A General Equilibrium Analysis of Climate Change Impacts on Tourism

Maria Berrittella, Andrea Bigano, Roberto Roson and Richard S.J. Tol

NOTA DI LAVORO 127.2004

OCTOBER 2004

CCMP – Climate Change Modelling and Policy

Maria Berrittella, Abdu Salam International Centre for Theoretical Physics, Department of Economics, "La Sapienza" University, and Environment Department, University of York

Andrea Bigano, Abdu Salam International Centre for Theoretical Physics, Fondazione Eni Enrico Mattei, and Centre for Economic Studies, Katholieke Universiteit Leuven

Roberto Roson, Abdu Salam International Centre for Theoretical Physics, Fondazione Eni Enrico Mattei, and Department of Economics, Università Ca’ Foscari di Venezia

Richard S.J. Tol, Centre for Marine and Climate Research, Hamburg University, Institute for Environmental Studies, Vrije Universiteit, and Center for Integrated Study of the Human Dimensions of Global Change, Carnegie Mellon University

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=609742

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, e-mail: working.papers@feem.it
A General Equilibrium Analysis of Climate Change Impacts on Tourism

Summary
This paper studies the economic implications of climate-change-induced variations in tourism demand, using a world CGE model. The model is first re-calibrated at some future years, obtaining hypothetical benchmark equilibria, which are subsequently perturbed by shocks, simulating the effects of climate change. We portray the impact of climate change on tourism by means of two sets of shocks, occurring simultaneously. The first shocks translate predicted variations in tourist flows into changes of consumption preferences for domestically produced goods. The second shocks reallocate income across world regions, simulating the effect of higher or lower tourists’ expenditure. Our analysis highlights that variations in tourist flows will affect regional economies in a way that is directly related to the sign and magnitude of flow variations. At a global scale, climate change will ultimately lead to a welfare loss, unevenly spread across regions.

Keywords: Climate change, Computable general equilibrium models, Tourism

JEL Classification: D58, L83, Q51, Q54

We had useful discussions about the topics of this paper with Carlo Carraro, Sam Fankhauser, Jacqueline Hamilton, Marzio Galeotti, Francesco Bosello, Marco Lazzarin, Andrea Galvan, Claudia Kemfert, Hans Kremers, Hom Pant, Katrin Rehdanz, Kerstin Ronneberger and Guy Jakeman. The Volkswagen Foundation through the ECOBICE project, the EU DG Research Environment and Climate Programme through the DINAS-Coast project (EVK2-2000-22024), the US National Science Foundation through the Center for Integrated Study of the Human Dimensions of Global Change (SBR-9521914), the Michael Otto Foundation for Environmental Protection, and the Ecological and Environmental Economics programme at ICTP-Trieste provided welcome financial support.

Address for correspondence:
Andrea Bigano
Fondazione Eni Enrico Mattei
Corso Magenta 63
20123 Milano
Italy
Phone: +390252036983
Fax: +390252036946
E-mail: andrea.bigano@feem.it
A GENERAL EQUILIBRIUM ANALYSIS OF CLIMATE CHANGE IMPACTS ON TOURISM

Maria Berrittella\textsuperscript{a,b,c}, Andrea Bigano\textsuperscript{* a,d,e}, Roberto Roson\textsuperscript{a,d,f}, Richard S.J. Tol\textsuperscript{g,h,i}

\textsuperscript{a} Abdus Salam International Centre for Theoretical Physics, EEE Programme, Trieste, Italy
\textsuperscript{b} Department of Economics, "La Sapienza" University, Rome, Italy
\textsuperscript{c} Environment Department, University of York, York, United Kingdom
\textsuperscript{d} Fondazione Eni Enrico Mattei, Italy
\textsuperscript{e} Centre for Economic Studies, Katholieke Universiteit Leuven, Belgium
\textsuperscript{f} Department of Economics, Università Ca’ Foscari di Venezia, Venice, Italy
\textsuperscript{g} Centre for Marine and Climate Research, Hamburg University, Hamburg, Germany
\textsuperscript{h} Institute for Environmental Studies, Vrije Universiteit, Amsterdam, The Netherlands
\textsuperscript{i} Center for Integrated Study of the Human Dimensions of Global Change, Carnegie Mellon University, Pittsburgh, PA, USA


Abstract

This paper studies the economic implications of climate-change-induced variations in tourism demand, using a world CGE model. The model is first re-calibrated at some future years, obtaining hypothetical benchmark equilibria, which are subsequently perturbed by shocks, simulating the effects of climate change. We portray the impact of climate change on tourism by means of two sets of shocks, occurring simultaneously. The first shocks translate predicted variations in tourist flows into changes of consumption preferences for domestically produced goods. The second shocks reallocate income across world regions, simulating the effect of higher or lower tourists’ expenditure. Our analysis highlights that variations in tourist flows will affect regional economies in a way that is directly related to the sign and magnitude of flow variations. At a global scale, climate change will ultimately lead to a welfare loss, unevenly spread across regions.

Key words

Climate Change, Computable General Equilibrium Models, Tourism.

JEL Classification

D58, L83, Q51, Q54

\* Corresponding author. Address: Fondazione Eni Enrico Mattei, Corso Magenta 63, 20123 Milano, Italy. E-mail: andrea.bigano@feem.it.
1. Introduction

Climate plays an obvious role in tourist destination choice. The majority of tourists spend their holidays lazing in the sun, a sun that should be pleasant but not too hot. The Mediterranean particularly profits from this, being close to the main holiday-makers of Europe’s wealthy, but cool and rainy Northwest. Climate change would alter that, as tourists are particularly footloose. The currently popular holiday destinations may become too hot, and destinations that are currently too cool would see a surge in their popularity. This could have a major impact on some economies. About 10% of world GDP is now spent on recreation and tourism. Climate change will probably not affect the amount of money spent, however, but rather where it is spent. Revenues from tourism are a major factor in some economies, however, and seeing only part of that money move elsewhere may be problematic. This paper studies the economic implications of climate-change-induced changes in tourism demand.

The literature on tourist destination choice used to be largely silent on climate (Crouch, 1995; Witt and Witt, 1995), perhaps because climate was deemed to be obvious or beyond control of managers and perhaps because climate was seen to be constant. Recently, however, an increasing number of studies have looked at the effects of climate change on the behaviour of tourists from a particular origin or on the attractiveness of a particular holiday destination. Few of these studies look at the simultaneous changes of supply and demand at many locations. In fact, few of these studies look at all at economic aspects, the main exception being Maddison (2001), Lise and Tol (2002) and Hamilton (2003) who estimates the changes in demand of
British, Dutch and German tourists, respectively. Hamilton et al. (2004) do look at supply and demand for all countries, but their model is restricted to tourist numbers. This paper tries to fill this gap in the literature. We study climate-change-induced variations in the demand for and the supply of tourism services. We go beyond a partial equilibrium analysis of the tourism market, however, and also add the general equilibrium effects. In this manner, we get a comprehensive estimate of the redistribution of income as a result of the expected redistribution of tourists due to climate change.

The paper is built up as follows. Section 2 presents our estimates of changes in international tourist flows. Section 3 outlines the general equilibrium model used in this analysis. Section 4 presents how tourism is included in this model. Section 5 discusses the basic tourism data. Section 6 shows the results of our climate change experiment. Section 7 concludes. An appendix describes the general equilibrium model structure and its main assumptions.

2. Estimates of changes in international tourist flows

We take our estimates of changes in international tourist flows from Hamilton et al. (2004). Theirs is an econometrically estimated simulation model of bilateral flows of tourists between 207 countries; the econometrics is reported in Maddison (2001), Lise and Tol (2002) and Hamilton (2003). The model yields the number of international tourists generated by each country. This depends on population, income per capita and climate. Other factors may be important too, of course, but are supposed to be captured in a country-specific constant. The tourists from each country are then
distributed over the remaining 206 destination countries. The attractiveness of a destination country depends on its per capita income, climate, a country-specific constant, and the distance from the origin country.

Although simple in its equations, the model results are not. This is because climate change has two effects. On the one hand, climate change makes destination countries more or less attractive. On the other hand, climate change also affects the number of people who prefer to take their holiday in their home country rather than travelling abroad. This in itself leads to surprising results. The UK, for instance, would see its tourist arrivals fall because, even though its climate improves, its would-be tourists rather stay in their home country where the climate also gets better. As another example, Zimbabwe would see its tourism industry grow because, even though its climate deteriorates, it is still the coolest country in a region where temperatures are rising.

Table 1 shows the changes in international and interregional departures and international arrivals for 2050 for the eight regions used in this study, based the SRES A1 scenario for climate change, economic growth, and population growth. Obviously, the regional aggregation hides many effects, such as the redistribution of the tourists from southern to middle Europe. Figure 1 shows total international flows for all countries for the same year and scenario.
<table>
<thead>
<tr>
<th></th>
<th>Interregional</th>
<th>IntraRegional</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Arrivals</td>
<td>Departures</td>
</tr>
<tr>
<td>USA</td>
<td>-7537352</td>
<td>-21688924</td>
</tr>
<tr>
<td>EU</td>
<td>-43222063</td>
<td>-37619622</td>
</tr>
<tr>
<td>EEFSU</td>
<td>3116282</td>
<td>-43201505</td>
</tr>
<tr>
<td>JPN</td>
<td>-417310</td>
<td>-4293235</td>
</tr>
<tr>
<td>RoA1</td>
<td>16063980</td>
<td>-27747421</td>
</tr>
<tr>
<td>EEx</td>
<td>-31822804</td>
<td>11251183</td>
</tr>
<tr>
<td>CHIND</td>
<td>-484779</td>
<td>97167</td>
</tr>
<tr>
<td>RoW</td>
<td>-50746662</td>
<td>10366678</td>
</tr>
</tbody>
</table>

Table 1. Changes in international and interregional departures, and international arrivals, in 2050 (number of tourists).

