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Is Environmental Sustainability Influenced by Socioeconomic and Sociopolitical Factors? Cross-Country Empirical Evidence

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ABSTRACT
The current study attempts to understand the relationships among Environmental Quality (EQ), Human Development (HD) and political and governance regimes in a cross-country framework through secondary data analysis. The underlying hypothesis is that in addition to income, as reflected from the literature on the Environmental Kuznets Curve hypothesis, several other factors, including socioeconomic (e.g. human development and corruption) and sociopolitical (e.g. ability to exercise democratic rights) factors, may influence environmental policy-making, and thereby environmental sustainability, in a country. The EQ (i.e. environmental sustainability) of the countries in the current study is denoted by their Environmental Performance Index (2008). Human development is represented by Human Development Index (2007). Democracy Index (2008) and Corruption Perceptions Index (2008) are considered as proxies for political transparency in a country and its susceptibility to rent-seeking activities, respectively. The cross-country empirical findings confirm the closer association between the socioeconomic and sociopolitical factors and sustainable development. Copyright © 2010 John Wiley & Sons, Ltd and ERP Environment.

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Introduction

THE ENVIRONMENTAL SUSTAINABILITY OF A COUNTRY/REGION IS GENERALLY INFLUENCED BY A NUMBER OF FACTORS. The traditional literature on environment has focused on several routes through which the growth–environment process in a country could be affected. First, the Environmental Kuznets Curve (EKC) hypothesis focuses on the relationship between income level of a country and its environmental sustainability (Cole *et al.*, 1997; Stern *et al.*, 1996), indicating that growing income level beyond a threshold might be associated with the demand for better environment and consequent adoption of superior governance mechanism

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(e.g. better pollution abatement practices). Second, the Pollution Haven Hypothesis (PHH) looks into the possibility of environmental degradation in a country owing to trade-investment nexus, i.e. whether the foreign direct investment (FDI) flow in a country is directed more towards the pollution-intensive sectors/regions and influencing the production pattern negatively (Basel Action Network, 2007; Cole *et al.*, 2010; He, 2006; Merican *et al.*, 2007; Wagner and Timmins, 2009).[1] Looking at the problem alternatively, countries with stricter environmental regulation might tend to import more environmentally sensitive goods from countries with weaker environmental regulations, production of which causes substantial environmental degradation in the territory of the latter. Third, although not directly related to environmental degradation, the Natural Resource Curse Hypothesis (NRCH) proposes a negative relationship between resource endowment and growth scenario in a country (Dietz *et al.*, 2007; Komarulzaman and Alisjahbana, 2006).[2]

In line with the EKC, PHH and NRCH mentioned above, it could be argued that a couple of related factors might also influence the environmental performance of a country. For instance, enhanced economic growth in a country may be translated into economic development and improve Human Development (HD) level. The HD augmentation in the current period may in turn strengthen the citizen perception about environmental sustainability in the subsequent periods. Therefore, enhancement of HD may be considered a positive factor for improving environmental sustainability.

Second, despite growing income/HD, the PHH effect might be intensified in a country if the government is not sensitive to the enhanced demand for a cleaner environment for the population. This might happen when the government is autocratic and so not concerned with facing the electorate in the long run. Moreover, to have employment generation and economic growth, less democratic regimes may compromise with environmental standards in the short run. This would prompt the industries to take advantage of this loophole and become engaged in polluting activities/invest less on the pollution abatement process.

A similar scenario might also occur if the environmental governance is susceptible to pressures or overtures from the local firms/multinational corporations involved in environmentally-sensitive business activities. In both these cases, the existing political economic and governance scenario and the presence of rent-seeking activities, may lead to environmental degradation.

Moreover, the influence of socioeconomic and sociopolitical factors on growth may be consolidated through the NRCH route as well. The literature on NRCH suggests that the natural resource base may produce a negative impact on growth if considered in isolation, but a positive direct impact on growth may be witnessed if explanatory variables on sociopolitical (e.g. corruption), economic (e.g. investment, openness, terms of trade) and socioeconomic (e.g. schooling) indicators are included (Papyrakis and Gerlagh, 2003). The empirical results of Dietz *et al.* (2007) also identified corruption to be a significant cause of low savings in resource-rich countries, as the same depresses investment. The low growth rate may in turn affect environmental sustainability.

