Naghavi, Alireza

Working Paper
Multilateral Environmental Agreements and Trade Obligations: A Theoretical Analysis of the Doha Proposal

Nota di Lavoro, No. 52.2005

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

Suggested Citation: Naghavi, Alireza (2005) : Multilateral Environmental Agreements and Trade Obligations: A Theoretical Analysis of the Doha Proposal, Nota di Lavoro, No. 52.2005, Fondazione Eni Enrico Mattei (FEEM), Milano

This Version is available at:
http://hdl.handle.net/10419/74281

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.
Multilateral Environmental Agreements and Trade Obligations: A Theoretical Analysis of the Doha Proposal
Alireza Naghavi

NOTA DI LAVORO 52.2005

APRIL 2005

CCMP – Climate Change Modelling and Policy

Alireza Naghavi, Paris-Jourdan Sciences Economique and Università di Modena e Reggio Emilia

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=692481

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
Multilateral Environmental Agreements and Trade Obligations: A Theoretical Analysis of the Doha Proposal

Summary

The Doha declaration on trade and environment proposed to clarify the relationship between multilateral environmental agreement (MEA) trade obligations and WTO rules by only guaranteeing economic integration upon ratification of certain MEAs. In other words, it pushed to authorize the use of trade measures against non-compliance, denying a non-signatory of its WTO rights to exercise countervailing tariffs. This paper demonstrates that the Doha proposal can be effective when environmental policy and its trade obligations are endogenous. Under plausible circumstances, ratification by a non-signatory to the MEA along with free trade as a reward is the unique equilibrium outcome. Delocation to pollution havens does not occur, as optimal tariffs are positive if standards are not adopted. Tariffs however only work as a credible threat and do not emerge in equilibrium. Results are consistent with broad empirical evidence that opposes the pollution haven hypothesis and suggests capital movements to be non-pollution related.

Keywords: Environmental policy, WTO, Location of firms, Green tariffs, Multilateral environmental agreements, Doha declaration

JEL Classification: F13, F18, F23, H23, Q56, R38

I am grateful for invaluable comments and extensive guidance and support by Peter Neary while working on this paper. I would also like to thank Richard Baldwin, Scott Barrett, Erwin Bulte, Dermot Leahy, Kresimir Zigic and the participants of the ZEW workshop in Mannheim on the management of global commons (June 2004) for helpful comments. Financial support from the Institute for the Study of Social Change at University College Dublin is acknowledged.

Address for correspondence:

Alireza Naghavi
PSE, Ecole Normale Supérieure
48 Boulevard Jourdan
75014 Paris
France
Phone:+33 1 43136393
Fax:+33 1 43136382
Email: Alireza.Naghavi@mail.enpc.fr
1. Introduction

The link between trade liberalization and environmental protection is increasingly gaining importance with the latter constituting a bigger part of WTO rounds in recent years. The primary debate led by environmentalists is that trade liberalization damages the environment. One argument has been that in the absence of trade policy instruments, governments may be tempted to distort their environmental policies to protect their domestic economy. If allowed, they can impose a loose regime of environmental regulation for fear that tougher environmental policies may damage the competitiveness of their firms. Such policies may also cause domestic firms to relocate plants abroad to pollution havens, mainly developing countries (South), or close down altogether in response to foreign competition that faces less strict environmental regulation and hence lower production costs.

When it comes to enforcing environmental standards on a global level, the South has shown to be lagging behind regardless of rising international concern over the environment. While intellectual property rights have officially found their way onto the WTO agenda through the TRIPS agreement and labor standards have failed to make a convincing case for inclusion, environmental protection remains in a limbo state. The notion of enforcing environmental standards globally through the WTO is however moving closer to realization with the latter devoting greater attention to environmental negotiations in recent rounds. A significant part of the Doha declaration in 2001 for instance dealt with trade and environment. In fact, there are about 200 multilateral environmental agreements (MEA) in place today, of which

---

1 For a survey of traditional and strategic literature on environment and trade see Neary (2000).
2 Barrett (1994) for instance shows that in imperfectly competitive international markets, governments may be tempted to impose a weak environmental policy where the marginal cost of abatement is less than the marginal damage from pollution.
3 Neary (2004) addresses and analyzes the key issues of the Doha development agenda and obstacles that must be overcome for successful negotiations in future rounds of the WTO.
only 20 contain trade provisions. Loopholes currently allow non-signatories to use their WTO rights to protest trade restrictions put against them by a MEA. This has lead to suggestions to eliminate such free riding opportunities by only allowing WTO members that are also parties to a MEA to practice their WTO rights. As a first step, ministers have agreed in the new Article 31 (i) of the Doha text to launch negotiations on the relationship between existing WTO rules and specific trade obligations set out in MEAs. WTO in this case could give a signatory country the choice to only accept greater economic integration with another country if the latter agrees to ratify and adopt stronger environmental standards. In other words, it allows rivals of a non-signatory country to impose punishing tariffs on its imports for having laxer environmental regulations in the case of non-compliance (http://www.wto.org/english/thewto_e/minist_e/min01_e/mindecl_e.htm). Can such tariffs be justified, and if so, what is their impact on the location of firms and environmental policies in the South?

Theoretical literature on environmental policy and the location of firms goes as far back as Markusen, et al. (1993). They look at exogenous trade costs and environmental policies and show that the latter can have a very strong impact on a firm’s decision about location when

---

4 Examples are the Montreal Protocol on substances that deplete the ozone layer, the Convention on Biological Diversity, the Convention on International Trade in Endangered Species, the Basel Convention on the international movement of toxic waste, and the United Nations Framework Convention on Climate Change and its Kyoto Protocol aimed at curbing emissions of greenhouse gas.

5 WTO ministerial conference in Doha set Jan. 1, 2005 as the deadline for negotiations on clarifying the relationship between WTO rules and the trade obligations established by the MEAs. The fifth WTO ministerial conference in Cancun however did not give much emphasis to green issues and no consensus was reached to produce a new mandate or reaffirm the existing timeframe. (http://www.wto.org/english/thewto_e/minist_e/min03_e/min03_e.htm)

6 Barrett (1997) shows how committing to trade sanctions in a MEA such as the Montreal Protocol can work as a credible threat to deter free-riding and sustain cooperation. Zigic (2000) further shows how punitive tariffs can be used as a credible threat to improve intellectual property rights regime in the same spirit as they are projected to improve environmental standards in the Doha proposal.
firms are “footloose”. Motta and Thisse (1994) consider a different setting where firms are initially established in their country of origin and do not incur any fixed cost when operating at home. They also examine the impact of a country’s exogenous environmental policy on the location and production choices of its firm. They show that a firm is less likely to relocate as a response to environmental policies because fixed costs of establishing a domestic plant are sunk when the game begins. Hoel (1997) extends the study to endogenize environmental policy demonstrating that governments have an incentive to choose loose environmental standards to attract firms as long as the disutility from pollution is not high enough to promote a ‘Not In My Back Yard’ policy. Finally, Ulph and Valentini (2001) show on the contrary that environmental dumping is greater when plants are ‘not’ footloose as this can create strategic rent-shifting incentives for governments. On the empirical side, studies on the issue have largely rejected any link between firm location and environmental policy. Smarzynska and Wei (2001), Eskeland and Harrison (2003) and Grether and Melo (2003) are a few examples of recent empirical works that find little or no evidence on the pollution haven hypothesis.