Figure 1. The change in arrivals and departures due to climate change, as a percentage of arrivals and departures without climate change; countries are ranked to their average annual temperature in 1961-1990.

---

1 Here is the meaning of acronyms: Usa [USA], European Union [EU], Eastern Europe and Former Soviet Union [EEFSU], Japan [JPN], Rest of Annex 1 (developed) countries [RoA1], Energy Exporters [EEx], China and India [CHIND], Rest of the World [RoW].
3. Assessing the general equilibrium effects: model structure and simulation strategy

To assess the systemic, general equilibrium effects of tourism impacts, induced by the global warming, we made an unconventional use of a multi-country world CGE model: the GTAP model (Hertel, 1996), in the version modified by Burniaux and Truong (2002), and subsequently extended by ourselves. The model structure is briefly described in the appendix.

First, we derived benchmark data-sets for the world economy at some selected future years (2010, 2030, 2050), using the methodology described in Dixon and Rimmer (2002). This entails inserting, in the model calibration data, forecasted values for some key economic variables, in order to identify a hypothetical general equilibrium state in the future.

Since we are working on the medium-long term, we focused primarily on the supply side: forecasted changes in the national endowments of labour, capital, land, natural resources, as well as variations in factor-specific and multi-factor productivity.

Most of these variables are “naturally exogenous” in CGE models. For example, the national labour force is usually taken as a given. In this case, we simply shocked the exogenous variable “labour stock”, changing its level from that of the initial calibration year (1997) to some future forecast year (e.g., 2030). In some other cases we considered variables, which are normally endogenous in the model, by modifying the partition between exogenous and endogenous variables. In the model, simulated changes in primary resources and productivity induce variations in relative prices, and a structural adjustment for the entire world economic system. The model output
describes the hypothetical structure of the world economy, which is implied by the selected assumptions of growth in primary factors.

We obtained estimates of the regional labour and capital stocks by running the G-Cubed model (McKibbin and Wilcoxen, 1998). This is a rather sophisticated dynamic CGE model of the world economy, with a number of notable features, like: rational expectations intertemporal adjustment, international capital flows based on portfolio selection (with non-neutrality of money and home bias in the investments), sticky wages, endogenous economic policies, public debt management. We coupled this model with GTAP, rather than using it directly, primarily because the latter turned out to be much easier to adapt to our purposes, in terms of disaggregation scale and changes in the model equations.

We got estimates of land endowments and agricultural land productivity from the IMAGE model version 2.2 (IMAGE, 2001). IMAGE is an integrated assessment model, with a particular focus on the land use, reporting information on seven crop yields in 13 world regions, from 1970 to 2100. We ran this model by adopting the most conservative scenario about the climate (IPCC B1), implying minimal temperature changes.

A rather specific methodology was adopted to get estimates for the natural resources stock variables. As explained in Hertel and Tsigas (2002), values for these variables in the original GTAP data set were not obtained from official statistics, but were indirectly estimated, to make the model consistent with some industry supply elasticity values, taken from the literature. For this reason, we preferred to fix exogenously the price of the natural resources, making it variable over time in line
with the GDP deflator, while allowing the model to compute endogenously the stock levels.

4. Impact modelling in the CGE Framework

To model the tourism-related impact of climate change, we run a set of simulation experiments, by shocking specific variables in the model. The procedure we followed was conditioned by the fact that the GTAP database is centred on the concept of Gross Domestic Product. In other words, national income is defined as revenue produced within the borders of the national territory, independently of the citizenship of the persons involved. This should be kept in mind when considering the influence on the national income of an extra foreign tourist. Because of the GDP definition, the additional expenditure generated by tourism activities is not accounted for as exports, but as additional domestic consumption. Furthermore, foreign income spent inside the national territory amounts to a sort of income transfer. Accordingly, in the model we simulated the effects of a tourists’ flows variation by altering two sets of variables, considering changes in the structure of final consumption and changes in international income transfers.

Structural variations in domestic consumption are simulated on the basis of two hypotheses. First, it is assumed that aggregate tourism expenditure is proportional to the number of tourists, both domestic and foreign, visiting a country in a given year. This change is due to the variation in the arrivals of foreign tourists, and to the variation in the presence of domestic tourists. This second effect can be decomposed in two components: the variation in the “basis” of domestic tourists, and the variation in the departures of domestic tourists towards foreign destinations. Consequently, the
structure of tourism expenditure is supposed not to differ, significantly, between an average foreign tourist and an average domestic tourist. Second, tourism expenditure is restricted to expenditure on hotels, restaurants, and recreational activities. Other consumption items, like transportation, have not been taken into account, because of data limitations.

We consider estimated changes in arrivals, departures and domestic tourists, with and without climate change. In each year, percentage variations in the total number of tourists, in country $r$, are computed as:

$$\mu_r = \frac{\Delta A_r + \Delta RT_r - \Delta D_r}{|A_r^0 + RT_r^0|}$$

(1)

where: $A_r$ are interregional arrivals ($A_r^0$ in the baseline, i.e. without climate change), $D_r$ are interregional departures ($D_r^0$ in the baseline), $RT_r$ is the number of regional domestic tourists. We define $RT_r^0$, in the baseline, as $RT_r^0 = RA_r^0 + NT_r^0$, where $RA_r^0$ are intra-regional arrivals and $NT_r^0$ is the basis of domestic tourists in the baseline.

Also, we make the assumption that the basis of domestic tourists in each country, $NT_r$, is unaffected by climate change. This assumption is reasonable, at least for limited climate impacts, and it is unavoidable for our study because of the lack of estimates on the effect of climate change on domestic tourism.

---

2 Transportation is a special industry in most CGE models, including GTAP. International transport is treated in a way that makes impossible to trace the geographical origin of firms selling transport services. Domestic transport is a cost margin, working like indirect taxation. Most transport activities, involving some amount of self-production, are hidden under consumption of energy, reparation services, vehicles, etc. Transportation industries only account for services sold under formal market transactions.

3 In Equation (1) the time index is omitted. Note however that three such expressions are computed, one for each simulation year.
Note that, in order to compute changes in tourist flows, we consider only interregional arrivals and departures, disregarding arrivals and departures from and to countries within the same macro-region. This avoids an overestimation of regional income transfers, but results in an underestimation of climate impacts on tourism demand, since intra-regional impacts cannot show up in our results (by construction, intra-regional arrivals must equal intra-regional departures). Combined with our assumption of no climate effects on the basis of domestic tourists in each country, this implies that $\Delta RT = 0$.

In our model, both recreational services and hotels-restaurants are sub-industries of the macro industry “Market Services”. To derive the share of the sub-industry “recreational industry” in the aggregate, we computed:

$$\lambda_{Rcr,r} = \frac{VDP_{Rcr,r}}{VDP_{MS,r}} \quad (2)$$

where $VDP$ stands for “value of domestic purchases” for recreational services ($Rcr$) and total Market Services ($MS$) in the base year. The term on the denominator was obtained from the GTAP 5 database at its maximum level of disaggregation.

Analogously, for hotels and restaurants ($HT$), we computed:

$$\lambda_{HT,r} = \frac{VDP_{HT,r}}{VDP_{MS,r}} \quad (3)$$

---

4 These are international tourists. However, since a region typically comprises more than one nation, tourists moving from one country to another within the same region are accounted for as domestic tourists.

5 We would expect intra-regional impacts to be particularly strong in Europe, given the tourist flows projections in Hamilton et al. (2004). Finer disaggregations, which would solve this problem, are left for future research.
However, because hotels and restaurants are merged with “Trade” in the GTAP 5 database, we reverted to an alternative information source for expenditure on hotels and restaurants in the base year (Euromonitor, 2002).

The exogenous change in the demand for market services, induced by the variation (positive or negative) in tourist flows, has therefore been computed in terms of share of the base year expenditure:

\[ \alpha_{MS,r} = \mu_r(\lambda_{Rec,r} + \lambda_{HT,r}) \]  

Yet, consumption levels, including those of market services, are endogenous variables in the model. Consequently, we interpreted our input data, expressing the additional tourism expenditure, as coming from a partial equilibrium analysis, which disregards the simultaneous price changes occurring in all other markets. In practice, we imposed a shift in some parameter values, which could produce the required variation in expenditure if all prices and income levels would stay constant. Ex post, however, the expenditure variation observed in the model output turns out to be slightly different from the initial variation, because of the general equilibrium effects on price and income levels.

In order to compute the extra income needed to finance the expenditure of foreign tourists, we considered the variation, with and without climate change, of the net tourism inflow (arrivals – departures) in each country. To be consistent with general equilibrium conditions, the algebraic sum of all income transfers introduced in the model equations must be zero. However, the sum over countries of all net tourism inflows is not, in general, zero, because our data on tourist flows allow for a tourist to

---

6 To comply with budget constraints and the Walras’ law, expenditure shares are rebalanced, by means of counteracting reductions for consumption items not related to tourism.
travel to more than one destination per year. Some re-scaling is therefore necessary.

The net additional expenditure generated by foreign tourists has been estimated as:

\[ \Delta E_r = \Delta E_r - \sum_r \Delta E_r \times \left( \frac{|\Delta E_r|}{\sum_r |\Delta E_r|} \right) \quad (5) \]

where: \( \Delta E_r = VDP_{MS,r} \times \alpha_{MS,r} \)

In the simulations, this element is inserted into the equation computing the national income as the total value of all domestic primary resources. This ensures that the redistribution of income is globally neutral and that income shocks have the same sign as demand shocks.

5. Baseline estimates for domestic tourism volumes

In order to compute the estimated variation in the total number of tourists, some data on the number of domestic tourists in the baseline \( NT_r^0 \) is necessary. This parameter is included in \( RT_r^0 \), in the denominator of equation (1).

