Received March 31, 2014

Revised May 19, 2014

Accepted May 27, 2014

Environmental Policy Performance and Political Development: Do Democracies Outperform Authoritarian Regimes?

DAVID S. KELLEHER* AND GEUM-SOO KIM**

The pursuit of sustainable development initially centered on understanding how economic development and environmental quality are related. More recently, many have focused on how political development and environmental quality are related. Researchers have examined a variety of environmental problems using a variety of political measures. While there is support for the idea that democracies outperform more authoritarian regimes on various environmental issues, the results are somewhat mixed and ambiguous, not least because the individual studies lack comparability and generalizability. To take stock and address this problem we use a comprehensive dataset of environmental performance outcomes and political variables to systematically address whether democracies do indeed outperform authoritarian regimes across a range of environmental issues. Our results suggest that for environmental issues that are tied to human health, two governance indicators, “voice and accountability” and “control of corruption,” explain international variation in environmental health indicators independently of per capita income, which is also statistically significant. Turning to measures of ecosystem vitality, unlike environmental health indicators, ecosystem measures bear more disparate relations to economic and political measures. Thus, while support for “democratic environmentalism” may only be partial, support for “authoritarian environmentalism” is non-existent.

Keywords: Environmental Policy, Political Development,
Democracy, Corruption, Environmental
Performance Index (EPI)

* Professor, Hoseo University; E-mail: kelleher@hoseo.edu

** Professor, Hoseo University; E-mail: gsgim@hoseo.edu

I. INTRODUCTION

U.N. Secretary General Ban Ki-Moon has stated that climate change poses an “existential threat” to humankind. In both China and the United States, the two largest greenhouse gas-emitting countries, approximately 40% of Chinese and Americans agree that climate change poses a “major threat” to their countries, with an additional 37% describing it a “minor threat.”¹ With this in mind, which country has the political system that is better able to respond effectively to this threat: China with its authoritarian system or the US with its democratic system? The answer is not obvious, in part because of the crisis of confidence that has beset democracy in recent years, a crisis that *The Economist* (2014) attributes partly to the very rise of China, while the US has become a byword for gridlock. Whether a “Beijing Consensus” proves successful in legitimating authoritarianism, and in particular, legitimates environmental authoritarianism on climate change and other policies because of a corresponding failure of democracy, remains to be seen (Halper 2012; Beeson 2010; Gilley 2012; Shearman and Smith 2007).

In the meantime, stepping back from the particular examples of the China and the US, we may wish to ask the more fundamental question: Do differences in political institutions help explain differences in environmental policy outcomes across a large range of countries? That is the fundamental question that we attempt to address in this exploratory research. Put another way, we are asking whether political development, in particular, the development of democratic institutions and practices, impinges on the extent to which countries can successfully pursue sustainable development.

In the last quarter century, the term “sustainable development” has evolved from a vague concept to a widely-accepted paradigm for pursuing socio-economic development. While the debate continues concerning precisely how to define let alone measure sustainable development, policymakers increasingly invoke it as a normative framework within which to promote economic and social change. To a large extent, the success of these normative efforts depends on an empirical understanding of the relationship between socio-economic change and environmental change. Within social science, economists have sought to illuminate the relationship between economic development and environmental outcomes, with a large number of those efforts being pursued within the analytical framework of the Environmental Kuznets Curve (EKC).

The EKC posits an inverted U-shaped curve that appears to identify the relationship over time between income per capita and environmental degradation, where environmental degradation initially increases with income growth, but after peaking, begins to decline with further growth of income. More recently, political scientists have joined this discussion and have sought to draw attention to the fact that the environmental impacts of economic change may depend significantly on political institutions and the policymaking choices to which they give rise. In other

words, policy choices modulate the impact of economic growth on the natural environment, and those choices are shaped by the political environment.

The literature on the relationship between political institutions and environmental policymaking is still at a fairly nascent stage, at least in terms of viewing this relationship through the prism of the EKC. The findings with respect to the impact of political institutions on environmental policymaking suggest myriad effects. Upon closer analysis, the diversity of findings may reflect the various ways of defining and measuring political institutions in conjunction with various measures of environmental performance. With this in mind, this paper seeks to take stock of these alternative measures in an effort to assess their applicability and explanatory value.

As it stands, the literature contains a small but steadily expanding number of studies wherein researchers examine a given environmental policymaking indicator or pollutant (e.g. SO_2), and seek to understand how, after controlling for income and other variables, variations in political institutions (as defined by some particular measure) may explain variations in this environmental outcome across time and/or space. In terms of the applicability of the findings, it is widely recognized that environmental indicators differ in their relationship to economic development (i.e. some environmental indicators such as SO_2 conform to the inverted-U of the EKC; others do not). Moreover, when turning to the independent effect of political institutions, findings that depend on a particular measure of political institutions may not generalize beyond the scope of the particular aspects of political institutions captured by that measure (even if that measure is itself an aggregate index of several variables). Thus, variations in dependent variables compounded by variations in independent variables limit the ability to make generalizations on the basis of a single study's findings concerning the relationship between environmental quality and political institutions.

While the steady accretion of such studies continues to flesh out the overall picture of the relationship between environmental quality and political institutions, there may be value in pausing to attempt a more systemic approach towards explaining this relationship. On the one hand, we may wish to ask: Does a given variable for political institutions explain not just variations in air pollution, but variations in water pollution and other environmental indicators as well? On the other hand, we may wish to ask: For a given environmental indicator, do alternative measures of political institutions yield similar findings? In simple methodological terms, for the first question, we need to alternate the dependent variable, while using a consistent set of independent variables, including our variable of primary interest, the political variable. For the second question, for each dependent variable of interest, we need to explore alternate measures of the political variable. Ideally, a consistent, robust dataset would allow us to explore both questions.

We attempt that exploratory analysis in this paper. Our aim is to identify

which environmental variables seem to be most correlated with political institutions, while at the same time, identifying which measures of political institutions offer the most robust explanatory power. In the following section, we canvass the relationships between environmental performance, economic development, and political institutions. This will begin with a discussion of the background and recent findings concerning the EKC before turning our attention squarely to the issue of political institutions. In the third section, we present a basic analysis of the factors which may shape environmental performance of countries, highlighting various measures of governance. For this analysis, we rely primarily on data that underlie the Environmental Performance Index (EPI) and Environmental Sustainability Index (ESI) along with data on governance indicators derived from the World Bank. In the fourth section, we make some concluding remarks and note the issues for future research.

II. ECONOMIC DEVELOPMENT, POLITICAL DEVELOPMENT, AND ENVIRONMENTAL IMPACTS: EXPLORING THE INTERRELATIONS

While our goal in this research is to determine whether differences in political development explain differences in environmental policy performance, we need to view that relationship within a broader web of interrelations regarding economic development, political development, and environmental impacts. First, we examine the relationship between economic development and the environment by focusing on the Environmental Kuznets Curve (EKC) literature. Second, we examine the relationship between political development and the environment. Third, we examine the relationship between corruption and the environment.

1. Economic Development and Environmental Impacts: The Environmental Kuznets Curve (EKC)

The idea that the relationship between economic development and environmental impacts could be characterized as an inverted U first emerged in the early 1990s. When Grossman and Krueger (1991) were investigating the potential environmental impacts of the North America Free Trade Agreement, they found that when plotting environmental degradation on the vertical (Y) axis against income per capita on the horizontal (X) axis, in several cases, an inverted U shape emerged. Several years after “sustainable development” was coined by the World Commission on Environment and Development (1987), the World Bank decided to devote its annual development report to environmental issues (World Bank 1992). The background study for that report (Shafik and Bandyopadhyay 1992) identified several relationships between economic development and the environment. Some environmental indicators worsened when economies developed (e.g. carbon dioxide emissions), some became better (e.g. access to clean water), while some indicators

initially worsened, peaked, then improved, like an inverted U (e.g. sulfur dioxide concentrations). Panayotou (1993) reportedly coined the term “Environmental Kuznets Curve” after noting it was an inversion of the famous U shape found by Kuznets (1955) when studying the relationship between economic development and inequality. Grossman and Krueger (1995) then followed up their initial study with a more comprehensive look at the relationship between income growth and the environment, with a view towards identifying which environmental indicators followed the EKC pattern.

From that period forward, a large number of studies have emerged to explain, document, or dismiss the EKC and its intuitively appealing explanation of the relationship between economic development and the environment. One part of the literature has sought to explain, in some cases through formal models, the logic behind why the inverted U shape emerges. An oft-cited example is Dinda (2004), who discusses five factors that would explain the shape of the EKC. The first factor discussed is income elasticity of environmental quality demand; the logic being that when a country achieves a higher standard of living, people increasingly value environmental amenities.

The second factor has to do with the effects of economic scale, technology and composition. As the scale of production increases with economic growth, there are concomitant increases in natural resource consumption, emissions, and wastes. However, development often involves a change in the composition of the economy towards knowledge-intensive, clean industries and away from energy-intensive, polluting industries. At lower levels of development, the scale effect outweighs the composition and technological effects, resulting in increasing environmental damage (the upward sloping portion of the EKC). Beyond a certain point, however, the composition and technological effects begin to outweigh the scale effect, resulting in decreasing environmental degradation (the downward sloping portion of the EKC). The third factor that Dinda (2004) identified is international trade, although this effect is also ambiguous. Some have argued that poorer countries with less stringent environmental regulations disproportionately attract pollution-intensive industries (i.e. the “pollution haven hypothesis”). In other words, environmental damage is effectively displaced to these countries (i.e. the “environmental displacement hypothesis”). However, others have argued that foreign direct investment often involves a transfer of technology that may be less polluting and more efficient than indigenous technology. Thus, the overall effect of international trade on the environment in developing countries is not obvious. The role of market mechanisms and the role of regulations comprise the last two factors. In the case of regulations, their stringency, quality and especially the institutional willingness to enforce them varies widely among countries, and this too could explain the changing shape of the relationship between the economy and environment as countries develop.

