

Deroian, Frédéric

**Working Paper**

## Cost-Reducing Alliances and Local Spillovers

Nota di Lavoro, No. 10.2005

**Provided in Cooperation with:**

Fondazione Eni Enrico Mattei (FEEM)

*Suggested Citation:* Deroian, Frédéric (2005) : Cost-Reducing Alliances and Local Spillovers, Nota di Lavoro, No. 10.2005, Fondazione Eni Enrico Mattei (FEEM), Milano

This Version is available at:

<https://hdl.handle.net/10419/74116>

**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.*

## **Cost-Reducing Alliances and Local Spillovers**

Frédéric Deroian

NOTA DI LAVORO 10.2005

**JANUARY 2005**

CTN – Coalition Theory Network
--------------------------------

Frédéric Deroian, *F.O.R.U.M Université Paris X*

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=655042>

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

# **Cost-Reducing Alliances and Local Spillovers**

## **Summary**

Firms raise cost-reducing alliances before competing with each other, but cannot fully internalize the shared knowledge. When spillovers are local and transit through the network of alliances, stable architectures with a moderate level of asymmetry are identified.

**Keywords:** Oligopoly, Cost-Reducing alliances, Local spillovers, Network stability

**JEL Classification:** C70, L13, L20

*Address for correspondence:*

Frédéric Deroian  
F.O.R.U.M Université Paris X  
Bâtiment K  
200, avenue de la République  
92001 Nanterre  
France  
Phone: +33140977805  
Fax: +33140975907  
E-mail: fderoian@u-paris10.fr

# 1 Introduction

We extend the model of Goyal and Joshi (2003) to involuntary spillovers. We assume that the knowledge generated by a technological alliance generates spillovers affecting a subset of firms distinct from the allied, and we examine three modes of spillover dissemination. In the benchmark case, spillovers affect the whole population of firms. By contrast, in the two latter spillovers spread through the network of alliances; they affect either the direct neighborhoods of the partners, or the whole component each partner is embedded in.

By introducing local spillovers, the proposed game contains both positive and negative externalities. This enables us to examine non monotonic impacts of network characteristics on profitability of link formation. As a preliminary remark, we observe that when spillovers disseminate globally, they have no particular influence on individual incentives to form alliances and the complete network emerges. Then, we test the spillovers' spreading through the network of alliances. This entails the formation of networks with moderate asymmetry and under-connected with regard to social welfare. When spillovers spread toward the direct neighborhood of the allied, we notably isolate a class of graphs containing a unique *incomplete* component. When spillovers spread in the whole component of the allied, the possible stable architectures are reduced to the union of complete components of distinct size; furthermore the size of stable components satisfies a non-monotonic relationship with respect to spillovers intensity.

This paper can be inserted in the literature on strategic cooperation. Beyond the fact our model extends Goyal and Joshi (2003)'s seminal work, the moderate level of asymmetry in the stable networks shall be compared with Calvo-Armengol (2004); This work provides a qualitatively similar conclusion in a model of job search, in which individual payoffs exhibit increasing return in own links and decreasing return in the partners' links. Second, the emergence of asymmetric and complete components (in the case spillovers affect the whole component of the partners) shall be compared with Bloch (1995). With respect to this work, a rather similar mechanism applies: the incitation to refuse a connection increases with the difference between the partner's and own component size. But, there is also a major difference: in our context small components (typically whose cardinal is less than half the population) may not coalesce. Further, the non-monotonicity of the set of stable networks

with respect to spillovers' intensity is intrinsic to our context.

Section 2 presents the model, section 3 the results. The last section is an appendix providing all proofs.

## 2 The model

We consider an industry containing a set  $N = \{1, \dots, n\}$  of firms. We set up a standard two-periods game in which the first is devoted to the formation of cost-reducing alliances and the second to competition. For this purpose, we propose a spillover-augmented version of the game initiated by Goyal and Joshi (2003).

**Graphs.** We denote  $\lfloor \cdot \rfloor$  as the floor operator and  $|\cdot|$  means the cardinal of a set. A non directed graph represents the firms (the nodes) plus the set of bilateral alliances between the firms (the edges between nodes). We denote by  $G$  the set of all non directed graphs with  $n$  nodes. We shall abuse the notation by writing that some link  $ij \in g$ . We denote by  $N_i(g)$  the set of agents with whom agent  $i$  forms a link in the graph  $g$  (agent  $i$  is not included in the set by convention) and  $\mu_i(g)$  represents the cardinal of this set. We need to define  $v_{ij}(g) = |N_i(g) \cap N_j(g)|$ ,  $v_{ij}(g) \in \{0, \dots, n-2\}$ , representing the number of common partners of agents  $i$  and  $j$  in the graph  $g$ .

Symbol  $g - ij$  (resp.  $g + ij$ ) shall denote the graph  $g$  less (resp. plus) the link  $ij$ . The *subgraph*  $A(g)$  of a graph  $g$  is the graph containing agents in  $A(g)$  plus all links involving in the graph  $g$  the pairs of agent in  $A(g)$ . A *complete subgraph* is a subgraph such that every pair of agents in the subgraph forms a link. A *path* in the graph  $g$  is a sequence of nodes  $\{a_0, \dots, a_p\}$  such that  $a_i a_{i+1} \in g$  for all  $i \in \{0, \dots, p-1\}$ . A *component*  $C(g)$  in the graph  $g$  is a subgraph such that there is a path between any pair of agents in the component, and there is no link in the graph  $g$  between any agent inside the component and any agent outside the component. We shall denote  $i \in C(g)$  when agent  $i$  belongs to component  $C(g)$ . Finally,  $L(C(g))$  will represent the set of links in the component  $C(g)$ . For clarity and when there are no confusions, we shall omit the argument  $g$  from the main symbols:  $\mu$ ,  $C$ ,  $A$ .

**Technologies and spillovers.** We assume positive marginal cost and no fixed cost. Individual marginal costs are decreasing functions  $c_i(\mu_i(g))$  in the number of alliances in which firms are involved. The function is assumed to be linear with slope  $-\gamma$  (linearity is crucial for

obtaining uniqueness of stable networks). Involuntary spillovers may arise in the industry. When firms  $i$  and  $j$  engage in a common R&D effort, other firms benefit from marginal cost reduction, by the amount  $\rho \in [0, \gamma]$ . We denote by  $\tau$  the ratio  $\frac{\rho}{\gamma}$ . When spillovers spread in the whole population (resp. a strict subset), we shall talk about *global* (resp. *local*) spillovers.

**The two-stage game.** In the first stage, firms simultaneously raise collaborative links. Throughout the rest of the paper, we assume that forming links is non costly. We apply the standard stability criterion of pairwise stability, adapted from Jackson and Wolinsky (1996): (i) for  $ij \in g$ ,  $\pi_i(g) > \pi_i(g - ij)$  and  $\pi_j(g) > \pi_j(g - ij)$ , (ii) for  $ij \notin g$ , if  $\pi_i(g + ij) > \pi_i(g)$ , then  $\pi_j(g + ij) \leq \pi_j(g)$ . Once alliances are formed, firms compete with each other in order to maximize individual profits. Given a network  $g$ , we denote by  $\pi_i(g)$  the profit made by firm  $i$  on this network. In that specific case, each firm produces some homogenous good, sold at price  $p_i$  and in quantity  $q_i$ . The linear inverse demand schedule is given by  $p_i = \alpha - q_i - \sum_{j \neq i} q_j$  in the region where the price is positive, with  $\alpha > 0$  measuring the absolute size of the market.

**Network architectures.** The empty (resp. complete, denoted  $g^c$ ) network is the graph such that no pair (resp. every pair) of agents forms a link. The class  $g_k$ , with  $k \in \{\frac{n}{2} + 1, \dots, n - 1\}$  if  $n$  is even and with  $k \in \{\frac{n-1}{2} + 1, \dots, n - 1\}$  if  $n$  is odd, denotes a network containing two complete components, the greatest being of size  $k$ . We also present networks with incomplete components. We first remark that a network  $g$  can always be decomposed as follows: partition  $g$  into a set of disjoint complete subgraphs  $A_1(g), \dots, A_p(g)$  such that  $\sum_{i \leq p} |A_i| = n$ . This set is said *minimal* when there is no partition with less elements. Then we can build the graph  $g$  as considering the collection  $\{A_i\}_{i \in \{1, \dots, p\}}$  and completing the residual links between the sets. When possible and for convenience, we shall abuse the notation by writing  $g = \{A_i\}_{i \in \{1, \dots, p\}}$  (the notation gives no precision about the links between agents in distinct subgraphs). We denote by  $\Gamma(q, \alpha)$  the component architecture such that (i) it contains  $(\alpha + 1)q$  agents,  $\alpha \geq 2$  being an integer, (ii) the component is minimally partitioned into two distinct complete subgraphs  $\{A_1, A_2\}$  with  $|A_2| = q \geq 2$ , (iii)  $\mu_k = (\alpha + 1)q - 2$  for any  $k \in A_1$  (so agents in  $A_1$  have  $q - 1$  partners in  $A_2$ ), (iv)  $\mu_i = (\alpha + 1)(q - 1)$  for any  $i \in A_2$ . Note that every agent in any complete subgraph has the same number of partners, whereas two agents in two distinct complete subgraphs do not. Hence, the component  $\Gamma(q, \alpha)$  contains two complete subgraphs and every agent in the greatest complete subgraph forms connections with all agents less one in the smallest complete subgraph. Further, the organization of links between the two

subgraphs is such that any two agents in a given complete subgraph have the same number of partners (see figure 1).

