ECONSTOR
Make Your Publications Visible.

A Service of

ZBW Leibniz-Informationszentrum Wirtschaft
Leibniz Information Centre for Economics

Lahiri, Somdeb

Working Paper

Stable Matchings for the Room-mates Problem

Nota di Lavoro, No. 116.2003

Provided in Cooperation with:
Fondazione Eni Enrico Mattei (FEEM)

Suggested Citation: Lahiri, Somdeb (2003) : Stable Matchings for the Room-mates Problem, Nota di Lavoro, No. 116.2003, Fondazione Eni Enrico Mattei (FEEM), Milano

This Version is available at:
https://hdl.handle.net/10419/118149

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.

WWW.ECONSTOR.EU

Mitglied der Leibniz-Gemeinschaft

Stable Matchings for the Room-mates Problem

Somdeb Lahiri

NOTA DI LAVORO 116.2003

DECEMBER 2003

CTN – Coalition Theory Network

Somdeb Lahiri, *School of Economic and Business Sciences, University of Witwatersrand at Johannesburg*

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

Stable Matchings for the Room-mates Problem

Summary

We show that, given two matchings for a room-mates problem of which say the second is stable, and given a non-empty subset of agents S if (a) no agent in S prefers the first matching to the second, and (b) no agent in S and his room-mate in S under the second matching prefer each other to their respective room-mates in the first matching, then no room-mate of an agent in S prefers the second matching to the first. This result is a strengthening of a result originally due to Knuth (1976).
In a paper by Sasaki and Toda (1992) it is shown that if a marriage problem has more than one stable matchings, then given any one stable matching, it is possible to add agents and thereby obtain exactly one stable matching, whose restriction over the original set of agents, coincides with the given stable matching. We are able to extend this result here to the domain of room-mates problems.
We also extend a result due to Roth and Sotomayor (1990) originally established for two-sided matching problems in the following manner: If in a room-mates problem, the number of agents increases, then given any stable matching for the old problem and any stable matching for the new one, there is at least one agent who is acceptable to this new agent who prefers the new matching to the old one and his room-mate under the new matching prefers the old matching to the new one.
Sasaki and Toda (1992) shows that the solution correspondence which selects the set of all stable matchings, satisfies Pareto Optimality, Anonymity, Consistency and Converse Consistency on the domain of marriage problems. We show here that if a solution correspondence satisfying Consistency and Converse Consistency agrees with the solution correspondence comprising stable matchings for all room-mates problems involving four or fewer agents, then it must agree with the solution correspondence comprising stable matchings for all room-mates problems.

Keywords: Stable matchings, Room-mate problem

JEL: C71, C78

Address for correspondence:

Somdeb Lahiri
School of Economic and Business Sciences
University of Witwatersrand at Johannesburg
220 New Commerce Building
Private Bag 3, WITS 2050
Johannesburg
Gauteng
South Africa
E-mail: lahiri@sebs.wits.ac.za
Or lahiri@webmail.co.za

1. Introduction :

A salient feature of many markets is to match one agent with another. This is particularly true, in the case of assigning tasks to individuals where each task is under the supervision of an individual, and where the set of supervisors and the set of workers are disjoint. Such markets are usually studied with the help of "two sided matching models" introduced by Gale and Shapley (1962) called the marriage problem. However, not all matching problems where disjoint pairs are required to form, is dichotomous. For instance in a doubles version of a tennis tournament, pairs are formed from a given pool of players, without any obvious dichotomy existing within the pool. In the case of "mixed doubles" however, a man and a woman need to form a pair, as in the case of a two-sided matching market. The problem of forming disjoint pairs out of a given set of agents is what Gale and Shapley(1962) called a room-mates problem. The marriage problem is indeed a special case of their room-mates problem.

The solution concept proposed by Gale and Shapley (1962), called a stable matching, requires that there should not exist two agents, who prefer each other, to the individual they have been paired with. It was shown in Gale and Shapley (1962), in a framework where every agent has preference defined by a linear order over the entire set of agents, that a room-mates problem may not admit any stable matching although a marriage problem always does. Indeed, given a marriage problem, there is always a stable matching which no man considers inferior to any other stable matching, and there is always a stable matching that no woman considers inferior to any other stable matching. The first is called an M – optimal stable matching (i.e. stable matching optimal for men) and the second one a W – optimal stable matching (i.e. stable matching optimal for women). An overview of the considerable literature on marriage problems that has evolved out of the work of Gale and Shapley (1962), is available in Roth and Sotomayor (1990). Lahiri (2002) contains alternative simpler proofs of some existing results and some new conclusions for two-sided matching problems.

Tan (1991) obtained a necessary and sufficient condition for the existence of a stable matching for a room-mates problem. Chung (2000), generalized a result of Roth and Vande Vate (1990) originally established in the context of the marriage

model, to show that the satisfaction of a "no odd rings" condition was sufficient for a room-mates problem to admit a stable matching. This result was shown to hold even when preferences were not necessarily strict. Diamantoudi, Miyagawa and Xue (2002), were able to show that a process of "myopic blocking" would necessarily converge to the set of stable matchings of a room-mates problem with strict preferences, provided the required set was non-empty. However, while the body of literature on existence of stable matchings for room-mates problems is quite enormous, there has been very little investigation of the properties of such matchings, if and when they do exist. This paper attempts to fill this gap by analyzing the co-operative theory of stable matchings for room-mates problems.

The first significant result that we present here is a strengthening of a result originally due to Knuth (1976). The original result said that given any two stable matchings for a marriage problem, if no man prefers the first matching to the second, then no woman prefers the second matching to the first. In Lahiri (2002) we show that, given two matchings for a marriage problem of which say the second is stable, if (a) no man prefers the first matching to the second, and (b) no man and the woman he is paired with under the second matching prefer each other to their respective assignments in the first matching, then no woman prefers the second matching to the first. In this paper we are able to extend the above result to the domain of all room-mates problems in the following manner: Given two matchings for a room-mates problem of which say the second is stable, and given a non-empty subset of agents S if (a) no agent in S prefers the first matching to the second, and (b) no agent in S and his room-mate in S under the second matching prefer each other to their respective room-mates in the first matching, then no room-mate of an agent in S prefers the second matching to the first. As a consequence, we obtain an extension of a result in Lahiri (2002) from the domain of marriage problems to the domain of room-mates problems. The earlier result, which was a generalization of the Strong Stability Theorem of Demange, Gale and Sotomayor (1987) for a particular case, says that if an unstable matching for a marriage problem is no better for any man compared to a given stable matching, then there is a pair under the stable matching who block the unstable matching. Our result here says that if for a subset of agents it is the case that an unstable matching is no better than a given stable matching, and if all blocking pairs of the unstable matching comprise an agent from the set and an agent from the set of room-mates of the given set, then there is a pair of room-mates in the stable matching who block the unstable matching.

In a paper by Sasaki and Toda (1992) it is shown that if a marriage problem has more than one stable matchings, then given any one stable matching, it is possible to add agents and thereby obtain exactly one stable matching, whose restriction over the original set of agents, coincides with the given stable matching. We are able to extend this result here to the domain of room-mates problems.

A theorem due to Roth and Sotomayor (1990), says that if in a marriage problem, the number of women increases, then there is a non-empty subset of men and the set of women they are assigned to under the M – optimal stable matching, such that given any stable matching for the old marriage problem and any stable matching for the new one, every man in the set prefers the new matching to the

old one and every woman in the set prefers the old matching to the new one. This result requires the use of a theorem due to Gale and Sotomayor (1985), which says that with more women around, men prefer the new optimal stable matchings to the corresponding ones of the old marriage problem, while the opposite is true for woman. However, the staring point of the above result due to Roth and Sotomayor (1990) is the following: If in a marriage problem, the number of women increases by one, then given any stable matching for the old marriage problem and any stable matching for the new marriage problem, there is a non-empty subset of men and the set of women they are paired with under the new stable matching, such that every man in the set prefers the new matching to the old one and every woman in the set prefers the old matching to the new one. In this paper we extend this latter result to the domain of all room-mates problems in the following manner: If in a room-mates problem, the number of agents increases, then given any stable matching for the old problem and any stable matching for the new one, there is at least one agent who is acceptable to this new agent who prefers the new matching to the old one and his room-mate under the new matching prefers the old matching to the new one.

Sasaki and Toda (1992) shows that the solution correspondence which selects the set of all stable matchings, satisfies Pareto Optimality, Anonymity, Consistency and Converse Consistency on the domain of marriage problems. The observation that a similar result is true on the domain of all room-mates problems is quite immediate. However, the solution correspondence comprising matchings which resemble a kind of serial dictatorship is always non-empty valued on the domain of all room-mates problems and also satisfies the above mentioned properties. We show here that if a solution correspondence satisfying Consistency and Converse Consistency agrees with the solution correspondence comprising stable matchings for all room-mates problems involving four or fewer agents, then it must agree with the solution correspondence comprising stable matchings for all room-mates problems.

