The Determinants of Multilateral Environmental Agreement Membership

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February 14, 2009

Abstract

Environmental agreements are voluntary coalitions which mostly regulate emissions and the exhaustion of natural resources. The analysis of why and under which conditions countries (or policy makers) may be inclined towards concluding such agreements or not has been the focus of a body of theoretical work at the interface of environmental economics and the economics of coalition games. Traditional theoretical work predicted that environmental agreements are hard to sustain due to the lacking enforceability of associated contracts and the incentive to free-ride. This hypothesis is at odds with the enormous surge of such agreements in reality over the last few decades. Recent work by Rose and Spiegel (2009) suggests that environmental agreements will be concluded and are stable, because they work as a signal and help economies to get access to export (and possibly other) credits. Hence, the reason for a conclusion of such agreements is their interdependence with other policies, especially ones that are related to international business. This paper sheds light on the determinants of multilateral environmental agreement (MEA) participation. In particular, we pay attention to a country's international openness by means of chosen trade and investment policies.

JEL classification: C23; C25; Q50; Q56; F18

Keywords: Environmental economics; Environmental agreements; Multilateral agreements; Dynamic panel data; Count data

1 Introduction

Freeness of trade and multinational investment are often seen as major obstacles to the protection of natural resources and the avoidance or reduction of emissions.[1] It appears unsatisfactory that, at the beginning of the 21st century there

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[1]For instance, Greenpeace (2003, "How does the WTO affect you, and why should you care about it?" p. 1) argues that "*The free trade agenda is increasing the production and*

is still little scope for a country to commit itself to the avoidance of environmental damage in a binding way. However, the existence of *bilateral* and – probably more importantly – of *multilateral* environmental agreements (MEAs) and the enormous surge of memberships in existing and new agreements of that kind over the last four decades display a spark of hope that countries adopt strategies of environmental protection at the international level even in the absence of their formal enforceability.

MEAs may be clustered into five categories, which reflect the dimensions of environmental protection: biodiversity; atmosphere; land; chemicals and hazardous wastes; and regional seas and related agreements. Their objectives and priorities vary significantly not only across these clusters but even within them. The first MEA – Agreement concerning Co-operation in the Quarantine of Plants and their Protection against Pests and Diseases – has been concluded in 1960, covered 8 countries, and dealt with plant protection. Until 2006, another 353 MEAs came into existence so that the median one out of the 178 most important economies was involved in 51 MEAs in that year.

From the perspective of traditional theoretical work on environmental coalitions (see Chander and Tulkens, 1992; Finus and Rundshagen, 1998; Finus, van Ierland and Dellink, 2006), this surge in MEA membership is puzzling. Membership in a MEA is voluntary and there is no supra-national institution to enforce commitments expressed in the associated contracts. Hence, when interpreting environmental agreements as ones that are concluded in isolation of other means of economic policy, there is little reason for countries to adopt costly measures required to fulfill their voluntary contracts. Recently, Rose and Spiegel (2009) emphasized that environmental agreements should be seen as one dimension in a large array of economic policies. Countries conclude such agreements to get favorable treatment in other dimensions. In particular, Rose and Spiegel (2009) argue and illustrate that participation in *bilateral* environmental agreements provides a signal which leads to easier access to capital assets from partners in such agreements.

It is this paper's task to shed light on the determinants of MEAs. In particular, we want to shed light on how trade liberalization – e.g., through membership in preferential trade agreements – or investment liberalization affect MEA membership. We argue that membership in MEAs is to some extent reflective of environmental protection along the five aforementioned lines. Then, is trade or investment liberalization associated with a country's reduced inclination towards MEA membership and, in turn harmful for environmental protection? Our results suggest the opposite conclusion and indicate that international economic coalitions provide a building bloc for the conclusion of environmental agreements. We interpret our results as indirectly supporting the arguments in

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consumption of natural resources at a rapid rate. This is adding to the destruction of ancient forests, leading to overfishing, as well as creating more and more pollution. WTO rules are also being used to undermine global environmental agreements, principles and standards" (). Moreover, Greenpeace (2003, "Why is the WTO a problem?" p. 1) notes that "*Trade rules can undermine environmental rules, laws and regulations. [...] Because of this, countries are less likely to take action under certain global environmental agreements.*" Finally, they state that "*Free trade is accelerating the use of natural resources such as water, forests, fisheries, and minerals, much faster than they can be regenerated.*" While these remarks mostly pertain to the consequences of membership in the World Trade Organization (WTO) – and, hence, multilateral trade liberalization – environmental activists have similar reservations vis-à-vis the formation of preferential trade agreements (see Hanyona, 2000; Hochstetler, 2002a, 2003).

Rose and Spiegel (2009): an increasing dependence of countries upon each other through the process of globalization raises the pressure to agree upon eventually costly environmental rules.

The remainder of the paper is organized as follows. The subsequent section provides a review of previous research on the conclusion of environmental agreements. Section 3 sheds light on key features of the data on environmental agreement membership in a large panel of countries and years. In particular, this section will illustrate that such memberships are highly persistent so that dynamic methods should be applied in empirical work. Section 4 briefly summarizes the econometric models applied to estimate the regression parameters of interest. Section 5 presents and discusses the findings and quantifies the impact of trade and investment liberalization on MEA memberships. The last section concludes with a summary of the most important findings.

2 Previous work on environmental agreement membership

In the sequel, we distinguish between theoretical and empirical contributions to the explanation of environmental agreement memberships.

2.1 Economic theory of environmental agreements

Economic theory addressed the issue of environmental agreement formation in games mainly from two angles. One is to treat a clean environment associated with such agreements as a public good which can not be achieved, since countries find themselves in a prisoners' dilemma (see Weikard, Finus and Altamirano-Cabrera, 2006). The alternative class of models emphasizes the role of communications and negotiations (see Carraro, 1998; Bloch and Gomes 2003; Finus, 2003; Caparrós, Hammoudi, and Tazd"ıt, 2004; Carraro, Marchiori; and Sgobbi, 2005) which may not take place in the aforementioned strand of research.[2]

In contrast to the above work, Breton, Sbragia, and Zaccour (2008) focus on the dynamics of international environmental agreement memberships in a dynamic game of emissions. Their model of the evolution and stability of such agreements can lead to different steady states of full cooperation or partial cooperation which are stable over time, and also to situations without feasible or stable agreements. The outcome depends on the number of initially cooperating countries, the level of pollution, and the way and extent to which defectors may be punished.[5]

Rose and Spiegel (2009) concentrate on the interaction between economic and non-economic relations. They show that the number of bilateral and multilateral environmental agreements have a positive impact on cross-holding assets. Both the number of MEAs and bilateral ones increase economic exchange due to its non-economic commitment to joint interests. With their theoretical model

[2] These theoretical models form the basis of some climate change simulation models – such as CLIMNEG World Simulation Model (CWS)[10], the Stability of Coalitions Model (STACO)[13], or the Climate Framework for Uncertainty, Negotiation and Distribution (FUND)[29, 31]. These models suggest that the detection of environmental depletion through climate change, the corresponding influences on the economy, and the value of cooperation promote the conclusion of environmental agreements.

they proof that the number of MEAs equals a credible signal for a countrie's discount rate, the reason for increasing cross-holded assets with this country.[27]

2.2 Empirical analysis of environmental agreements

Previous empirical work on the formation of environmental coalitions and agreements either focused on single multilateral agreements, on a subset of the existing bilateral agreements, or a subset of multilateral agreements with no participation restriction and which are no amendments to previous agreements.

