

Fujita, Masahisa; Weber, Shlomo

Working Paper

Strategic Immigration Policies and Welfare in Heterogeneous Countries

Nota di Lavoro, No. 2.2004

Provided in Cooperation with:

Fondazione Eni Enrico Mattei (FEEM)

Suggested Citation: Fujita, Masahisa; Weber, Shlomo (2004) : Strategic Immigration Policies and Welfare in Heterogeneous Countries, Nota di Lavoro, No. 2.2004, Fondazione Eni Enrico Mattei (FEEM), Milano

This Version is available at:

<https://hdl.handle.net/10419/117881>

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.

**Strategic Immigration Policies
and Welfare
in Heterogeneous Countries**
Masahisa Fujita and Shlomo Weber

NOTA DI LAVORO 2.2004

JANUARY 2004

ETA – Economic Theory and Applications

Masahisa Fujita, *Institute of Economic Research, Kyoto University*
Shlomo Weber, *Department of Economics, Southern Methodist University and CORE, Catholic
University of Louvain*

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

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

Strategic Immigration Policies and Welfare in Heterogeneous Countries

Summary

In this paper we consider a model with two industrialised countries and immigrants that come from “the rest of the world”. The countries are distinguished on the basis of three parameters: population size, bias towards immigrants, and production complementarity between native population and immigrants. We consider a non-cooperative game where each country makes a strategic choice of its immigration quotas. We first show that our game admits a unique pure strategy Nash equilibrium and then study the welfare implications of countries’ choices. It turns out that a country with a higher degree of production complementarity and a higher level of tolerance towards immigrants would allow a larger immigration quota and achieve a higher welfare level. Our results call for coordinated and harmonised immigration policies that may improve the welfare of both countries.

Keywords: Immigration quotas, Heterogeneity, Production complementarity, Welfare, Policy Harmonisation

JEL Classification: C72, F22, O3, R1

We wish to thank Jacques Thisse for useful comments.

Address for correspondence:

Shlomo Weber
Department of Economics
Southern Methodist University
Dallas
USA
Phone: + 1214 768 3577
E-mail: sweber@post.cis.smu.edu

1 Introduction

In describing an array of industries across countries, one can immediately come to the conclusion that different production technologies impose distinct requirements on the level and distribution of labor skills and the way workers in those industries interact with each other. For example, over the years Japan has achieved a very high level of performance in the industries (cars, sophisticated consumer goods) that require a high level of precision and consistent quality control. These industries are characterized by a large number of production stages and technological progress is usually achieved through the series of small but incessant improvements called “kaizen” (see, e.g., Imai (1989)). This type of production requires not only highly educated and able workers, but also a consistent and extensive level of interaction between them. This results in emergence of a labor force that is quite homogeneous in its educational, cultural, and linguistic background.

On the other hand, the United States specializes in “knowledge”, and especially, software industries that rely on talents and abilities of individuals coming from a wide range of diverse educational and cultural environments. The success of Silicon Valley in the late nineties is often attributed to the diversified backgrounds of scientists, engineers and entrepreneurs who arrived from places like India, China, Taiwan, Israel, among others. In fact, Saxenian (1999) points out more than 30 percent of new businesses in Silicon Valley had an Asian-born co-founder.¹ However, this diversity did not prevent, and, in fact, even reinforced the commonality of workers’ purpose and goals. Saxenian (1996) describes how workers in Silicon Valley enjoyed frequent and intensive exchange of information through a variety of formal and informal contacts. The exchange was facilitated by the frequent moves of workers from one firm to another (the average time spent by an individual in one firm was about two years), and a flexible industry structure (it has been often claimed that in Silicon Valley a firm is simply a vehicle allowing an individual to work.)

The nature of knowledge production indicates the importance of interaction between different workers and, especially, complementarity of their talents and skills, that is quite different from the multi-stage technological process in high-precision manufacturing (see Milgrom and Roberts (1990)

¹The openness to immigrants is historically a relatively new phenomena. Chinese immigration (forbidden in the U.S. in 1880) and Japanese immigration (forbidden in 1905) were considered incompatible with American cultural foundations and unwarranted from the economic point of view (Maignan et al (2003)).

and Kremer (1993)).

In general, the production complementarity is based on two sources, *internal heterogeneity*, that describes the diversity of talents within the existing group of workers engaged in a given industry, and *external heterogeneity*, that captures the diversity between the existing group of workers and “newcomers” to the industry. The first type of heterogeneity has been the focus of the Grossman and Maggi (2000) two-country analysis, which introduced a model with a diverse talent pool within each country and examined, among other issues, an assignment of different individuals to complementary tasks, and its impact on trade patterns between two countries. Our goal is to examine an external heterogeneity between “native” population and immigrant workers in an industry that exhibits a production complementarity.

We consider three groups of individuals, citizens of two countries, A and B , and immigrants, denoted by I . Since our focus is on heterogeneity between A and B in terms of their production complementarities with the immigrant population, we assume that each of the three groups is homogeneous in nature and consists of identical individuals. Using the language of Esteban and Ray (1994) in their study of polarization, we focus on heterogeneity across three clusters and assume a complete homogeneity within each of them.

In our model there are three parameters that distinguish between two countries. The first, mentioned above, is the degree of production complementarity between countries’ native population and immigrants. Secondly, countries vary in their population size. Finally, the countries may differ with respect to their “bias” towards immigrants. Indeed, one may accept the fact the United States has a lower bias or higher degree of tolerance towards immigrant population than Europe and Japan. The distinctive difference in attitudes towards immigrants can be explained by a variety of historical, cultural, ethnic, religious, geographic, and economic reasons. We do not discuss this issue here and simply accept various degrees of tolerance towards immigrants.

We consider a non-cooperative game between two countries strategically choosing their immigration quotas. We first prove that for any set of parameters of our model there exists a unique pure strategies Nash equilibrium. We further investigate the equilibrium levels of welfare and show that a country with a higher production complementarity and lower immigration basis would enjoy a higher

welfare and accept a larger number of immigrants than its counterpart. It turns out that while a more populous country would attract a larger number of immigrants, its relative immigration quota would nevertheless be lower than in a smaller country.

We also discuss a possible coordination and harmonization of immigration policies that may improve the welfare of both countries. Even though the coordinated reduction of immigration quotas may be beneficial for both countries, one should realize that this conclusion has been stated with respect to equilibrium levels of immigration. In terms of empirical implications, one can justifiably argue that immigration quotas in industrialized countries are far away from the equilibrium levels, and, therefore, a raise of quotas, rather than their reduction, would be a prudent policy recommendation.

The paper is organized as follows. In the next section we introduce the model and provide examples that illuminate our assumptions. In Section 3 we introduce the immigration game and state our result on the existence and uniqueness of a Nash equilibrium. In Section 4 we compare the welfare of two countries as well as the level of the immigration quotas chosen by the countries in equilibrium. Section 5 is devoted to discussion on harmonization of immigration policies aimed at the welfare improvement of two countries. Finally, we provide the concluding results. All the proofs of our results are relegated to the Appendix.

2 The Model

There are two “industrialized” countries, A and B , and unlimited source of immigration from the “rest of the world”. Both countries possess a degree of complementarity in production between native population (natives) and immigrants and one of the main features of our model is that we allow for heterogeneity of degree of complementarity. Thus two countries may face different effects of immigrants’ contribution towards its production capabilities. More specifically, the production function of country $j = A, B$ is given by

$$Q_j = (N_j^{\alpha_j} + I_j^{\alpha_j})^{\frac{1}{\alpha_j}},$$

where N_j is the country population of natives and I_j is the number of immigrants to country j . The parameter α_j represents the reverse measure of production complementarity between natives and

immigrants in j . We assume that $0 < \alpha_j < 1$. Within this range, smaller values of α_j reflect a higher degree of production complementarity.

To further comment on our choice of the range α_j 's, note that when $\alpha_j \leq 0$, the complementarity is so strong that the output Q_j tends to zero when the number of immigrants I_j approaches zero. This would imply that the country would be actually unable to survive without the influx of immigrants. In order to avoid this unrealistic situation, we rule out all non-positive values of α_j . On the other hand, the iso-quant curves of country j are strictly concave when $\alpha_j > 1$, implying that the mix of natives and immigrants is actually harmful for production purposes. This may happen if the cultural gap between two populations is too wide, which makes it difficult to integrate the heterogeneous population into the production process. In the case when $\alpha_j = 1$, the mix of two populations has a neutral effect and has neither positive nor negative benefit in production. Summarizing all these arguments, our analysis is focused on the interesting and meaningful case of $0 < \alpha_j < 1$, where natives and immigrants possess a sufficient degree of heterogeneity to enhance the productivity. At the same time, the degree of heterogeneity is sufficiently small to allow beneficial integration of two populations into the production process.

