries in the framework of a general equilibrium with an international market of permits.

3.1 Study of the equilibrium

With the equilibrium price $q \geq 0$ on the market of permits, competitive firms in country i maximize $z_i - qbz_i^{1+\beta}$ subject to $z_i \leq 1$. Thus the index of technology used is the same in both countries:

$$z_i = z(q) \equiv \min\left\{1, \left(\frac{1}{qb(1+\beta)}\right)^{\frac{1}{\beta}}\right\} \quad (15)$$

The equilibrium wage in country i is equal to the marginal productivity of labor:

$$w_i = (1 - \alpha)m(q)AK_i^\alpha H_i^{-\alpha} \quad (16)$$

where $m(q) = z(q) - qbz(q)^{1+\beta}$. And the income net of wage and of cost of additional permits is

$$\pi_i = \alpha m(q)AK_i^\alpha H_i^{1-\alpha} + q\bar{E}_i \quad (17)$$

Using $E_i = bz(q)^\beta Y_i$ and $Y_i = z(q)AK_i^\alpha H_i^{1-\alpha}$, we obtain the following relation:

$$\pi_i = \alpha \left(\frac{1}{bz(q)^\beta} - q \right) E_i + q \bar{E}_i \quad (18)$$

The equilibrium of the market of permits implies $E_1 + E_2 \leq \bar{E}_1 + \bar{E}_2$ with equality if $q > 0$.

The equilibrium of the market of capital implies $K_1 + K_2 = \bar{K}$ and $\pi_1/K_1 = \pi_2/K_2$.

In a world without permits, the equilibrium values of production, Y_i^0 , capital stock, K_i^0 , and emissions, E_i^0 are proportional to the efficient labor supplies, H_i . Then, the total production, $Y_1^0 + Y_2^0$, is equal to the potential world output, \mathcal{Y} ,

$$Y_1^0 + Y_2^0 = A(H_1 + H_2)^{1-\alpha} \bar{K}^\alpha \equiv \mathcal{Y}(\bar{K}) \quad (19)$$

and so the total emissions are

$$E_1^0 + E_2^0 = b\mathcal{Y}(\bar{K}) = \tilde{E} \quad (20)$$

The same equilibrium occurs in the world with permits if and only if $\bar{E}_1 + \bar{E}_2 \geq \tilde{E}$ and in this case the equilibrium price of permits, q^0 , is equal to zero (region A on figure 1).

When the total number of permits is sufficiently low, there exists an unique world equilibrium with under-use of potential output, *i.e.* $z^* = z(q^*) < 1$. The equilibrium ratio of emissions, $e^* = E_2^*/E_1^*$, is a function of the given values of the two ratios: $\mu = H_2/H_1$ of efficient labors and

$\bar{e} = \bar{E}_1/\bar{E}_2$ of initial allocations of permits. Only if the two ratios are equal, $\bar{e} = \mu$, the equilibrium ratios of capital stock, productions and emissions are equal and proportional to the ratio of efficient labors, and then there is no inefficiency.

If the two ratios of efficient labors and of allocations of permits are different, say for example $\mu < \bar{e}$, then the equilibrium ratio e^* satisfies: $\mu < e^* < \bar{e}$. Then, the capital allocation satisfies

$$(K_2^*/K_1^*)^\alpha = e^* \mu^{\alpha-1} \quad (21)$$

and there is an inefficiency of capital allocation which results from the effects of the permits allocation on the return to capital. The world production can be increased by re-allocating capital and keeping the same total world emission. This property leads to a reduction factor, $\gamma^* < 1$, such that the total production is $Y_1^* + Y_2^* = \gamma^* z^* \mathcal{Y}(\bar{K})$, z^* being defined by the corresponding total emissions

$$\gamma^* (z^*)^{1+\beta} b \mathcal{Y}(\bar{K}) = \bar{E}_1 + \bar{E}_2 \quad (22)$$