For instance, Beron, Murdoch, and Vijverberg (2003) develop a correlated probit model to study the probability of the 89 largest countries of the world to ratify the Montreal Protocol. They distinguish above all between "*power*" and "*spillover*" determinants of these countries. Power is reflected in the influence a country has on the net benefit of ratifying the Montreal Protokol similar to positive network correlations. "*Spillovers*" allow to internalize partly the detrimental effect of an emission of ozone-depleting substances on other countries than the emitting one. The higher the contemporary emissions of a country the its relative cutback in emissions will be and the more improtant its role in emission agreements will be. Due to this "*spillovers*" generate correlations in the decisions through trade with other countries. However, Beron, Murdoch, and Vijverberg (2003) did not find evidence of a role for "*power*", contrary to the hypotheses. They argue that economic power may well have a significant effect in international arrangements, but further reseach is needed on testing such a variable.

Murdoch, Sandler, and Vijverberg (2003) focus on the ratification of the Helsinki Protocol (which regulates sulfur emissions in Europe) in 1990. They derive hypotheses about environmental treaty participation in a two-stage game. In a first stage, countries decide whether to participate in an agreement at all or not. In a second stage, they determine the level of participation or the extent of concessions made – i.e., emissions reduced. Empirically, they employ a spatial probit model to estimate the probability of participation in the Helsinki Protocol for 25 European countries to estimate the first-stage part of they theoretical model. Their results suggest that a higher level of a country's spillings and its marginal cost of emission reductions exert a significant positive impact on the probability of participation. Other variables do not display a significant impact in the spatial binary choice model.[25]

Alternatively, Naughton (2006) analyzes the role of cross border pollution as an incentive to cooperate with neighboring countries for multilateral environmental agreement membership. In particular, she hypothesizes that the probability of an environmental agreement in place declines with geographical distance between two countries. She estimates the role of determinants of membership based on 41 countries, 37 international environmental agreements, and the period 1980-1999. Using a spatial model for normally distributed, unlimited independent variables, and cross-sectional data, she finds evidence of increased cooperation among proximate countries. Moreover, an increase in invard FDI or OECD membership raise the probability of participation in one of the 37 agreements.[26]

Rose and Spiegel (2009) study the economic benefits of non-economic partnerships such as environmental agreements. Although environmental agreement membership comes at a cost, it may generate benefits which render them attractive on net. Using a sample of 221 country-pairs and the period 2001-2003, they provide empirical evidence of the increased cross-holdings of assets at the country-pair level if an environmental agreement is in place. Hence, countries may raise bilateral capital flows when participating in environmental agreements. Their evidence suggests that this is true for both bilateral and multilateral environmental agreement participation.[27]

3 Data on MEA participation

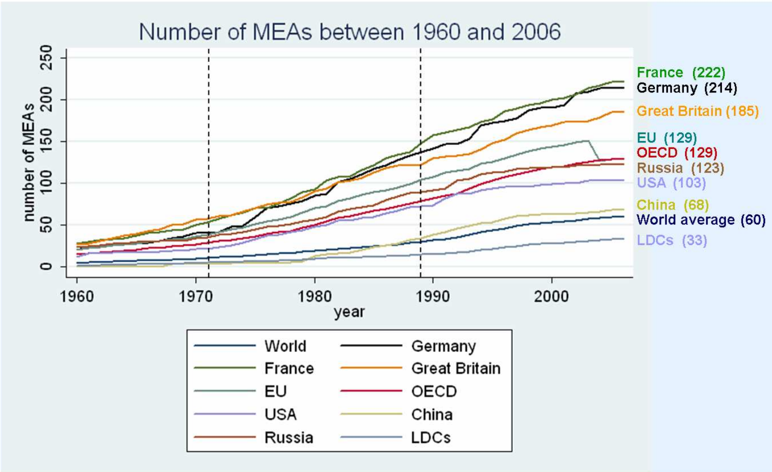
Before turning to the regression analysis, it seems useful to study features of the data on MEA participation which will represent the dependent variable of our empirical models. We gathered information about MEA participation of 178 countries between 1960 and 2006 from two sources. The basis forms the Socioeconomic Data and Applications Center's (SEDAC) database maintained by the Center for International Earth Science Information Network (CIESIN, 2006). In particular, we only considered those MEAs of the data-set which fall into one of the five aforementioned categories. Several other environmental agreements related to economic, social, cultural, space, or noise treaties were not included. Then, we augmented and updated this information by using data from Mitchell (2003, 2007).[3] The augmented data-set covers the universe of MEAs covering the considered dimensions. Altogether 353 such agreements have been concluded among subsets of the 178 countries between 1960 and 2006.

The dependent variable we focus on varies across countries and years. It is a count of the number of agreements a country is a member of in a any year within the considered time span. Since this variable is strictly non-negative, methods for unlimited dependent variables are unlikely appropriate for its empirical analysis.

After 1972, the year of the Stockholm Conference, the number of MEAs has increased tremendously. Inter alia because of the conclusion of the Montreal Protocol, the number of MEA memberships also increased after 1989. Figure 1 illustrates that MEA participation is not only but mainly a phenomenon in the developed part of the world.[4] Notice that the number of MEAs of the European Union (EU) declines in 2004. The reason for this has to do with the Eastern Enlargement of the European Union as will become transparent in the subsequent two figures.

