

Lise, Wietze

Working Paper

A game model of people's participation in forest management in Northern India

Nota di Lavoro, No. 91.2002

Provided in Cooperation with:

Fondazione Eni Enrico Mattei (FEEM)

Suggested Citation: Lise, Wietze (2002) : A game model of people's participation in forest management in Northern India, Nota di Lavoro, No. 91.2002, Fondazione Eni Enrico Mattei (FEEM), Milano

This Version is available at:

<https://hdl.handle.net/10419/119698>

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.

Fondazione Eni Enrico Mattei

**A Game Model of People's
Participation in Forest
Management in Northern India**

Wietze Lise

NOTA DI LAVORO 91.2002

OCTOBER 2002

ETA – Economic Theory and Applications

Wietze Lise, *Institute for Environmental Studies, Vrije Universiteit
Amsterdam*

This paper can be downloaded without charge at:

The Fondazione Eni Enrico Mattei Note di Lavoro Series Index:
http://www.feem.it/web/attiv/_wp.html

Social Science Research Network Electronic Paper Collection:
http://papers.ssrn.com/abstract_id=XXXXXX

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

A Game Model of People's Participation in Forest Management in Northern India

Summary

People have a marginal role in managing forests located in the vicinity of their villages in Northern India. This situation is scrutinised in this paper by studying strategic play of forest users. Thereto, a 1 versus $n - 1$ game of people's participation in forest management is estimated for three institutional and historical distinct cases at the state and village level. Critical discount factors are derived to verify whether incentives exist for villagers to mutually participate in managing commonly used forests. This paper find such incentives in varying degrees for games at the state level and for games in 28 of the considered 32 villages.

Keywords: Game estimation, repeated games, people's participation, forest management, rural India

JEL: C72, Q20

A former version of this paper has been presented at the Workshop on "Game Practice and the Environment", jointly organised by Università del Piemonte Orientale and Fondazione Eni Enrico Mattei, Alessandria, April 12-13, 2002.

The author appreciates comments from attendants to presentations of previous versions of this paper at the Faculty of Economic Administration and Social Sciences, Bilkent University, Ankara, 12 October 1999, at a Game Theory Seminar Tilburg University, 12 November 1999, at a Workshop on Economic Theory, Economics department, Bilkent University, Ankara, 30 March 2000, and, most recently, at the Game Practice and the Environment workshop in Alessandria, Italy, 12-13 April 2002. The author is grateful for the internal budget of the Institute for Environmental Studies, which enabled the author to finish this paper. Remaining errors are the author's.

Address for correspondence:

Wietze Lise
Institute for Environmental Studies
Vrije Universiteit
De Boelelaan 1087
1081 HV Amsterdam
The Netherlands
E-mail: wietze.lise@ivm.vu.nl

1 Introduction

The role of people in forest management in India has been low. This paper argues that such a marginal role is not justified, given the potential of people to participate voluntarily. A higher level of people's participation may well result in a better quality of the forest, which is both beneficial for the nearby living people and the state.

While most forests in India are under the control of the state, there exist some forests which are managed by nearby living people. Forests are commonly owned by a number of people, in that sense it can be considered as a common-pool resource. The problem of managing a common-pool resource, or simply the common-pool resource problem, has become a topic of debate after the appearance of Hardin's (1968) 'tragedy of the commons.' The 'tragedy of the commons' is rephrased by Stevenson (1991) as the 'tragedy of open access', because the tragedy does not occur in a common property regime, where the rights are well-defined. A well-defined group of users in combination with well-defined rights make a common property regime. The well-functioning of a common property regime depends on the amount of people's involvement.

To analyse the common-pool resource problem, let us distinguish between common-pool resource *situation* and common-pool resource *dilemma* (Ostrom *et al.*, 1994). In a common-pool resource situation there are multiple individuals who are using a common-pool resource. This becomes a common-pool resource *dilemma* when the following conditions hold simultaneously.

1. Individual optimal strategies lead to suboptimal outcomes for the group, due to uncoordinated behaviour.
2. There are institutional feasible alternatives, where collective optimal outcomes can be achieved (ibid.).

The common-pool resource situation does not have to be a dilemma, as Hardin presumes, but in case of a conflict it is useful to know how it can be resolved. The prisoner's dilemma and the chicken's game are typical examples, which satisfies these two conditions.

There is an interesting debate in the literature on how to model a common-pool resource situation

using game theoretic modeling. While such an approach has many similarities to the situation of forest management, it has not been applied to such a situation before. On the one hand, both Ostrom (1990) and Wade (1987, 1988) argue that classical approaches of the ‘tragedy of the commons’ (Hardin, 1968; Hardin and Baden, 1977) and ‘the logic of collective action’ (Olson, 1965) lead to metaphorical policy devices, which cannot be used directly in decision making. On the other hand, Ostrom and Wade are in favor of using game theory for modeling common-pool resource situations. The advantage of simple game theoretic models is that they are easy to understand, while such models can point out conflicts which can emerge when a common-pool resource situation becomes a common-pool resource dilemma.

To solve a common-pool resource dilemma, Wade (1988) pleads for the formation of local organisations for coordinating people’s actions for managing a common-pool resource. Basu and Mishra (1993) argue that there does not need to be a common-pool resource dilemma in a single period in the sense of Wade, but the common-pool resource dilemma shows up in the long run. This can be modeled as a hawk/dove game, where people choose between the *dove* and the *hawk* strategy. Playing *dove* means preserving the common-pool resource, while *hawk* results in exploitation of the common-pool resource. Playing *hawk* too often brings the common-pool resource on the brink of disaster. Hence, degradation of the common-pool resource is not immediately apparent, but it is observed gradually over time.

Runge (1981, 1984, 1986) pleads, as contrary to the common belief that the common-pool resource situation is rather akin to the assurance game, where one prefers to do what the other does, while mutual participation has the highest preference. This is, typically, not a dilemma and it leads to a self-enforceable solution. It explains why ‘the tragedy of the commons’ has not yet emerged on a larger scale.

Hence, strong arguments to model the common-pool resource situation as a prisoner’s dilemma (R. Hardin, 1982; G. Hardin and Baden, 1977; Taylor, 1987; Bendor and Mookherjee, 1987), an assurance game (Runge, 1981, 1984, 1986) and a hawk-dove game (Basu and Mishra, 1993) or, what is the same, a chicken’s game (Taylor, 1987) can be found in the literature. The prisoner’s dilemma and chicken’s

game constitute *collective dilemmas* (Bardhan, 1993a; Bates, 1988). This debate has not yet brought an answer of the same tenor.

Bardhan (1993a, 1993b) goes even further to argue that the common-pool resource dilemma can change from one dilemma to the other or can even be resolved as time goes on. He gives an informal discussion on this transition process. In many practical situations, people face the same choice-situation over and again. Those situations can be modeled as repeated dilemmas (Axelrod, 1984; Kreps *et al.*, 1982; Kreps and Wilson, 1982; Milgrom and Roberts, 1982). A simple way to rationalise cooperation in repeated games is by considering *infinite repetitions*, which is the route of this paper.

It is customary in applied game theory to start with identifying the game in a situation and then continue to discuss the implications. This paper follows the opposite route. The kind of strategic play in the field is not identified beforehand. Instead, the game being played is verified through an econometric technique using primary data from a field survey in rural India, which was an enquiry into people's willingness to participate in forest management (Lise, 1997b, 2001; Lise *et al.*, 2001). The estimation result shows which game the people have been playing at the village and state level. This result is compared with the situation in the field and the implications are discussed.

This paper is set up as follows. Forest management is as a special case of common-pool resource management, about which a number game theoretic models exist. These models form a starting point for setting up a game model of people's participation in forest management (Section 2). Section 3 derives for all generic bi-matrix symmetric games the discount factors, which are used to verify whether incentives exist for people to voluntarily participate in forest management. Section 4 applies the model to three Indian states, namely Haryana, Bihar and Uttar Pradesh. The nature of the data is discussed and the game estimation procedure is explained and performed at the state and village level. The last section provides conclusions and recommendations.

2 The model

In order to study the opportunities of local people to voluntarily participate in the management of forest adjacent to their villages, let us model this as a non-cooperative game. The strategy of a peasant

in rural India is to choose the extent of participation in forest management. Here participation means the amount of involvement of a villager in a local organisation in the village to manage an adjacent forest. Participation also means for a peasant to adhere to rules as formulated during village meetings. Their participation is awarded with the right to (partially) access the forest from which they can collect resources like fuelwood and fodder (=their payoff). Let us refer to this situation as the *participation game*.

The simplest form of such a game consists of only two persons, who have a choice between two alternatives: to participate or not. Let us assume that the players of the game have the same preferences. While villagers generally do not all have the same preferences, there are many situations where they are comparable or where they have equal opportunities.

Considering the motivation above, the participation game can be formalised as follows.

- a. The set of players consists of two persons: $\{1, 2\}$. Let us label the two persons as challenger i and contender $-i$, where the challenger is the person which we consider in the analyses, while the contender represents other persons in the village, which are evaluated in the mind of the challenger.
- b. Player i chooses the level of participation θ_i . For the time being, we only focus on two choices. Then we can abbreviate the set of actions as {Participate, Do not participate}, or in short as $\{P, D\}$.
- c. The payoff to the challenger i is $\pi_i(\theta_i, \theta_{-i})$, where θ_i is the action taken by player i . The total payoff set in the situation with two choice alternatives and two players, consists of four different numerical values: $\{x, y, a, b\}$.

Table 1 shows the payoff matrix of the symmetric two-person repeated game described above. While the game, introduced above, is a two person game, the estimated game in Section 4 is more general, as it is a 1 versus $n - 1$ -person game.

To interpret the estimated games in Section 4, it is useful to classify all generic games. For that, we divide all 24 possibilities for ordering the payoffs a, b, x, y into twelve distinct cases, based on strict

inequalities. Games with equal payoffs are called *transition games*. In 12 cases the game has a unique Nash equilibrium. In 10 of these 12 cases the individual best response matches with the collective preferred outcome. Such a game is called the *Pareto game*. In the remaining two cases, the individual best response conflicts with the collective preferred outcome; the well-known prisoner's dilemma.

The other 12 cases have two pure-strategy Nash equilibria. In 6 of these 12 cases, mutual participation a Nash equilibrium of the game. These games are known as coordination and assurance games. In the other 6 cases, the Nash equilibria have one player participating and the other does not. These games are well-known as the battle-of-sexes and chicken's games.

The coordination and battle-of-sexes games are very similar to, respectively, the assurance and chicken's game. There is, however, a difference. For the coordination and battle-of-sexes games the Nash equilibria payoffs are strictly greater than the remaining payoffs, which is not true for the assurance and chicken's games. Table 2 shows the taxonomy of two-person two-action symmetric games.

3 Critical discount factors of the repeated participation game

The participation game can also be repeated infinitely over time. Such a game can be analysed by considering trigger strategies. Trigger strategies are a code of behaviour, where the players agree to participate until a certain condition is violated, after that they do not participate forever to punish the deviant. Formally, challenger i follows a *trigger strategy* to proceed in the game: $\sigma_{it} = \{\text{"Participate at time } t \text{ as long as a certain condition is satisfied"}\}$.

For analysing repeated games, subgame perfect equilibria generally need to be found. However, in our specific case, it suffices to look at Nash equilibria, as they coincides with subgame perfect equilibria in our case of infinite repetitions and trigger strategies, as such games can be analysed as supergames which are equivalent to normal form games.

