The Impact of International Organizations on the Environment: An Empirical Analysis

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Abstract
When analyzing the impact of international organizations on environmental governance, two main issues arise. First, we have to quantify the participation of the organizations on countries they deal with. Second, the environmental impact of this involvement has to be measured. This paper attempts to do this. We employ panel data to empirically analyze whether and to what extent the presence of IMF, World Bank, regional Multilateral Development Banks, WTO and Global Environmental Facilities has an impact on environmental governance and outcomes. Our results for a huge number of countries and years show that IMF, AfDB and UNEP affect environmental quality predominantly positively, while the impact of the World Bank and the EBRD is negative. There are mixed results for IADB and WTO membership. ADB and UNDP have no significant impact on the natural environment. Environmental governance is not affected by the international organizations investigated here.

Keywords: International Organizations, Environment, Governance, IMF, World Bank, WTO, Trade Liberalization

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1. Introduction

In the last two decades, or at least since the release of the Brundtland Report[1], international organizations (IOs) have started considering the importance of environmental concerns in their policies. Multilateral Development Banks (MDBs) have tried to embody environmental policy in their lending programs, both through conditionality and through the institutionalization of environmental impact assessment procedures within the project release process. In the early 90s the International Monetary Fund (IMF) also decided to include environmental considerations in its lending programs, since major environmental problems could have effects on macroeconomic variables affecting a country's stability. On the other hand, the World Trade Organization (WTO) has been heavily criticized by environmental NGOs for neglecting the environmental impact of its policies. International organizations have also developed purely environmental facilities – Global Environmental Facilities (GEF) – making environmental governance and policy an issue of its own in this kind of lending and not only a side issue to be taken into account among other things.

But although IOs have been developing environmental issues in their policy making, critics still consider their programs and policies to have mainly adverse effects on the environment. They criticize IOs for being badly coordinated and not considering environmental problems as their priority in its relations with borrowing countries. Indeed, discussion about the creation of a World Environmental Organization (WEO) to increase international environmental governance is mostly based on efficiency arguments and the adverse consequences of lending policies and trade liberalization on the natural environment. In addition, the issue of a WEO as a counterpart to organizations with mainly economic focus is being raised.

Clearly, the question whether international organizations harm or benefit the natural environment is an empirical one. This paper tries to answer the question. Our analysis includes IOs whose main task is promoting economic development, growth and trade and test whether their presence and projects in different countries have on average significant effects on environmental governance and outcomes. Our analysis also includes the United Nations Development and Environmental Programs' GEF.

To quantify the presence and influence of an IO in a specific country, we focus on the number of programs that the IO implemented there. Regarding WTO, we use membership status of the country. We also tried duration of membership which produces similar results. The impact

[1] World Commission of Environment and Development (1987).

assessment on environmental outcomes employs four dependent variables measuring the degree of water and air pollution and roundwood production. Environmental governance is captured by a composite index intended to measure environmental sustainability.

Where data availability allows, we employ panel data to test our hypotheses. In some cases, however, we are restricted to rely on cross-section regressions. Our results show that IMF, AfDB and UNEP affect environmental quality predominantly positively, while the impact of the World Bank and the EBRD is negative. There are mixed results for IADB projects and WTO membership. ADB and UNDP have no significant impact on the natural environment. Environmental governance is not at all affected by any of the international organizations investigated here.

The remainder of this paper is organized as follows. The next section presents our hypotheses for the individual organizations covered under this study. The third section describes data and methodology used in the empirical investigation, while the results are shown in section 4. Finally, the fifth section contains a short summary.

2. Hypotheses

International Monetary Fund

In early 1991, the IMF's Executive Board decided the Fund should take environmental issues into account when they are crucial for a country's macroeconomic stability (Gandhi 1998). In fact, IMF Policy Framework Papers and Poverty Reduction Strategy Papers (PRSPs) frequently include a discussion of environmental policies.[2] In countries with active discussions about green taxes or energy reforms, the IMF also takes these issues into account in its regular review of its members' economies (Gandhi 1998).

According to the IMF (2004), the links between its macroeconomic mandate and the environment are substantial. IMF programs address policies in borrower countries; policies – in turn – can affect the environment. Clearly, environmental aspects are rarely covered directly under the Fund's conditionality.[3] However, policies included on efficiency grounds are often also beneficial for the environment. Conditions and advice aim at promoting a more rational use of resources and discourage waste, and might thereby benefit environmental quality. The IMF

[2] Gandhi (1998) and Friends of the Earth (1999) provide specific examples.
[3] Dreher (2002) gives a detailed overview of conditions included in IMF and World Bank programs.

(2004) gives three examples:[4] First, subsidies and tax relief on agricultural inputs are frequently subject to conditionality – they are inefficient; and they harm the environment. Second, taxes yielding substantial revenue can sometimes also be used to discourage environmentally harmful activities. And third, publicly owned natural resources can be a significant source of revenues. Even without explicit environmental conditionality, then, IMF programs would benefit the environment.

IMF policies, however, have always been subject to criticism, and such criticism also refers to its role with the natural environment. For example, NGOs blame the Fund's programs to lead to reductions in environmental spending, increase natural resource exploitation, and weaken environmental laws (e.g. Ghandi 1998, Friends of the Earth 1999). Spending cuts can adversely affect level and quality of services such as waste management, sanitation, and environmental regulation standards (Gueorguieva and Bolt 2003). Capacity to monitor and regulate polluters is reduced. Decentralization and privatization redistribute power in favour of the private sector, undermining the state's ability to protect the environment and regulate industries (Killick 1993). The urban poor might be forced to, e.g., cut forests for fuelwood or exploit marginal lands for food. Reductions in interest rate subsidies cut farmers' access to the credit markets and make them switch to extensive farming techniques, thereby contributing to deforestation and soil erosion.

IMF programs aim at increasing exports and generating foreign reserves. As a consequence, countries might over-exploit their natural resources, generating excessive pollution and environmental destruction (Friends of the Earth 1999). Pandey and Wheeler (2001) show that currency devaluations – that have been a frequent IMF condition until the 80s – significantly increase deforestation over a sample of 112 developing countries and 38 years. Trade liberalization – which is a frequent condition in IMF programs – might imply negative consequences for the natural environment as "dirty" industries migrate to liberalized developing countries, where environmental standards and thus the costs of pollution are lower.[5]

Clearly, trade liberalization also implies effects that are beneficial for environmental protection. As one specific example, liberalization can increase profitability of raising herbs, leading to preservation of forests as trees are necessary to protect the herbs (Jayarajah and

[4] See Gandhi (1998) for more examples.
[5] See Beghin (2000) for a summary of this literature.

Branson 1995). Overall, however, world market demand for commodities destructive for the environment is much higher than those for more benign products (Battikha 2002).

Another channel by which the IMF might influence the natural environment is its impact on external debt. It has been argued, that developing countries are forced to environmentally damaging activities in order to be able servicing their debt, particularly regarding tropical deforestation (see, e.g., Capistrano 1990). The direction of the Fund's impact is, however, not obvious. While its loans alleviate short-term pressure, the medium and long-term consequence of an IMF loan might well be an increase in indebtedness, and in debt service payments.

Summarizing the discussion, the direction of the overall impact of the IMF on the environment is not obvious *a priori*. We derive two alternative hypotheses from this:

Hypothesis 1a: IMF involvement improves environmental governance and outcomes.

Hypothesis 1b: IMF involvement deteriorates environmental governance and outcomes.

World Bank

The World Bank carries out projects and provides loans for structural adjustment. Both project loans and program loans are subject to conditionality, which is to some extent similar to the conditions set by the IMF (Dreher 2002). However, whereas the majority of the Fund's conditions focuses on macroeconomic targets, World Bank conditionality is more structural in nature. Bank programs include conditions directly referring to the natural environment – in the 1990s, 23 percent of its SALs contained such conditions (World Bank 2001). Policies like the creation and strengthening of environmental institutions, the implementation of policies for environmental protection, or environmental taxation are explicitly covered.[6] Our second hypothesis is therefore:

Hypothesis 2: World Bank involvement improves environmental governance.

Apart from conditions referring directly to the environment, World Bank programs cover a range of other areas that have indirect positive environmental consequences. For example, measures increasing the prices of agricultural products might increase incentives and abilities to

[6] Nielson and Tierney (2003) provide a description and explanation of recent environmental policies at the Bank. See also Gutner (2005a, 2005b).

conserve soil. Higher energy prices are likely to promote conservation of fossil fuels (Hansen and Hansen 1999). The introduction of electricity tariffs can increase energy efficiency (Gueorguieva and Bolt 2003). The Bank's programs sometimes imply declining use of fertilizers and pesticides, which is likely to improve water quality (Lovei 1999).[7]

All those conditions imply:

Hypothesis 3a: World Bank involvement improves environmental outcomes.