Given this background, the current paper attempts to estimate the determinants of environmental sustainability in a country, by looking at the socioeconomic (e.g. economic growth, HD) and sociopolitical (e.g. democracy, corruption) factors. The paper is organized along the following lines. First, the relationship between Environmental Quality (EQ) of a country and its income level (EKC hypothesis) is explored. Then, the relationship between EQ and HD is analyzed. The subsequent analysis focuses on the relationship between environmental performance of a country and the prevailing democracy and corruption levels respectively. At the end, policy conclusions are drawn on the basis of the empirical findings.

Data

The present analysis attempts to identify the determinants of the overall environmental performance of the countries through a cross-sectional analysis. In accordance with the availability of the latest data, 2007–08 has been

[1] Merican *et al.* (2007) show that FDI inflow adds to pollution levels in Malaysia, Thailand and the Philippines. CUTS (2003) noted that countries like Papua New Guinea, the Philippines and Indonesia had lowered their environmental standard to attract FDI in mining sector.
[2] Komarulzaman and Alisjahbana (2006) noted that countries like Iran and Venezuela, richly endowed with natural resources like oil and gas, generally experience a lower economic growth rate compared with their natural-resource-poor counterparts like Japan, Singapore and South Korea.

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taken as the period of analysis here. The data series used for the current analysis has been obtained from various reports, published by academic forums as well as international and multilateral agencies. A total of 146 countries, for which data on the environmental, socioeconomic and sociopolitical achievements in the recent period are consistently obtainable, are considered for the analysis.

It has generally been observed in the literature that a composite environmental index properly summarizes the environmental condition of a country, and is more meaningful than individual pollution indicators (Adriaanse, 1993; Adriaanse *et al*., 1995; Blanc *et al*., 2008; Esty *et al*., 2005; Jones *et al*., 2002; Rogers *et al*., 1997). Following this discourse, the current study considers the data on Environmental Performance Index (EPI) for 2008 from Esty *et al*. (2008), as a representative of the environmental sustainability of a country. A higher EPI score for a country implies better environmental sustainability. Switzerland is at the top position in the EPI scale with a score of 95.5, whereas Niger is placed at the bottom with a score of 39.1.

The data on the Human Development Index (HDI) for 2007 (UNDP, 2009) has been considered for the present study. The UNDP considers income, health profile and education achievements of a country to construct the HDI score. It is observed from the report that Norway is at the top position with a score of 0.971, whereas Niger is found at the bottom with a score of 0.340. The data on per capita income of a country [measured by per capita gross domestic product (PCGDP) in purchasing power parity (PPP) adjusted US$) have also been obtained from UNDP (2009).

The data on political freedom of a country (i.e. Democracy Index, DI) has been collected from the Economist Intelligence Unit's 'Index of Democracy 2008' report (Economist Intelligence Unit, 2008). A higher DI score obtained by a country implies that it is more democratic, i.e. the country is characterized by more liberal political regimes. Sweden tops the list with a score of 9.88, while North Korea with a score of 0.86 is placed at the bottom. To segregate the various dimensions of political freedom in a country and their impact on the environment, apart from the composite score on democratic achievements, several sub-indices of democratic achievements are also considered in the current regression analysis. The sub-indices considered here include, Electoral Process and Pluralism Score, Functioning of Government Score, Political Participation Score, Political Culture Score, Civil Liberties Score.

The effect of corruption in a country is measured through the Corruption Perceptions Index (CPI) for 2008. The data across the countries is taken from the *Global Corruption Report 2009: Corruption and the Private Sector*, published by Transparency International (2009). A higher score obtained by a country in the ranking analysis denotes a less corrupt society. Denmark tops the CPI list with a score of 9.3, while Myanmar is located at the other extreme with a meagre score of 1.3.

The short forms of the variables considered in the regression models of the present analysis are summarized below:

EPI08SCR	Environmental Performance Index 2008 Score
PCGDP07	Per Capita Gross Domestic Product 2007 (in PPP US$)
HDI07SCR	Human Development Index 2007 Score
DISCORE	Democracy Index 2008 Score
DIEPSCR	Democracy Index 2008 – Electoral Process and Pluralism Score (Sub-index of DI)
DIFGSCR	Democracy Index 2008 – Functioning of Government Score (Sub-index of DI)
DIPPSCR	Democracy Index 2008 – Political Participation Score (Sub-index of DI)
DIPCLSCR	Democracy Index 2008 – Political Culture Score (Sub-index of DI)
DICLSCR	Democracy Index 2008 – Civil Liberties Score (Sub-index of DI)
LNCPI08	Natural Logarithm of Corruption Perception Index 2008 Score

