POLICY RESEARCH WORKING PAPER 1448

Environmental Regulation and Development

A Cross-Country Empirical Analysis

Susmita Dasgupta
Ashoka Mody
Subhendu Roy
David Wheeler

Environmental protection has not been restricted to wealthy nations. Starting at the lowest level of development, regulation increases steadily with income per capita. The characteristic progression is from natural resource protection, through regulation of water pollution, to air pollution control.

The World Bank
Policy Research Department
Environment, Infrastructure, and Agriculture Division
April 1995

Policy Research Working Paper 1448

Summary findings

Dasgupta, Mody, Roy, and Wheeler develop comparative indices of environmental policy and performance for 31 countries using a quantified analysis of reports prepared for the United Nations Conference on Environment and Development.

In cross-country regressions, they find a very strong, continuous association between their indicators and national income per capita, particularly when adjusted for purchasing power parity.

Their results suggest a characteristic progression in development. Poor agrarian economies focus first on natural resource protection. With increased urbanization and industrialization, countries move from initial regulation of water pollution to air pollution control

The authors highlight the importance of institutional development. Environmental regulation is more advanced in developing countries with relatively secure property rights, effective legal and judicial systems, and efficient public administration.

This paper — a product of the Environment, Infrastructure, and Agriculture Division, Policy Research Department — is part of a larger effort in the department to study the relationship between environmental regulation and economic development. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Elizabeth Schaper, room N10-037, extension 33457 (27 pages). April 1995.

ENVIRONMENTAL REGULATION AND DEVELOPMENT: A CROSS-COUNTRY EMPIRICAL ANALYSIS

by

Susmita Dasgupta*
Ashoka Mody
Subhendu Roy
David Wheeler

* S. Dasgupta and S. Roy are Consultants and D. Wheeler is Principal Economist in the Environment, Infrastructure and Agriculture Division of the World Bank's Policy Research Department. A. Mody is Principal Economist in the Private Sector Development and Privatization Division of the World Bank's Cofinancing and Financial Advisory Services Department.

EXECUTIVE SUMMARY

Since the Stockholm Conference on Environment and Development in 1972, many countries have taken steps to mitigate environmental damage. More systematic comparative analysis of countries' environmental performance would undoubtedly help clarify the major policy issues and options. Unfortunately, comparable data on regulatory measures are available only for developed countries, and even these data are frequently scanty.

In this paper, we undertake a comparative assessment using environmental reports presented to the United Nations Conference on Environment and Development (UNCED, 1992) by 145 countries. From the information in these reports, we have developed a set of indicators which measure the status of environmental policy and performance. This paper describes our methodology, the indices, and some results from a statistical analysis of their relationship to other more conventional measures of socioeconomic development.

The UNCED reports are similar in form as well as coverage, and permit cross-country comparisons. To an impressive degree, they seem to reflect real environmental conditions and issues. For this exercise, we have randomly selected 31 UNCED reports from the total of 145 (see Table 2A, p. 6). These 31 countries range from highly industrialized to extremely poor, they are drawn from every world region, and they range in size and diversity from China to Jamaica.

Our analysis focuses on three dimensions of environmental policy and performance: Overall, "Green" sector, and "Brown" sector. We develop and test a set of hypotheses about regulatory development which can be summarized as follows:

- Overall environmental performance should be positively correlated with:

  1) Income per capita;
  2) Degree of popular representation;
  3) Freedom of information;
  4) Security of property rights;
  5) Development of the legal and regulatory system.

  Controlling for these variables,

- "Green" sector indices should be positively correlated with:

  1) Rural population density;
  2) Agricultural and forest production share of national output.

- "Brown" sectors indices should be positively correlated with:

  1) Particular focus on public health, indexed by life expectancy;
  2) Urban share of total population;
  3) Urban population density;
  4) Manufacturing share of national output.

Our analysis of overall regulatory performance reveals strong cross-country associations with income per capita, security of property rights, and general development of the legal and regulatory system. Surprisingly, however, we find only insignificant or perverse associations with degree of popular representation and freedom of information.

For both the Green and Brown indices, performance is again strongly associated with income per capita, freedom of property and (in small samples) measures of regulatory efficiency. The two specifically rural-sector variables (population density; proportion of GDP in agriculture and forestry) are only weakly associated with the Green index. The fit is much better for the Brown index: degree of urbanization, population density and manufacturing share in GDP all have the expected signs and relatively high significance. Life expectancy as a proxy for public health priority has no independent effect.

In summary, our findings suggest that a detailed, quantified analysis of the UNCED reports can yield comparable and plausible indices of environmental policy performance across countries. Cross-country variations in our environmental index are well-explained by variations in income per capita, degree of urbanization and industrialization, security of property rights, and general administrative efficiency.

1. Introduction

Since the Stockholm Conference on Environment and Development in 1972, many countries have taken steps to mitigate environmental damage. General environmental legislation is already common, although detailed rules and regulations are still far from universal. In many developing countries, it is clear that enforcement of environmental laws has been hampered by inadequate staffing and funding. Anecdotes abound, but more systematic comparative analysis of countries' environmental performance would undoubtedly help clarify the major policy issues and options. Unfortunately, comparable data on regulatory measures are available only for developed countries, and even these data are frequently scanty.