However, World Bank projects have frequently been criticized. Much of its lending supports projects and programs in environmentally sensitive areas, such as energy, agriculture and transport.

Conditions included under the Bank's programs and projects might also imply negative environmental consequences. For example, measures increasing the prices of agricultural products could lead to intensified cultivation and erosion (Hansen and Hansen 1999). The same might happen as a consequence of increased input prices. The impact of structural adjustment on energy use can also be negative, as the introduction of electricity tariffs might imply increasing use of traditional fuels, in turn increasing air pollution (Gueorguieva and Bolt 2003).[8]

World Bank conditionality frequently aims at reducing the public sector. The private sector, however, is less likely to internalize environmental costs (Battikha 2002). Export promotion, trade liberalization and privatization might also damage the environment. As Pandey and Wheeler (2001) argue, the World Bank's structural adjustment measures might increase deforestation in the program country.[9] Thus:

Hypothesis 3b: World Bank involvement deteriorates environmental outcomes.

Regional Multilateral Development Banks

We focus on the Interamerican Development Bank (IADB), the Asian Development Bank (ADB), the African Development Bank (AfDB) and the European Bank for Reconstruction and Development (EBRD). Although these regional Multilateral Development Banks (MDBs) all rely

[7] For case studies regarding the evidence of structural adjustment on water quality see Munasinghe and Cruz (1994) and Goldin and Roland-Host (1994).
[8] Munasinghe and Cruz (1994) provide case study evidence.
[9] Apart from its influence on the program country's wood production, the Bank might influence wood production in other countries, as exports and imports of the program country change (Pandey and Wheeler 2001).

on comparable structures and operating systems and conduct similar policies as the World Bank, there are important differences. Above all, MDBs do not exert comparable pressure on their borrowers to implement structural and macroeconomic conditionality (Mikesell and Williams 1992). They mostly engage in project lending or concentrate on certain economic areas like, e.g., agriculture or energy.

In all four regional MDBs environmental issues became prominent in the late 80s, even though these issues have not directly influenced their policies until many years later.[10] They all included the preparation of Environmental Impact Assessments (EIA) in their project analysis procedure and institutionalized environmental issues through internal units designed for that purpose. Moreover, they allow or even encourage participation of national experts and institutions at different degrees in their analysis of the environmental impact of lending projects. In this way the MDBs intend to enhance and promote environmental governance and try integrating national organizations and institutions into the environmental assessment process.

Accordingly, the Environmental Protection Division of the IADB, founded in 1989, analyzes the potential environmental consequences of a project together with the project team, in order to identify necessary studies to be carried out by the borrower countries in order to formulate the EIA. Based on both the EIA and the project team's analysis, the Environmental Management Committee (EMC) elaborates the loan report that is to be approved by the director's board (IADB 1990). A similar procedure is followed at the ADB, where the Environmental Division (formerly the Office of the Environment) analyzes environmental consequences of projects since 1988 (ADB 1994, 1995). Because of its initial difficulties in raising funds and the late incorporation of non-African donors to the AfDB, the environmental issue was there only implemented in 1991, when EIA started to be part of the standard procedure in structural loans (Mikesell and Williams 1992). Finally, although the EBRD has been heavily criticized for its environmental policies because of lending projects referring to old Soviet-built nuclear plants and because environmental projects amount to only about 10 percent of its lending portfolio, it has environmental procedures similar to the other MDBs and played an important role as advisor of the Preparation Committee for the Environment for Europe Process (Gutner 2002).

[10] Runnals (1986), e.g., attests that the IADB did not have an adequate system of environmental impact analysis in 1985 although the Environmental Management Committee (EMC) had been founded two years before. Analogously, project environmental reports were made by the ADB since 1981, but without an adequate framework and in depth analysis (Mikesell and Williams 1992).

In this way, every regional MDB included in our analysis has an institutionalized procedure concerning the environmental impact analysis of its lending projects and is therefore supposed to positively impact on environmental governance. The incorporation and strengthening of national institutions in the EIA process, extensive research about the natural environmental, training public sector officials in environmental policy[11], and their function as knowledge centres for future environmental issues (AfDB 2001) imply:

Hypothesis 4: Regional MDB involvement improves environmental governance.

Following the same line of reasoning as those for the World Bank above, we derive two further hypotheses referring to environmental outcomes. Regional MDBs might in fact affect environmental quality directly and indirectly by implementing programs with medium or high environmental sensitivity. Examples are projects in the agro-industry, fish farming, small-scale irrigation, water supply and power generation, and particularly large-scale irrigation, hydropower and water management, resettlement, new ports, airports and harbours, forestry or livestock projects (Mikesell and Williams 1992).

Again, the potential impact and its positive or negative implications are not obvious *a priori*. Agricultural credit loans, for example, can on one side mitigate rural-urban migration processes, alleviating waste and water management problems in overcrowded cities or reducing urban pollution, but – on the other hand – can also produce intensified cultivation and soil erosion. As irrigation projects can improve agricultural output and create incentives to remain in rural regions, they might also damage soil through salinization, displace families from the water reservoir areas or pollute downstream waterways (ADB 1987). Hydropower dams can improve energy efficiency. However, they negatively affect wildlife, wildlands, fishery or other downstream water projects, as turbidity will deteriorate aquatic life recreation or soil erosion and chemical pollution of upland streams could finally stored in the water delivery system and then be carried downstream affecting other water uses (Dixon 1989, Goldsmith and Hildyard 1984). Even forestry projects directly intending the conservation of a certain ecosystem or the protection of water resources might have adverse impacts, as the modification of migration trends through population resettlement, the destruction of indigenous cultures living in primary forests or the

[11] As for example in the Development Management Training of the AfDB or through the Joint African Institute (AfDB 2001).

modification of the ecosystem affecting species in their composition or number (Lawrence 2001, ADB 1999).[12]

Hence, we can formulate the alternative hypotheses:

Hypothesis 5a: Regional MDB involvement improves environmental outcomes.

Hypothesis 5b: Regional MDB involvement deteriorates environmental outcomes.

Global Environmental Facilities

Global Environmental Facilities (GEF) were proposed in 1990 by the World Bank, as a consequence of the discussion distinguishing between domestic and global environmental impact and the increasing concern about global environmental issues. Since implementing projects to increase global environmental quality is not always profitable for developing (and other) countries, the idea to provide funds at low interest rates for these kinds of loans arose. The GEF were created in World Bank resolution 91-5, under management of the World Bank itself and to be executed through three implementing agencies, the World Bank, the United Nations Development Program (UNDP) and the United Nations Environmental Program (UNEP).

The direct involvement of the World Bank in the GEF has been heavily criticized. According to some NGOs, the World Bank hardly managed to care about environmental issues in its own programs and should therefore not lead an environmental "agency" as the GEF was understood to be. They stressed the need for independent implementing agencies (Mikesell and Williams 1992), particularly as they feared any World Bank involvement would allow the Bank to expand its conditionality to "green areas" (Streck 2001).[13]

Other critics of the GEF requested a larger number of implementing agencies to improve the efficacy and the quality of the projects through the competition for GEF funds, since they predicted a leading role of the World Bank in the GEF distribution (Steck 2001) and a suboptimal aid allocation.[14] Congleton's (2002) estimates suggest that GEF allocation is not maximizing

[12] For a detailed description on the effects of multipurpose dams, irrigation, forestry and livestock projects, agricultural credit loans and loans for infrastructure and extractive industry see Mikesell and Williams (1992). They also for case studies on different MDBs projects in that areas. See also Hansen and Hansen (1999).

[13] In this context the benefits and drawbacks of an independent World Environmental Organization (WEO) have also been discussed. The main arguments in favour of a WEO can be found in Biermann (2001, 2002). For further discussion on see von Moltke (2001), Lodefalk and Whalley (2002) and Newell (2002).

[14] The optimality of GEF allocation and the role of agency problems in analyzed by Congleton (2002) and Lewis (2003).

international environment quality, as less than a half of the allocation of the loans can be explained by the model estimates used.

However, a more direct empirical test of the impact of GEF on environmental quality is missing. Given that the GEF are directly designed to promote environmental governance[15] we hypothesize:

Hypothesis 6: GEF improve environmental governance.

Hypothesis 7: GEF improve environmental outcomes.

World Trade Organization

The impact of the WTO on the natural environment has also been subject to heated debate.[16] A vast array of environmental NGOs blames the WTO for neglecting the environmental consequences of its policies.[17] However, the WTO has also been defended. According to Oxley (2001), the WTO gives great latitude to its members to restrict trade to protect the environment.[18] In the Marrakech Agreement (establishing the WTO) there is explicit reference to sustainable development as one of the WTO's general objectives. Its article XX.g permits restrictions if they complement national programs for conservation of resources.[19] WTO members are allowed to adopt national environmental protection policies, provided they do not discriminate between imported and domestic products (WTO 2004).