The immigrant wage, w_I , in both countries is determined via supply function given by

$$w_I = c + \gamma(I_A + I_B),$$

where c and γ are positive constants.

In addition to their size and complementarity parameters, two countries are distinguished by their bias towards immigrants. That is, for $j = A, B$, the welfare of country j is given by²

$$W_j = Q_j - w_I I_j - b_j \frac{I_j}{N_j},$$

²Here we implicitly assume a circular flow of migration between country j and the rest of the world (called “temporary migration” (Wong (1995))), when immigrants do not stay in j for “too long”. Thus, the welfare of country j is that of its natives only. More generally, we may replace the term $w_I I_j$ by $\theta_j w_I I_j$, where $\theta_j \in [0, 1]$ is a parameter reflecting the degree of integration of immigrants in country j 's society. $\theta = 1$ corresponds to our model whereas other extreme case $\theta = 0$ represents the case of the complete integration of immigrants where their earnings are fully accounted in the country welfare.

where b_j is a (positive) bias parameter of country j . In economic terms, the bias effect can be compared to heterogeneous congestion effects imposed on the native population.

Denote by x_j the (relative) immigration quota of country $j = A, B$:

$$x_j = \frac{I_j}{N_j}.$$

Then

$$Q_A = N_A(1 + x_A^\alpha)^{\frac{1}{\alpha}}, \quad Q_B = N_B(1 + x_B^\beta)^{\frac{1}{\beta}},$$

$$w_I = c + \gamma(N_A x_A + N_B x_B),$$

$$W_A = Q_A - w_I N_A x_A - b_A x_A, \quad W_B = Q_B - w_I N_B x_B - b_B x_B,$$

where, for simplicity of notation, the degrees of complementarity α_A and α_B are replaced by α and β , respectively.

To illustrate the features of our model, consider the following examples:

Example 2.1: Let country A be the United States and B Japan. Suppose that all immigrants are from China. Given closeness of Chinese and Japanese cultures, the degree of complementarity of Chinese immigrants in Japan is relatively low. The situation is obviously different in the U.S., where, after receiving an appropriate education, Chinese immigrants exhibit a higher degree of complementarity. Thus, the reverse degree of complementarity of “natives” and immigrants in the U.S., α , is lower than β , the corresponding degree in Japan. One may also accept the view that the U.S. is more open to immigration than Japan, implying $b_A < b_B$. Finally, a larger population in the U.S. yields $N_A > N_B$. To summarize, this example satisfies the following relationship between the parameters of the model:

$$\alpha < \beta, \quad b_A < b_B, \quad N_A > N_B. \tag{1}$$

Example 2.2: The relationship indicated by (1) can be obtained from a slightly different story, where the degree of complementarity of two populations in production depends not only on their cultural heterogeneity but also on what industry they work in. As in Example 2.1, let country A be the United States and B is Japan, but suppose that all immigrants come now from

India. We may assume that the cultural gap between Americans and Indians is roughly the same as between Indians and Japanese. One can also assume that while Japan specializes in the production of high-quality manufacturing, the U.S. specialization lies in software development. Then the mix of heterogeneous populations of Japanese and Indians may be rather harmful in refining the high-quality manufacturing through incessant “kaizen” in the production process. In contrast, mixing appropriately heterogeneous populations of Americans and Indians will yield a higher complementarity in software development. Thus again the *reversed* degree of complementarity in the U.S., α , would be lower than that in Japan, β . The other inequalities in (1) are held for the same reasons as in Example 2.1.

As it is commonly known, the number of immigrants in the U.S. is larger than that in Japan. In Section 3 we shall re-examine the relationship described in (1) and demonstrate that our theoretical conclusions are consistent with the existence of the immigration gap between two countries.

In the next section we examine strategic interaction between two countries in determining their immigration and show the existence and uniqueness of a pure strategies Nash equilibrium in the two-country non-cooperative game.

3 The Immigration Game

To proceed with the formal framework, we consider a multidimensional parameter space P , where each point $p \in P$ represents degrees of production complementarity, population size, and immigration bias of two countries. That is,

$$P \equiv \{p = (\alpha, \beta, N_A, N_B, b_A, b_B) | 0 < \alpha, \beta < 1, N_A, N_B, b_A, b_B > 0\}.$$

Let point $p = (\alpha, \beta, N_A, N_B, b_A, b_B)$, that describes the parameters of the “world economy”, be given. We consider a game $\Gamma(p)$ between two countries, A and B , whose strategic choices are determined by their relative immigration quotas, x_A and x_B , respectively. Countries’ payoffs are represented by their welfare levels, $W_A(x_A, x_B)$ and $W_B(x_A, x_B)$, that depend on their production levels, immigrant wages, and the immigration bias of this country’s population. Specifically, for

country $j = A, B$ we assume that

$$W_j(x_A, x_B) = Q_j - w_I N_j x_j - b_j x_j.$$

Thus, we have the following expressions for players' payoffs:

$$W_A(x_A, x_B) = N_A(1 + x_A^\alpha)^{\frac{1}{\alpha}} - [c + \gamma(N_A x_A + N_B x_B)]N_A x_A - b_A x_A, \quad (2)$$

$$W_B(x_A, x_B) = N_B(1 + x_B^\alpha)^{\frac{1}{\alpha}} - [c + \gamma(N_A x_A + N_B x_B)]N_B x_B - b_B x_B. \quad (3)$$

Since both payoff functions are continuously differentiable and concave in x_A for any x_B , we determine countries' best responses to their rival's choices by solving the first order conditions:

$$\frac{\partial W_A}{\partial x_A} = 0 \quad \text{and} \quad \frac{\partial W_B}{\partial x_B} = 0.$$

It is easy to verify that the best response of countries A and B , respectively, is determined by the following equations:

$$f_\alpha(x_A) - 2\gamma N_A x_A = c + \gamma N_B x_B + \frac{b_A}{N_A} \quad (4)$$

$$f_\beta(x_B) - 2\gamma N_B x_B = c + \gamma N_A x_A + \frac{b_B}{N_B}, \quad (5)$$

where

$$f_\delta(x) \equiv (1 + x^\delta)^{\frac{1}{\delta}-1} x^{\delta-1} = (1 + x^{-\delta})^{\frac{1-\delta}{\delta}}$$

for every two positive numbers δ and x .

The following lemma summarizes the property of the function $f_\delta(x)$ that will be useful for our analysis:

Lemma \mathcal{A} : (i) The function $f_\delta(x)$ is decreasing in x on \mathfrak{R}_{++} for every $\delta \in (0, 1)$.

(ii) The function $f_\delta(x)x$ is increasing in x on \mathfrak{R}_{++} for every $\delta \in (0, 1)$.

(iii) The function $f_\delta(x)$ is decreasing in δ on \mathfrak{R}_{++} for every positive x .

(iv) $\lim_{x \rightarrow 0} f_\delta(x) = +\infty$ for every $\delta \in (0, 1)$.

(v) $\lim_{x \rightarrow +\infty} f_\delta(x) = 1$ for every $\delta \in (0, 1)$.

Lemma \mathcal{A} guarantees (see Figure 1) that the solution to (4), $x_A^*(x_B)$ is well-defined, positive-valued, continuous and strictly decreasing in x_B , and approaches zero as x_B tends to infinity.

Insert Figure 1.

Since the same properties hold for the best response of country B , $x_B^*(x_A)$, determined by (5), we obtain our first result:

Proposition 3.1: For every $p \in P$, the immigration game $\Gamma(p)$ admits an equilibrium in pure strategies.

Our main result is actually stronger as we are able to demonstrate the uniqueness of a Nash equilibrium for every choice of the model parameters:

Proposition 3.2: For every $p \in P$, the immigration game $\Gamma(p)$ has a unique equilibrium in pure strategies. Moreover, in equilibrium, both countries choose strictly positive immigration quotas.