Results

Environment and Income

The literature on the relationship between per capita income (PCGDP) of a country and its environmental performance generally attempts to verify the existence of an inverted U-shaped curve in the PCGDP versus pollution

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indicator plane (EKC). The relationship implies that with a rise in income; EQ worsens up to a certain PCI level, but improves thereafter with further prosperity, as countries either shift to cleaner production technologies or focus more on pollution abatement (Andreoni and Levinson, 2001). Studies based on both ambient concentration of pollutants (Grossman and Krueger, 1995; Selden and Song, 1994) or actual emissions of pollutants (Bruvoll and Medin, 2003; de Bruyn *et al.*, 1998) support the EKC hypothesis. Recent studies show that while local pollutants like sulphur dioxide (SO_2), suspended particulate matter (SPM) and carbon monoxide (CO) support the EKC hypothesis; other pollutants exhibit either monotonicity or an N-shaped relationship (Dinda, 2004).

The income–environment relationship literature has been expanded further, by looking into the inequality angle and its socioeconomic and sociopolitical consequences. Drosdowski (2006) has reported an ambiguity in the relative strength of these forces by pointing out that while growth stabilizes democracy; a democratic framework is more prone towards HD formation (increased expenditure of education and health) and creation of better environmental regulation. On the other hand, economic growth, laden with corruption, may lead to resource depletion and subsequently to environmental degradation and climate change. Similarly, inequality in the growth process may limit political freedom (Boyce, 2003; 2007), and thereby negatively influence environmental sustainability. Clement and Meunie (2008) however noted that the relationship between inequality and pollution may not be universal, but may be pollutant- and context-specific. On the other hand, Scruggs (1998) has questioned the influence of inequality on EQ.

Apart from the cross-country studies, the existence of the EKC hypothesis has been estimated for provinces within a country as well. For instance, the analysis of Mukherjee and Kathuria (2006) and Mukherjee and Chakraborty (2009) have tested the same for India. Though the EKC hypothesis was not proved, the non-linearity in the relationship between income and environmental achievements has been confirmed by their analysis.

In line with the evidence from the literature, certain variants of the following model are estimated in the current analysis. Non-linearity in the relationship between environmental performance and income level of a country is expected and the empirical model incorporates higher-order terms of income in the regression equation. The human development achievements, democracy and corruption are used as the control variables.

$$EPI08SCR = \alpha + \beta_1 \mathrm{PCGDP07} + \beta_2 \mathrm{PCGDP07\hat{}2} + \beta_3 \mathrm{PCGDP07\hat{}3} + \beta_4 \mathrm{PCGDP07\hat{}4} + \beta_5 \mathrm{HDI07SCR} + \beta_6 \mathrm{DISCORE} + \beta_7 LNCPI08 + \varepsilon$$

where α is a constant, values of β are the coefficients, and ε is the disturbance term.

The regression results showing the relationship between environmental performance and income levels of the countries are reported in Table 1. There is a significant relationship between the two series. Significance of the higher-order terms of PCGDP07 in the models confirms the presence of non-linearity in the relationship. It is observed from the first two models that while the first-order (PCGDP07) and cubic (PCGDP07^3) terms are positively related with EQ, the square (PCGDP07^2) and quadruple (PCGDP07^4) terms are negatively related. In other words, the EPI of the countries is influenced by growing income level, it increases initially with income, but decreases with further rise of the same.[3] Hence, unlike the relationship proposed by the EKC hypothesis, an inverted U-shaped curve is obtained, where EPI goes down with subsequent rise in income.[4]

Models 3 and 4 take into account all the socioeconomic and sociopolitical determinants of EQ. It is observed that while environmental sustainability of a country is positively related to its HD and DI, its relationship with respect to PCGDP07 totally reverses. To be precise, while PCGDP07 is now negatively related to EPI, PCGDP07^2 is positively related to it, in line with the EKC hypothesis. The inclusion of explanatory variables like HD and democracy improves the explanatory power of the estimated regression models (as reflected from the improvement

[3] The decomposition of income by sources might play a major role in this context. The analysis of Mukherjee and Chakraborty (2009) with respect to India argued that as the States move from agriculture to manufacturing further intensification of the latter activities results in degradation of environment in terms of air and water pollution. As States move further to service sectors, its environment improves. Therefore, the study argued for arriving at an optimal composition of income from agriculture, industry and the service sector that could be sustainable for long-term prosperity of a particular State.