Other researchers have sought to explore whether the EKC can be adequately

modeled from a theoretical standpoint. One elegant model was put forth by Andreoni and Levinson (2001) to explain the micro-foundations of an EKC relationship, where that relationship does not depend on the dynamics of growth, political institutions, or even externalities, but rather simply depends on increasing returns in the technological link between consumption of a desired good and abatement of its undesirable byproduct. Others have put forth straightforward microeconomic models of the market for environmental quality that directly relate the transmission of changing market equilibria to the points on the EKC (Munasinghe 1999).

Over the years, most of the studies within the EKC literature have been devoted to empirically examining the evidence. Harbaugh et al. (2002), with the benefit of retrospective data cleaning and ten additional years of data, found that Grossman and Krueger's evidence for an EKC for certain pollutants was much less robust than previously thought. These findings echo a number of other analyses that have cast doubt on the robustness of the EKC, many of which focus on the econometric pitfalls that tend to characterize efforts to empirically support the EKC (Perman and Stern 2003, Stern 2004; Copeland and Taylor 2004; Choumert et al. 2013). Nevertheless, others insist that, with the proper choice of variables, the EKC remains a powerful framework for explaining the economy-environment relationship (Dasgupta et al. 2006; Buitenzorgy and Mol 2011; Mukherjee and Chakraborty 2013).

Also on the empirical front, a number of researchers have sought to identify economic factors other than income per capita that might impinge on environmental quality. For example, some have examined not simply the level but the distribution of income to determine if inequality has an effect on environmental quality. Some find theoretical and/or empirical evidence to support the notion that inequality exacerbates environmental quality (Torras and Boyce 1998, Magnani 2000, Bimonti 2002). On the other hand, some suggest that inequality may actually result in greater environmental protection (Scruggs 1998). Still others argue that the effect of inequality on environmental quality is likely to be indeterminate (Heerink et al. 2001) or marked by a highly non-linear relationship that depends on per capita income level (Vona and Patriarca 2011).

2. Political Development and Environmental Impacts: Is Democracy Good for the Environment?

Both within the EKC framework and outside of it, a number of researchers have sought to understand how political development can affect the environment. Research has tended to focus on the extent of democracy and the prevalence of corruption as two aspects of governance that may impact environmental outcomes. For both democracy and corruption, to the extent that they affect economic growth,

they may indirectly affect the environment. Moreover, both democracy and corruption may have direct impacts on environmental policy and environmental outcomes. In this section, we first consider democracy's effect on economic growth, and then consider its effect on the environment. In the next section, we follow that same approach for corruption.

First, as for whether liberal political institutions contribute to economic growth, perhaps we should start by acknowledging that both pursuing economic growth and promoting democracy are goals in their own right. Glaeser et al. (2004, 271-272) identify two broad approaches in economic research to accomplish these goals: "The first approach emphasizes the need to start with democracy and other checks on government as the mechanisms for securing property rights. The second approach emphasizes the need for human and physical capital accumulation to start the process." The second approach is often associated with the pioneering work of Lipset (1960) and the seminal works by Barro (1996, 1997) and McGuire and Olson (1996). According to Glaeser et al., this approach seems to accord well with the experiences of South Korea, Taiwan, and China. All three countries grew rapidly under dictatorships, with South Korea and Taiwan developing into democracies. Of course, others have also maintained that the economic success of some East Asian countries was due to authoritarian regimes that were well-poised to avoid rent-seeking and politically motivated policy mistakes (Haggard 1990). Indeed, Glaeser et al. (2004, 274) "find evidence consistent with the example of South Korea, namely that economic growth and human capital accumulation cause institutional improvement, rather than the other way around."

Turning squarely to the issue of how political development directly affects environmental outcomes, Pellegrini and Gerlagh (2006) remind us that when environmental issues initially came to the fore in the 1960s and 1970s, environmentalists emphasized the need to restrict freedoms and accept constraints to political choices. Indeed, as we mentioned in the introduction, appeals to authoritarianism environmentalism continue to emerge that are well received in China and elsewhere.² Nevertheless, from the 1980s onward, the predominant view has been that democracy can be beneficial for the environment. As for why, Payne (1995) points to social science over the preceding decades that suggests five reasons why democracies do a better job of protecting the environment: 1) individual rights and the open marketplace of ideas; 2) regime responsiveness; 3) political learning (from environmental policy experiences); 4) internationalism (and increased participation in international environmental treaties and organizations); and 5) open markets (which can facilitate the emergence of green consumerism, market-based environmental regulations, etc.).

In contrast to democracies, there are compelling reasons to assume that dictatorships will do worse at providing public goods such as environmental protection (Olson 1993), while there are also theoretical reasons (and empirical

evidence) to suggest that the effect of dictatorships on the environment is indeterminate (Congleton 1992). It may be recalled that one of the broad explanations for the downward sloping portion of the EKC is that, as societies become wealthier, their demands for increased environmental amenities increases (or rather the associated income elasticity increases). Thus, not surprisingly, researchers have examined whether democratic freedoms are associated with better environmental outcomes, even after accounting for per capita income growth. An important contribution to this literature was Barrett and Graddy (2000). When they replicated Grossman and Krueger's (1995) analysis but included civil and political liberties as explanatory variables, they found that they exerted an independent effect (i.e. increased liberties were associated with better environmental outcomes in some, but not all, cases). Torras and Boyce (1998) also found democratic institutions to be important, especially at lower levels of per capita income.

Overall, as discussed by Bernauer and Koubi (2009), the literature indicates that democracy does have a positive effect on the provision of the public good of environmental protection. Moreover, within democracies, they show that, at least with respect to SO₂ emissions, important distinctions can be made between presidential and parliamentary systems (similar results were found by Fredriksson and Wollscheid 2007). In addition, the relative strength of interest groups opposing and supporting stronger environmental policies is a statistically significant variable (see also Fredriksson 2005). However, Persson and Tabellini (2009) make the compelling argument that the level of democracy at a given point in time is far less important than the consolidation of democracy over a number of years ("democratic capital") that explains political and economic change. Fredriksson and Neumayer (2013) apply the concept of "democratic capital" in an analysis of climate change policies and find it to be a powerful determinant of policy outcomes. In perhaps the most comprehensive survey of the literature on explaining national environmental performance, Fiorino (2011, 377) concludes that: "In sum, although much of the research finds positive relationships between measures of democracy and environmental performance, some of the results are mixed and ambiguous." Moreover, he cautions that: "Conclusions regarding this generally positive relationship should be tempered by the complexity of the relationships that are subsumed under the concepts of democracy and environment" (Fiorino 2011, 378).

Closely related to the research on political institutions is another body of research that focuses on "institutional capacity and policy diffusion." This body of research focuses on the institutional capacity of societies to solve environmental problems, where that capacity is outside the scope of government institutions themselves. Much of the research has been spearheaded by Janicke and Widener (Janicke 1992; Janicke and Widener 1997; Widener and Janicke 2002). They have highlighted the importance of structural conditions within societies that appear to be important in explaining why some countries are more successful than others in

solving environmental problems. They focus on structural pre-conditions such as “informational capacity” which includes scientific and technical knowledge, professionalism of relevant actors, availability of information on environmental conditions, knowledge diffusion, etc. Other important concepts are “participatory capacity” which refers to the degree of access to decision-making institutions, and “integrative capacity” which refers to the ability to coordinate action across sectors and institutions. This approach is echoed by Knutsen (2013) who argues that we should distinguish democracy from state capacity as each exerts differential effects on economic growth. An example of environmental policy research informed by the “institutional capacity and policy diffusion” perspective is Shin (2013) who found that institutional factors explain why China was unsuccessful in instituting a sulfur dioxide emissions policy despite strong support.

3. Corruption, Economic Development, and Environmental Impacts

Next, we briefly consider another aspect of governance, namely corruption, that may impinge on economic growth, democracy itself, and environmental policy performance. Looking first at whether corruption affects economic growth (and perhaps indirectly, environmental outcomes), Drury et al. (2006) found that corruption had no significant effect on economic growth in democracies, while non-democratic countries suffered significant economic harm from corruption. As for whether there is a causal link between corruption and democracy, Pellegrini and Gerlagh (2006, 337) maintain that, if one considers them as contemporary variables, there is no evidence of a causal relationship between corruption and democracy. Nevertheless, decades-long experience with democracy is generally associated with less corruption.

As for whether corruption impinges directly on environmental outcomes, both theoretical and empirical research points to a negative effect. In their game theoretic modeling, Lopez and Mitra (2000) demonstrate that corruption and environmental policy stringency are characterized by a negative relationship. Fredriksson and Svensson (2003) provide a theoretical model which indicates that environmental quality is negatively influenced by both corruption and political instability, and also provide empirical evidence to support their hypotheses.

As for considering the effect of corruption squarely within the EKC framework, Welsch (2004) provided a seminal contribution. He tried to carefully distinguish between the direct and indirect effects of corruption on environmental outcomes. To the extent that corruption has a negative impact on economic growth, it may have an indirect, negative effect on environmental quality. Corruption may also have a direct, negative effect on environmental policymaking, enforcement, and pollution levels. His empirical analysis found strong evidence for the direct effect (i.e. for a given level of income, higher corruption is associated with lower

environmental quality). As for the indirect effect, Welsch found that this depended on the level of economic development. For low-income countries, corruption appeared to clearly impede economic development. The upshot was that, by reducing corruption, low-income countries could improve both economic and environmental outcomes. Somewhat comparable results have been found by Cole (2006).

III. EMPIRICAL ANALYSIS

Our review of the literature leads us to agree with Fiorino (2011), whose survey of the literature on national environmental performance is arguably the most comprehensive of its kind. As noted above, Fiorino maintains that, while there is broad empirical support for the hypothesis that democratic institutions are associated with better environmental performance, the evidence is somewhat mixed and ambiguous, not least because of the various measures of political institutions and the plethora of particular environmental outcomes that have been studied. As we indicated in the introduction, while the steady accumulation of research continues to sketch out the overall picture of the relationship between environmental quality and political institutions, there may be value in pausing to attempt a more systemic parsing of this relationship. Two related questions emerge. Does a given measure of political institutions explain variations across a range of environmental indicators? For a given environmental indicator, do alternative measures of political institutions yield similar findings?

