

Political Regimes, Democratic Institutions and Environmental Sustainability: A Cross-national analysis

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Introduction

During the 1990s environmental economists, sociologists, and political scientists, started to pay attention to the impact of politics on environmental performance. The first results indicated that democratic forms of government improved environmental quality (Congleton, 1992). Subsequent work, largely confirmed this view, but with some exceptions (Midlarsky 1998, Barrett and Graddy 2000). This work is part of a large and growing interest in the effects of political institutions on economic outcomes and human well-being.

Previous studies relating political regimes and environmental outcomes are subject to two broad criticisms. First, they do an inadequate job of conceptualizing and measuring “environmental policy performance.” Almost all existing studies focus on only one or two specific environmental problem—e.g., sulfur dioxide emissions, deforestation, lead content of gasoline—or they fail to evaluate performance on multiple indicators jointly. Second, most of these studies contain some basic methodological flaws that impugn their empirical results.

This paper provides advances on both of these fronts. First, we provide a systematic evaluation of the studies addressing the relationship between democracy and national performance measures. We critically evaluate previous work and use eight indicators of three different aspects of environmental performance that should provide a

more accurate indication of national environmental performance. Second, our evaluation of the theoretical literature leads us to propose that scholars take into account recent democratic *history* not contemporaneous democratic institutions when evaluating national performance. Third, we evaluate the statistical robustness of previous findings and their substantive significance. Finally, we go beyond the current attention to the effect of regime on the level of one or two pollutants at a time to evaluate whether democracies actually deliver *improvements over time* on multiple indicators *simultaneously*. Our results, to summarize briefly raise doubts about the environmental efficacy of democracy. What evidence we do find to support a positive democratic effect on environmental performance is most likely explained by the economic collapse of the Eastern bloc, not political liberalization there or abroad.

Democracy and environmental quality: the argument and evidence

When Grossman and Krueger (1995) established that the relationship between per capita income and environmental degradation was an inverted U (the so-called Environmental Kuznets Curve), they asserted that the link between income and environmental quality would not be automatic, but would operate via public policy responses that were ultimately induced by popular support for greater environmental quality. Since then, an emerging literature on environmental economics and environmental politics has started to pay attention to the political factors of environmental performance.

Grossman and Krueger's argument is that it assumes that rising demand for environmental protection is automatically supplied. However, there are host of collective action and market failure dilemmas that characterize environmental pollution problems.

One is incomplete and imperfect markets in pollutants. A second is incomplete information about the causes and effects of problem. A third problem is that a socially efficient response requires the selection of a *public* policy by a political actor. This last, in particular, is the entrée for investigation of the effects of different political regimes.

Why Democracy?

One reason for believing that democracy is conducive to better environmental outcomes is that it facilitates the expression of demands for environmental protection. The free flow of information that typically characterizes democracy (*vis-à-vis* autocracy) allows policy learning (Barret and Graddy, 2000, Midlarsky, 1998). Another theoretical argument why democracy positively affects environmental quality is the claim that autocracies provide fewer public consumption goods relative to democracies (Congleton, 1992; Deacon, 1999). While governments of all types must provide public goods, governments tend to do so balancing the costs and benefits that are *politically* relevant. In democracy, the controlling group is the entire citizenry and the relevant balancing equates marginal cost and marginal benefit to the median citizen. If political control is vested in small, rich elite, i.e., an autocracy, then the policies adopted will reflect a balancing of costs and benefits to this elite group. Because control of resources is concentrated, the elite group can be expected to bear a disproportionately large ratio of public goods costs to benefits. This implies that autocracies will tend to support fewer environmental protection goods. Even if environmental protection benefits are normal or superior goods, as a society grows richer, the elite are likely to enjoy only a small fraction of economy-wide benefits (Deacon, 2003: 12). It is worth noting that this relationship is not really iron-clad. If, for

example, environmental protection is a normal good, for example, it is plausible that a society with an autocratic elite would provide an (socially) *excessive* amount of environmental goods relative to what would be provided if taxes were used for some other activity, or if taxes were lower.¹

A third argument sometimes advanced for democracy is the regime's time horizon. Several authors have argued that authoritarian regimes have a time horizon that is shorter than a democratic regime, and thus care less about the longer-term effective of lax environmental standards (Congleton, 1992: 417; Deacon, 1999:10-12). Theoretically, however, this view is not terribly persuasive. The assumption is that autocratic regimes are less stable, but little evidence is offered to suggest that. The probability that a democratic government falls does not seem obviously lower than the probability that an autocratic one falls. (The cost of losing power – i.e., summary execution versus quiet retirement-- may be a greater risk in non-democracies, however.)

Empirically, a number of papers report an empirical association between democracy and better environmental indicators of atmospheric and water pollution (Congleton, 1992; Murdoch et al., 1997; Torras and Boyce, 1998; Barret and Graddy 2000; Carlsson and Ludstrom, 2003; Li and Reuveny, 2006); conservation (Neumayer, 2002, Gates et al., 2003); deforestation (Ehrhardt-Martinez, 2002; Li and Reuveny, 2006); soil degradation (Li and Reuveny, 2006); and participation on environmental international agreements (Congleton, 1992; Neumayer, 2002; Gates, et al., 2003). While some existing papers assess environmental policy commitments, such as country's

¹ It is not necessarily true that elites would be indifferent between public and private provision if environmental protection was a superior good. That is because protection still has public good characteristics. Without the autocratic government as a coordinating mechanism, voluntary provision might not be forthcoming.

participation on international environmental treaties, others aim to assess the direct impact of the pollutants over the environment.