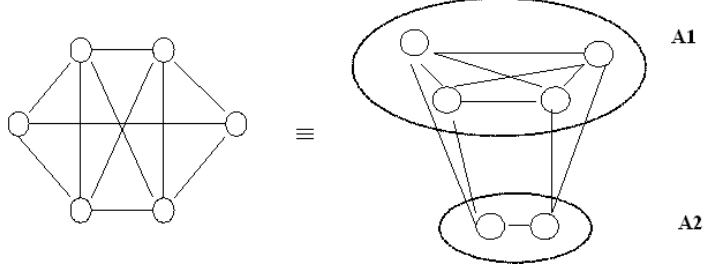


Figure 1:  $n = 6$ ; the network architecture  $\Gamma(2, 2)$

We generalize this class to  $r \geq 2$  complete subgraphs as follows: we denote by the class  $\Gamma(q, \alpha_1, \dots, \alpha_{r-1})$  the component architecture, containing  $(\sum_{i=1}^{r-1} \alpha_i + 1)q$  agents, minimally partitioned into  $r$  complete subgraphs  $\{A_i\}_{i=1, \dots, r}$ , with  $|A_r| = q$ ,  $|A_i| = \alpha_i |A_{i+1}|$ ,  $\alpha_i \geq 2$  being an integer, and such that:

$$\begin{cases} \text{for all } j \in \{1, \dots, r\}, \text{ for all } i, i' \in A_j, ii' \in g \text{ and } \mu_i = \mu_{i'} \\ \text{for all } i, j, i < j, \forall k \in A_i, |N_k(g) \cap A_j| = |A_j| - 1 \\ \text{for all } i, j \text{ such that } \mu_j < \mu_i \text{ and } ij \notin g, \text{ then } v_{ij} = \mu_j \end{cases}$$

Notably, considering two agents in two distinct complete subgraphs, the agent in the largest subgraph forms a link with all agents less one in the other subgraph; also, for any pair of agents with different number of partners and not forming a link, the set of partners of the less connected agent belongs to the set of partners of the other agent. To finish, we denote by  $\Gamma'(q, \alpha_1, \dots, \alpha_{r-1})$  the class of graphs with  $n = (1 + \sum_{i=1}^{r-1} \alpha_i)q + 1$  agents and consisting in the union of one isolated agent and one component  $\Gamma(q, \alpha_1, \dots, \alpha_{r-1})$ .

### 3 Results

We examine the stability of strategic networks when spillovers disseminate through the graph of alliances. Beforehand, we present the benchmark case where each new alliance affects the marginal costs of the whole population of agents, *i.e.* generates global spillovers.

### 3.1 Global spillovers

A well-known property of the Cournot oligopoly with linear demand (see Yi [1998]) states that a simultaneous symmetric (favorable) shock on all marginal costs induces positive individual quantity variations in Cournot equilibrium. Then basically:

**Result 3.1** *Under global spillovers, the complete network is uniquely stable.*

(Proof omitted as resulting from Yi [1998])

### 3.2 Neighbor-restricted spillovers

In this case, the marginal cost of agent  $i$  in the graph  $g$  writes:

$$c_i(g) = c_0 - \gamma\mu_i(g) - \rho \sum_{j \in N_i(g)} \sum_{k \in N_j(g) \setminus N_i(g)} \mu_k(g)$$

**Proposition 3.1** *Suppose that spillovers are neighbor-restricted. Then, the set of possibly stable architectures is reduced to the complete network, the network  $g_{n-1}$ , and some networks in the classes  $\Gamma(\alpha_1, \dots, \alpha_{r-1})$  and  $\Gamma'(\alpha_1, \dots, \alpha_{r-1})$ ,  $r \geq 2$ . Furthermore,*

- (i)  $\{g^c\}$  is stable for any  $\tau \in [0, 1]$ ,
- (ii)  $\{g^{n-1}\}$  is stable for any  $\tau \in [\frac{n-1}{2(n-2)}, 1]$ ,
- (iii) the class  $\{\Gamma(q, \alpha)\}$  is stable for any  $\tau \geq \frac{n-1}{n-3+\alpha}$ ,
- (iii') the class  $\{\Gamma'(q, \alpha)\}$  is stable for any  $\tau \geq \max[\frac{n-1}{n-3+\alpha}, \frac{q}{2(q-1)}]$ ,
- (iv) other stable networks exist in the classes  $\Gamma(\{\alpha_i\}_{i=1, \dots, r-1})$  and  $\Gamma'(\{\alpha_i\}_{i=1, \dots, r-1})$ ,  $r \geq 3$  (under conditions given in the proof).

Let us present a stable incomplete network  $g$  with 3 minimally complete subgraphs defined as follows:  $g = \{A_1, A_2, A_3\}$ , with  $|A_1| = \alpha|A_2| = \alpha\beta|A_3|$  ( $\alpha, \beta \geq 2$  and integers),  $|A_3| \geq 2$ . By definition,  $\mu_k = n - 3$  for all  $k \in A_1$ ,  $\mu_j = n - \alpha - 2$  for all  $j \in A_2$ ,  $\mu_i = n - (\alpha + 1)\beta - 1$  for all  $i \in A_3$ . The graph is stable if  $\tau \geq \max\left[\frac{n-1}{n-4+\alpha}, \frac{n-1}{n-1+(\beta-2)(\alpha+1)}\right]$ . Hence, if  $\alpha = 2$ , the graph is always instable; if  $\alpha = 3$ , the graph is stable for  $\tau = 1$ ; if  $\alpha \geq 4$ , the graph is stable for any  $\tau \geq \frac{n-1}{n-4+\alpha}$  as soon as  $\beta \geq \frac{3\alpha-1}{\alpha+1}$ .

**Remark 3.1.1.** In the case  $n = 3$ , if  $g^0$  denotes the graph with one link,  $S = \{g^c\}$  for any  $\tau \in [0, 1[$  and  $S = \{g^c, g^0\}$  when  $\tau = 1$ . If  $n \in \{4, 5\}$ ,  $S = \{g^c\}$  for any  $\tau \in [0, 1]$ . If



$n = 6$ , denote  $\tilde{g}$  as the graph depicted in the figure 1. Then  $S = \{g^c\}$  for any  $\tau \in [0, 1[$  and  $S = \{g^c, \tilde{g}\}$  as  $\tau = 1$ .

**Remark 3.1.2.** Some moderate level of asymmetry applies. For instance, the following claim indicates that an incomplete component does not contain one agent that would be linked to all other agents:

**Claim 3.1** *Suppose that  $n \geq 3$  and that a stable graph  $g$  contains one incomplete component  $C$ . Then, no agent in the component has  $|C| - 1$  partners.*

This moderate asymmetry mainly stems from two properties possessed by stable networks:

**(P1)** *Suppose that a stable graph  $g$  contains one incomplete component  $C$ . Then for every pair of agents  $(i, j)$  in the component  $C$  such that the link  $ij \notin g$ ,  $\mu_i \neq \mu_j$ .*

**(P2)** *A stable graph  $g$  with  $ik \notin g$  and  $\mu_k > \mu_i$  must satisfy  $v_{ik} = \mu_i$ .*

By property (P1) if two agents do not form a connection, they do not have the same number of partners. Property (P2) states that if two agents who do not form a link in a stable graph have a distinct number of partners, then all the partners of the agent having the least number of partners are also partners of the other. The former property favors asymmetric networks, whereas the latter ensures some minimal overlapping between asymmetrically positioned agents.

**Remark 3.1.3.** When the inverse demand is concave, a major implication is that the condition of link formation profitability becomes dependent on equilibrium quantities<sup>2</sup>.

**Remark 3.1.4.** The set efficient networks, defined as the sum of aggregate surplus and consumer surplus, is reduced to the complete network. The proof is formally identical to Goyal and Joshi (2003, 2004). Indeed, one just have to recall that  $c_i(g) > c_i(g^c)$  whenever  $g \neq g^c$ ; for that, note that, in the complete network, for each agent the number of direct alliances as well as partners' partners are maximized. Hence, part of stable networks are under-connected with respect to social welfare.