Clearly, the main channel by which the WTO might affect the natural environment is its impact on trade liberalization. However, the direction of the impact of the WTO on liberalization is not obvious *a priori*. For example, Guisinger (2001) does not find empirical evidence suggesting that WTO membership is a significant determinant of the rate of trade liberalization. To the contrary, the WTO affects the level of trade protection (Guisinger 2005).

Whether liberalization is actually beneficial or detrimental to the environment is also subject to considerable controversy.[20] According to the WTO (2004), trade liberalization

[15] The facilities have to belong to one of four focal areas, 1) climate change, 2) biological diversity, 3) international waters and 4) ozone layer depletion. Hence, projects as the creation of alternative energy resources to reduce CO_2 emission or the deviation of roads in order to protect a certain species and maintain biodiversity, became now candidates for GEF, since they were considered to be of global environmental relevance.
[16] For an in depth discussion, see MacMillan (2001).
[17] Examples are Friends of the Earth, Greenpeace, One World and World Wildlife Fund.
[18] See also Sampson (2003).
[19] WTO policies are therefore much in line with the preferences of most environmental NGOs. Cone (2002) provides an interesting illustration.
[20] Alpay (2002) provides an extensive summary.

improves allocation and efficient use of natural resources. The Secretariat of the WTO identifies a range of channels through which the removal of trade restrictions improves environmental quality.[21] Among them is a more efficient factor use through enhanced competition, poverty reduction through trade expansion and encouragement of a sustainable rate of natural resource exploitation, and an increase in the availability of environment-related goods and services through market liberalization. Firms from developed countries might find it cheaper to use the same technology for production in developing countries they use at home, thus contributing to cleaner production in the developing country. In their review article Beghin and Potier (1997) conclude that trade liberalization does not induce wholesale specialization in dirty manufacturing industries in the developing world. Wheeler and Martin (1992) show that liberalization contributed to the international diffusion of clean technology in wood pulp production.

By expanding the scale of production, liberalization can, however, also decrease environmental quality. According to Reed (1996) and Daly (1996), trade liberalization discourages the internalization of environmental costs in developing countries as a consequence of increased competition from developed countries. Environmental standards might be considered being non-tariff barriers so they would be discouraged. As Killick (1993) points out, liberalization is likely to induce a shift in production towards tradable goods, increasing pressure to exploit natural resources.

Evidence in favour of a negative link from liberalization to environmental quality is provided by Mani and Wheeler (1991). Their cross-section analysis shows that pollution intensive production has fallen considerably in the OECD while it has risen in the developing world.[22] Giordano (1994) suggests that free trade can compound over-exploitation of natural resources in countries without clearly defined property rights.

In summary, the previous discussion implies two alternative hypotheses:

Hypothesis 8a: WTO involvement improves environmental governance and outcomes.

Hypothesis 8b: WTO involvement deteriorates environmental governance and outcomes.

[21] WT/CTE/W/67, 7 November 1997, "Environmental Benefits of Removing Trade Restrictions and Distortions", Note by the Secretariat.

[22] However, Mani and Wheeler (1991) also show that the tendency to form pollution havens is quite limited.

3. Data and Method

Our regressions employ cross-sectional and pooled time-series cross-sectional data. The panel data are averages over five years. They cover the time period 1970-2000 and extend to a maximum of 112 countries. Since some of the data are not available for all countries or periods, the panel data are unbalanced and the number of observations depends on the choice of explanatory variables. The cross-section-analysis uses the most recent data available for the dependent variables and averages over the last 30 years for the explanatory variables. The analysis refers to about 90 countries.

The panel regressions are estimated using feasible generalized least squares (FGLS). This allows estimation in the presence of AR(1) autocorrelation within panels and cross-sectional heteroscedasticity across panels. Our cross-section regressions are estimated by OLS and robust regressions. The robust regression technique weighs observations in an iterative process. Starting with OLS, estimates are obtained through weighted least squares where observations with relatively large residuals get smaller weight. This results in estimates not being overly influenced by any specific observation.

We employ five dependent variables to test our hypotheses. The first is biochemical oxygen demand (BOD), which is a proxy for water pollution. According to the European Environment Agency, a high demand can indicate falling levels of dissolved oxygen, implying dangerous consequences for river diversity.[23] BOD is available for a maximum of 114 countries over the period 1980-2001 (World Bank 2005). We employ the logarithm of emissions in kilogram per day and capita. In the literature on air pollution, the most frequently used measures are carbon dioxide (CO_2) and sulphur dioxide (SO_2) emissions (Gassebner, Lamla and Sturm 2005). We include the logarithm of CO_2 and SO_2 (in metric tons per capita) to our empirical analysis. Data for CO_2 are available for up to 188 countries covering the years 1970-2000 (World Bank 2005). However, as Gassebner, Lamla and Sturm (2005) point out, these data are based on calculations instead of being measured directly. The source for SO_2 data is Stern (2005). It is available over the period 1970-2000 for a maximum of about 200 countries. In constructing the dataset, Stern combined various sources and interpolated or extrapolated missing data.

As our fourth measure of environmental quality we employ round wood production (measured as the log of thousand cubic meters produced per capita). Data is available from the

[23] http://themes.eea.eu.int/Specific_media/water/indicators/bod/index_html.

Food and Agriculture Agency of the United Nations (FAO) over the period 1970-2003, for about 170 countries.

The fifth measure is no outcome variable but a composite index intended to measure environmental sustainability. The Environmental Sustainability Index (ESI) is calculated by The Environmental Performance Measurement Project in collaboration with the Center for International Earth Science Information Network (CIESIN) and the World Economic Forum. The ESI is a composite index tracking a diverse set of socioeconomic, environmental, and institutional indicators that characterize and influence environmental sustainability at the national level. As these data are not available prior to 2001, we cannot employ panel data methods to analyze them. We employ the most recent (2005) data for our cross-section analysis.

Our selection of control variables follows the previous literature as closely as possible. In choosing the covariates for the CO_2, SO_2 and BOD equations, we rely on the robustness analysis of Gassebner, Lamla and Sturm (2005). We employ those variables that have been shown to be robust and are available for a sufficient number of countries and years. We use the level and square of (the logarithm of) GDP per capita to take account of the Environmental Kuznets Curve. Openness to trade is also included.[24] The effect of trade may occur via the scale effect, the composition effect, and the technique effect.[25] *A priori*, trade may thus increase or reduce pollution.[26] A dummy for left-wing governments is included to account for a potentially higher degree of sympathy towards environmental protection by those governments. A dummy for dictatorships is included, as dictators might take greater care of the environment to verify their leading position than democratically elected leaders would. We include population density and the share of urban population in total population to account for demographic factors. Higher population density and greater urbanization are likely to increase pollution. The value added in the manufacturing industry (in percent of GDP) takes account of a country's industrialization. It is hypothesized to increase pollution. Finally, fertilizer consumption (in 100 grams per hectare of arable land) is employed. Fertilizer consumption can be interpreted as reflecting a country's

[24] Note that GDP might also be affected by the involvement of international organizations. If, for example, IMF programs increase economic growth in the program countries, the scale effect of higher GDP might deteriorate environmental quality. We neglect this channel here.

[25] The scale effect refers to the negative environmental quality arising from an increase in production. The technique effect arises from a shift towards cleaner technology resulting from shifting preferences in line with higher incomes. The composition effect results from trade-induced changes in the composition of output that affects the environment.

[26] Clearly, the level of trade can also be endogenous to environmental quality. However, the instrumental variables approach of Frankel and Rose (2002) shows very similar effects among their OLS and IV estimates. We therefore neglect this potential endogeneity here.

general attitude towards environmental protection (Gassebner, Lamla and Sturm 2005). It is likely to be associated with greater water and air pollution.[27] The panel regressions also include regional dummy variables for Africa, Eastern and Central Europe, Asia, and Latin America (which turn out to be jointly significant in almost all regressions).[28] However, the coefficients of the dummies are not reported in the tables. Appendix A lists all variables with their exact sources and definitions, while Appendix B provides descriptive statistics.

In choosing the covariates for the analysis of roundwood production we follow Pandey and Wheeler (2001). We therefore include (the log of) the export and import prices for roundwood, the quantity of world exports of roundwood and the oil price to our list of explanatory variables. As none of these additional variables turns out to be significant at conventional levels, we stick to the model introduced for CO_2, SO_2 and BOD. We employ the same covariates when analysing the environmental sustainability index.

Given the potential indirect effect of the international organizations on environmental quality via trade liberalization discussed above, we also include liberalization measures. Our measure has been developed by Gwartney and Lawson (2004) as part of their economic freedom index. It reflects the freedom to trade internationally, where higher scores reflect greater freedom. The index ranges from zero to 10 and comprises taxes on international trade, regulatory trade barriers, the actual size of the trade sector as compared to its expected size, the difference between the official exchange rate and the black market rate, and international capital market controls. It is available over the period 1970-2002 for a maximum of 123 countries.