In this paper, we understand performance via the assessment of measured results of a number of common environmental problems. This way environmental performance refers to the results of human responses to human-induced environmental pollution problems (Scruggs, 1999: 11). We use the terms environmental performance and environmental outcomes in the paper as interchangeable terms since both denote the same orientation toward actual and measurable environmental quality.²

A critique of existing studies

The literature on political determinants of environmental performance contains two shortcomings. First, since 1990, more than thirty studies that we located have used different environmental indicators to assess whether political factors contribute to better environmental performance (See appendix 1). These indicators include: *carbon monoxide* (Neumayer, 2003); *smoke* (Torras and Boyce, 1998; Barret and Graddy, 2000; Binder and Neumayer, 2005); *heavy particles* (Torras and Boyce, 1998; Barret and Graddy, 2000; Binder and Neumayer, 2005; Esty and Porter, 2005); *Chlorofluorocarbon (CFCs)* (Congleton, 1992; Murdoch and Sandler, 1997; Murdoch et al., 1997); *sulfur dioxide* (Murdoch and Sandler, 1997; Murdoch et al., 1997; Torras and Boyce, 1998; Barret and Graddy, 2000; Neumayer, 2003; Binder and Neumayer, 2005; Esty and Porter 2005); *greenhouse gas (GHG) emissions* (Murdoch and Sandler, 1997; Midlarsky, 1998; Congleton, 1992; Carlsson and Lundstrom, 2003; Neumayer, 2003; Jorgenson, 2006; Li

² An example of environmental outcomes versus symbolic commitment would be the actual levels (or the reduction) of carbon dioxide emission in a given country in contrast with the signature of the Kyoto protocol (Buttel 2000; Fisher and Freudenberg 2004: 161).

and Reuveny, 2006); *biological and chemical oxygen concentration in water* (Barret and Graddy, 2000; Li and Reuveny, 2006); *fecal concentration in water* (Torras and Boyce, 1998; Barret and Graddy, 2000); *lead content of gasoline* (Decon, 1999; Fredrikson et al., 2005); *deforestation* (Midlarsky, 1998; Ehrhardt-Martinez et al., 2002; Li and Reuveny, 2006; Shandra, 2007); *soil erosion* (Midlarsky, 1998); and *land protected from development* (Midlarsky, 1998; Neumayer, 2002; Gates, et al., 2003).

Somewhat more recently, we have seen the development of multi-dimensional indicators of environmental protection. The *Environmental Sustainability Index* (ESI) relies on more than 20 “elements of environmental sustainability” (e.g., Esty and Porter, 2005; Li and Reuveny, 2006; Fredricksson and Wollscheid, 2007), while the *Ecological Footprint Index* (EF) (e.g., York et al., 2003) relies on bio-physical measures of sustainability (Wackernagel et al., 1999).

A pervasive problem in comparing regime performance internationally is the “information gap” (Srebotnjak, 2007: 409). The amount of environmental data available is much greater in developed countries, and this produces some potential selection bias issues in the empirical literature. Perhaps for this reason, most of the previous articles using larger samples rely on one or two indicators of environmental performance³. Two exceptions are Midlarsky (1998) and Li and Reuveny’s (2006). Both studies use larger samples and a group of environmental indicators representing different aspects of environmental quality. Midlarsky (1998) finds no evidence of democracies improving soil erosion by chemicals, and freshwater availability, and even negative effects of democracies over CO₂, deforestation, and soil erosion by water. The study only finds a

³ We are not taking account of a couple of studies that use larger samples but address international environmental *commitments* and not indicators of environmental performance as dependent variable such as Neumayer (2002), Gates, et al. (2003), and Roberts (2004).

positive effect of democracy on protected land. Li and Reuveny (2006), in turn, find a positive effect of democracies in reducing CO₂, Nitrogen oxides emissions and the level of organic pollution in water, and also a positive effect of democratic regimes in falling the rates of deforestation and the share of severely and very severely degraded land. Li and Reuveny also find a positive effect of democracy over the percentage of forested area. These mixed findings, especially in studies that use large samples and address diverse aspects of environmental quality, fail to establish that democracies *are simultaneously making progress on multiple* dimensions of environmental quality.

Our paper evaluates whether democratic regimes are associated with *changes* in eight indicators of environmental performance between 1990 and 2000. The eight indicators selected are: Carbon Monoxide (CO), Biochemical Oxygen Demand (BOD), Sulfur Dioxide (SO₂), Nitrogen Oxides (NO), Carbon Dioxide (CO₂), Methane (CH₄), Protected Areas, and Forest Area. We selected these indicators based on availability, and because they seem to be representative of three different aspects of environmental quality: land, water, and air.⁴ CO and BOD are representatives of environmental issues localized in which public health of human communities are at stake. CO₂ and methane emission represent two greenhouse gasses that impact the global commons. Finally, protected areas and forest areas are two representative indicators of land conservation. Though not an exhaustive set of measures of overall environmental quality, they do reflect a diverse set of environmental conditions on the following dimensions:

⁴ For example, Murdoch and Sandler (1997: 297) showed that environmental pollutants may face different strategic behavior. European countries had different environmental performance in reducing sulfur and nitrogen oxides during the 1980s due mostly to the different character of collective problem associated to each pollutant.

1. National/Local Pollution Following Barret and Graddy's (2000) reasoning, democracies, which are more attentive to popular demand, should contribute to better environmental performance on pollution a) where concerns are high, and b) where pollutants directly affect the population. The existing literature is not conclusive regarding the effect of democratic institutions on air and water pollution. Barret and Graddy (2000) found that for number of air and water pollutants political freedom affects positively environmental quality. However, Torras and Boyce (1998), in a sample of between 19 and 52 countries (varying depending of the pollutant), find that democracies in low-income countries have a more positive effect over smoke, heavy particles and dissolved oxygen, a water pollution indicators. The study, using political and civil rights as measurement of democracy only, finds such positive effect on smoke in high-income countries. In the same vein, Binder and Neumayer (2005) in a sample of about 17 to 35 countries concur with Torras and Boyce (1998) in finding weak evidence that a greater extent of democracy is associated with lower pollutant levels such as sulfur dioxide, smoke and heavy particles. Finally, Li and Reuveny (2006) using a larger sample of about 102 to 142 countries find that the effect of democracy on air and water pollutants is sensitive to the measurement for democracy. While the levels of NO and BOD become less threatening for human health when democracy is measured by a continue scale, the some indicators do not appear associated with democracy when it is converted to a dichotomous variable.

2. Global Hazards A second aspect of environmental quality is global hazards, such as greenhouse emission and CFCs. Here no direct population bears a disproportionate environmental hazard. Neumayer (2002: 144) suggests that while some

environmental problems directly affecting the health of a country's population are likely to improve with democracy, pollutants that can be externalized upon the future and/or people outside a country's boundaries are likely to worsen. Esty and Porter (2005: 407) argue that when harms have a significant transboundary dimensions, they constitute "super externalities," and often prove difficult to address. In contrast with environmental pollutants that affect directly the health of population, the international scientific community and national state were still debating the very existence of global warming into the 1990s.

While these accounts suggest that global commons problems might be hard for everyone to regulate, it is important to note that these problems may still generate action even if it is "non-rational." Indeed, the logic of collective action suggests that individual support for, and compliance with, national environmental regulations may be just as non-rational.