The taxonomy of Table 2 will be used to derive necessary conditions under which mutual participation can be sustained in the infinitely repeated participation game. The main question studied is the following: Assuming that both players participate, do they have an incentive to deviate? It is possible

to assign to each game a so-called *critical discount factor*, denote this as ϕ . If the people discount their future –with factor δ which is equal for both players– above the critical discount factor, mutual participation can be sustained in equilibrium. The smaller the value of a critical discount factor, the greater is the likelihood to preserve mutual participation. It is a well-known from the Folk theorem (Fudenberg and Maskin, 1986) that such critical discount factors can be found. Let us consider two special cases first: the prisoner’s dilemma and the chicken’s game.

There exists a conflict between individual and group rationality in the standard repeated prisoner’s dilemma. Mutual participation becomes a possible outcome in the infinitely repeated prisoner’s dilemma if the players follow the following trigger strategy σ_{it}^{pd} , assuming that they started with mutual participation.

$$\sigma_{it}^{\text{pd}} = \begin{cases} \text{P} & \text{as long as } \theta_{t-1} = (\text{P}, \text{P}) \\ \text{D} & \text{if } \exists i \in N, \exists \tau < t : \theta_{i\tau} = \text{D}. \end{cases}$$

This trigger strategy prescribes to participate until a player deviates. After that both players do not participate forever. It is well-known how to calculate the critical discount factor ($\phi^{\text{pd}} = \frac{a-x}{a-y}$) from this trigger strategy (see for instance Stahl (1991)).

The chicken’s game has two pure Nash equilibria: (P,D) and (D,P). Consider the following *complex* trigger strategy:

$$\sigma_{it}^{\text{ch}} = \begin{cases} \text{P} & \text{as long as (1) } \theta_{t-1} = (\text{P}, \text{P}) \text{ or } (\text{D}, \text{D}); \text{ or:} \\ & \text{(2) } \exists \tau < t : (\forall s < \tau : \theta_s = (\text{P}, \text{P}) \text{ or } (\text{D}, \text{D})) \wedge (\theta_{i\tau} = \text{D} \wedge \theta_{-i\tau} = \text{P}) \\ \text{D} & \text{if } \exists \tau < t : (\forall s < \tau : \theta_s = (\text{P}, \text{P}) \text{ or } (\text{D}, \text{D})) \wedge (\theta_{i\tau} = \text{P} \wedge \theta_{-i\tau} = \text{D}) \end{cases}$$

Trigger strategy σ_{it}^{ch} prescribes to *keep on participating as long as the other did not deviate first*. Trigger strategy σ_{it}^{ch} differs from σ_{it}^{pd} , because the deviant returns to participation, when the other person implements the infinite queue of deviations. In this manner, the deviant can ascertain a higher payoff b instead of y . Payoff b is the highest payoff the challenger can get, when the contender deviates, which is the least desirable action. Hence, b is the minimax payoff. When both players follow this behaviour, then the critical discount factor can be derived similarly as in the last case of the prisoner’s dilemma. This yields the following critical discount factor: $\phi^{\text{ch}} = \frac{a-x}{a-b}$.

Consider the following trivial strategy which sustains mutual participation, since it is a Nash equilibrium; ‘mp’ stands for *mutual participation*.

$$\sigma_{it}^{\text{mp}} = \left\{ \begin{array}{l} \text{P} \quad \text{irrespective of the choice of the other player} \end{array} \right.$$

Behavioral strategy σ_{it}^{mp} is not a trigger strategy, because sustainability of mutual participation can be achieved by participating. In that case, the potential deviator has to participate as well in order to maximise his/her payoff ($\phi^{\text{mp}} = 0$).

It is also possible to consider the trivial strategy which sustains mutual non-participation, which is again a Nash equilibrium. Superscript ‘rp’ stands for *reverse Pareto game*:

$$\sigma_{it}^{\text{rp}} = \left\{ \begin{array}{l} \text{D} \quad \text{irrespective of the choice of the other player} \end{array} \right.$$

This is the opposite of the previous strategy, and it recommends to never participate ($\phi^{\text{rp}} = 0$).

Finally, it is also possible that a mix of participation and non-participation is the Nash equilibrium. In that case each player wants to take the opposite action from the other player. Let us refer to these cases as ‘other games’. The strategy σ_{it}^{og} can be described as follows:

$$\sigma_{it}^{\text{og}} = \left\{ \begin{array}{l} \text{P} \quad \text{as long as } \theta_{-i,t-1} = \text{D} \\ \text{D} \quad \text{if } \theta_{-i,t-1} = \text{P} \end{array} \right.$$

In this case, mutual participation cannot take place as well ($\phi^{\text{og}} = 1$).

The question, whether it is profitable to deviate from mutual participation in the past, can be answered by summarising the critical discount factor for every possible game. The result of this section is summarised in the following lemma.

Lemma 1 *If σ_{it}^{ag} in Equation 1 is the code of behavior then mutual participation can be sustained if and only if $\delta \geq \phi$, where ϕ is as given in Table 3.*

$$\sigma_{it}^{\text{ag}} = \left\{ \begin{array}{ll} \sigma_{it}^{\text{pd}} & \text{for the prisoner's dilemma } (a > x > y > b) \\ \sigma_{it}^{\text{ch}} & \text{for the chicken's game } (a > x > b > y) \\ \sigma_{it}^{\text{mp}} & \text{for games with (P,P) a Nash equilibrium } (x > a) \\ \sigma_{it}^{\text{rp}} & \text{for the reverse Pareto game } (y > \max\{b, x\}; a > x) \\ \sigma_{it}^{\text{og}} & \text{for all other games in Table 2} \end{array} \right. \quad (1)$$

4 Estimation of games

4.1 Forest management in three Indian states

In order to apply the game model of people's participation, data is used from a comparative study in three states of India: Haryana, Uttar Pradesh and Bihar. These cases were selected because of their differences with respect to forest quality, kind of forest resources and the way the village council is organised. At the same time these three cases all have in common that they are driven by voluntary people's participation.

In Haryana, the state leases the forest to a number of villages, since 1977. In each village, villagers have formed a council to manage their forest, namely a Hill Resource Management Society (HRMS). All residents of the village became members of that HRMS. In most villages the state has built dams to serve a double purpose: to check soil erosion of the hilly area of the forests and to provide irrigation water to the villagers. In order to share damwater equally, HRMSs allotted water rights to their members, but this did not work in every village. Moreover, a number of dams failed to provide any irrigation water, and land is distributed quite unequally. Besides income derived from damwater, resources like fodder, fuelwood, bamboo and fiber grasses could be collected as well from the forest.

In Bihar, a non-governmental organisation encourages villagers to pool private land for planting trees since 1984. They adopted the Haryana model to the local circumstances in Bihar. The output from the pool is shared equally among its members of the well-organised village committee. One third of the profit goes to the people who pool land, one third to people who plant and maintain the saplings, and one third to the village development fund. The role of the state is negligible in these villages. The people who work on the pool receive a stipend, besides a part of the output from the pool.

In the hilly region of Uttar Pradesh, the state allowed for the creation of forest councils by villagers since 1931. A well-organised forest council decides on how to manage a communal forest. The role of the state in Uttar Pradesh is somewhere between Haryana and Bihar. Resources like fuelwood, fodder and timber can be collected from the forest at a rotation basis in order to preserve the quality of the forest. Land and cattle holding is fairly equal in the hills of Uttar Pradesh and women are involved

in forest management to a larger extent than in Haryana and Bihar.

Table 4 points out the diversity between the three situations of forest management. In total 385 households from 32 villages have been interviewed. I selected representatives of the households randomly, by visiting these villages in 1995 and 1996. The variation in the data sample can be found in Lise (2000). In the field survey, I covered 9, 12 and 11 villages and 127, 123 and 135 households in Haryana, Bihar and Uttar Pradesh. My field survey also yielded a broad range of information about the following groups of socio-economic variables:

- Their attitude to the environment;
- Their attitude to the village council for forest management;
- Ownership of land, cattle and private assets;
- Income from different sources;
- Caste, religion, gender, education, family size, etc.

Table 9 shows a selection of the socio-economic variables which have been constructed from this data.¹

4.2 Games at the state level

The participation game of Section 2 can be quantified as follows (Lise, 2001). The payoff (π_i) is generally derived from the total sum of the amount of resources which are collected by the members of a village council for forest management times the average market value of these products. The payoff in Haryana includes besides fuelwood, fodder, fibre grass, and bamboo also the added value of damwater. The payoff in Bihar consists of the stipend paid to villagers working in the pool and the yield from the common pool. In Uttar Pradesh the payoff solely consists of the market value of collected fuelwood, fodder and timber.

The level of participation (θ_i) of the challenger is constructed in two steps. First, indicators of participation are derived by interviews with members of a village council for forest management. Each member responded to a number of questions about their contribution to, benefit from and

¹The questionnaires can be found in Lise (1997).

involvement in forest management. People can choose their level of participation in many aspects of forest management. These can be broadly divided in three different components.²

- i. Contribution by plantation in and protection of the forest.
- ii. Sharing in the benefits from using the forest.
- iii. Involvement in decision-making and evaluation of forest management.

Their psychological responses are recorded on an integer scale varying from 1 to 5, where a high number represents a high willingness to participate. One way to aggregate such indicators of participation into a level of participation is by performing a factor analysis on these indicators. This is, for example, possible by running the **FACTOR** procedure of SPSS. A factor analysis is a method for translating a large set of variables into the main choice-variable: the principal component. Table 5 shows the first principal component for the three cases considered in this study.

Hence, we have the pair (π_i, θ_i) for all 385 interviewed households across 32 villages in three Indian states. Within a particular village, the level of participation of the contender (ϑ_i) can be calculated by aggregating the level of participation of the *other* villagers. This paper aggregates the level of participation of other villagers in two ways. First by taking the mean, which can be considered as being risk neutral towards the strategy of other players (mean situation). Second by taking variance, where a player is risk averse toward the strategy of other players, as one opposing player gets a high weight in this case (variance situation). This leads to triplet $(\pi_i, \theta_i, \vartheta_i)$.

There is an important distinction between the mean and the variance situation. In the mean situation, a large value of a level of participation always means ‘participate’, while a small value means ‘do not participate’. This is not the case in the variance situation, where the action of the contender is conditional on the action of the challenger. When the variance is small, the actions of the challenger and the contender naturally have to be the same, but when the variance is large, the action of the contender must be *opposite* to the action of the challenger.

A game can be estimated by normalising the levels of participation (θ_i, ϑ_i) of all interviews between 0 and 1. The interviews can then be divided into four *payoff* groups based on these normalised levels

²Refer to Pongquan (1992) for a comparative discussion on the definition of people’s participation.

of participation. One way to do so is by the QUICK CLUSTER procedure of SPSS. The QUICK CLUSTER procedure has the characteristic that the within-group distances are minimised and the between-group distances are maximised. This way of creating four payoff groups is called the *Euclidean cluster method*. Alternatively, the sample could also be split into four payoff groups of equal size, with the help of an EXCEL spreadsheet . The latter way of creating payoff groups is called the *homogeneous grouping method*. Finally, the payoffs can be derived by taking the averages within the payoff group.

Table 6 shows the games at the state level which are estimated using the Euclidean cluster method and the homogeneous grouping method. Furthermore, a distinction has been made concerning the risk perception of the challenger towards the strategy of the contender (mean or variance situation)). Hence, there are four possible outcomes per state. The Euclidean cluster method leads to most reliable result from a game theoretic point of view as the method clusters together villagers with similar levels of participation. Hence, the first 6 games of Table 6 are most likely to represent the actual game being played. There are, however, still two options. Out of these two options, the variance situation seems to provide the best representation of the reality, as the estimation results for the Euclidean cluster method and the homogeneous grouping method are the closest. This implies that the consulted villagers would not mind if all villagers have a the same attitude to the forest, but they seem to be sensitive towards radical different levels of participation of other villagers.