For most countries, the volume of domestic tourist flows is derived using 1997 data of the Euromonitor (2002) database. For some other countries, we rely upon alternative sources, such as national statistical offices, other governmental institutions or trade associations. For very small states (mostly town states\(^7\)), we assumed that the number of domestic tourists is zero. For those countries in which data on domestic tourism is not available, we use a weighted mean of figures for other countries in the same region.

\(^7\) Andorra, Malta, Monaco and San Marino. Data were available for Hong Kong, Macau, Singapore and Liechtenstein.
We updated these values to 2010, 2030 and 2050, relying on equation (2) in Hamilton et al. (2004). In particular, we assumed that income influences the decision of being a tourist at home exactly in the same way as the decision of being a tourist abroad.

Moreover, we assumed that the rest of the explanatory variables in equation (2) of Hamilton et al. (2004) do not change with time or are not relevant for the basis of domestic tourists. Also, we did not impose any upper limit to the number of occasions in which an individual can behave as a tourist in any given year\(^8\).

Equation (2) of Hamilton et al. (2004) boils down to:

\[
\ln \frac{D_{t_i}}{pop_i} = 1.51 + 0.86 \ln Y_i, \quad (6)
\]

where \(D_{t_i}, \text{pop}_i\) and \(Y_i\) are, respectively, domestic tourists, population and per capita income in country \(i\). The updated values of domestic tourists in country \(i\) in year \(t\) can be estimated from baseline data through:

\[
D_{t_i}^0 = \left[ 1 + 0.86 \frac{Y_i' - Y_i^0}{Y_i^0} \right] \frac{\text{pop}_i'}{\text{pop}_i^0} D_{t_i}^0 \quad (7)
\]

Aggregated regional values for 2010, 2030 and 2050, are shown in Table 2 below. To these values one must then add intra-regional tourist arrivals in the baseline simulations for each year (\(RA_r^0\)) (derived from the tourist arrivals equation (1) in Hamilton et al. (2004)) to get the total number of people performing their tourist activities within their macro-region of origin in the baselines, \(RT_r^0\).

---

\(^8\) The latter assumption may be necessary, because income growth in the long run can translate into a very high tourist activity. Imposing restrictions would be fairly arbitrary, however, and fortunately our combination of income projections and income elasticity does not lead to unrealistic results for 2050.
<table>
<thead>
<tr>
<th></th>
<th>Tourist activity</th>
<th>Final tourist volumes (thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1997</td>
<td>2010</td>
</tr>
<tr>
<td>USA</td>
<td>3.68</td>
<td>4.42</td>
</tr>
<tr>
<td>EU</td>
<td>1.41</td>
<td>1.87</td>
</tr>
<tr>
<td>EEFSU</td>
<td>0.64</td>
<td>0.97</td>
</tr>
<tr>
<td>JPN</td>
<td>0.62</td>
<td>0.75</td>
</tr>
<tr>
<td>RoA1</td>
<td>2.71</td>
<td>3.32</td>
</tr>
<tr>
<td>EEx</td>
<td>0.74</td>
<td>0.94</td>
</tr>
<tr>
<td>CHIND</td>
<td>0.44</td>
<td>0.56</td>
</tr>
<tr>
<td>RoW</td>
<td>0.85</td>
<td>1.08</td>
</tr>
</tbody>
</table>

Table 2. Domestic tourism in the base year and projections for simulation years, in terms of ratio of tourists to population (left) and total number of tourists (thousands, right).

In 1997, domestic tourists were lower than regional population, with the exception of the USA, “Rest of Annex 1” (other developed, RoA1) countries and the EU.

Updating the 1997 data with equation (7), we found that the relative ranking of domestic tourism activity remains unchanged. However, in 2050, there is enough income to allow for at least 1.26 domestic tourist experiences for everybody in the world. In some regions, due to the assumed lack of an upper limit to tourism expenditure, domestic tourist activity becomes very intensive (up to 8.41 experiences per year, for US residents).

6. Simulation results

In our simulations, economic impacts get more substantial with time, because of rising temperature levels. Time also plays a role in the distribution of costs and benefits, bringing about a few important qualitative changes. For economy of space,

---

9 Annex 1 of the Kyoto protocol, on the reduction of greenhouse gases emissions, lists the signing nations (broadly coincident with OECD countries).
we shall focus our discussion on results for the year 2050. Results for 2010 and 2030 are reported only when qualitatively different from those of 2050.

6.1. Shocked variables

Table 3 shows the climate change impacts on private domestic demand and household income, in terms of variation from the baseline. Notice that, for the European Union, shocks are positive in 2010 and 2030, but they become negative in 2050.

At the global (world) level, these shocks are neither positive nor negative, as they entail a redistribution of income both within a region (changes in consumption patterns) and across regions (income transfers). Therefore, aggregate results are solely due to structural composition effects.

<table>
<thead>
<tr>
<th></th>
<th>Private domestic demand for Market Services ( % change)</th>
<th>Private households’ real income (1997 Millions US $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>0.0004 0.047 0.110</td>
<td>10.833 2373.6 9279.3</td>
</tr>
<tr>
<td>EU</td>
<td>0.0005 0.008 -0.080</td>
<td>13.050 373.26 -9424.3</td>
</tr>
<tr>
<td>EEFSU</td>
<td>0.0027 0.310 0.712</td>
<td>7.652 1803.9 7419.0</td>
</tr>
<tr>
<td>JPN</td>
<td>0.0014 0.162 0.361</td>
<td>18.759 4013.0 15987.2</td>
</tr>
<tr>
<td>RoA1</td>
<td>0.0051 0.631 1.517</td>
<td>24.342 5312.9 21516.3</td>
</tr>
<tr>
<td>EEx</td>
<td>-0.0022 -0.243 -0.530</td>
<td>-34.377 -6348.9 -20576.5</td>
</tr>
<tr>
<td>CHIND</td>
<td>0.00002 0.003 0.008</td>
<td>0.033 9.221 39.660</td>
</tr>
<tr>
<td>RoW</td>
<td>-0.0025 -0.265 -0.568</td>
<td>-40.292 -7536.9 -24240.7</td>
</tr>
</tbody>
</table>

Table 3. Initial shocks on private domestic demand and private household income.

Shifts in demand and income are different before and after the simulation, because the imposed swing is based on the partial equilibrium assumption of unchanged prices and income. The difference between shocks and equilibrium level is larger in relative terms for demand shocks than for income shocks.
6.2. Trade

Figure 2 shows the effects in terms of regional trade balances. Any increase (decrease) in tourism expenditure is generally associated with increased (decreased) net imports.

This is due to a series of overlapping effects. First, higher income levels induce higher imports. In the model, general equilibrium conditions require the equality of the balance of payments, but the trade balance may be in deficit, if this is compensated by capital inflows. International investment is driven by expectations on future returns, which are linked to current returns (see the appendix). Higher domestic demand creates an upward pressure on the price of primary resources, and higher returns on capital attract foreign investment. Because of accounting identities, financial imbalances mirror trade balance surpluses of deficits.

On the other hand, if the share of expenditure on services rises within the demand structure, the aggregate propensity to import decreases, because the share of imports in the services is generally lower than in the rest of the economy. This effect is, however, dominated by the first one. There is only one exception: China and India [CHIND] in the year 2010.
Figure 2. Net exports in 2010 (wide, light bars; left axis) and in 2050 (narrow, dark bars; right axis).

6.3 Gross Domestic Product

In general variations in the GDP (Figure 3) follow the shocks’ pattern. However, in terms of magnitude, the relative ranking of our initial shocks does not always coincide with the relative ranking of GDP changes. This is a consequence of setting our analysis in a general equilibrium framework, where trade and substitution effects can dampen or amplify the impact of initial shocks.

Figure 3. GDP percentage changes with respect to the baseline in 2050.
6.4. Primary factors and industrial output

Demand for primary factors is linked to final demand. As services use neither land nor natural resources, but relies on capital and labour in very similar shares, relative demand for these factors grows in those regions experiencing positive shocks, and vice versa.

Supply of primary factors is fixed in the short run. When demand for services increases, prices of labour and capital also increase (Figure 4). On the other hand, the price of other primary resources falls, despite the fact that positive shocks are associated with more expenditure generated by foreign tourists. As it has already been pointed out, the increased return on capital also triggers the multiplicative effect on foreign investment.

Figure 4. Real primary factors’ prices. Change with respect to the baseline, 2050\(^{10}\).

\(^{10}\) Again, factor price changes are analogous but smaller in most regions in 2010 and 2030. The main exception is the EU in 2010 and in 2030, where changes have signs opposite to those observed and 2050 (as a direct consequence of the change of shocks’ signs).
Table 4 shows variations in industrial production levels for 2050. Comparing it with Figure 4, it can be noticed that decreases (increases) in land prices are generally associated with decreases (increases) in production levels for some agricultural industries. Also, decreases (increases) in prices of natural resources are associated with decreases (increases) in the output of energy production industries, such as coal and oil.