Midlarsky (1998) and Carlsson and Lundstrm (2003) find that democracies do not have a positive effect on reduced levels of emission of carbon dioxide. However, Li and Reuveny (2006) do find an effect. Regarding other greenhouse gasses such as methane, studies also present mixed results. While Congleton (1992) show that democracies have lower levels of methane emissions, Jorgenson (2006) do not find association between democratic competition and popular participation and methane emissions.

3. Nature Conservation A third level of analysis involves environmental conservation. The value that societies give to protect the environment is based not only on concerns about the human health but also on an increasing appreciation of protecting

the environment as a value itself. Among the issues that reflect this trend are the loss of endangered species and rainforest and jungles. Cross national surveys show that individuals tend to appreciate environmental conservation (Inglehart 1995, Bloom 1995, Israel 2004, Inglehart and Wwelzer 2005). Because democracies are more sensitive to the global discourse toward environmental protection since in these regimes ideas flow more freely, democracies would have a stronger commitment with environmental conservation. Therefore, we might expect that democracies will produce more nature conservation. In the case of rates of deforestation, the cross-national studies are once again inconclusive. While Midlasky (1998) in a sample of between 74 and 100 countries finds that democracies have poorer environmental performance, Ehrhardt-Martinez (2002) in a sample of less developed countries covering between 54 and 74 countries shows that democracies only accompanied with strong state capacity do improve forestation. Shandra (2007) does not find any correlation between democracy and rates of deforestation, but he finds that the greater presence International NGOs is correlated with lower rates of deforestation in non-core countries. For protected areas Neumayer (2002) using a large sample of more that 150 countries finds that democracy is correlated with land area under protected status

Preliminary results: unconditional effects of political freedom on environmental performance

As we noted in the introduction, an important limitation of existing empirical work on the effects of democracy on environmental quality is the fact that almost all previous work fails to address the question of whether democracies really are (or have been) any more

effective than non-democracies at addressing environmental problems over time.

Existing results are based on regression coefficients predicting the *level* of pollution based on deviations from an observed, conditional mean. Li and Reuveny (2006), for example, present estimated effects of democracy which suggest that CO₂ emissions per capita are noticeably lower in democracies. Yet mean emissions per capita are in reality twice as high in democracies (7.5 versus 3.5 in 2000), *and the difference has grown larger over time*. (They were 6.0 versus 4.8 in 1990.)

Taking the kinds of “conditional effects” that multiple regression does can ignore larger question of interest to environmental policy makers, e.g., is democracy’s effect robust . A perfect example of how “conditioning” can make a mockery of progress is to the official US climate change policy. The stated policy is to reduce the amount of greenhouse gas emissions intensity (i.e., emissions *per unit of GDP*) by 18% between 2002 and 2012. But that only requires that economic growth rise *faster* than emissions. By this calculation, emissions can rise to infinity as long as GDP reaches infinity first.⁵ By the intensity measure, this US intensity reduces intensity by *les than* it fell in the preceding fifty years. Indeed, based on this conditional goal, the United States has been aggressively reducing its GHG problem since before it even became a problem, as have the Chinese, since their GHG intensity is about 25% of what it was in 1970.

For Li and Rueveny and others, their predictions are, in fact, extrapolations from “thinly populated” areas of the parameter space. There are not many poor stable democracies or rich, stable autocracies. Moreover, rich autocracies-- the UAE, Qatar, Kuwait, Bahrain, Saudi Arabia, and Singapore-- are dominated by petro-states. It seems

⁵ Technically, one can make the same argument about our study since we are looking at emissions per person. However, most expect and advocate that population stop growing. Virtually no one suggests the same of per capita income.

unlikely that if these countries became democracies, the public would rise up to demand large cuts in their per capita CO₂ emissions. In any case, the more pressing question to ask about the effectiveness of democratic government with respect to the environment is whether democracies are more likely to actually reduce emissions over time, not whether they increase emissions more slowly.

Do democracies exhibit better environmental performance?

Levels of environmental performance Perhaps the most intuitive first cut at the question of whether democracies enjoy better environmental performance is to ask whether democracy and environmental pollution measured at some time t are correlated. This is the typical approach in the existing literature.⁶ Yet it is also a poor empirical specification, because the causal mechanisms by which democracy is supposed to work are very unlikely to have instantaneous effects. Democracy works to bolster environmental protection is via free dissemination of new interests, mobilization of voters (or leaders) around those ideas, etc., all of which culminates in better environmental conditions. Even more formal public choice models, which posit that environmental protection is more strict when policy is responsive to a median voter with a below average stake in the economic status quo, assume that the “democracy effect” requires democratic institutions in equilibrium. For these reasons, we think the first cut at testing for an environmental effect of democracy should compare performance at time t

⁶ See, for example, Congleton 1992 and Fredriksson, et al 2005. Some works do more than cross-sectional analyses (e.g, Li and Reuveny 2006, Bernauer and Koubi 2004) specify the effect of democracy as (conditionally) simultaneous. Barret and Graddy (2000) defend a four-year moving average “to reflect the expected lag between changes in freedoms and changes in environmental quality.” Such a short lag we feel considerably misunderstands the history of the environmental policy processes in countries we are familiar with. A notable exception is Midlarsky (1998), who, like us, finds little evidence that democracies exhibit better performance.

with the recent democratic history of the country over decades. The implications of positing contemporaneous correlation between democracy and pollution levels are important. As we suggest later, this specification probably biases results in favor of finding a democratic effect.

The first column in Table 1 provides the bivariate correlation between seven of our eight environmental performance measures in 2000 against each country's average Freedom House ranking between 1972 and 2000. (Forested area is excluded because data on the level in 2000 was not available.) We rely on Freedom House's indices of Civil Liberties (CL) and Political Rights (PR), which have been used widely in the literature (Barret and Graddy, 2000). Since lower Freedom House scores indicate greater political freedom, a positive correlation coefficient suggests that democracies have better pollution performance, except for the variable Protected Area, where a positive correlation indicates better democratic performance. The second part of Table 1 shows mean values for democracies and non-democracies, where we have scored democracy 1 when the country's average Freedom House score in the 1972-2000 period is 6 or less.⁷ A list of each group is in Appendix 2.

⁷ Though the level of democracy necessary to be proclaimed free by the Freedom House is 4 in each given year, using this level for the average score would be more of a measure of "continuous" democracy rather than "average" democracy.