[4] For instance looking at the upper end of the income stream it is observed that in Kuwait, per capita GDP in 2007 is US$ 47,812 and EPI during 2008 is 64.5. However, for a richer country, the United Arab Emirates, the per capita GDP in 2007 is US$ 54,626, but its EPI is lower compared with that of Kuwait at 64.0.

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Dependent variable	EPI08SCR			
Independent variable	Model 1	Model 2	Model 3	Model 4
Constant	5.7E+01 ***	5.5E+01 ***	1.8E+01 ***	1.6E+01 ***
	(1.4E+00)	(1.6E+00)	(3.2E+00)	(3.4E+00)
PCGDP07	2.7E-03 ***	3.7E-03 ***	−4.0E-04 ***	−5.1E-04 ***
	(2.7E-04)	(5.1E-04)	(1.2E-04)	(1.5E-04)
PCGDP07^2	−7.6E-08 ***	−1.6E-07 ***	2.8E-09 **	3.7E-09 **
	(1.1E-08)	(4.0E-08)	(1.4E-09)	(1.6E-09)
PCGDP07^3	5.8E-13 ***	2.6E-12 **		
	(9.3E-14)	(1.0E-12)		
PCGDP07^4		−1.5E-17 *		
		(7.8E-18)		
HDI07SCR			7.2E+01 **	7.3E+01 ***
			(5.0E+00)	(5.1E+00)
DISCORE			1.1E+00 ***	8.2E-01 **
			(2.9E-01)	(3.3E-01)
LNCPI08				2.7E+00
				(2.0E+00)
No. of observations (included)	144	144	144	143
Adj. R^2	**0.598**	**0.607**	**0.805**	**0.807**
D-W Stat	2.166	2.210	2.166	2.135
F-Stat	69.405	56.187	148.363	119.528

Table 1. Relationship between Environmental Performance and Income Levels
Figures in parentheses show the White heteroscedasticity-consistent standard error for the estimate coefficient; ***, ** and * indicate that the estimated coefficient is significant at 0.01, 0.05, and 0.10 level, respectively.

in adjusted R^2). Therefore, it can be argued that apart from income, non-inclusion of human wellbeing, democratic and social contours of the economy in the estimation of EKC type relationship could be misleading. Greater political freedom and higher human development level, in addition to income growth, are found to be conducive for better environmental sustainability.

Model 4 further extends the analysis by incorporating a corruption index among the explanatory variables. It is observed that the relationship of EPI with PCGDP07, PCGDP07^2, HDI and DISCORE are found to be analogous with the Model 3 estimation results. In addition, the corruption index is also found to be positively related to EPI, implying that less corruption in a country is conducive for a cleaner environment. This suggests that there is a need for separately estimating the impact of HD and political freedom on EPI.

The interrelationship between EPI and PCGDP07, as reflected from the regression analysis, is reported in Figure 1. An inverted U-shaped relationship between the two series is noticed from the figure. The figure suggests that the EPI of a country increases initially with its income level, but comes down after reaching a peak, which arguably is caused by intensification of economic activities. However, with a further rise in income, EPI reaches a trough and starts increasing once again. Clearly the results show a richer relationship pattern vis-a-vis the standard U-shaped contour proposed by the EKC hypothesis in environmental quality (negative of pollution) versus per capita income plane.

Environment and Human Development

Income growth in a country in general is associated with increase in human development parameters (Ginkel *et al.*, 2001; Mukherjee and Chakraborty, 2009, 2010), which are likely to intensify the demand for a cleaner environment. On the other hand, the need to manage HD for ensuring environmental sustainability has also been quoted in the literature (Melnick *et al.*, 2005). The close association between HD and sustainable development is