At present, therefore, comparative analysis must begin with basic data construction. One promising source is the set of environmental reports presented to the United Nations Conference on Environment and Development (UNCED, 1992) by 145 countries. The reports are reasonably comparable because the UN imposed a standard reporting format.

Using a multidimensional survey of 31 national UNCED reports, we have developed a set of comparative indices for the status of environmental policy and performance. This paper describes our methodology, the indices, and some results from a statistical analysis of their relationship to other more

conventional measures of socioeconomic development. In the following section, we begin with a description of the UNCED reports. Section 3 explains our indexing method, while Section 4 sets out some preliminary hypotheses about the relationships linking environmental policy and performance to socioeconomic development. Section 5 reports and discusses some statistical tests of the hypotheses; and Section 6 concludes the paper.

2. The UNCED Reports

As part of the preparations for the United Nations Conference on Environment and Development (UNCED - Rio de Janeiro, June 1992), all UN member governments were asked to prepare national environmental reports. Detailed preparation guidelines were laid down at the First Preparatory Committee meeting in Nairobi in August, 1990.[1] The UNCED secretariat suggested that the reports be prepared by working groups representing government, business and non-governmental organizations (NGO's). The guidelines recommended that the reports provide information on: (i) the drafting process; (ii) problem areas; (iii) past and present capacity building initiatives; (iv) recommendations and priorities for environment and development; (v) financial arrangements and funding requirements; (vi) environmentally sound technologies;

[1] United Nations General Assembly document A/CONF.151/PC/8 and A/CONF.151/PC/8/Add.1

(vii) international cooperation; and (viii) expectations about UNCED.

The resulting reports are similar in form as well as coverage, and permit cross-country comparisons. Undoubtedly, the participation of NGO's has helped assure that the UNCED reports are not mere government handouts. To a striking degree, they seem to reflect real environmental conditions and issues. While we recognize that self-reporting always carries the risk of misrepresentation, we should also note that almost all currently available environmental information is self-reported by firms and governments. The UNCED reports differ principally in the absence of any formal sanction for misreporting.

3. Quantifying Environmental Performance

For this exercise, we have randomly selected 31 UNCED reports from the total of 145 (see Table 2A, p. 6). These 31 countries range from highly industrialized to extremely poor, they are drawn from every world region, and they range in size and diversity from China to Jamaica.

Our survey considers the state of policy and performance in four environmental dimensions: Air, Water, Land and Living Resources. We analyze the apparent state of policy as it affects the interactions between these four environmental dimensions and five activity categories: Agriculture, Industry, Energy, Transport and the Urban Sector. Although many overlaps

undoubtedly exist, we attempt to draw a separate assessment for the interaction of each activity category with each environmental dimension.

Our survey assessment uses twenty five questions to categorize the state of (i) environmental awareness; (ii) scope of policies adopted; (iii) scope of legislation enacted; (iv) control mechanisms in place; and (v) the degree of success in implementation.[2] The status in each category is graded "High, Medium, Low," with assigned values of 2, 1 and 0 respectively. For each UNCED country report, all twenty-five questions are answered for each element of the matrix in Table 1. With 20 elements in the matrix, 500 assessment scores are developed for each country.

We compute four composite indices by adding scores within each environmental dimension. We also calculate a total score to provide a composite index of the state of environmental policy and performance. Finally, we have used our scoring system to establish separate indices for three particularly interesting policy dimensions: the extent of environmental awareness; enactment of policies; and success in implementation. We use all three sets of indices for the cross-country analysis reported in Section 5.

---

[2] The survey instrument is included in the Appendix. All country scores are available on request.

Table 1

Evaluation Format

Sector/ Activity	Air	Water	Land	Living Resources
Agriculture				
Industry				
Energy				
Transport				
Urban				

Using the four dimensional indices and a composite index, we summarize our results as country rankings in Table 2A. Actual values are displayed in Table 2B. Table 2A also ranks countries on the basis of per capita GNP (PCGNP) and per capita GDP estimates compiled by the UN International Comparisons Program (ICPGDP). The ICPGDP computation explicitly adjusts the standard income data to take account of purchasing power parity. Where countries in our sample are not covered in the most recent International Comparisons Program Study (Phase V, 1985), we have adopted a World Bank estimate. The 1985 figures have been extrapolated to 1990 using World Bank estimates of real per capita GDP growth.

Table 3 presents summary statistics for the four dimensional performance indices, whose possible maximum values are all 250. The results suggest fairly similar distributions with the exception of Air, which has a significantly lower mean and greater variance. Our statistical results suggest that air pollution gets relatively low priority in poor countries but