<table>
<thead>
<tr>
<th>Industry</th>
<th>USA</th>
<th>EU</th>
<th>EEFSU</th>
<th>JPN</th>
<th>RoA1</th>
<th>EEx</th>
<th>CHIND</th>
<th>RoW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>-0.007</td>
<td>0.102</td>
<td>-0.487</td>
<td>-0.439</td>
<td>-0.759</td>
<td>0.355</td>
<td>0.014</td>
<td>0.299</td>
</tr>
<tr>
<td>Wheat</td>
<td>-0.078</td>
<td>-0.021</td>
<td>-0.149</td>
<td>0.298</td>
<td>0.300</td>
<td>0.146</td>
<td>-0.021</td>
<td>0.122</td>
</tr>
<tr>
<td>Cereals</td>
<td>0.035</td>
<td>0.074</td>
<td>0.031</td>
<td>0.168</td>
<td>0.149</td>
<td>-0.011</td>
<td>0.042</td>
<td>-0.080</td>
</tr>
<tr>
<td>Vegetables &amp; Fruits</td>
<td>0.065</td>
<td>0.088</td>
<td>0.027</td>
<td>-0.045</td>
<td>0.057</td>
<td>0.100</td>
<td>0.016</td>
<td>0.100</td>
</tr>
<tr>
<td>Animals</td>
<td>-0.090</td>
<td>0.040</td>
<td>-0.165</td>
<td>-0.287</td>
<td>-0.460</td>
<td>0.139</td>
<td>-0.013</td>
<td>0.151</td>
</tr>
<tr>
<td>Forestry</td>
<td>-0.211</td>
<td>0.024</td>
<td>-0.396</td>
<td>-0.375</td>
<td>-0.751</td>
<td>0.217</td>
<td>-0.020</td>
<td>0.169</td>
</tr>
<tr>
<td>Fishing</td>
<td>-0.177</td>
<td>0.049</td>
<td>-0.490</td>
<td>-0.396</td>
<td>-0.721</td>
<td>0.312</td>
<td>-0.040</td>
<td>0.325</td>
</tr>
<tr>
<td>Coal</td>
<td>-0.084</td>
<td>0.061</td>
<td>-0.333</td>
<td>-0.443</td>
<td>-0.868</td>
<td>0.280</td>
<td>-0.004</td>
<td>0.202</td>
</tr>
<tr>
<td>Oil</td>
<td>-0.096</td>
<td>-0.040</td>
<td>-0.406</td>
<td>-0.488</td>
<td>-0.501</td>
<td>0.148</td>
<td>-0.041</td>
<td>0.089</td>
</tr>
<tr>
<td>Gas</td>
<td>-0.095</td>
<td>0.168</td>
<td>-0.604</td>
<td>-1.034</td>
<td>-0.951</td>
<td>0.480</td>
<td>-0.125</td>
<td>0.341</td>
</tr>
<tr>
<td>Oil Products</td>
<td>0.042</td>
<td>0.120</td>
<td>-0.268</td>
<td>-0.314</td>
<td>-0.808</td>
<td>0.098</td>
<td>0.018</td>
<td>0.113</td>
</tr>
<tr>
<td>Electricity</td>
<td>-0.099</td>
<td>0.125</td>
<td>-0.465</td>
<td>-0.498</td>
<td>-1.940</td>
<td>0.208</td>
<td>-0.025</td>
<td>0.314</td>
</tr>
<tr>
<td>Water</td>
<td>-0.058</td>
<td>0.074</td>
<td>-0.217</td>
<td>-0.399</td>
<td>-0.372</td>
<td>0.178</td>
<td>0.010</td>
<td>0.194</td>
</tr>
<tr>
<td>Energy Intensive Industries</td>
<td>-0.143</td>
<td>0.154</td>
<td>-0.720</td>
<td>-0.470</td>
<td>-1.610</td>
<td>0.423</td>
<td>-0.017</td>
<td>0.406</td>
</tr>
<tr>
<td>Other Industries</td>
<td>-0.089</td>
<td>0.099</td>
<td>-0.535</td>
<td>-0.476</td>
<td>-1.445</td>
<td>0.407</td>
<td>0.012</td>
<td>0.324</td>
</tr>
<tr>
<td>Market Services</td>
<td>0.062</td>
<td>-0.038</td>
<td>0.376</td>
<td>0.204</td>
<td>0.764</td>
<td>-0.288</td>
<td>-0.013</td>
<td>-0.223</td>
</tr>
<tr>
<td>Non-Market Services</td>
<td>-0.081</td>
<td>-0.011</td>
<td>-0.091</td>
<td>-0.180</td>
<td>-0.619</td>
<td>-0.015</td>
<td>0.028</td>
<td>-0.034</td>
</tr>
</tbody>
</table>

Table 4. Percentage changes in industrial output with respect to the baseline in 2050.

6.4. CO$_2$ emissions

Figure 5 displays the impact on the yearly amount of CO$_2$ emissions. In our simulations, variations in CO$_2$ emissions are quite small. However, recall that we excluded transportation industries from the set of tourism activities.

Interestingly, emissions generally move in the opposite direction of GDP and demand shocks. This means that the industry mix drives the effect: when more tourists arrive, consumption patterns change towards relatively cleaner industries.
Figure 5. CO₂ emissions. Changes with respect to the baselines in 2010 (wide, light bars; left axis) and in 2050 (narrow, dark bars; right axis).

6.5. Welfare

Figure 6: Equivalent variation in 2010 (wide, light bars; left axis) and in 2050 (narrow, dark bars; right axis).
Figure 6 illustrates the effects on income equivalent variations (a welfare index\textsuperscript{11}).

Total (world) welfare constantly decreases during the three periods\textsuperscript{12}. At the regional level, welfare impacts have the same sign as income and demand shocks.

The main winners are the countries whose climate is currently too cold to attract many tourists, such as the former Soviet Union’s countries and Canada (which is inside the Rest of Annex 1 group). Also, USA and Japan gain substantially. The EU enjoys a tiny welfare gain in 2010 and 2030, but suffers substantial losses in 2050. Welfare losses are mainly borne by the Rest of the World macro-region, which gathers the poorest countries and, incidentally, those that are also more exposed to other negative climate change effects (relevant for the tourism industry), such as sea-level rise (Bosello et al., 2004a).

---

\textsuperscript{11} EV measures the amount of income variation, at constant prices (1997 US$), which would have been equivalent to the simulation outcome, in terms of utility of the representative consumer.

---

Figure 7. Welfare decomposition of equivalent variation (2050).
Following Hanslow (2000), and Huff and Hertel (2000), we decompose the welfare changes in a series of components. As Figure 7 shows, most of the change in welfare is due to income variations, with the exception of China and India [CHIND], where allocative and trade effects prevail. This suggests that, for most regions, the main structural effect is due to the additional spending generated by foreign tourists.

7. Conclusion

Climate change will affect many aspects of our lives, and holiday habits are among the ones most sensitive to variations in climate. This implies that a very important service sector, the tourism industry, will be directly affected, and this may have important economic consequences.

This paper is a first attempt at evaluating these impacts within a general equilibrium framework, and establishes two things. Firstly, we show that tourism has impacts throughout the economy. This implies that economic studies, focusing on the tourism industry only, miss important effects. Secondly, we estimate the economy-wide impacts of changes in international tourism induced by climate change. Impacts on domestic demand and household income spread to the rest of the economy through substitution with other goods and services, and through induced effects on primary factors demand and prices. Also, changes in the rate of return of capital influence investment flows, which affects income and welfare.

12 In this setting, climate conditions do not have any direct impact on utility. As stated previously, the shocks are neutral in the aggregate, as they only imply a redistribution of resources. Yet, Figure 6 highlights that this redistribution generates small welfare losses.
Despite the crude resolution of our analysis, which hides many climate-change-induced shifts in tourist destination choices, we find that climate change may affect GDP by –0.3% to +0.5% in 2050. Economic impact estimates of climate change are generally in the order of –1% to +2% of GDP for a warming associated with a doubling of the atmospheric concentration of carbon dioxide (Smith et al., 2001), which is typically put at a later date than 2050. As these studies exclude tourism, this implies that regional economic impacts may have been underestimated by more than 20%. The global economic impact of a climate-change-induced change in tourism is quite small, and approximately zero in 2010. In 2050, climate change will ultimately lead to a non-negligible global loss.

Net losers are Western Europe, energy exporting countries, and the rest of the world. The Mediterranean, currently the world’s prime tourism destination, would become substantially less attractive to tourists. The “Rest of the World” region contains the Caribbean, the second most popular destination, which would also become too hot to be pleasant. The “Rest of the World” also comprises tropical countries, which are not so popular today and would become even less popular under global warming. Energy exporting countries lose out because energy demand falls. China and India are hardly affected. North America, Australasia, Japan, Eastern Europe and the former Soviet Union are positively affected by climate change.

This study has a number of limitations, each of which implies substantial research beyond the current paper. We already mentioned the coarse spatial disaggregation of the computable general equilibrium model. In particular, finer disaggregation could highlight that climate impacts in Europe will be very different between northern countries and southern countries.
We only consider the direct effects of climate change on tourism. We ignore the effects of sea level rise, which may erode beaches or at least require substantial beach nourishment, and which may submerge entire islands, particularly popular atolls (Bosello et al., 2004a). In the aggregate, we likely underestimated the costs of climate change on tourism. Disaggregate effects may be more subtle. Remaining atolls may be able to extract a scarcity rent, perhaps even witness a temporary surge in popularity under the cynical slogan “come visit before it is too late”. We also overlooked other indirect effects of climate change, such as those on the water cycle, perhaps misrepresenting ski-tourism, and those on the spread of diseases (Bosello et al., 2004b), perhaps further deterring tourists. On the economic side, the structure of the CGE does not allow us to estimate the effects of tourism travel, but only the effects of tourism expenditure in the destination country. Finally, our exercise is based on a rather ad-hoc scenario, in which all climate change effects occur suddenly and unexpectedly in a given reference year. In reality, climate change and its impacts are phenomena which evolve over time, and so do the expectations and the adaptive behaviour of economic agents. All these issues are deferred to future research.

Such research is worthwhile. We show that there is a substantial bias in previous studies of the economic impacts of climate change, and therewith a bias in the recommendations of cost-benefit analyses on greenhouse gas emission reduction. We also show that the economic ramifications of climate-change-induced tourism shifts are substantial.
Acknowledgements

We had useful discussions about the topics of this paper with Carlo Carraro, Sam Fankhauser, Jacqueline Hamilton, Marzio Galeotti, Francesco Bosello, Marco Lazzarin, Andrea Galvan, Claudia Kemfert, Hans Kremers, Hom Pant, Katrin Rehdanz, Kerstin Ronneberger and Guy Jakeman. The Volkswagen Foundation through the ECOBICE project, the EU DG Research Environment and Climate Programme through the DINAS-Coast project (EVK2-2000-22024), the US National Science Foundation through the Center for Integrated Study of the Human Dimensions of Global Change (SBR-9521914), the Michael Otto Foundation for Environmental Protection, and the Ecological and Environmental Economics programme at ICTP-Trieste provided welcome financial support.
References


Appendix

A Concise Description of GTAP-EF Model Structure

The GTAP model is a standard CGE static model, distributed with the GTAP database of the world economy (www.gtap.org). The model structure is fully described in Hertel (1996), where the interested reader can also find various simulation examples. Over the years, the model structure has slightly changed, often because of finer industrial disaggregation levels achieved in subsequent versions of the database.