In the case of the Euclidean cluster method and the variance situation, partial participation is observed in Haryana (reverse battle-of-sexes game), conditional participation in Bihar (coordination game) and unconditional participation in Uttar Pradesh (Pareto game). This typically represents the actual situation. Partial participation takes place in Haryana, because of unequal landholding and a great difference between rich and poor. In Bihar the villagers are quite hesitant in pooling their privately owned land, but they are willing to, if others are. In Uttar Pradesh the people in the village are quite equitable and seem to have great stake in participating in forest management. Table 6 shows for the case of the Euclidean cluster method and the mean situation, a higher incentive to participate than in the variance situation. This indicates that, if a villager is risk neutral towards the distribution of the level of participation of other villagers, mutual participation is more likely to emerge.

Table 7 shows the average level of participation (final cluster centers) in each payoff group. It was necessary to consider 5 instead of the usual 4 clusters in the case of Haryana, otherwise the difference between some final cluster center would not be statistically significant. High levels of participation are underlined to distinguish between high and low levels of participation, which we labeled as ‘Participate’ and ‘Do not participate’ in Table 1. From Table 7, we can also see that the number of observations is quite unevenly distributed. While the amount of mutual participation in Haryana is around 28% (payoff group ‘x’), the amount of mutual participation in Bihar and Uttar Pradesh is varying between 62% and 82%.

4.3 Games at the village level

The Eclidean cluster method is used here to derive the games at the state level. This method is not useful for deriving games at the village level as there is not enough information available in one village for estimating a game. In a single village we can observe either equilibrium behaviour or off-equilibrium behaviour. We, crucially, need the variation over a number of villages for spanning the full payoff matrix meaningfully.

I assume here that the homogeneous grouping method can be used to explore games at the village level, in case the estimated games are sufficiently similar to the ones found with the Euclidean cluster method. We can see from Table 6 that the games in Haryana and Bihar are the same and that the game in Uttar Pradesh changes from a Pareto game to a quite similar coordination game.

Let us divide the data into four equally sized payoff groups via the homogeneous grouping method, to explore the games at the village level. Then, we take the payoff as a dependent variable and try to find which socio-economic variables can be included as descriptive variables. This is equal to estimating the following equation, for each payoff group, in each state.

$$\begin{aligned}
\pi = & \beta_1 \text{ ANIMUN} + \beta_2 \text{ AVAGE} + \beta_3 \text{ CAPIT} + \beta_4 \text{ CAPP} + \beta_5 \text{ CASGR} \\
& + \beta_6 \text{ CONPC} + \beta_7 \text{ EDU15} + \beta_8 \text{ EDU7} + \beta_9 \text{ EDUS} + \beta_{10} \text{ FODTOT} \\
& + \beta_{11} \text{ FORDEP} + \beta_{12} \text{ FWTOT} + \beta_{13} \text{ LANDO} + \beta_{14} \text{ NRCH} + \beta_{15} \text{ NRSGE} \\
& + \beta_{16} \text{ RELNR} + \beta_{17} \text{ RES} + \beta_{18} \text{ SEXS} + \beta_{19} \text{ WFMOV} + \text{constant} + \text{error}
\end{aligned} \tag{2}$$

The estimated coefficients are shown in Table 8 for each payoff equation. These coefficient are estimated with the *STEPWISE* procedure of SPSS, such that only significant variables are included into the regression equation. By substituting the village level average values into statistical significant socio-economic variables which describe the payoffs (Table 8), it is possible to derive village level games. The average payoffs and related games at the village level are shown in Tables 10 to 12.

In order to interpret the games at the village level, let us consider whether mutual participation can be sustained or not when the game is played repeatedly. As argued in Section 3, when the critical discount factor is zero, mutual participation can always be sustained. Mutual participation cannot be sustained when the critical discount factor is one. A fraction between zero and unity denotes the non-trivial discount factor. Then participation can be sustained only if the people are sufficiently patient.

In three villages of Haryana, Godam, Thathar and Salehpur, it is expected that mutual participation can be sustained. These are recently formed Hill Resource Management Societies. Since I did not observe a participatory breakdown in the other villages, they may be able to sustain mutual participation. It is quite surprising to find a critical discount factor of 1 in Sukhomajri (Mishra, 1996) and Salehpur (Lise, 1997a) in Table 10, as these villages are known as the most successful cases in Haryana. In Sukhomajri the participatory process once started, where the villagers and the state representatives came to an agreement over sharing the benefits. Salehpur is known as the more recent successful revival of Sukhomajri. However, at the time of the interviews, the perception of the villagers was not as positive as during the earlier successful years. This might explain why mutual participation was found not to be sustainable.

In Bihar, Muru is the only village where mutual participation is already breaking down, mainly due to destruction of the pool by wildlife. Table 11 shows indeed a critical discount factor of 1. Mutual participation is weakening in Bhusaria, because of difficulties in protecting the pool. In Tandwa & Sakanpirhi, the people are losing faith in the pooling process, as the common pool did not yet substantially benefit them. The pooling process is benefiting only a part of the people in Chapri. However, mutual participation is likely to be preserved in Sindhorwa. Mutual participation is unlikely

to break down in the other villages, where planting in the pool is still going on and funding of labor in the pool is still taking place.

Based upon the insights from the field in Uttar Pradesh, incentives for participation are not expected to be found in Thamana and Sagar. In Thamana the communal forest is almost gone. In that respect it is surprising to find a Pareto game for that village (Table 12). In Sagar, where the president of the forest council is suspended, mutual participation is expected to break down. The meetings are proceeding well in Sagar, but conflicts emerge in the field, when they try to carry out the agreed-upon rules. In Than, Nishni, Bachher, Makkumath, and Reema, mutual participation can be sustained as expected. In Ulli, only a part of the villagers is actually interested in preserving the forest. In both Panyali and Ushara, the people are paying a yearly fee for collecting resources from the communal forest, this is also true for Shama (by fining). This may be the reason that the people are not interested in contributing to planting in the communal forest. This may also be the reason why we find a critical discount factor of 1 for Panyali.

5 Conclusions and recommendations

The main objective of this paper was to estimate a game model, where it is not a priori known which game people play; whether they act in harmony with each other or not. This choice-situation is modeled as a repeated game where villagers choose their level of participation in forest management in Northern India. Trigger strategies are calculated to find critical discount factors above which mutual participation could be sustained.

Formal game theory was applied to a practical situation. The model is driven by and applied to the voluntary choice of villagers to participate in forest management to make it more cost effective. The estimated game in this paper is by no means restricted to this particular application alone. Moreover, it can be applied to any situation where actors have to solve collective action problems in managing a common resources.

From an empirical point of view, this paper finds that the willingness of people to participate in forest management differs across the three cases. I find partial participation in Haryana, conditional

participation in Bihar and unconditional participation in Uttar Pradesh. The willingness to sustain mutual participation at the village level gives a more favorable picture: in 28 out of the 32 studied villages, mutual participation can be sustained.

The main conclusion from a theoretical point of view is that the homogeneous grouping method, the game estimator at the village level, works well for most villages, but not all of them. This could have been caused by the quality of the data which have been collected. Nevertheless, this paper has shown that the Euclidean cluster method, the game estimator at the state level, leads to reliable results and can be recommended for further application in other situations.

References

- Axelrod, R., 1984. *The Evolution of Co-operation*. Penguin books, London.
- Bardhan, P., 1993a. Analytics of the institutions of informal cooperation in rural development. *World Development*, 21(4):633–639.
- Bardhan, P., 1993b. Rational fools and cooperation in a poor hydraulic economy, In: Pattanaik, P. et al., (Eds.), *Development, Welfare and Ethics: a Festschrift for Amartya Sen*. Oxford University press, Oxford.
- Basu, K., Mishra, A., 1993. Sustainable development and the commons problem, a simple approach, in: Bardhan, P., Chaudhuri, M. D., Krishnan, T. N., (Eds.), *Development and Change, Essays in Honour of K. N. Raj*. Oxford University press, Oxford.
- Bates, R. H., 1988. Contra contractarianism: some reflections on the new institutionalism. *Politics and Society*, 16:387–401.
- Bendor, J., Mookherjee, D., 1987. Institutional structure and the logic of ongoing collective action. *American Political Science Review*, 81(1):129–154.
- Fudenberg, D., Maskin, E., 1986. The Folk theorem in repeated games with discounting or with incomplete information. *Econometrica*, 54:533–554.
- Hardin, G., 1968. The tragedy of the commons. *Science*, 162:1243–1248.
- Hardin, G., Baden, J., 1977. *Managing the Commons*. Freeman publishing Co., San Francisco.

- Hardin, R., 1982. *Collective Action*. John Hopkins University press, Resources for the future, Inc., Baltimore and London.
- Kreps, D. M., Milgrom, P. R., Roberts, J., Wilson, R., 1982. Rational cooperation in the finitely repeated prisoner's dilemma. *Journal of Economic Theory*, 27:245–252.
- Kreps, D. M., Wilson, R., 1982. Sequential equilibria. *Econometrica*, 50:863–894.
- Lise, W., 1997a. A village betrayed. *Down to Earth*, 5(21, March 31):38–39.
- Lise, W., 1997b. An Econometric and Game Theoretic Approach to Common Pool Resource Management: Case Studies in Rural India. PhD thesis, Delhi School of Economics, University of Delhi, India.
- Lise, W., 2000. Factors influence people's participation in forest management in India. *Ecological Economics*, 34(3):379–392.
- Lise, W., 2001. Estimating a game theoretic model. *Computational Economics*, 18(2):141–157.
- Lise, W., Garrido, A., Iglesias, E., 2001. A game model of farmers' demand for irrigation water from reservoirs in Southern Spain. *Risk Decision and Policy*, 6(3):167–185.
- Milgrom, P. R., Roberts, D. J., 1982. Predation, reputation and the entry deterrence. *Journal of Economic Theory*, 27:280–312.
- Mishra, P. R., 1996. *Amar-sandesh, Daula ka Sukhomajri (Immortal tidings, the wealth of Sukhomajri)* (in Hindi). Reprint. Society for Hill Resource Management School, Daltonganj, Bihar, India.
- Olson, M., 1965. *The Logic of Collective Action, Public Goods and the Theory of Groups*. Harvard University press, Cambridge, Mass.
- Ostrom, E., 1990. *Governing the Commons, The Evolution of Institutions for Collective Action. Political Economy of Institutions and Decisions*. Cambridge University press, Cambridge.
- Ostrom, E., Gardner, R., Walker, J., 1994. *Rules, Games and Common-pool Resources*. Ann Arbor, The University of Michigan press, Michigan.
- Pongquan, S., 1992. *Participatory Development Activities at Local Level: Case Studies in Villages of Central Thailand: an Analysis of People's Participation in the Planned Development Process*

- Using the Concept of the “Linking Loops”. PhD thesis, Agricultural University Wageningen, the Netherlands.
- Runge, C. F., 1981. Common property externalities: isolation, assurance and resource depletion in a traditional grazing context. *American Journal of Agricultural Economics*, 63:595–606.
- Runge, C. F., 1984. Institutions and the free rider: the assurance problem in collective action. *The Journal of Politics*, 46:154–181.
- Runge, C. F., 1986. Common property and collective action in economic development. *World Development*, 14:623–635.
- Stahl II, D. O., 1991. The graph of prisoner’s dilemma supergame payoffs as a function of the discount factor. *Games and Economic behaviour*, 3(3):368–384.
- Stevenson, G. G., 1991. *Common Property Economics: a General Theory and Land Use Applications*. Cambridge University press, New York.
- Taylor, M., 1987. *The Possibility of Cooperation*. Cambridge University press, Cambridge.
- Wade, R., 1987. The management of common property resources: collective action as an alternative to privatisation or state regulation. *Cambridge Journal of Economics*, 11:95–106.
- Wade, R., 1988. *Village Republics: Economic Conditions for Collective Action in South India*. Cambridge University press, Cambridge.