As our concern is with policy choices arising from political institutions, to the extent possible, we need to examine environmental indicators that are tied to policy performance (as opposed to physical environmental attributes that are beyond policymakers' control). Thus, we examine the environmental indicators contained in the 2008 Environmental Performance Index (EPI) produced by the Yale Center for Environmental Law and Policy in conjunction with Columbia University (Esty et al. 2008).³ With respect to political institutions, we examine a series of governance indicators created by the World Bank (Kaufmann et al. 2007) that have not been used typically in the literature.⁴ Our unit of analysis is at the national level, and we include 128 countries in our study.⁵ Appendix A provides descriptive statistics for the main variables analyzed (while the full dataset is available from authors upon request).

1. Econometric Model and Data

In essence, the equation which forms the basis for our analyses is the following:

$$\text{Environmental Perf.} = f(\text{economic development, political development, institutional capacity}) \quad (1)$$

Our dependent variable, environmental performance, consists of the overall EPI score, and in turn, its various policy components. In contrast to indicators of environmental quality such as ambient concentrations or emissions, we believe the EPI is more clearly a direct reflection of government capacity and policymaking decisions. As political institutions are the focus of this paper, we feel the EPI is preferable to other (more indirect) measures of environmental policymaking performance. That having been said, the EPI is an aggregate index comprised of six policy categories that may demonstrate important differences with respect to the “environmental quality/economic development/political institutions” nexus of relationships. Therefore, in addition to using the aggregate EPI as a dependent variable, we examine its policy categories and subcategories as dependent variables as well.

As indicated in Figure 1, the two broad objectives within the EPI are “environmental health” and “ecosystem vitality.” These two objectives, which are equally weighted in the EPI, are further broken down into six policy categories: environmental health, air pollution, water, biodiversity and habitat, productive natural resources, and climate change. Two of these policy categories, environmental health and productive natural resources, are broken down into subcategories. Ultimately, these categories (subcategories) are comprised of twenty-five indicators. Reflecting the EPI’s focus on policy performance (as opposed to a focus on physical environmental attributes themselves) these indicators reflect the extent to which a country has reached internationally-applicable policy targets.⁶ For example, within the policy category “environmental health” there is a subcategory, “air pollution (effects on humans),” which contains the indicator “indoor air pollution.” The associated target is 0% of households using solid fuels. Countries are thus assessed as to the extent they reach this target. For our dependent variable, we examine the overall EPI as well as the policy categories and subcategories. All scores are scaled from 0 to 100, with 100 reflecting the target being reached.

On the other side of the equation, our principal variables of interest are economic development (which we proxy by using GNP per capita) and political development. In contrast to other studies that choose a single proxy for political institutions, we compare nine different measures. First, we consider two of the most frequently used proxies in the extant literature: a measure of democracy developed by the Polity IV project (*polity*), and a measure of political and civil liberties developed by Freedom House (*liberties*). We also use a measure of environmental governance (*enviro_gov*) that was developed for the 2005 Environmental Sustainability Index (ESI; not to be confused with EPI), on the basis of principal components analysis of World Economic Forum survey data on environmental governance. Finally, we use a set of six dimensions of governance measured by World Bank researchers (Kaufmann et al. 2007, 3-4):

FIGURE 1. 2008 ENVIRONMENTAL PERFORMANCE INDEX (EPI)

1. "Voice and accountability" (*voice*) measures the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.
2. "Political stability and absence of violence" (*polstab*) measures perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including domestic violence and terrorism.
3. "Government effectiveness" (*goveff*) measures the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.
4. "Regulatory quality" (*regqual*) measures the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.
5. "Rule of law" (*law*) measures the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence.
6. "Control of corruption" (*corrupt*) measures the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.

These are measures that may indicate the capacity and willingness of governments to improve environmental performance. We expect the estimated coefficients for these variables to be positive, with the exception being civil and political liberties.⁷

As for other control variables of interest, we explore the explanatory potential of four additional variables that our literature review suggested may be important. These variables may capture important differences between countries that are not wholly reflected in per capita income nor captured by measures of political institutions. The first variable concerns what Dinda (2004) identified as one possible explanation for the EKC, namely international trade. The argument has been made that pollution-intensive industries may be displaced from richer countries with stronger environmental regulations to poorer countries with laxer environmental regulations (the "displacement hypothesis" or "pollution haven hypothesis"). To capture this possible influence on environmental performance, we use a variable that measures the value of pollution-intensive products and raw materials as a percentage of total imports ("*enviro_displace*").⁸

The other three control variables are inspired by the "institutional capacity and policy diffusion" literature we discussed above in Section II. This literature posits that there are important structural conditions that vary among countries that may impinge on national environmental performance whereas these capacity differences may not be fully reflected in economic or political measures. The first

form of institutional capacity we consider is private sector responsiveness (“*priv_sect_capacity*”).⁹ The second form of institutional capacity we consider is science and technology (“*sci_tech_capacity*”).¹⁰ The final variable we consider that may reflect policy diffusion is knowledge creation in environmental science, technology, and policy (“*enviro_knowledge*”).¹¹

2. Empirical Results

(1) Stage I: Comparing Alternative Measures of Political Institutions

Our analysis is based on OLS regressions using a cross-sectional data set covering 128 countries. In the first stage of the analysis, we compare alternative measures of political institutions. In the second stage, we compare alternative measures of environmental performance. As discussed in the introduction above, the question we seek to answer in the first stage is the following: For a given environmental indicator, do alternative measures of political institutions yield similar findings? Thus, for a given dependent variable, after including income as a dependent variable, we consider the independent effect of 9 alternative political indicators. First, we consider our broadest measure of environmental performance, the overall EPI, and regress it against the natural log of income per capita (*ln_gdp*) and each of the 9 political variables in turn. Next, we consider the two major objective measures within the EPI, “environmental health” and “ecosystem vitality.” As indicated in Figure 1, these two broad objectives (each given a 50% weighting with EPI), contain several categories and subcategories. “Environmental health” is geared towards measuring how environmental conditions affect human health, while “ecosystem vitality” is geared more towards measuring the health of ecosystems themselves. The results of regressing income and our 9 alternative measures against EPI are shown in Table 1.¹² The results of regressing income and our 9 alternative measures against “environmental health” and “ecosystem vitality” are shown in Table 2 and Table 3, respectively.

In discussing the results in Table 1, it should be noted at the outset that per capita income alone is positively and significantly correlated with EPI, as expected.¹³ When we add the 9 alternative measures for our political variable, though the coefficient for income changes somewhat, it retains significance at the 95% confidence level with one exception; when adding “government effectiveness” (*goveff*) to the model, the t-stat for income drops to 1.46. With regards to the 9 alternative measures of the political variable, in accordance with previous research where they are frequently used, the Polity IV measure of democracy (*polity*) as well as the Freedom House measure of civil and political liberties (*liberties*) display the expected signs¹⁴ and are highly significant; the same is true of our measure of environmental governance (*enviro_gov*). Turning to the 6

governance indicators constructed by the World Bank—voice and accountability (*voice*), political stability (*polstab*), government effectiveness (*goveff*), regulatory quality (*regqual*), rule of law (*law*), and control of corruption (*corrupt*) – these variables are also positively and highly significantly correlated with overall EPI.

TABLE 1. DEPENDENT VARIABLE: EPI [COEFFICIENT (T-STATISTIC)]

	Model 1.1	Model 1.2	Model 1.3	Model 1.4	Model 1.5	Model 1.6	Model 1.7	Model 1.8	Model 1.9
C	41.347	62.196	40.342	41.076	38.772	44.357	41.581	44.618	44.183
<i>ln_gdp</i>	3.155*** (4.020)	2.576*** (3.314)	1.151 (1.461)	2.198*** (2.970)	2.659*** (3.455)	1.565** (2.210)	1.844** (2.605)	1.785** (2.397)	1.968*** (2.665)
<i>polity</i>	0.980*** (6.414)								
<i>liberties</i>		-3.429*** (-6.951)							
<i>enviro_gov</i>			0.674*** (7.696)						
<i>voice</i>				0.2616*** (8.362)					
<i>polstab</i>					0.249*** (7.143)				
<i>goveff</i>						0.293*** (9.811)			
<i>regqual</i>							0.298*** (9.581)		
<i>law</i>								0.265*** (8.607)	
<i>corrupt</i>									0.251*** (8.246)

Turning our attention to Table 2, where we focus on the “environmental health” half of the overall EPI score, we find results that are quite comparable to those we found for the overall EPI. Including the 9 alternative political measures does not alter the positive, highly significant correlation between income and, in this case, “environmental health” (with the exception again being the addition of *enviro_gov*). That finding is to be expected given that the indicators that comprise “environmental health,” such as environmental burden of disease, adequate sanitation, and drinking water, are intimately related to economic growth and development.¹⁵ As for the alternative political indicators, each of them is significantly correlated with “environmental health,” with confidence levels exceeding 99%. At this point, the results suggest that political institutions may influence environmental performance independent of per capita income level, at least with respect to the broad objective of “environmental health.” At the same time, the fact that all of our political measures yield similar results does not allow us to make meaningful distinctions as to which one of these political measures best captures and expresses this apparent influence.