Table 2A
Sample Country Rankings:
Income and Environmental Performance Indices

Country	PCGNP	ICPGDP	Air	Water	Land	Living Resources	Total
Switzerland	1	1	2	2	2	1	2
Finland	2	3	4	3	3	4	4
Germany	3	2	1	1	1	2	1
Netherlands	4	4	3	4	4	3	3
Ireland	5	5	5	5	4	5	5
Korea	6	8	7	7	8	7	7
Trinidad	7	6	10	11	11	12	11
Brazil	8	10	12	16	16	13	15
S.Africa	9	9	8	9	9	10	9
Bulgaria	10	7	6	6	6	6	6
Jamaica	11	16	11	8	7	8	8
Tunisia	12	13	9	10	10	11	10
Thailand	13	11	15	24	18	23	19
Jordan	14	12	17	14	15	22	16
Paraguay	15	14	24	20	20	17	21
Papua NG	16	21	28	27	29	30	29
Philippines	17	17	18	24	20	18	20
Egypt	18	15	21	12	24	27	22
Zambia	19	26	22	23	20	20	23
Ghana	20	20	18	19	18	18	17
Pakistan	21	19	13	14	13	13	13
China	22	18	15	16	12	9	12
Kenya	23	24	23	16	16	16	18
India	24	23	13	13	14	14	14
Nigeria	25	22	26	21	25	24	24
Bangladesh	26	25	25	29	27	29	26
Malawi	27	27	18	22	23	21	27
Bhutan	28	30	30	31	30	28	30
Ethiopia	29	31	31	30	31	31	31
Tanzania	30	29	29	28	28	26	28
Mozambique	31	28	27	26	26	25	25

Table 2B
Sample Country Data
Income and Environmental Performance Indices

Country	PCGNP ($1990)	ICPODP (I$1990)	Air	Water	Land	Living Resources	Env
Switzerland	32,680	21,690	231	240	238	238	947
Finland	26,040	15,620	214	229	231	220	894
[illegible]rmany	22,320	16,920	236	242	241	232	951
Netherlands	17,320	14,600	219	226	229	226	900
Ireland	9,550	9,130	203	223	229	216	871
Korea	5,400	7,190	150	170	189	177	686
Trinidad	3,610	8,510	118	149	159	138	564
Brazil	2,680	4,780	113	127	130	123	15
S.Africa	2,530	5,500	136	165	173	145	619
Bulgaria	2,250	7,900	168	198	199	185	750
Jamaica	1,500	3,030	114	168	193	158	633
Tunisia	1,440	3,979	128	158	161	142	589
Thailand	1,420	4,610	98	113	129	109	449
Jordan	1,240	4,530	95	131	138	110	474
Paraguay	1,110	3,120	84	117	123	119	443
Papua NG	860	1,500	54	91	100	84	329
Philippines	730	2,320	93	113	123	118	447
Egypt	600	3,100	92	134	118	97	441
Zambia	420	810	87	115	123	114	439
Ghana	390	1,720	93	124	129	118	464
Pakistan	380	1,770	105	131	144	128	508
China	370	1,950	98	127	151	153	529
Kenya	370	1,120	85	127	130	121	463
India	350	1,150	105	132	143	127	507
Nigeria	290	1,420	75	106	114	105	400
Bangladesh	210	1,050	77	89	109	91	366
Malawi	200	670	93	116	122	111	352
Bhutan	190	510	39	54	70	93	256
Ethiopia	120	310	20	56	67	75	218
Tanzania	110	540	50	90	103	98	341
Mozambique	80	620	56	98	112	102	378

increases more rapidly in importance with income. By contrast, low income countries such as Tanzania, Mozambique, Bhutan and Bangladesh seem to focus first on the natural resources which are critical to their livelihood -- soils, forests and water.

Table 3

Indices of Environmental Policy-Summary Measures for 31 Countries

Resource	Mean	s.d.	Maximum	Minimum
Air	113.84	56.61	236.0	20.0
Water	140.61	50.91	242.0	54.0
Land	149.03	48.26	241.0	67.0
Living	137.84	46.70	238.0	75.0

4. The Political Economy of Environmental Management: Some Preliminary Hypotheses

Environmental degradation affects national welfare by damaging human health, economic activities and ecosystems. Because environmental problems represent a classic externality, some government regulation is generally warranted. From an economist's perspective, desirable regulation should weigh two factors: the benefits associated with reduced environmental damage and the opportunity cost of mitigation. In reality, the extent and focus of government intervention will also reflect national political and institutional considerations.

4.1 Benefits

The demand for environmental quality should increase with income per capita, and we would expect this to be strongly reflected in the country scores. In addition, demographic and sectoral differences may play an important role. For example, economies with high rural population densities and heavy dependence on agriculture and forest extraction should be particularly concerned with agricultural water supply, soil erosion, and deforestation. In our Evaluation Format (Table 1), the relevant scoring cells are located at the intersection of Agriculture with Water, Land and Living Resources.[3] If environmental policy reflects basic economic considerations in resource-dependent economies, we would expect country scores in these dimensions to be positively correlated (ceteris paribus) with rural population density and the share of agricultural and forest production in national output.

By contrast, urbanized and industrialized economies should exhibit more concern with the potential health impacts of air and water pollution on densely populated areas. The relevant cells in this context are located at the intersections of the Air and Water columns with Industry, Energy, Transport and Urban. We would expect country scores in these dimensions to be correlated with the urban share of national population, urban population density, and the share of manufacturing in national output.

---

[3] Agriculture includes wood production from plantations and primary forests.

4.2 Opportunity Costs

Governments must make resource allocation decisions with constrained budgets, so we would expect the benefits of environmental improvement to be weighed against opportunity costs. In particular, environmental management has to share a limited social welfare budget with public health, education and other needs. Therefore the poorer the country, the more limited environmental management resources are likely to be. This should be another source of positive correlation between income per capita and country scores.