The proof of this proposition is relegated to the Appendix. We would like to point out that the reason for uniqueness of an equilibrium is the fact that the best response curves, $x_A^*(x_B)$ and $x_B^*(x_A)$ are negatively sloped, and, moreover, have derivatives between 0 and -1 . That is, a raise by ϵ of an immigration quota in country A would trigger a decline in immigration quota in B by the amount which is less than ϵ (see Figure 2).

Insert Figure 2.

Thus, two best response curves cannot have more than one point of intersection, which, together with Proposition 3.1, guarantees uniqueness of an equilibrium.

In the next section we compare the welfare and equilibrium levels of immigration quotas in two countries. We shall examine how differences in population size, degree of complementarity and immigration bias impact the variance in welfare and immigration quotas chosen by countries A and B .

4 Cross-Country Comparison of Welfare and Immigration Quotas

For every choice of the model parameters $p \in P$, the (unique) Nash equilibrium will be denoted by $(x_A^e(p), x_B^e(p))$.

We begin this section by providing a welfare comparison between the countries when they differ in their production complementarity, population size and immigration bias.

Consider the point $p = (\alpha, \beta, N_A, N_B, b_A, b_B) \in P$. The welfare levels of two countries in the equilibrium of the game $\Gamma(p)$, $W_A(x_A^e(p), x_B^e(p))$ and $W_B(x_A^e(p), x_B^e(p))$, will be denoted simply by $W_A^e(p)$ and $W_B^e(p)$, respectively.

The next result shows that a country with a lower immigration bias attains a higher level of welfare:

Proposition 4.1: Assume that $p = (\alpha, \beta, N_A, N_B, b_A, b_B) \in P$ is such that $\alpha = \beta$, $N_A = N_B$ but $b_A < b_B$. Then $W_A^e(p) > W_B^e(p)$.

Furthermore, a country with a higher degree of complementarity has a higher level of welfare:

Proposition 4.2: Assume that $p = (\alpha, \beta, N_A, N_B, b_A, b_B) \in P$ is such that $\alpha < \beta$, $N_A = N_B$, and $b_A = b_B$. That is, the countries differ only with respect to their degree of complementarity. Then $W_A^e(p) > W_B^e(p)$.

Finally, a more populous country is better off relatively to its smaller counterpart:

Proposition 4.3: Assume that $p = (\alpha, \beta, N_A, N_B, b_A, b_B) \in P$ is such that $\alpha = \beta$, $N_A > N_B$, and $b_A = b_B$. That is, the countries differ only with respect to their population size. Then $W_A^e(p) > W_B^e(p)$.

Now let us turn to the comparison of the equilibrium immigration quotas. First, we state that if the countries differ only with respect to their immigration tolerance, then the less biased country would accept a larger number of immigrants:

Proposition 4.4: Let $p = (\alpha, \beta, N_A, N_B, b_A, b_B) \in P$ is such that $\alpha = \beta$, $N_A = N_B$ but $b_A < b_B$.

That is, the countries differ only with respect to their “bias” with A being less biased country.

Then A would accept a larger number of immigrants, i.e., $x_A^e(p) > x_B^e(p)$.

The next proposition shows that the country with a higher degree of complementarity would choose a higher immigration quota:

Proposition 4.5: Assume that $p = (\alpha, \beta, N_A, N_B, b_A, b_B) \in P$ is such that $N_A = N_B = N$, and $b_A = b_B$, $\alpha < \beta$. That is, the countries differ only with respect to their degree of complementarity, with A exhibiting a higher level of complementarity degree. (Recall that α and β are reverse measures of complementarity.) Then $x_A^e(p) > x_B^e(p)$.

Since the size of two countries was identical in Propositions 4.4 and 4.5, there was no need to distinguish between the relative and absolute number of immigrants to A and B . We now turn to the case where the countries are heterogeneous with respect to their population size. First, we compare the number of immigrants to A and B :

Proposition 4.6: Assume that $p = (\alpha, \beta, N_A, N_B, b_A, b_B) \in P$ is such that $\alpha = \beta$, $b_A = b_B = b$, but $N_A > N_B$. That is, A is a more populous country. Then the number of immigrants I_A in A would exceed the number of immigrants I_B in B , i.e., $I_A = x_A^e(p)N_A > I_B = x_B^e(p)N_B$.

The next corollary examines the aggregate effect of differences in population size, degree of complementarity and immigration bias. We consider the case where, as in Examples 2.1 and 2.2, country A has a larger population size, higher degree of complementarity and lower immigration bias than country B . Then the number of immigrants to country A exceeds the number of immigrants to country B , which is consistent with the fact that the number of immigrants in the U.S. is larger than that in Japan.

Proposition 4.7: Let $p = (\alpha, \beta, N_A, N_B, b_A, b_B) \in P$ be such that $\alpha < \beta$, $b_A < b_B$ and $N_A > N_B$. Then $I_A > I_B$.

To state our next result regarding a relative number of immigrants, we consider countries with a large native population. Formally, define a subset P' of the parameter space P by:

$$P' \equiv \{p = (\alpha, \beta, N_A, N_B, b_A, b_B) \in P \mid c + \frac{2b_A}{N_A} + \frac{2b_B}{N_B} < 1\}.$$

Obviously, a sufficient condition for a point $p = (\alpha, \beta, N_A, N_B, b_A, b_B)$ to belong to the set P' is that both countries have a large population.

It is interesting to note that a smaller country would impose a higher immigration quota than its larger counterpart:

Proposition 4.8: Assume that $p = (\alpha, \beta, N_A, N_B, b_A, b_B) \in P'$ is such that $\alpha = \beta$, $N_A > N_B$, and $b_A = b_B$. That is, the countries differ only with respect to their population size. Then the relative number of immigrants is negatively correlated with the size of a country, i.e., $x_A^e(p) < x_B^e(p)$.

5 Harmonization of Immigration Policies

In this section we address the question how coordinated and harmonized immigration policies of countries A and B may improve their welfare. We consider the first best outcome when countries jointly choose their immigration quotas. It turns out that the equilibrium immigration levels yield an excessive number of immigrants. This result clearly calls for a need for coordinated immigration policies that might be beneficial for both countries. To reinforce this point, we show that a harmonized reduction, both relative and absolute, of equilibrium immigration levels would raise countries' welfare.

For every point p in the parameter space P we consider a cooperative outcome $(x_A^c(p), x_B^c(p))$ that maximizes the joint welfare of two countries. That is, for a given $p \in P$, the countries attempt to find:

$$\max_{(x_A, x_B) \in \mathfrak{R}_{++}^2} \{W_A(x_A, x_B) + W_B(x_A, x_B)\}$$

The first result of this section is surprisingly strong. It states that, regardless of differences in size, bias toward immigrants and degree of complementarity between natives and immigrants, the total number of immigrants allowed under the non-cooperative regime is *excessive* as compared with the first-best outcome.

Proposition 5.1: For every point $p = (\alpha, \beta, N_A, N_B, b_A, b_B) \in P$ the total number of immigrants in equilibrium is larger than that generated by the cooperative outcome:

$$N_A x_A^c(p) + N_B x_B^c(p) < N_A x_A^e(p) + N_B x_B^e(p).$$

Proposition 5.1 obviously rules out the situation where both countries raise their immigration levels under cooperative outcome. However, it is still possible that in the case of two countries with vastly different characteristics, one of the countries would raise its immigration quota under first best

solution. This situation is clearly impossible for two countries with similar characteristics: then their immigration quotas are excessive with respect to the first best:

Proposition 5.2: Let point $p = (\alpha, \alpha, N, N, b, b) \in P$ represent two countries with identical characteristics. Then there exist positive numbers ϵ_1, ϵ_2 and ϵ_3 such that every point $p' = (\alpha, \beta, N_A, N_B, b_A, b_B)$, satisfying $|\alpha - \beta| < \epsilon_1, |N_A - N_B| < \epsilon_2, |b_A - b_B| < \epsilon_3$, the following inequalities hold:

$$x_A^c(p') < x_A^e(p') \quad \text{and} \quad x_B^c(p') < x_B^e(p')$$

We complete this section by analyzing how the countries can increase their welfare by implementing harmonized immigration policies. We consider two approaches, harmonized relative reduction and harmonized absolute reduction. Under the first policy, both countries reduce their immigration levels by the same percentage point. Alternatively, they may agree on the same number of immigrants eliminated from their respective equilibrium quotas.