TABLE 2. DEPENDENT VARIABLE: ENVIRONMENTAL HEALTH

	Model 2.1	Model 2.2	Model 2.3	Model 2.4	Model 2.5	Model 2.6	Model 2.7	Model 2.8	Model 2.9
C	11.437	49.092	15.455	12.409	8.055	19.263	13.504	19.787	18.492
<i>ln_gdp</i>	6.545*** (4.000)	5.262*** (3.232)	1.553 (0.959)	4.622*** (2.975)	5.314*** (3.413)	2.961** (2.135)	3.679** (2.573)	3.415** (2.329)	3.880*** (2.652)
<i>polity</i>	1.631*** (5.121)								
<i>liberties</i>		-5.682*** (-5.500)							
<i>Enviro _gov</i>			1.347*** (7.478)						
<i>voice</i>				0.469*** (7.152)					
<i>polstab</i>					0.480*** (6.802)				
<i>gofeff</i>						0.599*** (10.228)			
<i>regqual</i>							0.585*** (2.573)		
<i>law</i>								0.541*** (8.916)	
<i>corrupt</i>									0.504*** (8.359)

TABLE 3. DEPENDENT VARIABLE: ECOSYSTEM VITALITY

	Model 3.1	Model 3.2	Model 3.3	Model 3.4	Model 3.5	Model 3.6	Model 3.7	Model 3.8	Model 3.9
C	71.261	75.331	65.181	69.745	69.489	69.457	69.661	69.459	69.887
<i>ln_gdp</i>	-0.235 (-0.324)	-0.112 (-0.150)	0.749 (0.950)	-0.228 (-0.299)	0.001 (0.002)	0.165 (0.210)	0.006 (0.007)	0.151 (0.193)	0.051 (0.062)
<i>polity</i>	0.330** (2.340)								
<i>liberties</i>		-1.180** (-2.487)							
<i>Enviro _gov</i>			0.002 (0.028)						
<i>voice</i>				0.053* (1.675)					
<i>polstab</i>					0.018 (0.544)				
<i>gofeff</i>						-0.011 (-0.358)			
<i>regqual</i>							0.012 (0.347)		
<i>law</i>								-0.010 (-0.308)	
<i>corrupt</i>									-0.001 (-0.045)

Turning our attention to Table 3, where we focus on the “ecosystem vitality” half of the overall EPI score, we find results that differ markedly from those found for overall EPI and “environmental health.” First, when we simply regress per capita income against “ecosystem vitality” we find virtually no correlation (results not in table).¹⁶ Notwithstanding, to facilitate comparison with results given above, we include the 9 alternative political measures. These results indicate that *polity* and *liberties* are correlated with “ecosystem vitality” at the 5% level of significance; *voice* is correlated at the 10% level, whereas the other political measures are not highly correlated with “ecosystem vitality.” However, we are far from confident that these results alone are an adequate basis for concluding that these measures offer meaningfully superior explanatory value vis-à-vis the other political measures.

Indeed, any conclusions regarding “ecosystem vitality” may depend on peering within this broad grouping of environmental categories and subcategories, and the indicators upon which they are based. A cursory examination of the 19 indicators that ultimately comprise “ecosystem vitality” suggests important differences in terms of economic development and quite possibly political development as well. For example, one of these indicators is CO₂ emissions per capita, which previous research has found to be positively related to per capita income.¹⁷ In the present context, this figure is negatively related to the target for reducing emissions per capita, and thus is associated with lowered “ecosystem vitality” values. On the other hand, poor water quality is often associated with a lack of development. In the present context, higher per capita income is positively related to water quality, and thus is associated with higher “ecosystem vitality” values. In short, it would be unwise to ignore these differences and draw conclusions regarding relationships between ecosystem vitality, per capita income and political institutions. For this reason, and because we wish to explore the explanatory potential of the other variables (apart from income and political variables), we move to the second stage of our analyses.

(2) Stage II: Models of Various Measures of Environmental Performance

In this stage, we alternate our dependent variable, and for each dependent variable, explore various combinations of our independent variables. Here, with respect to our political variables, we are interested in determining whether a particular political variable is capable of explaining variation across a range of environmental indicators. As for the dependent variables, we begin with the broad objectives of “environmental health” and “ecosystem vitality.” We then examine each of the five categories within “ecosystem vitality.” However, as the category “productive natural resources” is itself divided into subcategories, we choose to examine individually its subcategories, namely forestry, fisheries, and agriculture. We thus consider nine different dependent variables.

As for the independent variables, in terms of the political variables, we have opted to use two of the World Bank governance indicators, “voice and accountability” (*voice*) and “control of corruption” (*corrupt*). The reasons for opting to use World Bank indicators include the following. They represent a 10-year average of consistently measured dimensions. Also, they are scaled in similar units (0-100 scores) facilitating comparability. As for the choice of these two indicators among the six available, this is driven largely by the fact that “voice and accountability” appears to be the most broadly representative measure of political system, while “control of corruption” is a politico-economic phenomenon that is increasingly considered within the literature as having an impact that may be conceptually (if not statistically) separated from other political dimensions.¹⁸ The other control variables, again, are *enviro_displace* (which measures the extent to which pollution-intensive products are imported, thus displacing or exporting environmental impacts); *priv_sect_capacity* (capacity of the private sector to respond to environmental opportunities and pressures); *sci_tech_capacity* (scientific and technological capacity); and *enviro_knowledge* (creation and dissemination of knowledge concerning environmental processes).

We begin by using the dependent variable “environmental health,” whose subcategories we ignore.¹⁹ Because our two political variables, *voice* and *corrupt*, are so highly correlated, we alternate their use in the models. Similarly, *priv_sect_capacity* and *sci_tech_capacity* are highly correlated, thus we choose not to include them in the same model. To some extent, conceptually, one would expect that *enviro_knowledge* is also related to these two variables, but statistically, that is not the case. Thus, we include *enviro_knowledge* in two alternate models. The general, full form of our models is the following:

$$DV = \beta_0 + \beta_1 \ln_gdp + \beta_2 voice/corrupt + \beta_3 enviro_displace + \beta_4 priv_sect_capacity/sci_tech_capacity + \beta_5 enviro_knowledge + \varepsilon \quad (2)$$

The results for “environmental health” are shown in Table 4. Models 4.1 and 4.2, where we simply regress income and *voice* or *corrupt*, alternatively, against “environmental health” are comparable to the results we saw earlier in Models 2.4 and 2.9.²⁰ The addition of *enviro_displace* does not materially affect the *voice/corrupt* variables, but does reduce the significance of income below 90%. *Priv_sect_capacity* and *sci_tech_capacity* do not offer notable results, while *enviro_knowledge* is positively and significantly related to “environmental health.”

Turning to the “ecosystem vitality” half of the EPI, these results are displayed in Table 5. Models 5.1 and 5.2, where we simply regress income and *voice* or *corrupt*, alternatively, against “ecosystem vitality” are comparable to the results we saw earlier in Models 3.4 and 3.9. Neither income nor *voice/corrupt* are significantly correlated with ecosystem. Among the “other” variables, curiously,

enviro_knowledge is negatively correlated with “ecosystem vitality” at the 10% level of significance. But as noted in our discussion of results connected with the broad, variegated objective of “ecosystem vitality,” we are wary of attaching much value to these results.

TABLE 4. DEPENDENT VARIABLE: ENVIRONMENTAL HEALTH

	Model 4.1	Model 4.2	Model 4.3	Model 4.4	Model 4.5	Model 4.6	Model 4.7	Model 4.8	Model 4.9	Model 4.10
C	12.409	18.492	20.841	32.634	20.253	32.030	22.543	34.672	41.188	43.276
<i>ln_gdp</i>	4.623*** (2.825)	3.880** (2.522)	2.472 (1.559)	1.980 (1.235)	2.498 (1.538)	2.016 (1.227)	2.378 (1.473)	1.798 (1.125)	0.694 (0.433)	0.418 (0.236)
<i>voice</i>	0.469*** (7.999)		0.430*** (7.315)		0.435*** (6.953)		0.401*** (6.502)		0.243*** (3.789)	
<i>corrupt</i>		0.504*** (9.712)		0.441*** (7.808)		0.446*** (7.472)		0.413*** (6.923)		0.231*** (3.068)
<i>enviro_displace</i>			0.580** (2.082)	0.289 (1.050)	0.581** (2.089)	0.287 (1.046)	0.604** (2.122)	0.328 (1.149)	0.749** (2.097)	0.815** (2.260)
<i>priv_sect_capacity</i>					-0.718 (-0.312)	-0.725 (-0.321)			2.131 (1.214)	
<i>sci_tech_capacity</i>							2.844 (1.223)	3.229 (1.506)		1.894 (1.047)
<i>enviro_knowledge</i>									0.188** (2.029)	0.167* (1.830)

TABLE 5. DEPENDENT VARIABLE: ECOSYSTEM VITALITY

	Model 5.1	Model 5.2	Model 5.3	Model 5.4	Model 5.5	Model 5.6	Model 5.7	Model 5.8	Model 5.9	Model 5.10
C	69.745	69.887	62.395	60.050	63.012	61.139	62.172	60.181	66.381	66.339
<i>ln_gdp</i>	-0.228 (-0.254)	0.051 (0.054)	0.809 (0.939)	1.149 (1.308)	0.781 (0.892)	1.083 (1.211)	0.822 (0.954)	1.138 (1.289)	1.101 (1.080)	1.146 (1.113)
<i>voice</i>	0.053 (1.570)		0.053 (1.538)		0.048 (1.337)		0.057 (1.588)		0.082* (1.678)	
<i>corrupt</i>		-0.001 (-0.042)		0.011 (0.329)		0.002 (0.070)		0.009 (0.268)		0.050 (1.087)
<i>enviro_displace</i>			-0.079 (-0.810)	-0.019 (-0.193)	-0.080 (-0.804)	-0.016 (-0.160)	-0.082 (-0.839)	-0.016 (-0.166)	-0.195 (-1.025)	-0.123 (-0.676)
<i>priv_sect_capacity</i>					0.752 (0.549)	1.308 (0.929)			0.515 (0.375)	
<i>sci_tech_capacity</i>							-0.373 (-0.350)	0.208 (0.188)		0.793 (0.674)
<i>enviro_knowledge</i>									-0.173*** (-3.222)	-0.177*** (-3.105)

Looking at the categories that comprise “ecosystem vitality,” we begin by examining “air pollution.” As indicated by the results in Table 6, the regressions do not indicate that we have statistically significant findings. Indeed, while income is positively related to “air pollution,” the coefficient falls short of being statistically significant, whereas the political and other variables do not display even

the expected signs. “Air pollution” is comprised of two indicators, ecosystem ozone and sulfur dioxide emissions. Given that previous studies have found evidence that SO₂ emissions are related to income, the lack of similar findings here is somewhat surprising. This may owe to the particular way in which SO₂ emissions are expressed, which is in terms of proximity to the target of 0 tons SO₂/populated land, then scaled from 1-100 (as is the case for all the categories). As discussed by Esty et al. (2008, 48) the ecosystem ozone findings are even less straightforward, given that even less industrialized areas with low industrial ozone emissions may nevertheless rank poorly because of high biomass burning, as is the case for Central African countries.