Turning to the impact of international organizations, we employ a range of dummy variables. Most of these variables have been coded according to the organizations' annual reports. Data on regional development banks has been provided by Hicks et al. (2005). The influence of the IMF and the development banks is captured by the average yearly number of programs (or projects) starting in the preceding five-year period.[29] This is meant to capture the overall influence of the financial institutions, i.e., the impact of available or disbursed money, the policy

[27] All variables are taken from the World Bank's (2005) World Development Indicators. The exceptions are the dummies for left-wing governments and the dictatorship dummy. The former is from Beck et al. (2001), the latter has been constructed employing the Polity IV index of democracy (Marshall and Jaggers 2000). It takes the value one for scores smaller than three on the Polity index, and zero otherwise.

[28] The dummies showed to be insignificant in the cross-section regressions, so we exclude them here.

[29] Using program dummies to capture the impact of international organizations on policy and outcome measures is standard in the empirical literature. Atoyan and Conway (2005) and Dreher (2005a, 2005b) are recent examples.

conditions they attach to their loans and their policy advice.[30] An alternative possibility of capturing the environmental impact of the Development Banks would be classifying their projects according to category, and focus on those with direct environmental relevance. For example, Nielson and Tierney (2003) coded (World Bank-) projects as either predominantly environmental or not. However, projects attempting to improve the environment on paper might not be implemented as agreed, thus not being a good proxy for the Banks' impact on the natural environment. The Banks take environmental issues into account in their non-environmental projects also. Projects might thus affect the environment independent of whether they are classified as being primarily environmental or not (Gutner 2005b). Using overall project dummies is thus preferable.[31] We construct variables for the UN development program and environment program along the same lines.

With respect to the WTO, two variables have been employed. The first is the average number of years the country has been WTO member in the preceding five year period.[32] The second is the total number of years the country has been WTO member since 1970.

As one problem with measuring the influence of international organizations on environmental quality, countries with poorer environmental record might self select into (the programs of) these institutions. However – except for the Global Environmental Facilities – the international organizations included in our analysis do not primarily address environmental issues. As we control for other factors of development, such self-selection is unlikely to be an issue here. We thus neglect the potential endogeneity in our analysis.

When estimating the regressions, we would not only want to capture the direct impact of the international organizations on environmental quality, but also their indirect effect via trade liberalization. We therefore estimate 2SLS in addition to FGLS and OLS. In our 2SLS regressions, we follow Guisinger (2005, p. 128: Table 1) to select potential determinants of trade liberalization. Again we do not include variables that are not available for a sufficient number of countries and years. We include a countries' (log) GDP per capita (World Bank 2005), its democracy score (Marshall and Jaggers 2000), a dummy that takes the value one for countries

[30] See Boockmann and Dreher (2003) for an attempt to separate these effects of the international organizations on economic freedom. Dreher (2005a, 2005b) analyzes the impact of those channels of IMF involvement on fiscal and monetary policy and, respectively, economic growth.

[31] Clearly, dummies for program agreements do tot take the degree to which the program is implemented into account also. Ideally, we would also want to control for the degree of compliance with program conditionality. Unfortunately, no appropriate data exist.

[32] The WTO replaced the GATT in 1995. We treat GATT and WTO membership as continuous.

with a presidential system (Beck et al. 2001), and dummies that are one if a country's exports are mainly manufactured goods, mainly fuel, and, respectively, if the country is undeveloped (all Easterly and Sewadeh 2002). Regarding the impact of international organizations, we employ the same variables as in the environmental quality regressions.

The next section reports the results of the empirical analysis.

4. Results

We start with the determinants of trade liberalization. Our panel analysis refers to 90 countries. We include the number of projects agreed on for each international organization one at the time. The final column includes all organizations. Table 1 reports the results. As can be seen, trade liberalization is more likely with higher GDP per capita, with a coefficient significant at the one percent level in all regressions. In most regressions, trade liberalization is also more likely in democracies. Manufactured exports, fuel exports and the dummies for development and presidential systems have no robustly significant impact. A Wald test shows that all variables are jointly significant at the one percent level in all regressions.[33] Turning to the impact of the international organizations, the results show that the ADB significantly promotes trade liberalization according to both specifications. The same is true for the UNDP and WTO membership. EBRD and UNEP have a significantly positive impact when included individually, but not in the full model specification of column 10.[34] In the final equation, trade liberalization is less likely with more AfDB and IADB projects. According to the estimates of column 10, one additional ADB project over the whole five-year-period increases the index of trade liberalization by 0.07 points; an additional UNDP GEF loan by 0.54 points. WTO membership increases the index by 0.03 points, while an additional AfDB (IADB) project reduces the index by 0.09 (0.07) points. The impact of the international organizations on trade liberalization is jointly significant at the one percent level.

We now turn to the impact of the international organizations on the environment. Table 2 reports (panel) results for CO_2, SO_2, BOD and roundwood production, with and without

[33] We do not report the R-squared statistic as with GLS the total sum of squares cannot be broken down in the same way as with OLS, making the R-square statistic less useful as a diagnostic tool for GLS regressions. Specifically, an R-square statistic computed from GLS sums of squares need not be bounded between zero and one and does not represent the percentage of total variation in the dependent variable that is accounted for by the model. Additionally, eliminating or adding variables in a model does not always increase or decrease the computed R-square value.

[34] Clearly, the projects of some organizations are to some extent correlated. Correlation, however, never exceeds 0.50 and is well below 0.15 in most cases.

employing instruments. As can be seen, the results show some support for the environmental Kuznets curve hypothesis: In most regressions per capita GDP increases environmental damage, while its square has a significantly negative coefficient. The obvious exception is roundwood production, where production is significantly lower with higher GDP and higher with its square. The results also show that environmental degradation tends to be more severe with greater economic openness, bigger manufacturing sectors, more intensive use of fertilizer and lower population density. Greater urbanization significantly increases CO_2 and SO_2 emissions, but significantly reduces roundwood production and BOD emissions. The dummies for left-wing governments and dictatorships exert a significant influence in some regressions without, however, showing a consistent picture among the GLS and IV estimates. The index of trade liberalization is significant at least at the five percent level in two equations only. According to the 2SLS results of column 2, an increase in the index by 0.1 points reduces CO_2 emissions by more than ten percent. Column 7 shows that the same increase increases roundwood production by 0.1 percent. In calculating the total impact of the international organizations we have to keep their indirect effects via these two channels into account.

The results show a substantial impact of the international organizations. In all regressions this impact is jointly significant at the one percent level. Generally, the impact of the international organizations is most strongly when it comes to CO_2 emissions and roundwood production. The following discussion refers to results that are consistent across the GLS and 2SLS specifications.

Regarding SO_2 emissions, IMF programs and WTO membership improve air quality at the one percent level of significance. IADB projects decrease BOD levels, with a coefficient significant at the five percent level at least. The influence is quantitatively relevant. One additional IMF program reduces SO_2 emissions (in metric tons per capita) between 11-16 percent. The impact of WTO membership is quantitatively smaller: membership over a five-year-period reduces emissions by about 0.1 percent. An additional IADB project reduces BOD emissions (in kg per day and capita) between 1.5 and 4.2 percent.

CO_2 emissions rise significantly with a greater number of World Bank and EBRD projects, and a smaller number of AfDB and IADB projects (when only the direct impact of the organizations is taken into account). According to the GLS regressions, the direct quantitative impact is smallest for the IADB, where an additional project reduces emissions by 1 percent. It is greatest for the AfDB with an additional project implying a reduction in emissions by almost 6 percent. When we take the indirect effect of the organizations via their impact on trade

liberalization into account, however, the positive direct impact of AfDB and IADB projects on environmental quality is reversed. One additional five-year project by the AfDB increases emissions by 4 percent in total, one project by the IADB increases emissions by 2 percent.

Turning to roundwood production, finally, the results are again ambiguous. Emissions rise significantly with IADB and EBRD projects and WTO membership, while they are reduced by UNEP projects. The direct quantitative impact of an additional project lies between 0.8 percent (for the IADB) and almost 22 percent (UNEP). The positive impact of the IADB on environmental quality is slightly reduced by its indirect impact on trade liberalization, so that an additional five-year-project reduces emissions by 0.7 percent in total.