This paper endogenizes the decision of firms on location and governments’ policies on trade and environment to see whether proposals made at the Doha round can be effectively implemented. It shows that when pollution related costs realistically constitute only a small portion of firms’ total cost, tariffs can work in line with Barrett (1997) as a successful credible threat to make environmental harmonization and free trade the unique subgame perfect equilibrium outcome. If a non-signatory country deviates, optimal green tariffs are positive

---

7 In their model they also give the multinational firm the choice of closing down home production altogether and establishing a plant abroad to serve both markets. Additionally, they assume the other firm to be a local firm with its location (as well as the other country’s policy) as given.

8 Although we examine all levels of pollution tax in the paper, only very low values reflect reality and are of relevance for the results. A wide range of studies such as Noerdstrom and Vaughan (1999) show that pollution related costs only account for a very small proportion of a firm’s total costs. These costs only come up to no more than 1% of production costs for an average industry in the North and at most 5% for the worst polluters. Hence, we emphasize the results for low enough levels of emission tax.
eliminating multinationals’ incentives to delocate.\(^9\) Therefore, the so-called escape to pollution havens is not an equilibrium outcome in accordance with recent empirical findings, and all capital movements occur due to other non-pollution related factors.

The Doha proposal is illustrated in the following game: in the first stage, the Southern government chooses whether or not to adopt standards taking into consideration that the North can impose a tariff against its imports in the second stage upon non-compliance. If the South chooses to harmonize its environmental standards, tariffs are abolished to allow for economic integration as a complement or a reward. The governments also anticipate firms’ decision on output and location. The Northern firm moves next by choosing location in the third stage and competes in production with the Southern firm in the final stage. The stages of the game are illustrated in figure 1. The rest of the paper is organized as follows: Section 2 describes the model and solves the final two stages of the game when environmental standards are not enforced in the South. Section 3 introduces the other branch of the game where the South ratifies with the MEA and shows the outcome on output and location under harmonized standards. Section 4 finds the optimal tariff set by the North and the optimal environmental policy chosen by the South, and analyzes possible equilibria of the Doha proposal. Section 5 concludes.

2. Asymmetric Environmental Standards

2.1. The Model

There are two countries in the model: the North and the South. The regions are assumed to be symmetric in all aspects aside from their environmental regulations. The North is assumed to enforce environmental standards by imposing a pollution tax on emissions released by firms during production. The South in contrast can choose to adopt standards and enjoy trade liberalization or to keep its lax environmental regulations and pay tariffs.\(^{10}\) The latter option

\(^9\) Green tariffs refer to trade barriers raised for environmental purposes, i.e. trade obligations in MEAs.

\(^{10}\) While Southern policy with regards to participating in a MEA is endogenized, the magnitude of the standards required in the MEA remains exogenous in the model.
allows local as well as foreign firms operating in the South to produce without any additional charges for causing pollution. There is however a green tariff in this case set optimally by the North against all dirty imports from the South, including re-exports of the Northern firm.\footnote{Note that the model only considers goods that are directly related to the environmental problem.}

The model assumes two firms with one belonging to each country. They produce a homogeneous good and compete in an oligopolistic manner à la Cournot. Firms compete in segmented markets and choose the optimal output for each market separately. The Northern firm is a multinational and can decide on production location. It can stay at home and serve both markets from its Northern headquarters. It can also build a subsidiary in the South to serve the Southern market, but still maintain production in the North to serve its home interests. Alternatively, it can close down home production altogether and completely delocate for pollution-related purposes to serve both markets from the South. The Southern firm on the other hand is assumed to be a local firm for simplicity and only produces in its domestic country.\footnote{This locational framework follows Motta and Thiesse (1994).}

Demand is assumed to be linear and takes the familiar form

\[ p_i = a - Q_i \quad \text{for} \quad i = N, S, \] (1)

where \( Q \) is the total consumption in each region, and subscripts \( N \) and \( S \) represent the North and the South. Total consumption in each region is

\[
\begin{align*}
Q_N^E &= q_{SN} + q_{NN} \quad Q_S^E = q_{SS} + q_{NS} \\
Q_N^F &= q_{SN} + q_{NN} \quad Q_S^F = \tilde{q}_{SS} + \tilde{q}_{SS} \ast \\
Q_N^D &= \tilde{q}_{SN} + \tilde{q}_{SN} \ast \quad Q_S^D = \tilde{q}_{SS} + \tilde{q}_{SS} \ast
\end{align*}
\] (2)

where the first subscript indicates where the good is produced and the second denotes where it is consumed. Superscript \( E \) represents the case where the Northern firm produces only in the North and exports to the South, \( F \) when it undertakes FDI to serve the Southern market locally, and \( D \) when it completely delocates and re-exports back to the North. The tilde above \( q \) denotes a situation where both firms produce in the South, while a star distinguishes
Northern foreign production from local output by the Southern firm. The costs of production are divided between non-pollution related costs $c$ and pollution tax $\tau$ paid on emissions that are released from producing one unit of the good.

Looking at the case of non-compliance in the rest of this section, the profit function for the Northern firm when all of its production takes place in the North is

$$\pi_N^F = q_{NN} (a - Q_N^F - c - e_0) + q_{NS} (a - Q_S^F - c - e_0), \quad (3a)$$

where $e_0$ represents the unit emission discharged by each firm. It also denotes the pollution intensity of the industry at hand. This locational scenario implies that the Northern firm must pay a pollution tax on its entire production. When it builds a subsidiary in the South to serve each market locally, it only pays a pollution tax on the goods it produces in the North for the domestic market:

$$\pi_N^F = q_{NN} (a - Q_N^F - c - e_0) + \tilde{q}_{SS} *(a - Q_S^F - c) - \Gamma. \quad (3b)$$

$\Gamma$ is the fixed cost of setting up a plant abroad which is independent of output. If the Northern firm completely delocates to serve both markets from the South, it avoids paying pollution taxes altogether, but is bound to pay tariffs on its exports back to the North:

$$\pi_N^D = \tilde{q}_{SN} *(a - Q_N^D - c - t) + \tilde{q}_{SS} *(a - Q_S^D - c) - \Gamma. \quad (3c)$$

The profit of the Southern firm takes the form

$$\begin{align*}
\pi_S^I &= q_{SN} (a - Q_N^I - c - t) + q_{SS} (a - Q_S^I - c) \\
\pi_S^F &= q_{SN} (a - Q_N^F - c - t) + \tilde{q}_{SS} (a - Q_S^F - c) \\
\pi_S^D &= \tilde{q}_{SN} (a - Q_N^D - c - t) + \tilde{q}_{SS} (a - Q_S^D - c)
\end{align*} \quad (4)$$

for each scenario that prevails subsequent to the Northern firm’s decision on production location. Recall that there is no environmental tax enforced in the South here, but a tariff is paid on Southern exports to the North.\footnote{Tariffs and pollution taxes have been normalized to the market size to allow for the elimination of $(a-c)$ from all upcoming equations.} Adopting backward induction, section 2.2 first solves the problem of firms in the final stage where they compete in output.
2.2. Production

In the export case, production by the Northern firm in the North for each market is

\[ q_{SN} = \frac{1 + t - 2\tau e_0}{3}, \quad (5) \]

\[ q_{SS} = \frac{1 - 2\tau e_0}{3}, \quad (6) \]

while the Southern firm produces

\[ q_{SS} = \frac{1 + \tau e_0}{3}, \quad (7) \]

\[ q_{SN} = \frac{1 - 2t + \tau e_0}{3}. \quad (8) \]