Table 6. Dependent Variable: Ecosystem Vitality-Air Pollution (Effects on Ecosystems)

	Model 6.1	Model 6.2	Model 6.3	Model 6.4	Model 6.5	Model 6.6	Model 6.7	Model 6.8	Model 6.9	Model 6.10
C	79.133	78.799	80.307		79.830	84.799	79.632	84.433	91.943	91.339
<i>ln_gdp</i>	1.582 (1.611)	1.655 (1.647)	1.878 (1.577)		1.899 (1.558)	1.464 (1.212)	1.915 (1.602)	1.515 (1.285)	1.198 (0.726)	1.337 (0.852)
<i>voice</i>	-0.059 (-1.249)		-0.069 (-1.192)		-0.065 (-1.144)		-0.058 (-1.163)		-0.035 (-0.327)	
<i>corrupt</i>		-0.064 (-1.339)				-0.054 (-1.009)		-0.045 (-0.987)		-0.026 (-0.373)
<i>enviro_ displace</i>			-0.128 (-0.762)		-0.128 (-0.763)	-0.191 (-1.297)	-0.138 (-0.817)	-0.209 (-1.435)	-0.424 (-1.193)	-0.463 (-1.563)
<i>priv_sect_ capacity</i>					-0.583 (-0.340)	-0.786 (-0.423)			-0.168 (-0.067)	-1.951 (-0.810)
<i>sci_tech_ capacity</i>							-1.130 (-0.694)	-1.617 (-0.910)	-0.036 (-0.338)	-0.034 (-0.321)
<i>enviro_ knowledge</i>									-0.037 (-0.338)	-0.034 (-0.321)

TABLE 7. DEPENDENT VARIABLE: ECOSYSTEM VITALITY-WATER (EFFECTS ON ECOSYSTEMS)

	Model 7.1	Model 7.2	Model 7.3	Model 7.4	Model 7.5	Model 7.6	Model 7.7	Model 7.8	Model 7.9	Model 7.10
C	51.552	52.148	39.363	38.919	40.125	41.228	38.750	39.533	61.491	62.610
<i>ln_gdp</i>	0.127 (0.108)	0.817 (0.603)	0.690 (0.527)	1.559 (1.018)	0.655 (0.502)	1.419 (0.950)	0.724 (0.554)	1.504 (0.981)	-2.160 (-1.517)	-2.083 (-1.326)
<i>voice</i>	0.293*** (5.571)		0.368*** (6.031)		0.361*** (5.393)		0.378*** (5.893)		0.390*** (4.317)	
<i>corrupt</i>		0.158*** (2.921)		0.216*** (3.679)		0.197*** (3.263)		0.207*** (3.471)		0.270*** (3.761)
<i>enviro_ displace</i>			0.068 (0.300)	0.112 (0.456)	0.067 (0.300)	0.1181 (0.485)	0.059 (0.257)	0.123 (0.499)	0.442 (1.301)	0.701** (2.092)
<i>priv_sect_ capacity</i>					0.930 (0.422)	2.773 (1.192)			0.299 (0.118)	
<i>sci_tech_ capacity</i>							-1.024 (-0.599)	0.972 (0.556)		1.031 (0.551)
<i>enviro_ knowledge</i>									-0.199* (-1.931)	-0.212* (-1.814)

TABLE 8. DEPENDENT VARIABLE: ECOSYSTEM VITALITY-BIODIVERSITY AND HABITAT

	Model 8.1	Model 8.2	Model 8.3	Model 8.4	Model 8.5	Model 8.6	Model 8.7	Model 8.8	Model 8.9	Model 8.10
C	43.203	37.052	24.994	7.441	29.374	11.587	26.701	8.953	26.724	25.587
<i>ln_gdp</i>	1.217 (0.590)	1.664 (0.796)	2.403 (0.988)	3.337 (1.448)	2.206 (0.893)	3.086 (1.304)	2.309 (0.945)	3.203 (1.372)	3.404 (1.324)	3.269 (1.298)
<i>voice</i>	-0.103 (-1.257)		-0.203** (-1.992)		-0.242** (-2.237)		-0.232** (-2.232)		-0.157 (-1.033)	
<i>corrupt</i>		-0.077 (-0.939)		-0.176* (-1.842)		-0.209** (2.049)		-0.197** (-2.064)		-0.109 (-0.929)
<i>enviro_ displace</i>			0.555 (1.400)	0.826** (2.124)	0.553 (1.314)	0.837** (2.000)	0.579 (1.406)	0.855** (2.113)	0.641 (1.260)	0.589 (1.255)
<i>priv_sect_ capacity</i>					5.347 (1.490)	4.978 (1.341)			4.636 (1.135)	
<i>sci_tech_ capacity</i>							2.853 (0.916)	2.395 (0.774)		5.397* (1.677)
<i>enviro_ knowledge</i>									-0.488*** (-2.974)	-0.503*** (-3.193)

Within “ecosystem vitality” the next category is “water” (which includes water quality and areas under water stress). As shown in Table 7, interestingly, income is not correlated with “water,” yet each of our political variables is a robust performer in all 10 models. *Enviro_displace* is significant only in Model 7.10. Curiously, as we saw earlier with the regressions involving the whole “ecosystem vitality” objective as the dependent variable, *enviro_knowledge* is negatively correlated and marginally significant (at the 10% level). European countries tend to score highly on both water quality and water stress, whereas not surprisingly, most arid and semi-arid countries as well as conflict-ridden areas score poorly. In the absence of a control variable that would account for specific geographic conditions, it is difficult to ascertain whether our seemingly robust political variables underscore the importance of democracy and/or lack of corruption in forming water-related policy, or whether they spuriously reflect the fact that many arid and semi-arid countries may perform poorly in political terms.

Our next set of models uses “biodiversity and habitat” as the dependent variable. This category includes four different indicators: conservation risk index, effective conservation, critical habitat protection, and marine protected areas. At first blush, our regression results are quite provocative in that we find significant *negative* correlations with our political variables in Models 8.3–8.8. However, the measurement, data availability, and scoring issues that underlie the various indicators that comprise “biodiversity and habitat” suggest that we treat these results with some caution (Esty et al. 2008, 53–57).

Our next three sets of models concern “productive natural resources,” which is comprised of the following subcategories, forest, fisheries, and agriculture, which we analyze in turn. Table 9 indicates the results for “natural resources-

forestry,” which gauges the extent to which forest growth stock is changing. Deforestation, a major problem in some developing countries, results in a poor score on this measure; Indonesia receives the lowest score, “0”. Income does not appear as a significant variable whereas our political variables (*voice* and *corrupt*) are positive and significantly related to forestry outcomes throughout the Models 9.1-9.10. We might expect that *enviro_displace* would be positive and significantly related as well, give that this variable captures the extent to which extractive resources, including forest products are imported, thus lessening the burden on a country’s own forests. However, while *enviro_displace* is positively correlated, it is not highly significant.

TABLE 9. DEPENDENT VARIABLE: ECOSYSTEM VITALITY-NATURAL RESOURCES-FORESTRY

	Model 9.1	Model 9.2	Model 9.3	Model 9.4	Model 9.5	Model 9.6	Model 9.7	Model 9.8	Model 9.9	Model 9.10
C	67.563	85.917	65.779	72.973	66.554	74.186	65.941	74.025	70.341	73.403
<i>ln_gdp</i>	1.254 (0.795)	-1.218 (-0.958)	-0.258 (-0.156)	-1.368 (-0.998)	-0.293 (-0.177)	-1.442 (-1.081)	-0.267 (-0.158)	-1.462 (-1.066)	0.241 (0.182)	-0.261 (-0.204)
<i>voice</i>	0.193*** (3.339)		0.265*** (3.411)		0.258*** (3.277)		0.262*** (3.408)		0.141* (1.813)	
<i>corrupt</i>		0.280*** (5.073)		0.379*** (5.392)		0.369*** (4.982)		0.364*** (5.132)		0.223*** (2.737)
<i>enviro_displace</i>			0.411 (1.450)	0.271 (1.099)	0.411 (1.443)	0.274 (1.113)	0.413 (1.451)	0.291 (1.166)	0.302 (0.838)	0.181 (0.517)
<i>priv_sect_capacity</i>					0.947 (0.415)	1.457 (0.661)			2.725 (1.632)	
<i>sci_tech_capacity</i>							0.272 (0.139)	1.668 (1.268)		0.203 (0.147)
<i>enviro_knowledge</i>									0.126* (1.788)	0.103 (1.647)