To summarize the impact of the international organizations, IMF, AfDB and UNEP affect environmental quality predominantly positively, while the there are mixed results for IADB and WTO membership. ADB and UNDP have no significant impact on the natural environment. impact of the World Bank and the EBRD is negative. The World Bank and, particularly, the EBRD exert a negative influence. According to the OLS regressions, an additional project increases CO_2 emissions by 7 percent over a five-year period, SO_2 emissions by 5 percent, BOD emissions by 4 percent and roundwood production by 6 percent. The significantly negative impact of EBRD projects might arise from region-specific environmental problems. After the end of communism, CO_2 and SO_2 levels relative to output have been comparably high. The main sources of these high pollution levels came from stack emissions from small- and medium-size firms, together with domestic heating, all of them mainly based on low quality lignite with high sulphur content (Gutner 2002). However, the regression analysis includes regional dummies and also controls for other relevant determinants of emissions. The negative impact of the EBRD is thus difficult to explain. Our data do not, however, take project cancellations and delays into account that have been quite substantial in EBRD projects (Gutner 2002). The results might thus arise from poor compliance and implementation rather than EBRD projects per se.

Arguably, as many international organizations took environmental issues into account starting in the mid-80s only, the negative results presented here might be driven by the choice of sample period. Table 3 therefore replicates the analysis for the 2SLS regressions over the period 1985-2000. The substantially reduced number of observations results in generally higher standard errors, implying a greater number of insignificant coefficients. As can be seen, the major results regarding the impact of the international organizations on the environment, however, remain. In the more recent period, however, the UNEP seems to have increased CO_2 emissions, while the

results for round wood production are generally less significant. In some cases the results for SO_2 are now fairly similar to those reported for CO_2. This is true for the impact of the IADB, UNDP, and WTO membership. However, projects by the AfDB now significantly increase SO_2 emissions (while their impact on the level of CO_2 remains negative). At the ten percent level of significance, World Bank projects exert a negative impact in the more recent period.

Table 4, finally, shows the results of our cross-section estimates. As can be seen, these results also show some support for the Kuznets curve hypothesis, implying an increase in air pollution with increasing per capita GDP, whereas its square has a significantly negative coefficient in the case of CO_2. BOD is the exception here – production is significantly reduced by higher GDP and increases with its square. Greater economic openness, larger manufacturing sectors and more intensive use of fertilizer affect the natural environment adversely, whilst population density and fertilizer use have a significantly negative impact on environmental sustainability which is in line with Gassebner, Lamla and Sturm (2005). In their interpretation, the use of fertilizer is a proxy for the attitude towards environmental protection in a specific country. Greater urbanization significantly increases SO_2 emissions, and – contrary to the results of the panel approach – also significantly increases BOD emissions. The dummies for left-wing governments and dictatorships have a significantly negative effect on environmental governance and sustainability, contradicting our *a priori* expectations.

The tests for joint significance in the cross-sectional analysis are in most regressions significant at the one percent level. In the long run, however, the individual impact of the international organizations seems to be much more limited as compared to the medium term effects reported above. The results show that CO_2 emissions rise significantly with programs by the Word Bank, and are significantly reduced with programs by the IMF, AfDB, and IADB. The EBRD significantly increases roundwood production. All these results are in line with those of the panel approach reported above. Regarding the environmental sustainability index, we fail to find a consistent picture among the different specifications and organizations.

5. Summary

This study empirically investigated the impact of key international organizations on environmental governance and outcomes. Overall, we find that international organizations significantly affect the natural environment. However, many results are not entirely consistent

among the different specifications analyzed for each international organization and environmental measure.

To summarize, we find that IMF, AfDB and UNEP affect environmental quality predominantly positively, while the impact of the World Bank and the EBRD is negative. There are mixed results for IADB and WTO membership. ADB and UNDP have no significant impact on the natural environment. Regarding environmental governance as proxied by the environmental sustainability index our results show no significant impact of the international organizations investigated here.

References

Alpay, Savas, 2002, How Can Trade Liberalization Be Conducive to a Better Environment? A Survey of the Literature, mimeo, Beykent University.

Atoyan, Ruben and Patrick Conway, 2005, Evaluating the Impact of IMF Programs: A Comparison of Matching and Instrumental-Variable Estimators, *Review of International Organizations*, forthcoming.

Battikha, Anne-Maria, 2002, Structural Adjustment and the Environment: Impacts of the World Bank and IMF Conditional Loans on Developing Countries, mimeo, Virginia Polytechnic Institute and State University.

Beck, T.; G. Clarke; A. Groff; P, Keefer and P. Walsh, 2001, New tools in comparative political economy: The Database of Political Institutions, *World Bank Economic Review* 15, 1: 165-176.

Beghin, John, 2000, Environment and Trade in Developing Economies: A Primer for the World Bank's Global Economic Prospects 2001, Iowa State University, Department of Economics Research Papers 1872.

Beghin, John and Michael Potier, 1997, Effects of Trade Liberalization on the Environment in the Manufactoring Sector, *The World Economy* 20, 4: 435-56.

Capistrano, A., 1990, Macroeconomic Influences on Tropical Forest Depletion: a Cross Country Analysis, Ph.D. dissertation, University of Florida, Gainesville.

Cone, Sydney M., 2002, The Environment and the World Trade Organization, Research Paper Series 02-10, New York Law School.

Daly, Hermann, 1996, *Beyond Growth*, Boston, Massachusets: Beacon Press.

Dreher, Axel, 2002, The Development and Implementation of IMF and World Bank Conditionality, HWWA Discussion Paper 165, Hamburgisches Welt-Wirtschafts-Archiv, Hamburg.

Dreher, Axel, 2005a, Does the IMF Influence Fiscal and Monetary Policy? *The Journal of Policy Reform* 8, 3: 225-238.

Dreher, Axel, 2005b, IMF and Economic Growth: The Effects of Programs, Loans, and Compliance with Conditionality, *World Development*, forthcoming.

Easterly, William and Mirvat Sewadeh, 2002, Global Development Network Growth Database, World Bank, Washington, DC.

Frankel, J. and A. Rose, 2002, Is Trade Good or Bad for the Environment? Sorting Out the Causality, NBER Working Paper 9021.

Food and Agriculture Organization of the United Nations (FAO), 2004, FAOSTAT on-line statistical service, http://apps.fao.org.

Friends of the Earth, 1999, The IMF: Selling the Environment Short, Report, http://www.foe.org /international.

Gandhi, Ved P., 1998, The IMF and the Environment, External Relations Department, IMF, Washington, DC.

Gassebner, Martin; Michael Lamla and Jan-Egbert Sturm, 2005, Economic, Demographic and Political Determinants of Pollution Reassessed: A Sensitivity Analysis, University of Konstanz, mimeo.

Giordano, Mark, 1994, Tropical Forest Policy and Trade: A Case Study of Malaysia, in: John Sullivan (ed.), Environmental Policies: Implications for Agricaltural Trade, USDA-ERS FAER 252.

Guisinger, Alexandra, 2001, The Determinants of Trade Tariff Liberalization, mimeo, Yale University.

Guisinger, Alexandra, 2005, Understanding Cross-Country Patterns in Trade Liberalization, Ph.D. Thesis, Yale University.

Goldin, I. and D. Roland-Host, 1994, Economic Policies for Sustainable Resource Use in Morocco, mimeo.

Gueorguieva, Anna and Katharine Bolt, 2003, A Critical Review of the Literature on Structural Adjustment and the Environment, Environmental Economics Series No. 90, The World Bank.

Gutner, Tamar, 2005a, World Bank Environmental Reform: Revisiting Lessons from Agency Theory, *International Organization* 59: 773-783.

Gutner, Tamar, 2005b, Explaining the Gaps between Mandate and Performance: Agency Theory and World Bank Environmental Reform, *Global Environmental Politics* 5, 2: 10-35.

Gwartney, James and Robert Lawson, 2004, Economic Freedom of the World: 2004 Annual Report, The Fraser Institute.

Hansen, Jorgen K. and Stein Hansen, 1999, Integrating Environmental Concerns into Economy-Wide Policies in Developing Countries: The Role of Multilateral Development Banks, *Environment and Development Economics* 4, 1: 45-68.

Hicks, Rob; Dan Nielson; Brad Parks; Timmons Roberts and Mike Tierney, 2005, Project Level Aid (PLAID) Database.

Hughes, G. and L. Lovei, 1999, Economic Reform and Environmental Performance in Transition Countries, World Bank Technical Paper 446, Eastern Europe and Central Asia Pollution Management Series, Washington, DC, World Bank.

International Monetary Fund, 2004, The IMF and the Environment, A Factsheet, Washington, DC.

Jayarajah, Carl and William Branson, 1995, Structural Adjustment and Sectoral Adjustment – World Bank Experience, 1980-1992, World Bank, Washington DC.

Killick, Tony, 1993, *The Adaptive Economy – Adjustment Policies in Small, Low-Income Countries*, Washington, DC, World Bank.

MacMillan, Fiona, 2001, *WTO and the Environment*, Sweet & Maxwell, London.

Mani, Muthukumar and David Wheeler, 1999, In Search of Pollution Havens? Dirty Industry in the World Economy, 1960-1995, in: Per Fredriksson (ed.), Trade, Global Policy, and the Environment, World Bank, 1999.