The larger the gap between the ratio of efficient labors, μ , and the ratio of allocations of permits, \bar{e} , the smaller the value of the reduction factor, γ^* . This conclusion corresponds to the region B on figure 1 which is characterized by the condition:

$$\bar{E}_1 + \bar{E}_2 < \gamma^* b \mathcal{Y}(\bar{K}) \quad (23)$$

For the intermediary values of total number of permits (region C on figure 1) which are characterized by

$$\gamma^* b \mathcal{Y}(\bar{K}) \leq \bar{E}_1 + \bar{E}_2 < \tilde{E} \quad (24)$$

there is full-use of potential output in the two countries with a positive price of permits $q^* > 0$, *i.e.* $z^* = z(q^*) = 1$. This has an inefficiency effect on the capital allocation if $\bar{e} \neq \mu$. Then there is a reduction factor, $\hat{\gamma}$, which has similar properties as in region B and satisfies:

$$\hat{\gamma}b\mathcal{Y}(\bar{K}) = \bar{E}_1 + \bar{E}_2 \quad (25)$$

The three regions A, B, C of the international equilibrium are represented on the following figure with coordinate the quantity of permits attributed to country 1, \bar{E}_1 and to country 2, \bar{E}_2 ,

INSERT FIGURE 1

Regions corresponding to different equilibria.

3.2 The economic consequences of attribution rules of permits

We consider rules of attribution of permits based on the equilibrium variables in the world without permits. At this equilibrium production, capital and emissions are proportional to the ratio of the efficient labors.

A grandfathering rule attributes permits proportionally to these variables and thus to efficient labor. Then the equilibrium with an international market of permits is simply a proportional reduction of productions and emissions resulting from the common index z^* . There is no change of capital allocation. Such a rule is efficient since it leads to the maximum of the world production subject to a given total emission of pollutants.

Consider now an attribution rule proportional to population.

Defining human capital in a country i as the ratio of efficient labor H_i on population N_i , $h_i = H_i/N_i$, we assume $h_2 < h_1$, and we consider the following population attribution rule,

$$\bar{e} = \frac{\bar{E}_2}{\bar{E}_1} = \frac{N_2}{N_1} > \frac{H_2}{H_1} = \mu \quad (26)$$

We can interpret this world as representing a North-South distinction in which the South (country 2) has a lower human capital level than the North (country 1) (see Copeland and Taylor (1994)). Such an attribution is beneficial for the South since at the international equilibrium with the same total emissions (or permits) as in the grandfathering rule, the South produce more, it is a net seller of permits and receives more capital. But it also pollutes more and the total world production is reduced. There is a dilemma between efficiency and redistribution.

Another rule would be to attribute permits proportionally to the per capita variables of the equilibrium in the world without permits. This rule implies

$$\bar{e} = \frac{Y_2^0/N_2}{Y_1^0/N_1} = \mu \frac{N_1}{N_2} \quad (27)$$

This attribution is in favor of the lowest population country.

4 Market for pollution permits and factor income

In this section, we refer to JMR (2003 a) and we study some consequences on the equilibrium of an international allocation of permits assuming that a fraction, f , of permits, \bar{E} , is allocated freely to firms, $\bar{E}^F = f\bar{E}$, while the remainder is auctioned, $\bar{E}^G = (1 - f)\bar{E}$. We consider a model with n identical countries. This assumption leads to a symmetric equilibrium with $K_i = \bar{K}/n$, $L_i = \bar{L}/n$ for $i = 1, \dots, n$, where \bar{K} is the total capital stock and \bar{L} is the total labor in the economy.

In this framework, we analyze the effect of the market for permits on the equilibrium wage, w and on the income of shareholders, π . The introduction of a market of permits always decreases the wage rate but it may decrease or increase profits. It increases profits if restrictions on emissions are not too strong and the fraction of permits allocated to firms is large enough. We show that there is another allocation which restores the neo-classical equilibrium property of the equality between factor income and marginal productivity.

4.1 Equilibrium

4.1.1 The equilibrium with full-use of potential output

In an equilibrium with full-use of potential output, we have $z^* = 1$ and emissions are equal to potential emissions $\tilde{E} = \psi(1)F(\bar{K}, \bar{L})$. There are two possibilities.