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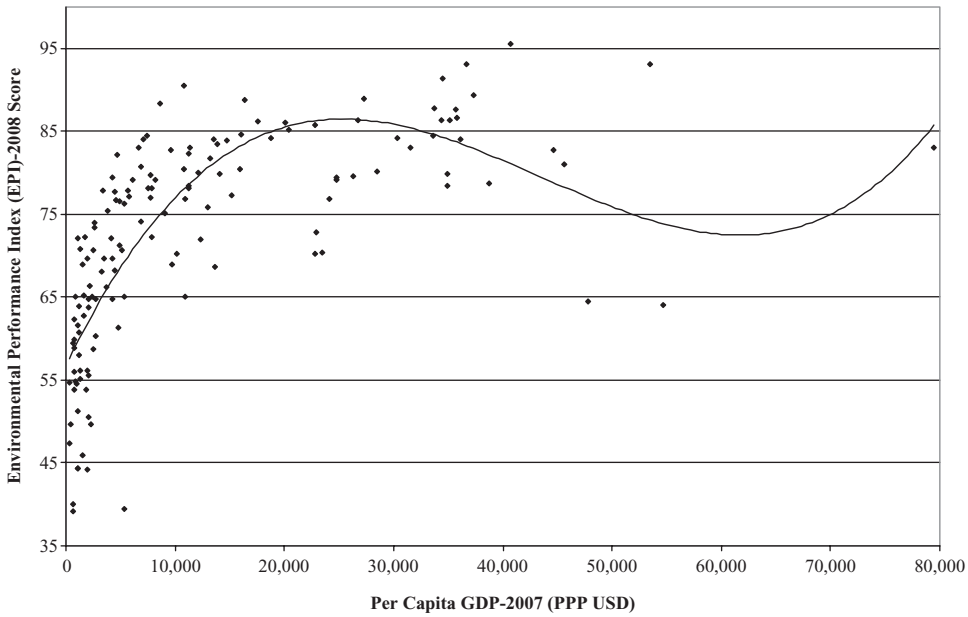

Figure 1. Environmental Performance Index (EPI) 2008 versus Per Capita (PPP US$) 2007

reported by several studies (Khagram *et al.*, 2003). In addition, in line with the analysis on EPI and environment, it is observed that socioeconomic inequality might lead to environmental inequality and degradation (Boyce, 2003).

Costantini and Salvatore (2008) have tried to explain the inter-linkage between HD achievements, EPI and growth path of a country. They argue that if the economic growth in a country is not associated with investments in human capital accumulation, institutions will remain underdeveloped and as a result resources exploitation would lead to the NRCH phenomenon. Poorer economic growth would follow, and low HD levels would sustain, which might compromise environmental sustainability in the long run.

Empirical analyses on the relationship between EPI and HD has shown the presence of non-linearity. Jha and Bhanu Murthy (2001) reported the existence of an inverted N-shaped curve in the environmental quality–HD plane in a cross-country framework. The empirical findings of Mukherjee and Chakraborty (2009) for the Indian states supported this contention.

Democracy can be used as a major control variable in the analysis, because the relationship between HD and democracy is a major area of discussion in economic literature (Drèze and Sen, 1995; Przeworski *et al.*, 2000). The idea here is that increasing the HD level enhances citizen confidence and expectation from the policy-makers and as a result their participation level in the democratic process increases. This, with a rise in income, might lead to greater demand for a cleaner environment by the citizens. On the other hand, a democratic government is always wary of the political business cycle in the long run and attempts to enhance economic growth, HD level and the environment surrounding the electorate in its own interest. However, an autocratic regime may or may not share this motivation.[5]

The relationship between HD and democracy can be explained further with the findings of the UNDP (2004) report on Latin American countries. It is observed from the report that despite progress in certain areas, participation in elections is often uneven, and in some countries new entrants to electoral contests still face barriers. As a result the core issues of poverty and inequality are often not properly addressed.[6] On the other hand, the lack of economic and human resources leads to a weakened judicial system, which affects the growth process further. From a cross-country framework, Mukherjee and Chakraborty (2010) have shown that HD is positively and linearly

[5] The development process of Singapore (high HD) and Cambodia (moderate HD) may present the two extreme cases in this regard.
[6] UNDP (2004) notes that the level of inequality in Latin American countries is higher than the corresponding world average.

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related to both democracy and income level of the countries. All these may also lead to environmental repercussions.