---

<sup>2</sup>Indeed, straightforward comparative statics at equilibrium indicate that (i) when  $P'(Q)$  is decreasing then the equilibrium total demand  $Q$  increases, and (ii) a favorable cost shock on a subset  $K$  of firms, denoted  $dC^k = \sum_{k \in K} dc_k$ , entails positive profit for firm  $i$  if  $\frac{|dc_i|}{|dC_{-i}^k|} > \frac{1+Rq_i}{n+RQ_{-i}}$ , where  $R = \frac{P''(Q)}{P'(Q)}$ ,  $dC_{-i}^k = dC^k - dc_i$  and  $Q_{-i} = Q - q_i$ . Denoting  $H_i = \frac{1+Rq_i}{n+RQ_{-i}}$ ,  $H_i < \frac{1}{n}$  iff  $q_i > \frac{Q}{n+1}$  (assuming  $R > 0$ ). A link is profitable for the two involved agents  $i, j$  whenever  $\mu_i < f_i(\mu_j)$  and  $\mu_j < f_j(\mu_i)$ , with  $f_i(x) = \left\lceil \frac{n-1+R(Q-2q_i)}{2+2Rq_i} \right\rceil \left( \frac{1}{\tau} + \mu_j - v_{ij} \right)$ . Hence, the greater the equilibrium quantity  $q_i$ , the smaller agent  $i$ 's incentive to form a new link.

### 3.3 Component-restricted spillovers

In this case, the marginal cost of agent  $i$  in the graph  $g$  writes:

$$c_i(g) = c_0 - \gamma\mu_i(g) - \rho[|L(C_i(g))| - \mu_i(g)]$$

Another form of moderate asymmetry is detected.

**Proposition 3.2** *Suppose that spillovers are component-restricted. Then:*

- (i) *stable networks are the union of complete components of distinct size,*
- (ii) *the incentive of link formation in a given complete component is non-monotonic (decreasing then increasing) with respect to the size of the partner's component.*

The figure 2 illustrates the non-monotonicity of the result. The curve describes the critical values  $\tau_k$  associated with each graph  $g_k$  in the case  $n = 17$ . For a given value of  $k$ , the graph  $g_k$  is stable if  $\tau \geq \tau_k$ .

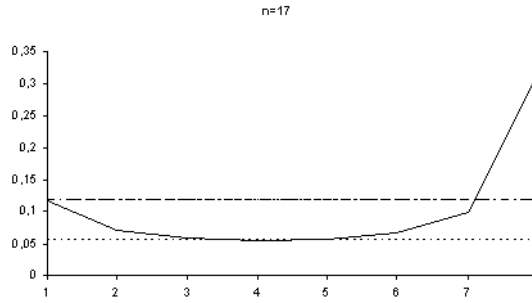


Figure 2: Non monotonicity of stable graphs  $g_k$  with respect to  $\tau$ ; X-axis= $k$ , Y-axis= $\tau_k$

This result is easily interpreted. When considering two agents in two distinct complete components, the agent in the greatest one is the less interested by the alliance. When her potential partner is in a very small component, her incentive to form a link decreases with the size of the partner's component since more agents shall receive spillovers from her own component. On the opposite, when the size of the partner's component is sufficiently large, she can expect receiving a more substantial amount of spillovers from the other component, which finishes to dominate the negative incentive.

**Remark 3.2.1.** Examples of stable graphs with 3 complete components: the smallest population size entailing stability of three components for  $\tau = 1$  is  $n = 10$  and the triplet  $(1, 4, 5)$

is stable (each number in the triplet denotes the size of a complete component). To find a stable network with four components we must reach the size  $n = 55$ , and we find  $(1, 10, 19, 25)$  as being stable. Five stable components requires to go around  $n = 2000$ . For instance, the network  $(1, 63, 324, 659, 953)$  is easily seen to be stable (see the end of the appendix for an illustration of how checking that a network containing complete components is stable).

**Remark 3.2.2.** Two components of size less than  $\frac{n}{2}$  may not coalesce (if their sizes are sufficiently different, the agent in the largest component shall not find the link profitable - see in the appendix the lemma 4.3 and the illustration given after the proof of the proposition 3.2).

**Remark 3.2.3.** The proposition also applies for smoothly concave inverse-demand function. Furthermore, like in the preceding subsection, ‘convexification’ of demand makes profitability depend on quantities<sup>3</sup>.

**Remark 3.2.4.** Like in the preceding subsection, the unique efficient network is the complete network.

## 4 Appendix

### Proof of proposition 3.1.

*Profitability of link formation:* in homogenous Cournot oligopoly with linear demand, equilibrium quantity of firm  $i$  writes  $q_i = \frac{\alpha - nc_i + \sum_{j \neq i} c_j}{n+1}$ . Consider a non complete graph  $g$  and one link  $ij \notin g$ . Then, the equilibrium quantity in the graph  $g + ij$  writes:

$$q_i(g+ij) = \frac{\alpha - n(c_i(g) - \gamma - \rho(\mu_j - v_{ij})) + c_j(g) - \gamma - \rho(\mu_i - v_{ij}) + \sum_{k \neq i,j} c_k - \rho(\mu_i(g) + \mu_j(g) - v_{ij})}{n+1}$$

---

<sup>3</sup>Hence, a link is profitable for the two involved agents  $i, j$  whenever  $\zeta_i < f_i(\zeta_j)$  and  $\zeta_j < f_j(\zeta_i)$ , with

$$f_i(x) = 1 - \frac{x}{2} - \frac{1}{x} + \frac{1}{2} \sqrt{\left(x - 2 + \frac{2}{x}\right)^2 - 4\left(\frac{1}{H_i} + n - 1\right)\left[\frac{2}{\tau}\left(\frac{1}{H_i} - 1\right) - 2(n-2)\right]}$$

When  $H_i$  increases, the function increases so that the unique positive root of  $f(x) - x$  increases. As a consequence, when the inverse-demand function is concave, if  $q_i < q_j < \frac{Q}{n+1}$ , then  $H_i < H_j < \frac{1}{n}$  and the condition of link formation profitability is more restrictive than under linear demand; when  $q_i > q_j > \frac{Q}{n+1}$ , then  $H_i > H_j > \frac{1}{n}$  and the condition is less restrictive; when  $q_i < \frac{Q}{n+1} < q_j$ , then  $H_i < \frac{1}{n} < H_j$  and the condition is more (resp. less) restrictive for agent  $i$  (resp. agent  $j$ ).

so that:

$$q_i(g + ij) - q_i(g) > 0 \text{ iff } \mu_i < \frac{n-1}{2\tau} + \frac{n-2}{2}(\mu_j - v_{ij}) + \frac{\mu_j}{2}$$

The link is formed if this relation is true simultaneously for agents  $i$  and  $j$  (substituting labels  $i$  and  $j$  in this above inequality). Denote  $f_\tau(\mu_j, v_{ij}) = \frac{n-1}{2\tau} + \frac{n-2}{2}(\mu_j - v_{ij}) + \frac{\mu_j}{2}$ . We note that  $f_\tau$  is decreasing *w.r.t.* both parameter  $\tau$  and argument  $v_{ij}$ . Hence, the condition under which the link formation is profitable is more restrictive when  $\tau$  and  $v_{ij}$  attain their maximum value.

Thus, points (i) and (ii) of the proposition are checked directly by direct inspection. Concerning the points (iii), (iii') and (iv), we need first to use the following lemma:

**Lemma 4.1** *A stable network contains either one component or two components with one being an isolated agent.*

**Proof.** Suppose that a stable network  $g$  contains two components. Consider two agents  $i$  and  $j$  in each. Then  $v_{ij} = 0$ . The link  $ij$  is profitable for agent  $i$  if  $\mu_i < \frac{n-1}{2} \left( \frac{1}{\tau} + \mu_j \right)$ . Note that if  $\mu_j \geq 1$  the condition is automatically satisfied. Then a stable network with two components contains at most one isolated agent. To finish, check that two distinct isolated agents have an incentive to form a link.  $\square$

The lemma strongly restricts the set of stable architectures. Second, we focus on stable networks with incomplete components and show uniqueness of the classes  $\Gamma$  and  $\Gamma'$ , by remarking two properties:

**Property (P1)** *Suppose that a stable graph  $g$  contains one incomplete component  $C$ . Then for every pair of agents  $(i, j)$  in the component  $C$  such that the link  $ij \notin g$ ,  $\mu_i \neq \mu_j$ .*

**Proof.** Suppose that  $\mu_i = \mu_j = \mu$  and that the link  $ij$  is not profitable. The required condition writes  $\mu \geq \frac{n-1}{2\tau} + \frac{(n-1)\mu}{2} - \frac{(n-2)v_{ij}}{2}$ , that is  $n-1 \leq (n-2)v_{ij} - (n-3)\mu$ . The right hand side is increasing in  $v_{ij}$  and in the case  $v_{ij} = \mu$ , we obtain  $n-1 \leq \mu$ , which is impossible.  $\square$

**Property (P2)** *A stable graph  $g$  with  $ik \notin g$  and  $\mu_k > \mu_i$  must satisfy  $v_{ik} = \mu_i$ .*

**Proof.** We must have  $\mu_k \geq \frac{n-1}{2\tau} + \frac{\mu_i}{2} + \frac{n-2}{2}(\mu_i - v_{ik})$ . If  $\mu_i - v_{ik} \geq 1$ , this is impossible for all admissible value of  $\tau$ .  $\square$

Properties (P1) and (P2) jointly ensure that some incomplete component in a stable network belongs to the class  $\Gamma(q, \alpha_1, \dots, \alpha_{r-1})$ .