Collection of Tables

Table 1: The participation game.

Challenger:	Contender:	
	Participate (=P)	Do not participate (=D)
Participate (=P)	x, x	b, a
Do not participate (=D)	a, b	y, y

Table 2: Classification of games based on the payoff ordering.

Number of possibilities	Name of the game ^a	Payoff ordering	
		standard	reverse
1	prisoner's dilemma	$a > x > y > b$	$b > y > x > a$
5	Pareto game ^b	$x > \max\{a, y\}; b > y$	$y > \max\{b, x\}; a > x$
1	assurance game	$x > a > y > b$	$y > b > x > a$
2	coordination game	$x > y > \max\{a, b\}$	$y > x > \max\{a, b\}$
1	chicken's game	$a > x > b > y$	$b > y > a > x$
2	battle-of-sexes game ^c	$\min\{a, b\} > x > y$	$\min\{a, b\} > y > x$

^a The prisoner's dilemma, assurance game, coordination game and the chicken's game are well-known. Two other games, Pareto game and the battle-of-sexes game are added to complete the classification.

^b In the Pareto game the players have a dominating strategy which coincides with the collective preferred outcome.

^c The battle-of-sexes game is opposite to the coordination game: the Nash equilibria consist of a participating and a deviating player.

Table 3: The critical discount factors ϕ .

Name of the game:	standard	reverse
prisoner's dilemma	$\frac{a-x}{a-y}$	0
Pareto game	0	1
assurance game	0	0
coordination game	0	0
chicken's game	$\frac{a-x}{a-b}$	1
battle-of-sexes game	1	1

Table 4: Diversity among the three regional studies.

State	Haryana	Uttar Pradesh	Bihar
Name of local organisation	Hill Resource Management Society	forest council	village society
Number of organisations in 1996	48	4645	44
started in	1977	1931	1984
initiated by	state	people	non-governmental organisation
property regime	state	common	private (group)

Table 5: First principal component per state, derived from indicators of participation.

State:	Haryana	Bihar	Uttar Pradesh
Planting in the forest	0.383		0.048
Contribution to the forest/pool	0.226	0.172	0.177
Benefiting from the forest/pool	0.094	0.098	0.233
Ability to use the pool		0.082	
Benefits from using the pool		0.156	
Importance of meetings		0.535	0.095
Agreement with decisions	0.049	0.832	0.771
Attendance of meetings	0.797	0.787	0.594
Ability to influence decisions	0.682	0.868	0.810
Frequency of meetings	0.792	-0.020	0.275
Interest in the meetings	0.640	0.292	0.842
Gain from meetings	0.611	0.271	0.815
Suggesting in meetings	0.584	0.280	0.488
Percentage of variance explained	45.1%	36.0%	35.4%
Number of observations	127	123	135

Note: Numbers in bold face denote a dominating indicator (factor loading ≥ 0.5 or ≤ -0.5). An empty cell means that the observations on that indicator are missing.

Source: See text.

Table 6: The estimated games at the institutional level in three states.

The Euclidean cluster method:

Model	x	y	a	b	Payoff order	Name of the game	ϕ
I.har	4468	6771	4352	7413	$b > y > x > a$	reverse prisoner's dilemma	0
I.bih	13225	1129	7772	7001	$x > a > b > y$	Pareto game	0
I.upr	2394	0	1849	0	$x > a > b = y$	Pareto/assurance game	0
II.har	4960	6134	10431	9397	$a > b > y > x$	reverse battle-of-sexes game	1
II.bih	12982	8109	752	6483	$x > y > b > a$	coordination game	0
II.upr	2806	1164	0	1367	$x > b > y > a$	Pareto game	0

The homogeneous grouping method:

Model	x	y	a	b	Payoff order	Name of the game	ϕ
I.har	4884	6493	5513	9145	$b > y > a > x$	reverse chicken's game	1
I.bih	13688	5923	11973	11963	$x > a > b > y$	Pareto game	0
I.upr	2037	2253	1896	2728	$b > y > x > a$	reverse prisoner's dilemma	0
II.har	5368	5725	6321	8781	$b > a > y > x$	reverse battle-of-sexes game	1
II.bih	18106	11832	6254	7545	$x > y > b > a$	coordination game	0
II.upr	2723	2550	1608	2042	$x > y > b > a$	coordination game	0

Notes:

I = the mean situation;

II = the variance situation;

har = Haryana, bih = Bihar, upr=Uttar Pradesh;

ϕ = the critical discount factor.

Table 7: Final cluster centres and the number of households within the clusters.

Model I.har: reverse assurance game					Model II.har: reverse battle-of-sexes game				
Cluster	θ	ϑ	π	cases	Cluster	θ	ϑ	π	cases
1	0.21	0.32	y	9	1	0.29	0.11	y	21
2	<u>0.67</u>	<u>0.54</u>	x	34	2	<u>0.94</u>	<u>0.97</u>	b	3
3	<u>0.55</u>	0.10	b	48	3	0.59	0.06	y	47
4	0.04	<u>1.00</u>	a	1	4	<u>0.82</u>	0.08	x	36
5	<u>0.84</u>	0.39	b	35	5	0.72	<u>0.28</u>	a	20
Model I.bih: Pareto game					Model II.bih: coordination game				
Cluster	θ	ϑ	π	cases	Cluster	θ	ϑ	π	cases
1	0.11	0.30	y	2	1	0.19	<u>0.52</u>	a	3
2	<u>0.87</u>	<u>0.63</u>	x	77	2	0.66	0.09	y	19
3	0.63	<u>0.69</u>	a	20	3	<u>0.87</u>	0.14	x	82
4	<u>0.84</u>	0.13	b	24	4	<u>0.82</u>	<u>0.96</u>	b	19
Model I.upr: Pareto/assurance game					Model II.upr: Pareto game				
Cluster	θ	ϑ	π	cases	Cluster	θ	ϑ	π	cases
1	<u>0.74</u>	<u>0.84</u>	x	111	1	<u>0.74</u>	<u>0.41</u>	b	35
2	<u>0.88</u>	0.00	b	1	2	0.17	<u>0.91</u>	a	4
3	0.38	<u>0.85</u>	a	19	3	0.26	0.19	y	10
4	0.17	0.29	y	4	4	<u>0.72</u>	0.09	x	86

Notes:

θ is the level of participation of the challenger;

ϑ is the level of participation of the contender;

har = Haryana, bih = Bihar, upr=Uttar Pradesh;

$\{a, b, x, y\} \in \pi$ is the payoff or gain from participation.

Table 8: The payoff equations in Haryana, Bihar and Uttar Pradesh.

State Variable	Haryana				Bihar				Uttar Pradesh			
	<i>x</i>	<i>y</i>	<i>a</i>	<i>b</i>	<i>x</i>	<i>y</i>	<i>a</i>	<i>b</i>	<i>x</i>	<i>y</i>	<i>a</i>	<i>b</i>
Const	-3649 (2753)	13761 (2432)	12062 (2480)	-7867 (4288)	-87484 (18387)	7184 (12236)	-17293 (8367)	3819 (1464)	1141 (429)	1849 (898)	1293 (584)	-2478 (1027)
ANIMUN	966 (270)								437 (62)			
AVAGE					2229 (420)							
CAPIT				-0.0009 (0.0003)							-0.0042 (0.0019)	
CAPPC	0.012 (0.003)											
CASGR		-1976 (753)	-2064 (837)	2621 (1060)			4446 (1747)					
CONPC						-15.3 (7.3)						
EDU15										-1198 (423)		
EDU7										1116 (478)		
EDUS												177 (68)
FODTOT	-34.8 (13.4)			171 (14)								36.9 (10.9)
FORDEP	4886 (2300)											
FWTOT										50.8 (14.5)	61.6 (12.8)	
LANDO								480 (123)	-14.7 (6.0)			
NRCH				-1355 (615)								
NRSGE							1564 (755)					
RELN	3355 (1483)	-2096 (720)										
RES					60028 (17570)							
SEXS					53781 (16419)							
WFMOV												292 (113)
R ²	0.868	0.306	0.169	0.856	0.677	0.402	0.295	0.344	0.619	0.469	0.490	0.411

Note: The values in brackets denote the standard errors. The last row shows the number of observations in the payoff group.

Table 9: The meaning of the used socio-economic variables.

$\pi \in \{a, b, x, y\}$ = Payoff [Rs/year], where Rs are expressed in 1996 prices.

ANIMUN = Animal units expressed in ‘cow’-units ($[OX] + [COW] + 1.2 \times [BUFFALO] + 0.25 \times [GOAT] + 0.10 \times [PIG] + 2.67 \times [MULE] + 2.67 \times [CAMEL] + 2.67 \times [HORSE]$).

AVAGE = Average age of all family members.

CAPIT = Capital owned by the whole family. (Rs/year)

CAPPC = Per capita capital. (Rs/year)

CASGR = Caste-group (number between 1 and 5, higher number is lower caste).

CONPC = Total value of per capita consumption. (Rs)

EDU7 = Average years of schooling of people above 7 years.

EDU15 = Average years of schooling of people above 15 years.

EDUS = Education of the interviewed person.

FODTOT = Total use of fodder. (quintal/year)

FORDEP = Forest dependence (the amount of goods collected from the forest divided by the total need).

FWTOT = Total use of fuelwood. (quintal/year)

LANDO = Amount of private land owned. (acres)

NRCH = Number of children.

NRSGE = Number of children expected to be send to school.

RELNR = Religion number. (1. Hindu, 2. Muslim, 3. Christian, 4. other)

RES = Level of resources based on the first principal component of three environmental indicators: DEGRA (To which extent do you consider the current state of the forest degraded?), STA10 (What was the state of the forest about 10 years ago?), FODQU (What is the quality of the resources, like fodder and fuelwood extracted from the forest?), which is finally normalised between zero and unity.

SEXS = Gender of interviewed person.

WFMOV = Number of family members working outside the village.

Table 10: The estimated payoffs in villages in Haryana.

Village name:	x	y	a	b	payoff order	Name of the game	ϕ
Godam	4280 (2857)	3762 (2432)	3806 (2480)	-1251 (302)	$x > a > y > b$	assurance game	0
Mandpa	15121 (4792)	7714 (2432)	7934 (2480)	16965 (4093)	$b > x > a > y$	Pareto game	0
Sukhomajri	5194 (3389)	7398 (2553)	7603 (2614)	9320 (1757)	$b > a > y > x$	reverse battle-of-sexes game	1
Dhamala	9740 (4344)	4218 (2808)	7149 (2706)	20290 (5693)	$b > x > a > y$	Pareto game	0
Main Nada	10503 (3904)	7337 (2562)	7934 (2480)	7703 (67)	$x > a > b > y$	Pareto game	0
Masoompur	7513 (3532)	6884 (2651)	7067 (2722)	10171 (3482)	$b > x > a > y$	Pareto game	0
Thathar	6890 (3184)	5876 (2658)	6014 (2731)	3996 (1363)	$x > a > y > b$	assurance game	0
Salehpur	5130 (3443)	6726 (2688)	6902 (2764)	15389 (2060)	$b > a > y > x$	reverse battle-of-sexes game	1
Harijan Nada	5189 (3993)	3702 (3169)	4838 (2898)	7779 (1329)	$b > x > a > y$	Pareto game	0
All villages # observations	5368 (32)	5725 (31)	6321 (32)	8781 (32)	$b > a > y > x$	reverse battle-of-sexes game	1

Note: The values in brackets denote the standard errors. Choice of the challenger is based on the first principal component. Choice of the contender is based on the variance, among the challengers within a village.