TABLE 10. DEPENDENT VARIABLE: ECOSYSTEM VITALITY- NATURAL RESOURCES-FISHERIES

	Model 10.1	Model 10.2	Model 10.3	Model 10.4	Model 10.5	Model 10.6	Model 10.7	Model 10.8	Model 10.9	Model 10.10
C	77.794	74.557	94.104	91.159	94.451	91.906	94.110	91.578	108.577	105.216
<i>ln_gdp</i>	-1.143 (-0.595)	-0.579 (-0.305)	-1.918 (-1.059)	-1.387 (-0.775)	-1.942 (-1.025)	-1.443 (-0.768)	-1.896 (-1.053)	-1.418 (-0.781)	-2.416 (-0.953)	-1.763 (-0.754)
<i>voice</i>	0.051 (0.588)		-0.044 (-0.519)		-0.046 (-0.515)		-0.057 (-0.616)		0.002 (0.018)	
<i>corrupt</i>		0.013 (0.148)		-0.119 (-1.423)		-0.124 (-1.382)		-0.132 (-1.457)		-0.105 (-0.788)
<i>enviro_displace</i>			-0.084 (-0.374)	0.015 (0.065)	-0.083 (-0.368)	0.018 (0.076)	-0.067 (-0.292)	0.035 (0.145)	-0.302 (-0.577)	-0.148 (-0.300)
<i>priv_sect_capacity</i>					0.405 (0.115)	0.774 (0.222)			0.001 (0.001)	
<i>sci_tech_capacity</i>							1.645 (0.489)	1.791 (0.539)		2.651 (0.621)
<i>enviro_knowledge</i>									-0.292** (-2.151)	-0.277** (-2.022)

TABLE 11. DEPENDENT VARIABLE: ECOSYSTEM VITALITY-NATURAL RESOURCES-AGRICULTURE

	Model 11.1	Model 11.2	Model 11.3	Model 11.4	Model 11.5	Model 11.6	Model 11.7	Model 11.8	Model 11.9	Model 11.10
C	79.893	78.540	78.154	77.437	77.255	76.462	78.020	77.196	94.114	95.288
<i>ln_gdp</i>	-0.404 (-0.462)	-0.278 (-0.303)	-0.599 (-0.604)	-0.487 (-0.486)	-0.586 (-0.585)	-0.462 (-0.453)	-0.596 (-0.597)	-0.474 (-0.468)	-1.791 (-1.365)	-1.911 (-1.468)
<i>voice</i>	0.018 (0.638)		0.043 (1.286)		0.052 (1.469)		0.046 (1.165)		0.045 (0.670)	
<i>corrupt</i>		0.020 (0.613)		0.036 (0.914)		0.047 (1.125)		0.041 (0.911)		0.045 (0.640)
<i>enviro_ displace</i>			0.055 (0.396)	0.054 (0.351)	0.061 (0.429)	0.055 (0.359)	0.054 (0.384)	0.050 (0.321)	0.136 (0.420)	0.134 (0.410)
<i>priv_sect_ capacity</i>					-1.332 (-0.976)	-1.433 (-1.071)				
<i>sci_tech_ capacity</i>							-0.279 (-0.213)	-0.472 (-0.362)	-1.994 (-1.053)	-1.199 (-0.828)
<i>enviro_ knowledge</i>									-0.204*** (-2.827)	-0.199*** (-2.847)

Turning to “natural resources – fisheries,” this subcategory reflects both overfishing and the use of ecosystem-destroying trawling. Both activities are capital-intensive and tend to be practiced by economically developed countries; hence the negative coefficient for per capita income (though it is not statistically significant) in Models 10.1-10. The remaining variables, including our political measures, are not significant, with the exception of *enviro_knowledge* which is negatively correlated with fisheries for unclear (and perhaps spurious) reasons.

As for the subcategory “natural resources – agriculture,” it is comprised of 5 indicators that suggest different possible relationships with our economic and political variables. For example, one of the indicators is agricultural subsidies, which is included because of the deleterious effects of agricultural subsidies on ecosystems (e.g. excessive chemical use, farming in sensitive areas, etc.). While the vast majority of countries do not extend public agricultural subsidies to farmers, a minority of countries do so, especially the richer, typically European ones. Thus, per capita income is negatively related to this particular indicator within “natural resources – agriculture.” On the other hand, another indicator is pesticide regulation, where the poorest (and often less democratic) countries tended to receive the lowest scores. As a consequence, in view of the heterogeneity within this subcategory, it is hardly surprisingly that clear results do not emerge (Models 11.1-11.10).

Finally, we turn our attention to the category “climate change,” which accounts for a full 25% weighting of the overall EPI. This category is comprised of three indicators: CO₂ emissions per capita, CO₂ emissions per electricity generation, and industrial carbon intensity. Once again, clear relationships with respect to economic and political variables remain elusive. Among the highest ranking

countries in this category are poorer countries with subsistence agriculture and little industry alongside richer countries such as Switzerland, Norway and Sweden which are at the forefront of innovative policies to reduce greenhouse gases (GHGs). As a consequence, not surprisingly, the economic, political, and “other” variables do not point to readily identifiable relationships that can be generalized. Looking at Table 12 reveals that *enviro_displace* consistently exhibits a significant, negative relationship, though for reasons that are unclear and may simply reflect a statistical artifact.

TABLE 12. DEPENDENT VARIABLE: ECOSYSTEM VITALITY-CLIMATE CHANGE

	Model 12.1	Model 12.2	Model 12.3	Model 12.4	Model 12.5	Model 12.6	Model 12.7	Model 12.8	Model 12.9	Model 12.10
C	80.893	81.045	73.530	73.440	73.181	73.553	72.704	72.916	69.526	69.406
<i>ln_gdp</i>	-1.069 (-0.778)	-0.631 (-0.436)	0.773 (0.596)	1.004 (0.753)	0.789 (0.611)	0.997 (0.750)	0.819 (0.636)	1.050 (0.793)	2.153 (1.461)	2.257 (1.514)
<i>voice</i>	0.033 (0.671)		0.035 (0.745)		0.038 (0.777)		0.049 (0.991)		0.079 (1.254)	
<i>corrupt</i>		-0.048 (-0.906)		-0.015 (-0.345)		-0.016 (-0.350)		-0.008 (-0.179)		0.039 (0.631)
<i>enviro_ displace</i>			-0.366** (-2.273)	-0.331** (-2.115)	-0.366** (-2.251)	-0.331** (-2.106)	-0.378** (-2.312)	-0.341** (-2.146)	-0.690** (-2.212)	-0.6163** (-2.022)
<i>priv_sect_ capacity</i>					-0.426 (-0.219)	0.135 (0.068)	-1.382 (-0.932)	-0.831 (-0.538)	-0.527 (-0.284)	
<i>sci_tech_ capacity</i>										-0.311 (-0.181)
<i>enviro_ knowledge</i>									-0.108 (-1.405)	-0.108 (-1.343)

IV. CONCLUSIONS

From the early 1990s, a literature dominated by the concept of the environmental Kuznets curve (EKC) has emerged which has sought to identify how environmental outcomes are driven by economic processes. The findings from that literature sketch a rough portrait that suggests that, the undeniable intuitive appeal of the EKC notwithstanding, its applicability may be limited to a range of environmental outcomes. Moreover, to the extent that environmental outcomes are policy-driven, restricting our vision to the economic determinants of environmental outcomes while ignoring the political environment in which they occur may lead us to erroneous conclusions. While a vein within the EKC literature has sought to address this shortcoming by drawing attention to how political institutions may modulate the impact of economic activities on the environment, these studies have suffered from a larger problem afflicting the EKC literature. That problem inheres in the fact that studies devoted to particular environmental outcomes (e.g. SO₂) using a particular measure of political institutions (e.g. rule of

law) lack both comparability and generalizability.

To address this shortcoming, we have sought to construct and utilize a comprehensive dataset of environmental performance outcomes and political variables that may shed some light on the following related questions: Does a given variable for political institutions explain not just variation in one particular environmental indicator such as air pollution, but variations in water pollution and other environmental indicators as well? On the other hand, for a given environmental indicator, do alternative measures of political institutions yield similar findings? Our exploratory analysis of various Environmental Performance Index (EPI) indicators coupled with political indicators derived from the World Bank and other sources leads us to conclude that the answer to the second question is affirmative. While conceptually separate, operational measurements of governance indicators lead to similar statistical findings. With regards to the explanatory value of political variables relative to various environmental outcomes, we are constrained by the fact that internationally comparable variables of environmental outcomes are difficult to obtain. Arguably the best effort thus far, in terms of coverage and (importantly for our purposes) relation to policy, has been the EPI data concerning environmental performance indicators.

Our results suggest that, in terms of environmental health indicators, our two chosen governance indicators, “voice and accountability” and “control of corruption” explain international variation in health indicators independently of per capita income, which is also statistically significant. The addition of other variables such as those related to the pollution displacement hypothesis (*enviro_displace*), private sector capacity to respond to environmental pressures (*priv_sect_capacity*), scientific and technological capacity, and environmental knowledge creation (*enviro_knowledge*), does not offer much additional explanatory value; indeed their addition reduces the significance of our income variable. Turning to “ecosystem vitality,” the results are more variegated. Unlike environmental health indicators, which are tied to environmental impacts on humans and are more closely linked to widely accepted notions of politico-economic development, ecosystem measures bear more disparate relations to economic and political measures. With regards to air pollution, water quality and water stress, biodiversity, forestry, fisheries, agriculture, and climate change, none of these measures was significantly related to per capita income, in contrast to findings found in the EKC literature. Our political variables were found to be significantly correlated with water quality and water stress as well as forestry, though not related to the other environmental indicators in a readily identifiable way. The institutional capacity variables also bore inconsistent relations to our ecosystem indicators.

We conjecture that our findings (or lack thereof) with respect to the ecosystem indicators may be due to the fact that, despite the policy-related targets in which these variables are expressed, they have irreducibly varied relations with

economic and political phenomena. The fact that a country scores highly on water indicators may simply be driven by natural endowments rather than political commitment. The fact that a country scores highly with respect to CO₂ emissions per capita may reflect a highly developed economy with an environmentally conscious electorate participating in a highly developed political system, or it may simply reflect a very lack of economic (and perhaps political) development.