Proposition 5.3: - Relative Reduction: For every point $p \in P$ there is $\lambda, 0 < \lambda < 1$ such that for all $\lambda', \lambda < \lambda' < 1$:

$$W_A(\lambda' x_A^e(p), \lambda' x_B^e(p)) > W_A^e(p), \quad W_B(\lambda' x_A^e(p), \lambda' x_B^e(p)) > W_B^e(p).$$

Proposition 5.4: - Absolute Reduction: For every point $p \in P$ there is $\mu > 0$ such that for all $\mu', 0 < \mu' < \mu$:

$$W_A(x_A^e(p) - \mu', x_B^e(p) - \mu') > W_A^e(p), \quad W_B(x_A^e(p) - \mu', x_B^e(p) - \mu') > W_B^e(p).$$

6 Concluding Remarks

In this paper we consider a model with two industrialized countries and a homogeneous mass of immigrants. The countries' characteristics may vary with respect to their population size, bias toward immigrants, and production complementarity between native population and immigrants. The latter is an outcome of distinctive production processes in two countries: one (e.g., software industry) is rooted in a heterogeneous labor force with a wide range of cultural, ethnic and educational

backgrounds, and the other (e.g., high-precision manufacturing) is based on homogeneity and a high degree of interaction between workers.

We consider a non-cooperative game between two countries where each of them makes a strategic decision by choosing its immigration quota. We first show that our game admits a unique pure strategies Nash equilibrium and then study the welfare implications of countries' choices. It turns out that a country with a higher degree of production basis and a higher level of tolerance towards immigrants would allow a larger immigration quota. In addition, we show that while a more populous country allows more immigrants, it would establish a lower ratio between immigrants and natives. We also argue that both countries can benefit by coordinating their strategies, and our results call for harmonized immigration policies aimed at improving the welfare of both countries.

To focus our analysis on difference in production complementarities between the native population in countries A and B , we assumed a complete homogeneity within each of the three groups, natives in A and B , and immigrants. The next natural step, left for future research, would be to generalize this model by allowing heterogeneity, both across countries and within immigrant population. It is especially important in analysis of high-tech knowledge industries, where ethnic, cultural, and social diversity play an even more important role. Indeed, as Florida and Gates (2001) and Florida (2002) show in their studies of metropolitan areas in the U.S., population diversity is a strong indicator of a metropolitan area's high-technology success. They argue that such indicators as the percentage of gay population, number of artists and "bohemians", as well as a high concentration of foreign-born residents are closely linked with the area's high-technology concentration and growth (see also Saxenian (1999)). Another important direction of future research would be an investigation of international trade consequences between countries as a function of their distinct industrial specialization and distribution of skills and talents across population (for the latter see Grossman and Maggi (2000) and Grossman (2002)).

7 Appendix

Proof of Lemma A: (i), (iv) and (v) are straightforward. For (ii) note that

$$\frac{d[f_\delta(x)x]}{dx} = (1+x^{-\delta})^{\frac{1}{\delta}-2}[-(1-\delta)x^{-\delta} + 1 + x^{-\delta}] = (1+x^{-\delta})^{\frac{1}{\delta}-2}[\delta x^{-\delta} + 1] > 0.$$

Finally, to prove (iii), we have $f_\delta(x) = e^{(\frac{1}{\delta}-1)\log(1+x^{-\delta})}$. Then

$$\frac{df_\delta(x)}{d\delta} = f_\delta(x)\left[-\frac{1}{\delta^2}\log(1+x^{-\delta}) - \frac{(\frac{1}{\delta}-1)x^{-\delta}\log x}{1+x^{-\delta}}\right].$$

This expression is negative when $x \geq 1$. Consider now the case where $0 < x < 1$. The last expression can be rewritten as

$$\begin{aligned} \frac{df_\delta(x)}{d\delta} &= -\frac{f_\delta(x)x^{-\delta}}{\delta^2(1+x^{-\delta})}[x^\delta \log(1+x^{-\delta}) + \log(1+x^{-\delta}) + \delta \log x - \delta^2 \log x] \\ &= -\frac{f_\delta(x)x^{-\delta}}{\delta^2(1+x^{-\delta})}[x^\delta \log(1+x^{-\delta}) + \log(1+x^\delta) - \delta^2 \log x] < 0. \quad \square \end{aligned}$$

Proof of Proposition 3.2: Equation (2) implies that the best response of country A is given by

$$\frac{dx_A^*}{dx_B} = -\frac{\gamma N_B}{(1-\alpha)x_A^{-\alpha-1}(1+x_A^{-\alpha})^{\frac{1-2\alpha}{\alpha}} + 2\gamma N_A}. \quad (6)$$

Similarly, the best response of country B , given by (3), is determined by

$$\frac{dx_B^*}{dx_A} = -\frac{\gamma N_A}{(1-\beta)x_B^{-\beta-1}(1+x_B^{-\beta})^{\frac{1-2\beta}{\beta}} + 2\gamma N_B}. \quad (7)$$

The inverse of equation (6) represents the slope of the best response curve of country A with respect to x_A axis. This inverse is given by the formula

$$-\frac{(1-\alpha)x_A^{-\alpha-1}(1+x_A^{-\alpha})^{\frac{1-2\alpha}{\alpha}} + 2\gamma N_A}{\gamma N_B}. \quad (8)$$

However, the expression in (7) is greater than $-\frac{N_A}{2N_B}$, whereas the expression in (8) is smaller than $-\frac{2N_A}{N_B}$.

That is, with respect to x_A axis, the best response curve of country B is everywhere flatter than that of country A . Thus, two best response curves do not intersect more than once and, together with Proposition 3.1, it implies the existence of a unique equilibrium. \square

Before proceeding with the proof of Propositions 4.1-4.3, we provide the proofs of Propositions 4.4-4.8:

Proof of Proposition 4.4: Note that the subtraction of (5) from (4) implies that for every $p \in P$

$$[f_\alpha(x_A^e(p)) - \gamma N_A x_A^e(p)] - [f_\beta(x_B^e(p)) - \gamma N_B x_B^e(p)] = \left[\frac{b_A}{N_A} - \frac{b_B}{N_B} \right] \quad (9)$$

Let $N = N_A = N_B$. (9) yields:

$$[f_\alpha(x_A^e(p)) - \gamma N x_A^e(p)] - [f_\alpha(x_B^e(p)) - \gamma N x_B^e(p)] < 0.$$

Since, by Lemma \mathcal{A} , the function $f_\alpha(x) - \gamma N x$ is declining in x , it follows that $x_A^e(p) > x_B^e(p)$. \square

Proof of Proposition 4.5: Let $N = N_A = N_B$ and $b = b_A = b_B$. From (9),

$$[f_\alpha(x_A^e(p)) - \gamma N x_A^e(p)] - [f_\beta(x_B^e(p)) - \gamma N x_B^e(p)] = 0.$$

Since, by Lemma \mathcal{A} , $f_\alpha(x_A^e(p)) > f_\beta(x_A^e(p))$, we have

$$[f_\beta(x_A^e(p)) - \gamma N x_A^e(p)] - [f_\beta(x_B^e(p)) - \gamma N x_B^e(p)] < 0.$$

Invoking Lemma \mathcal{A} again, we conclude that the function $f_\beta(x) - \gamma N x$ is declining in x , yielding $x_A^e(p) > x_B^e(p)$. \square

Proof of Proposition 4.6: If $x_A^e(p) \geq x_B^e(p)$, the statement is straightforward. If $x_A^e(p) < x_B^e(p)$, then by (9),

$$[f_\alpha(x_A^e(p)) - f_\alpha(x_B^e(p))] < [\gamma N_A x_A^e(p) - \gamma N_B x_B^e(p)].$$

Since, by Lemma \mathcal{A} , $f_\alpha(x_A^e(p)) > f_\alpha(x_B^e(p))$, it follows that $N_A x_A^e(p) > N_B x_B^e(p)$. \square

Proof of Proposition 4.7: If $x_A^e(p) \geq x_B^e(p)$, the statement is straightforward. Let $x_A^e(p) < x_B^e(p)$, Since $\frac{b_A}{N_A} < \frac{b_B}{N_B}$, (9) implies that

$$[f_\alpha(x_A^e(p)) - \gamma N_A x_A^e(p)] - [f_\beta(x_B^e(p)) - \gamma N_B x_B^e(p)] < 0.$$

By Lemma \mathcal{A} , $f_\alpha(x_A^e(p)) > f_\beta(x_A^e(p))$, and we have

$$[f_\beta(x_A^e(p)) - f_\beta(x_B^e(p))] - [\gamma N_A x_A^e(p) - \gamma N_B x_B^e(p)] < 0.$$

Since, by Lemma \mathcal{A} , $f_\beta(x_A^e(p)) > f_\beta(x_B^e(p))$, it immediately yields $N_A x_A^e(p) > N_B x_B^e(p)$. \square

Proof of Proposition 4.8: Let $p = (\alpha, \beta, N_A, N_B, b_A, b_B) \in P'$. Suppose that $x_A^e(p) \geq x_B^e(p)$. If $x_A^e(p) = x_B^e(p)$, (9) implies that $x_A^e(p) = \frac{b_A}{\gamma N_A N_B}$. Substituting this expression into (4) leads to

$$f_\alpha(x_A^e(p)) = c + \frac{2b_A}{N_A} + \frac{2b_B}{N_B}.$$

Since $p \in P'$, it follows that $f_\alpha(x_A^e(p)) < 1$, which is a contradiction to Lemma \mathcal{A} . Thus, $x_A^e(p) > x_B^e(p)$.