2. The Model :

Let X be a non-empty finite subset of $\aleph$(: the set of natural numbers), denoting the set of paticipating agents. Each agent $a \in X$ has preferences over X represented by a linear order R_a (: a binary relation R on X is said to be a linear order if it is reflexive, complete, anti- symmetric and transitive). Given a binary relation R on X and a non-empty subset S of X, let $R \mid S = R \cap (S \times S)$ and let $P(R) = \{ (x,y) \in R / (y,x) \notin R\}$ denote the asymmetric part of R.

A room-mates problem G is an array $< X, (R_a)_{a \in X} >$. Given a room-mates problem $G = < X, (R_a)_{a \in X} >$ and $a \in X$, the acceptable set for a, denoted $A(a) = \{b \in X / (b,a) \in R_a\}$.

Given $G = < X, (R_a)_{a \in X} >$ and $a,b,c \in X$, we denote $(b,c) \in R_x$ by $b\ R_x\ a$, $P(R_a)$ by P_a and $(b,c) \in P_a$ by $y\ P_x\ z$.

A room-mates problem $G = < X, (R_a)_{a \in X} >$ is called a marriage problem if there exists two non-empty disjoint subsets M and W of X, such that (i) $M \cup W = X$; (ii) for all $a,b,c \in X$: [$a,b \in M$, $c \in W$ with $a \neq b$ implies aP_ab and cP_ab]; (iii) for all $a,b,c \in X$: [$a,b \in W$, $c \in M$ with $a \neq b$ implies aP_ab and cP_ab]. We denote a marriage

problem as $<(M,W), (R_x)_{x\in M\cup W}>$. M is called the set of men and W the set of women.
Given a room-mates problem $G = < X, (R_a)_{a\in X} >$, a matching for G is a bijection μ from X to itself such that for all $a\in X$: (i) $\mu(a) \in A(a)$; (ii) $\mu(\mu(a)) = a$.

Since the identity function on X is a matching every room-mates problem admits at least one matching.

Given a matching μ for a room-mates problem $G = < X, (R_a)_{a\in X} >$, a pair $(a,b) \in X\times X$ is said to block μ, if $b\ P_a\ \mu(a)$ and $a\ P_b\ \mu(b)$. The matching μ is said to be stable if it does not admit any blocking pair.
Given two matchings μ,μ' for $G = < X, (R_a)_{a\in X} >$ and a non-empty subset S of X, we write:
(i) $\mu \geq_S \mu'$ if $\mu(a)\ R_a\ \mu'(a)$ for all $a \in S$;
(ii) $\mu >_S \mu'$ if $\mu \geq_S \mu'$ but $\mu \neq \mu'$;
(iii) $\mu >>_S \mu'$ if $\mu(a)\ P_a\ \mu'(a)$ for all $a \in S$
In the case where S is a singleton, $S = \{a\}$, we write $\mu\ R_a\ \mu'$ to denote $\mu \geq_{\{a\}} \mu'$ and $\mu\ P_a\ \mu'$ to denote $\mu >_{\{a\}} \mu'$.
Let E be the class of all room-mates. Given $G\in E$, let F(G) be the set off all matchings for G. Let $F = \bigcup_{G\in E} F(G)$. Let 2^F, denote the power set of F(i.e. the set of all subsets of F). A solution on E is a function $\varphi: E \to 2^F$, such that for all $G\in E$, $\varphi(G) \subset F(G)$.
The stable matching solution on E, denoted St is the solution on E, such that for all $G\in E$: $St(G) = \{\mu\in F(G)/\ \mu$ is a stable matching for $G\}$.

The following example due to Gale and Shapley (1962) shows that a room-mates problem need not admit any stable matching.

Example 1 (Gale Shapley (1962)) : Let $X = \{1,2,3,4\}$. Suppose the preferences of the agents are defined as follows:
Agent 1: $2\ P_1\ 3\ P_1\ 4\ P_1\ 1$;
Agent 2: $3\ P_2\ 1\ P_2\ 4\ P_2\ 2$;
Agent 3: $1\ P_3\ 2\ P_3\ 4\ P_3\ 3$;
Agent 4: $1\ P_4\ 2\ P_4\ 3\ P_4\ 4$.
Suppose the matching μ is such that $\mu(4) \neq 4$. If $A\mu(4) = 3$, then $\{2,3\}$ blocks μ; if $\mu(4) = 2$, then $\{1,2\}$ blocks μ; if $\mu(4) = 1$, then $\{1,3\}$ blocks μ. Hence if μ were a stable matching it should be the case that $\mu(4) = 4$. If $\mu(1) = 1$, then both (3.1) and (4,1) are blocking pairs. If $\mu(2) = 2$, then both (1.2) and (4,2) are blocking pairs. If $\mu(3) = 3$, then both (2.3) and (4,3) are blocking pairs. Thus, the given room-mates problem does not admit a stable matching.
Hence we cannot claim that St is non-empty valued.
Given $G = <X, (R_a)_{a\in X} > \in E$, a matching $\mu\in F(G)$ is said to be Pareto Optimal if there does not exist $\mu'\in F(G)$, such that $\mu'(a)R_a\ \mu(a)$ for all $a\in X$ and $\mu'(a)P_a\ \mu(a)$ for some $a\in X$.

3. Properties of Stable Matchings for Room-mates Problems:

Lemma 1: Let μ and $\bar{\mu}$ be stable matchings for a room-mates problem G. Let $a \in X$ and $b = \mu(a) \neq a$. If, $\mu(a) P_a \bar{\mu}(a)$, then $\bar{\mu}(b) P_b \mu(b)$.

Proof : Suppose $\mu, \bar{\mu}$, a and b are as above. If $b = \mu(a) P_a \bar{\mu}(a)$, then $\bar{\mu}(a) \neq b$. Thus stability of $\bar{\mu}$ requires, $\bar{\mu}(b) P_b a = \mu(b)$. Q.E.D.

The following lemma extends one due to Knuth (1976) and Lahiri (2002):

Lemma 2: Let G be a room-mates problem, for which $\bar{\mu}$ is a stable matching. Let S be a non-empty subset of X. Suppose that μ is a matching such that $\bar{\mu} \geq_S \mu$. If there does not exist $a \in S$, such that $(a, \bar{\mu}(a))$ blocks μ, then $\mu(b) R_b \bar{\mu}(b)$ for all $b \in \bar{\mu}(S)$.

Proof : Towards a contradiction suppose that $a = \bar{\mu}(b) P_b \mu(b)$, for some $a \in S$. Since $(a, \bar{\mu}(a)) = (a,b)$ does not block μ, and since $\mu(a) \neq b$, it must be the case that $\mu(a) >_a b = \bar{\mu}(a)$. This contradicts the hypothesis $\bar{\mu} \geq_S \mu$, and proves the lemma. Q.E.D.

Hence, if in Lemma 2, μ is a stable matching, then, $\bar{\mu} \geq_S \mu$. if and only if [$\mu(b) R_b \bar{\mu}(b)$ for all $b \in \bar{\mu}(S)$].

As a consequence of Lemma 2 we obtain the following stronger version of the Strong Stability Theorem due to Demange, Gale and Sotomayor (1987) extended from the domain of marriage problems to the domain of room-mates problems, which is valid for a special case.

Corollary of Lemma 2 : Let G be a room-mates problem and suppose μ is an unstable matching, such that $\mu^* >_S \mu$ for some stable matching μ^* and some non-empty subset S of X. Suppose that if (a,b) is a blocking pair for μ, then both $\{a,b\} \cap \mu^*(S) \neq \phi$ and $\{a,b\} \cap \mu^*(S) \neq \phi$. Then there exists $a \in S$, such that $(a, \mu^*(a))$ blocks μ .

Proof : Suppose towards a contradiction, that there does not exist a pair $(a, \mu^*(a))$ with $a \in S$ which blocks μ .
Suppose that for some $b \in \mu^*(S)$, we have $a = \mu^*(b) P_b \mu(b)$. Hence $\mu(a) P_a b = \mu^*(a)$. This contradicts $\mu^* >_S \mu$. Thus, $\mu(b) R_b \mu^*(b)$ for all $b \in \mu^*(S)$.