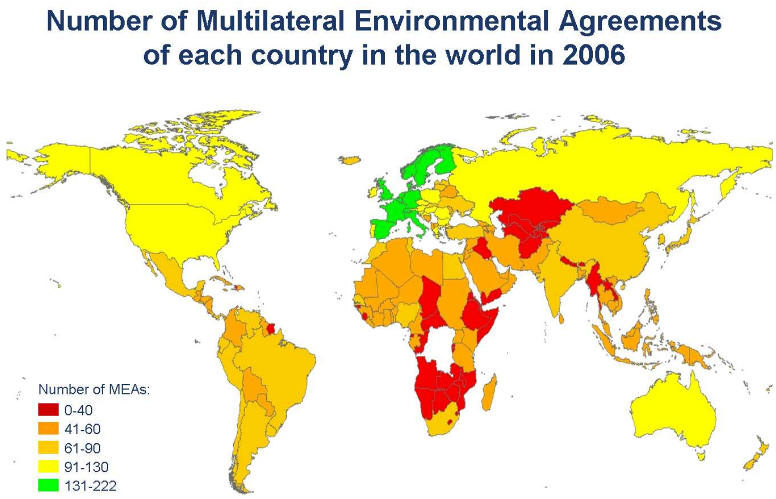
[3]We gratefully acknowledge provision of the data by Ron Mitchell.

[4]In the figure, we display the number of MEAs concluded across the years by a few individual countries as well as blocs thereof. Among the latter are the European Union (EU), the Organization of Economic Cooperation and Development (OECD), the less developed countries (LDCs), and the world as a whole. With aggregates such as EU, OECD, LDCs, or world, we compute the average member country's number of MEA memberships for each year. The definitions of the country aggregates change over time (for instance, the EU had 6 members in, e.g., 1969, but 10 members in 1983, and 25 members in 2006). LDCs are defined in accordance with the classification of UN Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (UN-OHRLLS).



source: *Ron Mitchell, SEDAC, CIESIN, World Bank*

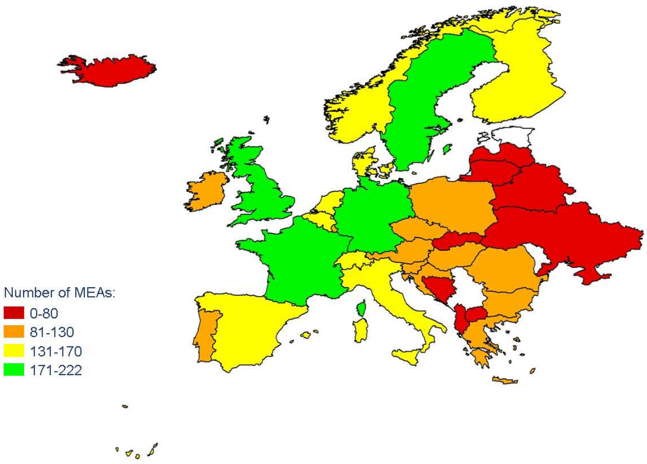
Beyond the evolvement of MEA membership over time, we provide further details on its geographical spread by means of maps. In particular, we display MEA memberships according to our definition for the year 2006 for both the world as a whole and Europe. The figures clearly illustrate that there is a region-specific element in the extent to which countries are inclined towards participation in MEAs.[5] Obviously countries in Europe participate in particularly many MEAs and the opposite is true for countries in Africa or Asia.



source: *Ron Mitchell, SEDAC, CIESIN, World Bank*

[5]Notice that a few countries are drawn in white in the maps, since our data basis of these countries is very fragmented.

Number of Multilateral Environmental Agreements in Europe in 2006



A closer look on Europe illustrates what we said before that Western European economies are much more eager to participate in MEAs than Central and Eastern European ones are. Consequently, seven Central and Eastern European countries' (and Cyprus' as well as Malta's) joining the EU in 2004 is responsible for the decline in the number of MEAs an average EU member country is a member of in 2004 and thereafter. No regressions are needed to see that these findings are correlated with economic, political, and environmental factors. What is less obvious is the extent to which the "*connectedness*" of countries in trade or investment agreements contributes to the process of MEA participation.

4 Econometric model

The descriptive features of the data on a country's participation in MEAs over time display a strong persistence. In any given period, the number of MEAs a country participates in has a strong impact on its subsequent involvement in MEAs. Hence, apart from fundamental economic, political, or environmental determinants of MEA membership, a country's MEA history should be allowed to play a role. This feature may be captured by the inclusion of a lagged dependent variable in the econometric model. We do so by following Blundell, Griffith, and Windmeijer (2002) to model the dynamics of the number of MEAs a country participates in as a linear feedback model (LFM). The LFM assumes that the conditional mean of the count variable is linear in the history of the process.

Let y_{it} denote the number of MEAs country i, $i = 1, ..., N$, is a member of in year t, $t = 1, ..., T$. Further, let x_{it} represent a vector of K explanatory variables. The conditional mean in the LFM is then defined as

$$\begin{aligned} E\left(y_{it}|y_{it-1}, x_{it}, v_i\right) &= \gamma y_{it-1} + exp\left(x'_{it}\beta\right) v_i \qquad (1) \\ &= \gamma y_{it-1} + \mu_{it}\nu_i, \end{aligned}$$

where $\nu_i \equiv exp(\eta_i)$ is a permanent scaling factor for the individual specific mean, and γ and β are parameters to be estimated. The LFM can be motivated as an entry-exit process with the probability of exit equal to $(1-\gamma)$. Note that $\mu_{it}\nu_i$ is non-negative, so that the mean value for y_{it} is bounded below by γy_{it-1}.

We apply several generalized method of moments (GMM) estimators. First we use a one-step estimator, where the moments weighting matrix does not depend on the parameters to be estimated. In order to gain in efficiency, we also apply an efficient two-step GMM, which uses the estimates from the one-step estimator for the moments weighting matrix. Additionally, we apply a continuously updated GMM estimator, that directly accounts for the dependence of the moments weighting matrix on the parameters in the optimization (see Hansen, Heaton, and Yaron, 1996).[6]

As demonstrated by Windmeijer (2002), the two-step GMM estimator can be severely biased downwards in small samples, i.e., for small N. This small sample bias also applies to the continuously updating GMM estimator. We therefore use a finite sample correction in order to account for the small sample bias by applying block-bootstrapping.[7] Further details to the applied estimators can be found in Appendix 8.1.

5 Explanatory variables of MEA membership

We use a set of explanatory variables to capture the most important determinants of MEA membership. In line with the aforementioned theoretical work on environmental agreements, we include and distinguish between three groups of explanatory variables: economic, political, and environmental covariates.

5.1 Economic determinants

As for the *economic* determinants of MEA membership, we include real gross domestic product (GDP) as a measure of a country's economic mass from Maddison's (2003) historical time-series which is available for a large set of countries. To cover more recent years, we extrapolate GDP data by using indices of the growth of GDP at real U.S. dollars from the World Bank's World Development Indicators 2008. Similarly, we gather information about population size from these two sources. The inclusion of log population together with log GDP accounts for size as well as income per capita in the empirical models. In the tables we use acronyms GDP and POP to refer to log GDP and log population, respectively.