Marshall, M.G. and Jaggers, K., 2000, Polity IV project: political regime characteristics and transitions, 1800-2000, http://www.cidcm.umd.edu/inscr/ polity/.

Munasinghe, Mohan, 1999, Introduction to Special Topic I: Structural Adjustment Programs and the Environment, *Environment and Development Economics* 4, 1: 9-18.

Munasinghe, Mohan and W. Cruz, 1994, Economywide Policies and the Environment: Emerging Lessons from Experience, Washington, DC, World Bank.

Nielson, Daniel L. and Michael J. Tierney, 2003, Delegation to International Organizations: Agency Theory and World Bank Environmental Reform, *International Organizations* 57, 2: 241-76.

Oxley, Alan, 2001, WTO and the Environment, Contributions from The Australian APEC Study Centre 2001-11.

Pandey, K. and D. Wheeler, 2001, Structural Adjustment and Forest Resources: The Impact of World Bank Operations, Policy Research Working Paper 2584, Washington, DC, World Bank.

Reed, David, 1996, *Structural Adjustment, the Environment, and Sustainable Development*, London, Earthscan Publications.

Sampson, Gary P., 2003, WTO, Trade, and the Environment, Symposium WTO Research Center Globalization and Consumer Benefits, Aoyama Gakuin University.

Wheeler, David and P. Martin, 1992, Prices, Policies, and the International Diffusion of Clean Technology: The Case of Wood Pulp Production, in P. Low (ed.), World Bank Discussion Paper, World Bank.

World Bank, 2001, Adjustment Lending Retrospective, Washington, DC.

World Bank, 2005, World Development Indicators, CD-Rom, Washington, DC.

World Trade Organization, 2004, Trade and Environment at the WTO: Background Document, WTO, Geneva.

Table 1: Trade Liberalization, 1980-2000, 90 countries (panel data)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(log) GDP p.c.	0.771	0.770	0.821	0.819	0.814	0.805	0.871	0.799	0.786	0.964
	(11.72***)	(11.53***)	(12.9***)	(12.64***)	(12.68***)	(13.58***)	(12.66***)	(12.79***)	(11.55***)	(6.66***)
Exports primarily manufactored,	0.592	0.562	0.180	0.186	0.191	0.153	0.175	0.173	0.223	0.138
dummy	(2.23**)	(2.09**)	(1.39)	(1.45)	(1.47)	(1.29)	(1.23)	(1.36)	(1.83*)	(0.21)
Exports primarily fuel,	-0.422	-0.430	-0.499	-0.520	-0.532	-0.538	-0.561	-0.468	-0.332	-0.368
dummy	(1.86*)	(1.9*)	(2.16**)	(2.3**)	(2.31**)	(2.52**)	(2.34**)	(2.09**)	(1.39)	(0.55)
Developing country,	0.312	0.332	0.526	0.665	0.678	0.689	0.701	0.658	0.822	0.710
dummy	(0.87)	(0.92)	(1.61)	(2.12**)	(2.11**)	(2.36**)	(2.04**)	(2.18**)	(2.43**)	(0.58)
Democracy, Index	0.038	0.039	0.036	0.033	0.034	0.033	0.021	0.033	0.027	0.025
	(2.99***)	(3.04***)	(2.69***)	(2.52**)	(2.6***)	(2.63***)	(1.5)	(2.58***)	(1.94*)	(1.43)
System Presidential, dummy	0.049	0.042	0.045	0.045	0.043	0.041	0.087	0.060	0.065	0.214
	(0.77)	(0.67)	(0.86)	(0.87)	(0.82)	(0.82)	(1.51)	(1.18)	(1.08)	(2.95***)
IMF programs (t-1)	-0.012									0.018
	(0.08)									(0.15)
World Bank programs (t-1)		0.011								0.024
		(0.5)								(0.94)
ADB (t-1)			0.086							0.066
			(2.89***)							(2.09**)
AFDB (t-1)				0.024						-0.086
				(0.65)						(3.07***)
IADB (t-1)					-0.021					-0.071
					(0.69)					(2.73***)
EBRD (t-1)						0.061				0.027
						(2.6***)				(1.24)
UNDP (t-1)							0.818			0.543
							(4.94***)			(3.16***)
UNEP (t-1)								0.802		0.261
								(2.34**)		(0.78)
WTO membership (t-1)									0.021	0.027
									(5.85***)	(3.53***)
Number of observations	461	461	599	599	599	599	599	599	599	461
Wald Test (Prob>chi2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes:
Estimated using feasible generalized least squares (FGLS). Corrected for first order autocorrelation within panels and cross-sectional heteroskedasticity across panels.
All regressions include regional dummy variables for Africa, Eastern and Central Europe, Asia, and Latin America.

t-statistics in parentheses.
Levels of significance: 1 percent (***), 5 percent (**), 10 percent (*).

Table 2: Environmental Quality, 1970-2000, 112 countries (panel data)

	CO_2		SO_2		BOD		Round Wood	
	(1)	(2)[a]	(3)	(4)[a]	(5)	(6)[a]	(7)	(8)[a]
(log) GDP p.c.	1.628	0.746	1.010	1.497	0.807	1.313	-1.152	-1.062
	(8.36***)	(3.36***)	(5.37***)	(5.05***)	(4.56***)	(4.23***)	(4.64***)	(2.89***)
(log) squared GDP p.c.	-0.045	0.039	-0.033	-0.065	-0.025	-0.060	0.070	0.069
	(3.35***)	(2.29**)	(2.49**)	(2.97***)	(2.09**)	(2.65***)	(3.99***)	(2.36**)
Openness	0.002	0.025	0.000	0.004	0.002	0.004	0.001	-0.004
	(4.31***)	(11.12***)	(0.69)	(1.48)	(3.22***)	(1.34)	(2.17**)	(1.24)
Manufacture, value added	0.011	0.015	0.014	0.017	0.042	0.054	0.000	0.000
	(4***)	(5.6***)	(5.42***)	(5.5***)	(16.76***)	(12.23***)	(0.06)	(0.13)
Fertilizer (per hectar)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.4)	(2.25**)	(3.06***)	(11.98***)	(3.57***)	(1.23)	(2.89***)	(2.38**)
Population density	-0.001	-0.003	-0.001	-0.001	0.000	0.000	-0.005	-0.002
	(7.03***)	(5.95***)	(7.94***)	(3.28***)	(2.26**)	(0.06)	(14.89***)	(5.13***)
Urbanization	0.014	0.022	0.013	0.018	-0.006	-0.005	-0.019	-0.024
	(10.26***)	(18.6***)	(8.1***)	(11.15***)	(3.85***)	(2.05**)	(9.9***)	(10.08***)
Government left-wing, dummy	0.017	-0.233	-0.006	0.067	0.126	0.081	-0.004	0.016
	(0.63)	(8.5***)	(0.21)	(1.89*)	(4.35***)	(1.33)	(0.17)	(0.35)
Dictatorship, dummy	0.042	-0.436	0.038	-0.007	-0.115	-0.188	-0.006	0.088
	(1.59)	(8.01***)	(1.35)	(0.12)	(3.99***)	(2.18**)	(0.32)	(1.21)
Trade liberalization, index	-0.008	-1.057	-0.005	-0.111	-0.002	-0.035	0.015	0.229
	(1)	(10.76***)	(0.87)	(1)	(0.21)	(0.26)	(2.32**)	(1.5)
IMF programs (t-1)	-0.046	-0.243	-0.112	-0.158	-0.001	-0.021	0.019	0.075
	(1.23)	(6.53***)	(4.61***)	(4.42***)	(0.03)	(0.21)	(0.76)	(2.14**)
World Bank programs (t-1)	0.016	0.069	-0.001	0.003	-0.005	-0.013	0.007	-0.005
	(2.82***)	(8.93***)	(0.21)	(0.35)	(0.87)	(1.11)	(1.44)	(0.53)
ADB (t-1)	-0.007	0.116	0.010	0.022	-0.007	-0.021	0.003	-0.020
	(1.4)	(9.36***)	(1.15)	(1.54)	(1.03)	(1.1)	(0.41)	(1.08)
AFDB (t-1)	-0.057	-0.053	-0.003	0.001	0.008	0.033	-0.001	-0.009
	(4.27***)	(3.87***)	(0.45)	(0.24)	(0.54)	(1.25)	(0.2)	(2.14**)
IADB (t-1)	-0.010	-0.055	-0.009	-0.012	-0.015	-0.042	0.008	0.016
	(2.06**)	(7.65***)	(1.42)	(1.51)	(2.5**)	(3.49***)	(2.38**)	(1.96*)
EBRD (t-1)	0.022	0.055	0.011	-0.012	-0.007	0.006	0.054	0.039
	(2.26**)	(6.12***)	(2.37**)	(1.33)	(0.87)	(0.13)	(4.84***)	(2.02**)
UNDP (t-1)	-0.147	0.802	0.050	0.065	-0.135	-0.034	-0.060	-0.247
	(2.93***)	(7.85***)	(0.91)	(0.59)	(2.07**)	(0.11)	(1.64)	(1.72*)
UNEP (t-1)	0.132	0.030	-0.021	0.180	-0.026	-0.609	-0.215	-0.196
	(1.27)	(0.26)	(0.19)	(1.63)	(0.12)	(0.3)	(2.14**)	(1.75*)
WTO membership (t-1)	0.003	0.012	-0.007	-0.008	-0.004	0.006	0.010	0.008
	(1.52)	(6.05***)	(3.68***)	(3.53***)	(1.71*)	(1.6)	(6***)	(4.22***)
Number of observations	417	393	412	393	269	260	398	381
Wald Test (Prob>chi2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Notes:
Estimated using feasible generalized least squares (FGLS). Corrected for first order autocorrelation within panels and cross-sectional heteroskedasticity across panels.
[a] Estimated with 2SLS; trade liberalization predicted with equation of Table 1, column 9.
All regressions include regional dummy variables for Africa, Eastern and Central Europe, Asia, and Latin America.
t-statistics in parentheses.
Levels of significance: 1 percent (***), 5 percent (**), 10 percent (*).