4.3 Political Economy

Political and institutional factors may also contribute significantly to cross-country variation in environmental policy and performance. Attention to environmental problems should reflect the political power of affected interest groups, the quality of their information about environmental damage, and the effectiveness of legal and regulatory institutions. Many environmental problems pit broad public interests against the profitable pursuit of manufacturing and extraction. Thus, we might expect our environmental performance indices to be correlated with measures of degree of popular representation, freedom of information and education. Performance should also be superior where legal and regulatory systems are relatively efficient. Finally, environmental objectives may be promoted

more strongly in economies where secure property rights lead to longer planning horizons.

4.4 Predicted Relationships

Within this simple framework, we can make some predictions about the probable strength and direction of empirical relationships across our sample countries. We consider cross-country variations in three sets of indices: (1) Overall policy and performance, along with separate scores for Air, Water, Land and Living Resources; (2) a "Green" index (interaction of Agriculture with Water, Land and Living Resources) and (3) a "Brown" index (interaction of Industry, Energy, Transport and Urban with Air and Water). We have also decomposed the Green and Brown indices into three subindices: Awareness of environmental problems; enactment of regulations; and success in implementation. However, as Table 4 indicates, the subindices are so highly correlated with the composite indices that more detailed analysis seems unnecessary.

Table 4

Correlation Matrix:
Component Scores

Green Subindices

	Composite	Awareness	Enactment	Success
Composite	1			
Awareness	.906	1		
Enactment	.982	.858	1	
Success	.968	.866	.910	1

Brown Subindices

	Composite	Awareness	Enactment	Success
Composite	1			
Awareness	.953	1		
Enactment	.989	.926	1	
Success	.984	.934	.951	1

To summarize briefly, the following predictions are consistent with our hypotheses:

- Overall environmental performance should be positively correlated with:

  1) Income per capita;
  2) Degree of popular representation;
  3) Freedom of information;
  4) Security of property rights;
  5) Development of the legal and regulatory system.

  Controlling for these variables,

- Green indices should be positively correlated with:

  1) Rural population density;
  2) Agricultural and forest production share of national output.

- Brown indices should be positively correlated with:

  1) Particular focus on public health, indexed by life expectancy[4];
  2) Urban share of total population;
  3) Urban population density;
  4) Manufacturing share of national output.

[4] We recognize some risk of endogeneity, but we regard it as minimal in this case. Life expectancy is influenced by many policy and other variables which are not directly related to environmental concerns.

5. Results

5.1 Income and Environmental Performance

The correlation between income and composite environmental rankings is clear in Table 2A. Comparisons of bivariate regressions on the two income measures, recorded in Tables 5A and 5B, reveal significantly tighter fits for ICPGDP. The income elasticity of environmental policy performance is positive and highly significant in all environmental dimensions. Air seems to have a much higher income elasticity than the others. The scatter of the composite environmental index (Env) against ICPGDP (Figure 1) indicates that the relationship is continuous over the entire range of incomes.

5.2 Political Economy and Institutional Variables

For the reasons previously noted, effective environmental management may be seriously handicapped by lack of political, civil, and economic liberty; lack of an independent judicial system; and an inefficient or corrupt bureaucracy. To test these ideas, we have fitted regressions with several sets of institutional indicators previously used in the literature. In each case, limited availability of the indicators has forced us to run regressions on subsamples of countries.

Our first test employs a widely-used set of political, civil and economic liberty indicators developed by Gastil.[5] These

[5] See Scully (1992) for details.

Table 5A

Impact of PCGNP on Environmental Indicators*

Dependent Variable	Intercept	ln PCGNP	Adjusted R^2
ln Air	2.70 (11.93)	0.27 (8.70)	0.71
ln Water	3.55 (22.84)	0.19 (8.80)	0.72
ln Land	3.79 (27.70)	0.17 (8.75)	0.72
ln Living	3.73 (29.60)	0.16 (9.26)	0.74
ln Env	4.89 (34.80)	0.19 (9.78)	0.76

* t-statistics in parentheses.

