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Dynamic Development in a Sustainable World

Background Paper

# Environmental Commitment, Democracy and Inequality

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# *Environmental Commitment, Democracy and Inequality.*

## *A Background Paper to World Development Report 2003*[1]

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**ABSTRACT**

This paper tests the hypothesis that democracies exhibit stronger environmental commitment than non-democracies using a variety of econometric techniques (single equation and three-stage least squares estimations). A number of proxy variables are used in lieu of environmental commitment, a non-observable variable. Strong evidence is found that democracies sign and ratify more multilateral environmental agreements, participate in more environmental intergovernmental organizations, comply better with reporting requirements under the Convention on International Trade in Endangered Species of Fauna and Flora, put a greater percentage of their land area under protections status, are more likely to have a National Council on Sustainable Development in their country and have more environmentally relevant information available than non-democracies. The results are robust with respect to employing a simultaneous equation model in which instrumental variables are used for democracy and income to check for potential omitted variable bias. With a smaller and somewhat biased sample, due to lack of income inequality data for many non-democratic countries, we found that democracy still has a positive effect on environmental commitment in some cases. Income inequality has a negative indirect effect on environmental commitment due to its detrimental effect on democracy. Sometimes income inequality is also estimated to have a direct effect, but the direction of this effect is inconsistent across our range of proxy variables of environmental commitment. We report the results based on the use of one index of democracy, but we find robustness across four indices of democracy. Decomposing the institutional components of democracy, we find that participation, rather than executive constraints or patterns of executive recruitment, plays the major role with regard to environmental commitment. Conflict (interstate and intrastate – both large and small) was not related to environmental commitment.

## 1. Introduction

Is democracy good or bad for the environment? This is a complex question without a clear cut answer. As Desai (1998a: 301) concedes: 'whether democracies are more likely to be environmentally friendly is not entirely clear'. Indeed, there is only weak statistical evidence in favor of democracy promoting environmental outcomes. Do democracies show stronger environmental commitment than non-democracies? This question refers only to a subset of the democracy and environment problem area, but it has the advantage that it has a clear affirmative answer, as the empirical analysis in this paper will show.

After presenting some theoretical considerations on the democracy and environment relationship and reviewing the relevant empirical literature, the case for focusing on environmental commitment is put forward. The hypothesis that democracies exhibit stronger environmental commitment is empirically tested and strongly confirmed by the analysis. Much of our analysis regards *international* environmental commitment. Our results are robust across a variety of model specifications, different measures of democracy, and over a wide range of proxies for environmental commitment.

Of course, it would have been desirable to analyze more comprehensively domestic environmental commitment as well; however, due to a lack of comparable cross-sectional data, only three of the variables used in the empirical analysis of this paper can be interpreted as proxies for domestic environmental commitment -- namely, the percentage of land area under protection status, the presence of a National Council on Sustainable Development and the availability of environmentally relevant information.

Section 2 discusses important theoretical considerations concerning the democracy and environment relationship. Section 3 reviews and critiques the existing empirical literature. Much of this literature looks at environmental outcomes rather than environmental commitment and in section 4 we make the case for focusing on environmental commitment instead. In section 5 we introduce

four measures of democracy. The dependent variables and the hypotheses to be tested are described in section 6, the independent variables in section 7. Section 8 presents and discusses the results of our analysis.

## 2. Democracy and Environment: Theoretical Considerations

Payne (1995) has provided what amounts to probably the most comprehensive theoretical treatise in favor of a positive impact of democracy on the environment. The gist of his argument is that in democracies citizens are better informed about environmental problems (freedom of press) and can better express their environmental concerns and demands (freedom of speech), which will facilitate an organization of environmental interests (freedom of association), which will in turn put pressure on policy entrepreneurs operating in a competitive political system to respond positively to these demands (freedom of vote), both domestically as well as via international cooperation. In non-democratic systems, on the other hand, governments are likely to restrict the access of their population to information, restrict the voicing of concerns and demands, restrict the organization of interests and isolate themselves from the citizens' preferences. In other words, in democracies if citizens are concerned about environmental problems this will eventually require policy makers to exhibit stronger environmental commitment to address these concerns and honor the demand for environmental protection measures.

The same cannot be said of non-democracies, for which Chadwick (1995: 575) argues that 'environmental signals and concerns which conflict with state development plans may be silenced, and state managers may even fool themselves into thinking such concerns do not exist'. He further suggests that non-democracies tend to de-sensitize themselves from environmental problems

concentrated in areas of the excluded and powerless populace, thus systematically neglecting the costs of environmental degradation.

Congleton (1992) examines how the median voter in a democratic system and an authoritarian ruler in a non-democratic system would set environmental regulations so as to maximize their respective utilities. There are two relevant factors. First, Congleton assumes that a shorter time horizon will lead to less strict environmental regulations. This can be justified by the long-term nature of many environmental problems. Since authoritarian rulers tend to have a shorter time horizon for fear of being thrown out of office, he predicts that democracies may have stricter environmental regulations than non-democracies. Second, the authoritarian ruler also appropriates a larger share of income from the economy. The effect of this on the strictness of environmental regulations is ambiguous. On the one hand, a larger national income share might lead to less strict regulations given that such regulations are costly in terms of reducing available national income: 'An increase in the fraction of national income going to the individual of interest increases the marginal cost of environmental standards faced by him, since he will now bear a larger fraction of associated reductions in national income' (ibid: 416). On the other hand, appropriation of a larger share of the national income might also lead to stricter environmental standards if we assume that environmental quality is a normal, if not luxury, good where a higher income leads to increased demand for environmental quality.

In a slightly different vein, Desai (1998b: 11) suspects that 'as democracy is dependent on economic development, and since economic growth and prosperity generally result in environmental pollution and ecological destruction, democracy would not necessarily be protective of the environment'. Generally, while environmental problems directly affecting the health of a country's population are likely to improve with economic growth (at least after some threshold of income has been achieved), pollutants that can be externalized upon the future and/or people outside a country's

boundaries are likely to worsen (Neumayer, 1999; Panayotou, 2000). An example for the latter would be carbon dioxide ($CO_2$) emissions. In our analysis here we address this problem by explicitly modeling both the relationship between democracy and environmental commitment and the relationship between economic development and environmental commitment while accounting for latent variables relating to both democracy and economic wealth.

On a final note, it has been argued by some that it might be more difficult in democracies than in autocracies to constrain environmentally damaging economic activities as well as population growth since in autocracies the government does not have to pay as much attention to its citizens rights to engage in such activities and their rights for procreation. It is exactly this issue that writers such as Hardin (1968) or Heilbronner (1974) had in mind in voicing their early concern on whether democracy could be relied upon to solve environmental problems.

In conclusion, while a good theoretical case can be made for democracy having a positive impact on environmental performance, there are a number of considerations pointing in the opposite direction. The effect of democracy on the environment is therefore a complex one. It is doubtful, to say the least, whether this complexity is fully addressed in simply entering income as a control variable in empirical studies. Indeed, this is why we use a three-stage least squares estimation technique.

## 3. Review and Critique of Existing Empirical Literature

Both political scientists and economists have addressed the empirical links between democracy and environment. In accordance with the unfortunate, but quite common, disciplinary divide, the economists' research efforts are not recognized by political scientists and vice versa. Congleton (1992) represents one of the earliest empirical contribution by economists. Ideally, in order to test his

theory (as described in the last section), he would need to address differences in domestic environmental regulation. For lack of data, he sees himself unable to do so and instead performs ordinary least squares (OLS) regressions on Chlorofluorocarbon (CFC) and methane emissions as well as logit estimates of signature of the 1985 Vienna Convention for the Protection of the Ozone Layer and the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, using Freedom House data for the democracy variable. He finds that democratic countries, after controlling for a range of variables, are more likely to sign the Vienna Convention and the Montreal Protocol, but also have higher methane and CFC emissions. Murdoch & Sandler (1997) show, however, that while democracies might have higher absolute levels of CFC emissions, as indicated by Congleton (1992), democracy is also a marginally significant determinant of CFC emission *reductions* between 1986 and 1989.[2]

Both Barrett & Graddy (2000) and Torras & Boyce (1998) use the panel data, with which Grossman & Krueger (1995) in their famous contribution established empirical links between a country's income level and its water and air pollution emissions (laying the foundation for the so-called Environmental Kuznets Curve (EKC) literature).[3] Barrett & Graddy, using Freedom House data and generalized least squares with a random effects estimator, find that countries with high political rights and civil liberties tend to have lower air and water pollution levels. Torras & Boyce, using the same data, come to similar findings using OLS instead. Scruggs (1998), using Freedom House data in OLS estimation, finds that democracy is statistically insignificant once one controls for income inequality in the case of dissolved oxygen, fecal coliform and particulates emissions. It assumes statistical significance only for the case of sulphur dioxide ($SO_2$) emissions.

[2] Similar results for $NO_x$ and $SO_2$ emission reductions are reported in Murdoch, Sandler &Sargent (1997).

[3] For a good overview of this literature, see Panayotou (2000).

The problem with these studies stems from the use of the Freedom House data in a panel format. The Freedom House data have been collected by an advocacy group to evaluate the state of democracy in the world for a given year. The scale changes over time and it is not designed as a series. Indeed, some cases (e.g. Mexico, Uruguay) rise and fall along the scale in association with global changes in the number of countries that are democratic in years in which these countries exhibited no institutional change. This is particularly problematic in the middle parts of the Freedom House scale. The Freedom House scales of civil and political rights are unsuitable for cross-temporal analysis, but we use it here only for cross-sectional analysis.

In political science, Gleditsch & Sverdrup (1995/2002) run simple bivariate correlations, using Polity data, with a range of environmental variables. Midlarsky (1998), using Freedom House, Polity and a third data set based on Bollen (1993) for measuring democracy, runs multivariate OLS regressions with several environmental aspects as the dependent variable, such as deforestation, $CO_2$ emissions, soil erosion and land area protection. He finds that democratic countries tend to have higher deforestation rates, higher $CO_2$ emissions, possibly higher soil erosion, but also protect a higher percentage of their land area. Contrary to Midlarsky (1998), Didia (1997) finds that democracies have lower deforestation rates, but only simple bivariate regression analysis is employed.

All these empirical studies suffer from a number of weaknesses. No comprehensive critique is attempted here, rather we concentrate on the aspects most relevant to this study. Congleton (1992) based his analysis on data from 1988. Were he to repeat his analysis with data from 2001, his attempt to arrive at significant results would be frustrated by the fact that both the Vienna Convention and the Montreal Protocol have achieved almost universal coverage in the meantime. What he would need to do then is to look at whether democracies have signed or ratified these agreements *earlier* in time than non-democracies. Studies using a proportional hazards model have found that

democracies, as measured by Freedom House data, are more likely than non-democracies to have ratified early the United Nations Framework Climate Change Convention (Fredriksson & Gaston, 2000) as well as the Convention on Biological Diversity and the Convention on International Trade in Endangered Species of Fauna and Flora (Neumayer, 2002b).

Even more troublesome, Congleton's original sample is likely to have been biased. This is because at the early stages of multilateral action on ozone layer depletion, it was very much a developed country concern as well as a phenomenon largely caused by developed country emissions. While some developing countries were pro-active from the beginning, most waited to see what developed countries were willing to offer them for curtailing their future growth in consumption of ozone depleting substances (Benedick, 1998). Consequently, in 1988 out of the 28 signatory or contracting parties to the Vienna Convention 19 were developed countries, that is member countries of the Organisation of Economic Co-operation and Development (OECD). So were 18 of the 29 parties to the Montreal Protocol. Because all OECD countries are democracies, this leads to biased estimates.