Point (iii):

**Lemma 4.2** *Suppose that a stable graph contains one component  $C$ , with  $C$  minimally partitioned into two complete subgraphs  $A_1, A_2$ , and  $|A_2| = q < |A_1|$ . Then, (i) if  $\frac{n-q}{q}$  is not an integer the graph is instable, (ii) if  $n - q = \alpha q$ ,  $\alpha$  being an integer, then the component is in the class  $\Gamma(q, \alpha)$  and one needs  $\tau \geq \frac{n-1}{n-3+\alpha}$ .*

**Proof.** (i) if  $\frac{n-q}{q}$  is not an integer, then it is not possible to get property (P1). Indeed, from (P1) it stems that if two distinct agents in a stable graph  $g$  have the same number of links, then they form a link in  $g$ . This leads to the building up of complete subgroups of agents having all the same number of partners. Hence, if the component  $C$  is incomplete, the component can be minimally partitioned into at least two complete subgraphs. We suppose here that there are two minimally complete subgraphs. If agents in  $A_i$  have the same number of partners, this means that they have the same number of partners *outside*  $A_i$ . But this is not possible to fix  $\frac{|A_1|}{|A_2|}$  as not integer and to have that any agent in  $A_2$  has the same number of partners in  $A_1$ .

(ii) the result basically follows from property (P2). Indeed, as  $A_2$  is a complete subgraph, the property implies that any agent in  $A_1$  has  $q - 1$  partners in  $A_2$ . The conditions for stability of the class is the following. Given that  $|A_2| = q$  and  $|A_1| = \alpha q$ ,  $\mu_k = n - 2$  for all  $k \in A_1$  and  $\mu_j = (1 + \alpha)(q - 1)$  for all  $j \in A_2$ . Since  $v_{ik} = \mu_i$ , forming the link is not profitable to agent  $k$  if  $\tau \geq \frac{n-1}{n-3+\alpha}$ . Hence the constraints define exactly the class  $\Gamma(q, \alpha)$ .  $\square$

Point (iii'): for the class  $\Gamma'(q, \alpha)$  to be stable, we need more. Consider agent  $j \in A_2$ ,  $k \in A_1$  (where  $A_1$  and  $A_2$  are the two subgraphs of the component  $\Gamma$ ) and denote by  $l$  the isolated agent. In addition to the conditions of the lemma just above, if agent  $j$  has not interest to form the link  $jl$ , then the graph is stable ( $\mu_j < \mu_k$  so the constraint on the link  $jl$  is stronger than the constraint on the link  $kl$ ). But agent  $j$  has not interest to form the link  $jl$  if  $\mu_j \geq \frac{n-1}{2\tau}$ . Replacing  $\mu_j$  by its value  $(q - 1)(1 + \alpha)$  and noting that  $n - 1 = q(\alpha + 1)$  this entails  $\tau \geq \frac{q}{2(q-1)}$  (Note that, given that  $n - 1 = (\alpha + 1)q$ ,  $\frac{n-1}{n-3+\alpha} < \frac{q}{2(q-1)}$  iff  $q < \frac{3\alpha}{\alpha+1}$ ).

Point (iv):

**Lemma 4.3** *Suppose that a stable graph contains one component  $C$ , with  $C$  minimally partitioned into  $r$  complete subgraphs  $A_1, \dots, A_r$ , and  $|A_i| = \alpha_i |A_{i+1}|$ . Then the stable graphs are built as follows: (i)  $A_i$  is a complete subgraph, (ii) for all  $(i, j) \in A_i \times A_j$ ,  $j > i$ , then agent  $i$  forms a link with  $|A_j| - 1$  agents in  $A_j$ , (iii) for all  $(i, j) \in A_i \times A_j$ ,  $j > i$ , then  $v_{ij} = \mu_j$ , (iv)  $\tau \geq \max_{(j,k)/\mu_j < \mu_k} \left\lceil \frac{n-1}{2\mu_k - \mu_j} \right\rceil$ .*

(The proof is omitted, replicating directly the above one - using properties *P1* and *P2*.) The point (iv) follows directly: the class  $\Gamma(q, \alpha_1, \dots, \alpha_{r-1})$  is stable under the requirement on  $\tau$  given in the lemma; the stability of the class  $\Gamma'(q, \alpha_1, \dots, \alpha_{r-1})$  requires the additional condition  $\tau \geq \frac{q}{2(q-1)}$ . To finish, uniqueness is ensured by recalling to mind the lemma 4.1. ■

**Proof of the claim 3.1.** Consider a stable graph  $g$  with an incomplete component; consider, in this component, three agents  $i, j$  and  $k$  such that  $ij \in g$ ,  $ik \notin g$  and without loss  $\mu_k > \mu_i$ . Straightforward computations show that  $\mu_k > \mu_j - \frac{1}{2} + \frac{n-2}{2} \left( 1 + v_{ij}(g - ij) - v_{ik}(g) \right)$ . Suppose that  $\mu_j = |C| - 1$ : then  $v_{ij}(g - ij) = \mu_i - 1$ , entailing  $\mu_k > n - \frac{3}{2} + \frac{n-2}{2} \left( \mu_i - v_{ik}(g) \right)$ . Since  $v_{ik}(g) \leq \mu_i$ , this is not possible. □

**Proof of proposition 3.2.** Point (i):

*In a stable graph, components are complete; stability of the complete network:* consider a non complete graph  $g$  and suppose that there exists a component containing two agents  $i$  and  $j$  such that  $ij \notin g$ . Then we see immediately that these two agents have an incentive to form a link. Indeed, we are replaced in a game similar to the case of global spillovers, since forming a link induces spillovers to the other agents of the component, but agent  $i$  (resp. agent  $j$ ) does not receive spillovers from agent  $j$ 's component (resp. agent  $i$ 's component) as they already belong to the same one. Hence, following Yi (1998), it basically stems that the component is complete. Further, we deduce that the complete network is stable for all values of  $\tau \in [0, 1]$ .

*Profitability of link formation between two distinct complete components:* consider a network  $g$  containing two distinct complete components, and two agents  $i$  and  $j$  taken from two distinct components. Let us denote the size of (resp. the number of links in) agent  $i$ 's

component as  $\zeta_i$  (resp.  $L_i$ ). We compute the equilibrium quantity variation of agent  $i$  when the alliance  $ij$  is formed as follows:

$$q_i(g + ij) - q_i(g) = \frac{n(\gamma + \rho L_j) - (\gamma + \rho L_i) - (\zeta_i - 1)\rho(L_j + 1) - (\zeta_j - 1)\rho(L_i + 1)}{n + 1}$$

That is, as replacing  $L$  by  $\frac{\zeta(\zeta-1)}{2}$ :

$$q_i(g + ij) - q_i(g) > 0 \text{ iff } \zeta_i^2 + \left(\frac{2}{\zeta_j} + \zeta_j - 2\right)\zeta_i - \left[\frac{2(n-1)}{\tau\zeta_j} + (n+1)(\zeta_j - 1) - 2\frac{\zeta_j - 2}{\zeta_j}\right] < 0$$

This order-2 polynomial admits two roots of opposite sign. Hence, it is profitable for both agents  $i$  and  $j$  to form an alliance with each other when  $\zeta_i < f(\zeta_j)$  and  $\zeta_j < f(\zeta_i)$ , with

$$f_\tau(x) = 1 - \frac{x}{2} - \frac{1}{x} + \frac{1}{2}\sqrt{\left(x - 2 + \frac{2}{x}\right)^2 + 4(n+1)(x-1) + \frac{8(n-1)}{\tau x} - \frac{8(x-2)}{x}}$$