If $\bar{E} > \tilde{E}$ (excess supply on the market for permits) the equilibrium price of permits is zero then the net value $m(q^* = m(0))$ is equal to one, and $E^* = \tilde{E}$. The equilibrium wage and rate of return on capital are equal to

their marginal productivities, $w^* = F'_L(\bar{K}, \bar{L})$, $\pi^*/K(\bar{K}, \bar{L})$.

The other possibility arises when $\bar{E} = \tilde{E}$. Then, any value of q^* between zero and \bar{q} is an equilibrium price for permits. All permits are used but there is no transaction on the market for permits. Nonetheless, the fact that $q^* > 0$ affect factor income. In particular, $w^* = m(q^*)F'_L(\bar{K}, \bar{L})$ is smaller than the marginal productivity of labor because $m(q^*) = 1 - q\psi(1) < 1$.

4.1.2 The equilibrium with under-use of potential output

When $\bar{E} < \tilde{E}$ we have necessarily $E^* = \bar{E}$ in the symmetric equilibrium and $\psi(z(q^*)) = \frac{E^*}{F(\bar{K}, \bar{L})} < \frac{\tilde{E}}{F(\bar{K}, \bar{L})} = \psi(1)$. There exists a unique \bar{z} , $0 < \bar{z} < 1$ solution of $\psi(\bar{z}) = \frac{\bar{E}}{F(\bar{K}, \bar{L})}$. Therefore, the equilibrium price of permits is given by $q^* > \bar{q}$ solution of $z(q^*) = \bar{z}$

4.2 Effect on factor income

4.2.1 Wage and profit

When the equilibrium price for permits, q^* , is equal to zero, factor incomes are equal to their marginal productivities. When the equilibrium price is positive the equilibrium wage and profit are affected by the permits value,

$$w^* = m(q^*)F'_L(\bar{K}, \bar{L}) = z^*\theta^*F'_L(\bar{K}, \bar{L}), \quad (28)$$

with

$$\theta^* = 1 - \frac{\psi(z^*)}{z^*\psi'(z^*)} < 1.$$

Since $\theta^* < 1$, the equilibrium wage rate is smaller than the marginal productivity of labor $\partial Y/\partial L$. The factor θ^* is equal to $1 - 1/\varepsilon_\psi^*$ where ε_ψ^* is the elasticity of ψ in z^* . This is a consequence of costly pollution permits.

The profits per unit of capital is

$$\frac{\pi^*}{\bar{K}} = m(q^*)F'_K(\bar{K}, \bar{L}) + q^* \frac{\bar{E}^F}{\bar{K}} = \theta^* \frac{\partial Y}{\partial K} + q^* \frac{\bar{E}^F}{\bar{K}}. \quad (29)$$

The factor θ^* applies also to the marginal productivity of capital, but the value of permits given to the firm is added.

In the special case where all permits are auctioned ($f = 0, \bar{E}^F = 0$), the two equilibrium returns of the production factors are proportional to marginal productivities.

$$w^* = \theta^* \frac{\partial Y}{\partial L} \quad \text{and} \quad \frac{\pi^*}{\bar{K}} = \theta^* \frac{\partial Y}{\partial K}. \quad (30)$$

The same factor θ^* applies to the marginal productivities and it is smaller than one if there is under-use of potential output. We show that the equilibrium with a market for permits coincides with the equilibrium with a tax q^* on emissions, *if and only if* all permits are charged to firms (see JMR (2003 a)).

4.2.2 The possibility of increased profits

When $\bar{E} = \tilde{E}$, $q^* > 0$, $z^* = 1$ and $\theta^* < 1$. The factor θ^* applies to wages. But there exist a possibility of increased profits. A first condition for profits to increase is that the equilibrium index z^* should be close enough to 1. This means that the restriction on emissions should be not too strong. A second condition requires a positive upper bound on the proportion of auctioned permits, or equivalently a lower bound, which is smaller than one, on the fraction of free of charge permits. With these two conditions in the equilibrium with an active market of permits ($q^* > 0$), profits are larger than

in the economy without permits. For example, considering a Cobb-Douglas production technology with $\alpha = 1/3$, $\beta = 2$, and a ratio of emissions on production larger than 0.7, if all permits are free of charge ($f = 1$), and the amount of permits reduces production from less to 30%, profits are increased and all the burden are financed by the reduction of wages.