Table 1: Unconditional Effects for Environmental Performance Levels

	Correlation with Average FH 72-00	Democracies		Non Democracies	
		mean	variance	mean	variance
CO per capita	0.03	0.29	0.50	0.28	0.37
NOs per capita	-0.18	0.05	0.032	0.03	0.04
SO ₂ per capita	-0.14	0.04	0.039	0.03	0.04
CO ₂ per capita	-0.25	7.46	5.14	3.8	6.81
NO ₂ per capita	-0.21	1.22	1.87	0.57	0.61
CH ₄ per capita	-0.05	1.61	1.74	1.39	1.56
BOD concentration	0.08	287	500	292	960
Protected area (% of total area)	-0.28	0.21	0.212	0.12	0.13

The results provide no evidence that democracies have lower environmental impacts than non-democracies. All of the correlations are low. More importantly, most coefficients are in the wrong direction, suggesting that greater political freedom is associated with *more pollution*, and directly contradicting the large majority of existing results. The one piece of evidence of better performance consistent with the democratic boost is the Protected Area.

Improvement in environmental indicators The distribution of performance measures, i.e., per capita pollution levels across countries, shows the dependent variables are not non-normally distributed. There are, for all of the variables considered here, a small number of extreme values. Figure 1 shows the distribution of national per capita emissions of CO₂ in 2000, which is representative of the other variables.

Simple differencing fails to produce anything resembling normally distributed variables. However, the difference of the logged variables (i.e., $\ln(X_{2000}) - \ln(X_{1990})$) does result series that bear some semblance of normal distribution. (Protected Area and Forest Area are again exceptions.)

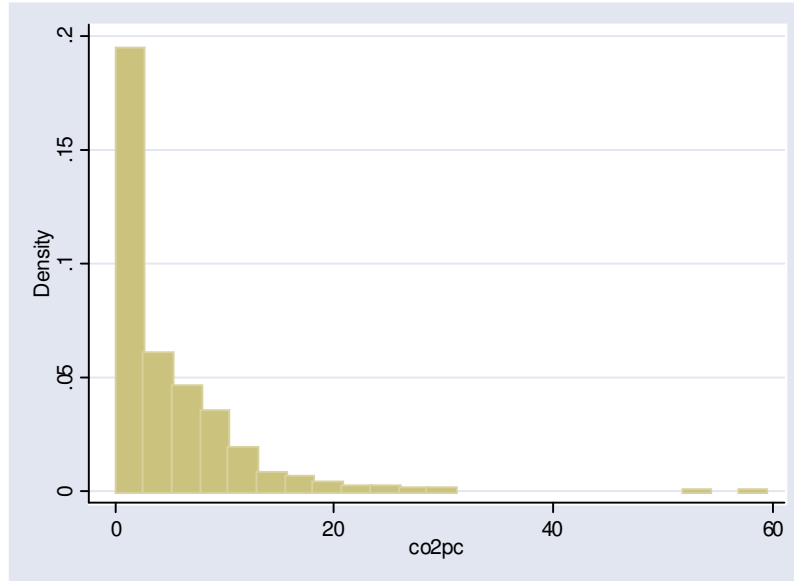


Figure 1: Histogram of the distribution of national CO2 emissions per capita

It is important to understand why this normal distribution is potentially important. While it is true that a normal distribution of a dependent variable is neither necessary nor sufficient for regression residuals to be normally distributed (they need only be normal conditional on the regressors), normality of the disturbances is required for the textbook confidence intervals of parameters estimates (i.e., the basis for computing p-values) to apply. There is not really any evidence to suggest that the independent variables in any published empirical models really “make up” for the kind of non-normality we see.

An additional advantage of using our transformation is that it allows us to test whether democracies were more likely *actually reduce* pollution in the 1990s (or expand their protected or forested areas). Looking at change is relevant because widespread environmental problems are comparatively recent political issues, and their importance is politically (and sometimes scientifically) contested. Prior to their “political discovery,” democracies would presumably be no more likely to limit pollution than non-

democracies. In other words, we might expect to see differences in democracies and non-democracies in their *abatement* of pollution in recent years.

Table 2 displays the results of the analysis that was performed on per capita emissions using the difference in logs as the measure of environmental performance. In this part, we also included the percentage change in forested area as a variable. (It was not available in annual levels). Its expected correlation with democracy, like Protected Area, is negative. The results suggest largely negative evidence about the environmental performance of democracies vis-à-vis non-democracies. The correlation coefficients tend to suggest that, save for increased habitat protection (protected land and reforestation), more political freedom was associated with less environmental improvement in the 1990s.

Table 2: Unconditional Effects for Change in Environmental Performance (1990 to 2000)

	Correlation with Average FH 72-00	Democracies		Non Democracies	
		% with better performance	obs	% with better performance	obs
change in ln(CO per capita)	0.01	64.3	42	52.0	123
change in ln(N20 per capita)	-0.17	27.9	43	37.9	124
change in ln(SO2 per capita)	-0.04	46.5	43	45.2	124
change in ln(CO2 per capita)	-0.12	33.3	42	45.0	120
change in ln(NO2 per capita)	-0.11	70.0	40	75.6	119
change in ln(CH4 per capita)	-0.02	70.7	41	78.2	119
change in ln(BOD concentration)	-0.05	51.2	29	58.6	41
change in Protected Area Share	-0.16	100.0	43	99.0	119
change in Forested Area Share	-0.19	30.6	42	52.4	121

In the second part of Table 2, we show the percentage of countries (divided into democracies and non-democracies) that experienced improved performance between 1990 and 2000, no matter how large or small the improvement. Here we also find disappointing results. Only for CO emissions do we find potential evidence of superior

performance by democratic countries. And even this difference is not statistically significant.

Combined environmental performance As noted in the introduction, a shortcoming of existing research on democracy and environmental performance is the fact that performance in almost all studies tends to be measured by a single indicator at a time. Even if all of these results were consistent, which they are not, one cannot infer a joint effect. That is, even if democracies performed (no) better on average on many separate indicators, it would not necessarily mean that democracies perform (no) better on the combination. And that is what we would really like to know: do democracies actually do better on a *combination* of measures.

To find out, we simply counted the number of measures on which the country has moved in the right direction, no matter how large or small the change.⁸ Table 3 shows the frequency distribution of improvements for democratic and non-democratic countries. Performance 1 includes BOD, which is not available for most of the countries; Performance 2 excludes BOD, significantly increasing the number of cases classified. The results here suggest quite mixed results. While democracies were less likely to achieve “excellent performance”, measured as improvement in 6 of 8 (or 6 of 7); but they were slightly more likely to avoid “poor performance,” measured as improvement in three or fewer measures.