*In a stable graph, two components cannot have equal size:* we know from the above analysis that in stable networks components are complete. Consider two agents  $i$  and  $j$  of distinct complete components with equal size  $\zeta$ . From above we note that the link is profitable iff  $\zeta < f_\tau(\zeta)$ , i.e.  $-2\zeta^3 + (n+3)\zeta^2 - (n+5)\zeta + \frac{2(n-1)}{\tau} + 4 > 0$ . We define the function  $g_\tau(x) = -2x^3 + (n+3)x^2 - (n+5)x + \frac{2(n-1)}{\tau} + 4$ , for  $x \in \{1, \dots, \frac{n}{2}\}$  if  $n$  is even and for  $x \in \{1, \dots, \frac{n-1}{2}\}$  if  $n$  is odd. First we observe that for all values of  $x$ ,  $g_\tau(x)$  is decreasing with parameter  $\tau$ . So, in order to show that the function is positive for all  $x \leq \frac{n}{2}$ , it is sufficient to consider the case  $\tau = 1$ . We easily see that  $g_1(0) > 0$ ,  $g_1(+\infty) = -\infty$ ,  $g_1'(0) < 0$  and  $g_1''(x) \leq 0 \Leftrightarrow x \geq \frac{n+3}{6}$  when  $x > 0$ . We deduce that this order-3 polynomial  $g_1(\cdot)$  admits a unique positive root, and the polynomial is positive (resp. negative) for any positive value of  $x$  smaller (resp. greater) than this root. To finish, we see that for  $n$  even,  $g_1(\frac{n}{2}) > 0$  and for  $n$  odd,  $g_1(\frac{n+1}{2}) > 0$ . If  $n$  is even,  $g_1(\frac{n}{2}) = \frac{n^2-2n+8}{4}$ , which is positive. If  $n$  is odd,  $g_1(\frac{n+1}{2}) = 0$ . Hence, the root is beyond half of the population. This means that two agents belonging to two distinct complete components of equal size have always an incentive to form a link.

Point (ii): let us define the function  $h_\tau(x, y) = \frac{2(n-1)}{\tau} + (n+1)y(y-1) - (xy+2)(x+y-2)$ , with  $x \in \{1, \dots, n-1\}$  and  $y \in \{1, \dots, n-x\}$ . Then  $h_\tau(\zeta_i, \zeta_j) = (n+1)(q_i(g + ij) - q_i(g))$ . For any  $\tau \in [0, 1]$ , note that (1) if  $1 \leq y < x$ ,  $h_\tau(x, y) < h_\tau(y, x)$ : the agent in the greatest complete component has always less incentive to form a link than the other. (2)  $\forall x > 0$ ,  $h_\tau(x+1, y) < h_\tau(x, y)$ : when the size of the complete component of some agent increases, the agent has less incentive to form a link with some agent in a component of fixed size. (3)

$h_\tau(x, y+1) - h_\tau(x, y) > 0$  iff  $y > \frac{x^2-x+2}{2(n+1-x)}$ : the incentive of link formation of some agent in a given complete component is non-monotonic (decreasing then increasing) with respect to the size of the partner's component. ■

Let us say more concerning bounds on the sizes of stable components: the solution  $x_\tau^*$  of the equation  $x = f_\tau(x)$  is also the root of  $g_\tau(x)$ , which has been seen to be greater than half the population. From the following basic lemma we will deduce that for two distinct components to be stable the difference in their size must be large enough:

**Lemma 4.4** *Consider a function  $t$  with real argument in  $[1, +\infty)$ , such that  $t$  is continuous, differentiable with continuous derivative, strictly increasing,  $t(x) = x$  admits a unique solution  $x^*$  and  $t'(x^*) < 1$ . Then, (i) for any  $y > x^*$ , if  $x < t(y)$ , then  $y > t(x)$ , (ii) for any  $y \in ]t(1), x^*[$ , there exists  $t^{-1}(y) > 0$  such that for all  $x \in ]t^{-1}(y), y[$  (resp.  $x < t^{-1}(y)$ ), then  $x < t(y)$  and  $y < t(x)$  (resp.  $x < t(y)$  and  $y > t(x)$ ).*

The function  $f_1$  defined above is increasing and satisfies the conditions of the lemma. Part (i) entails that one does not have simultaneously  $\zeta_i < f_1(\zeta_j)$  and  $\zeta_j < f_1(\zeta_i)$  as soon as  $\max(\zeta_i, \zeta_j) > x_1^*$ . Part (ii) implies that two distinct components of size less than  $x_1^*$  may coexist in a stable graph if their sizes are not too much close. Note that, when  $\tau$  increases the constraint is relaxed, so that whatever  $\tau_a < \tau_b$ , whatever stable graph  $g_a$  for  $\tau_a$  there exists a stable graph  $g_b$  for  $\tau_b$  such that  $g_a$  is a subgraph of  $g_b$  (even if function  $f$  does not satisfies the conditions of the lemma for  $\tau < 1$ ). This means that any stable network for  $\tau < 1$  is also a union of complete components. We give a simple illustration of how checking that a network composed of complete components is or is not stable, in the case  $n = 10$  and  $\tau = 1$  (this is the minimum network size generating a stable union of three complete components):

y	$x_1^*(y)$						
1	4						
2	4						
3	4.4						
4	4.9						
5	5.3						

5	unstable					
4	unstable		stable	stable		
3	unstable		unstable	stable	stable	stable
2	unstable		unstable	stable	stable	stable
1	unstable	unstable	unstable	stable	stable	stable
	1	2	3	4	5	6

Table 1:  $n = 10$ ,  $\tau = 1$

The left-hand table represents, for two components of size  $y$  and  $x$ ,  $y \leq x$ , the maximum size  $x_1^*(y)$  below which two agents belonging to the respective components find profitable



to form a link. The condition examines the link formation profitability of the agent in the greatest component -the less incited-; for instance the line  $y = 3, x_1^*(3) = 4.4$  should be interpreted as ‘an agent in a component of size 4 (resp. 5 or more) finds profitable (resp. not profitable) to form a link with some agent in a component of size 3’. This makes possible to determine which potential link would be profitable for both parties, as summarized in the right-hand table: coordinates represent component sizes, with the convention that the size  $x$  is on the X-axis and the size  $y$  ( $\leq x$ ) on the Y-axis; when the link is profitable (resp. not profitable) to both partners, the word ‘unstable’ (resp. ‘stable’) is used. We check that  $S = \{(1, 4, 5), g_6, g_7, g_8, g_9, g^c\}$ , where  $(1, 4, 5)$  denotes the network composed of three complete components of size 1, 4 and 5.

## References

- Bloch, F., 1995, Endogenous structures of association in oligopolies, *Rand Journal of Economics*, **26**, 537-556.
- Calvo-Armengol, A., 2004, Job contact networks, *Journal of Economic Theory*, **115**, 191-206.
- Goyal, S. and S. Joshi, 2003, Networks of collaboration in oligopoly, *Games and Economic Behavior*, **43**, 57-85.
- Goyal, S. and S. Joshi, 2004, Erratum to “Networks of collaboration in oligopoly” [Games Econ. Behav. 43 (1) (2003) 57-85], *Games and Economic Behavior*, **46**, 219.
- Jackson, M. and A. Wolinsky, 1996, A Strategic model of economic and social networks, *Journal of Economic Theory*, **71**, 44-74.
- Yi, S., 1998, Endogenous formation of joint ventures with efficiency gains, *Rand Journal of Economics*, **29**, 610-631.