Since μ is unstable there exists a pair (a,b) which blocks μ. Thus, $bP_a\mu(a)$ and $aP_b\mu(b)$. Suppose $a \in S$. Let $b \in \mu^*(S)$.If we can show $\mu^*(a)\ R_a\ b$, then we are done. Towards a contradiction suppose $b\ P_a\ \mu^*(a)$. Since μ^* is stable, $\mu^*(b) >_b a$. Thus $\mu^*(b) >_b \mu(b)$. This contradicts, $\mu(b') R_b \mu^*(b')$ for all $b' \in \mu^*(S)$.
Thus there exists $a \in S$, such that $(a,\mu^*(a))$ blocks μ . Q.E.D.

The following lemma is worth noting:
Lemma 3: Let G be a room-mates problem for which μ is a stable matching. Let S be any non empty proper subset of X and let $Y = S \cup \mu(S)$ or $Y = X \setminus (S \cup \mu(S))$. Suppose $Y \neq \phi$. and let $G' = \langle Y, (R'_a)_{a \in Y} \rangle$, where $R'_a = R_x \mid Y$. Let μ' denote the restriction of μ to Y. Then μ' is a stable matching for G'.

Proof: Stability of μ' is easy to establish. Q.E.D.

Lemma 4: Let μ be a stable matching for a room-mates problem $G = \langle X, (R_a)_{a \in X} \rangle$. Then μ is Pareto Optimal for G.

Proof: Towards a contradiction suppose there is a matching $\mu' \in F(G)$ such that $\mu'(a) R_a \mu(a)$ for all $a \in X$ and $\mu'(a) P_a \mu(a)$ for at least one $a \in X$. Suppose $c = \mu'(b) P_b \mu(b)$. Thus $\mu'(c) = b \neq \mu(c)$ and $\mu'(c)\ R_c\ \mu(c)$ implies $\mu'(c)\ P_c\ \mu(c)$. Thus, (b,c) is a blocking pair for μ, contradicting its stability. Thus μ is Pareto Optimal. Q.E.D.

As a consequence of Lemma 3, we obtain the following version of a result originally due to Sasaki and Toda (1992).
Lemma 5: Let μ, μ' with $\mu \neq \mu'$ be stable matchings for a room mates problem $G = \langle X, (R_a)_{a \in X} \rangle$. Then there exits a room-mates problem $G' = \langle Y, (R'_a)_{a \in Y} \rangle$ and a stable matching μ^1 for G' such that (i) $Y \setminus X$ is a singleton say 'n'; (ii) $R'_a|X = R_a$ for all $a \in X$; (iii) $\mu^1|X = \mu$ (iv) there does not exist any stable matching μ^2 for G' such that $\mu^2|X = \mu'$.

Proof: By Lemma 4, μ is Pareto Optimal. Since $\mu \neq \mu'$, there exists $b \in X$ such that $\mu(b) P_b\ \mu'(b)$.
For a, $c \in X \setminus \{b\}$, let R'_a be the linear order such that (i) aP_ac implies $aP'_anP'_ac$; and (ii) $R'_a|X = R_a$.
Let R'_b be the linear order such that $R'_b|X = R_b$ and for all $a \in X \setminus \{b\}$, $aP_b\ \mu'(b)$ implies $aP'_bnP'_b\ \mu'(b)$.
Let R'_n be any linear order such that for all $a \in X \setminus \{b\}$: $bP'_n n\ P'_n a$.
Let μ^2 be any matching such that $\mu^2|X = \mu'$. Hence, $\mu^2(n) = n$. Thus, $n\ P'_b\ \mu'(b)$ and $bP'_n n\ P'_n a$ for all $a \in X \setminus \{b\}$ implies (b,n) is a blocking pair for μ^2.
Now, $\mu(b) P_b\ \mu'(b)$ implies $\mu(b) P'_b\ n$. Let μ^1 be any matching such that $\mu^1|X = \mu$. Thus, $\mu^1(n) = n$. Thus, (b,n) is not a blocking pair for μ^1. Further, $nP_n\ a$ for all $a \in X \setminus \{b\}$, implies that (a,n) cannot be a blocking pair if $a \in X \setminus \{b\}$. Since $\mu^1|X = \mu$

and μ is stable for G, there can thus be no other blocking pair for μ^1. Thus, μ^1 is stable for G'. Q.E.D.

Corollary of Lemma 5: Let $G = <X, (R_a)_{a\in X}>$ be a room-mates problem with $\#St(G) > 1$. Let $\mu \in St(G)$.Then there exits a room-mates problem $G' = <Y, (R'_a)_{a\in Y}>$ with $X \subset Y$, $\#Y - \#X = St(G) - 1$, and a stable matching μ^1 for G' such that (i) $R'_a|X = R_a$ for all $a \in X$; (ii) $\mu^1|X = \mu$ (iv) $St(G') = \{\mu^1\}$.

The final theorem of this section is an extension of a similar theorem due to Roth and Sotomayor (1990) from the domain of marriage problems to the domain of room-mates problems. This result says that if a new participant is added to a room-mates problem, then given any stable matching for the earlier problem and any stable matching for the new one where the new entrant is paired off with another agent, there is at least one agent on the new arrival's admissible set, who is better off at the second stable matching. Further, the room-mate of this particular beneficiary of the second stable matching, is now worse off than before.

Theorem 1: Let $G = <X, (R_a)_{a\in X}>$ and $G' = <Y, (R'_a)_{a\in Y}>$, where $Y = X \cup \{a_o\}$, for some $a_o \notin X$. Let $R_a = R'_a \mid X$, for all $a \in X$. Let μ be a stable matching for G and let μ' be a stable matching for G'. If $\mu'(a_0) \neq a_0$, then there exists $b \in T = \{a \in X / a P_{a_0} a_0\}$ such that $\mu'(b) P_b \mu(b)$ and $b >_{\{\mu'(b)\}\cap X} \mu'(\mu(b))$.

Proof : Let $X = \{a_1,\ldots,a_K\}$ and $Y = X \cup \{a_0\}$. Let R_i denote R_{a_i} and P_i denote P_{a_i} for $i = 0,1,\ldots,K$. Since $\mu'(a_0) \neq a_0$, $\mu'(a_0) \in T$. Let $\mu'(a_0) = a_1$. If $a_0 P_1 \mu(a_1)$, then take $b = a_1$. Thus, $\mu'(b) P_b \mu(b)$ and $b >_{\{\mu'(b)\}\cap X} \mu'(\mu(b))$, the latter being vacuously true. Hence, suppose, $a_2 = \mu(a_1)\ P_1\ a_0 = \mu'(a_1)$. Since μ' is stable, it must be the case that $\mu'(a_2)\ P_2\ a_1 = \mu(a_2)$. If $a_2 \in T$, then we can take $b = a_2$ and obtain $\mu'(b) P_b \mu(b)$ and $b >_{\{\mu'(b)\}\cap X} \mu'(\mu(b))$.
Having obtained a_n , $n \geq 2$, by the above procedure, where (i) $[a_n = \mu(a_{n-1}), a_n \notin T, a_n = \mu(a_{n-1})\ P_{n-1}\ a_n = \mu'(a_{n-1})$, if n is even]; (ii) $[a_n = \mu'(a_{n-1}), a_n = \mu'(a_{n-1})\ P_{n-1}\ a_n = \mu(a_{n-1})$, if n is odd], let $a_{n+1} = \mu(a_n)$, if n is odd, and $a_{n+1} = \mu'(a_{n-1})$, if n is even. Suppose there exists $0 \leq j < t \leq K$, such that $a_{2j} = a_{2t}$, a_{2j} and a_{2t} are obtained by the above procedure and $a_{2j}, a_{2t}, \notin T$. Without loss of generality suppose k is the first such t. If $j \geq 1$, Then, $a_{2j-1} = a_{2k-1}$ and $a_{2j-2} = a_{2k-2}$, leading to a contradiction. Thus, suppose $j = 0$. Thus, $a_0 = a_{2k} = \mu(a_{2k-1})$, which is not possible, since $a_0 \notin X$. Hence, there does not exist $0 \leq j < t \leq K$, such that $a_{2j} = a_{2t}$, a_{2j} and a_{2t} are obtained by the above procedure and $a_{2j}, a_{2t}, \notin T$.
Since X is finite, there exists a smallest k such that $a_{2k} \in T$. Let $b = a_{2k}$. Thus, $\mu'(b) P_b \mu(b)$ and $b >_{\{\mu'(b)\}\cap X} \mu'(\mu(b))$. Q.E.D.

4. Some Consequences for the Marriage Problem:
A stable matching μ_M for a marriage problem G is said to be M- optimal (i.e. optimal for men) if $\mu_M \geq_M \mu$, whenever μ is any stable matching for G.

A stable matching μ_W for a marriage problem G is said to be W- optimal (i.e. optimal for women) if $\mu_W \geq_W \mu$, whenever μ is any stable matching for G.