⁸ Perhaps the most conventional approach to combining scores is to sum standardized individual scores in some fashion. This is objectionable here for several reasons. First, there are still a number of very large outlying values in the individual series. This raises the prospect that a combined score is completely determined by one measure. Second, and more generally, this approach tends to overly reward (or punish) very good (very bad) performance on one measure. Since we are more interested in seeing “balanced” improvements.

Table 3: Frequency Distribution of Environmental Performance Improvements

Count of indicators for which scores improved 1990-2000	Democracies		Non-Democracies	
	Performance	Performance	Performance	Performance
	Score 1	Score 2 (excl BOD)	Score 1	Score 2 (excl BOD)
0	0	0	0	0
1	0	0	3	8
2	3	12	7	30
3	6	7	6	17
4	4	8	6	15
5	7	3	3	8
6	1	5	3	21
7	3	5	6	12
8	4	na	5	na
Total	28	40	39	111

A Preliminary Summary

It is important to recall several factors for understanding the effect of democracy on environmental performance in this section. First, the results here addressed the *unconditional* impact of democracy, something that has not really been done in previous studies. It is obviously important to evaluate the effects of democracy in a multivariate setting. Too often, however, analyses have tended to jump straight to estimating (often highly) conditional effects. These conditional effects can be so fine-grained that they are hardly form a basis for making any policy recommendations. Should we really advocate democracy as a general solution to environmental problems.

Second, this section operationalized democracy as the recent *history* of democracy and correlated it with more contemporary environmental performance measures, based on the argument that there are considerable lagged effects in most causal

explanations of how democracy affects environmental protection, effects which are not well accounted for in the existing literature.

Third, the results here focus more on “absolute” and “combined” improvements in environmental performance than previous literature (the most important caveat being that pollution measures are per capita reductions.) Fourth, our results suggest some reasons to think that previous empirical results are particularly reliable statistically, because national pollution data such like these tend to be plagued with a number of extreme values that might be unduly influencing estimates.

Democracy and the environment: multivariate analysis

Our review of the literature indicated a very long list of variables that have served as possible controls in our evaluation of the effects of democracy. Our greatest concern when trying to correctly estimate the impact of democracy, however, should be only with those controls that are correlated with *both* performance and democracy, yet which are themselves not an *outcomes* of democratic institutions. That is because factors that affect environmental performance, but are not empirically correlated with democracy, should not seriously affected our empirical estimates for democracy.⁹

First, in addition to our democracy measure (average Freedom House score between 1972 and 2000), we include the *real total growth rate* (not per capita) during the 1990-2000 period to see if faster total production growth, which previous research suggests is weakly correlated with, but not a result of, democracy, will undermine

⁹ Variables that are associated with environmental performance but unrelated to democratic institutions will improve our ability to predict performance more accurately (i.e., raising the R²), but only affect our estimate of the effect of democracy if these variables are correlated with democracy.

environmental performance (See Rodrik 2007).¹⁰ Second, we include *income per capita* under the assumption that more wealth leads to greater demands to reduce pollution (as well as probably a higher level of pollution). There is widespread acknowledgement that income per capita is correlated with democracy. Furthermore, while there is widespread controversy as to whether democracy is caused by, or independent of, economic development (Przeworski and Limongi 1997, Acemoglu, et al 2007), there is little to the argument that greater income is in fact caused by democracy. Data for income come from the World Bank.

We do not include an income-squared term (a la Grossman and Krueger) in the model because our dependent variable is the *number* of improvements in environmental performance measures. We expect this number to be strictly increasing in income: poor countries may increase pollution across the board resulting in improvements in few areas. Middle income countries will begin to start cutting some pollutants, so would be expected to have an intermediate number of good scores. Finally, rich countries should be improving on many or all measures.

Finally, and related to the second point, we include a measure of *economic liberalism*, because the institutions that facilitate economic output (e.g., property rights and rule of law) are distinct from the institutions of representative democracy (competitive elections and political equality), and may independently affect environmental performance (Barro 1997). The data for economic liberalism is taken from the average “Economic Freedom of the World Scores for 1980-2000 (Gwartney and Lawson 2007).

¹⁰ The growth rate is not correlated with gdp per capita or democracy, though the latter two are closely correlated

We acknowledge that environmental pollution typically violates the assumptions of efficient prices in the market. However, the measures of economic freedom used here capture the broad “market orientation” of the economy, and thus should serve to indicate the capability to use environmental resources more efficiently. Moreover, if economic liberalism is bad for the environment on balance, and democracies perform well in spite of generally having liberal economies, this control would only strengthen the conditional effect of democracy on performance.

As compliments to the economic growth measure explained above, we also include in our model indicators of the change in both political and economic freedom between the pre-1990s and the 1990s. This allows us to get some sense of whether it is the change in freedom may help to account for the change in performance. For political freedom we used the difference in the average annual Freedom House scores for between two periods: 1972-1989 and 1990 and 2000. A decrease of 4 points or more in the score was coded 1, a “political liberalization,” while all other differences were scored 0. For economic freedom, we used the difference in the (average) scores for 1980, 1985 and 1990 and for 1995 and 2000; a higher score implying greater economic liberalization. For this measure we simply used the absolute change in the score.

Estimating strategy and results

The reported estimates are based on OLS with Huber-White standard errors. Summary statistics for all variables are given in Appendix 3. In order to get a sense of how sensitive the estimates for democracy are, we show several different model specifications that include democracy.

The first set of results that we estimate is largely comparative purposes. It uses specification similar to the one in Li and Reuveny (2006), and are found in Table 4. (For these three results only, we operationalized democracy as the average level of political freedom *during the 1990s*, that is, measured simultaneous with performance.) The results suggest that a increasing political freedom is associated with a .06 to .08 *increase* in performance. However, this estimate is not statistically significant. The last column includes a dummy for the Eastern bloc countries. It foreshadows a claim that we develop later, namely that the breakup of the Communist bloc is what is essentially driving recent international statistical evidence of a “democracy effect.”