4.3 A fair and efficient distribution of pollution permits

When some free permits are distributed to firms, the equilibrium does not satisfy the neo-classical properties of equality of factor income with marginal productivity. There exist a distribution of permits which restore this equilibrium property. Moreover, the problem of the use of the auction's revenue by the government can be avoided by allocating in a correct way permits to the firms and to the wage earners. This allocation corresponds to attribute freely all permits to firms, \bar{E}^F and workers \bar{E}^L , proportionally to their contribution to production, *i.e.* $\bar{E}^F = \bar{E}(KF'_K/F)$ and $\bar{E}^L = \bar{E}(LF'_L/F)$.

According to neo-classical theory, if there is some external effect linked to production, the additional income or cost should be shared between inputs proportionally to there contributions to production. As we have seen giving permits to firms leads to a bias that benefits shareholders. It is even possible that it increases profits. This pleads in favor of an auction scheme, but does not solve the government's redistributive problem. We show that a fair and efficient solution exists, that consists in allocating free of charge permits to production factors proportionally to their contribution to production. In fact, grandfathered permits do not necessarily create windfall

gains for shareholders if their allocation is judiciously made to all production factors.

5 Environmental efficiency

In JMR (2003 b) we study an industry with n firms. These firms produce a same good with Cobb-Douglas technologies which differ by productivity and emission.

Pollution is restricted by a tradable market of permits in the industry. Firm i receives a stock of permits \bar{E}_i , $i = 1, \dots, n$, which it can buy or sell on a market of permits and decides its level of production and so of emission.

The price of input (wage rate, w) and demand curve to the industry are given: $p(Y)$ is the inverse demand curve with $p'(Y) < 0$.

5.1 The equilibrium

First, we assume that each firm i is endowed by a specific technology characterized by two parameters B_i and b_i , respectively productive efficiency and pollution effect.

Each firm i , $i = 1, \dots, n$, produces the same good with labor L_i and the potential output is

$$\tilde{Y}_i = B_i L_i^\alpha \tag{31}$$

with a given stock of capital $B_i = AK_i^{1-\alpha} > 0$ and $0 < \alpha < 1$.

Firms are competitive, considering prices as given: p of the produced good, w of labor and q of permits. Each firm i holds a given stock of permits \bar{E}_i and, like in the two precedent papers, its maximizes its profit (including the net gains on the permits market)

$$pY_i - wL_i + q(\bar{E}_i - E_i) \quad (32)$$

This implies

$$\frac{L_i}{Y_i} = \frac{\alpha\beta}{1 + \beta} \frac{p}{w} \quad (33)$$

At the equilibrium the ratio of productions is equal to the ratio of environmental efficiency factors. More precisely, we have the following result,

For two firms i and j such that $z_i < 1$ and $z_j < 1$ the ratios of emissions, output and labor are equal to the ratio of environmental efficiency factors,

$$\frac{E_i}{E_j} = \frac{Y_i}{Y_j} = \frac{L_i}{L_j} = \frac{D_i}{D_j}$$

where $D_i = (b_i^{1/\beta} B_i)^{\frac{1}{1-\alpha}}$

This result implies that at equilibrium (with $z_i < 1, \forall i$) labor, production and emissions of any firm i are proportional to there total levels in the industry. The coefficient of proportionality is determined by the environmental efficiency factors, $D - i$

$$\frac{L_i}{L} = \frac{Y_i}{Y} = \frac{E_i}{\bar{E}} = \frac{D_i}{\sum_{j=1}^n D_j} \equiv \zeta_i$$

The contribution of firm i to the total output is given by ζ_i which is proportional to $D_i = \left(b_i^{-\frac{1}{\beta}} B_i\right)^{\frac{1}{1-\alpha}}$. The environmental efficiency factor.