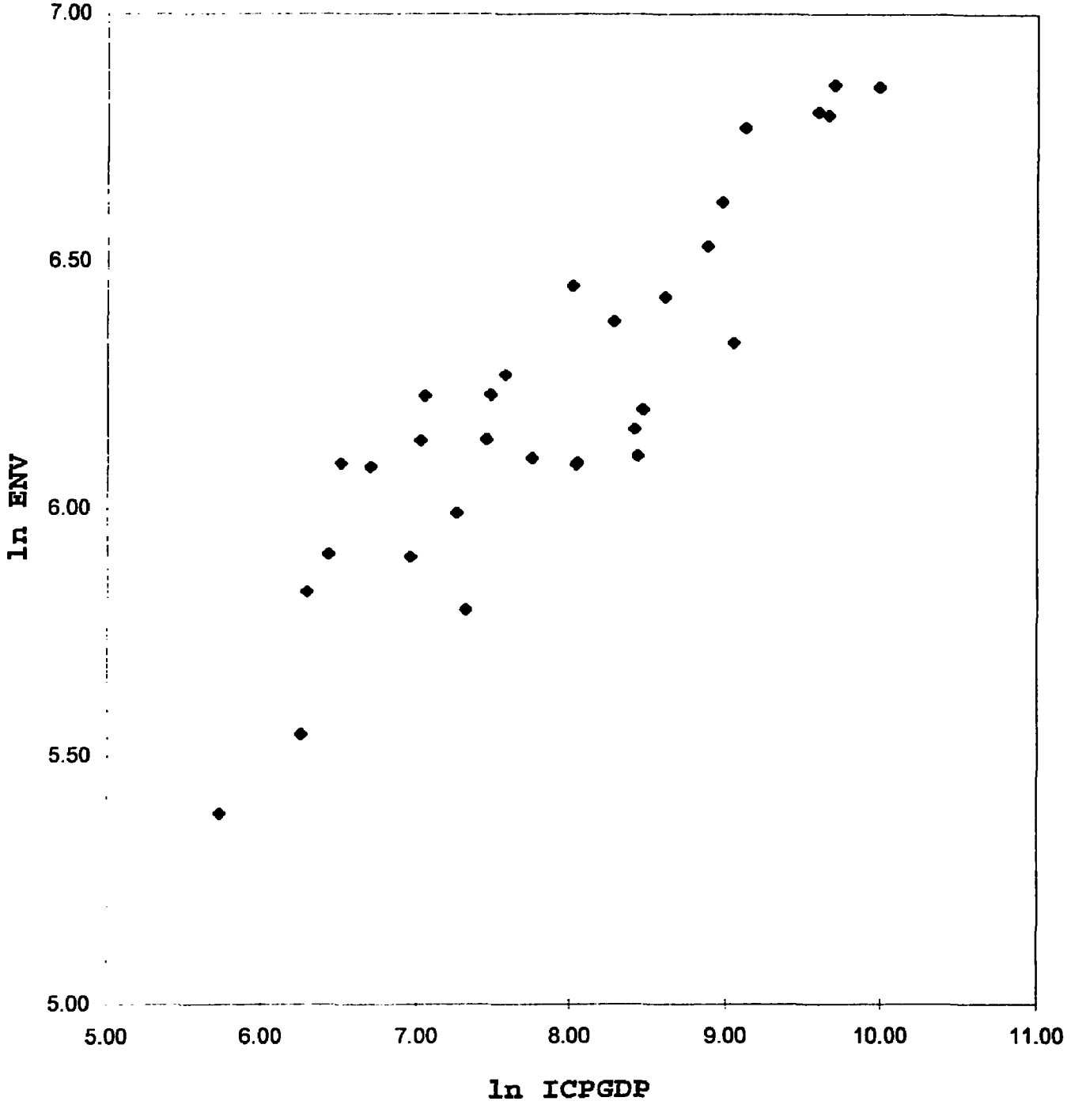
Table 5B

Impact of ICPGDP on Environmental Indicators

Dependent Variable	Intercept	ln ICPGDP	Adjusted R^2
ln Air	1.29 (4.06)	0.42 (10.59)	0.79
ln Water	2.59 (11.53)	0.30 (10.30)	0.78
ln Land	2.97 (14.52)	0.25 (9.82)	0.76
ln Living	3.03 (13.88)	0.23 (8.53)	0.71
ln Env	3.97 (18.72)	0.29 (10.79)	0.79

Figure 1

Overall Environmental Performance vs. ICP Income Per Capita



indicators are available for 29 of our selected 31 countries. Among the aspects that appear most relevant for our study are: freedom of property (FOP), freedom of information (FOI), freedom of print media (FPM), freedom of broadcast media (FBM), freedom of peaceful assembly (FPA) and the Gastil-Wright classification of types of economic system (TES) by degree of commercial freedom. In our regressions, only FOP and FOI are statistically significant (Table 6). Each of these indicators is coded 1 to 5, with higher scores for lower liberty, so the expected sign of the coefficients is negative for both indicators. Freedom of property has the expected sign, but the other result is quite surprising: Controlling for income and property rights, greater freedom of information is associated with lower environmental index values. We have no explanation for this anomaly, and we have dropped FOI from our final regressions (Table 9).

Table 6

Impact of Liberty Indexes on Environmental Indicators

Dependent Variable	Intercept	ln ICPGDP	ln FOP	ln FOI	Adjusted R^2
ln Air	1.42 (2.97)	0.41 (8.17)	-0.36 (-2.39)	0.27 (2.24)	0.80
ln Water	2.86 (9.54)	0.27 (8.44)	-0.26 (-2.80)	0.18 (2.38)	0.82
ln Land	3.17 (10.28)	0.23 (7.16)	-0.18 (-1.90)	0.12 (1.57)	0.77
ln Living	3.22 (9.57)	0.22 (6.27)	-0.27 (-2.57)	0.16 (1.90)	0.74
ln Env	4.18 (13.43)	0.27 (8.25)	-0.26 (-2.72)	0.18 (2.25)	0.82

As a second test, we have employed measures of bureaucratic delay and contract enforceability (or relative degree to which contractual agreements are honored) from Business Environmental Risk Intelligence, Inc. (BERI).[6] Scores for the BERI indicators are available for only fourteen of our thirty-one countries and are set so that positive relationships with environmental