Table 4: Regression Results

	1	2	3	4
DV: Number of Improvements in Seven Environment Performance Measures				
Democracy Score (Average FH Score for 1990-00)	-0.080 [1.98]**	-0.063 [1.23]	-0.060 [1.15]	-0.016 [.41]
Income 1990		0.00003 [1.22]	0.00003 [1.11]	0.00007 [2.65]
Population			0.00000047 [1.14]	0.00000011 [.36]
Trade Openness			0.0033 [0.75]	-0.0007 [.22]
Former Eastern bloc (dummy)				3.13 [14.75]***
Constant	4.48 [13.27]***	4.16 [8.51]***	3.89 [6.26]***	3.37 [6.61]***
Observations	151	140	140	140
R-squared	0.03	0.05	0.06	0.47
Joint SK-Test for Normality of residuals chi-2 p-value	0.00	0.00	0.00	0.25

Robust t-statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Results in Table 5 (columns 1 and 2) show that once we allow that the causal effect of democracy relies on establishing long-term institutions for representation and political voice (Table 5, columns 1 and 2), the effect of democracy disappears. In these

and later estimates the coefficient is reversed, though these estimates are generally not statistically different from zero.¹¹

The next results, shown in columns 3-9 in Table 5, are based on our model. We include income, economic liberalism, democratic institutional history, as well as economic growth, transitions towards democracy, and economic liberalization. Because we are missing values for a large number of cases, we provide estimates with and without the economic liberalism variables. These results do little to support the idea that democracies have higher environmental performance, and might shed some light on why recent results have found this.

The income level of a country is correlated with better performance in all of the models presented. Going from the poorest to the richest country increases the predicted performance by about three (out of seven) indicators. On the other hand, a faster rate of growth is associated with considerably worse performance. The estimated effect of doubling the size of a countries real economy reduces performance by 2.5 indicators.

Perhaps a more appropriate way to understand the effect of the growth variable in the context of the collapse of Eastern Europe. There are twenty-four countries in our dataset whose overall economies in 2000 were smaller than they were a decade before; all but five were in the former Eastern bloc. Only six former Eastern bloc countries experienced an absolute economic expansion the 1990s: Albania, Czech Republic, Hungary, Poland, Slovakia, and Slovenia.

The effect of democratizing in this period is associated with an improvement in performance. Even controlling for income and growth, liberalizing politically in this

¹¹ We estimate a similar, but somewhat smaller, effect if we define historic democracy is treated as a binary variable, i.e., 1 if the average freedom House score over the entire period is less than 6, zero otherwise.

period was associated with improvements in an additional 1 or 2 indicators on average. *The democratization effect, however, also seems to be driven by the collapse of the Soviet Union.* If we include a regional dummy for countries that were part of the Soviet bloc (as shown in columns 10 and 12), the estimated democratization effect declines precipitously, and is not statistically different from zero. Moreover, if we estimate a dummy variable interaction model (not shown), interacting a dummy for the former eastern bloc countries and all other variable in the model, the estimated coefficient for democratization in the Eastern bloc countries (conditional on the other variables) is negative, but not statistically significant.¹²

Economic freedom appears to have little or no systematic effect on environmental performance. The estimated effect over average economic freedom is not robust. The reported estimates vary widely but are all negative, while other (unreported) results suggest insignificant positive effects. Likewise, the effect of liberalization of the economy also has no clear effect on performance. One limitation of these economic data is that they are not available for a number of countries, including most of the former Soviet Republics and former Yugoslavia, as well as many wealthy non-democracies like Saudi Arabia.

¹² The mean performance score for Eastern bloc countries that were full democracies in 2000 (e.g., the Czech Republic and Bulgaria) was identical to the mean performance score in both a) countries that liberalized politically in the 1990s but were not full democracies by 2000 (e.g., Armenia and Russia) , and b) Eastern bloc countries that did not liberalize politically during the 1990s (e.g., Azerbaijan and Uzbekistan).

Table 5: Regression Results

	1	2	3	4	5	6	7	8	9	
		DV: Number of Improvements in Seven Environment Performance Measures								
Democracy Score	0.011	0.147	0.060	0.069	0.031	0.031	0.020	0.048	0.011	
Average FH score 1972-2000	[0.25]	[2.53]**	[1.09]	[0.98]	[0.48]	[0.48]	[0.31]	[0.87]	[0.22]	
Income 1990		0.0001	0.000074	0.00013	0.00011	0.00011	0.0001	0.00009	0.00008	
Political Liberalization in 1990s (dummy)		[3.10]**	[2.56]**	[4.30]**	[3.67]**	[3.67]**	[3.40]**	[3.79]**	[3.62]**	
Total Economic Expansion (1990-2000)			-2.56		1.48	1.48	0.27	1.24	0.20	
Economic Freedom Score (1980-2000)			[6.63]**	-0.433	[3.79]**	[3.79]**	[0.49]	[3.83]**	[0.63]	
Economic Liberalization Score				[1.76]*	-1.79	-1.79	-1.20	-2.19	-1.14	
Former Eastern bloc (dummy)					[3.03]**	[3.03]**	[2.32]**	[5.46]**	[2.91]**	
Constant	3.79	2.15	3.77	4.91	3.38	3.38	2.12	3.43	2.30	
Observations	[9.85]**	[3.87]**	[6.33]**	[2.92]**	[2.27]**	[2.27]**	[3.22]**	[6.14]**	[5.48]**	
R-squared	151	140	139	111	110	110	3.03	138	3.24	
Joint SKTest for Normality of residuals chi-2 p-value	0	0.09	0.33	0.16	0.44	0.44	0.49	0.43	0.52	
Robust t-statistics in brackets	0.00	0.00	0.47	0.10	0.31	0.31	0.42	0.34	0.22	

* significant at 10%, ** significant at 5%; *** significant at 1%

Conclusion

Over the years, there have been a surprisingly large number of studies that have examined, in one way or another, the effect of democratic institutions on measures of environmental pollution. However, most of these studies have not done a very good job of evaluating the evidence in light of prevailing explanations. Our results, which we think correct a number of outstanding specification and conceptual problems, indicate that there is not much evidence to support the impact of democracy on overall national environmental performance. Whether one examines individual indicators of environmental progress, or a conglomeration of them, we find almost no evidence to suggest that democratic countries, particularly the long-established democracies that the theoretical literature suggests are most likely to perform better, do, in fact, perform better. These “non-results” hold for both unconditional and conditional (i.e., controlling for other factors) performance.