\( t \geq 2\tau e_0 - 1 \) is a constraint for \( q_{NN} \geq 0 \) to hold so that the Northern firm continues to serve its home market through local production.\(^{14}\) \( t \leq \frac{1 + \tau e_0}{2} \) is also a necessary condition for the Southern firm to maintain its exports to the North, i.e. for \( q_{SN} \geq 0 \). This threshold value of \( t \) stops the importation of all dirty products to the North by blocking trade and gives the Northern firm a monopoly position in its home market. Such prohibitive tariff rates denote a complete ban on imports from the South making values of \( t \) above this level irrelevant for the analysis. In the case of FDI, \( q_{NN} \) and \( q_{SN} \) remain similar to (5) and (8) as the Northern firm keeps producing for its home market from a local plant. It however builds a subsidiary in the South to serve the latter locally, making the output aimed at the South

\[ \tilde{q}_{SS}^* = \tilde{q}_{SS} = \frac{1}{3} \quad (7') \]

for both firms. When the Northern firm delocates, production for the Southern market by both firms remains the same as (7'). The Northern firm also produces for its domestic market in the South and re-exports back to the North, making production by both firms aimed at the North

\[ \tilde{q}_{SN}^* = \tilde{q}_{SN} = \frac{1 - t}{3}. \quad (8') \]

\(^{14}\) It will be seen that this constraint is never binding as it coincides with the scenario of complete delocation, where the Northern firm does not produce at home and no longer pays an emission tax.
If the Northern firm produces at home for the domestic market, the direct effect of tariffs is to increase local production in the North and reduce imports from the South. Stricter standards per se have the reverse effect of reducing Northern production and encouraging production by the Southern firm. When the Northern firm exports to the South, \( \tau \) affects the entire production by both firms, whereas with FDI only goods targeted at the Northern market are influenced. As under FDI both firms produce in the South for the Southern market where no pollution tax exists, the optimal quantity produced by both firms resembles that in a typical Cournot case. Finally, if the Northern firm completely closes down production in the North and establishes a plant in the South to serve both markets, pollution taxes become irrelevant and tariffs reduce the exports of both firms to the North.

### 2.3. Location

In the third stage of the game, the Northern multinational must choose where to locate to serve each market. By substituting the optimal output back into the Northern firm’s profit function and comparing the profits for each case, we can find the locational outcome that yields the most profits. Northern profits for each scenario are simply

\[
\pi^E_N = q_{NN}^2 + q_{NS}^2, \tag{9a}
\]
\[
\pi^F_N = q_{NN}^2 + \tilde{q}_{SS}^\ast^2 - \Gamma, \tag{9b}
\]
\[
\pi^D_N = \tilde{q}_{SN}^\ast^2 + \tilde{q}_{SS}^\ast^2 - \Gamma. \tag{9c}
\]

Looking first at profits of keeping all production in the North against establishing an extra plant in the South, we can see that in the absence of relocation costs \( \Gamma \), a firm would always be better off by serving each market through a local subsidiary.\(^{15}\) The critical level of fixed costs that makes \( \pi^E_N = \pi^F_N \) is

\(^{15}\) This also reflects the branch of literature on environment and firms’ location pioneered by Markusen et al. (1993) that assumes firms to be footloose. Thus, there are no extra costs for relocation as they incur a plant specific fixed cost regardless of whether they build a plant at home or in the other region. The number of plants would however matter in determining the total fixed costs in this case.
When fixed costs are below this level, costs of relocation are sufficiently low making FDI the preferable scenario. Otherwise, relocation is too costly and the Northern firm keeps all production at home anyway leaving no concern about the supplementary influence of environmental policies on firm location. This scenario reflects a situation where there is no threat of relocation due to very high plant-specific fixed costs, or inflexible foreign investment laws and political instability in the host country. As we are interested in a case where relocation is at least partly an option, this paper focuses on a situation with sufficiently low fixed costs of relocation. The export scenario where the Northern firm keeps all production in the North is therefore ruled out under asymmetric standards.\(^{16}\)

We can now concentrate on the comparison between profits under FDI and delocation to distinguish between the standard form of capital movement and relocation due to pollution-related reasons. The threshold tariff rate below which the Northern firm completely delocates is the \(t\) that makes profits under the two options equal (\(\pi^E_N = \pi^D_N\)):

\[
x = \frac{4}{9}x(1-e)\tag{10}
\]

Figure 2 shows the locational choice of the Northern firm in the space of \(\tau\) and \(t\) for an emission level of \(e_0=1\). It is easy to see that a higher pollution tax in the North makes delocation to the South more attractive. The shaded area shows the region where tariffs halt trade. \(\frac{\partial x}{\partial \tau} > 0\) implies that tougher standards require a higher tariff on dirty goods from the South to impede delocation. We can also see that in the case of free trade, profits of completely delocating to the South are always higher than having local facilities in each country. This reinforces the complementary nature of economic integration and environmental standards by showing that without a trade policy, the smallest amount of

\(^{16}\) The dividing line between the export and the FDI case has been studied in Motta and Thissse (1994). It plays a more important role in their analysis, as they also look at differences in the market size between regions and changes in fixed costs of establishing a plant.
pollution tax could result in complete delocation of multinationals to countries with lax environmental regulations. As tariffs rise, delocation becomes less attractive for a larger range of Northern pollution tax.

3. Environmental Harmonization and Trade Liberalization

This section of the paper analyzes the consequences of policies that suggest global harmonization of environmental regulations. This can be interpreted as a successful implementation of policies discussed at the WTO Doha round, to only allow those WTO members integrate and enjoy trade liberalization who have ratified a MEA and raised their environmental standards to the level in force in signatory countries. Here the South upgrades its standards to the level imposed in the North, namely $\tau$, and enjoys free trade as a reward, i.e. tariff $t$ is abolished.

There is only one possible scenario in the case of harmonized standards as liberalized trade and symmetry in environmental policies make the multinational indifferent about location. There are no incentives for relocation in such situation, and the smallest form of relocation fixed costs causes firms to remain in their home country. Both firms now pay the pollution tax $\tau$ on the emissions they release during production, while trade is liberalized. The profit functions of the two firms are now

$$\pi_i^H = q_{iN} (a - Q_N^H - c - \tau_0) + q_{iS} (a - Q_S^H - c - \tau_0) \quad \text{for} \quad i = N, S, \quad (12)$$

where superscript $H$ stands for harmonized environmental standards. In this case, the quantity produced by each firm for the domestic and the foreign market is identical:

$$q_{NN}^H = q_{NS}^H = q_{SN}^H = q_{SS}^H = \frac{1 - \tau_0}{3}. \quad (13)$$

Profits are equal for both firm under harmonized standards and are

$$\pi_i^H = q_{iN}^{H^2} + q_{iS}^{H^2} \quad \text{for} \quad i = N, S. \quad (14)$$

Profits are lower the more stringent are the standards required in the MEA. We now turn to the first two stages of the game where the South decides whether or not to comply with environmental harmonization and the North chooses an optimal punishing tariff in the case of
non-compliance. By choosing to adopt standards, the South makes relocation redundant for
the Northern firm and forces the latter to keep all production at home. When the South
disagrees to adopt standards on the other hand, the Northern firm can decide whether to
undertake FDI or completely delocate production using the approach explained in section 2.3.

4. Optimal Policy by Governments

4.1. Welfare

This section introduces the components of welfare for the North and the South under each
scenario. Economic welfare in this setting is the sum of consumer surplus and producer
surplus minus the disutility caused by pollution, plus the tariff revenue for the North.