Table 7

Impact of BERI Indexes on Environmental Indicators

Dependent Variable	Intercept	ln ICPGDP	ln Delay	ln Contract	Adjusted R^2
ln Air	1.99 (3.48)	0.32 (3.23)	0.19 (0.56)		0.81
ln Water	3.21 (6.19)	0.18 (2.04)	0.31 (1.00)		0.72
ln Land	3.25 (6.18)	0.20 (2.19)	0.18 (0.57)		0.68
ln Living	2.99 (4.87)	0.21 (1.99)	0.24 (0.64)		0.66
ln Env	4.29 (7.96)	0.22 (2.40)	0.23 (0.72)		0.74
ln Air	2.05 (2.24)	0.32 (2.10)		0.16 (0.34)	0.81
ln Water	3.45 (4.15)	0.15 (1.11)		0.35 (0.82)	0.72
ln Land	3.43 (4.12)	0.18 (1.26)		0.22 (0.52)	0.68
ln Living	3.01 (3.06)	0.22 (1.34)		0.17 (0.33)	0.65
ln Env	4.42 (5.13)	0.21 (1.47)		0.23 (0.52)	0.73

[6] For a discussion of these indicators, see Keefer and Knack (1993).

management would be consistent with our prior hypotheses about the effect of judicial and administrative efficiency. The regression coefficients are positive, as expected, but none are statistically significant (Table 7).

Finally, we have tested a set of indicators which directly reflect the efficiency of the legal and judicial system (LJS) and the level of red tape in the bureaucracy (RTB). These were developed by the Country Assessment Service of Business International, Inc.[7] Unfortunately, the measures are available for only twelve of the thirty-one countries in our sample. In separate regressions for this subset of countries, both LJS and RTB emerge as significant explanatory variables. Since they are collinear, we have computed their first principal component (PC1) and used it as a composite regressor. When it is included with ICPGDP (Table 8) the results show substantial improvement in the explanatory power of the regressions: The adjusted R^2 increases between 9% and 24%. The change in outliers indicates that the improvement is especially striking for Ireland, India and Thailand.

5.3 Green and Brown Indices

For both Green and Brown indices, the regressions reported in Table 9 suggest that performance is again strongly associated

---

[7] See Wheeler and Mody (1992) for details.

with income per capita, freedom of property and (in small samples) measures of regulatory efficiency. The two rural-sector variables (population density; proportion of GDP in agriculture and forestry) are only weakly associated with the Green index (Table 9a). The fit is much better for the Brown index: degree of urbanization, population density and manufacturing share in GDP all have the expected signs and relatively high significance (Table 9b). Life expectancy as a proxy for public health priority has no independent effect.

6. Summary

Using a multidimensional survey analysis of the UNCED reports, we have developed a set of comparative indices of environmental policy and performance in thirty-one countries. We find a strong positive correlation between our environmental indicators and the level of economic development. The fit is substantially better when national incomes are adjusted for purchasing power parity. The income elasticity of the indices is positive and highly significant in all environmental dimensions. The pattern of elasticities suggests that protection measures for land and living resources precede those for water; action for reducing air pollution comes later.

Some impact for institutional development is also suggested by our results, although the information base is quite limited.

Table 8

Impact of ICPGDP, LJS and RTB on Environmental Indicators

Dependent Variable	Intercept	ln ICPGDP	PC1	Adjusted R^2
ln Air	1.60 (2.91)	0.38 (6.02)		0.76
ln Air	3.35 (8.81)	0.18 (4.07)	0.26 (6.18)	0.95
ln Water	2.59 (5.57)	0.29 (5.35)		0.72
ln Water	4.13 (16.68)	0.11 (3.73)	0.23 (8.37)	0.96
ln Land	2.79 (6.19)	0.27 (5.16)		0.70
ln Land	4.20 (13.15)	0.10 (2.78)	0.21 (5.96)	0.93
ln Living	2.79 (6.19)	0.27 (5.16)		0.70
ln Living	4.05 (9.12)	0.11 (2.15)	0.24 (4.91)	0.90
ln Env	3.77 (7.79)	0.31 (5.48)		0.73
ln Env	5.35 (18.08)	0.12 (3.58)	0.23 (7.15)	0.95

The level of explanation in all regressions improves significantly with the addition of the Business International effectiveness indices for legal/judicial and administrative systems and the Gastil measure of property rights protection. Similar BERI measures are not significant, however. We also obtain insignificant or perverse results for all Gastil measures of degree of popular representation and freedom of information.