The more sanguine view in some of the past research can be traced to several problems. First, previous cross-national work may have ignored outliers and distributional anomalies in their pollution variables that undermine conventional tests of parameter significance. Second, most previous estimates have looked at the comparative performance of democracies vis-à-vis non-democracies, not at progress in *reducing* environmental stresses. While relative performance matters, actual abatement is typically the goal. Third, previous work has often estimated the effects of democracy as if they were simultaneous, which seems highly implausible. Actual explanations of the way that

democracy works hinge on the idea that democratic institutions are the long-standing rules of the game, while empirical research has treated differently. Fourth, and intimately tied to the previous point, recent research has given democracy most of the credit, whether implicitly or explicitly, for the environmental improvements in Eastern Europe following the collapse of the Soviet Union. While a number of post-Communist countries became democracies, it is hard to sustain the argument that this coincidence was primarily the result of popular demands for environmental protection. Among other things, these countries experienced contemporaneous economic liberalization and restructuring brought on by the creation of market economies that were as much or more responsible for those changes. Once we try to control for the unique features of this geopolitical anomaly, we cannot sustain the claim that democracy, or democratization improvements environmental performance.

Of course, these results should not be taken to suggest that democracy is *incompatible* with good environmental performance. The evidence that we have does not seem to support the old, “neo-Malthusian” line that a “new Leviathan is the solution for environmental scarcity (Ophuls 1976, Heilbroner 1974).

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Appendix 1 Selected list of recent studies on democracy and environmental performance

This list contains information on about many of the statistical studies we have identified that evaluate the relationship between democracy and environmental performance.

The information only reports on the column “significance” the statistical relations between democracy and the dependent variables. The column “sample and period” does not includes the period or the specific year years for each variable. Since most of studies use data coming from different data-point we only indicates the temporal reference of the data. The Column (“explanatory variable’ include both the main political variables employed by the authors. Needless to say that he variable “democracy” has been measured in different ways; it has been measured as continuous variable using ether Freedom House and POLITY IV indexes, as well as dummy variable. We do not report here those model’s specifications.

Author	Sample and period	Explanatory variables	Dependent variables	Significance
Congleton (1992)	118 countries	Political factors: - Democracy Other variables: - Capitalist country - Reserves of oil - Reserves of gas - Area - GNP per capita	- Signature of Vienna and Montreal Protocol on CFC emissions - Methane - CFC	+ + +
Murdoch and Sandler (1997)	61 countries; data from 1986 and 1989	Political factors: - Democracy Other variables: - GNP - Population - Geographical location	Change on CFC emissions	+
Murdoch, Sandler and Sargent (1997)	25 European countries; data from 1985, 1987, 1990 and 1992	Political factors: - Democracy Other variables: - GNP - Forest - Population	- Reduction sulfur - Reduction of NO2	+ -
Midlarsky (1998)	74 to 100 countries, data from 1990	Political factors: - Democracy Other variables: - GDP - Population - Agriculture density - Precipitation - Domestic violence - Region (European location)	- Deforestation - CO2 - Soil Erosion by water - Protected land areas - Freshwater availability - Soil erosion by chemicals	- - - + NSS NSS

Torras and Boyce (1998)	18 to 58 countries; data from 1977 to 1991	Political factors: - Democracy Other variables: - Income - Coastal - Central city - Industrial - Residential - Year - Water temperature - Gini coefficient - Literacy - Urbanization	- SO - Smoke - Heavy particles - Disolved Oxygen - Fecal coliform - Population with access to safe water - Population with access to sanitation	+(*) + +(*) + - (*) + NSS NSS NSS
Deacon (1999)	48 countries; data from 1972 to 1992	Political factors: - Democracy Other variables: - Year - urbanization	- Sanitation - Safe drinking water - Lead content of gasoline	+ + -
Barret and Gradoy (2000)	22 to 73 countries during 1977 and 1990 depending in the indicator	Political factors: - Civil Freedom - Political Freedom - Green - Left wing party strength Other variables: - Income - Coast - Central city - Industrial - Residential - Population density - Year	- SO2 - Smoke - Heavy particles - Disolved Oxygen - Biological oxygen demand - Chemical 0oxygen demand - Nitrates - Fecal coliform - Total Coliform - Lead - Cadmium - Arsenic - Mercury - Nickel	+ + + NSS NSS NSS +(*) + - NSS NSS + NSS NSS
Neumayer (2002)	100 to 175, around 2000	Political factors: - Democracy	- The signing and ratification of multilateral environmental agreements (4 MEAs)	+
Gates, Gleditsch and Neumayer (2003)		Other variables: - GDP - Population	- The membership in environmental intergovernmental organizations - The extent to which reporting requirements for the CITIES are met - Percentage of country's land area under protection status - The existence of national	+ + + +

council on sustainable development in a country
 - The ability of environmentally relevant information concerning a country +

Ehrhardt-Martinez, Crenshaw and Jenkins 2002	54 to 14 less developed countries; data from 1980 to 1995	Political factors: - Democracy Other variables: - GDP - Urbanization - Population - Migration urban/rural - Labor in services - Secondary education - Protected areas - Government scope - Change in debt 1980-1990 - Forest export - Imports/exports 1980/1990 - Semi periphery	- Deforestation	+(*)
Carlsson and Lundstrom (2003)	75 countries; data from 1975 to 1995	Political factors: - Democracy Other variables: - GDP - GDP growth - Structure and use of market - Foreign trade - Price stability and legal security - Industrial share	- CO2	NSS
Neumayer (2003)	21 OECD; data from 1980, 1990 and 1999	Political factors: - Green - Left wing party strength Other variables: - GDP - Vehicles - GDP composition (manufacture) - Fossil fuel efficiency - GDP/ unit of energy	- SO2 - NO2 - Volatile Organic Compound CO - CO2	+ + + + +(*)
Shandra, John, London,	68 developing countries around	Political factors: - Democracy	Levels of CO2	NSS

Bruce, Whooley, Owen, and John Williamson (2004)	1980	<ul style="list-style-type: none"> - International NNGOs <p>Other variables:</p> <ul style="list-style-type: none"> - GDP - Rural population - Urban population - Geographical location - Level o commodity concentration - Level of Multinational concentration presence - Level of International Monetary Fund conditionality 		
Roberts et al (2004)	192 countries on 1999	<p>Political factors:</p> <ul style="list-style-type: none"> - Internal political institutions (Kauffman et al (2000)'s index of voice and accountability). - Social civil pressure (NGO's) <p>Other variables:</p> <ul style="list-style-type: none"> - Export diversification index - National capital index 	<ul style="list-style-type: none"> - Participation on 22 international environmental treaties 	+
Binder and Neumayer (2005)	17 to 35 countries; data from 1977 and 1988	<p>Political factors:</p> <ul style="list-style-type: none"> - ENGOs' strength - Democracy (Policy IV) <p>Other variables:</p> <ul style="list-style-type: none"> - Business lobby - Income - Inequality (Gini coefficient) - Literacy 	<ul style="list-style-type: none"> - S O2 - Smoke - Heavy particles 	<ul style="list-style-type: none"> +(*) +(*) +(*)
Fredriksson, Neumayer, Damania and Gates (2005)	104 countries; data from 1993, 1996 and 2000	<p>Political factors:</p> <ul style="list-style-type: none"> - Environmental lobby - Democratic participation - Democratic competition <p>Other variables:</p> <ul style="list-style-type: none"> - GDP - vehicles per capita 	<ul style="list-style-type: none"> - Lead content on gasoline 	+(*)
Esty and Porter (2005)	42 to 71 around 2000	<p>Political factors:</p> <ul style="list-style-type: none"> - Civil and political rights <p>Other variables:</p> <ul style="list-style-type: none"> - Environmental regulatory 	<ul style="list-style-type: none"> - Urban particulate concentrations - SO2 - Energy efficiency 	<ul style="list-style-type: none"> + + +