# NOTE DI LAVORO DELLA FONDAZIONE ENI ENRICO MATTEI

## Fondazione Eni Enrico Mattei Working Paper Series

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

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

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

## NOTE DI LAVORO PUBLISHED IN 2004

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

KTHC	36.2004	<i>Franca ECKERT COEN and Claudio ROSSI</i> (lxviii): <u>Foreigners, Immigrants, Host Cities: The Policies of Multi-Ethnicity in Rome. Reading Governance in a Local Context</u>
KTHC	37.2004	<i>Kristine CRANE</i> (lxviii): <u>Governing Migration: Immigrant Groups' Strategies in Three Italian Cities – Rome, Naples and Bari</u>
KTHC	38.2004	<i>Kiflemariam HAMDE</i> (lxviii): <u>Mind in Africa, Body in Europe: The Struggle for Maintaining and Transforming Cultural Identity - A Note from the Experience of Eritrean Immigrants in Stockholm</u>
ETA	39.2004	<i>Alberto CAVALIERE</i> : <u>Price Competition with Information Disparities in a Vertically Differentiated Duopoly</u>
PRA	40.2004	<i>Andrea BIGANO and Stef PROOST</i> : <u>The Opening of the European Electricity Market and Environmental Policy: Does the Degree of Competition Matter?</u>
CCMP	41.2004	<i>Micheal FINUS</i> (lxix): <u>International Cooperation to Resolve International Pollution Problems</u>
KTHC	42.2004	<i>Francesco CRESPI</i> : <u>Notes on the Determinants of Innovation: A Multi-Perspective Analysis</u>
CTN	43.2004	<i>Sergio CURRARINI and Marco MARINI</i> : <u>Coalition Formation in Games without Synergies</u>
CTN	44.2004	<i>Marc ESCRIHUELA-VILLAR</i> : <u>Cartel Sustainability and Cartel Stability</u>
NRM	45.2004	<i>Sebastian BERVOETS and Nicolas GRAVEL</i> (lxvi): <u>Appraising Diversity with an Ordinal Notion of Similarity: An Axiomatic Approach</u>
NRM	46.2004	<i>Signe ANTHON and Bo JELLES MARK THORSEN</i> (lxvi): <u>Optimal Afforestation Contracts with Asymmetric Information on Private Environmental Benefits</u>
NRM	47.2004	<i>John MBURU</i> (lxvi): <u>Wildlife Conservation and Management in Kenya: Towards a Co-management Approach</u>
NRM	48.2004	<i>Ekin BIROL, Ágnes GYÓVAI and Melinda SMALE</i> (lxvi): <u>Using a Choice Experiment to Value Agricultural Biodiversity on Hungarian Small Farms: Agri-Environmental Policies in a Transition al Economy</u>
CCMP	49.2004	<i>Gernot KLEPPER and Sonja PETERSON</i> : <u>The EU Emissions Trading Scheme. Allowance Prices, Trade Flows, Competitiveness Effects</u>
GG	50.2004	<i>Scott BARRETT and Michael HOEL</i> : <u>Optimal Disease Eradication</u>
CTN	51.2004	<i>Dinko DIMITROV, Peter BORM, Ruud HENDRICKX and Shao CHIN SUNG</i> : <u>Simple Priorities and Core Stability in Hedonic Games</u>
SIEV	52.2004	<i>Francesco RICCI</i> : <u>Channels of Transmission of Environmental Policy to Economic Growth: A Survey of the Theory</u>
SIEV	53.2004	<i>Anna ALBERINI, Maureen CROPPER, Alan KRUPNICK and Nathalie B. SIMON</i> : <u>Willingness to Pay for Mortality Risk Reductions: Does Latency Matter?</u>
NRM	54.2004	<i>Ingo BRÄUER and Rainer MARGGRAF</i> (lxvi): <u>Valuation of Ecosystem Services Provided by Biodiversity Conservation: An Integrated Hydrological and Economic Model to Value the Enhanced Nitrogen Retention in Renaturated Streams</u>
NRM	55.2004	<i>Timo GOESCHL and Tun LIN</i> (lxvi): <u>Biodiversity Conservation on Private Lands: Information Problems and Regulatory Choices</u>
NRM	56.2004	<i>Tom DEDEURWAERDERE</i> (lxvi): <u>Bioprospection: From the Economics of Contracts to Reflexive Governance</u>
CCMP	57.2004	<i>Katrin REHDANZ and David MADDISON</i> : <u>The Amenity Value of Climate to German Households</u>
CCMP	58.2004	<i>Koen SMEKENS and Bob VAN DER ZWAAN</i> : <u>Environmental Externalities of Geological Carbon Sequestration Effects on Energy Scenarios</u>
NRM	59.2004	<i>Valentina BOSETTI, Mariaester CASSINELLI and Alessandro LANZA</i> (lxvii): <u>Using Data Envelopment Analysis to Evaluate Environmentally Conscious Tourism Management</u>
NRM	60.2004	<i>Timo GOESCHL and Danilo CAMARGO IGLIORI</i> (lxvi): <u>Property Rights Conservation and Development: An Analysis of Extractive Reserves in the Brazilian Amazon</u>
CCMP	61.2004	<i>Barbara BUCHNER and Carlo CARRARO</i> : <u>Economic and Environmental Effectiveness of a Technology-based Climate Protocol</u>
NRM	62.2004	<i>Elissaios PAPYRAKIS and Reyer GERLAGH</i> : <u>Resource-Abundance and Economic Growth in the U.S.</u>
NRM	63.2004	<i>Györgyi BELA, György PATAKI, Melinda SMALE and Mariann HAJDÚ</i> (lxvi): <u>Conserving Crop Genetic Resources on Smallholder Farms in Hungary: Institutional Analysis</u>
NRM	64.2004	<i>E.C.M. RUIJGROK and E.E.M. NILLESEN</i> (lxvi): <u>The Socio-Economic Value of Natural Riverbanks in the Netherlands</u>
NRM	65.2004	<i>E.C.M. RUIJGROK</i> (lxvi): <u>Reducing Acidification: The Benefits of Increased Nature Quality. Investigating the Possibilities of the Contingent Valuation Method</u>
ETA	66.2004	<i>Giannis VARDAS and Anastasios XEPAPADEAS</i> : <u>Uncertainty Aversion, Robust Control and Asset Holdings</u>
GG	67.2004	<i>Anastasios XEPAPADEAS and Constadina PASSA</i> : <u>Participation in and Compliance with Public Voluntary Environmental Programs: An Evolutionary Approach</u>
GG	68.2004	<i>Michael FINUS</i> : <u>Modesty Pays: Sometimes!</u>
NRM	69.2004	<i>Trond BJØRNDAL and Ana BRASÃO</i> : <u>The Northern Atlantic Bluefin Tuna Fisheries: Management and Policy Implications</u>
CTN	70.2004	<i>Alejandro CAPARRÓS, Abdelhakim HAMMOUDI and Tarik TAZDAÏT</i> : <u>On Coalition Formation with Heterogeneous Agents</u>
IEM	71.2004	<i>Massimo GIOVANNINI, Margherita GRASSO, Alessandro LANZA and Matteo MANERA</i> : <u>Conditional Correlations in the Returns on Oil Companies Stock Prices and Their Determinants</u>
IEM	72.2004	<i>Alessandro LANZA, Matteo MANERA and Michael MCALEER</i> : <u>Modelling Dynamic Conditional Correlations in WTI Oil Forward and Futures Returns</u>
SIEV	73.2004	<i>Margarita GENIUS and Elisabetta STRAZZERA</i> : <u>The Copula Approach to Sample Selection Modelling: An Application to the Recreational Value of Forests</u>