Theorem 2 (Gale and Shapley (1962), Roth and Sotomayor (1990)) : Every marriage problem admits an M-optimal and a W- optimal stable matching.

It is proved in Lahiri (2002), that a direct consequence of Lemma 2 and the deferred acceptance procedure with men proposing used by Gale and Shapley (1962) and Roth and Sotomayor to establish Theorem 2, is the following theorem due to Gale and Soomayor (1985 a,b).

Theorem 3 (Gale and Sotomayor (1985 a,b)) : Let $G = \langle M,W, (R_x)_{x\in M\cup W} \rangle$ and $G' = \langle M,W', (R'_x)_{x\in X} \rangle$ be marriage problems, where $W \subset W'$, $X = M \cup W'$ and $R_x = R'_x \mid M\cup W$ for all $x \in M\cup W$.
Let μ_M and μ_W be the M – optimal and W – optimal stable matchings for G. Let μ'_M and μ'_W be the M – optimal and W – optimal stable matchings for G′. Then, (i) $\mu_M \geq_W \mu'_M$, $\mu_W \geq_W \mu'_W$; (ii) $\mu'_W \geq_M \mu_W$, $\mu'_M \geq_M \mu_M$.

As a consequence of Theorems 1 and 3, we get the following theorem:

Theorem 4 : (Roth and Sotomayor (1990)) : Let $G = \langle M,W, (R_x)_{x\in M\cup W} \rangle$ and $G' = \langle M,W', (R'_x)_{x\in X} \rangle$ be marriage problems, where $W \subset \subset W'$, $X = M \cup W^0$ and $R_x = R'_x \mid M\cup W$ for all $x \in M\cup W$. Let μ_M be the M – optimal stable matching for G, and let μ'_W be the W – optimal stable matching for G′. If there exists $w_o \in W' \setminus W$, such that $\mu'_W(w_o) \in M$, then there exists $m \in M$ and $w \in W'$, such that $w = \mu'(m)\ P'_m\ \mu(m)$ and $\mu(w) P'_w\ \mu'(w)$, whenever μ is a stable matching for G and μ' is a stable matching for G′.

Proof : Let $G^o = \langle M,W^o, (R^0_x \mid X)_{x\in Y} \rangle$, where $W^o = W \cup \{w_o\}$ and $Y = M\cup W^o$. By Theorem 3, $\mu^o_W \geq_{W^o} \mu'_W$. Thus, w_0 is not single under μ'_W implies w_o is not single under μ^o_W. By Theorem 1, $m \in M$ and $w \in W'$, such that $w = \mu^0_W(m) >_m \mu_M(w)$ and $\mu_M(w) >_w \mu^o_W(w)$. By Theorem 3, $\mu'_W \geq_M \mu^o_W$ and $\mu^o_M \geq_{W^o} \mu'_M$. Thus, $\mu'_W(m) >_m \mu_M(m)$ and $\mu_M(w) >_{\mu_M(S)\cap W^o} \mu'_W(w)$. This proves the theorem. Q.E.D.

5. Axiomatic Characterization of Stable matchings for Room-mates Problems:

Let PO be the solution on E, such that for all $G \in E$: $PO(G) = \{\mu \in F(G) / \mu$ is Pareto Optimal for G$\}$.
A solution φ on E is said to satisfy Pareto Optimality if for all $G \in E$, $\varphi(G) \subset PO(G)$.

It follows from Lemma 4, that St satisfies Pareto Optimality.

A solution φ on E is said to satisfy Consistency (CONS) if for any $G = \langle X, (R_a)_{a\in X}\rangle \in E$, $\mu\in\varphi(G)$ and non-empty subset Y of X satisfying $\mu(Y) = Y$, $\mu|Y \in\varphi(G')$ where $G' = \langle Y, (R_a|Y)_{a\in Y}\rangle$.

It follows from Lemma 3, that St satisfies CONS.

A solution φ on E is said to satisfy Converse Consistency (COCONS) if for any $G = \langle X, (R_a)_{a\in X}\rangle \in E$ and $\mu\in F(G)$: [$\mu|Y\in\varphi(G')$ for all $G' = \langle Y, (R_a|Y)_{a\in Y}\rangle$ where $Y = \{a,b, \mu(a), \mu(b)\}$ for two distinct elements a, b in X] implies [$\mu \in\varphi(G)$].

Since $\mu\in F(G)\setminus St(G)$ implies that there exists a blocking pair (a,b) so that $\mu|Y\notin St(G')$ where $G' = \langle Y, (R_a|Y)_{a\in Y}\rangle$ with $Y = \{a,b, \mu(a), \mu(b)\}$, clearly, St satisfies COCONS.

Proposition 1: Let φ be a solution on E satisfying CONS and COCONS. If $\varphi(G) = St(G)$ for all $G = \langle X, (R_a)_{a\in X}\rangle \in E$ with $\#X \le 4$, then $\varphi = St$.

Proof: Let $G = \langle X, (R_a)_{a\in X}\rangle \in E$ and $\mu\in\varphi(G)$. Since φ satisfies CONS, $\mu|Y\in\varphi(G')$ for all $G' = \langle Y, (R_a|Y)_{a\in Y}\rangle$ where $Y = \{a,b, \mu(a), \mu(b)\}$ for two distinct elements a, b in X. As a consequence of our assumption in the proposition, requiring equality of φ and St for all room-mates problems with at most four agents, $\mu|Y\in St(G')$ for all $G' = \langle Y, (R_a|Y)_{a\in Y}\rangle$ where $Y = \{a,b, \mu(a), \mu(b)\}$ for two distinct elements a, b in X. Since St satisfies COCONS, $\mu\in St(G)$. Thus, $\varphi(G) \subset St(G)$.
By a similar argument we can show that $St(G) \subset \varphi(G)$. Thus, $St(G) = \varphi(G)$.
Q.E.D.

Given $G = \langle X, (R_a)_{a\in X}\rangle \in E$ and a permutation π on X, let $G^\pi = \langle X, (R^\pi{}_a)_{a\in X}\rangle \in E$, where for all $a,b,c\in X$: [$\pi(b)R^\pi{}_{\pi(a)}\,\pi(c)$] if and only if [$bR_ac$].
If μ is a matching for G, then μ^π is the matching for G^π defined as follows: for all $a\in X$, $\mu^\pi(\pi(a)) = \mu(a)$.
A solution φ on E is said to satisfy Anonymity (AN) if for all $G= \langle X, (R_a)_{a\in X}\rangle \in E$ and all permutations π on X: [$\mu\in\varphi(G)$] implies [$\mu^\pi\in\varphi(G^\pi)$].
It is easily verified that St satisfies AN on E.

In view of the above we can state the following theorem.

Theorem 5: (i) St satisfies PO, CONS, COCONS and AN. (ii) Let φ be a solution on E satisfying CONS and COCONS. If $\varphi(G) = St(G)$ for all $G = \langle X, (R_a)_{a\in X}\rangle \in E$ with $\#X \le 4$, then $\varphi = St$.

However St is not the solution on E to satisfy PO,CONS,COCONS, AN.
Given $G = \langle X, (R_a)_{a\in X}\rangle \in E$ and a one-to-one function $p: \{1,\ldots,\#X\}\to X$, let $\mu^p(a) = a$ if $A(a) = \{a\}$. Let $Y = (a\in X / A(a) \neq \{a\}$.
Let $a_{p(1)} \in Y$, be such that (i) $a_{p(1)}R_{p(1)}a$ for all $a\in Y$; (ii) $p(1)\in A(a_{p(1)})$.

Let $\mu^p(p(1)) = a_{p(1)}$ and $\mu^p(a_{p(1)}) = p(1)$. Let $Y^1 = Y \setminus \{p(1), a_{p(1)}\}$. If $Y^1 = \phi$, then the procedure stops. Suppose, $Y^1 \neq \phi$. Let $q(1) = p(1)$, $t_1 = \min \{t / p(t) \in Y^1\}$ and $q(2) = p(t_1)$. Clearly, $q(2) = p(2)$ if $a_{p(1)} \neq p(2)$ and $q(2) = p(3)$ if $a_{p(1)} = p(2)$. Further, $\mu^p(q(1)) = a_{q(1)}$ and $\mu^p(a_{q(1)}) = q(1)$.Having defined Y^k , $q(k)$, $q(k+1)$ for $k \geq 1$, let $a_{k+1} \in Y^k$ be such that (i) $a_{k+1} R_{q(k+1)} a$ for all $a \in Y^k$; (ii) $q(k+1) \in A(a_{q(k+1)})$. Let $Y^{k+1} = Y^k \setminus \{q(k+1), a_{q(k+1)}\}$. If $Y^{K+1} = \phi$, then the procedure stops. Suppose, $Y^{K+1} \neq \phi$. Let $t_{K+1} = \min \{t / p(t) \in Y^{k+1}\}$ and $q(k+2) = p(t_{k+1})$. Let $\mu^p(q(k+1)) = a_{q(k+1)}$ and $\mu^p(a_{q(k+1)}) = q(k+1)$.