The independent variables in the current regression analysis therefore include the HD achievements of the countries. The higher-order terms of HD are included in the analysis for checking non-linearity. Income, democracy and corruption are incorporated in the model as the control variables. The variants of the following model are estimated here:

$$EPI08SCR = \alpha + \beta_1 \mathrm{HDI07SCR} + \beta_2 \mathrm{HDI07SCR\hat{}2} + \beta_3 \mathrm{HDI07SCR\hat{}3} + \beta_4 PCGDP07 + \beta_5 \mathrm{DISCORE} + \beta_6 LNCPI08 + \varepsilon$$

The regression models estimated to understand the relationship are presented in Table 2. First, it is observed that with a rise in HDI, EPI improves, as reflected from the positive relationship between the two from models 1–3 and 8. The non-linear relationship between EPI and HDI is confirmed from the regression results reported in models 4–7. It is observed that while the coefficient of the first-order term is positive, the same for the higher-order terms are negative in sign. Given the sign of the coefficients of the HDI term, it is observed that EPI increases with HDI but rate of growth of the former may come down with further growth in the latter.

It is observed from the regression results that both democracy and corruption are positively related to EQ, confirming that decline in corruption level, as well as enhancement of democracy level, is conducive for better environmental achievement. However, interestingly the coefficient of the PCGDP07 variable is found to be negative and significant. Therefore, the consideration of explanatory variables like democracy and corruption figures help in identifying the potential negative influence of the economic attainments on environment.

The relationship between EPI and HDI is represented in Figure 2, which resembles a non-linear relationship between EPI and HDI. In other words, as for income, the standard U-shaped figure as proposed by the EKC hypothesis is not supported by the EQ–HD interface.

The absence of the EKC relationship in the cases of income and HD with respect to EQ can be explained with the help of the disconnect between the two. It has often been observed that countries with lower income level have achieved higher HD indices and secured better environmental sustainability; thanks to higher education or health level. Income plays a small role in ensuring environmental sustainability here. Alternatively, better access to

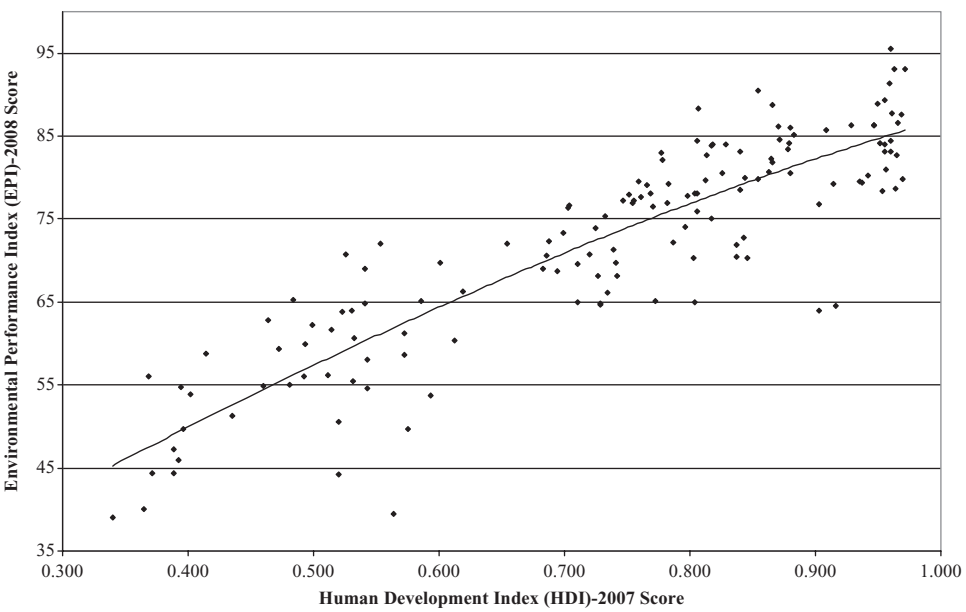

Figure 2. Environmental Performance Index (EPI) 2008 versus Human Development Index (HDI) 2007