Table 11: The estimated payoffs in villages in Bihar.

Village name:	x	y	a	b	payoff order	Name of the game	ϕ
Hendehas	23070 (19740)	8891 (14564)	4639 (9170)	7235 (745)	$x > y > b > a$	coordination game	0
Chapri	5669 (19458)	13577 (14987)	4639 (8997)	7302 (870)	$y > b > x > a$	reverse assurance game	0
Barhania	33293 (21448)	48476 (14065)	7768 (8555)	9267 (884)	$y > x > b > a$	reverse coordination game	0
Sindhorwa	38519 (22054)	17424 (15770)	6329 (8661)	4607 (259)	$x > y > a > b$	coordination game	0
Muru	1740 (20758)	23302 (18410)	6011 (8966)	9863 (1417)	$y > b > a > x$	reverse Pareto game	1
Bhusaria	9135 (20334)	3150 (13837)	8409 (8797)	6087 (2119)	$x > a > b > y$	Pareto game	0
Bakhari	27723 (22707)	7503 (13731)	4011 (8991)	5112 (269)	$x > y > b > a$	coordination game	0
Kumbhawa	19095 (22479)	14540 (13724)	5750 (9380)	6332 (639)	$x > y > b > a$	coordination game	0
Sakanpirhi and Tandwa	13223 (19434)	7991 (13366)	-8639 (9110)	7283 (673)	$x > y > b > a$	coordination game	0
Mundaria	23684 (21048)	805 (14599)	3208 (9231)	6346 (687)	$x > b > a > y$	Pareto game	0
Kashia	13302 (22033)	7499 (13359)	-1730 (9627)	5347 (509)	$x > y > b > a$	coordination game	0
Khamdih	8609 (21549)	11433 (13732)	5593 (9081)	4963 (240)	$y > x > a > b$	reverse coordination game	0
All villages # observations	18106 (31)	11832 (30)	6254 (31)	7545 (31)	$x > y > b > a$	coordination game	0

Note: The values in brackets denote the standard errors. Choice of the challenger is based on the first principal component. Choice of the contender is based on the variance, among the challengers within a village.

Table 12: The estimated payoffs in villages in Uttar Pradesh.

Village name:	x	y	a	b	payoff order	Name of the game	ϕ
Ulli	1966 (488)	1860 (1553)	1480 (678)	1148 (219)	$x > y > a > b$	coordination game	0
Than	2336 (506)	1745 (1544)	1294 (743)	2135 (317)	$x > b > y > a$	Pareto game	0
Thamana	1217 (721)	664 (2912)	31 (771)	1906 (350)	$b > x > y > a$	Pareto game	0
Nishni	2310 (479)	1846 (1509)	1321 (645)	1730 (153)	$x > y > b > a$	coordination game	0
Bachher	2229 (491)	1665 (1626)	1276 (661)	1076 (226)	$x > y > a > b$	coordination game	0
Makkumath	2723 (485)	2043 (1620)	1731 (695)	2695 (245)	$x > b > y > a$	Pareto game	0
Ushara	3335 (531)	4422 (1507)	3158 (759)	3294 (452)	$y > x > b > a$	reverse coordination game	0
Sagar	3168 (501)	2109 (1649)	1431 (700)	3229 (220)	$b > x > y > a$	Pareto game	0
Shama	3274 (541)	3191 (1469)	2558 (735)	3020 (261)	$x > y > b > a$	coordination game	0
Panyali	2975 (678)	4018 (2242)	3143 (919)	3109 (629)	$y > a > b > x$	reverse Pareto game	1
Reema	2122 (482)	2397 (1389)	1708 (667)	1742 (165)	$y > x > b > a$	reverse coordination game	0
All villages # observations	2723 (34)	2550 (33)	1608 (34)	2042 (34)	$x > y > b > a$	coordination game	0

Note: The values in brackets denote the standard errors. Choice of the challenger is based on the first principal component. Choice of the contender is based on the variance, among the challengers within a village.

NOTE DI LAVORO DELLA FONDAZIONE ENI ENRICO MATTEI

Fondazione Eni Enrico Mattei Working Papers Series

Our working papers are available on the Internet at the following addresses:

Server WWW: WWW.FEEM.IT

Anonymous FTP: FTP.FEEM.IT

http://papers.ssrn.com/abstract_id=XXXXXX

SUST	1.2001	<i>Inge MAYERES and Stef PROOST: <u>Should Diesel Cars in Europe be Discouraged?</u></i>
SUST	2.2001	<i>Paola DORIA and Davide PETTENELLA: <u>The Decision Making Process in Defining and Protecting Critical Natural Capital</u></i>
CLIM	3.2001	<i>Alberto PENCH: <u>Green Tax Reforms in a Computable General Equilibrium Model for Italy</u></i>
CLIM	4.2001	<i>Maurizio BUSSOLO and Dino PINELLI: <u>Green Taxes: Environment, Employment and Growth</u></i>
CLIM	5.2001	<i>Marco STAMPINI: <u>Tax Reforms and Environmental Policies for Italy</u></i>
ETA	6.2001	<i>Walid OUESLATI: <u>Environmental Fiscal Policy in an Endogenous Growth Model with Human Capital</u></i>
CLIM	7.2001	<i>Umberto CIORBA, Alessandro LANZA and Francesco PAULI: <u>Kyoto Commitment and Emission Trading: a European Union Perspective</u></i>
MGMT	8.2001	<i>Brian SLACK (xlv): <u>Globalisation in Maritime Transportation: Competition, uncertainty and implications for port development strategy</u></i>
VOL	9.2001	<i>Giulia PESARO: <u>Environmental Voluntary Agreements: A New Model of Co-operation Between Public and Economic Actors</u></i>
VOL	10.2001	<i>Cathrine HAGEM: <u>Climate Policy, Asymmetric Information and Firm Survival</u></i>
ETA	11.2001	<i>Sergio CURRARINI and Marco MARINI: <u>A Sequential Approach to the Characteristic Function and the Core in Games with Externalities</u></i>
ETA	12.2001	<i>Gaetano BLOISE, Sergio CURRARINI and Nicholas KIKIDIS: <u>Inflation and Welfare in an OLG Economy with a Privately Provided Public Good</u></i>
KNOW	13.2001	<i>Paolo SURICO: <u>Globalisation and Trade: A “New Economic Geography” Perspective</u></i>
ETA	14.2001	<i>Valentina BOSETTI and Vincenzina MESSINA: <u>Quasi Option Value and Irreversible Choices</u></i>
CLIM	15.2001	<i>Guy ENGELEN (xlii): <u>Desertification and Land Degradation in Mediterranean Areas: from Science to Integrated Policy Making</u></i>
SUST	16.2001	<i>Julie Catherine SORS: <u>Measuring Progress Towards Sustainable Development in Venice: A Comparative Assessment of Methods and Approaches</u></i>
SUST	17.2001	<i>Julie Catherine SORS: <u>Public Participation in Local Agenda 21: A Review of Traditional and Innovative Tools</u></i>
CLIM	18.2001	<i>Johan ALBRECHT and Niko GOBBIN: <u>Schumpeter and the Rise of Modern Environmentalism</u></i>
VOL	19.2001	<i>Rinaldo BRAU, Carlo CARRARO and Giulio GOLFETTO (xliii): <u>Participation Incentives and the Design of Voluntary Agreements</u></i>
ETA	20.2001	<i>Paola ROTA: <u>Dynamic Labour Demand with Lumpy and Kinked Adjustment Costs</u></i>
ETA	21.2001	<i>Paola ROTA: <u>Empirical Representation of Firms’ Employment Decisions by an (S,s) Rule</u></i>
ETA	22.2001	<i>Paola ROTA: <u>What Do We Gain by Being Discrete? An Introduction to the Econometrics of Discrete Decision Processes</u></i>
PRIV	23.2001	<i>Stefano BOSI, Guillaume GIRMANS and Michel GUILLARD: <u>Optimal Privatisation Design and Financial Markets</u></i>
KNOW	24.2001	<i>Giorgio BRUNELLO, Claudio LUPI, Patrizia ORDINE, and Maria Luisa PARISI: <u>Beyond National Institutions: Labour Taxes and Regional Unemployment in Italy</u></i>
ETA	25.2001	<i>Klaus CONRAD: <u>Locational Competition under Environmental Regulation when Input Prices and Productivity Differ</u></i>
PRIV	26.2001	<i>Bernardo BORTOLOTTI, Juliet D’SOUZA, Marcella FANTINI and William L. MEGGINSON: <u>Sources of Performance Improvement in Privatised Firms: A Clinical Study of the Global Telecommunications Industry</u></i>
CLIM	27.2001	<i>Frédéric BROCHIER and Emiliano RAMIERI: <u>Climate Change Impacts on the Mediterranean Coastal Zones</u></i>
ETA	28.2001	<i>Nunzio CAPPUCCIO and Michele MORETTO: <u>Comments on the Investment-Uncertainty Relationship in a Real Option Model</u></i>
KNOW	29.2001	<i>Giorgio BRUNELLO: <u>Absolute Risk Aversion and the Returns to Education</u></i>
CLIM	30.2001	<i>ZhongXiang ZHANG: <u>Meeting the Kyoto Targets: The Importance of Developing Country Participation</u></i>
ETA	31.2001	<i>Jonathan D. KAPLAN, Richard E. HOWITT and Y. Hossein FARZIN: <u>An Information-Theoretical Analysis of Budget-Constrained Nonpoint Source Pollution Control</u></i>
MGMT Coalition	32.2001	<i>Roberta SALOMONE and Giulia GALLUCCIO: <u>Environmental Issues and Financial Reporting Trends</u></i>
Theory Network	33.2001	<i>Shlomo WEBER and Hans WIESMETH: <u>From Autarky to Free Trade: The Impact on Environment</u></i>
ETA	34.2001	<i>Margarita GENIUS and Elisabetta STRAZZERA: <u>Model Selection and Tests for Non Nested Contingent Valuation Models: An Assessment of Methods</u></i>