Burniaux and Truong (2002) developed a special variant of the model, called GTAP-E, best suited for the analysis of energy markets and environmental policies. Basically, the main changes in the basic structure are:
- energy factors are taken out from the set of intermediate inputs, allowing for more substitution possibilities, and are inserted in a nested level of substitution with capital;
- database and model are extended to account for CO$_2$ emissions, related to energy consumption.

The model described in this paper (GTAP-EF) is a further refinement of GTAP-E, in which more industries are considered. In addition, some model equations have been changed in specific simulation experiments. This appendix provides a concise description of the model structure.

As in all CGE models, GTAP-EF makes use of the Walrasian perfect competition paradigm to simulate adjustment processes, although the inclusion of some elements of imperfect competition is also possible.

Industries are modelled through a representative firm, minimizing costs while taking prices are given. In turn, output prices are given by average production costs. The production functions are specified via a series of nested CES functions, with nesting as displayed in the tree diagram of figure A.1.

Notice that domestic and foreign inputs are not perfect substitutes, according to the so-called "Armington assumption", which accounts for product heterogeneity. In general, inputs grouped together are more easily substitutable among themselves than with other elements outside the nest. For example, imports can more easily be substituted in terms of foreign production source, rather than between domestic production and one specific foreign country of origin. Analogously, composite energy inputs are more substitutable with capital than with other factors.
Figure A.1. Nested tree structure for industrial production processes.

A representative consumer in each region receives income, defined as the service value of national primary factors (natural resources, land, labour, capital). Capital and labour are perfectly mobile domestically but immobile internationally. Land and natural resources, on the other hand, are industry-specific.

This income is used to finance the expenditure of three classes of expenditure: aggregate household consumption, public consumption and savings (figure A.2). The expenditure shares are generally fixed, which amounts to say that the top-level utility function has a Cobb-Douglas specification. Also notice that savings generate utility, and this can be interpreted as a reduced form of intertemporal utility.

Public consumption is split in a series of alternative consumption items, again according to a Cobb-Douglas specification. However, almost all expenditure is actually concentrated in one specific industry: Non-market Services.

Private consumption is analogously split in a series of alternative composite Armington aggregates. However, the functional specification used at this level is the Constant Difference in Elasticities form: a non-homothetic function, which is used to account for possible differences in income elasticities for the various consumption goods.

In the GTAP model and its variants, two industries are treated in a special way and are not related to any country.

International transport is a world industry, which produces the transportation services associated with the movement of goods between origin and destination regions, thereby determining the cost margin between f.o.b. and c.i.f. prices. Transport services are produced by means of factors submitted by all countries, in variable proportions.
Figure A.2. Nested tree structure for final demand.

In a similar way, a hypothetical world bank collects savings from all regions and allocates investments so as to achieve equality of expected future rates of return. Expected returns are linked to current returns and are defined through the following equation:

$$ r^e_s = r^c_s \left( \frac{ke_s}{kb_s} \right)^{\rho} $$

where: $ r $ is the rate of return in region $ s $ (superscript $ e $ stands for expected, $ c $ for current ), $ kb $ is the capital stock level at the beginning of the year, $ ke $ is the capital stock at the end of the year, after depreciation and new investment have taken place, $ \rho $ is an elasticity parameter, possibly varying by region.

Future returns are determined, through a kind of adaptive expectations, from current returns, where it is also recognized that higher future stocks will lower future returns. The value assigned to the parameter $ \rho $ determines the actual degree of capital mobility in international markets.

Since the world bank sets investments so as to equalize expected returns, an international investment portfolio is created, where regional shares are sensitive to relative current returns on capital.

In this way, savings and investments are equalized at the international but not at the regional level. Because of accounting identities, any financial imbalance mirrors a trade deficit or surplus in each region.
NOTE DI LAVORO PUBLISHED IN 2003


PRIV 2.2003 Ibiya SCHINDELE: Theory of Privatization in Eastern Europe: Literature Review

PRIV 3.2003 Wietze LISE, Claudia KEMFERT and Richard S.J. TOL: Strategic Action in the Liberalised German Electricity Market


KNOW 5.2003 Reyer GERLAGH: Induced Technological Change under Technological Competition

ETA 6.2003 Efrem CASTELNUOVO: Squeezing the Interest Rate Smoothing Weight with a Hybrid Expectations Model

SIEV 7.2003 Anna ALBERINI, Alberto LONGO, Stefania TONIN, Francesco TROMBETTA and Margherita TURVANI: The Role of Liability, Regulation and Economic Incentives in Brownfield Remediation and Redevelopment: Evidence from Surveys of Developers

NRM 8.2003 Elisabeth PAPYRAKIS and Reyer GERLAGH: Natural Resources: A Blessing or a Curse?

CLIM 9.2003 A. CAPARRÓS, J.-C. PEREAU and T. TAZDAÏT: North-South Climate Change Negotiations: a Sequential Game with Asymmetric Information

KNOW 10.2003 Giorgio BRUNELLO and Daniele CHECCHI: School Quality and Family Background in Italy

CLIM 11.2003 Efrem CASTELNUOVO and Marzio GALEOTTI: Learning By Doing vs Learning By Researching in a Model of Climate Change Policy Analysis

KNOW 12.2003 Carole MAIGNAN, Gianmarco OTTAVIANO and Dino PINELLI (eds.): Economic Growth, Innovation, Cultural Diversity: What are we all talking about? A critical survey of the state-of-the-art


KNOW 14.2003 Maddy JANSSENS and Chris STEYAERT (lix): Theories of Diversity within Organisation Studies: Debates and Future Trajectories

KNOW 15.2003 Tuzin BAYCAN LEVENT, Ennio MASUREL and Peter NIJKAMP (lix): Diversity in Entrepreneurship: Ethnic and Female Roles in Urban Economic Life

KNOW 16.2003 Alexandra BITUSIKOVA (lix): Post-Communist City on its Way from Grey to Colourful: The Case Study from Slovakia

KNOW 17.2003 Billy E. VAUGHN and Katarina MLEKOV (lix): A Stage Model of Developing an Inclusive Community

KNOW 18.2003 Selma van LONDON and Ari de RUITER (lix): Managing Diversity in a Glocalizing World

SIEV 20.2003 Giacomo CALZOLARI and Alessandro PAVAN (lx): Monopoly with Resale


PRIV 22.2003 Marco LiCALZI and Alessandro PAVAN (lx): Tilting the Supply Schedule to Enhance Competition in Uniform-Price Auctions

PRIV 23.2003 David ETTINGER (lx): Bidding among Friends and Enemies

PRIV 24.2003 Hannu VARTIAINEN (lx): Auction Design without Commitment


PRIV 26.2003 Christine A. PARLOUR and Kjell G. NYBORG and Ilya A. STREBULAEV (lx): Multiple Unit Auctions and Short Squeezes

PRIV 27.2003 Anders LUNANDER and Jan-Eric NILSSON (lx): Taking the Lab to the Field: Experimental Tests of Alternative Mechanisms to Procure Multiple Contracts


PRIV 29.2003 Emiel MAASLAND and Sander ONDERSTAL (lx): Auctions with Financial Externalities

ETA 30.2003 Michael FINUS and Bianca RUNDHAGEN: A Non-cooperative Foundation of Core-Stability in Positive Externality NTU-Coalition Games

KNOW 31.2003 Michele MORETTO: Competition and Irreversible Investments under Uncertainty

PRIV 32.2003 Philippe QUIRION: Relative Quotas: Correct Answer to Uncertainty or Case of Regulatory Capture?

KNOW 33.2003 Giuseppe MEDA, Claudio PIGA and Donald SIEGEL: On the Relationship between R&D and Productivity: A Treatment Effect Analysis