We show that the existence of an equilibrium with under-use of potential output by all firms implies that total emission \bar{E} is lower than an upper bound \bar{E}_0 . For all $\bar{E} < \bar{E}_0$, the equilibrium is unique and does not depend on the allocation of \bar{E} between firms.

5.2 Efficiency of production for given total permits

We propose an extension of the notion of productive efficiency including the environmental aspects. This is obtained with a combination of the two parameters of efficiency, the usual productive efficiency B_i and the pollution effect b_i , emission per unit of production. As we shall see, the following definition is useful in order to select the “best” technology in terms of both production and environmental quality.

Definition 1 *The environmental efficiency factor D_i of firm i combines the production efficiency factor B_i and the coefficient b_i of pollution emission, in the following way*

$$D_i = \left(b_i^{-\frac{1}{\beta}} B_i \right)^{\frac{1}{1-\alpha}} \quad (34)$$

If all firms have the same size, comparison between their environmental efficiency is equivalent to compare their environmental efficiency factors D_i . JMR (2003 b) show that *the larger the environmental efficiency factor, the larger the firm’s contribution to total production. In different economies with n firms having the same amount of labor and the same total pollution, the larger the sum of environmental efficiency factors, the larger total production.*

The classical framework of the Data Envelopment Analysis applied to environmental analysis (see Färe *et al.* (1989)) may be illustrated in our theoretical model. With the equilibrium condition $L_i/L = D_i/D$, we obtain the following relation between production and emissions depending on D_i .

$$Y_i = \left(\frac{L}{D} \right)^{\alpha \frac{\beta}{1+\beta}} D_i^{\frac{\beta}{1+\beta}} E_i^{\frac{1}{1+\beta}} \quad (35)$$

On figure 1 the corresponding curves are represented for different values of D_i and the equilibrium points are on the intersection with the line $Y_i/E_i =$

Y/\bar{E} . This line is the convex hull of the set of equilibrium pairs of production and emission. Our theoretical study allows to define the "best technology" in terms of environmental efficiency (D_1 in Figure 2).

Insert Figure 2

Note that some standard empirical environmental indicators may lead to a different order of environmental efficiency. Consider for example the ratio of emission on production (Jaggi and Freedman (1992)). In our model, in the equilibrium with a market of permits, this ratio is the same for all firms. The historical value of this ratio (without permits) $E_i/Y_i = b_i$ also does not give the same order as our environmental efficiency factors D_i , except if all B_i are equal.

Until now, we have consider that the production efficiency factors B_i are given. But, these factors can be considered as fixed only in the short run. In fact, there may be a size effect which we now explicit simply as a capital stock.

5.3 Capital stock and environmental efficiency

Assume now that the firm i has a capital stock, K_i and that the efficiency factor of production is

$$B_i = A_i K_i^{1-\alpha} \tag{36}$$

Then the potential output $\tilde{Y}_i = A_i K_i^{1-\alpha} L_i^\alpha$ is homogenous of degree one with respect to the two factors capital and labor.

In the long run, the productive efficiency is now characterized by A_i and the pollution technology is always characterized by b_i . With $B_i = A_i K_i^{1-\alpha}$,

the environmental efficiency factor,

$$D_i = (b_i^{-1/\beta} A_i)^{\frac{1}{1-\alpha}} K_i = \Delta_i K_i \quad (37)$$

is proportional to the capital stock. The factor of proportionality is $\Delta_i = (b_i^{-1/\beta} A_i)^{\frac{1}{1-\alpha}}$ which combines the efficiency factor of production, A_i and the factor of emissions, b_i . Δ_i is the environmental efficiency factor per unit of capital. The total production of firms is given by $Y = D^{(1-\alpha)\frac{\beta}{1+\beta}} \bar{E}^{\frac{1}{1+\beta}} L^{\alpha\frac{\beta}{1+\beta}}$ with

$$D = \sum_{i=1}^n D_i = \sum_{i=1}^n (b_i^{-1/\beta} A_i)^{\frac{1}{1-\alpha}} K_i \quad (38)$$

If capital could be reallocated, the maximum of production would be obtained by reallocating it to the firms having the largest efficiency factor per unit of capital and we obtain the following result,

Given a total stock of emission permits $\bar{E} < \bar{E}_0$ and a total stock of capital in the industry $\bar{K} = \sum_{i=1}^n K_i$, total production is maximum when all the capital stock is installed in firms which have the highest environmental efficiency factors per unit of capital.