regime
 - Stringency of standards
 - Regulatory structure
 - Subsidies
 - Information
 - Regulatory enforcement
 - Environmental institutions
 - Administrative structure
 - Scientific and technical infrastructure

Li and Reuveny (2006)	105 to 142 countries; data from 1961 to 2000	Political factors: - Democracy Other variables: - GDP - Trade openness - Population density - Military conflicts	- CO2 - NO2 - BOD - Deforestation (rate of) - Forestation - Land degradation	+(*) +(*) +(*) + + +
Jorgenson (2006)	41 to 68 ; data from 1995	Political factors: - Democracy Other variables: - State environmentalism - GDP - Urbanization - GDP composition - Export intensity - Cereal production - Beef production - Oil and natural gas energy production - Biomass energy production - Foreign direct investment	- Methane emissions	NSS
Fredriksson and Wollscheid (2007)	163 countries during the 1990s	Political factors - Freedom Huose - Parliamentary-presidential - Majoritarian-proportional - Investiture voting Other variables: - GDP - Trade openness - Demographic composition - Population - Independence - Region	- ESI - Environmental governance - Institutional capacity - Global stewardship - International participation - Greenhouse gases - Prices of super and diesel gasoline	+(*) + + +(*) +(*) +(*) +(*) +(*)
Shandra, John (2007)	Between 50 and 83 countries;	Political factors: - Democracy	- Forest area from the period 1990-2000	NSS

data from 1990 - International NGOs
organizations
- Inter-governmental
organizations

Other variables:

- GDP
- Economic growth
- Government expenditures
- Domestic Investment
- Population Growth
- Total forest stock
- Environmental treaty
ratification
- Total Exports
- Export-partner concentration
- Commodity concentration
- Foreign investment
- International Monetary
Found conditionality

(+) Denotes positive (in a qualitative sense, that means improving the environmental indicator) and statistically significant relationship between democracy and the specific dependent variable

(-) Denotes negative (in a qualitative sense, that means worsening the environmental indicator) and statistically significant relationship between democracy and the specific dependent variable

(NSS) Denotes no statistically significance

(*) Statistically significant depending on the models specification

Appendix 2: List Democratic and Non-Democratic Countries (FH Scores 1972-2000)

Democracies

American Samoa
 Andorra
 Antigua
 Argentina
 Australia
 Austria
 Bahamas
 Barbados
 Belgium
 Belize
 Botswana
 Canada
 Colombia
 Costa Rica
 Cyprus
 Denmark
 Dominica
 Dominican Rep.
 Fiji
 Finland
 France
 Greece
 Iceland
 India
 Ireland
 Israel
 Italy
 Jamaica
 Japan
 Luxemburg
 Malta
 Netherlands
 New Zealand
 Norway
 Papua New Guinea
 Portugal
 Spain
 Sweden
 Switzerland
 Trinidad & Tobago
 United Kingdom
 United States
 Venezuela

Non-Democracies

Afghanistan
 Albania
 Algeria
 Angola
 Armenia
 Azerbaujan
 Bahrain
 Bangladesh
 Belarus
 Benin
 Bhutan
 Bolivia
 Bosnia
 Brazil
 Brunei
 Bulgaria
 Burkina Faso
 Burundi
 Central African
 Rep
 Cambodia
 Cameron
 Cape Verde
 Chad
 Chile
 China
 Comoros
 Congo
 Congo, Dem Rep.
 Cote d'Ivoire
 Croatia
 Cuba
 Czech Rep.
 Djibouti
 Ecuador
 Egypt
 El Salvador
 Equatorial Guinea
 Eritrea
 Estonia
 Ethiopia
 French Guiana
 Gabon
 Gambia
 Georgia
 Germany
 Ghana
 Guatemala
 Guinea

Guyana
 Haiti
 Honduras
 Hungary
 Indonesia
 Iran
 Iraq
 Jordan
 Kazakhstan
 Kenya
 Kuwait
 Kyrgyzstan
 Laos
 Latvia
 Lebanon
 Liberia
 Libya
 Lithuania
 Macedonia
 Madagascar
 Malawi
 Malaysia
 Mali
 Mauritania
 Mexico
 Moldova
 Mongolia
 Morocco
 Mozambique
 Myanmar
 North Korea
 Namibia
 Nepal
 Nicaragua
 Niger
 Nigeria
 Oman
 Pakistan
 Panama
 Paraguay
 Peru
 Philippines
 Poland
 Qatar
 Romania
 Russia
 Rwanda
 South Africa
 South Korea
 Saudi Arabia
 Senegal
 Sierra Leone

Singapore
 Slovakia
 Slovenia
 Somalia
 SriLanka
 Sudan
 Syria
 Taiwan
 Tajikistan
 Tanzania
 Thailand
 Togo
 Tunisia
 Turkey
 Turkmenistan
 United Arab
 Emirates
 Uganda
 Ukraine
 Uruguay
 Uzbekistan
 Viet Nam
 Yemen
 Zambia
 Zimbabwe

Appendix 3: Summary Statistics for Regression Variables

	Obs	Mean	SD	Min	Max
Environmental Improvements (Performance 2)	152	3.9	1.89	1	7
Income per capita 1990	149	5198	7773	121.9	33434
Real Economic Expansion (1990-2000)	148	0.315	0.367	-0.66	1.68
Democracy Score*	167	8.6	3.6	2	14
Political Liberalization (dummy)	167	0.216	0.41	0	1
Economic Freedom (1980-2000)	121	5.77	1.08	3.48	8.48
Economic Liberalization	121	0.792	0.725	-1	2.8

* --Average Freedom House Score (1972-2000)