Table 9a

Regression Results for ln(Green)

Intercept	lnPCGNP	ln ICPGDP	ln FOP	ln(Share of agriculture in GDP)	ln (Pop. density)	Adjusted R^2
3.31 (25.55)	0.16 (8.66)					0.71
2.60 (12.29)		0.23 (8.65)				0.71
2.75 (4.69)		0.20 (3.85)	-0.11 (-1.31)	0.06 (0.93)	0.09 (1.32)	0 64
3.27 (11.11)		0.17 (5.38)	-0.16 (2.19)		0.09 (1.34)	0.73

Table 9b

Regression Results for ln(Brown)

Intercp	lnPCGNP	lnICPGDP	ln FOP	ln(Urban /total popula-tion)	ln(Popu-lation density)	ln (Manuf. share of GDP)	ln(Life expect-ancy)	Adj R^2
3.81 (24.25)	0.21 (9.75)							0.76
2.73 (12.40)		0.32 (11.75)						0.82
3.91 (2.63)		0.20 (2.27)	-0.19 (1.98)	0.14 (1.46)	0.06 (2.30)	0.16 (2.04)	-0.34 (-0.67)	0.82
2.94 (8.02)		0.16 (2.65)	-0.20 (2.20)	0.14 (1.46)	0.06 (2.25)	0.15 (1.95)		0.83

Table 9c

Green/Brown Impacts of ICPGDP, FOP and Regulatory Efficiency

Variable	Intercept	ln ICPGDP	ln FOP	ln RTB	ln LSJ	Adj R^2
ln(Green)	3.84 (9.37)	0.03 (0.52)	-0.17 (1.83)	0.39 (3.37)		0.93
ln(Brown)	3.95 (9.44)	0.09 (2.69)	-0.07 (1.09)	0.36 (4.20)	0.14 (1.07)	0.98

Decomposition of overall environmental performance into Brown and Green sectors yields some additional insight into the impact of demographics and economic structure on regulation. Controlling for income, comparative analysis of the Brown sector indices suggests a very significant country response to environmental pressures from industrialization and urbanization. However, our results do not reveal an equivalent response on the Green side beyond the effect of variations in income per capita.

In summary, our findings suggest that a detailed, quantified analysis of the UNCED reports can yield comparable and plausible indices of environmental policy performance across countries. Cross-country variations in our environmental index are well-explained by variations in income per capita, degree of urbanization and industrialization, security of property rights, and general administrative efficiency.

7. References

Keefer, P. and Knack, S., 1993, "Why Don't Poor Countries Catch Up? A Cross Country National Test of an Institutional Explanation", Center for Institutional Reform and the Informal Sector, University of Maryland at College Park, Working Paper No.60

Scully, G.W., 1992, Constitutional Environments and Economic Growth, (Princeton: Princeton University Press)

UNCED, 1990, Draft Format for National Reports (Geneva: United Nations Conference on Environment and Development)

UNEP, 1992, Saving Our Planet: Challenges and Hopes (Nairobi: United Nations Environment Programme)

Wheeler, D. and A. Mody, 1992, "International Investment Location Decisions", Journal of International Economics, 33, pp. 57-76

World Bank, 1992, World Development Report 1992: Development and the Environment, (World Bank, Washington D.C. and Oxford University Press, New York)

World Resources Institute, 1992, World Resources 1992-93, (World Resource Institute, New York and Oxford University Press, New York)

APPENDIX

Questionnaire for Evaluating Environmental Policy Performance

1. AWARENESS

   A. When did environmental awareness gain prominence?

      2 Pre 1972
      1 1972-89
      0 1990+

   B. How widespread is this awareness at present?

      2 Mass awareness countrywide
      1 Restricted to limited pockets of elite groups
      0 Very little awareness

   C. The extent of awareness regarding global dimensions

      2 Excellent
      1 Reasonable
      0 Very little

2. POLICY

   A. For how long has significant environmental policy existed?

      2 Dates back to 1970s
      1 Introduced in the last ten years
      0 Very little so far

   B. How did the policy evolve?

      2 As a felt need
      1 Of late as a result of diffusion of knowledge
      0 Yet to evolve significantly

   C. What is the coverage of the policy?

      2 Comprehensive with clearly laid down targets
      1 Some policy and some targets
      0 Very little policy

3. LEGISLATION

A. When did significant environmental legislation begin to be enacted?

2 Dates back to 1970s
1 Introduced in the last ten years
0 Very little so far

B. How extensive is the legislation so far?

2 Comprehensive and supported by detailed rules and regulations
1 Sketchy; some rules and regulations
0 Only a few or none at all

C. What is the extent of machinery for enforcement of laws?

2 Agency clearly entrusted with specified guidelines
1 Agency set up but yet to develop effectively
0 No agency or very little effort so far

4. CONTROL MECHANISM

A. What is the nature of regulatory instruments?

2 Both command and control as well as economic
1 Only command and control
0 Hardly any mechanism

B. What is the extent of power vested in the environmental protection agency?

2 Both formulation of policy as well as its enforcement
1 Only limited to policy
0 No agency or very little power

C. What is the degree of decentralization of such an agency?

2 Extensive
1 Somewhat
0 Very little

D. What is the extent of allocation of funds to the agency?

2 Reasonably good for carrying out allotted tasks
1 Some but not enough for effective functioning
0 None or very little

E. What is the extent of self regulation by polluters?

2 Extensive
1 Somewhat
0 Very little

F. How widespread is the involvement of NGOs in regulation?

2 Extensive
1 Somewhat
0 Very little

G. What is the progress of preparation of a national environmental action plan (NEAP)?

2 NEAP with detailed plans for identifiable regions have been prepared
1 Only a sketchy NEAP or plans for some regions
0 No action so far