Consumer surplus is the area under the demand curve and can be written as half of the total
output intended for each region squared:

\[ CS_i^j = \frac{Q_i^j}{2} \quad \text{for} \quad i = N, S, \quad j = F, D. \]  \hspace{1cm} (15)

Consumer surplus in the North and the South when the latter does not adopt standards is

\[ CS_N^F = \frac{(2-t-\pi_0)^2}{18}, \]  \hspace{1cm} (15a)

\[ CS_S^F = \frac{2}{9}, \]  \hspace{1cm} (15b)

\[ CS_N^D = \frac{2}{9}(1-t)^2, \]  \hspace{1cm} (15b)

\[ CS_S^D = \frac{2}{9}, \]  \hspace{1cm} (15b)

for FDI and delocation respectively. When standards are adopted, consumer surplus turns to

\[ CS_i^{HF} = \frac{2}{9}(1-\pi_0)^2 \quad \text{for} \quad i = N, S. \]  \hspace{1cm} (15c)

Producer surplus with no standards in the North is the profits in (9b) and (9c) for FDI and
delocation respectively. Producer surplus in the South on the other hand equals Southern
profits from (4) using the appropriate output for each case:

\[ \pi_S^F = q_{SN}^2 + \tilde{q}_{SS}^2, \]  \hspace{1cm} (16a)

\[ \pi_S^D = \tilde{q}_{SN}^2 + \tilde{q}_{SS}^2. \]  \hspace{1cm} (16b)
Equation (14) represents producer surplus for both regions with harmonized standards.

The third component of welfare is the disutility caused by pollution in each region. This is parameterized as $D_i$ and contains total emissions in each region and a parameter $d_i$, which measures the concern of the population of a country about pollution:

$$D_i = d_i E_i \quad \text{for} \quad i = N, S; \quad j = E, F, D.$$  \hspace{1cm} (17)

Another interpretation for parameter $d_i$ is the relative importance of the disutility caused by emissions against the utility gained from the other components of welfare.\(^{17}\)

Pollution is assumed to be of the transboundary type.\(^{18}\) Total world pollution depends on whether the non-signatory joins the MEA, the trade obligations of the MEA, and the location of the Northern multinational. Looking at the case with no standards, total world emission is

$$E^F = \frac{1}{3} e_0 (4 - t - \tau e_0),$$ \hspace{1cm} (18a)

$$E^D = \frac{2}{3} e_0 (2 - t),$$ \hspace{1cm} (18b)

when the multinational has a local subsidiary in each country and when it completely delocates respectively. Under harmonized standards, total emission turns to

$$E^H = \frac{4}{3} e_0 (1 - \tau e_0).$$ \hspace{1cm} (18c)

The first order conditions of emissions released with respect to pollution taxes and tariffs show how the environment can be affected through government policies. The derivatives are trivially negative with respect to $t$ and $\tau$ implying that green tariffs and emission taxes per se are beneficial for the environment. When delocation is binding ($t < \tau e_0$), pollution is always lower when standards are harmonized. When FDI is the locational outcome on the other hand,

\(^{17}\) Disutility here increases monotonically with pollution. Other functional forms can be used to describe disutility, but the merits of the results remain the same.

\(^{18}\) Note that most MEAs deal with transboundary or global issues. If pollution is local, there is no role for a MEA or the WTO.
pollution is lower only in a sub-region where $t < 3\tau e_0$. Higher tariffs prior to liberalizations reduce production by so much that pollution is actually lower than the harmonization case.

The important question that needs to be asked here is whether environmental policies can be optimally implemented in isolation or in conjunction with trade obligations through a MEA, taking into consideration their consequences on firm location and output and hence on total welfare. Total welfare for each country can now be summarized to

$$\begin{align*}
W_N^j &= \pi_N^j + CS_N^j - D_N^j + T \\
W_S^j &= \pi_S^j + CS_S^j - D_S^j
\end{align*}$$

for $j = F, D, H$ using the corresponding values found above for each component of welfare. $T$ is the tariff revenue and equals unit tariff rate $t$ times the total quantity exported to the North.

4.2. Optimal Northern Tariff

The welfare function derived in the previous section can now be used to see if it is optimal for the North to impose a punishing tariff on the South if the latter refuses to adopt the standards required in a MEA. The Northern government sets an optimal tariff that maximizes its welfare in the second stage for each scenario. It then compares Northern welfare for FDI and delocation using the respective optimal tariffs. Taking the decision of its firm on location into consideration, it chooses the optimal tariff that results in a higher Northern welfare.\(^{19}\)

The optimal tariff for each case can easily be found by differentiating Northern welfare in (19) with respect to $t$ using the appropriate components from the previous sections to get

$$\begin{align*}
t^{*F} &= \frac{1 + d_N e_0}{3}, \\
t^{*D} &= d_N e_0,
\end{align*}$$

for FDI and delocation respectively. The optimal tariff is positive for all levels of environmental standards and is increasing with higher pollution concerns in the North. Note from (20b) and (11) that a level of concern $d_N > \tau$ implies a tariff rate of $t^{*D} > \bar{t}$; therefore,

\(^{19}\) Recall that the tariff is set before the decision of the firm about location; therefore, there are no profit-shifting incentives present in the model.
$t^\phi$ is only binding for $d_N \leq \tau$ as delocation only occurs in this range. When $d_N > \tau$, the maximum tariff where delocation is still possible, $\tilde{\tau}$, is instead chosen. Given the optimal tariffs, there is a threshold level of pollution tax under which the North prefers a FDI situation to complete delocation in terms of welfare. This is the $\tau$, which makes welfare under FDI and delocation equal given the corresponding optimal tariffs:

$$\tilde{\tau} = \begin{cases} 
\frac{2 - d_N e_0 - \sqrt{3} [1 - 2 d_N e_0 (1 - d_N e_0)]}{3 e_0} & \text{for } d_N \leq \tau \\
\frac{3 e_0}{2 + d_N e_0 - \sqrt{21 + 6 d_N e_0 (1 - d_N e_0)}} \frac{3}{5 e_0} & \text{for } d_N > \tau.
\end{cases}$$ (21)

When unit emission is set to unity, this critical value of $\tau$ starts with 0.1 for $d_N=0$ and is continuously increasing in $d_N$ at a slow rate.\textsuperscript{20} Unless standards required in a MEA are unrealistically high, the Northern government prefers a FDI situation to delocation for all levels of $d_N$ when optimal tariffs are in place. This makes $t^\phi$ the relevant tariff for this region.

A higher concern over pollution in the North simply increases the optimal tariff and the range of environmental tax where the North prefers FDI to delocation.

The Northern optimal tariff is illustrated in figure 3 for $d_N=0$ along the applicable range of $\tau$.

The effects of changes in $d_N$ on $t^\phi$ and $\tilde{\tau}$ are also demonstrated in the figure. The thick line illustrates the optimal tariff used, which is $t^\phi$ for the range of $\tau$ where FDI is preferable to delocation ($0 \leq \tau \leq \tilde{\tau}$) and min $\{\tilde{\tau}, t^\phi\}$ thereafter. The optimal level of tariffs results in a FDI scenario in the region of interest implying that FDI for motives other than pollution is the only form of capital movement to the South. Even upon non-compliance by the South, delocation to pollution havens does not occur due to positive optimal tariffs, reinforcing empirical studies that have found weak or no evidence for the pollution haven hypothesis. Delocation is a purely theoretical outcome that only arises in the non-realistic case where pollution related costs amount to a very high fraction of total costs. This suggests an explanation for why

\textsuperscript{20} The qualitative results remain the same for other pollution intensities as all results adjust proportionally for different values of $e_0$. 

16
concerns over pollution havens are restricted to theory and not consistent with empirical evidence.

Proposition 1

A positive optimal Northern tariff makes FDI the equilibrium locational outcome if the South deviates and does not ratify. Pollution-related delocation hence does not take place in a plausible range of \( \tau \), discrediting the pollution haven hypothesis also in theory.

Taking the MEA trade obligations into consideration, the Southern government moves in the first stage to commit to its optimal environmental policy.