Barrett & Graddy (2000) group countries into low, medium and high civil and political freedom, using dummy variables, as well as entering civil and political freedoms as continuous variables in separate regressions. A closer look at their results reveals that the study provides only limited evidence for a positive impact of freedom on the environment. First, some of the variables have signs contrary to expectation. Secondly, practically none of the dummy or continuous variables are statistically significant on their own in spite of the quite high number of observations[4], which all other things equal boosts significance. It is only in their combination that these variables gain some statistical significance in all air pollution regressions. For the water pollution regressions even the combined explanatory power of the freedom variables is statistically insignificant in the majority of

[4] In many cases greater than 1000.

cases. Thirdly, as noted, the Freedom House democracy data are inappropriate for panel analysis. Thus, Barrett & Graddy (2000) provide at best some statistical evidence for a negative link between freedom and air and water pollution.

Torras & Boyce (1998) enter freedom only as a continuous variable and estimate separate coefficients for countries above and below $5000 per capita income in purchasing power parity. Out of 14 regressions, the freedom coefficient has an unexpected sign on six different occasions, particularly prevalent in the subset of high income countries, and is statistically insignificant in a further three cases. Another weakness of the study is that in spite of using panel data, no time-series for the freedom variable is constructed. Instead the freedom variable is set equal to the 1995 value throughout. While Freedom House measures are not designed for use in a panel, this is no solution. The empirical evidence resulting from their study is therefore not particularly strong either. Unfortunately, the two studies are not directly comparable with each other since differing statistical techniques are used and Torras & Boyce (1998) also control for income inequality and literacy.

## 4. The Case for Focusing on Environmental Commitment

The more general problem with much of the empirical literature is that it focuses too much on environmental outcomes instead of looking at environmental commitment. Take Midlarsky's (1998) examination of $CO_2$ emissions and soil degradation as an example. It suffers from the same kind of problem as Torras & Boyce (1998) and Barrett & Graddy (2000), which similarly concentrate on environmental outcomes. Why would we expect democracies to have more or less severe soil degradation? Soil degradation depends on a plethora of factors including natural ones, many of which we are unable to control for in a statistical analysis. No wonder then that no robust statistical relationship can be established. We would expect democratic countries to engage more in an

international agreement addressing soil erosion, if there was one. We would also expect democratic countries to engage more in activities stemming the spread of soil erosion. But we would not necessarily expect them to have less soil degradation, at least not until many years have passed and the prevention activities referred to above have had time to make an impact. Similarly, there are good reasons why we cannot expect democracies to have lower $CO_2$ emissions. This problem can be externalized upon the future and people outside a country's boundaries. The volume of $CO_2$ emissions is also strongly influenced by economic growth and the historic mix of primary energy types in use. Both are difficult for policy makers to control. Finally, this is a relatively new problem and one that it is not fully recognized by all democratic governments. Midlarsky (1998) finds a strong statistically significant relationship with only one of his democracy variables (Polity). Even this result is most likely an artifact of functional misspecification, however. As simple a transformation as including squared and cubic GDP per capita in the estimation (a standard procedure in the relevant EKC literature), renders democracy insignificant.[5] Again, we would expect democracies to more actively engage in a MEA addressing global warming such as the Kyoto Protocol and further below we will see that they actually do. But only years or decades later will this translate into a statistically significant relationship with $CO_2$ emissions (with respect to growth rates of emissions rather than to absolute levels, as modeled by Midlarsky, 1998).

Hence, at best there is to be expected only a weak link between democracy and (some) environmental outcomes. This is the ultimate reason, we would submit, why studies examining the impact of democracy on environmental outcomes *in general* provide only weak statistical evidence.[6]

[5] The results are available from the first author upon request.

[6] The rather ambiguous evidence with respect to the impact of democracy and democratisation on environmental outcomes is not confined to quantitative studies, but can also be found in case studies. See, for example, Potter (1996), Eamhart (1997), Tang &Tang (1999), Walker (1999).

Interestingly, the outcome variables for which Torras & Boyce (1998) find the strongest evidence for a significant relationship with democracy are smoke emissions and fecal coliform effluents – two variables that do not suffer from severe time lags between commitment and outcome, that are well within the control of policy makers, that strongly affect the health of citizens and success is easily monitored by the electorate. Similarly, the only dependent environmental outcome variable for which Midlarsky (1998) finds a relatively significant relationship with democracy, namely deforestation, is also the one, where he can put forward a relatively plausible theoretical argument establishing such a link.

A much stronger theoretical argument can be made for a positive relationship between democracy and environmental commitment. In democracies people can express their environmental preferences better, these preferences will be honored or addressed better by policy makers and this should translate into stronger revealed environmental commitment. But it need not translate into better environmental outcomes. The link between democracy and environmental outcomes is likely to be weaker the more factors outside a government's control impact upon outcomes, the longer the time span between environmental commitment and its effect on environmental outcomes is and the more difficult environmental outcomes are to monitor. If these conditions hold true, then the electorate in a democracy will appreciate the difficulty of holding governments accountable for environmental outcomes rather than commitment and will look for commitment instead.

What needs to be done therefore is to re-adjust the focus away from environmental outcomes and towards environmental commitment. Congleton (1992) in principle addresses environmental commitment, but his analysis has serious weaknesses as seen above. In one of his variables, namely protected land area (a variable included in this study as well), Midlarsky (1998) himself looks at environmental commitment rather than outcomes. So do Gleditsch & Sverdrup (1995/2002) in some of their variables, but simple bivariate analysis is often misleading and sensitive to the inclusion of

control variables. In some sense therefore this work builds upon and extends these earlier attempts. It tries to provide a comprehensive and robust empirical analysis of the impact of democracy on environmental commitment.

## 5. Measures of Democracy

Critical to understanding the impact of democracy on environmental commitments, is determining what constitutes democracy. A number of indices of democracy have been developed, drawing on different theories of democracy and measured in a variety of ways.[7] In general, we analyze the relationship between democracy and environmental commitment using four different indices of democracy, including:

- A combined index of democracy and autocracy based on the Polity project (Gurr & Jaggers 2000).
- A combined index of political rights and civil liberties based on Freedom House (2000) data.
- Vanhanen's (2000) index of democracy based on the Polyarchy dataset.
- A governance indicator named 'voice and accountability', developed by World Bank staff (Kaufman et al. 1999a, 1999b).

As expected, there is positive correlation among the various measures of democracy, but it is less than perfect (see table 1).[8] Each measure is based on a somewhat different conception of what constitutes democracy. We have run our analysis on each of these indices, but due to space

[7] For a recent overview comparing various democracy measures, see the special issue of *Comparative Political Studies*, Vol. 35, No. 1, February 2002.

[8] The signs of the correlation coefficients with the freedom variable have been reversed since higher scores in the Freedom House data mean lower freedom.

limitations, we only report the results using the Polity index. This index is based on theories of institutions and authority developed by Gurr (1974) and Eckstein (1973). More specifically, the Polity data are based on expert judgement on aspects of institutionalized democracy and autocracy within a country, both measured on an additive 0 to 10 scale (Jaggers & Gurr, 1995). A political system is thus categorized on the basis of the competitiveness of political participation, the competitiveness and openness of executive recruitment, as well as the constraints on the chief executive. The first concerns the regulation of *executive recruitment*, and is based on three indicators: "Regulation of Chief Executive Recruitment," "Competitiveness of Executive Recruitment," and "Openness of Executive Recruitment." The second dimension characterizes the *constraints on the executive* and is based on the single indicator "Decision Constraints on the Chief Executive." Basically this means a non-executive institution possessing political power.

< Insert Table 1 about here >

We also disentangle the three authority dimensions that constitute the institutional framework of a polity, including *executive recruitment, constraints on the executive, and political participation.* We test these three dimensions of democracy in section 8.3 and find that *political participation* proves to be the dimension of democracy that is most often significantly related to environmental commitment.

## 6. The Dependent Variables and the Hypotheses to be Tested

Of course, environmental commitment is a non-observable variable. We therefore use a range of variables, which are supposed to function as proxy variables. More specifically, these variables include:

- The signing and ratification of multilateral environmental agreements (MEAs).
- Membership in environmental intergovernmental organizations (EIOs).
- The extent to which reporting requirements for the Convention on International Trade in Endangered Species of Fauna and Flora (CITES) are met.
- The percentage of a country's land area under protection status.
- The existence of a National Council on Sustainable Development (NCSD) in a country.
- The availability of environmentally relevant information concerning a country.

Our basic hypothesis to be tested throughout is that democratic countries are more environmentally committed as measured by these proxy variables than non-democratic countries.

***Multilateral environmental agreements and environmental intergovernmental organizations***

One revelation of environmental commitment is the signing and ratification of MEAs. Of the more than 180 or so existing MEAs only a few are suitable for our purpose here. First, many of these MEAs are regional rather than global. Second, we want to look at MEAs that do not have quasi-universal membership. This is because it is exactly these MEAs where environmental commitment is needed on behalf of countries to join. MEAs with quasi-universal membership, on the other hand, are often agreements that can be joined without commitment to incurring any costly action, where costs could be either monetary or opportunity costs.

Having examined a great many MEAs, we decided to pick four that fulfill these criteria:[9] the Kyoto Protocol (84 signatures as of 26 October 2001; www.unfccc.org), the Copenhagen Amendment to the Montreal Protocol (115 ratifications as of 8 December 2000; www.unep.org/ozone), the Stockholm Convention on Persistent Organic Pollutants[10] (114 signatures as of 31 January 2002; www.chem.unep.ch); and the Cartagena Protocol on Biosafety (103 signatures as of 12 September 2001; www.biodiv.org).[11] These agreements cover four important areas of recent multilateral environmental concern, namely climate change, ozone layer depletion, hazardous chemicals and pesticides, and danger to biodiversity posed by genetically modified

[9] We also tested the Ramsar Convention on Wetlands (130 contracting parties as of 1 Feburary 2002; www.ramsar.org). Due to space constraints we decided not to include this MEA in the reporting below, but results were similar to the other MEAs looked at here.

[10] Neumayer (2002a) originally included the Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade. However, we found the Stockholm Convention to be the more ambitious MEA in the field of hazardous chemicals and pesticides. The Rotterdam Convention is mainly about notification procedures in international trade of these substances, whereas the Stockholm Convention actually bans the production, consumption and trade of a range of persistent organic pollutants.

[11] Some of these agreements have been concluded so recently that either no ratifications exist yet or there are so few that we needed to look at signatures instead of ratifications. This is somewhat unfortunate as a country is only bound to an agreement and therefore formally committed once it has ratified the agreement. Experience shows, however, that countries often feel bound by their signature, even if they have never ratified the agreement for whatever reason. The prime example for this type of behaviour is the United States, with the possible exception of the Kyoto Protocol, where it seems that the current US government does not regard itself bound by the signature of its predecessor. Ratification encompasses accession, acceptance or approval of an agreement as well.

organisms.[12] Data on the status of signature and ratification are from the homepages of the respective MEAs. A dummy for each MEA was created, which was set to 1 if a country had signed (or ratified in the case of the Copenhagen Amendment) the agreement and 0 otherwise.

Whether a country signs a particular MEA obviously depends on a great many factors that might differ from one MEA to another. In looking at the four MEAs taken together, we would therefore hope to get a more systematic result on what factors relate to a country's willingness to sign or ratify MEAs. A further variable was therefore created as the sum of the dummy variables for the MEAs, so that it ranges from 0 to 4 depending on how many of these MEAs a country has signed/ratified, if any.