Invoking (9), we obtain

$$[f_\alpha(x_A^e(p)) - \gamma N_A x_A^e(p) - \frac{b}{N_A}] - [f_\alpha(x_A^e(p)) - \gamma N_B x_A^e(p) - \frac{b}{N_B}] > 0,$$

or

$$x_B^e(p) < x_A^e(p) < \frac{b}{\gamma N_A N_B} \equiv \bar{x}.$$

Since the optimal response of country A is a declining function of x_B , equation (2) implies that

$$f_\alpha(\bar{x}) - 2\gamma N_A \bar{x} < c + \gamma N_B \bar{x} + \frac{b}{N_A} < c + \frac{2b}{N_A} + \frac{2b}{N_B}.$$

Since, by Lemma \mathcal{A} , the function $f_\alpha(\cdot)$ is decreasing and, moreover, $\lim_{x \rightarrow +\infty} f_\alpha(x) = 1$, the fact that $p \in P'$ yields a contradiction. Thus, $x_A^e(p) < x_B^e(p)$. \square

Proof of Proposition 4.1: Equations (2) and (3) imply that the equilibrium welfare levels of two countries $W_A^e(p)$ and $W_B^e(p)$, respectively, are given by:

$$W_A^e(p) = N_A(1 + (x_A^e(p))^\alpha)^{\frac{1}{\alpha}-1} + \gamma N_A^2 (x_A^e(p))^2 = N_A f_\alpha\left(\frac{1}{x_A^e(p)}\right) + \gamma N_A^2 (x_A^e(p))^2 \quad (10)$$

$$W_B^e(p) = N_B(1 + (x_B^e(p))^\beta)^{\frac{1}{\beta}-1} + \gamma N_B^2 (x_B^e(p))^2 = N_B f_\beta\left(\frac{1}{x_B^e(p)}\right) + \gamma N_B^2 (x_B^e(p))^2 \quad (11)$$

By Proposition 4.4, $x_A^e(p) > x_B^e(p)$. By Lemma \mathcal{A} , the function $f_\alpha(\frac{1}{x})$ is increasing in x . (10)-(11) then imply that $W_A^e(p) > W_B^e(p)$. \square

Proof of Proposition 4.2: By Proposition 4.5, $x_A^e(p) > x_B^e(p)$. Thus, as in the proof of Proposition 4.1, (10)-(11) guarantee that $W_A^e(p) > W_B^e(p)$. \square

Proof of Proposition 4.3: If $x_A^e(p) \geq x_B^e(p)$, the proof is straightforward. Let $x_A^e(p) < x_B^e(p)$. By Lemma \mathcal{A} , the function $f_\alpha(x)x$ is increasing in x . Thus

$$f_\alpha\left(\frac{1}{x_A^e(p)}\right) \frac{1}{x_A^e(p)} > f_\beta\left(\frac{1}{x_B^e(p)}\right) \frac{1}{x_B^e(p)} \quad \text{or} \quad \frac{f_\alpha\left(\frac{1}{x_A^e(p)}\right)}{f_\beta\left(\frac{1}{x_B^e(p)}\right)} > \frac{x_A^e(p)}{x_B^e(p)}.$$

Since, by Proposition 4.6, $\frac{x_A^e(p)}{x_B^e(p)} > \frac{N_A}{N_B}$, (10)-(11) imply that $W_A^e(p) > W_B^e(p)$. \square

Proof of Proposition 5.1: Take a point $p = (\alpha, \beta, N_A, N_B, b_A, b_B) \in P$. The cooperative outcome, $(x_A^c(p), x_B^c(p))$ satisfies the following first order conditions:

$$\frac{\partial(W_A + W_B)}{\partial x_A} = 0 \quad \text{and} \quad \frac{\partial(W_A + W_B)}{\partial x_B} = 0.$$

Expressions (2) and (3) imply, therefore, that the cooperative outcome satisfies the following;

$$f_\alpha(x_A) - 2\gamma N_A x_A = c + 2\gamma N_B x_B + \frac{b_A}{N_A}, \quad (12)$$

$$f_\beta(x_B) - 2\gamma N_B x_B = c + 2\gamma N_A x_A + \frac{b_B}{N_B}. \quad (13)$$

Notice that the only difference between the pairs of equations (12)-(13) and (4)-(5) is one of the coefficients on the right side. Consider therefore a more general one-parametrical system of two equations that subsumes both pairs, (4)-(5) and (12)-(13):

$$f_\alpha(x_A) - 2\gamma N_A x_A - c - q N_B x_B - \frac{b_A}{N_A} = 0, \quad (14)$$

$$f_\beta(x_B) - 2\gamma N_B x_B - c - q N_A x_A - \frac{b_B}{N_B} = 0. \quad (15)$$

If $q = \gamma$ it turns into (4)-(5) and if $q = 2\gamma$ it turns into (12)-(13). Denote the solutions of (14)-(15) by x_A^q and x_B^q , respectively. It suffices to show that the function $N_A x_A^q + N_B x_B^q$ declines in q on the interval $[\gamma, 2\gamma]$.

By the Implicit Functions Theorem we have:

$$\frac{dx_A^q}{dq} = -\frac{-N_B x_B^q (f'_\beta(x_B^q) - 2\gamma N_B) - q N_A N_B x_A^q}{\Delta},$$

where

$$\Delta = (f'_\alpha(x_A^q) - 2\gamma N_A)(f'_\beta(x_B^q) - 2\gamma N_B) - q^2 N_A N_B.$$

Since f'_α and f'_β are both negative, and $q \leq 2\gamma$, it follows that $\Delta > 0$.

Similarly,

$$\frac{dx_B^q}{dq} = -\frac{-N_A x_A^q (f'_\alpha(x_A^q) - 2\gamma N_A) - q N_A N_B x_B^q}{\Delta}.$$

Finally,

$$\frac{d(N_A x_A^q + N_B x_B^q)}{dq} = -\frac{N_A N_B \{[-f'_\alpha(x_A^q) x_B^q - f'_\beta(x_B^q) x_A^q] + (2\gamma - q)[N_A x_A^q + N_B x_B^q]\}}{\Delta}.$$

Since the function $f_\alpha(x)$ is decreasing and $2\gamma - q \geq 0$, the last expression is negative. \square

Proof of Proposition 5.2: Let $p = (\alpha, \beta, N_A, N_B, b_A, b_B) \in P$ be such that $\alpha = \beta, N_A = N_B, b_A = b_B$. Proposition 5.1 implies that $x_A^c(\bar{p}) = x_B^c(\bar{p}) < x_A^e(\bar{p}) = x_B^e(\bar{p})$. By the continuity argument, these relations will be preserved around the point p . That is, there is a neighborhood $U(p) \subset P$ such that $x_A^c(p) < x_A^e(p)$ and $x_B^c(p) < x_B^e(p)$ for every $\bar{p} \in U(p)$. \square

Proof of Proposition 5.3: Consider the function $W_A(\lambda x_A, \lambda x_B)$ where λ is a positive number. By (2),

$$W_A(\lambda x_A, \lambda x_B) = N_A(1 + x_A^\alpha)^{\frac{1}{\alpha}} - [c + \gamma(N_A x_A + N_B x_B)]N_A x_A - b_A x_A,$$