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Dependent variable	EPI08SCR							
Independent variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Constant	2.1E+01 ***	2.0E+01 ***	1.9E+01 ***	1.1E+01 *	4.7E+00	6.5E+00	1.2E+01 **	1.9E+01 ***
	(2.8E+00)	(2.8E+00)	(3.1E+00)	(5.7E+00)	(8.0E+00)	(7.9E+00)	(5.6E+00)	(2.9E+00)
HDI07SCR	7.3E+01 ***	6.8E+01 ***	7.0E+01 ***	9.1E+01 ***	1.2E+02 ***	1.2E+02 ***	9.1E+01 ***	6.7E+01 ***
	(4.4E+00)	(4.3E+00)	(4.6E+00)	(1.2E+01)	(2.4E+01)	(2.4E+01)	(1.2E+01)	(4.4E+00)
HDI07SCR^2					−5.0E+01 ***	−4.6E+01 **		
					(1.8E+01)	(1.8E+01)		
HDI07SCR^3				−2.5E+01 ***			−2.3E+01 ***	
				(8.8E+00)			(8.9E+00)	
PCGDP07	−1.8E-04 ***	−2.2E-04 ***	−2.6E-04 ***					−2.5E-04 ***
	(6.7E-05)	(6.0E-05)	(8.6E-05)					(7.3E-05)
DISCORE		1.0E+00 ***		1.1E+00 ***	1.1E+00 ***			8.5E-01 **
		(2.8E-01)		(3.6E-01)	(3.6E-01)			(3.3E-01)
LNCPI08			4.3E+00 **			2.7E+00 *	2.9E+00 *	1.6E+00
			(1.8E+00)			(1.6E+00)	(1.6E+00)	(1.9E+00)
No. of observations (included)	144	144	143	144	144	143	143	144
Adj. R^2	**0.787**	**0.804**	**0.801**	**0.791**	**0.790**	**0.777**	**0.777**	**0.804**
D-W Stat	2.311	2.210	2.262	2.272	2.276	2.340	2.339	2.193
F-Stat	265.943	195.924	186.195	181.138	180.544	165.756	166.060	146.389

Table 2. Relationship between Environmental Performance and Human Development
Figures in parentheses show the White heteroscedasticity-consistent standard error for the estimate coefficient; ***, ** and * indicate that estimated coefficient is significant at 0.01, 0.05, and 0.10 level, respectively.

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resources may produce cross-effects in terms of educational or health achievements. For instance Shah and Kumar (2008) note that an improved water situation leads to better human health and environmental sanitation, food security and nutrition and greater access to education for the poor. This complexity in relationship between the income and HD variable and dominance of the country effects may prohibit emergence of the EKC type contour in the present context.

Environment and Democracy

Given the fact that environmental sustainability and democracy are both influenced by several common factors like income and HD (Mukherjee and Chakraborty, 2010), there is a need to evaluate the direct relationship between the two. It is observed from the international literature on environment and democracy that no unambiguous conclusion on interrelationship between the two series can be drawn, as the evidence reported is ambiguous.

One section of the existing literature notes the positive relationship between democracy and environment. For instance, Payne (1995) noted the view expressed by Al Gore that spread of democracy is a prerequisite for the achievement of better EQ. Morrison (2009) also noted that democracy positively influences provision of environmental public goods as they relate to human health. It is observed that liberal democracies are more forthcoming in this arena compared with less liberal regimes. Silvia (1997) supported this contention by providing the Chilean example, where the laissez-faire principle adopted by the military regime not necessarily contributed towards environmental sustainability. Drosdowski (2006) explained the interrelationship between the EPI and political freedom by saying that democratic freedom, civil liberties etc. enable the individuals and social groups to raise environmental concerns effectively with the policy-makers, which is further aided by the free flow of information though media or academia. Pawowski (2007) observed that while generally three recognized dimensions of sustainable development aspects are noted (ecological, social and economic), there is ample scope to include technical, legal and political dimensions as well within the fold.

Jasanoff (1996) noted that citizen involvement in ensuring better quality of environment is increasingly being witnessed and provides the US experience in terms of determination of carcinogen traces in commodities, so as to avoid the risk of cancer. The analysis noted that the risk assessment over the years has become more responsive to its multiple political constituencies. A similar scenario has been witnessed in Europe (especially Germany).[7] On the other hand, Chatrchyan (2004) noted that shallow democratization and stagnation may have adversely affected environmental protection in post-communist countries.

The complex relationship between democracy, liberty and type of democracy has been explored by Bernauer and Koubi (2004). The study reported that while democracy leads to higher EQ, labor union power is systematically, negatively related to EQ. It also reported that presidential democracies are better environmental performers than parliamentarian democracies. Interestingly, EQ was reported to go up with the size of the winning electoral coalition, arguably indicating the ease with which a government can pursue its agenda.