At the outset, we began by noting the conflict between those who insist that authoritarian environmentalism holds the promise of resolutely addressing environmental problems such as climate change and those who insist that democratic environmentalism is better poised to deliver environmental solutions. To be sure, the relationships between democracy, democratization, and climate change are complex (Burnell 2012). Moreover, even if other research indicates that democracy tends to be associated with better climate change policy, it does not necessarily mean that promoting democracy abroad is compatible with addressing climate change (Hobson 2012). Nevertheless, what our findings show is that, at least for addressing environmental policy problems that are directly tied to human health, democracies do appear to outperform more authoritarian regimes. While the jury may still be out on whether democracies will ultimately outperform their more autocratic counterparts on climate change, for a number of other environmental indicators, the data analyzed here do not support those arguing for authoritarian environmentalism. Further study is warranted to discover if important differences in environmental policy performance exist within broadly similar groupings of democratic and authoritarian countries. Moreover, as panel data on environmental policy performance becomes more available and improves, this will enable the study of changes in policy performance over time.

REFERENCES

- Andreoni, J. and A. Levinson. 2001. The Simple Analytics of the Environmental Kuznets Curve. *Journal of Public Economics* 80(2): 269-286.
- Bernauer, T. and V. Koubi. 2009. Effects of Political Institutions on Air Quality. *Ecological Economics* 68: 1355-1365.
- Barrett, S. and K. Graddy. 2000. Freedom, Growth, and the Environment. *Environment and Development Economics* 5: 433-456.
- Barro, R. J. 1996. Democracy and Growth. *Journal of Economic Growth* 1: 1-27.
- Barro, R. J. 1997. *Determinants of Economic Growth: A Cross-Country Empirical Study*. Cambridge, MA: MIT Press.
- Beeson, M. 2010. The Coming of Environmental Authoritarianism. *Environmental Politics* 19(2): 276-294.
- Bimonti, S. 2002. Information Access, Income Distribution, and the Environmental Kuznets Curve. *Ecological Economics* 41: 145-156.

- Buitenzorgy, M. and A. P. J. Mol. 2011. Does Democracy Lead to a Better Environment? Deforestation and the Democratic Transition Peak. *Environmental and Resource Economics* 48: 59-70.
- Burnell, P. 2012. Democracy, Democratization and Climate Change: Complex Relationships. *Democratization* 19(5): 813-842.
- Choumert, J., P. C. Motel, and H. K. Dakpo. 2013. Is the Environmental Kuznets Curve for Deforestation a Threatened Theory? A Meta-analysis of the Literature. *Ecological Economics* 90: 19-28.
- Cole, M. A. 2006. Corruption, Income, and the Environment: An Empirical Analysis. *Ecological Economics* 62(3/4): 637-647.
- Congleton, R. D. 1992. Political Institutions and Pollution Control. *Review of Economics and Statistics* 74(3): 412-421.
- Copeland, B. R. and M. S. Taylor. 2004. Trade, Growth, and the Environment. *Journal of Environmental Literature* 42: 7-71.
- Dasgupta, S., K. Hamilton, K. Pandey, and D. Wheeler. 2006. Environment during Growth: Accounting for Governance and Vulnerability. *World Development* 34(9): 1597-1611.
- Dinda, S. 2004. Environmental Kuznets Curve Hypothesis: A Survey. *Ecological Economics* 49: 431-455.
- Drury, A. C., J. Krieckhaus, and M. Luszti. 2006. Corruption, Democracy, and Economic Growth. *International Political Science Review* 27(2): 121-136.
- The Economist*. 2014. What's Gone Wrong with Democracy (multi-part essay). *The Economist*.
- Esty, D. C., M. A. Levy, T. Srebotnjak, and A. de Sherbinin. 2005. *2005 Environmental Sustainability Index: Benchmarking National Environmental Stewardship*. New Haven: Yale Center for Environmental Law and Policy.
- Esty, D. C., M. A. Levy, C. H. Kim, A. de Sherbinin, T. Srebotnjak, and V. Mara. 2008. *2008 Environmental Performance Index*. New Haven: Yale Center for Environmental Law and Policy.
- Fiorino, D. J. 2011. Explaining National Environmental Performance: Approaches, Evidence, and Implications. *Policy Science* 44: 367-389.
- Fredriksson, P. G., E. Neumayer, R. Damania, and S. Gates. 2005. Environmentalism, Democracy, and Pollution Control. *Journal of Environmental Economics and Management* 49(2): 343-365.
- Fredriksson, P. G. and E. Neumayer. 2013. Democracy and Climate Change Policies: Is History Important? *Ecological Economics* 95: 11-19.
- Fredriksson, P. G. and J. Svensson. 2003. Political Instability, Corruption, and Policy Formation: The Case of Environmental Policy. *Journal of Public Economics* 87(7/8): 1383-1405.
- Fredriksson, P. G. and J. R. Wollscheid. 2007. Democratic Institutions versus Autocratic Regimes: The Case of Environmental Policy. *Public Choice* 130:

381-393.

- Gilley, B. 2012. Authoritarian Environmentalism and China's Response to Climate Change. *Environmental Politics* 21(2): 287-307.
- Glaeser, E. L., R. La Porta, F. Lopez-De-Silanes, and A. Shleifer. 2004. Do Institutions Cause Growth? *Journal of Economic Growth* 9: 271-303.
- Grossman, G. M. and A. B. Krueger. 1991. Environmental Impacts of a North American Free Trade Agreement. National Bureau of Economic Research Working Paper 3914. Cambridge, MA: NBER.
- Grossman, G. M. and A. B. Krueger. 1995. Economic Growth and the Environment. *Quarterly Journal of Economics* 110: 353-377.
- Haggard, S. D. 1990. *Pathways from the Periphery: The Politics of Growth in the Newly Industrializing Countries*. New York: Cornell University Press.
- Halper, S. 2012. *The Beijing Consensus: Legitimizing Authoritarianism in Our Time*. New York: Basic Books.
- Harbaugh, W. T., A. Levinson, and D. M. Wilson. 2002. Reexamining the Empirical Evidence for the Environmental Kuznets Curve. *Review of Economics and Statistics* 84(3): 541-551.
- Heerink, N., A. Mulatu, and E. Bulte. 2001. Income Inequality and the Environment: Aggregation Bias in Environmental Kuznets Curves. *Ecological Economics* 38(3): 359-367.
- Hobson, C. 2012. Addressing Climate Change and Promoting Democracy Abroad: Compatible Agendas?. *Democratization* 19(5): 974-992.
- Janicke, M. 1992. Conditions for Environmental Policy Success: An International Comparison. *The Environmentalist* 12: 47-58.
- Janicke, M. and H. Weidner (Eds.). 1997. *National Environmental Policies: A Comparative Study of Capacity-building*. New York: Springer.
- Kaufman, D., A. Kraay, and M. Mastruzzi. 2007. Governance Matters VI: Aggregate and Individual Governance Indicators 1996-2006. World Bank Policy Research Working Paper 4280, Washington, DC: World Bank.
- Kelleher, D. S. and G. S. Kim. 2007. Political Institutions and Environmental Performance: An Empirical Analysis of Environmental Performance Indices for 130 Countries. *International Area Studies Review* 11(3): 100-123.
- Knutsen, C. H. 2013. Democracy, State Capacity, and Economic Growth. *World Development* 43: 1-18.
- Kuznets, S. 1955. Economic Growth and Income Inequality. *American Economic Review* 49: 1-28.
- Lipset, S. M. 1960. *Political Man: The Social Bases of Politics*. Garden City, New York: Doubleday.
- Lopez, R. and S. Mitra. 2000. Corruption, Pollution, and the Kuznets Environmental Curve. *Journal of Environmental Economics and Management* 40(2): 137-150.

- Magnani, E. 2000. The Environmental Kuznets Curve, Environmental Protection Policy and Income Distribution. *Ecological Economics* 32: 431-443.
- McGuire, M. C. and M. Olson. 1996. The Economics of Autocracy and Majority Rule: The Invisible Hand and the Use of Force. *Journal of Economic Literature* 34(1): 72-96.
- Mukherjee, S. and D. Chakraborty. 2013. Is Environmental Sustainability Influenced by Socioeconomic and Sociopolitical Factors? Cross-country Empirical Evidence. *Sustainable Development* 21(6): 353-371.
- Munasinghe, M. 1999. Is Environmental Degradation an Inevitable Consequence of Economic Growth: Tunneling Through the Environmental Kuznets Curve. *Ecological Economics* 29: 89-109.
- Olson, M. 1993. Dictatorship, Democracy, and Development. *American Political Science Review* 87(3): 567-576.
- Panayotou, T. 1993. Empirical Tests and Policy Analysis of Environmental Degradation at Different Stages of Economic Development. Working Paper WP238, Geneva: Technology and Employment Programme, International Labour Office.
- Payne, R. A. 1995. Freedom and the Environment. *Journal of Democracy* 6(3): 41-55.
- Pelligrini, L. and R. Gerlagh. 2006. Corruption, Democracy, and Environmental Policy. *Journal of Environment and Development* 15(3): 332-354.
- Perman, R. and D. I. Stern. 2003. Evidence from Panel Unit Root and Cointegration Tests that the Environmental Kuznets Curve Does Not Exist. *Australian Journal of Agricultural and Resource Economics* 47: 325-347.
- Persson, T. and G. Tabellini. 2009. Democratic Capital: The Nexus of Political and Economic Change. *American Economic Journal: Macroeconomics* 1(2): 88-126.
- Pew Research Center. 2013. *Climate Change and Financial Instability Seen as Top Global Threats*. Washington, DC: Pew Research Center.
- Scruggs, L. A. 1998. Political and Economic Inequality and the Environment. *Ecological Economics* 26: 259-275.
- Shafik, N. and S. Bandyopadhyay. 1992. Economic Growth and Environmental Quality: Time Series and Cross-country Evidence. Background Paper for the World Development Report 1992, Washington, DC: World Bank.
- Shearman, D. J. C. and J. W. Smith. 2007. *The Climate Change Challenge and the Failure of Democracy*. Westport, CT: Praeger.
- Shin, S. 2013. China's Failure of Policy Innovation: The Case of Sulphur Dioxide Emission Trading. *Environmental Politics* 22(6): 918-934.
- Stern, D. I. 2004. The Rise and Fall of the Environmental Kuznets Curve. *World Development* 32(8): 1419-1439.
- Torras, M. and J. K. Boyce. 1998. Income, Inequality, and Pollution: A Reas-