Further we include a binary variable LDC to indicate less developed countries. This indicator is provided by the United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (UN-OHRLLS). It takes a value of unity if an economy is classified as a developing country and zero else. Among the 178 countries in our data-set, 18 are LDCs according to that definition.

[6] Additionally to the efficiency, an advantage of the continuously updated estimator is that it is invariant to curvature altering transformations of the population moment conditions (see Hall, 2005).

[7] For the one- and two-step GMM estimators we relied on the ExpEnd GAUSS routines which are made publicly available by Windmeijer (2002).

Finally, we include two economic determinants of primary interest to our study: a country's log potential exports and the number of bilateral investment treaties. We refer to the former as EXPORTS and to the latter as NBITS. EXPORTS measures the importance of bilateral and multilateral trade costs – most importantly for us, it is a measure of the bilateral and multilateral effects of trade liberalization through preferential trade agreement (PTA) membership. NBITS is a measure of a country's investment liberalization through bilateral investment treaties (BITs). While NBITS simply reflects the number of BITs of a country, EXPORTS respects a nonlinear relationship of trade costs and PTA membership on exports. We use EXPORTS instead of log observed exports to (i) avoid an endogeneity of the variable in the regressions – MEA membership could affect a country's bilateral trade flows – and (ii) to be able to compute the impact of PTA membership on MEA membership through exports, while respecting non-linear relationships between EXPORTS and PTA membership suggested by economic theory (see Anderson, 1979; Anderson and van Wincoop, 2003).

EXPORTS is a predicted variable from a non-linear regression model, following the approach to estimate gravity models by Anderson and van Wincoop (2003). We calculate EXPORTS annually by using the corresponding values of exporter and importer GDP and trade costs as well as PTA membership. However, for the ease of presentation and notation, let us skip the time index to explain how EXPORTS is calculated. Nominal bilateral goods exports of country i to country j X_{ij} in U.S. dollars may be expressed in the following way (see Feenstra, 2004, for a discussion):[8]

$$X_{ij} = \frac{GDP_i GDP_j}{GDP_W} t_{ij}^{1-\sigma} \Pi_i^{1-\sigma} P_j^{1-\sigma} \tag{2}$$

where $GDP_i \equiv \sum_j^N (X_{ij})$, $GDP_j \equiv \sum_i^N (X_{ji})$ denotes nominal GDP of countries i and j, respectively, and $GDP_W \equiv \sum_i^N \sum_j^N (X_{ij})$ is world GDP. $\sigma > 1$ is the constant elasticity of substitution among products/varieties, t_{ij} are economic trade costs, and Π_i, P_j are so-called *multilateral resistance terms* – a measure of country i's outward and country j's inward multilateral trade costs, respectively. For our purpose, we calculate

$$EXPORTS = \ln\left(\sum_{j=1}^{N} X_{ij}\right), \tag{3}$$

where N denotes the number of importer countries.

Empirically, $\frac{GDP_i GDP_j}{GDP_W}$ is observable, but $t_{ij}^{1-\sigma}\Pi_i^{1-\sigma}P_j^{1-\sigma}$ is not. We adopt the common assumption to model trade costs as

$$t_{ij}^{1-\sigma} = exp[\sum_{k}^{K}(\delta_k \tau_{k,ij})], \tag{4}$$

where K denotes the number of trade cost or trade facilitation variables $\tau_{k,ij}$ included in $t_{ij}^{1-\sigma}$, δ_k is a parameter of the k'th variable. While $\tau_{k,ij}$ is observed, δ_k has to be estimated. Estimates of δ_k are obtained from a gravity regression

[8]To compute

model, after including a stochastic term in (2), see Appendix 8.2 for details. For convenience and in line with the literature (see Anderson and van Wincoop, 2003), continuous variables $\tau_{k,ij}$ such as bilateral geographical distance enter in logarithmic form while indicator variables such as bilateral PTA membership enter as they are. Similar to $t_{ij}^{1-\sigma}$, $\Pi_i^{1-\sigma}$ and $P_j^{1-\sigma}$ are unobserved. Yet, they can be solved as solutions of a nonlinear system of $2N$ equations which are based upon knowledge of GDPs and estimates of $t_{ij}^{1-\sigma}$ (see Appendix 8.2 for details). Ultimately, with estimates of $t_{ij}^{1-\sigma}$, $\Pi_i^{1-\sigma}$, and $P_j^{1-\sigma}$, we may compute estimates of EXPORTS. Ultimately, we can also compute counterfactual values of EXPORTS which are based on the assumption that ceteris paribus all PTAs are abandoned world-wide. The difference between the cum-PTA vector of EXPORTS and the counterfactual sine-PTA vector of EXPORTS is a measure of the combined bilateral and multilateral effects on PTA membership on a country's log exports. With this difference at hand, we can compute the impact of PTA membership on MEA membership. The impact of NBITS on MEA membership is straightforward.

We use data on nominal exports X_{ij} in U.S. dollars from the United Nations World Trade Database, information on PTA membership from the World Bank, and variables on other trade costs (such as geographical distance, adjacency, or common language) from a data-set made publicly available by the Centre d'Études Prospectives et d'Informations Internationales (CEPII) to estimate EXPORTS.[9] Information on the number of bilateral investment treaties of each is taken from the United Nations Conference of Trade and Development Treaty Database (UNCTAD, 2007). Similar to MEA and PTA membership, the number of BITs varies considerably over time.

5.2 Political determinants

We have experimented with a variety of political indicators from various sources in the specification. Most of them did not exhibit sufficient variation over time to be included in the empirical model and led to poor convergence properties of the estimators. Here, we only present results which involve the index of political freedom as constructed by the Fraser Institute (see Gwartney, Lawson, Sobel, and Leeson, 2007) as a political determinant of MEA membership. This index ranges from 0 to 10, with higher values indicating more political freedom.