NRM	35.2001	<i>Carlo GIUPPONI</i> : <u>The Substitution of Hazardous Molecules in Production Processes: The Atrazine Case Study in Italian Agriculture</u>
KNOW	36.2001	<i>Raffaele PACI and Francesco PIGLIARU</i> : <u>Technological Diffusion, Spatial Spillovers and Regional Convergence in Europe</u>
PRIV	37.2001	<i>Bernardo BORTOLOTTI</i> : <u>Privatisation, Large Shareholders, and Sequential Auctions of Shares</u>
CLIM	38.2001	<i>Barbara BUCHNER</i> : <u>What Really Happened in The Hague? Report on the COP6, Part I, 13-25 November 2000, The Hague, The Netherlands</u>
PRIV	39.2001	<i>Giacomo CALZOLARI and Carlo SCARPA</i> : <u>Regulation at Home, Competition Abroad: A Theoretical Framework</u>
KNOW	40.2001	<i>Giorgio BRUNELLO</i> : <u>On the Complementarity between Education and Training in Europe</u>
Coalition Theory Network	41.2001	<i>Alain DESDOIGTS and Fabien MOIZEAU</i> (xlvi): <u>Multiple Politico-Economic Regimes, Inequality and Growth</u>
Coalition Theory Network	42.2001	<i>Parkash CHANDER and Henry TULKENS</i> (xlvi): <u>Limits to Climate Change</u>
Coalition Theory Network	43.2001	<i>Michael FINUS and Bianca RUNDSHAGEN</i> (xlvi): <u>Endogenous Coalition Formation in Global Pollution Control</u>
Coalition Theory Network	44.2001	<i>Wietze LISE, Richard S.J. TOL and Bob van der ZWAAN</i> (xlvi): <u>Negotiating Climate Change as a Social Situation</u>
NRM	45.2001	<i>Mohamad R. KHAWLIE</i> (xlvi): <u>The Impacts of Climate Change on Water Resources of Lebanon- Eastern Mediterranean</u>
NRM	46.2001	<i>Mutasem EL-FADEL and E. BOU-ZEID</i> (xlvi): <u>Climate Change and Water Resources in the Middle East: Vulnerability, Socio-Economic Impacts and Adaptation</u>
NRM	47.2001	<i>Eva IGLESIAS, Alberto GARRIDO and Almudena GOMEZ</i> (xlvi): <u>An Economic Drought Management Index to Evaluate Water Institutions' Performance Under Uncertainty and Climate Change</u>
CLIM	48.2001	<i>Wietze LISE and Richard S.J. TOL</i> (xlvi): <u>Impact of Climate on Tourist Demand</u>
CLIM	49.2001	<i>Francesco BOSELLO, Barbara BUCHNER, Carlo CARRARO and Davide RAGGI</i> : <u>Can Equity Enhance Efficiency? Lessons from the Kyoto Protocol</u>
SUST	50.2001	<i>Roberto ROSON</i> (xlvi): <u>Carbon Leakage in a Small Open Economy with Capital Mobility</u>
SUST	51.2001	<i>Edwin WOERDMAN</i> (xlvi): <u>Developing a European Carbon Trading Market: Will Permit Allocation Distort Competition and Lead to State Aid?</u>
SUST	52.2001	<i>Richard N. COOPER</i> (xlvi): <u>The Kyoto Protocol: A Flawed Concept</u>
SUST	53.2001	<i>Kari KANGAS</i> (xlvi): <u>Trade Liberalisation, Changing Forest Management and Roundwood Trade in Europe</u>
SUST	54.2001	<i>Xueqin ZHU and Ekko VAN IERLAND</i> (xlvi): <u>Effects of the Enlargement of EU on Trade and the Environment</u>
SUST	55.2001	<i>M. Ozgur KAYALICA and Sajal LAHIRI</i> (xlvi): <u>Strategic Environmental Policies in the Presence of Foreign Direct Investment</u>
SUST	56.2001	<i>Savas ALPAY</i> (xlvi): <u>Can Environmental Regulations be Compatible with Higher International Competitiveness? Some New Theoretical Insights</u>
SUST	57.2001	<i>Roldan MURADIAN, Martin O'CONNOR, Joan MARTINEZ-ALER</i> (xlvi): <u>Embodied Pollution in Trade: Estimating the "Environmental Load Displacement" of Industrialised Countries</u>
SUST	58.2001	<i>Matthew R. AUER and Rafael REUVENY</i> (xlvi): <u>Foreign Aid and Direct Investment: Key Players in the Environmental Restoration of Central and Eastern Europe</u>
SUST	59.2001	<i>Onno J. KUIK and Frans H. OOSTERHUIS</i> (xlvi): <u>Lessons from the Southern Enlargement of the EU for the Environmental Dimensions of Eastern Enlargement, in particular for Poland</u>
ETA	60.2001	<i>Carlo CARRARO, Alessandra POME and Domenico SINISCALCO</i> (xlix): <u>Science vs. Profit in Research: Lessons from the Human Genome Project</u>
CLIM	61.2001	<i>Efrem CASTELNUOVO, Michele MORETTO and Sergio VERGALLI</i> : <u>Global Warming, Uncertainty and Endogenous Technical Change: Implications for Kyoto</u>
PRIV	62.2001	<i>Gian Luigi ALBANO, Fabrizio GERMANO and Stefano LOVO</i> : <u>On Some Collusive and Signaling Equilibria in Ascending Auctions for Multiple Objects</u>
CLIM	63.2001	<i>Elbert DIJKGRAAF and Herman R.J. VOLLEBERGH</i> : <u>A Note on Testing for Environmental Kuznets Curves with Panel Data</u>
CLIM	64.2001	<i>Paolo BUONANNO, Carlo CARRARO and Marzio GALEOTTI</i> : <u>Endogenous Induced Technical Change and the Costs of Kyoto</u>
CLIM	65.2001	<i>Guido CAZZAVILLAN and Ignazio MUSU</i> (l): <u>Transitional Dynamics and Uniqueness of the Balanced-Growth Path in a Simple Model of Endogenous Growth with an Environmental Asset</u>
CLIM	66.2001	<i>Giovanni BAIOCCHI and Salvatore DI FALCO</i> (l): <u>Investigating the Shape of the EKC: A Nonparametric Approach</u>
CLIM	67.2001	<i>Marzio GALEOTTI, Alessandro LANZA and Francesco PAULI</i> (l): <u>Desperately Seeking (Environmental) Kuznets: A New Look at the Evidence</u>
CLIM	68.2001	<i>Alexey VIKHLYAEV</i> (xlvi): <u>The Use of Trade Measures for Environmental Purposes – Globally and in the EU Context</u>
NRM	69.2001	<i>Gary D. LIBECAP and Zeynep K. HANSEN</i> (li): <u>U.S. Land Policy, Property Rights, and the Dust Bowl of the 1930s</u>

NRM	70.2001	<i>Lee J. ALSTON, Gary D. LIBECAP and Bernardo MUELLER</i> (li): <u>Land Reform Policies. The Sources of Violent Conflict and Implications for Deforestation in the Brazilian Amazon</u>
CLIM	71.2001	<i>Claudia KEMFERT</i> : <u>Economy-Energy-Climate Interaction – The Model WIAGEM -</u>
SUST	72.2001	<i>Paulo A.L.D. NUNES and Yohanes E. RIYANTO</i> : <u>Policy Instruments for Creating Markets for Biodiversity: Certification and Ecolabeling</u>
SUST	73.2001	<i>Paulo A.L.D. NUNES and Erik SCHOKKAERT</i> (lii): <u>Warm Glow and Embedding in Contingent Valuation</u>
SUST	74.2001	<i>Paulo A.L.D. NUNES, Jeroen C.J.M. van den BERGH and Peter NIJKAMP</i> (lii): <u>Ecological-Economic Analysis and Valuation of Biodiversity</u>
VOL	75.2001	<i>Johan EYCKMANS and Henry TULKENS</i> (li): <u>Simulating Coalitionally Stable Burden Sharing Agreements for the Climate Change Problem</u>
PRIV	76.2001	<i>Axel GAUTIER and Florian HEIDER</i> : <u>What Do Internal Capital Markets Do? Redistribution vs. Incentives</u>
PRIV	77.2001	<i>Bernardo BORTOLOTTI, Marcella FANTINI and Domenico SINISCALCO</i> : <u>Privatisation around the World: New Evidence from Panel Data</u>
ETA	78.2001	<i>Toke S. AIDT and Jayasri DUTTA</i> (li): <u>Transitional Politics. Emerging Incentive-based Instruments in Environmental Regulation</u>
ETA	79.2001	<i>Alberto PETRUCCI</i> : <u>Consumption Taxation and Endogenous Growth in a Model with New Generations</u>
ETA	80.2001	<i>Pierre LASSERRE and Antoine SOUBEYRAN</i> (li): <u>A Ricardian Model of the Tragedy of the Commons</u>
ETA	81.2001	<i>Pierre COURTOIS, Jean Christophe PÉREAU and Tarik TAZDAÏT</i> : <u>An Evolutionary Approach to the Climate Change Negotiation Game</u>
NRM	82.2001	<i>Christophe BONTEMPS, Stéphane COUTURE and Pascal FAVARD</i> : <u>Is the Irrigation Water Demand Really Convex?</u>
NRM	83.2001	<i>Unai PASCUAL and Edward BARBIER</i> : <u>A Model of Optimal Labour and Soil Use with Shifting Cultivation</u>
CLIM	84.2001	<i>Jesper JENSEN and Martin Hvidt THELLE</i> : <u>What are the Gains from a Multi-Gas Strategy?</u>
CLIM	85.2001	<i>Maurizio MICHELINI</i> (liii): IPCC “Summary for Policymakers” in TAR. <u>Do its results give a scientific support always adequate to the urgencies of Kyoto negotiations?</u>
CLIM	86.2001	<i>Claudia KEMFERT</i> (liii): <u>Economic Impact Assessment of Alternative Climate Policy Strategies</u>
CLIM	87.2001	<i>Cesare DOSI and Michele MORETTO</i> : <u>Global Warming and Financial Umbrellas</u>
ETA	88.2001	<i>Elena BONTEMPI, Alessandra DEL BOCA, Alessandra FRANZOSI, Marzio GALEOTTI and Paola ROTA</i> : <u>Capital Heterogeneity: Does it Matter? Fundamental Q and Investment on a Panel of Italian Firms</u>
ETA	89.2001	<i>Efrem CASTELNUOVO and Paolo SURICO</i> : <u>Model Uncertainty, Optimal Monetary Policy and the Preferences of the Fed</u>
CLIM	90.2001	<i>Umberto CIORBA, Alessandro LANZA and Francesco PAULI</i> : <u>Kyoto Protocol and Emission Trading: Does the US Make a Difference?</u>
CLIM	91.2001	<i>ZhongXiang ZHANG and Lucas ASSUNCAO</i> : <u>Domestic Climate Policies and the WTO</u>
SUST	92.2001	<i>Anna ALBERINI, Alan KRUPNICK, Maureen CROPPER, Nathalie SIMON and Joseph COOK</i> (lii): <u>The Willingness to Pay for Mortality Risk Reductions: A Comparison of the United States and Canada</u>
SUST	93.2001	<i>Riccardo SCARPA, Guy D. GARROD and Kenneth G. WILLIS</i> (lii): <u>Valuing Local Public Goods with Advanced Stated Preference Models: Traffic Calming Schemes in Northern England</u>
CLIM	94.2001	<i>Ming CHEN and Larry KARP</i> : <u>Environmental Indices for the Chinese Grain Sector</u>
CLIM	95.2001	<i>Larry KARP and Jiangfeng ZHANG</i> : <u>Controlling a Stock Pollutant with Endogenous Investment and Asymmetric Information</u>
ETA	96.2001	<i>Michele MORETTO and Gianpaolo ROSSINI</i> : <u>On the Opportunity Cost of Nontradable Stock Options</u>
SUST	97.2001	<i>Elisabetta STRAZZERA, Margarita GENIUS, Riccardo SCARPA and George HUTCHINSON</i> : <u>The Effect of Protest Votes on the Estimates of Willingness to Pay for Use Values of Recreational Sites</u>
NRM	98.2001	<i>Frédéric BROCHIER, Carlo GIUPPONI and Alberto LONGO</i> : <u>Integrated Coastal Zone Management in the Venice Area – Perspectives of Development for the Rural Island of Sant’Erasmus</u>
NRM	99.2001	<i>Frédéric BROCHIER, Carlo GIUPPONI and Julie SORS</i> : <u>Integrated Coastal Management in the Venice Area – Potentials of the Integrated Participatory Management Approach</u>
NRM	100.2001	<i>Frédéric BROCHIER and Carlo GIUPPONI</i> : <u>Integrated Coastal Zone Management in the Venice Area – A Methodological Framework</u>
PRIV	101.2001	<i>Enrico C. PEROTTI and Luc LAEVEN</i> : <u>Confidence Building in Emerging Stock Markets</u>
CLIM	102.2001	<i>Barbara BUCHNER, Carlo CARRARO and Igor CERSOSIMO</i> : <u>On the Consequences of the U.S. Withdrawal from the Kyoto/Bonn Protocol</u>
SUST	103.2001	<i>Riccardo SCARPA, Adam DRUCKER, Simon ANDERSON, Nancy FERRAES-EHUAN, Veronica GOMEZ, Carlos R. RISOPATRON and Olga RUBIO-LEONEL</i> : <u>Valuing Animal Genetic Resources in Peasant Economies: The Case of the Box Keken Creole Pig in Yucatan</u>
SUST	104.2001	<i>R. SCARPA, P. KRISTJANSON, A. DRUCKER, M. RADENY, E.S.K. RUTO, and J.E.O. REGE</i> : <u>Valuing Indigenous Cattle Breeds in Kenya: An Empirical Comparison of Stated and Revealed Preference Value Estimates</u>
SUST	105.2001	<i>Clemens B.A. WOLLNY</i> : <u>The Need to Conserve Farm Animal Genetic Resources Through Community-Based Management in Africa: Should Policy Makers be Concerned?</u>
SUST	106.2001	<i>J.T. KARUGIA, O.A. MWAI, R. KAITHO, Adam G. DRUCKER, C.B.A. WOLLNY and J.E.O. REGE</i> : <u>Economic Analysis of Crossbreeding Programmes in Sub-Saharan Africa: A Conceptual Framework and Kenyan Case Study</u>
SUST	107.2001	<i>W. AYALEW, J.M. KING, E. BRUNS and B. RISCHKOWSKY</i> : <u>Economic Evaluation of Smallholder Subsistence Livestock Production: Lessons from an Ethiopian Goat Development Program</u>