- assessment of the Environmental Kuznets Curve. *Ecological Economics* 25: 147-160.
- Vona, F. and F. Patriarca. 2011. Income Inequality and the Development of Environmental Technologies. *Ecological Economics* 70(11): 2201-2213.
- Weidner, H. and M. Janicke (Eds.). 2002. *Capacity Building in National Environmental Policy: A Comparative Study of 17 Countries*. New York: Springer.
- Welsch, H. 2004. Corruption, Growth, and the Environment: A Cross-Country Analysis. *Environment and Development Economics* 9: 663-693.
- Wilson, J. K. and R. Damania. 2005. Corruption, Political Competition and Environmental Policy. *Journal of Environmental Economics and Management* 49(3): 516-535.
- Winslow, M. 2005. Is Democracy Good for the Environment? *Journal of Environmental Planning and Management* 48(5): 771-783.
- World Bank. 1992. *World Development Report 1992: Development and the Environment*. New York: Oxford University Press.
- World Commission on Environment and Development. 1987. *Our Common Future*. Oxford University Press, Oxford.

APPENDIX A: DESCRIPTIVE DATA FOR SELECT VARIABLES

Overall EPI Rank	Country	Environmental Health	Ecosystem Vitality	GDP per capita (US\$)	Voice and Accountability	Control of Corruption
1	SWITZERLAND	98.9	92.1	32,775	95.6	96.4
2	SWEDEN	99.4	86.9	30,392	97.7	98.4
3	NORWAY	99.3	86.9	37,667	97.6	97.5
4	FINLAND	99.3	83.6	30,420	98.0	99.9
5	COSTA RICA	93.2	87.7	9,646	82.5	76.6
6	AUSTRIA	98.1	80.7	30,736	92.3	94.5
7	NEW ZEALAND	99.0	78.8	23,109	98.7	98.5
8	COLOMBIA	91.4	85.2	6,886	35.9	38.9
9	FRANCE	99.4	76.2	28,877	85.4	90.8
10	ICELAND	99.3	75.8	33,610	95.4	96.8
11	CANADA	98.9	74.4	30,278	96.6	94.8
12	GERMANY	99.4	73.3	27,438	92.6	94.2
13	UNITED KINGDOM	99.4	73.2	30,237	89.4	95.2
14	SLOVENIA	97.8	74.8	20,890	84.1	81.0
15	SLOVAKIA	99.1	72.9	15,409	72.5	64.7
16	PORTUGAL	98.4	73.1	18,966	91.1	87.4
17	JAPAN	98.3	70.8	27,992	76.6	86.6
18	ECUADOR	91.7	77.0	3,982	43.9	21.8
19	HUNGARY	98.4	70.1	16,928	85.3	74.0
20	ITALY	98.6	69.8	26,496	80.7	75.1
30	BRAZIL	86.9	78.4	7,826	56.7	55.3
40	MEXICO	91.3	68.3	9,967	51.6	42.8
50	PERU	78.3	77.9	5,725	44.2	46.9
60	JORDAN	91.7	61.4	5,176	33.7	60.0
70	NEPAL	60.2	84.0	1,379	31.7	39.3
80	CONGO	51.0	88.4	1,159	17.7	13.9
90	MYANMAR	63.9	66.3	1,800	0.6	3.2
100	TOGO	52.0	72.6	1,306	13.0	23.9
128	NIGER	6.0	72.1	700	31.0	19.7
Average		73.3	70.3	9,743	46.1	47.1
SD		25.7	10.1	10,691	28.6	29.2
Min		6.0	38.2	630	0.6	1.9
Max		99.4	92.8	38,165	98.7	99.9

NOTE: a. The value underlying the 2008 EPI ranking is the overall EPI score, which is the simple average of the values for Environmental Health and Ecosystem Vitality whose component indicators are illustrated in Figure 1 (source: Esty et al. 2008).

b. GDP per capita is for 2008 in US dollars (source: Esty et al. 2008).

c. Voice and Accountability and Control of Corruption are expressed in terms of percentile ranking and represent the average annual values for the period 1996-2006 (source: Kaufmann et al. 2007).

ENDNOTES

- ¹ In China, 39% of respondents designated climate change as a “major threat” while an additional 36% designated it as a “minor threat.” In the USA, 40% of respondents designated climate change as a “major threat” while 37% designated it as a “minor threat.” Interestingly, more Americans were concerned about China’s power and influence, with 44% and 38% describing it as a major or minor threat, respectively. Correspondingly, when Chinese were asked about American power and influence, 39% and 40% described it as a major or minor threat, respectively (Pew Research Center 2013).
- ² A more current example of the call for environmental authoritarianism and rejection of democracy is Shearman and Smith (2007). Gilley (2011, 294) states that is notable that Shearman and Smith “was translated and published in China by the prestigious cabinet-level Chinese Academy of Social Sciences within two years of its original appearance, whereas influential works on ‘democratic environmentalism’ remain unavailable in China.”
- ³ We chose to examine EPI data for 2008 because we are interested in examining how political institutions, measured over the course of a multi-year period, affect subsequent environmental policy outcomes. As our data on political institutions spans the period 1996–2006, we chose the subsequent EPI data for 2008. As for why a multi-year period reflecting “democratic capital” is preferable to a single year, this was briefly explained above and is discussed in greater detail in Persson and Tabellin (2009) and Fredriksson and Neumayer (2013).
- ⁴ A study by Kelleher and Kim (2007) also examined the relationship between environmental performance measures and political variables within a framework that is similar to the one pursued here. However, that study differs from this research in several important ways. First, whereas that preliminary study used data from the initial 2006 Pilot EPI study, the data used here are from the substantially restructured and updated 2008 EPI study. Second, the Kelleher and Kim (2007) study confined itself to political variables that were embedded in the 2005 ESI, whereas this study uses updated data directly from the World Bank for the period of 1996–2006. As a result of using different data for both dependent and independent variables, our findings differ significantly from those obtained in the 2007 study. Another study which examines the 2008 EPI data but with different political variables and a different approach is Mukherjee and Chakraborty (2013).
- ⁵ The 128 countries used in the analysis were chosen on the basis of data availability. This was the maximum number of countries for which we had EPI data as well as data for the principal independent variables of interest.
- ⁶ See Esty et al. (2008, 20–21 and Appendix E) for weights, data sources, and targets for the various indicators and policy categories.
- ⁷ The “liberties” variable is constructed from the oft-used Freedom House measures of the civil liberties and political liberties in countries. Their measurement scale (1–7) assigns lower values to higher levels of liberty (i.e. countries with the maximum civil/political liberties are assigned values of 1). Thus, we would expect a negative correlation with environmental performance.
- ⁸ This variable was originally used in the 2005 Environmental Sustainability Index (ESI) (Esty et al. 2005, 333) that was developed by the same consortium that created the 2006 and 2008 EPI measures that supplanted it. See Esty et al. (2008, Appendix D) for a discussion of the differences between the 2005 ESI, 2006 EPI, and 2008 EPI.
- ⁹ This composite indicator of private sector capacity, or responsiveness, consists of 5 measures: Dow Jones Sustainability Group Index; average Innovest EcoValue rating of firms headquartered in a country; number of ISO 14001 companies; World Economic Forum Survey on private sector innovation; and participation in the Responsible Care Program of the Chemical Manufacturer’s Association (Esty et al. 2005, 15).
- ¹⁰ This composite indicator of institutional capacity in science and technology consists of 5 measures: innovation index, digital access index, female primary education completion rate, gross tertiary enrollment rate, and number of researchers per million inhabitants (Esty et al. 2005, 15).
- ¹¹ This variable attempts to measure the creation and dissemination of environmental knowledge by examining authorship of publications in nine leading peer-reviewed journals in the environmental science, technology, and policy fields (Esty et al. 2005, 313).

-
- ¹² In this table and the tables to follow, * = 10% level of significance, ** = 5% level of significance, *** = 1% level of significance. Significance values for the constant term are ignored. For each variable, coefficient estimates are given with t-statistics placed in parentheses directly underneath.
- ¹³ The simple regression between EPI and the natural log of per capita income yields a coefficient estimate of 3.691 with an associated probability of 0.0001.
- ¹⁴ Recall that *liberties*, due to variable construction, should be negatively correlated with environmental performance.
- ¹⁵ The simple regression between “environmental health” and the natural log of per capita income yields a coefficient estimate of 7.302 with an associated probability of 0.0001.
- ¹⁶ The simple regression between “ecosystem vitality” and the natural log of per capita income yields a coefficient estimate of 0.0796 with an associated probability of 0.9151.
- ¹⁷ Although the question of whether per capita CO₂ emissions ultimately decline at some point, in keeping with the EKC hypothesis, is the subject of considerable debate.
- ¹⁸ The choice of *voice* and *corrupt* also reflects the fact that a series of exploratory regressions revealed that the initial promise of *polity* and *liberties* noted in Table 2 was fleeting, while *voice* and *corrupt* appeared to be more consistent variables.
- ¹⁹ The three subcategories of environmental health are: 1) environmental burden of disease; 2) water (effects on humans); and 3) air pollution (effects on humans). Analyses (not shown) reveal virtually no difference among these subcategories in terms of explanatory value of the independent variables. The results are very similar to those for the broad category of environmental health shown in Table 4.
- ²⁰ Estimates for Models 2.4 and 2.9 differ slightly from Models 4.1 and 4.2 because the latter models (indeed all the models in Table 4-Table 12) use White heteroskedasticity-consistent standard errors and covariance.