Since, X is finite, there exists a smallest positive integer K, such that $Y^{K+!} = \phi$. At this stage, we would have obtained a matching μ^p for G. Call μ^p the p-serial dictatorship matching for G. Let $Ser(G) = \{\mu^p / p$ is a one-to-one function from $\{1,\ldots,\#X\}$ to $X\}$.

The serial dictatorship solution on E denoted Ser, is the solution on E such that for all $G = \langle X, (R_a)_{a \in X} \rangle \in E$, $Ser(G) = \{\mu^p / p$ is a one-to-one function from $\{1,\ldots,\#X\}$ to $X\}$.

The verification of the fact that Ser satisfies PO,CON,COCONS and AN, is tedious though routine.

Now consider the Gale-Shapley(1962) example of a room-mates as stated in Example 1. This problem does not admit any stable matching. However, it does admit the following serial dictatorship matchings: (a) 1 and 2 are room-mates; 3 and 4 are room-mates; (b) 2 and 3 are room-mates; 1 and 4 are room-mates; (c) 1 and 3 are room-mates; 2 and 4 are room-mates; (d) 1 and 4 are room-mates; 2 and 3 are room-mates. Hence Ser $\neq$ St.

References :

1. G. Demange, D. Gale and M. Sotomayor (1987) : " A further note on the stable matching problem", Discrete Applied Mathematics, Volume 16, pages 217-222.
2. D. Gale and L. Shapley (1962) : " College Admissions and the stability of Marriage", American Mathematical Monthly, Volume 69, pages 9 – 15.
2. D. Gale and M. Sotomayor (1985 a) : " Some Remarks on the Stable Matching Problem", Discrete Applied Mathematics, Volume 11, pages 223 – 232.
3. K.-S. Chung (2000): "On the existence of stable roommate Matchings", Games and Economic Behavior 33, 206-230.
4. E. Diamantoudi, E. Miyagawa, L. Xue (2002): " Random Paths to Stability in the Roommate Problem", (unpublished).
5. J. Hwang (n.d.) : " Modeling on College Admissions in terms of stable marriages", Academia Sinica (mimeo).
6. D. Knuth (1976) : "Marriages Stables", Montreal : Les Presses de l'Universite de Montreal.
7. S. Lahiri (2002): "The Co-operative Theory of Two-Sided Matching Problems: A Re-Examination", (mimeo) WITS University.

8. A.E. Roth and J.H. Vande Vate (1990): " Random paths to stability in two-sided Matchings", Econometrica 58, 1475-1480.
9. A. Roth and M. Sotomayor (1990) : “ Two – Sided Matching: A Study in Game Theoretic Modeling and Analysis”, Econometric Society Monograph No : 18, Cambridge University Press.
10. H. Sasaki and M. Toda (1992): "Consistency and Characterization of the Core of Two-Sided Matching Problems", Journal of Economic Theory 56, 218-227.
11. J.J.M. Tan (1991): " A necessary and sufficient condition for the existence of a complete stable matching", Journal of Algorithms 12, 154-178.

NOTE DI LAVORO DELLA FONDAZIONE ENI ENRICO MATTEI
Fondazione Eni Enrico Mattei Working Paper Series
Our working papers are available on the Internet at the following addresses:
http://www.feem.it/Feem/Pub/Publications/WPapers/default.html
http://papers.ssrn.com

SUST	1.2002	*K. TANO, M.D. FAMINOW, M. KAMUANGA and B. SWALLOW*: Using Conjoint Analysis to Estimate Farmers' Preferences for Cattle Traits in West Africa
ETA	2.2002	*Efrem CASTELNUOVO and Paolo SURICO*: What Does Monetary Policy Reveal about Central Bank's Preferences?
WAT	3.2002	*Duncan KNOWLER and Edward BARBIER*: The Economics of a "Mixed Blessing" Effect: A Case Study of the Black Sea
CLIM	4.2002	*Andreas LÖSCHEL*: Technological Change in Economic Models of Environmental Policy: A Survey
VOL	5.2002	*Carlo CARRARO and Carmen MARCHIORI*: Stable Coalitions
CLIM	6.2002	*Marzio GALEOTTI, Alessandro LANZA and Matteo MANERA*: Rockets and Feathers Revisited: An International Comparison on European Gasoline Markets
ETA	7.2002	*Effrosyni DIAMANTOUDI and Eftichios S. SARTZETAKIS*: Stable International Environmental Agreements: An Analytical Approach
KNOW	8.2002	*Alain DESDOIGTS*: Neoclassical Convergence Versus Technological Catch-up: A Contribution for Reaching a Consensus
NRM	9.2002	*Giuseppe DI VITA:* Renewable Resources and Waste Recycling
KNOW	10.2002	*Giorgio BRUNELLO*: Is Training More Frequent when Wage Compression is Higher? Evidence from 11 European Countries
ETA	11.2002	*Mordecai KURZ, Hehui JIN and Maurizio MOTOLESE*: Endogenous Fluctuations and the Role of Monetary Policy
KNOW	12.2002	*Reyer GERLAGH and Marjan W. HOFKES:* Escaping Lock-in: The Scope for a Transition towards Sustainable Growth?
NRM	13.2002	*Michele MORETTO and Paolo ROSATO*: The Use of Common Property Resources: A Dynamic Model
CLIM	14.2002	*Philippe QUIRION*: Macroeconomic Effects of an Energy Saving Policy in the Public Sector
CLIM	15.2002	*Roberto ROSON*: Dynamic and Distributional Effects of Environmental Revenue Recycling Schemes: Simulations with a General Equilibrium Model of the Italian Economy
CLIM	16.2002	*Francesco RICCI* (l): Environmental Policy Growth when Inputs are Differentiated in Pollution Intensity
ETA	17.2002	*Alberto PETRUCCI*: Devaluation (Levels versus Rates) and Balance of Payments in a Cash-in-Advance Economy
Coalition Theory Network	18.2002	*László Á. KÓCZY* (liv)*:* The Core in the Presence of Externalities
Coalition Theory Network	19.2002	*Steven J. BRAMS, Michael A. JONES and D. Marc KILGOUR* (liv): Single-Peakedness and Disconnected Coalitions
Coalition Theory Network	20.2002	*Guillaume HAERINGER* (liv): On the Stability of Cooperation Structures
NRM	21.2002	*Fausto CAVALLARO and Luigi CIRAOLO:* Economic and Environmental Sustainability: A Dynamic Approach in Insular Systems
CLIM	22.2002	*Barbara BUCHNER, Carlo CARRARO, Igor CERSOSIMO and Carmen MARCHIORI*: Back to Kyoto? US Participation and the Linkage between R&D and Climate Cooperation
CLIM	23.2002	*Andreas LÖSCHEL and ZhongXIANG ZHANG:* The Economic and Environmental Implications of the US Repudiation of the Kyoto Protocol and the Subsequent Deals in Bonn and Marrakech
ETA	24.2002	*Marzio GALEOTTI, Louis J. MACCINI and Fabio SCHIANTARELLI*: Inventories, Employment and Hours
CLIM	25.2002	*Hannes EGLI:* Are Cross-Country Studies of the Environmental Kuznets Curve Misleading? New Evidence from Time Series Data for Germany
ETA	26.2002	*Adam B. JAFFE, Richard G. NEWELL and Robert N. STAVINS*: Environmental Policy and Technological Change
SUST	27.2002	*Joseph C. COOPER and Giovanni SIGNORELLO*: Farmer Premiums for the Voluntary Adoption of Conservation Plans
SUST	28.2002	*The ANSEA Network*: Towards An Analytical Strategic Environmental Assessment
KNOW	29.2002	*Paolo SURICO*: Geographic Concentration and Increasing Returns: a Survey of Evidence
ETA	30.2002	*Robert N. STAVINS:* Lessons from the American Experiment with Market-Based Environmental Policies