Let us take the derivative of this welfare function with respect to λ :

$$\frac{dW_A(\lambda x_A, \lambda x_B)}{d\lambda} = N_A(1 + (\lambda x_A)^\alpha)^{\frac{1}{\alpha}-1} x_A^\alpha \lambda^{\alpha-1} - [c + 2\lambda\gamma(N_B x_B + N_A x_A)]\lambda N_A x_A - \lambda b_A x_A.$$

By evaluating the last expression at $\lambda = 1$ and at the point $(x_A^e(p), x_B^e(p))$, we obtain:

$$x_A^e(p)(f_\alpha(x_A^e(p)) - 2\gamma N_A x_A^e(p) - 2\gamma N_B x_B^e(p) - c - \frac{b_A}{N_A}),$$

which, by (4), is negative. Thus, a sufficiently small increase in λ would raise the welfare of country A . The argument for country B proceeds along the same lines. \square

Proof of Proposition 5.4: Consider the function $W_A(x_A + \varepsilon, x_B + \varepsilon)$, where ε is a real number. By (2), we have

$$W_A(x_A + \varepsilon, x_B + \varepsilon) = N_A(1 + (x_A + \varepsilon)^\alpha)^{\frac{1}{\alpha}} - [c + \gamma(N_A(x_A + \varepsilon) + N_B(x_B + \varepsilon))]N_A(x_A + \varepsilon) - b_A(x_A + \varepsilon).$$

By taking the derivative of this welfare function with respect to ε at $\varepsilon = 0$, we obtain:

$$N_A(1 + x_A^\alpha)^{\frac{1}{\alpha}-1} x_A^{\alpha-1} - [c + 2\gamma(N_B x_B + N_A x_A)]N_A x_A - b_A.$$

Equation (4) implies that at the point $(x_A^e(p), x_B^e(p))$ the last expression is negative. Thus, a sufficiently small increase in ε would raise the welfare of country A . The argument for country B proceeds along the same lines. \square

8 References

Esteban, J.M. and D. Ray (1994) "On the Measurement of Polarization", *Econometrica* 62 (4), 819-851.

- Florida, R. (2002), "Bohemia and economic geography", *Journal of Economic Geography* 2, 55-71.
- Florida, R. and G. Gates (2001), "Technology and tolerance: the importance of diversity to high-tech growth", Brookings Institute Discussion Paper, Washington, DC.
- Fujita, M. and J.-F. Thisse (2003), "Does economic agglomeration foster economic growth? And who gains and loses from it?" *Japanese Economic Review*, forthcoming.
- Grossman, G. and G. Maggi (2000), "Diversity and growth", *American Economic Review* 90 (5), 1255-1275.
- Grossman, G. (2002), "The distribution of talent and the pattern and consequences in international trade", CESifo Working Paper #745.
- Imai, M. (1989), *Kaizen: the key to Japan's competitive success*, McGraw-Hill, New York, NY.
- Kremer, M. (1993), "O-Ring theory of economic development", *Quarterly Journal of Economics* 108, 551-575.
- Lucas, R.E. (1988), "On the mechanics of economic development", *Journal of Monetary Economics* 22, 3-42.
- Maignan, C., Ottaviano, G. and D. Pinelli (2003), Economic growth, innovation, cultural diversity. What are we all talking about? A critical survey of the state-of-the-art, The Fondazione Eni Enrico Mattei Working Paper #12.2003.
- Milgrom, P. and J. Roberts (1990), "The economics of modern manufacturing: technology, strategy, and organization" *American Economic Review* 71, 845-858.
- Saxenian, A. (1996), *Regional advantage: culture and competition in Silicon Valley and Route 128*, Harvard University Press, Cambridge, MA.
- Saxenian, A. (1999), *Silicon Valley's New Immigrant Entrepreneurs*, Public Policy Institute of California, San Francisco, CA.
- Wong, K. (1995), *International trade in goods and factor mobility*, MIT University Press, Cambridge, MA.