In the short run, with the capital stocks are installed, the policy of allocation of permits has no effect on the short run equilibrium. Nevertheless, such a policy has an important effect on the profits per unit of capital of the firms and on future capital stocks.

5.4 Consequences of permits' allocation on the profitability of the firms

We also study two kind of allocation: grandfathering and an allocation of permits proportional to capital. We first show that the profit per unit of

capital depends both on environmental efficiency and, on permits' allocation. More precisely, we have,

The profit per unit of capital of the firm i is the sum of the benefits from the permits allocated to the firm and a net unitary profit which is proportional to the environmental efficiency factor per unit of capital.

Is an allocation policy in favor of the most environmental efficient firm ?

The allocation of permits proportional to capital implies that the most profitable firms are those having the largest environmental efficiency factor per unit of capital.

Indeed, with such an allocation all the ratios $\frac{\bar{E}_i}{K_i}$ are equal and we have $\frac{\pi_i}{K_i} > \frac{\pi_j}{K_j}$ if and only if $\Delta_i > \Delta_j$.

In practice, permits are not given proportionally to capital but allocated by grandfathering. If we note E_i^0 the emissions of firm i in the economy without permits, we have

$$\frac{E_i^0}{K_i} = b_i A_i^{\frac{1}{1-\alpha}} \left(\frac{\alpha p^0}{w} \right)^{\frac{\alpha}{1-\alpha}} \equiv G_i \left(\frac{\alpha p^0}{w} \right)^{\frac{\alpha}{1-\alpha}}$$

A grandfathering allocation is defined by a reduction factor of emission $\theta, 0 < \theta < 1, \bar{E}_i = \theta E_i^0 \forall i$.

Clearly, the order resulting from grandfathering ($G_i < G_j$) is different from the order of environmental efficiency (per unit of capital), except if the b_i 's are equal. More precisely, in the grandfathering allocation, the ratio of profits per unit of capital is independent of the reduction factor of emission.

Last, we show that in the simple case where all capital stocks are equal, *grandfathering may lead a more environmental efficient firm to have a lower profit per unit of capital.*

6 Conclusion

We have first investigated the economic consequences of different allocation rules of permits on the international equilibrium in a two-country model with capital and permit market. We have studied permit allocation rules proportional to production, emissions, physical capital (in level or *per capita*) and to population. We provide a full description of the international equilibrium for all initial allocations of permits. A permit market does not modify the competitive world equilibrium without permits when the total allocation is large enough. When it is not, there exists a unique equilibrium with under-use of the technology, or with full use of the technology in the two countries.

Given the total capital stock, capital mobility and fixed labor, the maximum of the world production subject to a total emissions constraint is reached at the equilibrium obtained by an allocation rule which is proportional to efficient labor (which include the grandfathering rule). They imply proportional reduction of pollution in all countries and have no effect on international capital allocation, under the assumption of the same technology in all countries.

The population allocation rule benefits for developing country (South) in every respects : production, capital transfert and income from the permit market. Nevertheless, *per capita* income remains lower in the developing country.

Per capita allocation rules have different size effects, depending on the ratio of population in the two countries. With the same level of population, the *per capita* rules lead to the efficiency allocation, and thus performs exactly like the level allocations rules. With a different level of population, the developing country benefits if and only if it has a lower level of population

than in the developed country which benefits in the opposite case.

Our results shed some light on the recurrent discussion between countries about the initial distribution of permits in a tradeable market. Regarding efficiency, the level allocation rules seems to be the best. But it does not allow for any evolution of the relative income between countries. This shows that the allocation of permits induces a dilemma between efficiency and development.