NRM	31.2002	*Carlo GIUPPONI and Paolo ROSATO:* Multi-Criteria Analysis and Decision-Support for Water Management at the Catchment Scale: An Application to Diffuse Pollution Control in the Venice Lagoon
NRM	32.2002	*Robert N. STAVINS*: National Environmental Policy During the Clinton Years
KNOW	33.2002	*A. SOUBEYRAN and H. STAHN* : Do Investments in Specialized Knowledge Lead to Composite Good Industries?
KNOW	34.2002	*G. BRUNELLO, M.L. PARISI and Daniela SONEDDA:* Labor Taxes, Wage Setting and the Relative Wage Effect
CLIM	35.2002	*C. BOEMARE and P. QUIRION* (lv): Implementing Greenhouse Gas Trading in Europe: Lessons from Economic Theory and International Experiences
CLIM	36.2002	*T.TIETENBERG* (lv): The Tradable Permits Approach to Protecting the Commons: What Have We Learned?
CLIM	37.2002	*K. REHDANZ and R.J.S. TOL* (lv): On National and International Trade in Greenhouse Gas Emission Permits
CLIM	38.2002	*C. FISCHER* (lv): Multinational Taxation and International Emissions Trading
SUST	39.2002	*G. SIGNORELLO and G. PAPPALARDO:* Farm Animal Biodiversity Conservation Activities in Europe under the Framework of Agenda 2000
NRM	40.2002	*S .M. CAVANAGH, W. M. HANEMANN and R. N. STAVINS:* Muffled Price Signals: Household Water Demand under Increasing-Block Prices
NRM	41.2002	*A. J. PLANTINGA, R. N. LUBOWSKI and R. N. STAVINS:* The Effects of Potential Land Development on Agricultural Land Prices
CLIM	42.2002	*C. OHL* (lvi): Inducing Environmental Co-operation by the Design of Emission Permits
CLIM	43.2002	*J. EYCKMANS, D. VAN REGEMORTER and V. VAN STEENBERGHE* (lvi): Is Kyoto Fatally Flawed? An Analysis with MacGEM
CLIM	44.2002	*A. ANTOCI and S. BORGHESI* (lvi): Working Too Much in a Polluted World: A North-South Evolutionary Model
ETA	45.2002	*P. G. FREDRIKSSON, Johan A. LIST and Daniel MILLIMET* (lvi): Chasing the Smokestack: Strategic Policymaking with Multiple Instruments
ETA	46.2002	*Z. YU* (lvi): A Theory of Strategic Vertical DFI and the Missing Pollution-Haven Effect
SUST	47.2002	*Y. H. FARZIN*: Can an Exhaustible Resource Economy Be Sustainable?
SUST	48.2002	*Y. H. FARZIN*: Sustainability and Hamiltonian Value
KNOW	49.2002	*C. PIGA and M. VIVARELLI*: Cooperation in R&D and Sample Selection
Coalition Theory Network	50.2002	*M. SERTEL and A. SLINKO* (liv): Ranking Committees, Words or Multisets
Coalition Theory Network	51.2002	*Sergio CURRARINI* (liv): Stable Organizations with Externalities
ETA	52.2002	*Robert N. STAVINS*: Experience with Market-Based Policy Instruments
ETA	53.2002	*C.C. JAEGER, M. LEIMBACH, C. CARRARO, K. HASSELMANN, J.C. HOURCADE, A. KEELER and R. KLEIN* (liii): Integrated Assessment Modeling: Modules for Cooperation
CLIM	54.2002	*Scott BARRETT* (liii)*:* Towards a Better Climate Treaty
ETA	55.2002	*Richard G. NEWELL and Robert N. STAVINS*: Cost Heterogeneity and the Potential Savings from Market-Based Policies
SUST	56.2002	*Paolo ROSATO and Edi DEFRANCESCO*: Individual Travel Cost Method and Flow Fixed Costs
SUST	57.2002	*Vladimir KOTOV and Elena NIKITINA* (lvii): Reorganisation of Environmental Policy in Russia: The Decade of Success and Failures in Implementation of Perspective Quests
SUST	58.2002	*Vladimir KOTOV* (lvii): Policy in Transition: New Framework for Russia's Climate Policy
SUST	59.2002	*Fanny MISSFELDT and Arturo VILLAVICENCO* (lvii): How Can Economies in Transition Pursue Emissions Trading or Joint Implementation?
VOL	60.2002	*Giovanni DI BARTOLOMEO, Jacob ENGWERDA, Joseph PLASMANS and Bas VAN AARLE:* Staying Together or Breaking Apart: Policy-Makers' Endogenous Coalitions Formation in the European Economic and Monetary Union
ETA	61.2002	*Robert N. STAVINS, Alexander F.WAGNER and Gernot WAGNER*: Interpreting Sustainability in Economic Terms: Dynamic Efficiency Plus Intergenerational Equity
PRIV	62.2002	*Carlo CAPUANO*: Demand Growth, Entry and Collusion Sustainability
PRIV	63.2002	*Federico MUNARI and Raffaele ORIANI*: Privatization and R&D Performance: An Empirical Analysis Based on Tobin's Q
PRIV	64.2002	*Federico MUNARI and Maurizio SOBRERO*: The Effects of Privatization on R&D Investments and Patent Productivity
SUST	65.2002	*Orley ASHENFELTER and Michael GREENSTONE*: Using Mandated Speed Limits to Measure the Value of a Statistical Life
ETA	66.2002	*Paolo SURICO:* US Monetary Policy Rules: the Case for Asymmetric Preferences
PRIV	67.2002	*Rinaldo BRAU and Massimo FLORIO*: Privatisations as Price Reforms: Evaluating Consumers' Welfare Changes in the U.K.
CLIM	68.2002	*Barbara K. BUCHNER and Roberto ROSON*: Conflicting Perspectives in Trade and Environmental Negotiations
CLIM	69.2002	*Philippe QUIRION*: Complying with the Kyoto Protocol under Uncertainty: Taxes or Tradable Permits?
SUST	70.2002	*Anna ALBERINI, Patrizia RIGANTI and Alberto LONGO*: Can People Value the Aesthetic and Use Services of Urban Sites? Evidence from a Survey of Belfast Residents
SUST	71.2002	*Marco PERCOCO:* Discounting Environmental Effects in Project Appraisal