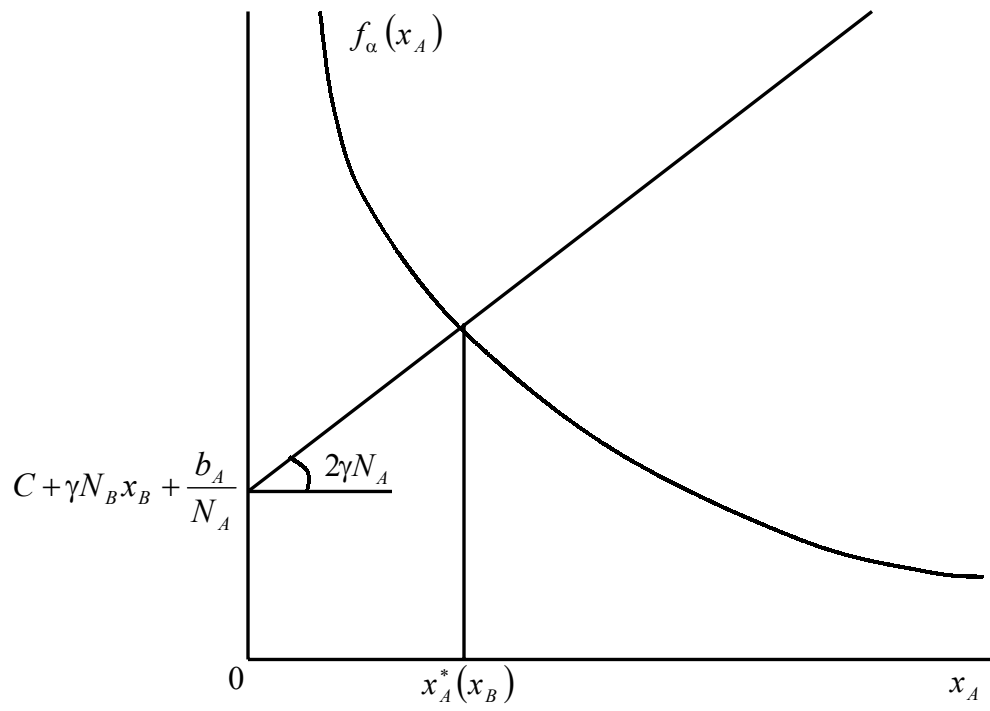


Figure 1. The determination of the best response function $x_A^*(x_B)$

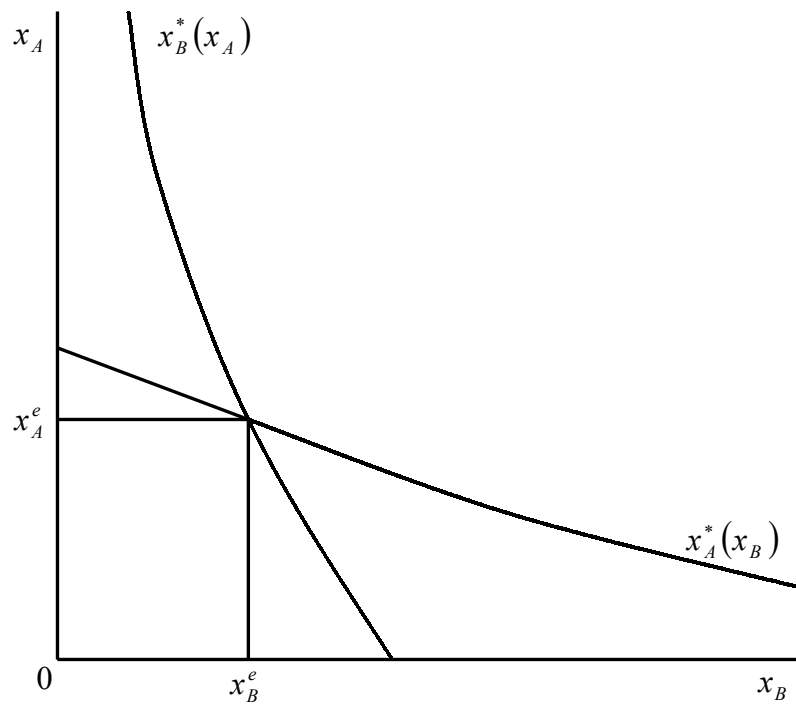


Figure 2. The uniqueness of the equilibrium

NOTE DI LAVORO DELLA FONDAZIONE ENI ENRICO MATTEI

Fondazione Eni Enrico Mattei Working Paper Series

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

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

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

NOTE DI LAVORO PUBLISHED IN 2003

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

ETA	35.2003	<i>Alessandra DEL BOCA, Marzio GALEOTTI and Paola ROTTA: <u>Non-convexities in the Adjustment of Different Capital Inputs: A Firm-level Investigation</u></i>
GG	36.2003	<i>Mathieu GLACHANT: <u>Voluntary Agreements under Endogenous Legislative Threats</u></i>
PRIV	37.2003	<i>Narjess BOUBAKRI, Jean-Claude COSSET and Omrane GUEDHAMI: <u>Postprivatization Corporate Governance: the Role of Ownership Structure and Investor Protection</u></i>
CLIM	38.2003	<i>Rolf GOLOMBEK and Michael HOEL: <u>Climate Policy under Technology Spillovers</u></i>
KNOW	39.2003	<i>Slim BEN YOUSSEF: <u>Transboundary Pollution, R&D Spillovers and International Trade</u></i>
CTN	40.2003	<i>Carlo CARRARO and Carmen MARCHIORI: <u>Endogenous Strategic Issue Linkage in International Negotiations</u></i>
KNOW	41.2003	<i>Sonia OREFFICE: <u>Abortion and Female Power in the Household: Evidence from Labor Supply</u></i>
KNOW	42.2003	<i>Timo GOESCHL and Timothy SWANSON: <u>On Biology and Technology: The Economics of Managing Biotechnologies</u></i>
ETA	43.2003	<i>Giorgio BUSETTI and Matteo MANERA: <u>STAR-GARCH Models for Stock Market Interactions in the Pacific Basin Region, Japan and US</u></i>
CLIM	44.2003	<i>Katrin MILLOCK and Céline NAUGES: <u>The French Tax on Air Pollution: Some Preliminary Results on its Effectiveness</u></i>
PRIV	45.2003	<i>Bernardo BORTOLOTTI and Paolo PINOTTI: <u>The Political Economy of Privatization</u></i>
SIEV	46.2003	<i>Elbert DIJKGRAAF and Herman R.J. VOLLEBERGH: <u>Burn or Bury? A Social Cost Comparison of Final Waste Disposal Methods</u></i>
ETA	47.2003	<i>Jens HORBACH: <u>Employment and Innovations in the Environmental Sector: Determinants and Econometrical Results for Germany</u></i>
CLIM	48.2003	<i>Lori SNYDER, Nolan MILLER and Robert STAVINS: <u>The Effects of Environmental Regulation on Technology Diffusion: The Case of Chlorine Manufacturing</u></i>
CLIM	49.2003	<i>Lori SNYDER, Robert STAVINS and Alexander F. WAGNER: <u>Private Options to Use Public Goods. Exploiting Revealed Preferences to Estimate Environmental Benefits</u></i>
CTN	50.2003	<i>László Á. KÓCZY and Luc LAUWERS (Ixi): <u>The Minimal Dominant Set is a Non-Empty Core-Extension</u></i>
CTN	51.2003	<i>Matthew O. JACKSON (Ixi): <u>Allocation Rules for Network Games</u></i>
CTN	52.2003	<i>Ana MAULEON and Vincent VANNETELBOSCH (Ixi): <u>Farsightedness and Cautiousness in Coalition Formation</u></i>
CTN	53.2003	<i>Fernando VEGA-REDONDO (Ixi): <u>Building Up Social Capital in a Changing World: a network approach</u></i>
CTN	54.2003	<i>Matthew HAAG and Roger LAGUNOFF (Ixi): <u>On the Size and Structure of Group Cooperation</u></i>
CTN	55.2003	<i>Taiji FURUSAWA and Hideo KONISHI (Ixi): <u>Free Trade Networks</u></i>
CTN	56.2003	<i>Halis Murat YILDIZ (Ixi): <u>National Versus International Mergers and Trade Liberalization</u></i>
CTN	57.2003	<i>Santiago RUBIO and Alistair ULPH (Ixi): <u>An Infinite-Horizon Model of Dynamic Membership of International Environmental Agreements</u></i>
KNOW	58.2003	<i>Carole MAIGNAN, Dino PINELLI and Gianmarco I.P. OTTAVIANO: <u>ICT, Clusters and Regional Cohesion: A Summary of Theoretical and Empirical Research</u></i>
KNOW	59.2003	<i>Giorgio BELLETTINI and Gianmarco I.P. OTTAVIANO: <u>Special Interests and Technological Change</u></i>
ETA	60.2003	<i>Ronnie SCHÖB: <u>The Double Dividend Hypothesis of Environmental Taxes: A Survey</u></i>
CLIM	61.2003	<i>Michael FINUS, Ekko van IERLAND and Robert DELLINK: <u>Stability of Climate Coalitions in a Cartel Formation Game</u></i>
GG	62.2003	<i>Michael FINUS and Bianca RUNDSHAGEN: <u>How the Rules of Coalition Formation Affect Stability of International Environmental Agreements</u></i>
SIEV	63.2003	<i>Alberto PETRUCCI: <u>Taxing Land Rent in an Open Economy</u></i>
CLIM	64.2003	<i>Joseph E. ALDY, Scott BARRETT and Robert N. STAVINS: <u>Thirteen Plus One: A Comparison of Global Climate Policy Architectures</u></i>
SIEV	65.2003	<i>Edi DEFRANCESCO: <u>The Beginning of Organic Fish Farming in Italy</u></i>
SIEV	66.2003	<i>Klaus CONRAD: <u>Price Competition and Product Differentiation when Consumers Care for the Environment</u></i>
SIEV	67.2003	<i>Paulo A.L.D. NUNES, Luca ROSSETTO, Arianne DE BLAEIJ: <u>Monetary Value Assessment of Clam Fishing Management Practices in the Venice Lagoon: Results from a Stated Choice Exercise</u></i>
CLIM	68.2003	<i>ZhongXiang ZHANG: <u>Open Trade with the U.S. Without Compromising Canada's Ability to Comply with its Kyoto Target</u></i>
KNOW	69.2003	<i>David FRANTZ (Iix): <u>Lorenzo Market between Diversity and Mutation</u></i>
KNOW	70.2003	<i>Ercle SORI (Iix): <u>Mapping Diversity in Social History</u></i>
KNOW	71.2003	<i>Ljiljana DERU SIMIC (Ixii): <u>What is Specific about Art/Cultural Projects?</u></i>
KNOW	72.2003	<i>Natalya V. TARANOVA (Ixii): <u>The Role of the City in Fostering Intergroup Communication in a Multicultural Environment: Saint-Petersburg's Case</u></i>
KNOW	73.2003	<i>Kristine CRANE (Ixii): <u>The City as an Arena for the Expression of Multiple Identities in the Age of Globalisation and Migration</u></i>
KNOW	74.2003	<i>Kazuma MATOBA (Ixii): <u>Glocal Dialogue- Transformation through Transcultural Communication</u></i>
KNOW	75.2003	<i>Catarina REIS OLIVEIRA (Ixii): <u>Immigrants' Entrepreneurial Opportunities: The Case of the Chinese in Portugal</u></i>
KNOW	76.2003	<i>Sandra WALLMAN (Ixii): <u>The Diversity of Diversity - towards a typology of urban systems</u></i>
KNOW	77.2003	<i>Richard PEARCE (Ixii): <u>A Biologist's View of Individual Cultural Identity for the Study of Cities</u></i>
KNOW	78.2003	<i>Vincent MERK (Ixii): <u>Communication Across Cultures: from Cultural Awareness to Reconciliation of the Dilemmas</u></i>