CCMP	74.2004	<i>Rob DELLINK and Ekko van IERLAND</i> : <u>Pollution Abatement in the Netherlands: A Dynamic Applied General Equilibrium Assessment</u>
ETA	75.2004	<i>Rosella LEVAGGI and Michele MORETTO</i> : <u>Investment in Hospital Care Technology under Different Purchasing Rules: A Real Option Approach</u>
CTN	76.2004	<i>Salvador BARBERÀ and Matthew O. JACKSON (lxx)</i> : <u>On the Weights of Nations: Assigning Voting Weights in a Heterogeneous Union</u>
CTN	77.2004	<i>Àlex ARENAS, Antonio CABRALES, Albert DÍAZ-GUILERA, Roger GUIMERÀ and Fernando VEGA-REDONDO (lxx)</i> : <u>Optimal Information Transmission in Organizations: Search and Congestion</u>
CTN	78.2004	<i>Francis BLOCH and Armando GOMES (lxx)</i> : <u>Contracting with Externalities and Outside Options</u>
CTN	79.2004	<i>Rabah AMIR, Effrosyni DIAMANTOUDI and Licun XUE (lxx)</i> : <u>Merger Performance under Uncertain Efficiency Gains</u>
CTN	80.2004	<i>Francis BLOCH and Matthew O. JACKSON (lxx)</i> : <u>The Formation of Networks with Transfers among Players</u>
CTN	81.2004	<i>Daniel DIERMEIER, Hülya ERASLAN and Antonio MERLO (lxx)</i> : <u>Bicameralism and Government Formation</u>
CTN	82.2004	<i>Rod GARRATT, James E. PARCO, Cheng-ZHONG QIN and Amnon RAPOPORT (lxx)</i> : <u>Potential Maximization and Coalition Government Formation</u>
CTN	83.2004	<i>Kfir ELIAZ, Debraj RAY and Ronny RAZIN (lxx)</i> : <u>Group Decision-Making in the Shadow of Disagreement</u>
CTN	84.2004	<i>Sanjeev GOYAL, Marco van der LEIJ and José Luis MORAGA-GONZÁLEZ (lxx)</i> : <u>Economics: An Emerging Small World?</u>
CTN	85.2004	<i>Edward CARTWRIGHT (lxx)</i> : <u>Learning to Play Approximate Nash Equilibria in Games with Many Players</u>
IEM	86.2004	<i>Finn R. FØRSUND and Michael HOEL</i> : <u>Properties of a Non-Competitive Electricity Market Dominated by Hydroelectric Power</u>
KTHC	87.2004	<i>Elissaios PAPYRAKIS and Reyer GERLAGH</i> : <u>Natural Resources, Investment and Long-Term Income</u>
CCMP	88.2004	<i>Marzio GALEOTTI and Claudia KEMFERT</i> : <u>Interactions between Climate and Trade Policies: A Survey</u>
IEM	89.2004	<i>A. MARKANDYA, S. PEDROSO and D. STREIMIKIENE</i> : <u>Energy Efficiency in Transition Economies: Is There Convergence Towards the EU Average?</u>
GG	90.2004	<i>Rolf GOLOMBEK and Michael HOEL</i> : <u>Climate Agreements and Technology Policy</u>
PRA	91.2004	<i>Sergei IZMALKOV (lxxv)</i> : <u>Multi-Unit Open Ascending Price Efficient Auction</u>
KTHC	92.2004	<i>Gianmarco I.P. OTTAVIANO and Giovanni PERI</i> : <u>Cities and Cultures</u>
KTHC	93.2004	<i>Massimo DEL GATTO</i> : <u>Agglomeration, Integration, and Territorial Authority Scale in a System of Trading Cities. Centralisation versus devolution</u>
CCMP	94.2004	<i>Pierre-André JOUVET, Philippe MICHEL and Gilles ROTILLON</i> : <u>Equilibrium with a Market of Permits</u>
CCMP	95.2004	<i>Bob van der ZWAAN and Reyer GERLAGH</i> : <u>Climate Uncertainty and the Necessity to Transform Global Energy Supply</u>
CCMP	96.2004	<i>Francesco BOSELLO, Marco LAZZARIN, Roberto ROSON and Richard S.J. TOL</i> : <u>Economy-Wide Estimates of the Implications of Climate Change: Sea Level Rise</u>
CTN	97.2004	<i>Gustavo BERGANTIÑOS and Juan J. VIDAL-PUGA</i> : <u>Defining Rules in Cost Spanning Tree Problems Through the Canonical Form</u>
CTN	98.2004	<i>Siddhartha BANDYOPADHYAY and Mandar OAK</i> : <u>Party Formation and Coalitional Bargaining in a Model of Proportional Representation</u>
GG	99.2004	<i>Hans-Peter WEIKARD, Michael FINUS and Juan-Carlos ALTAMIRANO-CABRERA</i> : <u>The Impact of Surplus Sharing on the Stability of International Climate Agreements</u>
SIEV	100.2004	<i>Chiara M. TRAVISI and Peter NIJKAMP</i> : <u>Willingness to Pay for Agricultural Environmental Safety: Evidence from a Survey of Milan, Italy, Residents</u>
SIEV	101.2004	<i>Chiara M. TRAVISI, Raymond J. G. M. FLORAX and Peter NIJKAMP</i> : <u>A Meta-Analysis of the Willingness to Pay for Reductions in Pesticide Risk Exposure</u>
NRM	102.2004	<i>Valentina BOSETTI and David TOMBERLIN</i> : <u>Real Options Analysis of Fishing Fleet Dynamics: A Test</u>
CCMP	103.2004	<i>Alessandra GORIA e Gretel GAMBARELLI</i> : <u>Economic Evaluation of Climate Change Impacts and Adaptability in Italy</u>
PRA	104.2004	<i>Massimo FLORIO and Mara GRASSEN</i> : <u>The Missing Shock: The Macroeconomic Impact of British Privatisation</u>
PRA	105.2004	<i>John BENNETT, Saul ESTRIN, James MAW and Giovanni URG</i> : <u>Privatisation Methods and Economic Growth in Transition Economies</u>
PRA	106.2004	<i>Kira BÖRNER</i> : <u>The Political Economy of Privatization: Why Do Governments Want Reforms?</u>
PRA	107.2004	<i>Pehr-Johan NORBÄCK and Lars PERSSON</i> : <u>Privatization and Restructuring in Concentrated Markets</u>
SIEV	108.2004	<i>Angela GRANZOTTO, Fabio PRANOVI, Simone LIBRALATO, Patrizia TORRICELLI and Danilo MAINARDI</i> : <u>Comparison between Artisanal Fishery and Manila Clam Harvesting in the Venice Lagoon by Using Ecosystem Indicators: An Ecological Economics Perspective</u>
CTN	109.2004	<i>Somdeb LAHIRI</i> : <u>The Cooperative Theory of Two Sided Matching Problems: A Re-examination of Some Results</u>
NRM	110.2004	<i>Giuseppe DI VITA</i> : <u>Natural Resources Dynamics: Another Look</u>
SIEV	111.2004	<i>Anna ALBERINI, Alistair HUNT and Anil MARKANDYA</i> : <u>Willingness to Pay to Reduce Mortality Risks: Evidence from a Three-Country Contingent Valuation Study</u>
KTHC	112.2004	<i>Valeria PAPPONETTI and Dino PINELLI</i> : <u>Scientific Advice to Public Policy-Making</u>
SIEV	113.2004	<i>Paulo A.L.D. NUNES and Laura ONOFRI</i> : <u>The Economics of Warm Glow: A Note on Consumer's Behavior and Public Policy Implications</u>
IEM	114.2004	<i>Patrick CAYRADE</i> : <u>Investments in Gas Pipelines and Liquefied Natural Gas Infrastructure What is the Impact on the Security of Supply?</u>
IEM	115.2004	<i>Valeria COSTANTINI and Francesco GRACCEVA</i> : <u>Oil Security. Short- and Long-Term Policies</u>