4.3. Optimal Southern Environmental Policy

We turn to the first stage of the game to analyze the Southern government’s policy choice, namely whether to adopt standards and enjoy trade liberalization or to continue to ignore MEAs and pay punishing green tariffs. Looking at the Southern welfare function from (19) after substituting for its components from the appropriate equations, it is easy to demonstrate if adopting standards would be beneficial for the South. Comparing (15a) and (15b) with (15c), we can see that Southern consumer surplus is always lower when environmental standards are harmonized. Southern producer surplus also falls with the adoption of standards if delocation prevails under no standards \((t<\tau_0)\). If FDI is the prospective non-compliance outcome on the other hand, there is a threshold tax level \( \tilde{\tau} < \frac{3 - 2t + \sqrt{8t^2 - 16t + 9}}{e_0} \) under which the Southern firm is better off when standards are harmonized in the two regions. This is due to tariff savings that arise from move to free trade. Yet, this advantage is only materialized for low values of \( \tau \), where switching policy results in higher total production by the Southern firm. Furthermore, \( \pi^D_S > \pi^F_S \) for \( t>\tau_0 \) implies that the interests of the Southern firm are always in conflict with the Northern firm’s preferences on location.

In the rest of this section, we focus on the case where there is no concern over pollution in the South \((d_S=0)\).\(^{21}\) In a delocation scenario, the South never finds it optimal to ratify as it is

\(^{21}\)While this makes the notation much easier to follow, all results hold for positive values of \(d_S\).
strictly better off with no standards. When FDI is the locational outcome under no standards on the other hand, there is a critical level of $\tau$ below which ratification is desired by the South. This level of pollution tax solves for $W_S^F = W_S^H$ and is

$$\bar{\tau} = \frac{5 - 2t + \sqrt{16t^2 - 32t + 25}}{3e_0}. \quad (22)$$

The hyperbola in figure 3 shows the locus where Southern welfare with ratification is equal to that of the FDI / no standards case. The area to the left of the curve is the region where the South is better off by adopting standards. Gains from producer surplus and tariff revenues outweigh consumer surplus losses in this region. Anticipating Northern optimal tariffs from the second stage $t^*F$, the South ratifies the MEA as the tariff makes the Southern policy choice fall right in the region where compliance is optimal. This makes harmonization the unique equilibrium outcome for the relevant range of $\tau$. Here tariffs work successfully as a credible threat to motivate environmental harmonization without actually being put into practice. The Doha proposal can hence be deemed effective for fairly low values of $\tau$ consistent with data, and is a subgame perfect equilibrium outcome. Only in the unlikely case of a very high $\tau$, standards would not be adopted and the equilibrium outcome turns to delocation.

**Proposition 2**

Trade obligations, i.e. green tariffs, work as a credible threat to persuade the South to ratify a MEA that requires an upgrading of its standards. The Doha proposal is hence effective as environmental harmonization with trade liberalization is the unique subgame perfect equilibrium outcome for a modest range of $\tau$.

5. Conclusion

This paper studies the importance of MEA trade obligations for a successful round of international environmental negotiations. It particularly emphasizes on the proposal made at the Doha round of the WTO with regards to the introduction of conditional consent for economic integration upon ratification of certain MEAs. Non-cooperation in this case allows
for punishing tariffs against a country with environmental standards weaker than those set out in the MEA. Building a framework to reflect the Doha proposal, the paper shows that for a modest range of requirements, it is optimal for a non-signatory country to upgrade its standards according to the MEA. Trade obligations in the MEA work only as a credible threat to deter delocation and motivate environmental harmonization. Even if the Southern government deviates, Northern optimal tariffs are positive so pollution motivated delocation never occurs.

It was found in the light of Carraro and Siniscalco (1994) that unlike conventional environmental policy recommendations, a policy to control pollution can only be optimal when it is a mix of complementary measures. Since a pollution tax alone may not be an effective policy tool, its role must be reassessed and trade obligations must be considered when reaching out for environmental targets. If green tariffs can serve as a successful threat against delocation and eco-dumping policies, they may at times be the only means of a move towards more successful international environmental negotiations. Yet, the paper shows that positive tariffs do not turn up in equilibrium.

The model in the paper is only a cornerstone to highlight the basic roles of green tariffs and the potential need for trade obligations to achieve the outcomes desired in a MEA. It can easily be extended to investigate an optimal emission tax rate for each region, or one to study whether a world optimal tariff through an international body can be used to induce participation in a MEA when the latter is globally optimal. It is interesting to study the effects of such tariffs and/or emission tax on the R&D effort by firms to abate pollution. It is also important to look into more direct measures of improving the environment such as abatement R&D subsidies to avoid creating a distortion. It must however be taken into account that such subsidies must be financed from costly taxation. Extending the model to include more countries is a next step to see the impact of the number of signatories on the decision of a non-signatory in regards to ratification. Another interesting line of research is to study the issue into a multi-firm, multi-sector general equilibrium framework.
References


Figure 1: R&D investment by the Northern Firm

I. Southern Government: environmental standards ($\tau$)
II. Northern Government: green tariffs ($t$)
III. Northern Firm: location
IV. Firms: production ($q$)

Figure 2: Location of the Northern Firm

no trade ($q_{SN}=0$)

FDI

delocation
Figure 3: Optimal Government Policies
Anil MARKANDYA, Suzette PEDROSO and Alexander GOLUB: Empirical Analysis of National Income and So2 Emissions in Selected European Countries

Masahisa FUJITA and Shlomo WEBER: Strategic Immigration Policies and Welfare in Heterogeneous Countries

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

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

Romano PIRAS: Growth, Congestion of Public Goods, and Second-Best Optimal Policy

Herman R.J. VOLLEBERGH: Lessons from the Polder: Is Dutch CO2-Taxation Optimal

Sandro BRUSCO, Giuseppe LOPOMO and S. VISWANATHAN (lxv): Merger Mechanisms

Wolfgang AUSSENEG, Pegaret PICHLER and Alex STOMP (lxv): IPO Pricing with Bookbuilding, and a When-Issued Market

Pegaret PICHLER and Alex STOMP (lxv): Primary Market Design: Direct Mechanisms and Markets

Florian ENGLMAIER, Pablo GUILLEN, Loreto LLORENTE, Sander ONDERSTAL and Rupert SAUSGRUBER (lxv): The Chopstick Auction: A Study of the Exposure Problem in Multi-Unit Auctions

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

Olad KADAN (lxv): Equilibrium in the Two Player, k-Double Auction with Affiliated Private Values

Maarten C.W. JANSSEN (lxv): Auctions as Coordination Devices

Gadi FIBICH, Arieh GAVIOUS and Aner SELA (lxv): All-Pay Auctions with Weakly Risk-Averse Buyers

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

Javier Rey-MAQUIEIRA PALMER, Javier LOZANO IBÁÑEZ and Carlos Mario GÓMEZ GÓMEZ (lxv): Impact of Tourism Consumption on GDP. The Role of Imports

Economic Growth in Latin American Countries: A Panel Data Approach

Marian WEBER (lxviii): The Economic Value of Cultural Diversity: Evidence from US Cities

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

Gianmarco I.P. OTTAVIANO and Giovanni PERI: Trade and Domestic Welfare

Divide and Conquer: Noisy Communication in Networks, Power, and Wealth Distribution

Dienva ARENDZ: Household Shareholding? Evidence from Italy

Marta STRYSZOWSKA: Econometric Identification and Estimation of Multi-Unit, Sequential, Oral, Ascending-Price Auctions With Asymmetric Bidders

Anna ALBERINI, Paolo ROSATO, Alberto LONGO and Valentina ZANATTA (lxv): Immigration and Local Urban Participatory Democracy: A Boston-Paris Comparison

Gianmarco I.P. OTTAVIANO and Giovanni PERI: Cross-Country Ethical Dilemmas in Business: A Descriptive Framework