5. MEASURE OF SUCCESS

A. What is the trend in environmental indicators?

2 Improving
1 Not much headway but steady
0 Deteriorating

B. Roughly what percentage of GDP is being devoted for environmental control measures?

2 More than 1%
1 Some but less than 1%
0 Almost none

C. What is the market share of pollution control industries in total industrial production?

2 Above the global average
1 Around average
0 Below average

D. What is the prevalence of environmental incidents/accidents?

2 Almost none
1 A few
0 Considerable

E. How good is the availability of environmental data?

2 Extensively compiled
1 Sporadically available
0 None or very little

F. What is the extent of interest in environmental studies and R & D?

2 Widespread
1 Somewhat
0 None or very little

G. How widespread is the involvement of NGOs in the environmental movement?

2 Considerable
1 Somewhat
0 None or very little

H. What is the prevalence of environmental litigation?

2 Considerable
1 Somewhat
0 None or very little

I. What is the level of media interest in environmental issues?

2 Very high
1 Somewhat
0 None or very little

Policy Research Working Paper Series

	Title	Author	Date	Contact for paper
WPS1425	On the Intersectoral Migration of Agricultural Labor	Donald Larson Yair Mundlak	February 1995	J. Jacobson 33710
WPS1426	Russian Unemployment: Its Magnitude, Characteristics, and Regional Dimensions	Simon Commander Ruslan Yemtsov	February 1995	V. Reid 35195
WPS1427	Corporate Governance and Equity Prices: Evidence from the Czech and Slovak Republics	Stijn Claessens	February 1995	F. Hatab 35835
WPS1428	Short-Term Supply Response to a Devaluation: A Model's Implications for Primary Commodity-Exporting Developing Countries	Bruno Boccara Fabien Nsengiyumva	February 1995	M. Pfeiffenberger 34963
WPS1429	The World Trade Organization's Agreement on Government Procurement: Expanding Disciplines, Declining Membership?	Bernard M. Hoekman Petros C. Mavroidis	March 1995	F. Hatab 38535
WPS1430	Intergovernmental Fiscal Relations and Poverty Alleviation in Viet Nam	Richard M. Bird Jennie I. Litvack M. Govinda Rao	March 1995	G. Coward 80494
WPS1431	The Industrial Pollution Projection System	Hemamala Hettige Paul Martin Manjula Singh David Wheeler	March 1995	A. Williams 37176
WPS1432	Using Financial Futures in Trading and Risk Management	Ignacio Mas Jesús Saá-Requejo	March 1995	K. Binkley 81143
WPS1433	Enterprise Restructuring in Eastern Europe: How Much? How Fast? Where? Preliminary Evidence from Trade Data	Bernard Hoekman Gerhard Pohl	March 1995	F. Hatab 35835
WPS1434	Government Credit Policy and Industrial Performance (Japanese Machine Tool Producers, 1963–91)	Charles W. Calomiris Charles P. Himmelberg	March 1995	P. Infante 37642
WPS1435	The Political Economy of Formal Sector Pay and Employment in Developing Countries	Arup Banerji J. Edgardo Campos Richard H. Sabot	March 1995	D. Evans 37496
WPS1436	An Empirical Model of Sunk Costs and the Decision to Export	Mark J. Roberts James R. Tybout	March 1995	J. Ngaine 37959

Policy Research Working Paper Series

	Title	Author	Date	Contact for paper
WPS1437	Travel Mode Substitution in São Paulo. Estimates and Implications for Air Pollution Control	Joffre Swait Gunnar S. Eskeland	March 1995	C. Jones 37699
WPS1438	Trade Reform, Efficiency, and Growth	Ejaz Ghani Carl Jayarajah	March 1995	A. Nokhostin 34150
WPS1439	Nontariff Barriers Africa Faces: What Did the Uruguay Round Accomplish, and What Remains to Be Done?	Azita Amjadi Alexander Yeats	March 1995	S. Lipscomb 33718
WPS1440	Poverty and Social Transfers in Poland	Christiaan Grootaert	March 1995	N. Sachdeva 82717
WPS1441	The Significance of Credits and Subsidies in Russian Agricultural Reform	Douglas Galbi	March 1995	N. Castillo 33490
WPS1442	Energy Price Increases in Developing Countries: Case Studies of Colombia, Ghana, Indonesia, Malaysia, Turkey, and Zimbabwe	Einar Hope Balbir Singh	March 1995	C. Jones 37699
WPS1443	Policy-Based Finance, Financial Regulation, and Financial Sector Development in Japan	Dimitri Vittas Akihiko Kawaura	April 1995	P. Infante 37642
WPS1444	Roads, Lands, Markets, and Deforestation: A Spatial Model of Land Use in Belize	Kenneth M. Chomitz David A. Gray	April 1995	E. Schaper 33457
WPS1445	Human Capital and Industry Wage Structure in Guatemala	Chris N. Sakellariou	April 1995	I. Conachy 33669
WPS1446	Review of Integrated Approaches to River Basin Planning, Development, and Management	Donna J. Lee Ariel Dinar	April 1995	C. Spooner 32116
WPS1447	Environmental Inspections and Emissions of the Pulp and Paper Industry: The Case of Quebec	Benoît Laplante Paul Rilstone	April 1995	E. Schaper 33457
WPS1448	Environmental Regulation and Development: A Cross-Country Empirical Analysis	Susmita Dasgupta Ashoka Mody Subhendu Roy David Wheeler	April 1995	E. Schaper 33457