ETA 34.2003 Alessandra DEL BOCA, Marzio GALEOTTI and Paola ROTA: Non-convexities in the Adjustment of Different Capital Inputs: A Firm-level Investigation
GG 36.2003  Matthieu GLACHANT: Voluntary Agreements under Endogenous Legislative Threats
PRIV 37.2003  Narjess BOUBAKRI, Jean-Claude COSSET and Omrane GUEDHAMI: Postprivatization Corporate Governance: the Role of Ownership Structure and Investor Protection
CLIM 38.2003  Rolf GOLOMBEK and Michael HOEL: Climate Policy under Technology Spillovers
KNOW 39.2003  Slim BEN YOUSSEF: Transboundary Pollution, R&D Spillovers and International Trade
CTN 40.2003  Carlo CARRARO and Carmen MARCHIORI: Endogenous Strategic Issue Linkage in International Negotiations
KNOW 42.2003  Tino GOESCHL and Timothy SWANSON: On Biology and Technology: The Economics of Managing Biotechnologies
CLIM 44.2003  Katrin MILLOCK and Céline NAUGES: The French Tax on Air Pollution: Some Preliminary Results on its Effectiveness
PRIV 45.2003  Bernardo BORTOLOTTI and Paolo POINOTTI: The Political Economy of Privatization
ETA 47.2003  Jens HORBACH: Employment and Innovations in the Environmental Sector: Determinants and Econometrical Results for Germany
CLIM 48.2003  Lorn SLOAN, Nolan MILLER and Robert STAVINS: The Effects of Environmental Regulation on Technology Diffusion: The Case of Chlorine Manufacturing
CLIM 49.2003  Lorn SLOAN, Robert STAVINS and Alexander F. WAGNER: Private Options to Use Public Goods. Exploiting Revealed Preferences to Estimate Environmental Benefits
CTN 50.2003  László A. KOCZY and Luc LAUWERS (lxii): Mapping Diversity in Social History
CTN 51.2003  Matthew O. JACKSON (lxii): Allocation Rules for Network Games
CTN 52.2003  Ana MAULEON and Vincent PINELLI: Farsightedness and Cautiousness in Coalition Formation
CTN 54.2003  Matthew HAAG and Roger LAGUNOFF (lxii): On the Size and Structure of Group Cooperation
CTN 55.2003  Tajji FURUSAWA and Hideo KONISHI (lxii): Free Trade Networks
CTN 56.2003  Halis Murat YILDIZ (lxii): National Versus International Mergers and Trade Liberalization
CTN 57.2003  Santiago RUBIO and Alistair ULPH (lxii): An Infinite-Horizon Model of Dynamic Membership of International Environmental Agreements
KNOW 58.2003  Carole MAIGNAN, Dino PINELLI and Gianmarco I.P. OTTAVIANO: ICT, Clusters and Regional Cohesion: A Summary of Theoretical and Empirical Research
KNOW 59.2003  Giorgio BELLETTINI and Gianmarco I.P. OTTAVIANO: Special Interests and Technological Change
ETA 60.2003  Ronnie SCHÖB: The Double Dividend Hypothesis of Environmental Taxes: A Survey
CLIM 61.2003  Michael FINUS, Ekko van IERLAND and Robert DELLINK: Stability of Climate Coalitions in a Cartel Formation Game
SIEV 63.2003  Alberto PETRUCCI: Taxing Land Rent in an Open Economy
CLIM 64.2003  Joseph E. ALDY, Scott BARRETT and Robert N. STAVINS: Thirteen Plus One: A Comparison of Global Climate Policy Architectures
SIEV 65.2003  Edi DEFRANCESCO: The Beginning of Organic Fish Farming in Italy
SIEV 66.2003  Klaus CONRAD: Price Competition and Product Differentiation when Consumers Care for the Environment
CLIM 68.2003  Zhongxiang ZHANG: Open Trade with the U.S. Without Compromising Canada’s Ability to Comply with its Kyoto Target
KNOW 69.2003  David FRANTZ (lxii): Lorenzo Market between Diversity and Mutation
KNOW 70.2003  Erode SORI (lxii): Mapping Diversity in Social History
KNOW 71.2003  Liijilana DERU SIMIC (lxii): What is Specific about Art/Cultural Projects?
KNOW 72.2003  Natalya V. TARANOVA (lxii): The Role of the City in Fostering Intergroup Communication in a Multicultural Environment: Saint-Petersburg’s Case
KNOW 73.2003  Kristine CRANE (lxii): The City as an Arena for the Expression of Multiple Identities in the Age of Globalisation and Migration
KNOW 74.2003  Kazuma MATOBA (lxii): Glocal Dialogue: Transformation through Transcultural Communication
KNOW 75.2003  Catarina REIS OLIVEIRA (lxii): Immigrants’ Entrepreneurial Opportunities: The Case of the Chinese in Portugal
KNOW 76.2003  Sandra WALLMAN (lxii): The Diversity of Diversity - towards a typology of urban systems
KNOW 77.2003  Richard PEARCE (lxii): A Biologist’s View of Individual Cultural Identity for the Study of Cities
KNOW 78.2003  Vincent MARK (lxii): Communication Across Cultures: from Cultural Awareness to Reconciliation of the Dilemmas
KNOW 79.2003  Giorgio BELLETTINI, Carlotta BERTI CERONI and Gianmarco I.P. OTTAVIANO: Child Labor and Resistance to Change
ETA 80.2003  Michele MORETTO, Paolo M. PANTEGHINI and Carlo SCARPA: Investment Size and Firm’s Value under Profit Sharing Regulation
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

PRA 3.2004  Adolfo DI CARLUCCIO, Giovanni FERRI, Cecilia FRALE and Ottavio RICCHI: Do Privatizations Boost Household Shareholding? Evidence from Italy

ETA 4.2004  Victor GINSBURGH and Shlomo WEBER: Languages Disenfranchisement in the European Union


PRA 8.2004  Wolfgang AUSSENEGG, Pegaret PICHLER and Alex STOMPER (Ixx): IPO Pricing with Bookbuilding, and a When-Issued Market

PRA 9.2004  Pegaret PICHLER and Alex STOMPER (Ixx): Primary Market Design: Direct Mechanisms and Markets


PRA 11.2004  Bjarni BRENDSTRUP and Harry J. PAARSCH (Ixx): Nonparametric Identification and Estimation of Multi-Unit, Sequential, Oral, Ascending-Price Auctions With Asymmetric Bidders

PRA 12.2004  Ohad KADAN (Ixx): Equilibrium in the Two Player, k-Double Auction with Affiliated Private Values

PRA 13.2004  Maarten C.W. JANSEN (Ixx): Auctions as Coordination Devices


PRA 15.2004  Orly SADE, Charles SCHNITZLEIN and Jaime F. ZENDER (Ixx): Competition and Cooperation in Divisible Good Auctions: An Experimental Examination

PRA 16.2004  Marta STRYSZOWSKA (Ixx): Late and Multiple Bidding in Competing Second Price Internet Auctions

CCMP 17.2004  Slim Ben YOUSSEF: R&D in Cleaner Technology and International Trade

NRM 18.2004  Angelo ANTOCI, Simone BORGHESI and Paolo RUSSU (Ixxv): Biodiversity and Economic Growth: Stabilization Versus Preservation of the Ecological Dynamics

SIEV 19.2004  Anna ALBERINI, Paolo ROSATO, Alberto LONGO and Valentina ZANATTA: Information and Willingness to Pay in a Contingent Valuation Study: The Value of S. Erasmo in the Lagoon of Venice


NRM 21.2004  Jacqueline M. HAMILTON (Ixxv): Climate and the Destination Choice of German Tourists


NRM 23.2004  Pius ODUNGA and Henk FOMLER (Ixxvii): Profiling Tourists for Balanced Utilization of Tourism-Based Resources in Kenya


NRM 27.2004  Raúl Hernández MARTÍN (Ixxv): Impact of Tourism Consumption on GDP. The Role of Imports


NRM 29.2004  Marian WEBER (Ixxv): Assessing the Effectiveness of Tradable Landuse Rights for Biodiversity Conservation: an Application to Canada's Boreal Mixedwood Forest

NRM 30.2004  Trond BJØRNDAL, Phoebe KOUNDOURI and Sean PASCOE (Ixxv): Output Substitution in Multi-Species Trawl Fisheries: Implications for Quota Setting


CTN 33.2004  Wilson PEREZ: Divide and Conquer: Noisy Communication in Networks, Power, and Wealth Distribution


KTHC 38.2004  Kiflemariam HAMDE Mind in Africa, Body in Europe: The Struggle for Maintaining and Transforming Cultural Identity - A Note from the Experience of Eritrean Immigrants in Stockholm

ETA 39.2004  Alberto CAVALIERE: Price Competition with Information Disparities in a Vertically Differentiated Duopoly

PRA 40.2004  Andrea BIGANO and Stef PROOST: The Opening of the European Electricity Market and Environmental Policy: Does the Degree of Competition Matter?

CCMP 41.2004  Micheal FINUS (Ixx): International Cooperation to Resolve International Pollution Problems