KNOW	79.2003	<i>Giorgio BELLETTINI, Carlotta BERTI CERONI and Gianmarco I.P.OTTAVIANO: <u>Child Labor and Resistance to Change</u></i>
ETA	80.2003	<i>Michele MORETTO, Paolo M. PANTEGHINI and Carlo SCARPA: <u>Investment Size and Firm's Value under Profit Sharing Regulation</u></i>
IEM	81.2003	<i>Alessandro LANZA, Matteo MANERA and Massimo GIOVANNINI: <u>Oil and Product Dynamics in International Petroleum Markets</u></i>
CLIM	82.2003	<i>Y. Hossein FARZIN and Jinhua ZHAO: <u>Pollution Abatement Investment When Firms Lobby Against Environmental Regulation</u></i>
CLIM	83.2003	<i>Giuseppe DI VITA: <u>Is the Discount Rate Relevant in Explaining the Environmental Kuznets Curve?</u></i>
CLIM	84.2003	<i>Reyer GERLAGH and Wietze LISE: <u>Induced Technological Change Under Carbon Taxes</u></i>
NRM	85.2003	<i>Rinaldo BRAU, Alessandro LANZA and Francesco PIGLIARU: <u>How Fast are the Tourism Countries Growing? The cross-country evidence</u></i>
KNOW	86.2003	<i>Elena BELLINI, Gianmarco I.P. OTTAVIANO and Dino PINELLI: <u>The ICT Revolution: opportunities and risks for the Mezzogiorno</u></i>
SIEV	87.2003	<i>Lucas BRETSCGHER and Sjak SMULDERS: <u>Sustainability and Substitution of Exhaustible Natural Resources. How resource prices affect long-term R&D investments</u></i>
CLIM	88.2003	<i>Johan EYCKMANS and Michael FINUS: <u>New Roads to International Environmental Agreements: The Case of Global Warming</u></i>
CLIM	89.2003	<i>Marzio GALEOTTI: <u>Economic Development and Environmental Protection</u></i>
CLIM	90.2003	<i>Marzio GALEOTTI: <u>Environment and Economic Growth: Is Technical Change the Key to Decoupling?</u></i>
CLIM	91.2003	<i>Marzio GALEOTTI and Barbara BUCHNER: <u>Climate Policy and Economic Growth in Developing Countries</u></i>
IEM	92.2003	<i>A. MARKANDYA, A. GOLUB and E. STRUKOVA: <u>The Influence of Climate Change Considerations on Energy Policy: The Case of Russia</u></i>
ETA	93.2003	<i>Andrea BELTRATTI: <u>Socially Responsible Investment in General Equilibrium</u></i>
CTN	94.2003	<i>Parkash CHANDER: <u>The γ-Core and Coalition Formation</u></i>
IEM	95.2003	<i>Matteo MANERA and Angelo MARZULLO: <u>Modelling the Load Curve of Aggregate Electricity Consumption Using Principal Components</u></i>
IEM	96.2003	<i>Alessandro LANZA, Matteo MANERA, Margherita GRASSO and Massimo GIOVANNINI: <u>Long-run Models of Oil Stock Prices</u></i>
CTN	97.2003	<i>Steven J. BRAMS, Michael A. JONES, and D. Marc KILGOUR: <u>Forming Stable Coalitions: The Process Matters</u></i>
KNOW	98.2003	<i>John CROWLEY, Marie-Cecile NAVES (Ixiii): <u>Anti-Racist Policies in France. From Ideological and Historical Schemes to Socio-Political Realities</u></i>
KNOW	99.2003	<i>Richard THOMPSON FORD (Ixiii): <u>Cultural Rights and Civic Virtue</u></i>
KNOW	100.2003	<i>Alaknanda PATEL (Ixiii): <u>Cultural Diversity and Conflict in Multicultural Cities</u></i>
KNOW	101.2003	<i>David MAY (Ixiii): <u>The Struggle of Becoming Established in a Deprived Inner-City Neighbourhood</u></i>
KNOW	102.2003	<i>Sébastien ARCAND, Danielle JUTEAU, Sirma BILGE, and Francine LEMIRE (Ixiii) : <u>Municipal Reform on the Island of Montreal: Tensions Between Two Majority Groups in a Multicultural City</u></i>
CLIM	103.2003	<i>Barbara BUCHNER and Carlo CARRARO: <u>China and the Evolution of the Present Climate Regime</u></i>
CLIM	104.2003	<i>Barbara BUCHNER and Carlo CARRARO: <u>Emissions Trading Regimes and Incentives to Participate in International Climate Agreements</u></i>
CLIM	105.2003	<i>Anil MARKANDYA and Dirk T.G. RÜBBELKE: <u>Ancillary Benefits of Climate Policy</u></i>
NRM	106.2003	<i>Anne Sophie CRÉPIN (Ixiv): <u>Management Challenges for Multiple-Species Boreal Forests</u></i>
NRM	107.2003	<i>Anne Sophie CRÉPIN (Ixiv): <u>Threshold Effects in Coral Reef Fisheries</u></i>
SIEV	108.2003	<i>Sara ANIYAR (Ixiv): <u>Estimating the Value of Oil Capital in a Small Open Economy: The Venezuela's Example</u></i>
SIEV	109.2003	<i>Kenneth ARROW, Partha DASGUPTA and Karl-Göran MÄLER(Ixiv): <u>Evaluating Projects and Assessing Sustainable Development in Imperfect Economies</u></i>
NRM	110.2003	<i>Anastasios XEPAPADEAS and Catarina ROSETA-PALMA(Ixiv): <u>Instabilities and Robust Control in Fisheries</u></i>
NRM	111.2003	<i>Charles PERRINGS and Brian WALKER (Ixiv): <u>Conservation and Optimal Use of Rangelands</u></i>
ETA	112.2003	<i>Jack GOODY (Ixiv): <u>Globalisation, Population and Ecology</u></i>
CTN	113.2003	<i>Carlo CARRARO, Carmen MARCHIORI and Sonia OREFFICE: <u>Endogenous Minimum Participation in International Environmental Treaties</u></i>
CTN	114.2003	<i>Guillaume HAERINGER and Myrna WOODERS: <u>Decentralized Job Matching</u></i>
CTN	115.2003	<i>Hideo KONISHI and M. Utku UNVER: <u>Credible Group Stability in Multi-Partner Matching Problems</u></i>
CTN	116.2003	<i>Somdeb LAHIRI: <u>Stable Matchings for the Room-Mates Problem</u></i>
CTN	117.2003	<i>Somdeb LAHIRI: <u>Stable Matchings for a Generalized Marriage Problem</u></i>
CTN	118.2003	<i>Marita LAUKKANEN: <u>Transboundary Fisheries Management under Implementation Uncertainty</u></i>

- CTN 119.2003 *Edward CARTWRIGHT and Myrna WOODERS: Social Conformity and Bounded Rationality in Arbitrary Games with Incomplete Information: Some First Results*
- CTN 120.2003 *Gianluigi VERNASCA: Dynamic Price Competition with Price Adjustment Costs and Product Differentiation*
- CTN 121.2003 *Myrna WOODERS, Edward CARTWRIGHT and Reinhard SELTEN: Social Conformity in Games with Many Players*
- CTN 122.2003 *Edward CARTWRIGHT and Myrna WOODERS: On Equilibrium in Pure Strategies in Games with Many Players*
- CTN 123.2003 *Edward CARTWRIGHT and Myrna WOODERS: Conformity and Bounded Rationality in Games with Many Players*
- 1000** *Carlo CARRARO, Alessandro LANZA and Valeria PAPPONETTI: One Thousand Working Papers*

NOTE DI LAVORO PUBLISHED IN 2004

- IEM 1.2004 *Anil MARKANDYA, Suzette PEDROSO and Alexander GOLUB: Empirical Analysis of National Income and SO₂ Emissions in Selected European Countries*
- ETA 2.2004 *Masahisa FUJITA and Shlomo WEBER: Strategic Immigration Policies and Welfare in Heterogeneous Countries*

- (lix) This paper was presented at the ENGIME Workshop on “Mapping Diversity”, Leuven, May 16-17, 2002
- (lx) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications”, organised by the Fondazione Eni Enrico Mattei, Milan, September 26-28, 2002
- (lxi) This paper was presented at the Eighth Meeting of the Coalition Theory Network organised by the GREQAM, Aix-en-Provence, France, January 24-25, 2003
- (lxii) This paper was presented at the ENGIME Workshop on “Communication across Cultures in Multicultural Cities”, The Hague, November 7-8, 2002
- (lxiii) This paper was presented at the ENGIME Workshop on “Social dynamics and conflicts in multicultural cities”, Milan, March 20-21, 2003
- (lxiv) This paper was presented at the International Conference on “Theoretical Topics in Ecological Economics”, organised by the Abdus Salam International Centre for Theoretical Physics - ICTP, the Beijer International Institute of Ecological Economics, and Fondazione Eni Enrico Mattei - FEEM Trieste, February 10-21, 2003
- (lxv) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications” organised by Fondazione Eni Enrico Mattei and sponsored by the EU, Milan, September 25-27, 2003

2003 SERIES

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

2004 SERIES

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