Environmentally committed countries can also be expected to participate strongly in environmental intergovernmental organizations (EIOs) for the same kind of reasoning that leads us to expect that they are more willing to sign and ratify MEAs than non-committed countries. The number of memberships in EIOs as of 1998 is taken from WEF (2001, annex 6), based on a codification of 100 intergovernmental organizations as "'environmental" and data from the Yearbook of International Organizations.[13] This leads us to our first two hypotheses to be tested:

H1: Democracies are more likely to sign or ratify MEAs than non-democracies.

H2: Democracies participate in more EIOs than non-democracies.

[12] Somewhat unfortunate is a lack of an agreement more directly addressing nature and wildlife conservation. The Convention on International Trade in Endangered Species of Fauna and Flora, which would otherwise be a good candidate, has quasi-universal membership (152 parties as of 22 March 2000). Fortunately, however, two of our other proxy variables for environmental commitment are connected to nature conservation and wildlife protection.

[13] The list of organisations coded as environmental is available from the first author on request.

***CITES reporting requirements***

Besides the signing and ratification of MEAs a good test for the extent of environmental commitment is a country's compliance with the requirements of a MEA. Those requirements are usually costly to comply with, hence more committed countries will be more willing to incur the costs. Unfortunately, quantitative compliance data for a large sample of countries is usually not available. However, there is one MEA for which such data exist, namely the percentage of reporting requirements CITES parties have met.[14] Data as of 1997 are from WRI (2000, table BI.4). This leads us to our third hypothesis:

H3: Democracies meet a higher percentage of their reporting requirements under CITES than non-democracies.

***Land area under protection status***

Land area under protection status is another variable concerned with more traditional nature conservation and wildlife protection. Data on the percentage of land area a country has put under protection according to any of the five management categories of the International Union for the Conservation of Nature (IUCN) as of 1997 come from WRI (2000, table BI.1). We postulate as our fourth hypothesis:

H4: Democracies put a higher percentage of their land area under protection status than non-democracies.

[14] It follows that the sample of countries comprises only those that are members of CITES.

***Presence of a National Council on Sustainable Development***

In the wake of the 1992 Earth Summit in Rio de Janeiro, many countries started to set up a National Council on Sustainable Development (NCSD) (132 countries as of 9 February 2001 had such a council; www.ecouncil.ac.cr). A dummy was created, which was set to 1 if a country had a NCSD, and 0 otherwise. The objective of these councils is the promotion and implementation of sustainable development at the national level, thus translating Agenda 21 into national strategies. The NCSDs can be regarded as the domestic level counterpart to the United Nations Commission on Sustainable Development (UNCSD), which was established after the Earth Summit. In almost all countries the NCSD is set up and coordinated by some governmental agency. The existence of a NCSD can thus be interpreted as a sign for a country's environmental commitment. This leads us to the following hypothesis:

H5: Democracies are more likely to have a National Council on Sustainable Development than non-democracies.

***Availability of environmentally relevant information***

Lack of standardized and internationally comparable environmentally relevant information has long since represented a problem to researchers. While very often information collection is undertaken by international organizations with relatively little influence of the domestic government, we would nevertheless expect an environmentally committed country to actively seek provision of environmentally relevant information, if only for the purpose of its own domestic environmental policy making. This could take place either via their own data collection or via encouraging international organizations to undertake the research necessary for information provision in their country.

The World Economic Forum (WEF) has commissioned an Environmental Sustainability Index (ESI), which aggregates 67 variables. While not all variables have a direct link to the environment, taken together they provide a good indication of a country's environmental sustainability potential. Information is not available for all 67 variables for all 122 countries covered (data taken from WEF, 2001, annex 6). We would expect that in the case of an environmentally committed country information on fewer variables are missing and therefore postulate our sixth hypothesis:

H6: Democracies have more variables available in the set of ESI variables than non-democracies.

< Insert Table 2 about here >

Table 2 provides a Pearson correlation matrix for the dependent variables (in the case of MEAs only the summary variable is included). The correlation coefficients are all positive as expected. This is important since they are after all supposed to proxy the same underlying non-observable phenomenon, environmental commitment. At the same time, the correlations are nowhere near 100%. Anything else would suggest redundancy among the proxy variables.

## 7. The Independent Variables

Turning to the independent variables, as concerns the democracy variables we use only the Polity measure for the estimations reported below. This is in order to save space and because we regard this measure to be the one that is theoretically best justified. The original Polity data set provides two indices on a 0 to 10 scale, one for the extent of a country's democratic and the other for its autocratic characteristics. Taking the data as coded by Gurr & Jaggers (2000), the democracy

scores range from 0 to 10 and the autocracy scores from 0 to –10. Our Polity measure is the sum of these two values. We tested the other three measures of democracy in sensitivity analysis and found that the results are robust with respect to the measure of democracy employed. The Freedom House political rights and civil liberties indices both run on a 1 to 7 scale. We have added up the two indices to create a continuous variable ranging from 2 to 14. The governance indicator developed by World Bank staff is standardized to have a mean of zero and a standard deviation of about one, with a minimum of about -1.8 and a maximum of about 1.7. Data come from Kaufmann, Kraay & Zoido-Lobatón (1999a,b). Finally, we have taken an index of democratization from Vanhanen (2000) that runs from 0 to about 44.

Besides democracy (our hypothesis to be tested), which other factors would one theoretically expect to impact upon the environmental commitment of a country? First, per capita income should have a positive impact upon environmental commitment. In economic terms this would mean that environmental commitment is a normal good. This need not imply that poor countries care less about the environment per se. Rather, because of their poverty they might prioritize issues other than the environment. Income per capita is measured as gross domestic product (GDP) per capita in purchasing power parity (PPP) in US$ in 1998, taken from UNDP (2000).[15]

We considered including a squared income term as well to allow for a non-linear effect of income on environmental commitment. The Environmental Kuznets Curve (EKC) literature often includes such a term finding that environmental outcomes first worsen with rising income until a threshold is reached after which they improve with rising incomes. In non-reported sensitivity analysis we tried inclusion of squared income. In almost all cases there was no evidence for a non-linear relationship so that income squared was not included in the estimations. In certain model

[15] For a few countries, the income data stem from years earlier than 1998. The bias is likely to be very small and would not have justified taking these countries out of the sample.

specifications we use instrumental variables for democracy and income in our three-stage least squares estimations. A presentation and discussion of these instrumental variables is contained in section 8.2.

Second, big and "important" countries should be more environmentally committed than small and "unimportant" ones. More important countries might show signs of stronger environmental commitment not necessarily due to stronger environmental concern per se. Rather, we hypothesize here that these countries will find it in their interest to demonstrate environmental commitment, particularly with respect to certain proxy variables for commitment, in order to demonstrate their importance in world politics, of which the environment represents one part. In other words, important countries want to be seen as good citizens and leaders in world environmental affairs. As a proxy for "importance" we use population size. This can be justified by the fact that countries with a big population often have significant military power and often play a leading role in world political matters. This holds true in spite of their often low levels of per capita income – witness such countries as Brazil, China, India and Russia. Of course, countries with a relatively small population, but high levels of income per capita can also be "important" international actors. However, since we control already for income per capita and cannot include both population and total GDP as this would create perfect collinearity with income per capita, we decided to use only population size as a proxy for a country's "importance". Data are taken from World Bank (2001a).

Besides these general control variables, which are included in the estimations for all dependent variables, we also use a number of specific variables for a few dependent variables that control for specific interests of countries. For the Kyoto Protocol we use a dummy for member countries of the Organization of Petroleum Exporting Countries (OPEC) given the well known opposition of this organization and the countries it represents against multilateral action on curbing greenhouse gas

emissions.[16] For the Copenhagen Amendment to the Montreal Protocol we use the log of net exports (production minus consumption) of chlorofluorocarbons (CFCs) in tons of ozone depleting potential averaged over the period 1986 to 1989, with data compiled from UNEP (1999).[17] We expect this variable to have a positive influence on a country's willingness to ratify the amendment because the same countries that produced CFCs before were also the prime candidates for producing substitutes and had therefore an incentive to bring the Montreal Protocol and its amendments into force. For the Stockholm Convention on Persistent Organic Pollutants the logged share of the value of chemical to all exports is used. Chemical exports are taken from UNCTAD (2000), general export data from World Bank (2001a).[18] With its restrictions on trade in certain hazardous chemicals, the Stockholm Convention should affect countries with a higher share of chemicals to all exports more than others. However, it is not quite clear a priori whether major chemical exporters had more to gain from participating and influencing the treaty process or from abstaining and boycotting the negotiations. The logged total number of species per capita existent in a country enters the model for the Biosafety Protocol as well as the CITES reporting requirements met, with data compiled from WCMC (1994). The idea is that these countries have a greater stake in biodiversity and species protection (Biosafety Protocol) and are likely to stand more in the spotlight if they fail to meet their reporting requirements under CITES. Finally, we also use population density (population divided by land area in square kilometres) for the model in which

[16] We also tested variables indicating the vulnerability of countries towards the effects of global warming. However, neither tropical location nor a dummy variable for low-lying countries tested significantly.

[17] We also tried absolute latitude as a proxy for vulnerability towards the consequences of ozone layer depletion, but it tested insignificantly throughout.

[18] Ideally, we would have used a variable measuring trade in *hazardous* chemicals only or, better still, in the hazardous chemicals covered by the Stockholm Convention. However, data constraints did not allow constructing such a variable.

percentage of land area under protection status is the dependent variable. This is because a country with a high population density will find it much more difficult to score high on this variable. Population density data stem from World Bank (2001a).

These are certainly not the only control variables one could think of in theory. However, in many cases it is simply not possible to construct an additional control variable for 150 or so countries. Indeed, no control variable could be found for the other dependent variables since they are so general that it would be difficult to find specific variables for which we would expect a statistically significant impact. Are our estimations severely affected by potential omitted variable bias? We believe not. Indeed, in section 8.2 we will use instrumental variables for democracy and income demonstrating robustness in our results in the sense that democracy and income remain determinants of environmental commitment in the majority of cases. If we assume, not unrealistically, that our instrumental variables are uncorrelated with any potentially omitted further control variables, then we have established a statistically significant effect of democracy and income on environmental commitment that is free from any potential omitted variable bias. Indeed, in applying tests of over-identification we find evidence that our instruments are not correlated with the error term and therefore with any potentially omitted variables.

## 8. Results

Neumayer (2002a) showed that democracies exhibit stronger environmental commitment. This held true for all of the four different measures of democracies presented above. Table 3 replicates the results for the Polity measure. Note that for each explanatory variable the reported numbers are always in the order of the coefficient, the standard error and the p-value. This order will be the same for all following tables. Those p-values, which are statistically significant at the .10 level are in italic,

those significant at the .05 level are additionally in bold. The estimation technique used depends on the dependent variable and is indicated in the table.[19] The statistically significant and positive impact of democracy on environmental commitment is discernible in all proxy variables. In accordance with expectation, in most cases income and population size are statistically significant and positively associated with environmental commitment. The special interest variables are significant with the expected sign apart from the case of the Stockholm Convention on persistent organic pollutants.

< Insert Table 3 about here >

In this paper, we extend the analysis of Neumayer (2002a) substantially. We briefly consider potential problems with multicollinearity, we check for robustness of the results with respect to potential omitted variable bias, we test for the effect of income inequality, we analyze which aspect of democracy is the driver behind environmental commitment, we examine whether regime instability is detrimental to environmental commitment and we assess whether countries in conflict exhibit weaker environmental commitment. Our results are remarkably robust across these various model specifications and for different measures of environmental commitment. They are also robust across indices of democracy, but, as mentioned already, to save space we present the results from the analysis for the Polity variable only.