KTHC 42.2004  Francesco CRESPI: Notes on the Determinants of Innovation: A Multi-Perspective Analysis
<table>
<thead>
<tr>
<th>Publication Code</th>
<th>Authors</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTN 43.2004</td>
<td>Sergio CURRARINI and Marco MARINI</td>
<td>Coalition Formation in Games without Synergies</td>
</tr>
<tr>
<td>CTN 44.2004</td>
<td>Marc ESCRIHUELA-VILLAR</td>
<td>Cartel Sustainability and Cartel Stability</td>
</tr>
<tr>
<td>NRM 45.2004</td>
<td>Sebastian BERVOETS and Nicolas GRAVEL</td>
<td>Appraising Diversity with an Ordinal Notion of Similarity: An Axiomatic Approach</td>
</tr>
<tr>
<td>NRM 46.2004</td>
<td>Signe ANTHON and Bo JELLEMARK THORSEN</td>
<td>Optimal Aforestation Contracts with Asymmetric Information on Private Environmental Benefits</td>
</tr>
<tr>
<td>NRM 48.2004</td>
<td>Ekin BIROL, Agnes GYOVAI and Melinda SMAIL</td>
<td>Using a Choice Experiment to Value Agricultural Biodiversity on Hungarian Small Farms: Agri-Environmental Policies in a Transition al Economy</td>
</tr>
<tr>
<td>CCMP 49.2004</td>
<td>Gernot KLEPPER and Sonja PETERSON</td>
<td>The EU Emissions Trading Scheme, Allowance Prices, Trade Flows, Competitiveness Effects</td>
</tr>
<tr>
<td>GG 50.2004</td>
<td>Scott BARRETT and Michael HOEL</td>
<td>Optimal Disease Eradication</td>
</tr>
<tr>
<td>CTN 51.2004</td>
<td>Dinco DIMITROW, Peter BORM, Roud HENDRICKX and Shao CHIN SUNG</td>
<td>Simple Priorities and Core Stability in Hedonic Games</td>
</tr>
<tr>
<td>SIEV 52.2004</td>
<td>Francesco RICCI</td>
<td>Channels of Transmission of Environmental Policy to Economic Growth: A Survey of the Theory</td>
</tr>
<tr>
<td>SIEV 53.2004</td>
<td>Anna ALBERINI, Maureen CROPPER, Alan KRUPNICK and Nathalie B. SIMON</td>
<td>Willingness to Pay for Mortality Risk Reductions: Does Latency Matter?</td>
</tr>
<tr>
<td>NRM 54.2004</td>
<td>Ingo BRAUER and Rainer MARGGRAF</td>
<td>Valuation of Ecosystem Services Provided by Biodiversity Conservation: An Integrated Hydrological and Economic Model to Value the Enhanced Nitrogen Retention in Renaturated Streams</td>
</tr>
<tr>
<td>NRM 55.2004</td>
<td>Tino GOESCHL and Tun LIN</td>
<td>Biodiversity Conservation on Private Lands: Information Problems and Regulatory Choices</td>
</tr>
<tr>
<td>NRM 56.2004</td>
<td>Tom DEDEURWAERDERE</td>
<td>Bioprospection: From the Economics of Contracts to Reflexive Governance</td>
</tr>
<tr>
<td>CCMPP 57.2004</td>
<td>Katrin REHDANZ and David MADDISON</td>
<td>The Amenity Value of Climate to German Households</td>
</tr>
<tr>
<td>NRM 59.2004</td>
<td>Valentina BOSETTI, Mariaester CASSINELLI and Alessandro LANZA</td>
<td>Using Data Envelopment Analysis to Evaluate Environmentally Conscious Tourism Management</td>
</tr>
<tr>
<td>NRM 60.2004</td>
<td>Tino GOESCHL and Danilo CAMARGO IGILIO</td>
<td>Property Rights Conservation and Development: An Analysis of Extractive Reserves in the Brazilian Amazon</td>
</tr>
<tr>
<td>CCMPP 61.2004</td>
<td>Barbara BUCHNER and Carlo CARRARO</td>
<td>Economic and Environmental Effectiveness of a Technology-based Climate Protocol</td>
</tr>
<tr>
<td>NRM 63.2004</td>
<td>Györgyi BELA, György PATAKI, Melinda SMAL and Marians HAJDU</td>
<td>Conserving Crop Genetic Resources on Smallholder Farms in Hungary: Institutional Analysis</td>
</tr>
<tr>
<td>NRM 64.2004</td>
<td>E.C.M. RULIGROK and E.E.M. NILLESEN</td>
<td>The Socio-Economic Value of Natural Riverbanks in the Netherlands</td>
</tr>
<tr>
<td>ETA 66.2004</td>
<td>Giannis VARDAS and Anastasios XEPAPAIDES</td>
<td>Uncertainty Aversion, Robust Control and Asset Holdings</td>
</tr>
<tr>
<td>GG 67.2004</td>
<td>Anastasios XEPAPAIDES and Constantina PASSA</td>
<td>Participation in and Compliance with Public Voluntary Environmental Programs: An Evolutionary Approach</td>
</tr>
<tr>
<td>GG 68.2004</td>
<td>Michael FINUS</td>
<td>Modesty Pays: Sometimes!</td>
</tr>
<tr>
<td>NRM 69.2004</td>
<td>Trond BJORNAL and Ana BRASIO</td>
<td>The Northern Atlantic Bluefin Tuna Fisheries: Management and Policy Implications</td>
</tr>
<tr>
<td>CTN 70.2004</td>
<td>Alejandro CAPARRÓS, Abdelhakim HAMMOUDI and Tariq TAŽDAIT</td>
<td>On Coalition Formation with Heterogeneous Agents</td>
</tr>
<tr>
<td>IEM 71.2004</td>
<td>Massimo GIOVANNINI, Margherita GRASSO, Alessandro LANZA and Matteo MANERA</td>
<td>Conditional Correlations in the Returns on Oil Companies Stock Prices and Their Determinants</td>
</tr>
<tr>
<td>IEM 72.2004</td>
<td>Alessandro LANZA, Matteo MANERA and Michael MCALEER</td>
<td>Modelling Dynamic Conditional Correlations in WTI Oil Forward and Futures Returns</td>
</tr>
<tr>
<td>SIEV 73.2004</td>
<td>Margarita GENIUS and Elisabetta STRAZZERA</td>
<td>The Copula Approach to Sample Selection Modelling: An Application to the Recreational Value of Forests</td>
</tr>
<tr>
<td>CCMPP 74.2004</td>
<td>Rob DELLLINK and Ekko van IERLAND</td>
<td>Pollution Abatement in the Netherlands: A Dynamic Applied General Equilibrium Assessment</td>
</tr>
<tr>
<td>ETA 75.2004</td>
<td>Rosella LEVAGGI and Michele MORETTO</td>
<td>Investment in Hospital Care Technology under Different Purchasing Rules: A Real Option Approach</td>
</tr>
<tr>
<td>CTN 76.2004</td>
<td>Salvador BARBERA and Matthew O. JACKSON</td>
<td>On the Weights of Nations: Assigning Voting Weights in a Heterogeneous Union</td>
</tr>
<tr>
<td>CTN 77.2004</td>
<td>Alex ARENAS, Antonio CABRALES, Albert DÍAZ-GUILERA, Roger GUIMERA and Fernando VEGA- REDONDO</td>
<td>Optimal Information Transmission in Organizations: Search and Congestion</td>
</tr>
<tr>
<td>CTN 78.2004</td>
<td>Francis BLOCH and Armando GOMES</td>
<td>Contracting with Externalities and Outside Options</td>
</tr>
<tr>
<td>CTN 79.2004</td>
<td>Rabah AMIR, Effrosyni DIAMANTOUDI and Licun XUE</td>
<td>Merger Performance under Uncertain Efficiency Gains</td>
</tr>
<tr>
<td>CTN 80.2004</td>
<td>Francis BLOCH and Matthew O. JACKSON</td>
<td>The Formation of Networks with Transfers among Players</td>
</tr>
<tr>
<td>CTN 81.2004</td>
<td>Daniel DIERMEIER, Hulya ERASLAN and Antonio MERLO</td>
<td>Biocameralism and Government Formation</td>
</tr>
</tbody>
</table>
on the Islands of the Venice Lagoon: A Spatially-Distributed Hedonic-Hierarchical Approach

Resources Management: A DSS Tool and a Pilot Study Application

Economy

for Security of Energy Supply

Results

Using Ecosystem Indicators: An Ecological Economics Perspective

Privatisation

in Italy

Pay for Reductions in Pesticide Risk Exposure

Sharing on the Stability of International Climate Agreements

Proportional Representation

the Implications of Climate Change: Sea Level Rise

CCMP 95.2004

Rod GARRATT, James E. PARCO, Cheng-ZHONG QIN and Amnon RAPOPORT (lxx): Potential Maximization and Government Formation

Kfir ELIZA, Debraj RAY and Ronny RAZIN (lxx): Group Decision-Making in the Shadow of Disagreement

Sanjeev GOYAL, Marco van der LEIJ and José Luis MORAGA-GONZALEZ (lxx): Economics: An Emerging Small World?

Edward CARTWRIGHT (lxx): Learning to Play Approximate Nash Equilibria in Games with Many Players

FINN R. FØRSUND and Michael HOLM: Properties of a Non-Competitive Electricity Market Dominated by Hydroelectric Power

Elissaitos PAPYRAKIS and Reyer GERLAGH: Natural Resources, Investment and Long-Term Income

Marzio GALEOTTI and Claudia KEMFERT: Interactions between Climate and Trade Policies: A Survey

A. MARKANDYA, S. PEDROSÓ and D. STREIMIKIENĖ: Energy Efficiency in Transition Economies: Is There Convergence Towards the EU Average?

Rolf GOLOMBEK and Michael HOLM: Climate Agreements and Technology Policy

Sergei IZMALKOV (lxx): Multi-Unit Open Ascending Price Efficient Auction

Gianmarco I.P. OTTAVIANO and Giovanni PERI: The Political Economy of Privatization: Why Do Governments Want Reforms?

The Cooperative Theory of Two-Sided Matching Problems: A Re-examination of Some

Francesco BOSELLO, Marco LAZZARIN, Roberto ROSÁN and Richard S.J. TOL: Economy-Wide Estimates of the Implications of the Climate Change: Sea Level Rise

Siddhartha BANDYOPADHYAY and Mandar OAK: Party Formation and Coalitional Bargaining in a Model of Proportional Representation

Hans-Peter WEIKARD, Michael FINUS and Juan-Carlos ALTAMIRANO-CABRERA: The Impact of Surplus Sharing on the Stability of International Climate Agreements

Chiara M. TRAVISI and Peter NIKKAMP: Willingness to Pay for Agricultural Environmental Safety: Evidence from a Survey of Milan, Italy, Residents

Chiara M. TRAVISI, Raymond J. G. FLORAX and Peter NIKKAMP: A Meta-Analysis of the Willingness to Pay for Reductions in Pesticide Risk Exposure

Valentina BOSSETTI and David TOMBERLIN: Real Options Analysis of Fishing Fleet Dynamics: A Test

Alessandra GORIA e Gretel GAMBARELLI: Economic Evaluation of Climate Change Impacts and Adaptability in Italy

Massimo DEL GATTO: Agglomeration, Integration, and Territorial Authority Scale in a System of Trading Cities. Centralisation versus devolution

Pierre-André JOUVE, Philippe MICHEL, and Gilles ROTILLON: Equilibrium with a Market of Permits

Bob van der ZWAAN and Reyer GERLAGH: Climate Uncertainty and the Necessity to Transform Global Energy Supply

Francesco BOSELLO, Marco LAZZARIN, Roberto ROSÁN and Richard S.J. TOL: Economy-Wide Estimates of the Implications of the Climate Change: Sea Level Rise

Gustavo BERGANTIÑOS and Juan J. VIDAL-PUGA: Defining Rules in Cost Spanning Tree Problems Through the Canonical Form

Edward CARTWRIGHT

Sanjeev GOYAL, Marco van der LEIJ and José Luis MORAGA-GONZALEZ (lxx): Economics: An Emerging Small World?