Florian ENGLMAIER, Pablo GUI LLEN, Loreto LLORENTE, Sander ON DERSTAL and Rupert SAUSGRUBER (lxv): The Chopstick Auction: A Study of the Exposure Problem in Multi-Unit Auctions

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

Nicoletta FERRO: Assessment of the Effectiveness of Tradable Landuse Rights for Biodiversity Conservation: an Application to Canada’s Boreal Mixedwood Forest

Pius ODUNGA and Henk FOLMER (lxvii): Profiling Tourists for Balanced Utilization of Tourism-Based Resources in Kenya

Jean-Jacques NOWAK, Mondher SAHLI and Pasquale M. SGRO (lxvii): Tourism, Trade and Domestic Welfare

Riaz SHAREEF (lxvii): Country Risk Ratings of Small Island Tourism Economies

Juan Luis EUGENIO-MARTÍN, Noelia MARTÍN MORALES and Riccardo SCARPA (lxvii): Tourism and Economic Growth in Latin American Countries: A Panel Data Approach

Raul Hernández MARTÍN (lxvii): Impact of Tourism Consumption on GDP. The Role of Imports

Nicoletta FERRO: Cross-Country Ethical Dilemmas in Business: A Descriptive Framework

Marian WEBER (lxviii): The Economic Value of Cultural Diversity: Evidence from US Cities

Linda CHAIB (lxviii): Immigration and Local Urban Participatory Democracy: A Boston-Paris Comparison
An Application to the Recreational Value of Forests

Gernot KLEPPER and Sonja PETERSON:

Andrea BIGANO and Stef PROOST:

Kiflemariam HAMDE:

Ingo BRÄUER and Rainer MARGGRAF:

Dinko DIMITROV, Peter BORM, Ruud HENDRICKX and Shao CHIN SUNG:

Anastasios XEPAPADEAS and Constadina PASSA:

Valentina BOSETTI, Mariaester CASSINELLI and Alessandro LANZA:

Correlations in the Returns on Oil Companies Stock Prices and Their Determinants

Heterogeneous Agents

Implications

Environmental Programs: An Evolutionary Approach

Possibilities of the Contingent Valuation Method

E.C.M. RUIJGROK

Netherlands

Resources on Smallholder Farms in Hungary: Institutional Analysis

Technology-based Climate Protocol

Analysis of Extractive Reserves in the Brazilian Amazon

Analysis to Evaluate Environmentally Conscious Tourism Management

Effects on Energy Scenarios

Notes on the Determinants of Innovation: A Multi-Perspective Analysis

Francesco RICCI: Channels of Transmission of Environmental Policy to Economic Growth: A Survey of the Theory

Anna ALBERINI, Maureen CROPPER, Alan KRUPNICK and Nathalie B. SIMON: Willingness to Pay for Mortality Risk Reductions: Does Latency Matter?

Ingo BRAÜER and Rainer MARGGRAF (lxvi): Valuation of Ecosystem Services Provided by Biodiversity Conservation: An Integrated Hydrological and Economic Model to Value the Enhanced Nitrogen Retention in Renaturated Streams

Timo GOESCHL and Tun LIN (lxvi): Biodiversity Conservation on Private Lands: Information Problems and Regulatory Choices

Tom DEDEURWAERDERE (lxvi): Bioprospection: From the Economics of Contracts to Reflexive Governance

E.C.M. RUIJGROK and E.E.M. NILLESEN (lxvi): The Socio-Economic Value of Natural Riverbanks in the Netherlands


Giannis VARDAS and Anastasios XEPAPADEAS: Uncertainty Aversion, Robust Control and Asset Holdings

Anastasios XEPAPADEAS and Constadina PASSA: Participation in and Compliance with Public Voluntary Environmental Programs: An Evolutionary Approach

Michael FINUS: Modesty Pays: Sometimes!

Francesco BOSETTI, Mariaesther CASSINELLI and Alessandro LANZA (lxvii): Using Data Envelopment Analysis to Evaluate Environmentally Conscious Tourism Management

Timo GOESCHL and Danilo CAMARGO IGLIORI (lxvi): Property Rights Conservation and Development: An Analysis of Extractive Reserves in the Brazilian Amazon

Economists and Karl CARRARO: Economic and Environmental Effectiveness of a Technology-based Climate Protocol

Eliosso PAPYRAKIS and Reyer GERLAGH: Resource-Abundance and Economic Growth in the U.S.

Györgyi BELA, György PATAKI, Melinda SMALE and Mariann HAJDÚ (lxvi): Conserving Crop Genetic Resources on Smallholder Farms in Hungary: Institutional Analysis

E.C.M. RUIJGROK and E.E.M. NILLESEN (lxvi): The Socio-Economic Value of Natural Riverbanks in the Netherlands


Giannis VARDAS and Anastasios XEPAPADEAS: Uncertainty Aversion, Robust Control and Asset Holdings

Anastasios XEPAPADEAS and Constadina PASSA: Participation in and Compliance with Public Voluntary Environmental Programs: An Evolutionary Approach

Michael FINUS: Modesty Pays: Sometimes!

Trond BJØRNDAL and Ana BRASÃO: The Northern Atlantic Bluefin Tuna Fisheries: Management and Policy Implications

Alejandro CAPARRÓS, Abdelhakim HAMMOUDI and Tarik TAZDAÏT: On Coalition Formation with Heterogeneous Agents

Massimo GIOVANNINI, Margherita GRASSO, Alessandro LANZA and Matteo MANERA: Conditional Correlations in the Returns on Oil Companies Stock Prices and Their Determinants

Alessandro LANZA, Matteo MANERA and Michael MCALEER: Modelling Dynamic Conditional Correlations in WTI Oil Forward and Futures Returns

Margherita GENIUS and Elisabetta STRAZZERA: The Copula Approach to Sample Selection Modelling: An Application to the Recreational Value of Forests
Rob DELLINK and Ekko van IERLAND: Pollution Abatement in the Netherlands: A Dynamic Applied General Equilibrium Assessment

Rosella LEVAGGI and Michele MORETTO: Investment in Hospital Care Technology under Different Purchasing Rules: A Real Option Approach

Salvador BARBERA and Matthew O. JACKSON (lxx): On the Weights of Nations: Assigning Voting Weights in a Heterogeneous Union

Alex ARENAS, Antonio CABRALES, Albert DÍAZ-GUILERA, Roger GUIMÉRÀ and Fernando VEGA-REDONDO (lx): Optimal Information Transmission in Organizations: Search and Congestion

Francis BLOCH and Armando GOMES (lx): Contracting withExternalities and Outside Options

Rahab AMIR, Efrosyni DIAMANTOUDI and Licun XUE (lx): Merger Performance under Uncertain Efficiency Gains

Francis BLOCH and Matthew O. JACKSON (lx): The Formation of Networks with Transfers among Players

Daniel DIEMEIJER, Hulya ERASLAN and Antonio MERLO (lx): Bicameralism and Government Formation

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

Kfir ELIAZ, Debaj Ray and Ronny RAZIN (lx): Group Decision-Making in the Shadow of Disagreement

Sanjeev GOTOY, Marco van der LEIJ and José Luis MORAGA-GONZÁLEZ (lx): Economics: An Emerging Small World?