NRM	72.2002	*Philippe BONTEMS and Pascal FAVARD*: Input Use and Capacity Constraint under Uncertainty: The Case of Irrigation
PRIV	73.2002	*Mohammed OMRAN:* The Performance of State-Owned Enterprises and Newly Privatized Firms: Empirical Evidence from Egypt
PRIV	74.2002	*Mike BURKART, Fausto PANUNZI and Andrei SHLEIFER:* Family Firms
PRIV	75.2002	*Emmanuelle AURIOL, Pierre M. PICARD:* Privatizations in Developing Countries and the Government Budget Constraint
PRIV	76.2002	*Nichole M. CASTATER***:** Privatization as a Means to Societal Transformation: An Empirical Study of Privatization in Central and Eastern Europe and the Former Soviet Union
PRIV	77.2002	*Christoph LÜLSFESMANN*: Benevolent Government, Managerial Incentives, and the Virtues of Privatization
PRIV	78.2002	*Kate BISHOP, Igor FILATOTCHEV and Tomasz MICKIEWICZ*: Endogenous Ownership Structure: Factors Affecting the Post-Privatisation Equity in Largest Hungarian Firms
PRIV	79.2002	*Theodora WELCH and Rick MOLZ*: How Does Trade Sale Privatization Work? Evidence from the Fixed-Line Telecommunications Sector in Developing Economies
PRIV	80.2002	*Alberto R. PETRUCCI*: Government Debt, Agent Heterogeneity and Wealth Displacement in a Small Open Economy
CLIM	81.2002	*Timothy SWANSON and Robin MASON* (lvi): The Impact of International Environmental Agreements: The Case of the Montreal Protocol
PRIV	82.2002	*George R.G. CLARKE and Lixin Colin XU:* Privatization, Competition and Corruption: How Characteristics of Bribe Takers and Payers Affect Bribe Payments to Utilities
PRIV	83.2002	*Massimo FLORIO and Katiuscia MANZONI*: The Abnormal Returns of UK Privatisations: From Underpricing to Outperformance
NRM	84.2002	*Nelson LOURENÇO, Carlos RUSSO MACHADO, Maria do ROSÁRIO JORGE and Luís RODRIGUES*: An Integrated Approach to Understand Territory Dynamics. The Coastal Alentejo (Portugal)
CLIM	85.2002	*Peter ZAPFEL and Matti VAINIO* (lv): Pathways to European Greenhouse Gas Emissions Trading History and Misconceptions
CLIM	86.2002	*Pierre COURTOIS*: Influence Processes in Climate Change Negotiations: Modelling the Rounds
ETA	87.2002	*Vito FRAGNELLI and Maria Erminia MARINA* (lviii): Environmental Pollution Risk and Insurance
ETA	88.2002	*Laurent FRANCKX* (lviii): Environmental Enforcement with Endogenous Ambient Monitoring
ETA	89.2002	*Timo GOESCHL and Timothy M. SWANSON* (lviii): Lost Horizons. The noncooperative management of an evolutionary biological system.
ETA	90.2002	*Hans KEIDING* (lviii): Environmental Effects of Consumption: An Approach Using DEA and Cost Sharing
ETA	91.2002	*Wietze LISE* (lviii): A Game Model of People's Participation in Forest Management in Northern India
CLIM	92.2002	*Jens HORBACH*: Structural Change and Environmental Kuznets Curves
ETA	93.2002	*Martin P. GROSSKOPF:* Towards a More Appropriate Method for Determining the Optimal Scale of Production Units
VOL	94.2002	*Scott BARRETT and Robert STAVINS*: Increasing Participation and Compliance in International Climate Change Agreements
CLIM	95.2002	*Banu BAYRAMOGLU LISE and Wietze LISE:* Climate Change, Environmental NGOs and Public Awareness in the Netherlands: Perceptions and Reality
CLIM	96.2002	*Matthieu GLACHANT*: The Political Economy of Emission Tax Design in Environmental Policy
KNOW	97.2002	*Kenn ARIGA and Giorgio BRUNELLO*: Are the More Educated Receiving More Training? Evidence from Thailand
ETA	98.2002	*Gianfranco FORTE and Matteo MANERA*: Forecasting Volatility in European Stock Markets with Non-linear GARCH Models
ETA	99.2002	*Geoffrey HEAL*: Bundling Biodiversity
ETA	100.2002	*Geoffrey HEAL, Brian WALKER, Simon LEVIN, Kenneth ARROW, Partha DASGUPTA, Gretchen DAILY, Paul EHRLICH, Karl-Goran MALER, Nils KAUTSKY, Jane LUBCHENCO, Steve SCHNEIDER and David STARRETT*: Genetic Diversity and Interdependent Crop Choices in Agriculture
ETA	101.2002	*Geoffrey HEAL:* Biodiversity and Globalization
VOL	102.2002	*Andreas LANGE*: Heterogeneous International Agreements – If per capita emission levels matter
ETA	103.2002	*Pierre-André JOUVET and Walid OUESLATI*: Tax Reform and Public Spending Trade-offs in an Endogenous Growth Model with Environmental Externality
ETA	104.2002	*Anna BOTTASSO and Alessandro SEMBENELLI*: Does Ownership Affect Firms' Efficiency? Panel Data Evidence on Italy
PRIV	105.2002	*Bernardo BORTOLOTTI, Frank DE JONG, Giovanna NICODANO and Ibolya SCHINDELE*: Privatization and Stock Market Liquidity
ETA	106.2002	*Haruo IMAI and Mayumi HORIE* (lviii): Pre-Negotiation for an International Emission Reduction Game
PRIV	107.2002	*Sudeshna GHOSH BANERJEE and Michael C. MUNGER*: Move to Markets? An Empirical Analysis of Privatisation in Developing Countries
PRIV	108.2002	*Guillaume GIRMENS and Michel GUILLARD*: Privatization and Investment: Crowding-Out Effect vs Financial Diversification
PRIV	109.2002	*Alberto CHONG and Florencio LÓPEZ-DE-SILANES*: Privatization and Labor Force Restructuring Around the World
PRIV	110.2002	*Nandini GUPTA*: Partial Privatization and Firm Performance
PRIV	111.2002	*François DEGEORGE, Dirk JENTER, Alberto MOEL and Peter TUFANO*: Selling Company Shares to Reluctant Employees: France Telecom's Experience

PRIV	112.2002	*Isaac OTCHERE*: Intra-Industry Effects of Privatization Announcements: Evidence from Developed and Developing Countries
PRIV	113.2002	*Yannis KATSOULAKOS and Elissavet LIKOYANNI*: Fiscal and Other Macroeconomic Effects of Privatization
PRIV	114.2002	*Guillaume GIRMENS:* Privatization, International Asset Trade and Financial Markets
PRIV	115.2002	*D. Teja FLOTHO:* A Note on Consumption Correlations and European Financial Integration
PRIV	116.2002	*Ibolya SCHINDELE and Enrico C. PEROTTI*: Pricing Initial Public Offerings in Premature Capital Markets: The Case of Hungary
PRIV	1.2003	*Gabriella CHIESA and Giovanna NICODANO*: Privatization and Financial Market Development: Theoretical Issues
PRIV	2.2003	*Ibolya SCHINDELE*: Theory of Privatization in Eastern Europe: Literature Review
PRIV	3.2003	*Wietze LISE, Claudia KEMFERT and Richard S.J. TOL*: Strategic Action in the Liberalised German Electricity Market
CLIM	4.2003	*Laura MARSILIANI and Thomas I. RENSTRÖM*: Environmental Policy and Capital Movements: The Role of Government Commitment
KNOW	5.2003	*Reyer GERLAGH*: Induced Technological Change under Technological Competition
ETA	6.2003	*Efrem CASTELNUOVO*: Squeezing the Interest Rate Smoothing Weight with a Hybrid Expectations Model
SIEV	7.2003	*Anna ALBERINI, Alberto LONGO, Stefania TONIN, Francesco TROMBETTA and Margherita TURVANI:* The Role of Liability, Regulation and Economic Incentives in Brownfield Remediation and Redevelopment: Evidence from Surveys of Developers
NRM	8.2003	*Elissaios PAPYRAKIS and Reyer GERLAGH*: Natural Resources: A Blessing or a Curse?
CLIM	9.2003	*A. CAPARRÓS, J.-C. PEREAU and T. TAZDAÏT*: North-South Climate Change Negotiations: a Sequential Game with Asymmetric Information
KNOW	10.2003	*Giorgio BRUNELLO and Daniele CHECCHI*: School Quality and Family Background in Italy
CLIM	11.2003	*Efrem CASTELNUOVO and Marzio GALEOTTI*: Learning By Doing vs Learning By Researching in a Model of Climate Change Policy Analysis
KNOW	12.2003	*Carole MAIGNAN, Gianmarco OTTAVIANO and Dino PINELLI (eds.)*: Economic Growth, Innovation, Cultural Diversity: What are we all talking about? A critical survey of the state-of-the-art
KNOW	13.2003	*Carole MAIGNAN, Gianmarco OTTAVIANO, Dino PINELLI and Francesco RULLANI* (lix): Bio-Ecological Diversity vs. Socio-Economic Diversity. A Comparison of Existing Measures
KNOW	14.2003	*Maddy JANSSENS and Chris STEYAERT* (lix): Theories of Diversity within Organisation Studies: Debates and Future Trajectories
KNOW	15.2003	*Tuzin BAYCAN LEVENT, Enno MASUREL and Peter NIJKAMP* (lix): Diversity in Entrepreneurship: Ethnic and Female Roles in Urban Economic Life
KNOW	16.2003	*Alexandra BITUSIKOVA* (lix): Post-Communist City on its Way from Grey to Colourful: The Case Study from Slovakia
KNOW	17.2003	*Billy E. VAUGHN and Katarina MLEKOV* (lix): A Stage Model of Developing an Inclusive Community
KNOW	18.2003	*Selma van LONDEN and Arie de RUIJTER* (lix): Managing Diversity in a Glocalizing World
Coalition Theory Network	19.2003	*Sergio CURRARINI:* On the Stability of Hierarchies in Games with Externalities
PRIV	20.2003	*Giacomo CALZOLARI and Alessandro PAVAN* (lx): Monopoly with Resale
PRIV	21.2003	*Claudio MEZZETTI* (lx): Auction Design with Interdependent Valuations: The Generalized Revelation Principle, Efficiency, Full Surplus Extraction and Information Acquisition
PRIV	22.2003	*Marco LiCalzi and Alessandro PAVAN* (lx): Tilting the Supply Schedule to Enhance Competition in Uniform-Price Auctions
PRIV	23.2003	*David ETTINGER* (lx): Bidding among Friends and Enemies
PRIV	24.2003	*Hannu VARTIAINEN* (lx): Auction Design without Commitment
PRIV	25.2003	*Matti KELOHARJU, Kjell G. NYBORG and Kristian RYDQVIST* (lx): Strategic Behavior and Underpricing in Uniform Price Auctions: Evidence from Finnish Treasury Auctions
PRIV	26.2003	*Christine A. PARLOUR and Uday RAJAN* (lx): Rationing in IPOs
PRIV	27.2003	*Kjell G. NYBORG and Ilya A. STREBULAEV* (lx): Multiple Unit Auctions and Short Squeezes
PRIV	28.2003	*Anders LUNANDER and Jan-Eric NILSSON* (lx): Taking the Lab to the Field: Experimental Tests of Alternative Mechanisms to Procure Multiple Contracts
PRIV	29.2003	*TangaMcDANIEL and Karsten NEUHOFF* (lx): Use of Long-term Auctions for Network Investment
PRIV	30.2003	*Emiel MAASLAND and Sander ONDERSTAL* (lx): Auctions with Financial Externalities
ETA	31.2003	*Michael FINUS and Bianca RUNDSHAGEN:* A Non-cooperative Foundation of Core-Stability in Positive Externality NTU-Coalition Games
KNOW	32.2003	*Michele MORETTO*: Competition and Irreversible Investments under Uncertainty
PRIV	33.2003	*Philippe QUIRION:* Relative Quotas: Correct Answer to Uncertainty or Case of Regulatory Capture?
KNOW	34.2003	*Giuseppe MEDA, Claudio PIGA and Donald SIEGEL*: On the Relationship between R&D and Productivity: A Treatment Effect Analysis
ETA	35.2003	*Alessandra DEL BOCA, Marzio GALEOTTI and Paola ROTA:* Non-convexities in the Adjustment of Different Capital Inputs: A Firm-level Investigation
GG	36.2003	*Matthieu GLACHANT*: Voluntary Agreements under Endogenous Legislative Threats
PRIV	37.2003	*Narjess BOUBAKRI, Jean-Claude COSSET and Omrane GUEDHAMI*: Postprivatization Corporate Governance: the Role of Ownership Structure and Investor Protection
CLIM	38.2003	*Rolf GOLOMBEK and Michael HOEL*: Climate Policy under Technology Spillovers