**8.1 Is there an independent effect of democracy on environmental commitment?**

Income and democracy are correlated. This begs the question whether the estimated effect of democracy on environmental commitment can truly be attributed to democracy. In other words,

[19] Note that the coefficients for probit estimations are transformed probability estimates at the mean of all independent variables, not the probit coefficients themselves.

does democracy pick up some of the statistically significant effect that might also be accounted for by the income variable? Is the effect of democracy spurious or is there an independent effect of democracy on environmental commitment? Similar doubts could be raised with respect to the effect of income.

A common answer to this type of problem is to do nothing as long as the estimated coefficients are statistically significant, the correlation between the two variables is not very high and the variance inflation factor is not above 10 (Kennedy, 1992). The former is certainly the case in our estimations as can be seen in Table 3. As concerns the correlation between income and democracy, the correlation coefficient is .40, which, whilst highly statistically significant, is still much below values that are commonly regarded as problematic (such as .80 or above). The variance inflation factor is hardly above 1. Also, we do not detect any of the usual symptoms of strong multicollinearity such as unstable parameter estimates in the face of small model modifications. So multicollinearity in itself is clearly not an issue here.

**8.2 Do our estimations suffer from potential omitted variable bias?**

A much more serious problem is potential omitted variable bias. It is hard to specify even theoretically which variables should impact upon a country's commitment with respect to a certain environmental aspect. It is even more difficult to construct actual specific control variables. We have tried to include as many theoretically justified control variables as we could. But if there are any other potentially omitted variables that are correlated with democracy or income, then omitted variable bias could pose problems for our estimations. We have therefore developed a simultaneous equation model, in which both income and democracy are endogenized and explained as a function of exogenous variables, so-called instrumental variables. If the positive and statistically significant effect of democracy on environmental commitment is still discernible in this simultaneous equation model,

then we have good reason to believe that it is not due to omitted variable bias. This will hold true as long as we believe, not unrealistically, that our instruments are not correlated with any potentially omitted variable. Indeed, we test this assumption via tests of over-identifying restrictions.

The instrumental variables we use are based in the theoretical literature explaining cross-country differences in income and democracy and can explain a substantial part of the variation in income and democracy in our sample. We use as instruments for democracy the following variables:

- The percentage of Muslim people among the total population. Data are taken from La Porta et al. (1999). Huntington (1991: 307) suggests that Islamic doctrine 'contains elements that may be both congenial and uncongenial to democracy'. He argues, however, that on the whole countries with a strong Muslim population are less likely to be democratic because Islam 'rejects any distinction between the religious community and the political community' (ibid.). Such a distinction proved necessary for the development of democracy in other countries.
- A dummy variable for countries with a Confucian tradition encompassing China, North and South Korea, Singapore and Vietnam. According to Huntington (1991: 300) classic Chinese Confucianism and its derivatives presents a barrier to democratization because it emphasizes 'the group over the individual, authority over liberty, and responsibilities over rights'.
- A dummy variable for fossil fuel exporters, taken from World Bank (2001b). Ross (2001) argues that countries that export fossil fuels are less likely to be democratic. Fossil fuel, particularly oil, exporters might be able to dampen calls for democracy with low tax rates and high government spending and to install security forces to repress such calls. The dependence on fossil fuel exports also could imply a delay of modernization effects where the relative lack of jobs in the industrial and service sectors could translate into less demand for democratic reforms.

- A dummy variable for countries with a Socialist legal tradition, taken from La Porta et al. (1999). They argue that 'socialist law is a clear manifestation of the State's intent to create institutions to maintain its power and extract resources, without much regard for protecting the economic interests or the liberties of the population. The goal of socialist law is to keep the Communist Party in power, not to protect property or freedom.' (La Porta et al. 1999: 231). In our source countries in transition like the former Communist Central and Eastern European countries are coded as having a Socialist legal tradition. The law has changed quite tremendously and is no longer socialist in many of these countries. However, the inclusion of these countries can be justified by the fact that the legacy of socialism makes it more difficult for these countries to achieve democracy all other things equal.

In deriving instruments for income we follow the "geography hypothesis" explanation of cross-country differences in income levels, which relates such differences to geographic, climatic or ecological differences across countries (see, for example, Gallup, Sachs & Mellinger 1999; McArthur & Sachs 2001). For example, tropical areas are faced with higher human and agricultural disease burdens. Countries with better access to sea coasts and navigable rivers are favored by lower transportation and trading costs. We note that there is a competing "institutional hypothesis", which explains such differences with reference to the institutional organization of societies (see, for example, Sokoloff & Engerman 2000; Engerman, Haber &Sokoloff 2001; Acemoglu, Johnson & Robinson 2001a,b; Easterly 2001). In our view the contest between the two hypotheses is unresolved. More importantly, we believe that the major difference between these two competing hypothesis is founded in the exact mechanism through which geography affects income, but that both hypotheses in the end refer to geographical factors as the source of explaining variation in cross-country income levels. For example, Acemoglu, Johnson & Robinson (2001a) suggest that where

European settlers were confronted with high mortality rates in the colonized areas, they were less likely to settle and more likely to install extractive institutions. Engerman, Haber & Sokoloff (2001) argue that colonies in tropical ecozones were conducive to growing crops such as sugar cane that promoted the use of slave labor, creating enormous inequalities and a drag on economic development.

For the purpose of this paper, the exact way in which geography affects income levels does not matter so much. We can keep these mechanisms in a kind of black box since our aim is to instrument for income with exogenous variables, not to explain the specific causal effects of cross-country differences in income levels. Given this, we use the instruments put forward by the "geography hypothesis" since they are available for many more countries than the main instrumental variable used by the "institutional hypothesis" (European settler mortality in the 17th, 18th and 19th century). As instruments for income we use the following variables, (with one exception, all data taken from Gallup, Sachs & Mellinger (1999):

- The share of land area in the geographical tropics. The absence of frost days leads to higher disease burdens and lower agricultural productivity, which hinders the development of tropical countries (Gallup, Sachs & Mellinger 1999; Masters & McMillan 2001).
- The share of population living within 100 kilometers to a sea border or navigable river. Access to sea borders or navigable rivers lowers transportation costs and allows countries to expand their trading, thus promoting economic development (Gallup, Sachs & Mellinger 1999).
- The amount of a country's hydrocarbon wealth, which fuelled early economic development (Gallup, Sachs and Mellinger 1999).
- A dummy variable for countries with a Socialist legal tradition, taken from La Porta et al. (1999). The justification for the inclusion of this variable is the same as given above for its inclusion as an

instrument for democracy. Once again, we stick to La Porta et al.'s coding of countries in transition as having a Socialist legal tradition. The legacy of socialism makes it more difficult for these countries to achieve high income levels all other things equal.

One might wonder whether the instrumental variables we use should be allowed to have a direct effect on environmental commitment as well. Of course, we could never allow all of the instrumental variables to have a direct effect on environmental commitment as this would lead to a non-identified model. However, is there any reason why one or the other of the instrumental variables should have a direct effect on environmental commitment in addition to its indirect effect via democracy or income? In our view, there is absolutely no reason to presume that any of our instrumental variables should have a direct effect on one of our proxy variables for environmental commitment. There is one exception. One could speculate that hydrocarbon wealth and being a fuel exporter might have an effect on a country's willingness to sign the Kyoto Protocol. However, since we control for OPEC membership we control for the organized form of the countries with the greatest hydrocarbon wealth and fuel exports already. We have therefore decided to allow an impact of our instrumental variables on environmental commitment only via the variables they instrument for.

All estimations were undertaken with three-stage least squares (3SLS) in STATA. Three-stage least squares involves three steps: First, predicted or instrumented values of the endogenous variables are generated, using all exogenous variables in the system. Second, a cross-equation covariance matrix is estimated. Third, the equation with the environmental commitment as the dependent variable is estimated with generalized least squares using the instrumented variables, other exogenous variables as well as the estimated covariance matrix. The estimation technique 3SLS has the important advantage over two-stage least squares (2SLS) that it uses the covariance matrix of disturbances, which improves the efficiency of estimation leading to smaller standard errors.

However, this improvement depends on the consistency of the covariance matrix estimates, since with 3SLS the misspecification of one equation affects the estimates in all other equations. In sensitivity analysis we have therefore tested the system of equations with 2SLS instead and found no substantial changes.

Three-stage least squares assumes that the dependent variable is continuous. Some of our proxies for environmental commitment, however, are binary and not continuous. The signing or ratification of an MEA (multilateral environmental agreement), membership in an EIO (environmental intergovernmental organization), and the existence of a NCSD (national council on sustainable development) are binary choices that reflect commitment to environmental policies. As binary choices, these variables are not continuous. In the single equation models we have used probit to estimate these models, a maximum likelihood estimation technique. There is no readily available maximum likelihood estimation technique that can account for the simultaneous structure accounted for in our 3SLS estimations. To provide consistent results across estimations, for both continuous and binary dependent variables, we have used the same estimation technique. Applying a linear probability model such as 3SLS to a binary dependent variable unfortunately suffers from some shortcomings. In particular the errors are dependent on the coefficients. Aldrich and Nelson (1984) demonstrate, however, that this is not necessarily a fatal problem. More importantly, we find remarkably robust results across all of our estimations, regardless of whether the dependent variable is binary or continuous. Given the consistency between the single equation probit estimations and the 3SLS estimations, we believe our results indicate a clear relationship between democracy and environmental commitment.

< Insert Table 4 about here >

Table 4 presents the results for the estimations of the simultaneous equation model. The top of this table shows the estimated coefficients for the equation with the proxy for environmental commitment as the dependent variable. As before, the numbers report coefficients, standard errors and p-values in that order. The set of coefficients belonging to the equation with logged income as the dependent variable follow on the next page. At the bottom of that table are the coefficients with democracy as the dependent variable.

Democracy as measured by the Polity variable works quite well as a predictor of environmental commitment. The variable assumes significance in the case of the Stockholm Convention and the Biosafety Protocol as well as the aggregate MEA variable. More democratic countries are also estimated to participate in more environmental intergovernmental organizations and to have a higher share of their land area under protection status. They are more likely to have a National Council on Sustainable Development and have less information missing from the Environmental Sustainability Index. Besides democracy, we find that richer countries in the majority of instances and more populous countries in some instances exhibit stronger environmental commitment in accordance with our theoretical expectations. The results on the specific control variables are as before, with the exception of population density, which loses significance in 3SLS.

In summary, we find evidence for an effect of democracy on environmental commitment in almost all cases even after endogenizing both income and democracy. But are our exogenous variables valid instruments? To test this we had to undertake tests for over-identifying restrictions, which effectively tests for whether some of the instruments at least are uncorrelated with the structural error and therefore with any potentially omitted variable. Since STATA does not have a routine to test for over-identifying restrictions after 3SLS, estimations were repeated for the Polity democracy variable in EViews with a General Methods of Moments estimator and consecutive tests for over-identifying restrictions. In the vast majority of cases, the null of valid restrictions failed to

become rejected. In a few instances the test statistic assumed marginal significance. However, with one exception, in all of these cases employing one of the other democracy variables lead to a successful passing of the test of over-identifying restrictions whilst also having a significant effect on environmental commitment. We are therefore confident that the exogenous variables we use are valid instruments for income and democracy. The one exception is for the dependent variable "Number of environmental intergovernmental organizations in which a country participates". For this variable we cannot be confident that the instruments are valid and the model is correctly specified (Davidson & Mackinnon 1993).