Francesco GRACCEVA: The Question of Generation Adequacy in Liberalised Electricity Markets

Giuseppe DI VITA: The Impact of Surplus Sharing on the Stability of International Climate Agreements

Hydroelectric Power

Small World?

and Coalition Government Formation

Kfir ELIZA, Debraj RAY and Ronny RAZIN (lxx): Group Decision-Making in the Shadow of Disagreement

Sanjeev GOYAL, Marco van der LEIJ and José Luis MORAGA-GONZALEZ (lxx): Economics: An Emerging Small World?

Edward CARTWRIGHT (lxx): Learning to Play Approximate Nash Equilibria in Games with Many Players

FINN R. FØRSUND and Michael HOLM: Properties of a Non-Competitive Electricity Market Dominated by Hydroelectric Power

Elissaitos PAPYRAKIS and Reyer GERLAGH: Natural Resources, Investment and Long-Term Income

Marzio GALEOTTI and Claudia KEMFERT: Interactions between Climate and Trade Policies: A Survey

A. MARKANDYA, S. PEDROSÓ and D. STREIMIKIENĖ: Energy Efficiency in Transition Economies: Is There Convergence Towards the EU Average?

Rolf GOLOMBEK and Michael HOLM: Climate Agreements and Technology Policy

Sergei IZMALKOV (lxx): Multi-Unit Open Ascending Price Efficient Auction

Gianmarco I.P. OTTAVIANO and Giovanni PERI: The Political Economy of Privatization: Why Do Governments Want Reforms?

The Cooperative Theory of Two-Sided Matching Problems: A Re-examination of Some

Francesco BOSELLO, Marco LAZZARIN, Roberto ROSÁN and Richard S.J. TOL: Economy-Wide Estimates of the Implications of the Climate Change: Sea Level Rise

Siddhartha BANDYOPADHYAY and Mandar OAK: Party Formation and Coalitional Bargaining in a Model of Proportional Representation

Hans-Peter WEIKARD, Michael FINUS and Juan-Carlos ALTAMIRANO-CABRERA: The Impact of Surplus Sharing on the Stability of International Climate Agreements

Chiara M. TRAVISI and Peter NIKKAMP: Willingness to Pay for Agricultural Environmental Safety: Evidence from a Survey of Milan, Italy, Residents

Chiara M. TRAVISI, Raymond J. G. FLORAX and Peter NIKKAMP: A Meta-Analysis of the Willingness to Pay for Reductions in Pesticide Risk Exposure

Valentina BOSSETTI and David TOMBERLIN: Real Options Analysis of Fishing Fleet Dynamics: A Test

Alessandra GORIA e Gretel GAMBARELLI: Economic Evaluation of Climate Change Impacts and Adaptability in Italy

Massimo DEL GATTO: Agglomeration, Integration, and Territorial Authority Scale in a System of Trading Cities. Centralisation versus devolution

Pierre-André JOUVE, Philippe MICHEL, and Gilles ROTILLON: Equilibrium with a Market of Permits

Bob van der ZWAAN and Reyer GERLAGH: Climate Uncertainty and the Necessity to Transform Global Energy Supply

Francesco BOSELLO, Marco LAZZARIN, Roberto ROSÁN and Richard S.J. TOL: Economy-Wide Estimates of the Implications of the Climate Change: Sea Level Rise

Gustavo BERGANTIÑOS and Juan J. VIDAL-PUGA: Defining Rules in Cost Spanning Tree Problems Through the Canonical Form

Edward CARTWRIGHT

Sanjeev GOYAL, Marco van der LEIJ and José Luis MORAGA-GONZÁLEZ: Economic Evaluation of Climate Change Impacts and Adaptability in Italy

Massimo FLORIO and Mara GRASSENI: The Missing Shock: The Macroeconomic Impact of British Privatisation

John BENNETT, Saul ESTRIN, James MAW and Giovanni URGA: Privatisation Methods and Economic Growth in Transition Economies

Kira BÖRNER: The Political Economy of Privatization: Why Do Governments Want Reforms?

Pehr-Johan NORBACK and Lars PERSSON: Privatization and Restructuring in Concentrated Markets

Angela GRANZOTTO, Fabio PRAVONI, Simone LIBRALATO, Patrizia TORRICELLI and Danilo MANGANI: Comparison between Artisanal Fishery and Manila Clam Harvesting in the Venice Lagoon by Using Ecosystem Indicators: An Ecological Economics Perspective

Somdeb LAHIRI: The Cooperative Theory of Two Sided Matching Problems: A Re-examination of Some Results

Giuseppe DI VITA: Natural Resources Dynamics: Another Look

Anna ALBERINI, Alistair HUNT and Anil MARKANDYA: Willingness to Pay to Reduce Mortality Risks: Evidence from a Three-Country Contingent Valuation Study

Valeria PAPPONETTI and Dino PINELLI: Scientific Advice to Public Policy-Making

Paulo A.L.D. NUNES and Laura ONOFRI: The Economics of Warm Glow: A Note on Consumer’s Behavior and Public Policy Implications

Patrick CAYRADE: Investments in Gas Pipelines and Liquefied Natural Gas Infrastructure What is the Impact on the Security of Supply?

Valeria COSTANTINI, Francesco GRACCEVA: Oil Security, Short- and Long-Term Policies

Valeria COSTANTINI and Francesco GRACCEVA: Social Costs of Energy Disruptions

Christian EGENHOFER, Kyriakos GIALOGLOU, Giacomo LUCIANI, Maroeska BOOTS, Martin SCHEEPERS, Valeria COSTANTINI, Francesco GRACCEVA, Anil MARKANDYA and Giorgio VICINI: Market-Based Options for Security of Energy Supply

David FISK: Transport Energy Security. The Unseen Risk?

Giacomo LUCIANI: Security of Supply for Natural Gas Markets. What is it and What is it not?

L.J. de VRIES and R.A. HAKVOORT: The Question of Generation Adequacy in Liberalised Electricity Markets

Alberto PETRUCCI:asset Accumulation, Fertility Choice and Nondegenerate Dynamics in a Small Open Economy

Carlo GIUPPONI, Jarosław MYSIĄK and Anita FASSIO: An Integrated Assessment Framework for Water Resources Management: A DSS Tool and a Pilot Study Application

<table>
<thead>
<tr>
<th>Journal</th>
<th>Issue</th>
<th>Authors</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETA</td>
<td>124.2004</td>
<td>Paul MENSINK</td>
<td>Instant Efficient Pollution Abatement Under Non-Linear Taxation and Asymmetric Information: The Differential Tax Revisited</td>
</tr>
<tr>
<td>NRM</td>
<td>125.2004</td>
<td>Mauro FABIANO, Gabriella CAMARSA, Rosanna DURSI, Roberta IVALDI, Valentina MARIN and Francesca PALMISANI</td>
<td>Integrated Environmental Study for Beach Management: A Methodological Approach</td>
</tr>
<tr>
<td>PRA</td>
<td>126.2004</td>
<td>Irena GROSFELD and Iraj HASHI</td>
<td>The Emergence of Large Shareholders in Mass Privatized Firms: Evidence from Poland and the Czech Republic</td>
</tr>
<tr>
<td>CCMP</td>
<td>127.2004</td>
<td>Maria BERRITTELLA, Andrea BIGANO, Roberto ROSON and Richard S.J. TOL</td>
<td>A General Equilibrium Analysis of Climate Change Impacts on Tourism</td>
</tr>
</tbody>
</table>
(lix) This paper was presented at the ENGIME Workshop on “Mapping Diversity”, Leuven, May 16-17, 2002
(lx) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications”, organised by the Fondazione Eni Enrico Mattei, Milan, September 26-28, 2002
(lxi) This paper was presented at the Eighth Meeting of the Coalition Theory Network organised by the GREQAM, Aix-en-Provence, France, January 24-25, 2003
(lxii) This paper was presented at the ENGIME Workshop on “Communication across Cultures in Multicultural Cities”, The Hague, November 7-8, 2002
(lxiii) This paper was presented at the ENGIME Workshop on “Social dynamics and conflicts in multicultural cities”, Milan, March 20-21, 2003
(lxiv) This paper was presented at the International Conference on “Theoretical Topics in Ecological Economics”, organised by the Abdus Salam International Centre for Theoretical Physics - ICTP, the Beijer International Institute of Ecological Economics, and Fondazione Eni Enrico Mattei – FEEM Trieste, February 10-21, 2003
(lxv) This paper was presented at the EuroConference on “Auctions and Market Design: Theory, Evidence and Applications” organised by Fondazione Eni Enrico Mattei and sponsored by the EU, Milan, September 25-27, 2003
(lxvi) This paper has been presented at the 4th BioEcon Workshop on “Economic Analysis of Policies for Biodiversity Conservation” organised on behalf of the BIOECON Network by Fondazione Eni Enrico Mattei, Venice International University (VIU) and University College London (UCL), Venice, August 28-29, 2003
(lxvii) This paper has been presented at the international conference on “Tourism and Sustainable Economic Development – Macro and Micro Economic Issues” jointly organised by CRENoS (Università di Cagliari e Sassari, Italy) and Fondazione Eni Enrico Mattei, and supported by the World Bank, Sardinia, September 19-20, 2003
(lxviii) This paper was presented at the ENGIME Workshop on “Governance and Policies in Multicultural Cities”, Rome, June 5-6, 2003
(lxix) This paper was presented at the Fourth EEP Plenary Workshop and EEP Conference “The Future of Climate Policy”, Cagliari, Italy, 27-28 March 2003
(lxx) This paper was presented at the 9th Coalition Theory Workshop on "Collective Decisions and Institutional Design" organised by the Universitat Autònoma de Barcelona and held in Barcelona, Spain, January 30-31, 2004
### 2003 SERIES

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

### 2004 SERIES

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