SUST	108.2001	<i>Gianni CICIA, Elisabetta D'ERCOLE and Davide MARINO: <u>Valuing Farm Animal Genetic Resources by Means of Contingent Valuation and a Bio-Economic Model: The Case of the Pentro Horse</u></i>
SUST	109.2001	<i>Clem TISDELL: <u>Socioeconomic Causes of Loss of Animal Genetic Diversity: Analysis and Assessment</u></i>
SUST	110.2001	<i>M.A. JABBAR and M.L. DIEDHOU: <u>Does Breed Matter to Cattle Farmers and Buyers? Evidence from West Africa</u></i>
SUST	1.2002	<i>K. TANO, M.D. FAMINOW, M. KAMUANGA and B. SWALLOW: <u>Using Conjoint Analysis to Estimate Farmers' Preferences for Cattle Traits in West Africa</u></i>
ETA	2.2002	<i>Efrem CASTELNUOVO and Paolo SURICO: <u>What Does Monetary Policy Reveal about Central Bank's Preferences?</u></i>
WAT	3.2002	<i>Duncan KNOWLER and Edward BARBIER: <u>The Economics of a "Mixed Blessing" Effect: A Case Study of the Black Sea</u></i>
CLIM	4.2002	<i>Andreas LÖSCHEL: <u>Technological Change in Economic Models of Environmental Policy: A Survey</u></i>
VOL	5.2002	<i>Carlo CARRARO and Carmen MARCHIORI: <u>Stable Coalitions</u></i>
CLIM	6.2002	<i>Marzio GALEOTTI, Alessandro LANZA and Matteo MANERA: <u>Rockets and Feathers Revisited: An International Comparison on European Gasoline Markets</u></i>
ETA	7.2002	<i>Effrosyni DIAMANTOUDI and Eftichios S. SARTZETAKIS: <u>Stable International Environmental Agreements: An Analytical Approach</u></i>
KNOW	8.2002	<i>Alain DESDOIGTS: <u>Neoclassical Convergence Versus Technological Catch-up: A Contribution for Reaching a Consensus</u></i>
NRM	9.2002	<i>Giuseppe DI VITA: <u>Renewable Resources and Waste Recycling</u></i>
KNOW	10.2002	<i>Giorgio BRUNELLO: <u>Is Training More Frequent when Wage Compression is Higher? Evidence from 11 European Countries</u></i>
ETA	11.2002	<i>Mordecai KURZ, Hehui JIN and Maurizio MOTOLESE: <u>Endogenous Fluctuations and the Role of Monetary Policy</u></i>
KNOW	12.2002	<i>Reyer GERLAGH and Marjan W. HOFKES: <u>Escaping Lock-in: The Scope for a Transition towards Sustainable Growth?</u></i>
NRM	13.2002	<i>Michele MORETTO and Paolo ROSATO: <u>The Use of Common Property Resources: A Dynamic Model</u></i>
CLIM	14.2002	<i>Philippe QUIRION: <u>Macroeconomic Effects of an Energy Saving Policy in the Public Sector</u></i>
CLIM	15.2002	<i>Roberto ROSON: <u>Dynamic and Distributional Effects of Environmental Revenue Recycling Schemes: Simulations with a General Equilibrium Model of the Italian Economy</u></i>
CLIM	16.2002	<i>Francesco RICCI (I): <u>Environmental Policy Growth when Inputs are Differentiated in Pollution Intensity</u></i>
ETA	17.2002	<i>Alberto PETRUCCI: <u>Devaluation (Levels versus Rates) and Balance of Payments in a Cash-in-Advance Economy</u></i>
Coalition Theory Network	18.2002	<i>László Á. KÓCZY (liv): <u>The Core in the Presence of Externalities</u></i>
Coalition Theory Network	19.2002	<i>Steven J. BRAMS, Michael A. JONES and D. Marc KILGOUR (liv): <u>Single-Peakedness and Disconnected Coalitions</u></i>
Coalition Theory Network	20.2002	<i>Guillaume HAERINGER (liv): <u>On the Stability of Cooperation Structures</u></i>
NRM	21.2002	<i>Fausto CAVALLARO and Luigi CIRAULO: <u>Economic and Environmental Sustainability: A Dynamic Approach in Insular Systems</u></i>
CLIM	22.2002	<i>Barbara BUCHNER, Carlo CARRARO, Igor CERSOSIMO and Carmen MARCHIORI: <u>Back to Kyoto? US Participation and the Linkage between R&D and Climate Cooperation</u></i>
CLIM	23.2002	<i>Andreas LÖSCHEL and ZhongXIANG ZHANG: <u>The Economic and Environmental Implications of the US Repudiation of the Kyoto Protocol and the Subsequent Deals in Bonn and Marrakech</u></i>
ETA	24.2002	<i>Marzio GALEOTTI, Louis J. MACCINI and Fabio SCHIANTARELLI: <u>Inventories, Employment and Hours</u></i>
CLIM	25.2002	<i>Hannes EGLI: <u>Are Cross-Country Studies of the Environmental Kuznets Curve Misleading? New Evidence from Time Series Data for Germany</u></i>
ETA	26.2002	<i>Adam B. JAFFE, Richard G. NEWELL and Robert N. STAVINS: <u>Environmental Policy and Technological Change</u></i>
SUST	27.2002	<i>Joseph C. COOPER and Giovanni SIGNORELLO: <u>Farmer Premiums for the Voluntary Adoption of Conservation Plans</u></i>
SUST	28.2002	<i><u>The ANSEA Network: Towards An Analytical Strategic Environmental Assessment</u></i>
KNOW	29.2002	<i>Paolo SURICO: <u>Geographic Concentration and Increasing Returns: a Survey of Evidence</u></i>
ETA	30.2002	<i>Robert N. STAVINS: <u>Lessons from the American Experiment with Market-Based Environmental Policies</u></i>
NRM	31.2002	<i>Carlo GIUPPONI and Paolo ROSATO: <u>Multi-Criteria Analysis and Decision-Support for Water Management at the Catchment Scale: An Application to Diffuse Pollution Control in the Venice Lagoon</u></i>
NRM	32.2002	<i>Robert N. STAVINS: <u>National Environmental Policy During the Clinton Years</u></i>
KNOW	33.2002	<i>A. SOUBEYRAN and H. STAHN : <u>Do Investments in Specialized Knowledge Lead to Composite Good Industries?</u></i>
KNOW	34.2002	<i>G. BRUNELLO, M.L. PARISI and Daniela SONEDDA: <u>Labor Taxes, Wage Setting and the Relative Wage Effect</u></i>
CLIM	35.2002	<i>C. BOEMARE and P. QUIRION (lv): <u>Implementing Greenhouse Gas Trading in Europe: Lessons from Economic Theory and International Experiences</u></i>