5.3 Environmental determinants

Finally, we include two environmental determinants of MEA membership: a country's CO_2 emissions per capita (CO2emissions) and a country's endowment with agricultural land (in percent of total land area; AgrLand). Both of them are taken from the World Bank's World Development Indicators 2008. We also experimented with other variables such as total CO_2 emissions from fossil-fuels (thousand metric tons of carbon), CO_2 emissions from solid fuel consumption (metric tons of carbon), CO_2 emissions from liquid fuel consumption (metric tons of carbon), CO_2 emissions from gas fuel consumption (metric tons of carbon), CO_2 emissions from cement production (metric tons of carbon), CO_2

[9] Here, we disregard the fact that, as an estimate, EXPORTS exhibits a confidence interval. This could be respected by using bootstrap methods, but with the models at hand the use of bootstrap would be computationally intensive.

emissions from gas flaring (metric tons of carbon), per capita CO_2 emissions (metric tons of carbon), CO_2 emissions from gas flaring, combustible renewables and waste (percent of total energy), combustible renewables and waste (metric tons of oil equivalent), electric power consumption (kWh per capita), electric power consumption (kWh), energy imports (net percent of energy use), energy use (kg of oil equivalent per capita), forest area (sq. km), land area (sq. km), organic water pollutant emissions (kg per day), organic water pollutant emissions (kg per day per worker), permanent cropland (percent of land area), surface area (sq. km), and water pollution (percent of total organic water pollutant emissions) of the chemical industry, clay and glass industry, food industry, metal industry, paper and pulp industry, textile industry, wood industry and other industries (all of them available from the World Development Indicators). However, these environmental variables are highly collinear with the included covariates (including CO2emissions and AgrLand) and they do not contribute significantly to the explanatory power of the model.[10]

6 Results

Table 1

	ONE-STEP	TWO-STEP	CUGMM	BOOTSTRAP
log y_{it-1}	0.198***	0.199***	0.0011***	0.2034***
	(11.139)	(64.2309)	(240.0872)	(8.598)
Economical determinants:				
GDP	0.5485***	0.5484***	0.0049***	0.543***
	(8.019)	(103.5318)	(119.4441)	(5.9869)
POPU	0.055	0.0594***	0.0188***	0.0448
	(0.8144)	(8.6253)	(36.4011)	(0.7446)
EXPORTS	0.318***	0.3154***	0.0034***	0.3119***
	(5.1909)	(38.6272)	(108.2624)	(4.5803)
NBITS	0.007***	0.007***	0.0001***	0.0068***
	(6.1229)	(44.7127)	(80.586)	(5.4015)
LDC	0.0933	0.1088	0.2805***	0.0622
	(0.271)	(0.4027)	(5.5031)	(0.2394)

(t-statistics in parentheses, * significance at ten, ** five, *** one percent)

[10]Results are available from the authors upon request.

	ONE-STEP	TWO-STEP	CUGMM	BOOTSTRAP
log y_{it-1}	0.1914***	0.1919***	0.001***	0.2029***
	(10.6145)	(59.4349)	(204.054)	(6.8781)
Economical determinants:				
GDP	0.5379***	0.5391***	0.0049***	0.5102***
	(7.6693)	(77.7879)	(108.6083)	(5.5918)
POPU	0.0566	0.0601***	0.0187***	0.0565
	(0.8453)	(8.8383)	(38.4599)	(0.9064)
EXPORTS	0.3097***	0.307***	0.0039***	0.2958***
	(4.9223)	(37.1758)	(79.8675)	(4.3976)
NBITS	0.0068***	0.0068***	0.0001***	0.0068***
	(6.1995)	(44.9448)	(89.6454)	(5.4212)
LDC	0.1049	0.1196	0.279***	0.0424
	(0.3053)	(0.4438)	(4.7317)	(0.1593)
Political determinants:				
PFI	0.01***	0.0099***	0.0002***	0.0253
	(8.75)	(32.4724)	(-21.8433)	(0.9865)

(t-statistics in parentheses, * significance at ten, ** five, *** one percent)

	ONE-STEP	TWO-STEP	CUGMM	BOOTSTRAP
log y_{it-1}	0.1967***	0.1957***	0.0027***	0.2082***
	(9.1358)	(49.5287)	(65.8501)	(6.2009)
Economical determinants:				
GDP	0.5458***	0.5516***	0.0074***	0.5272***
	(7.4202)	(59.6425)	(89.6824)	(5.0884)
POPU	0.0405	0.0448***	0.0115***	0.0376
	(0.609)	(5.9114)	(18.7036)	(0.5779)
EXPORTS	0.3002***	0.2995***	0.0063***	0.2917***
	(5.0845)	(35.1257)	(42.4315)	(4.075)
NBITS	0.0068***	0.0067***	0.0002***	0.0068***
	(6.4989)	(39.7272)	(28.8509)	(5.2869)
LDC	0.1069	0.1211	0.2678	0.0642
	(0.3147)	(0.4517)	(1.4614)	(0.2421)
Political determinants:				
PFI	0.0098***	0.0096***	0.0002***	0.0251
	(8.4879)	(36.2793)	(50.9089)	(0.9259)
Environmental determinants:				
CO2emissions	-0.0097	-0.0102***	0.0011***	-0.0096
	(-0.9841)	(-7.2073)	(-21.6885)	(-0.7023)
AgrLand	-0.0021	-0.0018***	0.0004***	-0.0016
	(-0.733)	(-3.4083)	(12.0479)	(-0.4793)

(t-statistics in parentheses, * significance at ten, ** five, *** one percent)

EU	Difference in prediction and counterfactual predition		Prediction of MEA	Counterfactual prediction of MEA
	Short run	Long run		
mean	15.3486	19.6954	50.3518	36.3402
min	0.0000		0.0000	0.0000
max	36.1945		118.0384	85.6590
std	10.6523		34.2937	24.7703

NAFTA	Difference in prediction and counterfactual predition		Prediction of MEA	Counterfactual prediction of MEA
	Short run	Long run		
mean	9.0865	11.6598	36.8890	28.8507
min	6.3042		25.8734	20.9855
max	12.9940		53.8509	42.0634
std	3.4840		14.9065	11.5116

ROW	Difference in prediction and counterfactual predition		Prediction of MEA	Counterfactual prediction of MEA
	Short run	Long run		
mean	3.4167	4.3843	13.7467	10.9320
min	0.0000		0.0000	0.0000
max	20.0025		67.6512	50.7258
std	4.5051		16.7701	13.2653

Table 7

WORLD	Difference in prediction and counterfactual predition		Prediction of MEA	Counterfactual prediction of MEA
	Short run	Long run		
mean	6.3060	8.0918	22.7748	17.2516
min	0.0000		0.0000	0.0000
max	36.1945		118.0384	85.6590
std	8.1061		26.7387	19.6582

Our results are summarized in Tables 1 to 7. In every table there are four columns. The first column refers to results based on the one-step GMM estimator, labeled, "ONE-STEP", column two reports estimates based on the efficient two-step GMM estimator, denoted by "TWO-STEP", the third column summarizes findings based on the continuously updated GMM estimates, labeled "CUGMM", and the last column reflects block-bootstrap results, denoted "BOOTSTRAP", which correct the small-sample bias in the estimates of the standard errors of the other estimators.

First note that the lagged dependent variable, labeled "$y_{i,t-1}$" exhibits a positive parameter estimate which is highly significantly different from zero in all models. This suggests that there is indeed strong persistence in the number of MEAs concluded by countries. Neglecting the inerently dynamic nature of MEA participation would invalidate estimates based on static models of MEA membership.