Our second paper study some consequences of an international allocation of permits assuming that a fraction of permits is allocated freely to firms, while the remainder is auctionned. We consider a model of international equilibrium with n identical countries. The assumption of countries using the same technology to produce the same good leads to a symmetric equilibrium. We analyze the effect of the market for permits on the equilibrium wage rate and on the income of shareholders. We show that the allocation of permits have some consequences on factor income. Giving permits to firms effectively leads to a bias that benefits to shareholders and the equilibrium does not satisfy the neo-classical properties of equality of factor income with marginal productivity . It is even possible that it increases profits (when restrictions on emissions are not very strong). This pleads in favor of an auction scheme, but does not solve the government's redistributive problem (the so-called "double-dividend" problem). We show that a fair and efficient solution exists, that consists in allocating free of charge permits to production factors proportionally to their contribution to production. This distribution of permits restaure the equality of factor income with marginal productivity.

In order to analyze environmental efficiency in an industry with different technologies, we have studied the equilibrium with a market of permits in the third paper. We show that the equilibrium does not depend on the stock

of permits allocated to the firms but on the total stock of permits and for each firm on its technology (including the stock of capital).

We said that, given total emissions, a technology is more efficient than another if it leads to a larger global production. With our model, the analysis of the equilibrium allows to define a theoretical measure of environmental efficiency. Our definition of the "environmental efficiency factor" combines for each firm the two parameters linked to productive efficiency and pollution effects. We show that the larger the environmental efficiency factor, the larger the firm's contribution to total production.

This definition takes into account the other production factors which are fixed. But the long run efficiency factor is defined per unit of capital. A policy of permit's allocation based on the environmental efficiency should take into account the time perspective.

We show that an allocation of permits proportional to capital implies that a firm having a larger environmental efficiency factor than an other has also larger profit per unit of capital. This result does not hold with a grandfathering allocation.

References

- [1] Baumol W. and W. E. Oates (1998), *The Theory of Environmental Policy*, Cambridge University Press.
- [2] Congressional Budget Office (2000), "Who Gains and Who Pays Under Carbon-Allowance Trading? The Distributional Effects of Alternative Policy Designs" Washington D.C.

- [3] Copeland B.R. and Taylor M.C. (1994), "North-South Trade and the Environment", *Quarterly Journal of Economics*, 109, 755-787.
- [4] Dales J.H. (1968), *Pollution, Property and Prices*, Toronto University Press.
- [5] Färe R., S. Grosskopf, Lovell C.A.K. and C. Pasurka (1989), "Multilateral Productivity Comparisons when some Outputs are Undesirable: a Nonparametric Approach", *Review of Economics and Statistics*, 71, 90-98.
- [6] Hahn R.W. (1989), "Economic prescriptions for environmental problems : How the patient followed the doctor's orders", *Journal of Economic Perspectives*, 3, 95-114.
- [7] Jaggi B. and M. Freedman (1992), "An examination of the impact of pollution performance on economic and market performance: pulp and paper firms", *Journal of Business Finance and Accounting*, 19, 697-713.
- [8] Jouvét P. A., P. Michel and J.P. Vidal [2000], "Intergenerational altruism and the environment", *Scandinavian Journal of Economics*, **102**, 135-150.
- [9] Jouvét P.A., Ph. Michel and G. Rotillon (2002), "Capital Allocation and International Equilibrium with Pollution Permit", Working Paper, Université Paris X.
- [10] Jouvét P.A., Ph. Michel and G. Rotillon (2003 a), "International markets for pollution permits and factor income", Working Paper, GREQAM.
- [11] Jouvét P.A., Ph. Michel and G. Rotillon (2003 b), "A theoretical measure of environmental efficiency", Working Paper, Université Paris X.