Table 3: Environmental Quality, 1985-2000, 75 countries (panel data)

	CO_2	SO_2	BOD	Round Wood
	(1)	(2)	(3)	(4)
(log) GDP p.c.	1.585	0.839	0.236	-2.267
	(7.16***)	(3.38***)	(0.69)	(2.68***)
(log) squared GDP p.c.	-0.030	-0.022	0.025	0.154
	(1.81*)	(1.17)	(1.01)	(2.38**)
Openness	0.025	0.008	0.004	-0.001
	(12.26***)	(3.73***)	(1.76*)	(0.11)
Manufacture, value added	0.026	0.022	0.055	-0.006
	(9.06***)	(7.4***)	(10.87***)	(0.61)
Fertilizer (per hectar)	0.000	0.000	0.000	0.000
	(4***)	(16.34***)	(1.33)	(0.65)
Population density	-0.003	-0.002	0.000	-0.003
	(8.67***)	(6.83***)	(1.08)	(2.15**)
Urbanization	0.022	0.029	-0.008	-0.027
	(15.06***)	(17.7***)	(2.94***)	(5.04***)
Government left-wing, dummy	-0.166	0.111	0.149	0.024
	(5.63***)	(3.45***)	(2.64***)	(0.23)
Dictatorship, dummy	-0.373	-0.090	-0.123	0.043
	(6.52***)	(1.45)	(1.44)	(0.21)
Trade liberalization, index	-1.010	-0.366	-0.079	0.348
	(11.49***)	(3.92***)	(0.87)	(1.09)
IMF programs (t-1)	-0.142	-0.202	-0.112	0.540
	(3.99***)	(9.15***)	(0.63)	(2.95***)
World Bank programs (t-1)	0.096	-0.014	0.012	-0.018
	(10.7***)	(1.74*)	(1.13)	(0.76)
ADB (t-1)	0.063	0.006	0.004	0.021
	(4.61***)	(0.33)	(0.17)	(0.4)
AFDB (t-1)	-0.099	0.027	0.048	-0.038
	(8.52***)	(3.43***)	(1.88*)	(1.07)
IADB (t-1)	-0.047	-0.016	-0.007	0.062
	(6.75***)	(2.13**)	(0.79)	(1.44)
EBRD (t-1)	0.052	0.012	-0.002	-0.044
	(6.72***)	(1.63)	(0.17)	(0.94)
UNDP (t-1)	0.714	0.214	-0.088	-0.810
	(7.52***)	(2.19**)	(0.76)	(2.2**)
UNEP (t-1)	0.615	-0.106	0.205	3.111
	(4.51***)	(1.09)	(1.09)	(1.81*)
WTO membership (t-1)	0.009	0.006	-0.009	0.022
	(4.48***)	(2.81***)	(3.16***)	(3.16***)
Number of observations	206	206	133	202
Wald Test (Prob>chi2)	0.00	0.00	0.00	0.00

Estimated with 2SLS; trade liberalization predicted with equation of Table 1, column 9.
All regressions include regional dummy variables for Africa, Eastern and Central Europe, Asia, and Latin America.
t-statistics in parentheses.
Levels of significance: 1 percent (***), 5 percent (**), 10 percent (*).

Table 4: Environmental Quality, 1970-2000 (cross section)