An increase in economic mass as captured by GDP leads to an increase in the number of MEAs concluded. Holding population constant, this suggests that marginally wealthier countries are more inclined towards MEA participation than less wealthier ones. This finding is statistically significant in all estimated models. To some extent, this finding supports the existence of an environmental Kuznetz-curve, which assumes an inverted U-shaped relationship between the level of GDP and environmental pollution. A smaller GDP is associated with less production and, hence, pollition. As GDP rises, an increase in production brings about more pollution. With even higher GDP, producers may face a pressure towards reducing pollution in spite of higher production volumes. Then, it may be opportune to engage in multilateral agreements as indicated by our results. Our results are supportive only of a positive nexus between GDP and a country's willingness to reduce pollution as indicated by a bigger involvement in MEAs.[11]

The results are less clear cut for population, POP. Controlling for a country's economic mass by means of GDP, a change in population size does not carry weight for the number of MEAs concluded.

Political freedom is positively and significantly differently from zero related to a country's number of MEA memberships concluded. Hence, higher degrees of political stability and democracy help proliferating a country's willingness to participate in MEAs, all else equal.

In line with our expectations, a higher degree of pollution in terms of CO_2 emissions reduces a country's willingness to commit itself to less pollution through MEAs. However, the negative point estimate is not significantly different from zero in the preferred specifications (ONE-STEP or BOOTSTRAP GMM).

Most importantly, our results are generally supportive of the view that a country's interconnectedness with others in terms of trade and investment leads to a broader engagement in multilateral environmental agreements. Both a larger number of bilateral investment agreements (BITs) and bilateral trade liberalization through preferential trade agreements (PTAs) lead to an increase in the number of MEAs concluded. While the former is obvious from the parameter estimate of NBITS in the estimated models, the latter is not. However, we had to estimate the parameter of PTAs as a determinant of EXPORTS. Very much in line with the literature on trade liberalization, we found a strong positive and statistically significant impact of PTAs on bilateral exports and, hence, multilateral EXPORTS in our model involving a cross-section of nominal exports for the year 2005. Consequently, a significant positive impact of PTA membership on EXPORTS together with a positive significant parameter of EXPORTS implies a positive effect of PTA membership for MEA participation.

Altogether, the results support the view that wealthier countries with a strong inclination towards trade and investment liberalization are more in favor of committing themselves to environmental standards, pollution reduction, and other means of environmental protection through MEA memberships than other countries, all else equal. At least to some extent, this finding is at odds with concerns of environmental activists whereby the globalization of goods trade and investments would be unambiguously detrimental for environmental protection.

How important is interconnectedness through trade and investment policy for MEA participation? Clearly, the nonlinear nature of the econometric model does not allow for a straightforward answer to that question which only rests upon parameter estimates. To shed light on the matter, let us focus on the role of trade liberalization and undertake a radical experiment, abandoning

[11] Notice that this conclusion is also not contradicted by the insignificant role of being an LDC for MEA membership after controlling for other determinants.

all PTAs concluded world-wide in all years covered in our data-set. Such a change affects EXPORTS through six channels. First of all, it affects nominal exports in (2) directly through the trade cost term $t_{ij}^{1-\sigma}$. Second, it affects exports indirectly (and in the opposite way) through both exporter and importer multilateral resistance terms Π_i and P_j, respectively. Third, by affecting exports it exerts an indirect effect on exporter, importer, and world GDP. Since GDPs and the number of PTAs concluded across the years, EXPORTS is a time-variant variable and the impact on EXPORTS of abandoning PTAs counterfactually is heterogeneous across the years. The time-specific effect of EXPORTS is then scaled by the corresponding parameter estimate. However, notice that even a homogeneous change in EXPORTS across countries and years would turn into heterogeneous effects on MEA membership by virtue of the nonlinear nature of the econometric model. The impact of PTA membership in MEA participation is computed as the model prediction of MEA participation cum PTAs relative to (minus) one without any PTAs.

Tables 6 to 6 summarize the quantitative effects of PTAs for the year 2006 – i.e., the last year in our data. Notice that the impact of PTA membership on the number of MEAs will be large in that year as compared to ones in the 1960s, since the number of PTAs in place by 2006 was large. There are four tables, since we compute effects for different country-groups: European Union (EU),[12] North American Free Trade Area (NAFTA),[13] the rest of the world (RoW), and the whole world covered (i.e., 178 economies). Each table has got four rows of data and four columns. The last two columns report absolute predictions of MEAs concluded with and without PTAs for the average country (in the top row) in each group considered in 2006.[14] The first column is simply the difference between the last two columns in each table. Notice that the first column represents short-run – or contemporaneous – effects of PTA membership in 2006. Introducing all existing PTAs in 2006 relative to a situation without any PTAs leads to an increase of about 6 MEAs for the average country included (see the upper left number in Table 6). This effect seems reasonable, since the average number of predicted MEAs in that year is about 23 (see the number in the third column at the top of that table). The effect is much lower in absolute terms for countries in the RoW, and it is highest for EU member countries.

Overall, these results suggest that, for the average economy considered (see Table 6), the number of MEAs concluded would be predicted to drop by more than a quarter if all preferential trade agreements would be abandoned. Even though the nexus between environmental protection and MEA participation is not trivial, we argue that such a large change in international cooperation through environmental agreements would bring about detrimental effects for environmental protection.

[12]Austria, Belgium, Switzerland, Czech Republic, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, Latvia, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Sweden

[13]Canada, Mexico, and the United States.

[14]We also report minimum and maximum effects along with the standard deviation of the effects across the countries in each group.