### 8.3 The effect of income inequality on environmental commitment

As a next step, we wanted to analyze the effect of income inequality on environmental commitment, using the ratio of the income share of the highest 10 per cent of households to the lowest 20 per cent as our variable. Data are taken from World Bank (2001a) and Encyclopedia Britannica (2001). Income inequality could have an effect on environmental commitment in two ways. First, there could be a direct effect. Boyce (1994) argues that greater levels of income inequality lead to more environmental degradation, whereas Scruggs (1998) suggests the opposite might be the case.[20] Torras & Boyce (1998) find some tentative evidence that income inequality is associated with worse environmental outcomes in terms of air and water pollution, Scruggs (1998) finds some evidence that points in the opposite direction. We therefore tested whether income inequality has any impact on environmental commitment. Second, income inequality could have an effect on environmental commitment through either democracy or income. Some argue that democracy and inequality are intrinsically linked. Vanhanen (1990; 1997; 2002) suggests that democratization is rooted in conditions in which power resources have become so widely distributed that a single group is no

[20] The detailed arguments are quite complex and cannot be dealt with here.

longer able to suppress its competitors or to maintain its hegemony. According to this perspective, a country's institutional composition stems from patterns of resource distribution, which in turn are a product of nature and history. Similarly, some economists argue that income inequality causes underdevelopment (Easterly 2001). Income inequality can therefore have a negative effect on environmental commitment via its negative effect on a country's level of democracy and income.

To test these various potential effects of income inequality we estimated several model specifications. We analyzed the effect of inequality as an exogenous variable, as an instrumental variable for both democracy and income, as an instrumental variable for income alone, as a fully endogenized variable with direct effects on environmental commitment, and as a fully endogenized variable with direct effects on environmental commitment as well as indirect effects, using inequality as one of the explanatory variables for democracy and income. This last model is the most general one, allowing inequality to affect environmental commitment through all ways possible.

In endogenizing inequality we have chosen to use almost the same instrumental variables as Easterly (2001). These instruments are dummy variables indicating whether a country produces *any* positive amount of the following commodities: bananas, coffee, maize, millet, rice, sugarcane, wheat, copper, silver and rubber, respectively. Data are taken from FAO (2002). In addition, we use the same dummy for whether a country is a fossil fuel exporter from World Bank (2001b) we also use as an instrument for democracy. The idea behind these instruments is that natural conditions favorable for the harvest of certain crops and the extraction of certain natural resources were also historically favorable for promoting high inequality in these countries vice versa for certain other crops. For more detail, see Easterly (2001) and the references cited therein.

< Insert Table 5 about here >

Table 5 presents results for the model that endogenizes inequality and allows for an effect on environmental commitment both directly and via democracy and income. The structure of this table is the same as for table 4. The principal problem with these estimations is that the cross-national coverage of measures of inequality are spotty. Including income inequality not only reduces our sample size from a range of 111-139 depending on the dependent variable to 105-123 observations. More importantly, it also leads to a biased sample since income inequality data are mainly missing for non-democratic countries.[21] Furthermore, the cross-country comparability of income inequality data is highly questionable and measurement errors are rampant (Atkinson and Brandolini 2001). Note that in using instrumental variables for income inequality, we hope to have reduced problems with measurement error somewhat if we assume, not unrealistically, that our instruments are not correlated with the measurement error.

Having noted the problems with the income inequality variable, we nevertheless present results in table 5. Income inequality has a negative indirect effect on environmental commitment via its detrimental effect on democracy in accordance with Vanhanen (1990; 1997; 2000). Contrary to Easterly (2001), however, we do not find a detrimental effect of inequality on income. In some cases, inequality is estimated to also have a direct effect on environmental commitment. However, the direction of the effect is inconsistent across our range of proxy variables for environmental commitment. On the one hand, inequality is estimated to have a positive effect on a country's willingness to sign or ratify more multilateral environmental agreements and to participate in environmental intergovernmental organizations. On the other hand, inequality is estimated to have a

[21] We could not establish inequality data for the following countries: Afghanistan, Albania, Angola, Bahrain, Belize, Bhutan, Cameroon, Comoros, Cuba, Cyprus, Democratic Republic of Congo (Zaire), Djibouti, Equatorial Guinea, Eritrea, Haiti, Iraq, Kuwait, Libya, Macedonia, North Korea, Oman, Qatar, Saudi Arabia, Somalia, Suriname, Syrian Arab Republic, United Arab Emirates, Yugoslavia (Serbia/Montenegro).

negative effect on a country's environmental commitment in terms of CITES reporting requirements met, the percentage of land area under protection status and the availability of environmentally relevant information. Income remains statistically significant in the majority of cases very similar to the results reported in Table 4, where income inequality was not included. Democracy does not fare quite as well. It is estimated to have a positive effect on participation in environmental intergovernmental organizations, land protection and availability of environmentally relevant information. We would like to stress, however, that these results need to be treated with great care, particularly because the sample is biased due to the fact that income inequality data are missing mainly for non-democracies.

### 8.4 Which aspects of democracy are the most important drivers of environmental commitment?

Democracy is a complex concept and the variables we use combine various conceptually distinct information into one single aggregate index. We examined which aspects of the aggregate democracy variable are the most important drivers of environmental commitment. We utilized a decomposition of two of our aggregate indices of democracy, namely *political participation*, *executive constraints* and *executive recruitment*.

Contrary to *executive recruitment* and *executive constraints*, the *political participation* measure was not taken directly from the Polity data set. This is because there are several problems with the Polity participation index. First, the components of the index are rather subjective. Second, the criterion for coding a polity as having regulated and competitive participation ignores aspects of enfranchisement that to some extent serve to define modern democracy. For instance, a polity that prohibits women, ethnic minorities, or non-property owners from voting is often regarded as having the same level of participation as a polity that grants voting rights to all groups. Third, the Polity

coding scheme classifies a large share of the polities as factional systems. Indeed, up to 40% of all polities fit this description. In polities with 'factional' participation, there is a 'pattern of intense, often violent competition between 'in' and 'out' factions', each having a fragile grasp of power (Gurr, 1974: 1486). The problem is that factionalism does not address the institutional composition of a country, but rather an outcome of an institutional arrangement.

Instead of taking over the data from the Polity participation index, we have therefore taken our data on participation from Gates et al. (2001). These authors have transformed the raw participation measures composing an aspect of the Polyarchy data set (Vanhanen 2000). Gates et al. (2001) undertake two sorts of transformations: First, they modify Vanhanen's participation index if the percent of the valid votes won by all parties except the plurality winner or winning electoral alliance is less than 30%. This transformation is useful for parsing out polities that have had very high participation in elections in which there were no real alternatives (e.g., the former communist states). If there is no real choice, the election does not really play a role in the selection of the executive. Second, Gates et al. (2001) take the natural logarithm of Vanhanen's participation index before they multiply it with his competition measure. This is in order to impose a marginally decreasing effect of participation. The effect of a change from 5% to 15% of the population voting is a much more significant shift than is a change from 45% to 55%. After these transformations were undertaken, the final participation measure then ranges between 0 and 4.5, where the higher number indicates greater levels of participation. All observations with 0% participation were given an additional 0.001% in order to avoid mathematically undefined terms.

Table 6 reports our estimation results entering the three dimensions of democracy in lieu of the aggregate Polity variable. In most cases *participation* is the variable that tests significantly. What this means is that the strength of environmental commitment is likely to depend most on the fundamental aspect of democracy, which in our view is participation.

< Insert Table 6 about here >

**8.5 Is regime instability detrimental to environmental commitment?**

A number of studies regarding the effects of democracy distinguish between the *level* and *stability* of democracy.[22] Thus, we wanted to find out whether countries that suffer from regime instability exhibit less environmental commitment. To test this, we constructed a variable measuring the number of times the political regime within a country has changed since 1960 or since independence if a country achieved independence after 1960 (data on independence taken from the Correlates of War dataset (Singer & Small 1994)). Regime change is defined as any change in indicators that results in a movement from one category in the Executive dimension, a change of at least two units in the Constraints dimension, or a movement in the Participation dimension of more than 0.5 in either direction from the original level (these three dimensions follow from Gurr's conceptualization of the authority patterns of a political system as introduced above). If a political system experiences two consecutive one-unit changes in Constraints, we define the second of these as a polity change. The creation or dissolution of states is also defined as a polity change. Finally, we define a *regime* as a political system between two polity changes. Data are taken from Gates et al. (2001).

Interestingly, controlling for the current regime type, we do not find a statistically significant negative impact of regime instability on environmental commitment (results not reported). This could be due to measurement problems. Gates et al.'s (2001) definition of political change is extremely sensitive to political change. Minor twitches in the political system are regarded to be signs of political instability. Unfortunately they do not make a distinction between minor and significant

[22] See Hegre, et al. (2001) who examine both level and stability with regard to the onset of civil war.

political changes. The alternative explanation is that political instability simply has no statistically significant relationship with environmental commitment.

### 8.6 Do countries in conflict exhibit weaker environmental commitment?

Given the recent interest in the relationship between conflict and the environment, we wanted to find out whether countries in conflict exhibit weaker environmental commitment. Conflict could have a negative impact on environmental commitment for a number of reasons. Perhaps the most important one is that during conflict and in its aftermath attention and priority is likely to shift towards the conflict itself and dealing with the damages it inflicts upon society and economy. Of course, environmental damage caused by conflicts might induce governments to exhibit greater environmental commitment in order to mitigate the damages, but we would expect this contrary effect to be of second order relevance. To test the potential negative aggregate effect of conflict on environmental commitment, we constructed three dummy variables: One for whether a country was in conflict of small size in the years 1995 to 2000, another one for whether a country was in conflict of large size during the same time period. The third dummy variable is for large civil conflicts. Small conflict is defined as any type of armed conflict resulting in more than 25 casualties in any one year. The threshold is much higher for large conflicts, which require more than 1,000 battle deaths in a single year to qualify. It is clear that due to the higher threshold, the dummy for large conflicts is nested within the dummy for small conflicts. In addition, we constructed three continuous variables measuring the number of small and large conflict years as well as large civil conflict years a country experienced during the 1990s. All these data were taken from Gleditsch et al. (2001). In the vast majority of cases we do not find a statistically significant negative effect of conflict experience on environmental commitment (results not reported). This holds true independent of whether we enter

either the dummy or continuous variables in isolation or in combination and holds true for both small and large conflicts as well as for the subset of large civil conflicts.

## 9. Conclusions

Taken together, the results reported in the last section provide strong evidence in favor of our hypothesis that democracies exhibit stronger environmental commitment than non-democracies. This result appears to be relatively robust with respect to our different proxy variables of environmental commitment. For the great majority of these proxies the democracy variable not only has the expected sign, but it is also statistically significant.

We considered whether the correlation between income and democracy is likely to create problems for our estimations. However, we believe that the correlation is too small to create serious problems. In other words, there is no reason to presume that the estimated positive effect of democracy simply picks up an effect that might as well be accounted for by income.

To investigate whether the effects of democracy and income on environmental commitment suffer from omitted variable bias, we used three-stage least squares estimations for a simultaneous equations model. We found no evidence that our results are triggered by omitted variable bias. We are therefore confident that both income and, in particular, democracy truly have a statistically significant impact on environmental commitment.

Both income and democracy have an important positive and synergistic effect on environmental commitment in most cases. Figure 1 shows this nicely for the proxy variable "Percentage of land area under protection status". It uses the estimated coefficients from table 3, holding population size and population density at their sample mean and defining low income and democracy as one standard deviation below the sample mean, high income and democracy as one standard deviation above the

mean. Countries with low income and low democracy have put the lowest percentage of their land area under protection status. The situation improves substantially if income rises to high level, even more so if, instead, democracy rises to high level. However, a truly outstanding level of environmental commitment is only estimated for a country with both high income and high democracy.