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

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

Elissaios PAPYRAS and Reyer GERLAGH: Natural Resources, Investment and Long-Term Income

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

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

Rolf GOLOMBEK and Michael HOEL: Climate Agreements and Technology Policy

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

Gianmarco L. P. OTTAVIANO and Giovanni PERRY: Cities and Cultures

Massimo DEL GAITTO: 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 BÖSELLO, Marco LAZZARIN, Roberto ROSON and Richard S.J. TOL: Economy-Wide Estimates of the Implications of Climate Change: Sea Level Rise

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

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 NIJKAMP: Willingness to Pay for Agricultural Environmental Safety: Evidence from a Survey of Milan, Italy, Residents

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

Valentina BOSETTI 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 FLORIO and Mara GRASSEN: The Missing Shock: The Macroeconomic Impact of British Privatisation

John BENNETT, Saul ESTRIN, James MAW and Giovanni URG: 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 PRANOVI, Simone LIBRALATO, Patrizia TORRICELLI and Danilo MAINARDI: Comparison between Artisanal Fishery and Manila Clam Harvesting in the Venice Lagoon by Using Ecosystem Indicators: An Ecological Economics Perspective

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

Valeria COSTANTINI and Francesco GRACCEVA: Oil Security, Short- and Long-Term Policies
Auctions
Price Sealed-Bid Auctions
Maximization and the Multiple-Good Monopoly and Evidence from Timber Auctions
Roberto BURGUET

Externalities
in Stabilization Policies?
Bookbuilding is Dominating Auctions
Real Option Analysis
Environmental Taxation Game
Herbert DAWID, Christophe DEISSENBERG and Pavel ŠEVČ

Influence of World Energy Prices for Public Goods: Finite Versus Continuous Mixing in Logit Models
Latent-Class Approach Based on Intensity of Participation
Savings
Analysis of Climate Change Impacts on Tourism

Valeria COSTANTINI, Francesco GRACCEVA: Social Costs of Energy Disruptions
Christian EGENHOFER, Kyriakos GIALLOGLOU, Giacomo LUCIANI, Maroelsa 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, Jaroslav MYSIAK and Anita FASSIO: An Integrated Assessment Framework for Water Resources Management: A DSS Tool and a Pilot Study Application

Paul MENSINK: Instant Efficient Pollution Abatement Under Non-Linear Taxation and Asymmetric Information: The Differential Tax Revisited

Mauro FABIANO, Gabriella CAMARSIA, Rosanna DURSI, Roberta VALDINI, Valentina MARIN and Francesca PALMISANI: Integrated Environmental Study for Beach Management: A Methodological Approach

Irena GROSFELD and Iraj HASHI: The Emergence of Large Shareholders in Mass Privatized Firms: Evidence from Poland and the Czech Republic

Maria BERRITTELLA, Andrea BIGANO, Roberto ROSON and Richard S.J. TOL: A General Equilibrium Analysis of Climate Change Impacts on Tourism

Reyer GERLAGH: A Climate-Change Policy Induced Shift from Innovations in Energy Production to Energy Savings

Elisatos PAPYRAKIS and Reyer GERLAGH: Natural Resources, Innovation, and Growth

Bernardo BORTOLOTTI and Mara FACCIO: Reluctant Privatization

Riccardo SCARPA and Mara THIENE: Destination Choice Models for Rock Climbing in the Northeast Alps: A Latent-Class Approach Based on Intensity of Participation


Santiago J. RUBIO: On Capturing Oil Rents with a National Excise Tax Revisited

Ascensión ANDINA DÍAZ: Political Competition when Media Create Candidates’ Charisma

Anna ALBERINI: Robustness of VSL Values from Contingent Valuation Surveys

Gernot KLEPPER and Sonja PETERSON: Marginal Abatement Cost Curves in General Equilibrium: The Influence of World Energy Prices

Sergio ACOCELLA, Giovanni Di BARTOLOMEO and Wilfried PAUWELS: Is there any Scope for Corporatism Pressure Groups in the Kyoto Protocol’s Adoption Process

François DEGEORGE, François DERRIEN and Kent L. WOMACK: Quid Pro Quo in IPOs: Why


Patrick BAYARI, Stephanie HOUGHTON and Steven TADELS (lxxi): Bidding for Incompete Contracts

Patrick BAJARI, Stephanie HOUGHTON and Steven TADELS (lxxi): Bidder for Incompete Contracts

Susan ATHEY, Jonathan LEVIN and Enrique SEIRA (lxxi): Comparing Open and Sealed Bid Auctions: Theory and Evidence from Timber Auctions

David GOLDBREICH (lxxi): Behavioral Biases of Dealers in U.S. Treasury Auctions

Roberto BURGUE (lxxi): Optimal Procurement Auction for a Buyer with Downward Sloping Demand: More

Claudio MEZZETTI, Aleksandar PEKE and Ilia TSEITLIN (lxxi): Sequential vs. Single-Round Uniform-Price Auctions


ClAUDIO MEZZETTI, Alejandro M. MANELLI and Daniel R. VINCENT (lxxi): Multidimensional Mechanism Design: Revenue Maximization and the Multiple-Good Monopoly

Nicola ACOCELLA, Giovanni Di BARTOLOMEO and Wilfried PAUWELS: Is there any Scope for Corporatism in Stabilization Policies?

John ASKER and Estelle CANTILLON: Does Endogenous Technical Change Make a Difference in Climate Policy Analysis? A Robustness Exercise with the FEEM-RICE Model

Patrick BAYARI, Stephanie HOUGHTON and Steven TADELS (lxxi): Bidding for Incompete Contracts

Barbara BUCHNER and Silvia DALL’OLIO: Russia: The Long Road to Ratification. Internal Institution and Pressure Groups in the Kyoto Protocol’s Adoption Process

Carlo CARRARO and Marzio GALEOTTI: Does Endogenous Technical Change Make a Difference in Climate Policy Analysis? A Robustness Exercise with the FEEM-RICE Model

Alejandro M. MANELLI and Daniel R. VINCENT (lxxi): Multidimensional Mechanism Design: Revenue Maximization and the Multiple-Good Monopoly

Nicola ACOCELLA, Giovanni Di BARTOLOMEO and Wilfried PAUWELS: Is there any Scope for Corporatism in Stabilization Policies?

Johan EYCKMANS and Michael FINUS: An Almost Ideal Sharing Scheme for Coalition Games with Externalities

Cesare DOSI and Michele MORETTO: Environmental Innovation, War of Attrition and Investment Grants
<table>
<thead>
<tr>
<th>CCMP</th>
<th>157.2004</th>
<th>Valentina BOSETTI, Marzio GALEOTTI and Alessandro LANZA: How Consistent are Alternative Short-Term Climate Policies with Long-Term Goals?</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETA</td>
<td>159.2004</td>
<td>William BROCK and Anastasios XEPAPADEAS: Spatial Analysis: Development of Descriptive and Normative Methods with Applications to Economic-Ecological Modelling</td>
</tr>
<tr>
<td>KTHC</td>
<td>160.2004</td>
<td>Alberto PETRUCCI: On the Incidence of a Tax on PureRent with Infinite Horizons</td>
</tr>
<tr>
<td>IEM</td>
<td>161.2004</td>
<td>Xavier LABANDEIRA, José M. LABEAGA and Miguel RODRIGUEZ: Microsimulating the Effects of Household Energy Price Changes in Spain</td>
</tr>
</tbody>
</table>