KNOW	39.2003	*Slim BEN YOUSSEF*: Transboundary Pollution, R&D Spillovers and International Trade
CTN	40.2003	*Carlo CARRARO and Carmen MARCHIORI*: Endogenous Strategic Issue Linkage in International Negotiations
KNOW	41.2003	*Sonia OREFFICE*: Abortion and Female Power in the Household: Evidence from Labor Supply
KNOW	42.2003	*Timo GOESCHL and Timothy SWANSON*: On Biology and Technology: The Economics of Managing Biotechnologies
ETA	43.2003	*Giorgio BUSETTI and Matteo MANERA*: STAR-GARCH Models for Stock Market Interactions in the Pacific Basin Region, Japan and US
CLIM	44.2003	*Katrin MILLOCK and Céline NAUGES*: The French Tax on Air Pollution: Some Preliminary Results on its Effectiveness
PRIV	45.2003	*Bernardo BORTOLOTTI and Paolo PINOTTI*: The Political Economy of Privatization
SIEV	46.2003	*Elbert DIJKGRAAF and Herman R.J. VOLLEBERGH*: Burn or Bury? A Social Cost Comparison of Final Waste Disposal Methods
ETA	47.2003	*Jens HORBACH*: Employment and Innovations in the Environmental Sector: Determinants and Econometrical Results for Germany
CLIM	48.2003	*Lori SNYDER, Nolan MILLER and Robert STAVINS:* The Effects of Environmental Regulation on Technology Diffusion: The Case of Chlorine Manufacturing
CLIM	49.2003	*Lori SNYDER, Robert STAVINS and Alexander F. WAGNER*: Private Options to Use Public Goods. Exploiting Revealed Preferences to Estimate Environmental Benefits
CTN	50.2003	*László Á. KÓCZY and Luc LAUWERS* (lxi): The Minimal Dominant Set is a Non-Empty Core-Extension
CTN	51.2003	*Matthew O. JACKSON* (lxi)*:*Allocation Rules for Network Games
CTN	52.2003	*Ana MAULEON and Vincent VANNETELBOSCH* (lxi): Farsightedness and Cautiousness in Coalition Formation
CTN	53.2003	*Fernando VEGA-REDONDO* (lxi): Building Up Social Capital in a Changing World: a network approach
CTN	54.2003	*Matthew HAAG and Roger LAGUNOFF* (lxi): On the Size and Structure of Group Cooperation
CTN	55.2003	*Taiji FURUSAWA and Hideo KONISHI* (lxi): Free Trade Networks
CTN	56.2003	*Halis Murat YILDIZ* (lxi): National Versus International Mergers and Trade Liberalization
CTN	57.2003	*Santiago RUBIO and Alistair ULPH* (lxi): An Infinite-Horizon Model of Dynamic Membership of International Environmental Agreements
KNOW	58.2003	*Carole MAIGNAN, Dino PINELLI and Gianmarco I.P. OTTAVIANO*: ICT, Clusters and Regional Cohesion: A Summary of Theoretical and Empirical Research
KNOW	59.2003	*Giorgio BELLETTINI and Gianmarco I.P. OTTAVIANO:* Special Interests and Technological Change
ETA	60.2003	*Ronnie SCHÖB:* The Double Dividend Hypothesis of Environmental Taxes: A Survey
CLIM	61.2003	*Michael FINUS, Ekko van IERLAND and Robert DELLINK*: Stability of Climate Coalitions in a Cartel Formation Game
GG	62.2003	*Michael FINUS and Bianca RUNDSHAGEN*: How the Rules of Coalition Formation Affect Stability of International Environmental Agreements
SIEV	63.2003	*Alberto PETRUCCI:* Taxing Land Rent in an Open Economy
CLIM	64.2003	*Joseph E. ALDY, Scott BARRETT and Robert N. STAVINS*: Thirteen Plus One: A Comparison of Global Climate Policy Architectures
SIEV	65.2003	*Edi DEFRANCESCO*: The Beginning of Organic Fish Farming in Italy
SIEV	66.2003	*Klaus CONRAD*: Price Competition and Product Differentiation when Consumers Care for the Environment
SIEV	67.2003	*Paulo A.L.D. NUNES, Luca ROSSETTO, Arianne DE BLAEIJ*: Monetary Value Assessment of Clam Fishing Management Practices in the Venice Lagoon: Results from a Stated Choice Exercise
CLIM	68.2003	*ZhongXiang ZHANG:* Open Trade with the U.S. Without Compromising Canada's Ability to Comply with its Kyoto Target
KNOW	69.2003	*David FRANTZ* (lix): Lorenzo Market between Diversity and Mutation
KNOW	70.2003	*Ercole SORI* (lix): Mapping Diversity in Social History
KNOW	71.2003	*Ljiljana DERU SIMIC* (lxii): What is Specific about Art/Cultural Projects?
KNOW	72.2003	*Natalya V. TARANOVA* (lxii):The Role of the City in Fostering Intergroup Communication in a Multicultural Environment: Saint-Petersburg's Case
KNOW	73.2003	*Kristine CRANE* (lxii)*:* The City as an Arena for the Expression of Multiple Identities in the Age of Globalisation and Migration
KNOW	74.2003	*Kazuma MATOBA* (lxii): Glocal Dialogue- Transformation through Transcultural Communication
KNOW	75.2003	*Catarina REIS OLIVEIRA* (lxii): Immigrants' Entrepreneurial Opportunities: The Case of the Chinese in Portugal
KNOW	76.2003	*Sandra WALLMAN* (lxii): The Diversity of Diversity - towards a typology of urban systems
KNOW	77.2003	*Richard PEARCE* (lxii): A Biologist's View of Individual Cultural Identity for the Study of Cities
KNOW	78.2003	*Vincent MERK* (lxii): Communication Across Cultures: from Cultural Awareness to Reconciliation of the Dilemmas
KNOW	79.2003	*Giorgio BELLETTINI, Carlotta BERTI CERONI and Gianmarco I.P.OTTAVIANO*: Child Labor and Resistance to Change
ETA	80.2003	*Michele MORETTO, Paolo M. PANTEGHINI and Carlo SCARPA*: Investment Size and Firm's Value under Profit Sharing Regulation
IEM	81.2003	*Alessandro LANZA, Matteo MANERA and Massimo GIOVANNINI:* Oil and Product Dynamics in International Petroleum Markets
CLIM	82.2003	*Y. Hossein FARZIN and Jinhua ZHAO*: Pollution Abatement Investment When Firms Lobby Against Environmental Regulation

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

(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 fur Europaische 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
(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

2002 SERIES

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

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

SUST *Sustainability Indicators and Environmental Valuation* (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)

2003 SERIES

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

GG *Global Governance* (Editor: Carlo Carraro)

SIEV *Sustainability Indicators and Environmental Valuation* (Editor: Anna Alberini)

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

KNOW *Knowledge, Technology, Human Capital* (Editor: Gianmarco Ottaviano)

IEM *International Energy Markets* (Editor: Anil Markandya)

CSRM *Corporate Social Responsibility and Management* (Editor: Sabina Ratti)

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

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

CTN *Coalition Theory Network*