< Insert Figure 1 about here >

We also examined the effect of inequality on environmental commitment. Inequality has a negative effect on environmental commitment via its negative effect on democracy. In some cases, inequality was also estimated to have a direct effect on environmental commitment. However, the direction of the effect is inconsistent across our range of proxy variables and no definite conclusions can therefore be drawn on the direct effect of inequality on environmental commitment. Our estimated results also have to be treated with care because the sample size becomes smaller and the sample becomes biased if income inequality is included. Even then, democracy remains a significant positive factor in the case of three proxy variables for environmental commitment.

Conflict is known to take priority and attention away from "soft" issues such as the environment at the same time as it inflicts environmental destruction upon society. Also, recently environmental issues have gained increased attention more generally in the conflict literature (Diehl & Gleditsch, 2001). Therefore, we were interested in finding out whether conflict had an effect on a country's environmental commitment, which on aggregate we would expect to be a negative one. We find no evidence for such an effect. Whatever negative impact conflict experience might have on a country, it does not translate into any less environmental commitment, at least not as measured by our proxy variables.

Political participation is the most important aspect of democracy that accounts for environmental commitment. The more exclusionary the political system, the less likely it will exhibit environmental commitment. At least with regard to the environment, getting more people involved in the political process is better than other types of political reforms. Other dimensions of political authority, such as executive recruitment and executive constraints play a lesser role with respect to environmental commitment. Similarly, political instability is not associated with environmental commitment. The type of political system is important, but not the frequency of changes in the system.

Democracies clearly suffer from deficiencies and even failures with respect to environmental commitment as well. For example, future generations are affected by environmental degradation, but cannot express their preferences in the political market place of the present. Environmental degradation that cuts across national boundaries may be hard to counteract without the existence of a transnational political authority. Environmental degradation also cuts across administrative boundaries within nation-states, which renders policies successfully addressing these problems more difficult (Doeleman 1997). But the point is that non-democracies equally suffer from these deficiencies, if not more. While democracy is less than perfect, there is no better alternative.

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Table 1. Pearson correlation matrix for democracy variables (N = 159).

| | FREE | POLIT | GOV | VAN |
|---|---|---|---|---|
| FREE | 1.00 | | | |
| POLIT | .92 | 1.00 | | |
| GOV | .94 | .83 | 1.00 | |
| VAN | .81 | .77 | .81 | 1.00 |

FREE: Joint index of Freedom House political rights and civil liberties variables.
POLIT: Polity index of democracy minus autocracy.
GOV: World Bank Governance variable.
VAN: Vanhanen's index of democracy.

Table 2. Pearson correlation matrix for dependent variables (N = 101).

| | MEAs | # env. IO | cites | landprot. | NCSD | ESI |
|---|---|---|---|---|---|---|
| MEAs | 1.00 | | | | | |
| # env. IO | .49 | 1.00 | | | | |
| cites | .25 | .43 | 1.00 | | | |
| landprot. | .23 | .19 | .32 | 1.00 | | |
| NCSD | .21 | .23 | .11 | .16 | 1.00 | |
| ESI | .54 | .64 | .51 | .17 | .33 | 1.00 |

MEAs: Sum of Multilateral Environmental Agreements a country has signed/ratified (0 to 4).
# env. IO: Number of environmental inter-governmental organizations a country participates in.
Cites: Percentage of reporting requirements met of the Convention on International Trade in Endangered Species of Fauna and Flora.
Landprot.: Percentage of land area under protection status.
NCSD: Dummy for the existence of a National Council on Sustainable Development.
ESI: Number of environmentally relevant variables available.

Table 3. Single equation analysis of environmental commitment.

| | Kyoto | Copenhag | Stockholm | Biosafety | MEAs | # env. IO | Cites | Landprot. | NCSD | ESI |
|---|---|---|---|---|---|---|---|---|---|---|
| lnGDP | 0.231 | 0.174 | 0.090 | -0.010 | 0.381 | 2.993 | 8.632 | 1.031 | 0.073 | 2.486 |
| | 0.047 | 0.040 | 0.045 | 0.040 | 0.079 | 0.451 | 2.384 | 0.564 | 0.030 | 0.256 |
| | ***0.000*** | ***0.000*** | ***0.045*** | 0.800 | ***0.000*** | ***0.000*** | ***0.000*** | *0.070* | ***0.016*** | ***0.000*** |
| polity | 0.017 | 0.010 | 0.020 | 0.026 | 0.081 | 0.205 | 1.252 | 0.275 | 0.016 | 0.244 |
| | 0.008 | 0.006 | 0.006 | 0.006 | 0.014 | 0.073 | 0.543 | 0.099 | 0.005 | 0.052 |
| | ***0.030*** | *0.092* | ***0.001*** | ***0.000*** | ***0.000*** | ***0.006*** | ***0.023*** | ***0.006*** | ***0.001*** | ***0.000*** |
| lnPOP | 0.071 | 0.020 | 0.086 | 0.097 | 0.155 | 2.089 | 7.382 | 0.108 | 0.073 | 1.623 |
| | 0.034 | 0.030 | 0.038 | 0.036 | 0.065 | 0.295 | 2.417 | 0.367 | 0.023 | 0.166 |
| | ***0.038*** | 0.506 | ***0.021*** | ***0.008*** | ***0.018*** | ***0.000*** | ***0.003*** | 0.768 | ***0.001*** | ***0.000*** |
| opec | 0.106 | | | | | | | | | |
| | -2.450 | | | | | | | | | |
| | *0.072* | | | | | | | | | |
| lnCFCexport | | 0.004 | | | | | | | | |
| | | 0.002 | | | | | | | | |
| | | ***0.045*** | | | | | | | | |
| lnCHEMexp | | | -0.079 | | | | | | | |
| | | | 0.056 | | | | | | | |
| | | | 0.156 | | | | | | | |
| lnSPECIESpc | | | | 0.078 | | | 4.971 | | | |
| | | | | 0.029 | | | 2.461 | | | |
| | | | | ***0.007*** | | | ***0.046*** | | | |
| popdensity | | | | | | | | -0.008 | | |
| | | | | | | | | 0.004 | | |
| | | | | | | | | ***0.034*** | | |
| constant | | | | | | -46.662 | -87.074 | -2.756 | | 5.929 |
| | | | | | | 6.072 | 36.693 | 7.178 | | 3.622 |
| | | | | | | ***0.000*** | ***0.019*** | 0.702 | | 0.104 |
| Pseudo $R^2$ | 0.285 | 0.233 | 0.127 | 0.152 | 0.162 | | | | 0.218 | |
| R-squared | | | | | | 0.529 | 0.358 | 0.118 | | 0.693 |
| N | 153 | 153 | 153 | 153 | 153 | 121 | 115 | 141 | 153 | 122 |
| Est. technique | Probit | Probit | Probit | Probit | Ord. Probit | OLS | OLS | OLS | Probit | OLS |

Table 4. Three-stage least squares analysis of environmental commitment.

| | Kyoto | Copenhag | Stockholm | Biosafety | MEAs | # env. IO | Cites | Landprot. | NCSD | ESI |
|---|---|---|---|---|---|---|---|---|---|---|
| lnGDP | 0.186 | 0.147 | 0.105 | -0.019 | 0.294 | 2.480 | 7.985 | -0.174 | 0.001 | 2.340 |
| | 0.053 | 0.045 | 0.063 | 0.054 | 0.117 | 0.575 | 3.410 | 0.863 | 0.042 | 0.345 |
| | ***0.000*** | ***0.001*** | *0.098* | 0.724 | ***0.012*** | ***0.000*** | ***0.019*** | 0.841 | 0.977 | ***0.000*** |
| polity | 0.013 | 0.005 | 0.020 | 0.021 | 0.081 | 0.452 | 1.116 | 0.426 | 0.018 | 0.273 |
| | 0.011 | 0.009 | 0.009 | 0.011 | 0.022 | 0.122 | 0.749 | 0.164 | 0.008 | 0.072 |
| | 0.235 | 0.546 | ***0.028*** | *0.055* | ***0.000*** | ***0.000*** | 0.136 | ***0.010*** | ***0.022*** | ***0.000*** |
| lnPOP | 0.043 | 0.001 | 0.078 | 0.077 | 0.125 | 2.125 | 5.837 | 0.037 | 0.079 | 1.650 |
| | 0.026 | 0.025 | 0.043 | 0.031 | 0.063 | 0.309 | 2.170 | 0.449 | 0.022 | 0.189 |
| | *0.094* | 0.956 | *0.073* | ***0.013*** | ***0.046*** | ***0.000*** | ***0.007*** | 0.934 | ***0.000*** | ***0.000*** |
| opec | -0.425 | | | | | | | | | |
| | 0.172 | | | | | | | | | |
| | ***0.014*** | | | | | | | | | |
| lnCFCexport | | 0.006 | | | | | | | | |
| | | 0.002 | | | | | | | | |
| | | ***0.007*** | | | | | | | | |
| lnCHEMexp | | | -0.080 | | | | | | | |
| | | | 0.060 | | | | | | | |
| | | | 0.187 | | | | | | | |
| lnSPECIESpc | | | | 0.083 | | | 4.371 | | | |
| | | | | 0.029 | | | 2.560 | | | |
| | | | | ***0.004*** | | | *0.088* | | | |
| popdensity | | | | | | | | -0.004 | | |
| | | | | | | | | 0.005 | | |
| | | | | | | | | 0.439 | | |
| constant | -1.736 | -0.504 | -1.409 | 0.138 | -2.218 | -43.971 | -59.385 | 7.536 | -0.562 | 6.570 |
| | 0.603 | 0.568 | 1.036 | 0.615 | 1.374 | 6.880 | 36.425 | 9.751 | 0.494 | 4.152 |
| | ***0.004*** | 0.375 | 0.174 | 0.822 | 0.106 | ***0.000*** | 0.103 | 0.440 | 0.255 | 0.114 |
| p-value Chi2 | ***0.000*** | ***0.000*** | ***0.004*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.032*** | ***0.000*** | ***0.000*** |
| # observations | 139 | 139 | 139 | 139 | 139 | 118 | 111 | 135 | 139 | 118 |

Table 4 (continued).