- [12] Kete N. (1992), "The U.S. acid rain control allowance trading system", *Climate Change - Designing a Tradable Permit System*, Paris OECD.
- [13] Montgomery D. W. (1972), "Markets in Licenses and Efficient Pollution Control Programs", *Journal of Economic Theory*, 395-418.
- [14] Noll R. (1982), "Implementing marketable emission permits", *American Economic Review*, Papers and Proceedings 72, 120-124.
- [15] Cropper, M. L. and W. E. Oates, « Environmental economics : a survey », *Journal of Economics Literature*, 30, (1992), 675-740.
- [16] Parry I.W.H. (2002), "Are Tradeable Emissions Permits a Good Idea?" *Ressources for the Future Issues Brief 02-33*, Washington D.C.
- [17] Pearce D.W. and R.K. Turner (1990), *Economic of natural resources and the environment*, Harvester Wheatsheaf.
- [18] Pezzey John C. V. (2002) "Distributing the Value of a Country's Tradeable Carbon Permits", 2nd CATEP Workshop on the Design and Integration of National Tradeable Permits Schemes for Environmental Protection.
- [19] Stavins R. and R.W. Hahn, (1993), "Trading in Greenhouse Permits : a Critical Examination of Design and Implementation Issues", Faculty Research Working Paper R93-15, Cambridge, Mass.; Harvard University.
- [20] Stokey N. L. (1998), " Are there limits to growth ? ", *International Economic Review*, 39, 1-31.

- [21] Tietenberg T. (1999), "Lessons from Using Transferable Permits to Control Systems in the United State." in Handbook of Environmental and Resource Economics, Edward Elgar, 275-292.D
- [22] Tietenberg T. (2003), "The Tradable Permits Approach to protecting the Commons: What Have We Learned?", Department of Economics, Colby College.

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

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

CTN	79.2004	<i>Rabah AMIR, Effrosyni DIAMANTOUDI and Licun XUE</i> (lxx): <u>Merger Performance under Uncertain Efficiency Gains</u>
CTN	80.2004	<i>Francis BLOCH and Matthew O. JACKSON</i> (lxx): <u>The Formation of Networks with Transfers among Players</u>
CTN	81.2004	<i>Daniel DIERMEIER, Hülya ERASLAN and Antonio MERLO</i> (lxx): <u>Bicameralism and Government Formation</u>
CTN	82.2004	<i>Rod GARRATT, James E. PARCO, Cheng-ZHONG QIN and Annon RAPOPORT</i> (lxx): <u>Potential Maximization and Coalition Government Formation</u>
CTN	83.2004	<i>Kfir ELIAZ, Debraj RAY and Ronny RAZIN</i> (lxx): <u>Group Decision-Making in the Shadow of Disagreement</u>
CTN	84.2004	<i>Sanjeev GOYAL, Marco van der LEIJ and José Luis MORAGA-GONZÁLEZ</i> (lxx): <u>Economics: An Emerging Small World?</u>
CTN	85.2004	<i>Edward CARTWRIGHT</i> (lxx): <u>Learning to Play Approximate Nash Equilibria in Games with Many Players</u>
IEM	86.2004	<i>Finn R. FØRSUND and Michael HOEL</i> : <u>Properties of a Non-Competitive Electricity Market Dominated by Hydroelectric Power</u>
KTHC	87.2004	<i>Elissaios POPYRAKIS and Reyer GERLAGH</i> : <u>Natural Resources, Investment and Long-Term Income</u>
CCMP	88.2004	<i>Marzio GALEOTTI and Claudia KEMFERT</i> : <u>Interactions between Climate and Trade Policies: A Survey</u>
IEM	89.2004	<i>A. MARKANDYA, S. PEDROSO and D. STREIMIKIENE</i> : <u>Energy Efficiency in Transition Economies: Is There Convergence Towards the EU Average?</u>
GG	90.2004	<i>Rolf GOLOMBEK and Michael HOEL</i> : <u>Climate Agreements and Technology Policy</u>
PRA	91.2004	<i>Sergei IZMALKOV</i> (lxx): <u>Multi-Unit Open Ascending Price Efficient Auction</u>
KTHC	92.2004	<i>Gianmarco I.P. OTTAVIANO and Giovanni PERI</i> : <u>Cities and Cultures</u>
KTHC	93.2004	<i>Massimo DEL GATTO</i> : <u>Agglomeration, Integration, and Territorial Authority Scale in a System of Trading Cities. Centralisation versus devolution</u>
CCMP	94.2004	<i>Pierre-André JOUVET, Philippe MICHEL and Gilles ROTILLON</i> : <u>Equilibrium with a Market of Permits</u>

- (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>