**NOTE DI LAVORO PUBLISHED IN 2005**

<p>| CCMP      | 1.2005  | Stéphane HALLEGATTE: Accounting for Extreme Events in the Economic Assessment of Climate Change                          |
| CCMP      | 2.2005  | Qiang WU and Paulo Augusto NUNES: Application of Technological Control Measures on Vehicle Pollution: A Cost-Benefit Analysis in China |
| CCMP      | 3.2005  | Andrea BIGANO, Jacqueline M. HAMILTON, Maren LAU, Richard S.J. TOL and Yuan ZHOU: A Global Database of Domestic and International Tourist Numbers at National and Subnational Level |
| CCMP      | 4.2005  | Andrea BIGANO, Jacqueline M. HAMILTON and Richard S.J. TOL: The Impact of Climate on Holiday Destination Choice               |
| ETA      | 5.2005  | Hubert KEMPFF: Is Inequality Harmful for the Environment in a Growing Economy?                                                |
| CCMP      | 9.2005  | Angelo ANTOCC: Environmental Resources Depletion and Interplay Between Negative and Positive Externalities in a Growth Model |
| CTN      | 10.2005 | Frédéric DEROIAN: Cost-Reducing Alliances and Local Spillovers                                                             |
| NRM      | 11.2005 | Francesco SINDICO: The GMO Dispute before the WTO: Legal Implications for the Trade and Environment Debate                 |
| PRCG     | 14.2005 | Clara GRAZIANO and Annalisa LUPORINI: Ownership Concentration, Monitoring and Optimal Board Structure                         |
| CSRM     | 15.2005 | Parashar KULKARNI: Use of Ecolabels in Promoting Exports from Developing Countries to Developed Countries: Lessons from the Indian LeatherFootwear Industry |
| KTHC     | 16.2005 | Adriana DI LIBERTO, Roberto MURA and Francesco PIGLIARU: How to Measure the Unobservable: A Panel Technique for the Analysis of TFP Convergence |
| KTHC     | 17.2005 | Alireza NAGHAVI: Asymmetric Labor Markets, Southern Wages, and the Location of Firms                                         |
| KTHC     | 18.2005 | Alireza NAGHAVI: Strategic Intellectual Property Rights Policy and North-South Technology Transfer                             |
| KTHC     | 19.2005 | Mombert HOPPE: Technology Transfer Through Trade                                                                               |
| PRCG     | 20.2005 | Roberto ROSON: Platform Competition with Endogenous Multithoming                                                              |
| CCMP     | 21.2005 | Barbara BUCHNER and Carlo CARRARO: Regional and Sub-Global Climate Blocs, A Game Theoretic Perspective on Bottom-up Climate Regimes |
| CTN      | 23.2005 | Michael PINUS, Pierre v. MOUCHE and Bianca RUNDSHAGEN: Uniqueness of Coalitional Equilibria                                     |
| CTN      | 25.2005 | Sondeb LAHIRI: The Core of Directed Network Problems with Quotas                                                               |
| NRM      | 27.2005 | Massimiliano MAZZANTI and Anna MONTINI: The Determinants of Residential Water Demand Empirical Evidence for a Panel of Italian Municipalities |
| CCMP     | 28.2005 | Laurent GILOTTE and Michel de LARA: Precautionary Effect and Variations of the Value of Information                           |
| NRM      | 29.2005 | Paul SARFO-MENSAH: Exportation of Timber in Ghana: The Menace of Illegal Logging Operations                                    |
| CCMP     | 30.2005 | Andrea BIGANO, Alessandra GORIA, Jacqueline HAMILTON and Richard S.J. TOL: The Effect of Climate Change and Extreme Weather Events on Tourism |
| NRM      | 31.2005 | Maria Angeles GARCIA-VALINAS: Decentralization and Environment: An Application to Water Policies                                |
| NRM      | 32.2005 | Chiara D’ALPAOS, Cesare DOSI and Michele MORETTO: Concession Length and Investment Timing Flexibility                           |
| CCMP     | 33.2005 | Joseph HUBER: Key Environmental Innovations                                                                             |
| CTN      | 34.2005 | Antoni CALVÓ-ARMENGOL and Rahmi İLKILIÇ (lxxii): Pairwise-Stability and Nash Equilibria in Network Formation           |
| CTN      | 35.2005 | Francesco FERI (lxxii): Network Formation with Endogenous Decay                                                            |
| CTN      | 36.2005 | Frank H. PAGE, Jr. and Myrna H. WOODERS (lxxii): Strategic Basins of Attraction, the Farsighted Core, and Network Formation Games |</p>
<table>
<thead>
<tr>
<th>Volume</th>
<th>Year</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTN</td>
<td>38</td>
<td>2005 Social Games: Matching and the Play of Finitely Repeated Games</td>
<td>Matthew O. JACKSON and Alison WATTS (lxxii): Social Games: Matching and the Play of Finitely Repeated Games</td>
</tr>
<tr>
<td>CTN</td>
<td>39</td>
<td>2005 The Egalitarian Sharing Rule in Provision of Public Projects</td>
<td>Anna BOGOMOLNAIA, Michel LE BRETON, Alexei SAVVATEEV and Shlomo WEBER (lxxii): The Egalitarian Sharing Rule in Provision of Public Projects</td>
</tr>
<tr>
<td>CTN</td>
<td>40</td>
<td>2005 Stochastic Stability in Network with Decay</td>
<td>Francesco FERI: Stochastic Stability in Network with Decay</td>
</tr>
<tr>
<td>PRCG</td>
<td>43</td>
<td>2005 Abnormal Returns in Privatization Public Offerings: The Case of Portuguese Firms</td>
<td>Carla VIEIRA and Ana Paula SERRA: Abnormal Returns in Privatization Public Offerings: The Case of Portuguese Firms</td>
</tr>
<tr>
<td>SIEV</td>
<td>44</td>
<td>2005 Combining Actual and Contingent Behavior to Estimate the Value of Sports Fishing in the Lagoon of Venice</td>
<td>Anna ALBERINI, Valentina ZANATTA and Paolo ROSATO: Combining Actual and Contingent Behavior to Estimate the Value of Sports Fishing in the Lagoon of Venice</td>
</tr>
<tr>
<td>CTN</td>
<td>45</td>
<td>2005 Participation in International Environmental Agreements: The Role of Timing and Regulation</td>
<td>Michael FINUS and Bianca RUNDHAGEN: Participation in International Environmental Agreements: The Role of Timing and Regulation</td>
</tr>
<tr>
<td>CCMP</td>
<td>46</td>
<td>2005 Are EU Environmental Policies Too Demanding for New Members States?</td>
<td>Lorenzo PELLEGRINI and Reyer GERLAGH: Are EU Environmental Policies Too Demanding for New Members States?</td>
</tr>
<tr>
<td>IEM</td>
<td>47</td>
<td>2005 Modeling Factor Demands with SEM and VAR: An Empirical Comparison</td>
<td>Matteo MANERA: Modeling Factor Demands with SEM and VAR: An Empirical Comparison</td>
</tr>
<tr>
<td>CTN</td>
<td>48</td>
<td>2005 A Characterization of Stochastically Stable Networks</td>
<td>Olivier TERCIEUX and Vincent VANNETELBOSCH (lxx): A Characterization of Stochastically Stable Networks</td>
</tr>
<tr>
<td>CTN</td>
<td>49</td>
<td>2005 R&amp;D Networks among Unionized Firms</td>
<td>Ana MAULEON, José SEMPERE-MONERRIS and Vincent J. VANNETELBOSCH (lxxii): R&amp;D Networks among Unionized Firms</td>
</tr>
<tr>
<td>CTN</td>
<td>50</td>
<td>2005 Optimal Transfers and Participation Decisions in International Environmental Agreements</td>
<td>Carlo CARRARO, Johan EYCKMANS and Michael FINUS: Optimal Transfers and Participation Decisions in International Environmental Agreements</td>
</tr>
<tr>
<td>KTHC</td>
<td>51</td>
<td>2005 From the Theory of the Firm to FDI and Internalisation: A Survey</td>
<td>Valeria GATTAI: From the Theory of the Firm to FDI and Internalisation: A Survey</td>
</tr>
</tbody>
</table>
### 2004 SERIES

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

### 2005 SERIES

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