	CO_2			SO_2			BOD			Round Wood			Sustainability		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(log) GDP p.c.	2.306	2.205	2.518	1.250	0.647	0.980	-1.428	-2.332	-1.358	-1.907	-1.000	-1.726	-0.027	0.366	3.776
	(3.26***)	(2.61**)	(2.81***)	(1.29)	(0.59)	(0.69)	(0.65)	(2.28**)	(0.84)	(1.12)	(0.65)	(0.88)	(0.05)	(0.78)	(0.41)
(log) squared GDP p.c.	-0.097	-0.094	-0.108	-0.066	-0.014	-0.038	0.120	0.159	0.117	0.129	0.063	0.118	0.044	0.111	-0.257
	(2.21**)	(1.68*)	(1.82*)	(1.04)	(0.19)	(0.4)	(0.85)	(2.42**)	(1.11)	(1.07)	(0.6)	(0.89)	(1.17)	(3.3***)	(0.42)
Openness	0.006	0.005	0.009	0.000	-0.001	0.008	0.009	0.009	0.010	0.002	0.006	-0.006	0.035	0.175	0.015
	(1.8*)	(1.44)	(1.87*)	(0.05)	(0.29)	(1.02)	(3.11***)	(2.74**)	(2.58**)	(0.28)	(1.1)	(0.74)	(0.25)	(1.25)	(0.31)
Manufacture, value added	0.021	0.017	0.024	0.023	0.038	0.032	0.043	0.040	0.046	0.007	0.033	-0.022	-0.001	0.000	-0.050
	(1.06)	(1.03)	(1.35)	(0.87)	(1.76*)	(1.15)	(3.15***)	(4.92***)	(2.87**)	(0.21)	(1.32)	(0.66)	(0.74)	(0.36)	(0.28)
Fertilizer (per hectar)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.027	-0.068	-0.001
	(0.98)	(0.94)	(0.45)	(0.55)	(1.58)	(0.66)	(0.91)	(2.57**)	(0.87)	(1.61)	(1.39)	(1.28)	(1.77*)	(7.52***)	(0.65)
Population density	0.000	0.000	0.000	0.000	0.000	-0.001	-0.002	0.000	-0.002	-0.004	-0.004	-0.002	-0.005	-0.057	-0.022
	(1.08)	(0.58)	(0.32)	(0.17)	(0.52)	(0.78)	(1.53)	(0.17)	(1.24)	(2.13**)	(3.05***)	(0.87)	(0.07)	(0.8)	(1.77*)
Urbanization	0.013	0.013	0.011	0.028	0.018	0.026	0.022	0.021	0.021	-0.022	-0.012	-0.022	-0.862	-0.905	0.007
	(1.46)	(1.51)	(1.3)	(2.01**)	(1.67*)	(1.92*)	(1.79*)	(3.45***)	(2.14*)	(1.48)	(0.95)	(1.37)	(0.5)	(0.5)	(0.08)
Government left-wing, dummy	0.072	0.044	0.037	0.076	-0.076	0.023	0.341	0.480	0.292	-0.089	-0.500	0.132	-5.516	-7.576	-0.386
	(0.38)	(0.21)	(0.16)	(0.26)	(0.28)	(0.06)	(1.23)	(2.95**)	(1.03)	(0.31)	(1.67*)	(0.33)	(2.36**)	(3.21***)	(0.16)
Dictatorship, dummy	0.057	0.132	0.122	0.528	0.294	0.471	-0.364	-0.265	-0.357	-0.552	-0.100	-0.447	-0.353	-2.193	-5.015
	(0.22)	(0.49)	(0.46)	(1.48)	(0.83)	(1.12)	(1.53)	(1.75)	(1.51)	(1.06)	(0.24)	(0.87)	(0.28)	(1.92*)	(1.75*)
Trade liberalization, index	-0.102	-0.033	-0.194	0.120	0.135	-0.279	-0.274	-0.169	-0.301	0.355	0.072	0.831	1.000	-4.423	1.303
	(0.81)	(0.26)	(0.93)	(0.67)	(0.78)	(0.84)	(2.53**)	(1.31)	(2.07*)	(1.54)	(0.39)	(2.23**)	(0.13)	(0.63)	(0.59)
IMF programs (t-1)	-0.652	-0.712	-0.786	-0.558	0.178	-0.557	-0.114	0.011	-0.090	0.888	0.637	0.702	8.680	1.627	8.230
	(2.02**)	(1.69*)	(1.92*)	(0.85)	(0.32)	(0.86)	(0.32)	(0.05)	(0.24)	(1.79*)	(1.03)	(0.93)	(1.62)	(0.44)	(1.93*)
World Bank programs (t-1)	0.133	0.123	0.128	-0.001	0.001	0.008	-0.061	-0.107	-0.057	-0.049	-0.037	-0.043	0.638	0.861	0.696
	(3.22***)	(2.15**)	(2.3**)	(0.02)	(0.01)	(0.09)	(1.02)	(2.16*)	(0.95)	(0.82)	(0.46)	(0.44)	(1.64)	(1.8*)	(1.22)
ADB (t-1)	0.058	0.046	0.052	0.018	-0.082	0.030	0.291	0.004	0.290	0.082	0.022	0.079	-0.335	0.113	-0.423
	(1.28)	(0.63)	(0.75)	(0.21)	(0.87)	(0.27)	(3.05***)	(0.03)	(3.29***)	(1.17)	(0.22)	(0.66)	(0.5)	(0.19)	(0.61)
AFDB (t-1)	-0.176	-0.189	-0.198	0.017	-0.208	-0.026	0.063	0.148	0.067	0.157	0.125	0.237	0.775	0.993	0.804
	(1.53)	(1.7*)	(1.79*)	(0.09)	(1.43)	(0.15)	(0.27)	(0.66)	(0.34)	(1.17)	(0.79)	(1.22)	(1.33)	(1.09)	(0.72)
IADB (t-1)	-0.101	-0.094	-0.105	-0.092	-0.133	-0.110	-0.078	-0.068	-0.078	0.162	0.073	0.204	0.348	0.721	0.437
	(2.89***)	(2.09**)	(2.44**)	(1.5)	(2.25**)	(1.61)	(1.92*)	(2.5**)	(1.7)	(2.65***)	(1.15)	(2.67***)	(0.74)	(1.89*)	(0.97)
EBRD (t-1)	0.070	0.076	0.068	0.046	-0.026	0.047	0.127	0.071	0.137	0.583	0.406	0.591	0.575	1.510	0.471
	(0.7)	(0.63)	(0.59)	(0.34)	(0.16)	(0.25)	(1.67)	(0.98)	(1.6)	(2.43**)	(2.34**)	(2.88***)	(0.62)	(1.45)	(0.39)
UNDP (t-1)	-0.425	-0.315	-0.550	-0.219	0.166	-0.411	1.823	0.718	1.858	1.126	0.992	1.554	2.997	1.916	3.676
	(0.81)	(0.46)	(0.85)	(0.3)	(0.18)	(0.4)	(2.05*)	(0.58)	(2.47**)	(1.47)	(1.01)	(1.37)	(0.5)	(0.34)	(0.56)
UNEP (t-1)	1.442	0.662	1.389	-2.851	-5.091	-1.314	11.305	3.372	11.242	-2.431	-2.621	-2.924	-39.763	-15.818	-47.994
	(0.77)	(0.12)	(0.27)	(1.06)	(0.73)	(0.16)	(2.79**)	(1.24)	(2.82**)	(0.95)	(0.35)	(0.33)	(2.17**)	(0.36)	(0.94)
WTO membership (t-1)	-0.157	-0.111	-0.031	0.020	0.216	0.017	-0.672	-0.217	-0.696	0.761	0.159	0.773	-1.221	-1.112	-0.580
	(0.67)	(0.47)	(0.13)	(0.06)	(0.71)	(0.05)	(2.29**)	(1.44)	(2.56**)	(1.95*)	(0.47)	(1.83*)	(0.58)	(0.57)	(0.24)
Method	OLS	Robust	IV	OLS	Robust	IV	OLS	Robust	IV	OLS	Robust	IV	OLS	Robust	IV
Adjusted R2	0.84		0.84	0.44		0.38	0.79		0.78	0.28		0.26	0.22		0.19
Observations	89	89	80	88	88	80	33	30	32	83	83	75	82	82	76
F-test (Prob>F)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.03
Normality test (Prob>chi2)	0.89	0.90	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.01	0.00	0.00
Heteroscedasticity test (Prob>chi2)	0.44			0.14			0.44			0.00			0.75		
RESET (Prob>F)	0.11			0.64			0.23			0.01			0.00		

Notes:
IV Estimates: trade liberalization predicted with equation of Table 1, column 9.

(robust) t-statistics in parentheses.
Levels of significance: 1 percent (***), 5 percent (**), 10 percent (*).

Appendix A: Sources and Definitions

Variable	Description	Source
Trade liberalization	Composite index measuring the freedom to trade internationally. Ranges from 1-10, with 10 showing more freedom.	Gwartney and Lawson (2004)
Exports primarily manufactored, dummy	Dummy that is one for countries exporting primarily manufactored goods and zero otherwise.	Easterly and Sewadeh (2002)
Exports primarily fuel, dummy	Dummy that is one for countries exporting primarily fuel and zero otherwise.	Easterly and Sewadeh (2002)
Developing country, dummy	Dummy that is one for developing countries and zero otherwise	Easterly and Sewadeh (2002)
Democracy, Index	Measures the general openness of political institutions on a score of 0-10, with higher values representing more democracy.	Marshall and Jaggers (2000)
System Presidential, dummy	Dummy that is 1 for countries with presidential system and zero otherwise.	Beck et al. (2001)
IMF	Number of loan approvals in a certain year.	IMF Annual Reports (various years)
World Bank	Number of loan approvals in a certain year.	www.worldbank.org
ADB	Number of loan approvals in a certain year.	Hicks et al. (2005)
AfDB	Number of loan approvals in a certain year.	Hicks et al. (2005)
IADB	Number of loan approvals in a certain year.	Hicks et al. (2005)
EBRD	Number of loan approvals in a certain year.	Hicks et al. (2005)
UNDP	Number of loan approvals in a certain year.	www.gefonline.org/home.cfm
UNEP	Number of loan approvals in a certain year.	www.gefonline.org/home.cfm
WTO	Dummy for membership in GATT/WTO.	www.wto.org
CO_2	Carbon dioxide in logarithm of metric tons per capita.	World Bank (2005)
SO_2	Sulphur dioxide in logarithm of metric tons per capita.	Stern (2005)
BOD	Biochemical oxygen demand in logarithm of emissions in kilogram per day and capita.	World Bank (2005)
Roundwood	Roundwood production in logarithm of thousand cubic meters per capita.	FAO (2004)
Environmental sustainability, index	Composite index tracking a diverse set of socioeconomic, environmental, and institutional indicators that characterize and influence environmental sustainability at the national	The Environmental Performance Measurement Project
(log) GDP p.c.	GDP per capita in constant 2000 US$.	World Bank (2005)
Openness	Sum of exports and imports in percent of GDP.	World Bank (2005)
Manufacture, value added	Manufacturing value added in percent of GDP.	World Bank (2005)
Fertilizer (per hectar)	Fertilizer consumption in 100 grams per hectare of arable land.	World Bank (2005)
Population density	Population density in people per sq km.	World Bank (2005)
Urbanization	Urban population in percent of total population.	World Bank (2005)

Appendix B: Descriptive Statistics

Variable	Mean	Minimum	Maximum	Standard Deviation
Trade liberalization	5.72	1.70	9.60	1.53
Exports primarily manufactored, dummy	0.10	0.00	1.00	0.31
Exports primarily fuel, dummy	0.12	0.00	1.00	0.32
Developing country, dummy	0.94	0.00	1.00	0.24
Democracy, Index	3.98	0.00	10.00	3.75
System Presidential, dummy	0.55	0.00	1.00	0.81
IMF	0.14	0.00	1.00	0.21
World Bank	2.01	0.00	15.20	2.30
ADB	0.57	0.00	15.80	1.86
AfDB	0.61	0.00	7.60	1.28
IADB	1.06	0.00	15.80	2.53
EBRD	0.23	0.00	15.00	1.17
UNDP	0.08	0.00	1.20	0.18
UNEP	0.02	0.00	0.08	0.08
WTO	0.58	0.00	1.00	0.48
CO_2	-0.05	-4.47	3.96	1.22
SO_2	-5.34	-9.34	-1.71	1.32
BOD	-5.84	-10.19	-3.71	1.01
Roundwood	-7.64	-13.82	-4.87	1.35
Environmental sustainability, index	49.94	36.30	71.80	7.07
(log) GDP p.c.	50.43	19.80	113.48	17.42
Openness	74.89	9.55	231.97	39.05
Manufacture, value added	15.15	0.63	39.20	7.60
Fertilizer (per hectar)	1000.94	0.90	30583.00	1965.14
Population density	99.82	1.44	1146.21	159.76
Urbanization	44.77	3.67	95.72	21.53