| | lnGDP | lnGDP | lnGDP | lnGDP | lnGDP | lnGDP | lnGDP | lnGDP | lnGDP | lnGDP |
|---|---|---|---|---|---|---|---|---|---|---|
| % land tropics | -1.470 | -1.472 | -1.473 | -1.470 | -1.473 | -1.531 | -1.700 | -1.502 | -1.457 | -1.527 |
| | 0.144 | 0.144 | 0.144 | 0.144 | 0.144 | 0.156 | 0.155 | 0.142 | 0.143 | 0.156 |
| | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** |
| % pop 100km | 1.235 | 1.232 | 1.239 | 1.233 | 1.217 | 1.214 | 1.200 | 1.195 | 1.195 | 1.218 |
| | 0.178 | 0.178 | 0.178 | 0.178 | 0.178 | 0.186 | 0.193 | 0.177 | 0.176 | 0.186 |
| | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** |
| hydrocarbon | 0.037 | 0.036 | 0.036 | 0.037 | 0.037 | 0.025 | 0.040 | 0.033 | 0.039 | 0.026 |
| | 0.014 | 0.014 | 0.014 | 0.014 | 0.014 | 0.015 | 0.016 | 0.014 | 0.014 | 0.015 |
| | ***0.008*** | ***0.009*** | ***0.010*** | ***0.008*** | ***0.008*** | 0.101 | ***0.010*** | ***0.019*** | ***0.004*** | *0.090* |
| socialist legacy | -0.360 | -0.369 | -0.372 | -0.365 | -0.366 | -0.379 | -0.296 | -0.393 | -0.369 | -0.417 |
| | 0.167 | 0.167 | 0.167 | 0.167 | 0.167 | 0.185 | 0.214 | 0.163 | 0.165 | 0.185 |
| | ***0.032*** | ***0.027*** | ***0.026*** | ***0.029*** | ***0.029*** | ***0.041*** | 0.167 | ***0.016*** | ***0.025*** | ***0.024*** |
| constant | 8.516 | 8.521 | 8.518 | 8.517 | 8.525 | 8.616 | 8.705 | 8.545 | 8.526 | 8.619 |
| | 0.144 | 0.144 | 0.144 | 0.144 | 0.144 | 0.153 | 0.155 | 0.141 | 0.142 | 0.152 |
| | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** |
| p-value Chi2 | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** |
| | **Polity** | **Polity** | **Polity** | **Polity** | **Polity** | **Polity** | **Polity** | **Polity** | **Polity** | **Polity** |
| % muslim | -0.116 | -0.117 | -0.116 | -0.116 | -0.116 | -0.115 | -0.113 | -0.115 | -0.116 | -0.120 |
| | 0.012 | 0.012 | 0.012 | 0.012 | 0.012 | 0.012 | 0.014 | 0.012 | 0.012 | 0.012 |
| | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** |
| confucianism | -6.379 | -6.379 | -6.365 | -6.357 | -6.308 | -8.118 | -6.193 | -6.449 | -6.388 | -7.280 |
| | 2.471 | 2.468 | 2.473 | 2.473 | 2.473 | 2.163 | 2.402 | 2.435 | 2.473 | 2.264 |
| | ***0.010*** | ***0.010*** | ***0.010*** | ***0.010*** | ***0.011*** | ***0.000*** | ***0.010*** | ***0.008*** | ***0.010*** | ***0.001*** |
| fuelexporter | -3.523 | -3.366 | -3.435 | -3.424 | -3.420 | -3.727 | -4.288 | -3.278 | -3.443 | -3.895 |
| | 0.944 | 0.943 | 0.944 | 0.944 | 0.944 | 0.913 | 0.951 | 0.945 | 0.944 | 0.942 |
| | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.001*** | ***0.000*** | ***0.000*** |
| socialist legacy | -3.218 | -2.987 | -3.096 | -3.077 | -3.112 | -3.853 | -4.489 | -3.314 | -3.095 | -2.531 |
| | 1.000 | 0.999 | 1.001 | 1.001 | 1.001 | 0.958 | 1.322 | 0.998 | 1.001 | 1.010 |
| | ***0.001*** | ***0.003*** | ***0.002*** | ***0.002*** | ***0.002*** | ***0.000*** | ***0.001*** | ***0.001*** | ***0.002*** | ***0.012*** |
| constant | 7.877 | 7.810 | 7.840 | 7.837 | 7.836 | 8.827 | 8.484 | 7.825 | 7.844 | 8.683 |
| | 0.630 | 0.630 | 0.631 | 0.631 | 0.631 | 0.604 | 0.647 | 0.635 | 0.631 | 0.610 |
| | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** |
| p-value Chi2 | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** |

Table 5. Three-stage least squares analysis of environmental commitment with income inequality included.

| | Kyoto | Copenhag | Stockholm | Biosafety | MEAs | # env. IO | Cites | Landprot. | NCSD | ESI |
|---|---|---|---|---|---|---|---|---|---|---|
| lnGDP | 0.343 | 0.221 | 0.254 | 0.091 | 0.847 | 2.908 | 5.738 | -1.805 | 0.034 | 2.396 |
| | 0.069 | 0.062 | 0.087 | 0.075 | 0.161 | 0.699 | 3.706 | 1.198 | 0.054 | 0.412 |
| | ***0.000*** | ***0.000*** | ***0.004*** | 0.224 | ***0.000*** | ***0.000*** | 0.122 | 0.132 | 0.524 | ***0.000*** |
| polity | -0.017 | -0.001 | 0.000 | 0.002 | -0.012 | 0.448 | 0.576 | 0.731 | 0.011 | 0.217 |
| | 0.014 | 0.012 | 0.013 | 0.015 | 0.030 | 0.150 | 0.778 | 0.232 | 0.010 | 0.087 |
| | 0.204 | 0.922 | 0.971 | 0.919 | 0.698 | ***0.003*** | 0.459 | ***0.002*** | 0.280 | ***0.013*** |
| lnPOP | 0.021 | -0.017 | 0.099 | 0.053 | 0.052 | 1.986 | 7.710 | -0.068 | 0.057 | 1.554 |
| | 0.030 | 0.027 | 0.047 | 0.035 | 0.069 | 0.320 | 2.202 | 0.510 | 0.023 | 0.192 |
| | 0.495 | 0.515 | ***0.035*** | 0.128 | 0.446 | ***0.000*** | ***0.000*** | 0.894 | ***0.013*** | ***0.000*** |
| inequality | 0.026 | 0.017 | 0.021 | 0.024 | 0.109 | 0.314 | -3.495 | -0.526 | -0.006 | -0.181 |
| | 0.016 | 0.014 | 0.016 | 0.022 | 0.037 | 0.185 | 1.216 | 0.290 | 0.012 | 0.104 |
| | 0.105 | 0.226 | 0.178 | 0.284 | ***0.003*** | *0.089* | ***0.004*** | *0.070* | 0.600 | *0.083* |
| opec | -0.388 | | | | | | | | | |
| | 0.200 | | | | | | | | | |
| | *0.053* | | | | | | | | | |
| lnCFCexport | | 0.006 | | | | | | | | |
| | | 0.003 | | | | | | | | |
| | | ***0.031*** | | | | | | | | |
| lnCHEMexp | | | -0.127 | | | | | | | |
| | | | 0.062 | | | | | | | |
| | | | ***0.040*** | | | | | | | |
| lnSPECIESpc | | | | 0.071 | | | 9.555 | | | |
| | | | | 0.048 | | | 3.414 | | | |
| | | | | 0.138 | | | ***0.005*** | | | |
| popdensity | | | | | | | | -0.007 | | |
| | | | | | | | | 0.006 | | |
| | | | | | | | | 0.198 | | |
| constant | 4.897 | 5.177 | 5.352 | 5.244 | 5.332 | 4.064 | 4.812 | 5.435 | 5.377 | 3.632 |
| | 1.452 | 1.562 | 1.512 | 1.543 | 1.423 | 1.473 | 1.735 | 1.501 | 1.518 | 1.482 |
| | ***0.001*** | ***0.001*** | ***0.000*** | ***0.001*** | ***0.000*** | ***0.006*** | ***0.006*** | ***0.000*** | ***0.000*** | ***0.014*** |
| p-value Chi2 | ***0.000*** | ***0.000*** | ***0.002*** | ***0.008*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.012*** | ***0.002*** | ***0.000*** |
| # observations | 123 | 123 | 123 | 123 | 123 | 109 | 105 | 120 | 123 | 109 |

Table 5 (continued).

| | lnGDP | lnGDP | lnGDP | lnGDP | lnGDP | lnGDP | lnGDP | lnGDP | lnGDP | lnGDP |
|---|---|---|---|---|---|---|---|---|---|---|
| % land tropics | -1.492 | -1.364 | -1.507 | -1.527 | -1.471 | -1.697 | -1.632 | -1.600 | -1.491 | -1.694 |
| | 0.185 | 0.182 | 0.186 | 0.185 | 0.185 | 0.210 | 0.206 | 0.181 | 0.186 | 0.210 |
| | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** |
| % pop 100km | 1.272 | 1.258 | 1.256 | 1.249 | 1.240 | 1.352 | 1.225 | 1.227 | 1.252 | 1.347 |
| | 0.190 | 0.191 | 0.191 | 0.191 | 0.189 | 0.201 | 0.205 | 0.191 | 0.190 | 0.201 |
| | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** |
| hydrocarbon | 0.032 | 0.027 | 0.028 | 0.029 | 0.028 | 0.028 | 0.033 | 0.027 | 0.032 | 0.028 |
| | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.016 | 0.017 | 0.016 | 0.016 | 0.016 |
| | ***0.043*** | *0.082* | *0.080* | *0.063* | *0.073* | *0.087* | *0.054* | *0.077* | ***0.041*** | *0.086* |
| socialist legacy | -0.288 | -0.403 | -0.380 | -0.363 | -0.391 | -0.240 | -0.294 | -0.334 | -0.331 | -0.285 |
| | 0.194 | 0.193 | 0.195 | 0.195 | 0.194 | 0.214 | 0.239 | 0.192 | 0.194 | 0.214 |
| | 0.138 | ***0.037*** | *0.051* | *0.062* | ***0.044*** | 0.262 | 0.219 | *0.081* | *0.088* | 0.182 |
| inequality | -0.010 | -0.046 | -0.011 | -0.008 | -0.022 | 0.041 | -0.013 | 0.003 | -0.013 | 0.038 |
| | 0.032 | 0.030 | 0.032 | 0.031 | 0.032 | 0.036 | 0.031 | 0.031 | 0.032 | 0.036 |
| | 0.752 | 0.121 | 0.722 | 0.788 | 0.500 | 0.247 | 0.682 | 0.929 | 0.675 | 0.288 |
| constant | 8.595 | 8.811 | 8.640 | 8.628 | 8.700 | 8.362 | 8.741 | 8.580 | 8.635 | 8.393 |
| | 0.240 | 0.234 | 0.242 | 0.239 | 0.242 | 0.259 | 0.231 | 0.239 | 0.242 | 0.259 |
| | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** |
| p-value Chi2 | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** |

| | Polity | Polity | Polity | Polity | Polity | Polity | Polity | Polity | Polity | Polity |
|---|---|---|---|---|---|---|---|---|---|---|
| % muslim | -0.107 | -0.110 | -0.111 | -0.112 | -0.113 | -0.105 | -0.109 | -0.113 | -0.112 | -0.114 |
| | 0.013 | 0.013 | 0.013 | 0.013 | 0.013 | 0.012 | 0.013 | 0.013 | 0.013 | 0.012 |
| | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** |
| confucianism | -5.959 | -6.503 | -6.584 | -6.524 | -6.586 | -8.246 | -6.547 | -6.147 | -6.767 | -7.259 |
| | 2.176 | 2.239 | 2.269 | 2.257 | 2.218 | 1.986 | 2.218 | 2.199 | 2.254 | 2.083 |
| | ***0.006*** | ***0.004*** | ***0.004*** | ***0.004*** | ***0.003*** | ***0.000*** | ***0.003*** | ***0.005*** | ***0.003*** | ***0.000*** |
| fuelexporter | -2.655 | -2.380 | -2.375 | -2.657 | -2.277 | -2.304 | -3.434 | -2.264 | -2.491 | -2.742 |
| | 1.127 | 1.069 | 1.128 | 1.083 | 1.129 | 1.011 | 1.024 | 1.137 | 1.127 | 1.085 |
| | ***0.018*** | ***0.026*** | ***0.035*** | ***0.014*** | ***0.044*** | ***0.023*** | ***0.001*** | ***0.046*** | ***0.027*** | ***0.011*** |
| socialist legacy | -6.821 | -5.522 | -5.916 | -5.475 | -5.564 | -5.916 | -5.259 | -6.425 | -5.808 | -4.633 |
| | 1.115 | 1.124 | 1.153 | 1.137 | 1.135 | 1.058 | 1.372 | 1.133 | 1.147 | 1.118 |
| | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** |
| inequality | -0.838 | -0.667 | -0.793 | -0.669 | -0.784 | -0.620 | -0.458 | -0.840 | -0.772 | -0.503 |
| | 0.170 | 0.159 | 0.171 | 0.164 | 0.171 | 0.171 | 0.152 | 0.173 | 0.172 | 0.175 |
| | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.002*** | ***0.000*** | ***0.000*** | ***0.004*** |
| constant | 14.339 | 12.903 | 13.874 | 13.023 | 13.743 | 12.996 | 11.826 | 14.220 | 13.751 | 12.219 |
| | 1.375 | 1.303 | 1.384 | 1.334 | 1.380 | 1.258 | 1.232 | 1.385 | 1.386 | 1.281 |
| | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** |
| p-value Chi2 | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** |