CLIM	36.2002	<i>T. TIETENBERG</i> (lv): <u>The Tradable Permits Approach to Protecting the Commons: What Have We Learned?</u>
CLIM	37.2002	<i>K. REHDANZ and R.J.S. TOL</i> (lv): <u>On National and International Trade in Greenhouse Gas Emission Permits</u>
CLIM	38.2002	<i>C. FISCHER</i> (lv): <u>Multinational Taxation and International Emissions Trading</u>
SUST	39.2002	<i>G. SIGNORELLO and G. PAPPALARDO</i> : <u>Farm Animal Biodiversity Conservation Activities in Europe under the Framework of Agenda 2000</u>
NRM	40.2002	<i>S.M. CAVANAGH, W. M. HANEMANN and R. N. STAVINS</i> : <u>Muffled Price Signals: Household Water Demand under Increasing-Block Prices</u>
NRM	41.2002	<i>A. J. PLANTINGA, R. N. LUBOWSKI and R. N. STAVINS</i> : <u>The Effects of Potential Land Development on Agricultural Land Prices</u>
CLIM	42.2002	<i>C. OHL</i> (lvi): <u>Inducing Environmental Co-operation by the Design of Emission Permits</u>
CLIM	43.2002	<i>J. EYCKMANS, D. VAN REGEMORTER and V. VAN STEENBERGHE</i> (lvi): <u>Is Kyoto Fatally Flawed? An Analysis with MacGEM</u>
CLIM	44.2002	<i>A. ANTOCI and S. BORGHESI</i> (lvi): <u>Working Too Much in a Polluted World: A North-South Evolutionary Model</u>
ETA	45.2002	<i>P. G. FREDRIKSSON, Johan A. LIST and Daniel MILLIMET</i> (lvi): <u>Chasing the Smokestack: Strategic Policymaking with Multiple Instruments</u>
ETA	46.2002	<i>Z. YU</i> (lvi): <u>A Theory of Strategic Vertical DFI and the Missing Pollution-Haven Effect</u>
SUST	47.2002	<i>Y. H. FARZIN</i> : <u>Can an Exhaustible Resource Economy Be Sustainable?</u>
SUST	48.2002	<i>Y. H. FARZIN</i> : <u>Sustainability and Hamiltonian Value</u>
KNOW	49.2002	<i>C. PIGA and M. VIVARELLI</i> : <u>Cooperation in R&D and Sample Selection</u>
Coalition Theory Network Coalition Theory Network	50.2002	<i>M. SERTEL and A. SLINKO</i> (liv): <u>Ranking Committees, Words or Multisets</u>
ETA	51.2002	<i>Sergio CURRARINI</i> (liv): <u>Stable Organizations with Externalities</u>
ETA	52.2002	<i>Robert N. STAVINS</i> : <u>Experience with Market-Based Policy Instruments</u>
ETA	53.2002	<i>C.C. JAEGER, M. LEIMBACH, C. CARRARO, K. HASSELMANN, J.C. HOURCADE, A. KEELER and R. KLEIN</i> (liii): <u>Integrated Assessment Modeling: Modules for Cooperation</u>
CLIM	54.2002	<i>Scott BARRETT</i> (liii): <u>Towards a Better Climate Treaty</u>
ETA	55.2002	<i>Richard G. NEWELL and Robert N. STAVINS</i> : <u>Cost Heterogeneity and the Potential Savings from Market-Based Policies</u>
SUST	56.2002	<i>Paolo ROSATO and Edi DEFRANCESCO</i> : <u>Individual Travel Cost Method and Flow Fixed Costs</u>
SUST	57.2002	<i>Vladimir KOTOV and Elena NIKITINA</i> (lvii): <u>Reorganisation of Environmental Policy in Russia: The Decade of Success and Failures in Implementation of Perspective Quests</u>
SUST	58.2002	<i>Vladimir KOTOV</i> (lvii): <u>Policy in Transition: New Framework for Russia's Climate Policy</u>
SUST	59.2002	<i>Fanny MISSFELDT and Arturo VILLAVICENCO</i> (lvii): <u>How Can Economies in Transition Pursue Emissions Trading or Joint Implementation?</u>
VOL	60.2002	<i>Giovanni DI BARTOLOMEO, Jacob ENGWERDA, Joseph PLASMANS and Bas VAN AARLE</i> : <u>Staying Together or Breaking Apart: Policy-Makers' Endogenous Coalitions Formation in the European Economic and Monetary Union</u>
ETA	61.2002	<i>Robert N. STAVINS, Alexander F. WAGNER and Gernot WAGNER</i> : <u>Interpreting Sustainability in Economic Terms: Dynamic Efficiency Plus Intergenerational Equity</u>
PRIV	62.2002	<i>Carlo CAPUANO</i> : <u>Demand Growth, Entry and Collusion Sustainability</u>
PRIV	63.2002	<i>Federico MUNARI and Raffaele ORIANI</i> : <u>Privatization and R&D Performance: An Empirical Analysis Based on Tobin's Q</u>
PRIV	64.2002	<i>Federico MUNARI and Maurizio SOBRERO</i> : <u>The Effects of Privatization on R&D Investments and Patent Productivity</u>
SUST	65.2002	<i>Orley ASHENFELTER and Michael GREENSTONE</i> : <u>Using Mandated Speed Limits to Measure the Value of a Statistical Life</u>
ETA	66.2002	<i>Paolo SURICO</i> : <u>US Monetary Policy Rules: the Case for Asymmetric Preferences</u>
PRIV	67.2002	<i>Rinaldo BRAU and Massimo FLORIO</i> : <u>Privatisations as Price Reforms: Evaluating Consumers' Welfare Changes in the U.K.</u>
CLIM	68.2002	<i>Barbara K. BUCHNER and Roberto ROSON</i> : <u>Conflicting Perspectives in Trade and Environmental Negotiations</u>
CLIM	69.2002	<i>Philippe QUIRION</i> : <u>Complying with the Kyoto Protocol under Uncertainty: Taxes or Tradable Permits?</u>
SUST	70.2002	<i>Anna ALBERINI, Patrizia RIGANTI and Alberto LONGO</i> : <u>Can People Value the Aesthetic and Use Services of Urban Sites? Evidence from a Survey of Belfast Residents</u>
SUST	71.2002	<i>Marco PERCOCO</i> : <u>Discounting Environmental Effects in Project Appraisal</u>
NRM	72.2002	<i>Philippe BONTEMS and Pascal FAVARD</i> : <u>Input Use and Capacity Constraint under Uncertainty: The Case of Irrigation</u>
PRIV	73.2002	<i>Mohammed OMRAN</i> : <u>The Performance of State-Owned Enterprises and Newly Privatized Firms: Empirical Evidence from Egypt</u>
PRIV	74.2002	<i>Mike BURKART, Fausto PANUNZI and Andrei SHLEIFER</i> : <u>Family Firms</u>
PRIV	75.2002	<i>Emmanuelle AURIOL, Pierre M. PICARD</i> : <u>Privatizations in Developing Countries and the Government Budget Constraint</u>
PRIV	76.2002	<i>Nichole M. CASTATER</i> : <u>Privatization as a Means to Societal Transformation: An Empirical Study of Privatization in Central and Eastern Europe and the Former Soviet Union</u>

PRIV	77.2002	<i>Christoph LÜLSFESMANN</i> : <u>Benevolent Government, Managerial Incentives, and the Virtues of Privatization</u>
PRIV	78.2002	<i>Kate BISHOP, Igor FILATOTCHEV and Tomasz MICKIEWICZ</i> : <u>Endogenous Ownership Structure: Factors Affecting the Post-Privatisation Equity in Largest Hungarian Firms</u>
PRIV	79.2002	<i>Theodora WELCH and Rick MOLZ</i> : <u>How Does Trade Sale Privatization Work? Evidence from the Fixed-Line Telecommunications Sector in Developing Economies</u>
PRIV	80.2002	<i>Alberto R. PETRUCCI</i> : <u>Government Debt, Agent Heterogeneity and Wealth Displacement in a Small Open Economy</u>
CLIM	81.2002	<i>Timothy SWANSON and Robin MASON</i> (Ivi): <u>The Impact of International Environmental Agreements: The Case of the Montreal Protocol</u>
PRIV	82.2002	<i>George R.G. CLARKE and Lixin Colin XU</i> : <u>Privatization, Competition and Corruption: How Characteristics of Bribe Takers and Payers Affect Bribe Payments to Utilities</u>
PRIV	83.2002	<i>Massimo FLORIO and Katuscia MANZONI</i> : <u>The Abnormal Returns of UK Privatisations: From Underpricing to Outperformance</u>
NRM	84.2002	<i>Nelson LOURENÇO, Carlos RUSSO MACHADO, Maria do ROSÁRIO JORGE and Luís RODRIGUES</i> : <u>An Integrated Approach to Understand Territory Dynamics. The Coastal Alentejo (Portugal)</u>
CLIM	85.2002	<i>Peter ZAPFEL and Matti VAINIO</i> (Iv): <u>Pathways to European Greenhouse Gas Emissions Trading History and Misconceptions</u>
CLIM	86.2002	<i>Pierre COURTOIS</i> : <u>Influence Processes in Climate Change Negotiations: Modelling the Rounds</u>
ETA	87.2002	<i>Vito FRAGNELLI and Maria Erminia MARINA</i> (Iviii): <u>Environmental Pollution Risk and Insurance</u>
ETA	88.2002	<i>Laurent FRANCKX</i> (Iviii): <u>Environmental Enforcement with Endogenous Ambient Monitoring</u>
ETA	89.2002	<i>Timo GOESCHL and Timothy M. SWANSON</i> (Iviii): <u>Lost Horizons. The noncooperative management of an evolutionary biological system.</u>
ETA	90.2002	<i>Hans KEIDING</i> (Iviii): <u>Environmental Effects of Consumption: An Approach Using DEA and Cost Sharing</u>
ETA	91.2002	<i>Wietze LISE</i> (Iviii): <u>A Game Model of People's Participation in Forest Management in Northern India</u>

(xlii) This paper was presented at the International Workshop on "Climate Change and Mediterranean Coastal Systems: Regional Scenarios and Vulnerability Assessment" organised by the Fondazione Eni Enrico Mattei in co-operation with the Istituto Veneto di Scienze, Lettere ed Arti, Venice, December 9-10, 1999.

(xliii) This paper was presented at the International Workshop on "Voluntary Approaches, Competition and Competitiveness" organised by the Fondazione Eni Enrico Mattei within the research activities of the CAVA Network, Milan, May 25-26, 2000.

(xliv) This paper was presented at the International Workshop on "Green National Accounting in Europe: Comparison of Methods and Experiences" organised by the Fondazione Eni Enrico Mattei within the Concerted Action of Environmental Valuation in Europe (EVE), Milan, March 4-7, 2000

(xlv) This paper was presented at the International Workshop on "New Ports and Urban and Regional Development. The Dynamics of Sustainability" organised by the Fondazione Eni Enrico Mattei, Venice, May 5-6, 2000.

(xlvi) This paper was presented at the Sixth Meeting of the Coalition Theory Network organised by the Fondazione Eni Enrico Mattei and the CORE, Université Catholique de Louvain, Louvain-la-Neuve, Belgium, January 26-27, 2001

(xlvii) This paper was presented at the RICAMARE Workshop "Socioeconomic Assessments of Climate Change in the Mediterranean: Impact, Adaptation and Mitigation Co-benefits", organised by the Fondazione Eni Enrico Mattei, Milan, February 9-10, 2001

(xlviii) This paper was presented at the International Workshop "Trade and the Environment in the Perspective of the EU Enlargement", organised by the Fondazione Eni Enrico Mattei, Milan, May 17-18, 2001

(xlix) This paper was presented at the International Conference "Knowledge as an Economic Good", organised by Fondazione Eni Enrico Mattei and The Beijer International Institute of Environmental Economics, Palermo, April 20-21, 2001

(l) This paper was presented at the Workshop "Growth, Environmental Policies and Sustainability" organised by the Fondazione Eni Enrico Mattei, Venice, June 1, 2001

(li) This paper was presented at the Fourth Toulouse Conference on Environment and Resource Economics on "Property Rights, Institutions and Management of Environmental and Natural Resources", organised by Fondazione Eni Enrico Mattei, IDEI and INRA and sponsored by MATE, Toulouse, May 3-4, 2001

(lii) This paper was presented at the International Conference on "Economic Valuation of Environmental Goods", organised by Fondazione Eni Enrico Mattei in cooperation with CORILA, Venice, May 11, 2001

(liii) This paper was circulated at the International Conference on "Climate Policy – Do We Need a New Approach?", jointly organised by Fondazione Eni Enrico Mattei, Stanford University and Venice International University, Isola di San Servolo, Venice, September 6-8, 2001

(liv) This paper was presented at the Seventh Meeting of the Coalition Theory Network organised by the Fondazione Eni Enrico Mattei and the CORE, Université Catholique de Louvain, Venice, Italy, January 11-12, 2002

(lv) This paper was presented at the First Workshop of the Concerted Action on Tradable Emission Permits (CATEP) organised by the Fondazione Eni Enrico Mattei, Venice, Italy, December 3-4, 2001

(lvi) This paper was presented at the ESF EURESCO Conference on Environmental Policy in a Global Economy “The International Dimension of Environmental Policy”, organised with the collaboration of the Fondazione Eni Enrico Mattei, Acquafredda di Maratea, October 6-11, 2001

(lvii) This paper was presented at the First Workshop of “CFEWE – Carbon Flows between Eastern and Western Europe”, organised by the Fondazione Eni Enrico Mattei and Zentrum für Europäische Integrationsforschung (ZEI), Milan, July 5-6, 2001

(lviii) This paper was presented at the Workshop on “Game Practice and the Environment”, jointly organised by Università del Piemonte Orientale and Fondazione Eni Enrico Mattei, Alessandria, April 12-13, 2002

2002 SERIES

CLIM *Climate Change Modelling and Policy* (Editor: Marzio Galeotti)

VOL *Voluntary and International Agreements* (Editor: Carlo Carraro)

SUST *Sustainability Indicators and Environmental Evaluation*
(Editor: Carlo Carraro)

NRM *Natural Resources Management* (Editor: Carlo Giupponi)

KNOW *Knowledge, Technology, Human Capital* (Editor: Dino Pinelli)

MGMT *Corporate Sustainable Management* (Editor: Andrea Marsanich)

PRIV *Privatisation, Regulation, Antitrust* (Editor: Bernardo Bortolotti)

ETA *Economic Theory and Applications* (Editor: Carlo Carraro)