7 Conclusions

(preliminary) In this paper we make use of the dynamic linear feedback model of Blundell, Grith, and Windmeijer (2002) to calculate the impact of economical, political, and environmental determinants on the number of MEAs ratied by a country. Our results can confirm the hypothesis that trade liberalisation actuates membership in MEAs. The increasing connectedness of nations through open trade boosts not only economic cooperation but also environmental arrangements. The strong positive values of our variables GDP, EXPORTS and NBITS indicate this conclusion. In other words globalisation drives ratication of MEAs all over the world. TO BE ADDED

8 Appendix

8.1 Econometric Model

A complication in estimating the econometric model arises as the within group mean scaling estimator will be inconsistent for small T, since the lagged dependent variable is predetermined.[15] For estimation by the generalized method of moments (GMM), the LFM may be quasi-differenced (see Wooldridge, 1997) with

$$q_{it} = \frac{y_{it} - \sum_{j=1}^{p} \gamma_j y_{it-j}}{\mu_{it}} - \frac{y_{it-1} - \sum_{j=1}^{p} \gamma_j y_{it-1-j}}{\mu_{it-1}}. \tag{5}$$

Define $\theta = [\gamma_1, \ldots, \gamma_p, \beta]'$. Then, the GMM estimator minimizes

$$\theta = \arg\min \left\{ \left(\frac{1}{N} \sum_{i=1}^{N} q_i' Z_i \right) W_N \left(\frac{1}{N} \sum_{i=1}^{N} q_i' Z_i \right) \right\}, \tag{6}$$

where q_i is the $T-p-1$ vector $[q_{it}]$, Z_i is the matrix of instruments and W_N is a weights matrix. We use the full set of sequential instruments so that Z_i is given by:

$$Z_i = \begin{bmatrix} y_{i1} & x_{i1} & x_{i2} & & & & & & \\ & & & \ddots & & & & & \\ & & & & y_{i1} & \cdots & y_{iT-2} & x_{i1} & \cdots & x_{iT-1} \end{bmatrix}. \tag{7}$$

The efficient weights matrix for the moments is defined as

$$W_N(\hat{\theta}_1) = \left(\frac{1}{N} \sum_{i=1}^{N} Z_i' q_i(\hat{\theta}_1) q_i(\hat{\theta}_1)' Z_i \right)^{-1}. \tag{8}$$

The one-step GMM estimator $\hat{\theta}_1$ uses $W_N = \left(\frac{1}{N} \sum_{i=1}^{N} Z_i' Z_i \right)^{-1}$ as the initial weights matrix. The asymptotic variance of $\hat{\theta}_1$ may be computed as

$$\hat{\text{var}}(\hat{\theta}_1) = \frac{1}{N} \left(C(\hat{\theta}_1)' W_N C(\hat{\theta}_1) \right)^{-1} W_N W_N^{-1}(\hat{\theta}_1) W_N C(\hat{\theta}_1) \left(C(\hat{\theta}_1)' W_N C(\hat{\theta}_1) \right)^{-1}, \tag{9}$$

[15] I.e., it is correlated with shocks in the past so that $E(x_{it}u_{it+j}) = 0$, j$\geqslant$ 0, and $E(x_{it}u_{it-s}) \neq 0$, s$\geqslant$ 1.

where

$$C(\hat{\theta}_1) = \frac{1}{N}\sum_{i=1}^{N} \frac{\partial Z_i' q_i(\theta)}{\partial \theta}\bigg|_{\hat{\theta}_1}. \tag{10}$$

The efficient two-step GMM estimator $\hat{\theta}_2$ uses the efficient weights matrix $W_N(\hat{\theta}_1)$, where $q_i(\hat{\theta}_1)$ is based on the one-step estimates $\hat{\theta}_1$. The asymptotic variance of the efficient two-step GMM estimator is computed as

$$\hat{\text{var}}(\hat{\theta}_2) = \frac{1}{N}\left(C(\hat{\theta}_2)' W_N C(\hat{\theta}_2)\right)^{-1}. \tag{11}$$

Hansen, Heaton, and Yaron (1996) suggest to directly account for the dependence of W_N on θ in the optimization, an estimator known as the continuous updating GMM estimator in the literature. The main advantage of the latter estimator is that it is invariant to curvature altering transformations of the population moment conditions (see Hall, 2005).

Because of the small sample bias of the two-step GMM estimator (see Windmeijer, 2002), we additionally use a finite sample correction based on block-bootstrapping. In order to preserve the time-structure of the data, we construct our bootstrap samples by drawing from the pool of 176 countries 2000 times with replacement, and then take for every drawn country all observations over time. We then calculate the mean and standard observations over the 2000 bootstraps for every estimated coefficient, leading to our estimates for the block-bootstrap. As the draws are taken from the sample, the finite-sample properties of our sample are preserved for the bootstrapped standard areas. For more details on the properties of the bootstrap method see for example Chapter 11 in Cameron and Trivedi (2005).

8.2 Multilateral resistance terms

Even though multilateral resistance terms are unobserved, they can be obtained as solutions to the system of nonlinear equations of the form

$$\Pi_i^{1-\sigma} = \sum_{j=1}^{N}\left(P_j^{\sigma-1}\theta_j t_{ij}^{1-\sigma}\right) \quad \forall\, i, \quad \theta_j = \frac{y_j}{y_W} \quad \forall\, j, \tag{12}$$

$$P_j^{1-\sigma} = \sum_{i=1}^{N}\left(\Pi_i^{\sigma-1}\theta_i t_{ij}^{1-\sigma}\right) \quad \forall\, j, \quad \theta_i = \frac{y_i}{y_W} \quad \forall\, i. \tag{13}$$

To solve for $\Pi_i^{1-\sigma}$ and $P_j^{1-\sigma}$, we only need to know nominal GDPs and bilateral economic trade costs. However, while GDPs may be directly gathered from statistical sources, this is impossible for economic trade costs. Typically, trade economists model them as $t_{ij} \equiv e^{\mathbf{z}'_{ij}\boldsymbol{\beta}}$, where $\mathbf{z}_{ij}$ is a vector of observable trade barrier variables and $\boldsymbol{\beta}$ is a corresponding vector of unobservable (but estimable) parameters relating the elements of $\mathbf{z}_{ij}$ to t_{ij}.

Specifically, we use the following observable variables as elements of $\mathbf{z}_{ij}$: bilateral geographical distance between countries i and j; an indicator of contiguity of countries i and j which is unity if two countries have a common land border and zero else; a common language indicator which is unity if countries i and j have a common official language and zero else; a continent dummy which is unity if two countries are located at the same continent; a colony indicator which is unity if two countries had a colonial relationship in the past; a current colony indicator which is unity if two countries had a colonial relationship after World War II; an indicator which is unity if the two units i and j form one country (such as Denmark and Greenland); and a preferential trade agreement indicator which is unity if two countries belong to a such an agreement in a given year.[16] All variables except for preferential trade agreement memberships are time-invariant and collected from the geographical data-set made available by the Centre d'Études Prospectives et Internationales (CEPII). We estimate the parameters $\boldsymbol{\beta}$ by means of a cross-sectional regression model based on data of the year 2006.

Potential trade flows are defined as the model predictions using equations (2) and (12) and estimates of the parameters $\boldsymbol{\beta}$ from a cross-sectional model cum fixed country effects for the year 2006. Notice that neighboring countries' weighted GDP and population exhibit time variation for two reasons: first, GDP and population change over time and so does weighted GDP and population; second, potential trade weights change since GDPs change, preferential trade agreement membership changes, and, indirectly, the multilateral resistance terms in (12) change through GDP and preferential trade agreement memberships.