ITEM	116.2004	<i>Valeria COSTANTINI and Francesco GRACCEVA: <u>Social Costs of Energy Disruptions</u></i>
ITEM	117.2004	<i>Christian EGENHOFER, Kyriakos GIALOGLOU, Giacomo LUCIANI, Maroeska BOOTS, Martin SCHEEPERS, Valeria COSTANTINI, Francesco GRACCEVA, Anil MARKANDYA and Giorgio VICINI: <u>Market-Based Options for Security of Energy Supply</u></i>
ITEM	118.2004	<i>David FISK: <u>Transport Energy Security. The Unseen Risk?</u></i>
ITEM	119.2004	<i>Giacomo LUCIANI: <u>Security of Supply for Natural Gas Markets. What is it and What is it not?</u></i>
ITEM	120.2004	<i>L.J. de VRIES and R.A. HAKVOORT: <u>The Question of Generation Adequacy in Liberalised Electricity Markets</u></i>
KTHC	121.2004	<i>Alberto PETRUCCI: <u>Asset Accumulation, Fertility Choice and Nondegenerate Dynamics in a Small Open Economy</u></i>
NRM	122.2004	<i>Carlo GIUPPONI, Jaroslav MYSLAK and Anita FASSIO: <u>An Integrated Assessment Framework for Water Resources Management: A DSS Tool and a Pilot Study Application</u></i>
NRM	123.2004	<i>Margaretha BREIL, Anita FASSIO, Carlo GIUPPONI and Paolo ROSATO: <u>Evaluation of Urban Improvement on the Islands of the Venice Lagoon: A Spatially-Distributed Hedonic-Hierarchical Approach</u></i>
ETA	124.2004	<i>Paul MENSINK: <u>Instant Efficient Pollution Abatement Under Non-Linear Taxation and Asymmetric Information: The Differential Tax Revisited</u></i>
NRM	125.2004	<i>Mauro FABIANO, Gabriella CAMARSA, Rosanna DURSI, Roberta IVALDI, Valentina MARIN and Francesca PALMISANI: <u>Integrated Environmental Study for Beach Management: A Methodological Approach</u></i>
PRA	126.2004	<i>Irena GROSFELD and Iraj HASHI: <u>The Emergence of Large Shareholders in Mass Privatized Firms: Evidence from Poland and the Czech Republic</u></i>
CCMP	127.2004	<i>Maria BERRITTELLA, Andrea BIGANO, Roberto ROSON and Richard S.J. TOL: <u>A General Equilibrium Analysis of Climate Change Impacts on Tourism</u></i>
CCMP	128.2004	<i>Reyer GERLAGH: <u>A Climate-Change Policy Induced Shift from Innovations in Energy Production to Energy Savings</u></i>
NRM	129.2004	<i>Elissaios PAPYRAKIS and Reyer GERLAGH: <u>Natural Resources, Innovation, and Growth</u></i>
PRA	130.2004	<i>Bernardo BORTOLOTTI and Mara FACCIO: <u>Reluctant Privatization</u></i>
SIEV	131.2004	<i>Riccardo SCARPA and Mara THIENE: <u>Destination Choice Models for Rock Climbing in the Northeast Alps: A Latent-Class Approach Based on Intensity of Participation</u></i>
SIEV	132.2004	<i>Riccardo SCARPA Kenneth G. WILLIS and Melinda ACUTT: <u>Comparing Individual-Specific Benefit Estimates for Public Goods: Finite Versus Continuous Mixing in Logit Models</u></i>
ITEM	133.2004	<i>Santiago J. RUBIO: <u>On Capturing Oil Rents with a National Excise Tax Revisited</u></i>
ETA	134.2004	<i>Ascensión ANDINA DÍAZ: <u>Political Competition when Media Create Candidates' Charisma</u></i>
SIEV	135.2004	<i>Anna ALBERINI: <u>Robustness of VSL Values from Contingent Valuation Surveys</u></i>
CCMP	136.2004	<i>Gernot KLEPPER and Sonja PETERSON: <u>Marginal Abatement Cost Curves in General Equilibrium: The Influence of World Energy Prices</u></i>
ETA	137.2004	<i>Herbert DAWID, Christophe DEISSENBERG and Pavel ŠEVČIK: <u>Cheap Talk, Gullibility, and Welfare in an Environmental Taxation Game</u></i>
CCMP	138.2004	<i>ZhongXiang ZHANG: <u>The World Bank's Prototype Carbon Fund and China</u></i>
CCMP	139.2004	<i>Reyer GERLAGH and Marjan W. HOFKES: <u>Time Profile of Climate Change Stabilization Policy</u></i>
NRM	140.2004	<i>Chiara D'ALPAOS and Michele MORETTO: <u>The Value of Flexibility in the Italian Water Service Sector: A Real Option Analysis</u></i>
PRA	141.2004	<i>Patrick BAJARI, Stephanie HOUGHTON and Steven TADELIS (lxxi): <u>Bidding for Incomplete Contracts</u></i>
PRA	142.2004	<i>Susan ATHEY, Jonathan LEVIN and Enrique SEIRA (lxxi): <u>Comparing Open and Sealed Bid Auctions: Theory and Evidence from Timber Auctions</u></i>
PRA	143.2004	<i>David GOLDREICH (lxxi): <u>Behavioral Biases of Dealers in U.S. Treasury Auctions</u></i>
PRA	144.2004	<i>Roberto BURGUET (lxxi): <u>Optimal Procurement Auction for a Buyer with Downward Sloping Demand: More Simple Economics</u></i>
PRA	145.2004	<i>Ali HORTACSU and Samita SAREEN (lxxi): <u>Order Flow and the Formation of Dealer Bids: An Analysis of Information and Strategic Behavior in the Government of Canada Securities Auctions</u></i>
PRA	146.2004	<i>Victor GINSBURGH, Patrick LEGROS and Nicolas SAHUGUET (lxxi): <u>How to Win Twice at an Auction. On the Incidence of Commissions in Auction Markets</u></i>
PRA	147.2004	<i>Claudio MEZZETTI, Aleksandar PEKEČ and Ilia TSETLIN (lxxi): <u>Sequential vs. Single-Round Uniform-Price Auctions</u></i>
PRA	148.2004	<i>John ASKER and Estelle CANTILLON (lxxi): <u>Equilibrium of Scoring Auctions</u></i>
PRA	149.2004	<i>Philip A. HAILE, Han HONG and Matthew SHUM (lxxi): <u>Nonparametric Tests for Common Values in First-Price Sealed-Bid Auctions</u></i>
PRA	150.2004	<i>François DEGEORGE, François DERRIEN and Kent L. WOMACK (lxxi): <u>Quid Pro Quo in IPOs: Why Bookbuilding is Dominating Auctions</u></i>
CCMP	151.2004	<i>Barbara BUCHNER and Silvia DALL'OLIO: <u>Russia: The Long Road to Ratification. Internal Institution and Pressure Groups in the Kyoto Protocol's Adoption Process</u></i>
CCMP	152.2004	<i>Carlo CARRARO and Marzio GALEOTTI: <u>Does Endogenous Technical Change Make a Difference in Climate Policy Analysis? A Robustness Exercise with the FEEM-RICE Model</u></i>
PRA	153.2004	<i>Alejandro M. MANELLI and Daniel R. VINCENT (lxxi): <u>Multidimensional Mechanism Design: Revenue Maximization and the Multiple-Good Monopoly</u></i>
ETA	154.2004	<i>Nicola ACOCELLA, Giovanni Di BARTOLOMEO and Wilfried PAUWELS: <u>Is there any Scope for Corporatism in Stabilization Policies?</u></i>
CTN	155.2004	<i>Johan EYCKMANS and Michael FINUS: <u>An Almost Ideal Sharing Scheme for Coalition Games with Externalities</u></i>
CCMP	156.2004	<i>Cesare DOSI and Michele MORETTO: <u>Environmental Innovation, War of Attrition and Investment Grants</u></i>

CCMP	157.2004	<i>Valentina BOSETTI, Marzio GALEOTTI and Alessandro LANZA: <u>How Consistent are Alternative Short-Term Climate Policies with Long-Term Goals?</u></i>
ETA	158.2004	<i>Y. Hossein FARZIN and Ken-Ichi AKAO: <u>Non-pecuniary Value of Employment and Individual Labor Supply</u></i>
ETA	159.2004	<i>William BROCK and Anastasios XEPAPADEAS: <u>Spatial Analysis: Development of Descriptive and Normative Methods with Applications to Economic-Ecological Modelling</u></i>
KTHC	160.2004	<i>Alberto PETRUCCI: <u>On the Incidence of a Tax on PureRent with Infinite Horizons</u></i>
IEM	161.2004	<i>Xavier LABANDEIRA, José M. LABEAGA and Miguel RODRÍGUEZ: <u>Microsimulating the Effects of Household Energy Price Changes in Spain</u></i>

#### NOTE DI LAVORO PUBLISHED IN 2005

CCMP	1.2005	<i>Stéphane HALLEGATTE: <u>Accounting for Extreme Events in the Economic Assessment of Climate Change</u></i>
CCMP	2.2005	<i>Qiang WU and Paulo Augusto NUNES: <u>Application of Technological Control Measures on Vehicle Pollution: A Cost-Benefit Analysis in China</u></i>
CCMP	3.2005	<i>Andrea BIGANO, Jacqueline M. HAMILTON, Maren LAU, Richard S.J. TOL and Yuan ZHOU: <u>A Global Database of Domestic and International Tourist Numbers at National and Subnational Level</u></i>
CCMP	4.2005	<i>Andrea BIGANO, Jacqueline M. HAMILTON and Richard S.J. TOL: <u>The Impact of Climate on Holiday Destination Choice</u></i>
ETA	5.2005	<i>Hubert KEMPF: <u>Is Inequality Harmful for the Environment in a Growing Economy?</u></i>
CCMP	6.2005	<i>Valentina BOSETTI, Carlo CARRARO and Marzio GALEOTTI: <u>The Dynamics of Carbon and Energy Intensity in a Model of Endogenous Technical Change</u></i>
IEM	7.2005	<i>David CALEF and Robert GOBLE: <u>The Allure of Technology: How France and California Promoted Electric Vehicles to Reduce Urban Air Pollution</u></i>
ETA	8.2005	<i>Lorenzo PELLEGRINI and Reyer GERLAGH: <u>An Empirical Contribution to the Debate on Corruption Democracy and Environmental Policy</u></i>
CCMP	9.2005	<i>Angelo ANTOCI: <u>Environmental Resources Depletion and Interplay Between Negative and Positive Externalities in a Growth Model</u></i>
CTN	10.2005	<i>Frédéric DEROIAN: <u>Cost-Reducing Alliances and Local Spillovers</u></i>

(lxv) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications” organised by Fondazione Eni Enrico Mattei and sponsored by the EU, Milan, September 25-27, 2003

(lxvi) This paper has been presented at the 4th BioEcon Workshop on “Economic Analysis of Policies for Biodiversity Conservation” organised on behalf of the BIOECON Network by Fondazione Eni Enrico Mattei, Venice International University (VIU) and University College London (UCL), Venice, August 28-29, 2003

(lxvii) This paper has been presented at the international conference on “Tourism and Sustainable Economic Development – Macro and Micro Economic Issues” jointly organised by CRENoS (Università di Cagliari e Sassari, Italy) and Fondazione Eni Enrico Mattei, and supported by the World Bank, Sardinia, September 19-20, 2003

(lxviii) This paper was presented at the ENGIME Workshop on “Governance and Policies in Multicultural Cities”, Rome, June 5-6, 2003

(lxix) This paper was presented at the Fourth EEP Plenary Workshop and EEP Conference “The Future of Climate Policy”, Cagliari, Italy, 27-28 March 2003

(lxx) This paper was presented at the 9<sup>th</sup> Coalition Theory Workshop on "Collective Decisions and Institutional Design" organised by the Universitat Autònoma de Barcelona and held in Barcelona, Spain, January 30-31, 2004

(lxxi) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications”, organised by Fondazione Eni Enrico Mattei and Consip and sponsored by the EU, Rome, September 23-25, 2004

**2004 SERIES**

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

**2005 SERIES**

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