Table 5 (continued).

| | Inequality | Inequality | Inequality | Inequality | Inequality | Inequality | Inequality | Inequality | Inequality | Inequality |
|---|---|---|---|---|---|---|---|---|---|---|
| bananas | -1.918 | -1.515 | -1.284 | -2.069 | -1.610 | 0.273 | -1.452 | -1.228 | -1.372 | 0.009 |
| | 1.105 | 1.208 | 1.171 | 1.184 | 1.063 | 1.134 | 1.259 | 1.142 | 1.180 | 1.145 |
| | *0.083* | 0.210 | 0.273 | *0.081* | 0.130 | 0.810 | 0.249 | 0.282 | 0.245 | 0.994 |
| coffee | 3.072 | 2.656 | 2.569 | 3.412 | 2.974 | 0.928 | 3.292 | 2.692 | 2.745 | 1.399 |
| | 1.247 | 1.352 | 1.314 | 1.322 | 1.201 | 1.219 | 1.421 | 1.311 | 1.323 | 1.233 |
| | ***0.014*** | ***0.049*** | *0.051* | ***0.010*** | ***0.013*** | 0.447 | ***0.020*** | ***0.040*** | ***0.038*** | 0.257 |
| maize | 1.316 | 1.135 | 1.377 | 1.587 | 1.322 | 0.408 | 0.145 | 0.916 | 1.131 | 1.340 |
| | 1.369 | 1.504 | 1.454 | 1.481 | 1.319 | 1.428 | 1.714 | 1.424 | 1.464 | 1.442 |
| | 0.336 | 0.451 | 0.344 | 0.284 | 0.316 | 0.775 | 0.932 | 0.520 | 0.440 | 0.353 |
| millet | -1.499 | -0.863 | -0.781 | -0.624 | -0.770 | -1.808 | -1.182 | -0.379 | -0.888 | -1.760 |
| | 0.868 | 0.949 | 0.918 | 0.930 | 0.842 | 0.886 | 1.099 | 0.910 | 0.923 | 0.892 |
| | *0.084* | 0.363 | 0.395 | 0.502 | 0.360 | ***0.041*** | 0.282 | 0.677 | 0.336 | ***0.048*** |
| rice | -0.303 | -0.325 | -0.700 | -0.942 | -0.943 | 0.178 | 2.543 | -0.479 | -0.550 | -0.073 |
| | 1.148 | 1.264 | 1.222 | 1.233 | 1.103 | 1.166 | 1.570 | 1.230 | 1.230 | 1.178 |
| | 0.792 | 0.797 | 0.567 | 0.445 | 0.392 | 0.879 | 0.105 | 0.697 | 0.655 | 0.950 |
| sugarcane | 2.755 | 3.447 | 2.703 | 3.054 | 2.836 | 2.900 | 1.836 | 2.422 | 2.857 | 2.813 |
| | 1.340 | 1.465 | 1.420 | 1.435 | 1.297 | 1.352 | 1.636 | 1.399 | 1.428 | 1.365 |
| | ***0.040*** | ***0.019*** | *0.057* | ***0.033*** | ***0.029*** | ***0.032*** | 0.262 | *0.083* | ***0.045*** | ***0.039*** |
| wheat | -0.972 | -1.550 | -1.603 | -1.355 | -1.302 | -0.300 | -1.576 | -1.641 | -1.550 | -0.591 |
| | 1.028 | 1.123 | 1.088 | 1.099 | 0.995 | 1.066 | 1.196 | 1.074 | 1.094 | 1.075 |
| | 0.344 | 0.168 | 0.141 | 0.218 | 0.190 | 0.779 | 0.188 | 0.127 | 0.157 | 0.582 |
| copper | -0.960 | -0.449 | -0.954 | -1.136 | -0.790 | -0.725 | -0.235 | -0.721 | -0.765 | -0.602 |
| | 1.120 | 1.238 | 1.195 | 1.207 | 1.077 | 1.118 | 1.426 | 1.164 | 1.203 | 1.128 |
| | 0.391 | 0.717 | 0.425 | 0.346 | 0.463 | 0.516 | 0.869 | 0.536 | 0.525 | 0.594 |
| silver | 1.508 | 0.536 | 1.327 | 1.394 | 1.073 | 1.241 | 0.701 | 1.568 | 1.199 | 1.352 |
| | 1.175 | 1.277 | 1.234 | 1.253 | 1.140 | 1.152 | 1.469 | 1.209 | 1.241 | 1.161 |
| | 0.199 | 0.675 | 0.282 | 0.266 | 0.347 | 0.281 | 0.633 | 0.195 | 0.334 | 0.244 |
| rubber | -0.829 | -1.563 | -1.042 | -1.731 | -1.312 | -0.612 | -1.355 | -1.238 | -1.293 | -0.686 |
| | 1.157 | 1.268 | 1.227 | 1.242 | 1.119 | 1.212 | 1.344 | 1.198 | 1.234 | 1.222 |
| | 0.473 | 0.218 | 0.396 | 0.164 | 0.241 | 0.614 | 0.313 | 0.301 | 0.295 | 0.575 |
| fuelexporter | 1.453 | 1.015 | 1.153 | 0.646 | 1.203 | 2.412 | 0.444 | 0.996 | 1.175 | 2.098 |
| | 1.155 | 1.180 | 1.173 | 1.158 | 1.098 | 1.037 | 1.193 | 1.186 | 1.185 | 1.062 |
| | 0.208 | 0.390 | 0.325 | 0.577 | 0.273 | ***0.020*** | 0.710 | 0.401 | 0.322 | ***0.048*** |
| constant | 32.840 | 32.974 | 32.912 | 33.378 | 32.909 | 33.235 | 33.343 | 32.749 | 32.268 | 32.758 |
| | 3.184 | 3.179 | 3.208 | 3.149 | 3.192 | 3.530 | 4.081 | 3.249 | 3.172 | 3.498 |
| | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** | ***0.000*** |
| p-value Chi2 | ***0.000*** | ***0.000*** | ***0.001*** | ***0.001*** | ***0.001*** | ***0.000*** | ***0.000*** | ***0.003*** | ***0.001*** | ***0.000*** |

Table 6. Single equation estimations of environmental commitment with disaggregated democracy variables.

| | kyoto | Copenhag | Stockholm | Biosafe | MEAs |
|---|---|---|---|---|---|
| lnGDP | 0.247 | 0.153 | 0.081 | -0.011 | 0.356 |
| | 0.052 | 0.040 | 0.049 | 0.043 | 0.086 |
| | ***0.000*** | ***0.000*** | *0.094* | 0.806 | ***0.000*** |
| executive constraints | 0.026 | -0.001 | 0.010 | 0.045 | 0.088 |
| | 0.031 | 0.029 | 0.029 | 0.030 | 0.062 |
| | 0.409 | 0.981 | 0.737 | 0.135 | 0.151 |
| executive recruitment | -0.009 | -0.002 | 0.011 | -0.041 | -0.030 |
| | 0.043 | 0.039 | 0.042 | 0.046 | 0.092 |
| | 0.844 | 0.962 | 0.794 | 0.369 | 0.748 |
| participation | 0.034 | 0.061 | 0.088 | 0.078 | 0.277 |
| | 0.045 | 0.038 | 0.036 | 0.040 | 0.085 |
| | 0.446 | 0.109 | ***0.015*** | *0.050* | ***0.001*** |
| lnPOP | 0.079 | 0.027 | 0.078 | 0.108 | 0.166 |
| | 0.035 | 0.030 | 0.038 | 0.035 | 0.066 |
| | ***0.022*** | 0.372 | ***0.040*** | ***0.003*** | ***0.011*** |
| opec | 0.093 | | | | |
| | -2.640 | | | | |
| | *0.066* | | | | |
| lnCFCexport | | 0.003 | | | |
| | | 0.002 | | | |
| | | 0.152 | | | |
| lnCHEMexp | | | -0.067 | | |
| | | | 0.056 | | |
| | | | 0.228 | | |
| lnSPECIESpc | | | | 0.087 | |
| | | | | 0.028 | |
| | | | | ***0.002*** | |
| Combined p-value | | | | | |
| democracy variables | 0.3912 | 0.1578 | ***0.0019*** | ***0.0019*** | ***0.0000*** |
| Pseudo R-squared | 0.2796 | 0.2198 | 0.136 | 0.1491 | 0.1569 |
| # observations | 151 | 151 | 151 | 151 | 151 |

Table 6 (continued).

| | # env. IOs | Cites | Landprot. | NCSD | ESI |
|---|---|---|---|---|---|
| lnGDP | 3.026 | 7.377 | 0.882 | 0.075 | 2.436 |
| | 0.501 | 2.449 | 0.633 | 0.032 | 0.287 |
| | ***0.000*** | ***0.003*** | 0.165 | ***0.019*** | ***0.000*** |
| executive constraints | -0.072 | -0.039 | 0.406 | 0.026 | 0.491 |
| | 0.296 | 1.343 | 0.351 | 0.022 | 0.162 |
| | 0.809 | 0.977 | 0.249 | 0.232 | ***0.003*** |
| executive recruitment | 0.747 | 0.419 | 0.546 | -0.025 | 0.052 |
| | 0.355 | 2.261 | 0.511 | 0.033 | 0.222 |
| | ***0.038*** | 0.853 | 0.287 | 0.457 | 0.816 |
| participation | 0.421 | 5.951 | 0.234 | 0.048 | 0.381 |
| | 0.462 | 2.693 | 0.449 | 0.028 | 0.298 |
| | 0.364 | ***0.029*** | 0.603 | *0.089* | 0.204 |
| lnPOP | 1.971 | 7.393 | 0.047 | 0.079 | 1.690 |
| | 0.295 | 2.364 | 0.393 | 0.023 | 0.176 |
| | ***0.000*** | ***0.002*** | 0.905 | ***0.001*** | ***0.000*** |
| lnSPECIESpc | | 5.114 | | | |
| | | 2.335 | | | |
| | | ***0.031*** | | | |
| population density | | | -0.008 | | |
| | | | 0.004 | | |
| | | | ***0.037*** | | |
| constant | -47.292 | -87.874 | -3.650 | | 2.561 |
| | 5.997 | 33.937 | 7.718 | | 3.700 |
| | ***0.000*** | ***0.011*** | 0.637 | | 0.490 |
| Combined p-value | | | | | |
| democracy variables | *0.058* | 0.1181 | 0.1629 | ***0.0114*** | ***0.0007*** |
| R-squared | 0.527 | 0.3404 | 0.1021 | | 0.6846 |
| Pseudo R-squared | | | | 0.2246 | |
| # observations | 120 | 114 | 139 | 151 | 121 |

Figure 1. The effects of income and democracy on land protection.