References

[1] Anderson, J.E. , E. van Wincoop (2003) "Gravity with gravitas: a solution to the border puzzle", *American Economic Review* 93, pp. 170-92.

[2] Beron K. J., j. C. Murdoch and W. P. M. Vijverberg (2003) "Why cooperate? Public goods, economic power, and the Montreal Protocol", *The Review of Economics and Statistics* 85, 286-297.

[3] Blundell R., R. Griffith and F. Windmeijer (2002) "Individual effects and dynamics in count data models", *Journal of Econometrics* 108, pp. 113-131.

[4] Blundell R., R. Griffith and J. Van Reenen (1995) "Dynamic count data models of technological innovation", *The Economic Journal* 105, pp. 333-344.

[5] Breton M., L. Sbragia, G. Zaccour (2008) "Dynamic Models for International Environmental Agreements", *Fondazione Eni Enrico Mattei* nota di lavoro 33.2008.

[6] Center for International Earth Science Information Network (CIESIN) (2006), Data-base from Socioeconomic Data and Applications Center (SEDAC) „Environmental Treaties and Resource Indicators", http://sedac.ciesin.columbia.edu/entri/.

[7] Chamberlain, G. (1993) "Feedback in panel data models", *Mimeo*, Econometric Society Summer Meeting, Boston.

[16] We use information on preferential trade agreements as notified to the World Trade Organization. These data are augmented and corrected by using information from the CIA's World Fact Book and preferential trade agreement secretariat web-sites.

[8] Chander P., H. Tulkens (1992) "Theoretical foundations of negotiations and cost sharing in transfrontier pollution problems", *European Economic Review* 36, pp. 388-398.

[9] Dahl, R. (2001), "African Trade Agreement - Not Entirely Free?", *Environmental Health Perspectives* 109, pp. A308.

[10] Eyckmans J, H. Tulkens (2003) "Simulating coalitionally stable burden sharing agreements for the climate change problem", *Resource and Energy Economics* 25, pp. 299-327.

[11] Feenstra, R. (2004) "Advanced International Trade: Theory and Evidence", *Princeton University Press* Princeton, NJ.

[12] Finus M., B. Rundshagen (1998) "Toward a positive theory of coalition formation and endogenous instrumental choice in global pollution control", *Public Choice* 96, pp. 145-186.

[13] Finus M., E. van Ierland, R. Dellink (2006) "Stability of climate coalitions in a cartel formation game", *Economics of Governance* 7, pp. 271-291, Springer-Verlag.

[14] Greenpeace (2003) "How does the WTO affect you, and why should you care about it?", *Greenpeace.*

[15] Greenpeace (2003) "Why is the WTO a problem?", *Greenpeace.*

[16] Gwartney J. , R. Lawson, R.S. Sobel , P.T. Leeson (2007) Economic Freedom of the World: 2007 Annual Report, Vancouver, *The Fraser Institute.* Data retrieved from www.freetheworld.com.

[17] Hall, A.R. (2005), *Generalized Method of Moments* Oxford University Press, Oxford.

[18] Hanse, L.P., J. Heaton, and A. Yaron (1996), "Finite Sample Properties of some alternative GMM estimators obtained from financial market data", *Journal of Business and Economic Statistics* 14, pp. 262-280.

[19] Hanyona, S. (2000), "Zambia mercury submissions to UNEP", *Earth Times News Service*, November 28th, 2000.

[20] Hochstetler, K. (2002), "After the Boomerang: Environmental Movements and Politics in the La Plata River Basin", *Global Environmental Politics* 2, pp. 35-57.

[21] Hochstetler, K. (2003), "Fading Green: Environmental Politics in the Mercosur Free Trade Agreement", *Latin American Politics and Society* 45, pp. 1-32.

[22] Maddison, A. (2003) "The World Economy: Historical Statistics", OECD, Paris.

[23] Mitchell, R. (2003) „International Environmental Agreements: A survey of their features, formation and effects", *Annual Review of Environment and Resources* 28, pp. 429-461.

[24] Mitchell, R. (2007) „International Environmental Agreements Database Project“, Version 2007.1, 2002-2007, http://iea.uoregon.edu/.

[25] Murdoch J.C., T. Sandler, P.M. Vijverberg (2003) "The participation decision versus the level of participation in an environmental treaty: a spatial probit analysis", *Journal of Public Economics* 87, pp. 337-362.

[26] Naughton H.T. (2006) "Cooperation in Environmental Policy: A Spatial Approach", *University of Oregon*, Eugene, OR 97403-1285

[27] Rose A.K., M.M. Spiegel (2009) "Non-Economic Engagement and International Exchange: The Case of Environmental Treaties" *Journal of Money, Credit, and Banking* Forthcoming.

[28] Sugiyama T., J. Sinton (2005) "Orchestra of Treaties: A Future Climate Regime Scenario with Multiple Treaties among Like-minded Countries", *International Environmental Agreements* 5, pp. 65-88.

[29] Swanson T., R. Manson (2002) "The Impact of International Environmental Agreements: The Case of the Montreal Protocol", *Fondazione Eni Enrico Mattei* nota di lavoro 81.2002.

[30] Tol, R.S.J. (1997a) "A Decision-Analytic Treaties on the Enhanced Greenhouse Effect", Vrije Universiteit, Amsterdam.

[31] Tol, R.S.J. (1997b) "On the optimal control of carbon dioxide emissions: An application of FUND", *Environmental Modeling and Assessment* 2, pp. 151-163 .

[32] United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (UN-OHRLLS), http://www.un.org/special-rep/ohrlls/ldc/list.htm.

[33] UNCTAD (2007) "World Investment Report - Transnational Corporations, Extractive Industries and Development", *United Nations Conference on Trade and Development*, New York and Geneva.

[34] Windmeijer F. (2002) "ExpEnd, A Gauss Programme for Non-Linear GMM Estimation of *EXP*onential Models with *END*ogenous Regressors for Cross Section and Panel Data", *CEMMAP Working Paper* CWP 14/02, The Institute for Fiscal Studies, Department of Economics, UCL.

[35] Windmeijer F. (2005) "A finite sample correction for the variance of linear efficient two-step GMM estimators", *Journal of Econometrics* 126, pp. 25-51.

[36] Windmeijer F. (2008) "GMM for Panel Count Data Models", in: M. Laszlo and P. Sevestre (eds.), *The Econometrics of Panel Data* Third Edition, Springer.

[37] Wooldridge J.M. (1997), Multiplicative Panel Data Models without the Strict Exogeneity Assumption, *Econometric Theory* 13, pp. 667-678.

[38] World Bank (2008) "World Development Indicators", World Bank Group, Washington.