The role of state, democracy level and involvement in international organizations also plays a key role in this regard (Li and Reuveny, 2006; Tucker, 2008). The cross-sectional empirical analysis of Congleton (1992) involving 118 countries showed that environmental policies in a country, including both pollution outputs and willingness to take part in international conventions on environment, could be affected by political institutions. The panel data analysis of Ruoff (2009a,b) involving developing countries also stresses the role of participation in international environmental organizations. The role of environmentalism has also been critically analyzed through the democracy prism. For instance, Parks *et al.* (2006) has examined whether domestic political institutions (e.g. party structures, nature of the policy-making process, etc.) promote or hinder the passage of environmental foreign aid policy. Lidskog and Elander (2009) focused on the interrelationship between democratic set-up, presence of formal and informal players and issues pertaining to climate change/global warming.

[7] 'Citizen protests and strong leadership from the Green Party led Germany in 1990 to enact the Genetic Engineering Law, which provided a framework for controlling previously unregulated industrial activity in biotechnology. Responding to citizen pressure, it also opened up participation on the government's key biotechnology advisory committee and created a new public hearing process for releasing genetically engineered organisms into the environment.' Jasanoff (1996).

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The literature in this sphere also focus on the institutional mechanisms though which the citizens can influence environmental risk decisions. Fiorino (1989, 1990) has noted that the major routes in this category include: public hearings, initiatives, public surveys, negotiated rule making, and citizens' review panels. Though each mechanism is characterized with certain positive aspects, several weak spots are also inherent in each of them; thereby relying on any one may lead to an inefficient outcome.

The other side of the literature however contradicts this standpoint. For instance Midlarsky (1998) has considered six measures of environmental protection or degradation (deforestation, carbon dioxide emission, soil erosion by water, protected land area, freshwater availability, soil erosion by chemicals) as the dependent variables in the multiple regression analyses. The analysis showed that the democracy variable was found to be negative and statistically significant for several categories of environment, contrary to general perception. The study concluded that theoretical assumptions regarding the positive effect of democracy on the environment need to be re-examined. Bernauer *et al*. (2008) also noted that networks are more important determinants of EPI than the effects of democracy.

The analysis of Chang and Cho (2005) examined the effect of democracy on a country's environmental conditions through a panel data analysis involving 27 Asian countries over 1991–2001. Although the study measures democracy by political rights and civil liberties; carbon dioxide damage, carbon dioxide emissions, energy depletion and net forest depletion are used among the dependent variables to explain the environmental sustainability scenario in a country. The results indicate that the democratization process in Asian countries might have negative influence for environmental scenario.

The analysis of Kelso (2006) indicates that the relationship between political democracy, civil liberties and EQ may not be unidirectional: although political democracy does decrease particulate emissions, both deforestation and carbon dioxide emissions increase with greater civil liberties. The ambiguity in the relationship between democracy and the environment has also been reported by Walker (1999), aided by case studies from Malawi, South Africa and Mozambique. Interestingly, the case studies revealed that even where the goals of democracy are realized; both negative as well as positive environmental consequences are reported, thereby weakening the causal link between the two.

Several studies have attempted to provide an explanation behind this apparent fallacy and the evolving political freedom scenario in the communist countries is often cited in this regard. For instance, Scruggs (2009) noted that previous positive findings between EQ and democracy can be attributed to changes in a few Eastern European countries. It also noted that with controls for general economic liberalization, no noticeable beneficial effect of democracy on environmental performance could be observed.

Another possible way of explaining the ambiguity in the literature is to analyze the governance patterns prevailing in countries more closely. It is often implicitly assumed that a democratic country would be characterized by a better governance mechanism. However, van Zeijl-Rozema *et al*. (2008) distinguish two types of governance: hierarchical governance and deliberative governance. The governance pattern significantly influences the degree of involvement of societal actors, with profound implications on environmental sustainability. Moreover the governance conditions may also influence the effectiveness of service provisions at the grassroots level (Davies, 2008).[8]

In light of the above discussion, variants of the following model are estimated here:

$$EPI08SCR = \alpha + \beta_1 Democracy + \beta_2 PCGDP07 + \beta_3 HDI07SCR + \beta_4 LNCPI08 + \varepsilon$$

where, in various versions of the model in place of Democracy; DISCORE, DICLSCR, DIEPSCR, DIFGSCR, DIPPSCR are used as explanatory variables.

The regression results of the above models are reported in Table 3. Models 1 and 2 look into the relationship between overall democracy score of a country and its environmental performance. The other versions of the model consider the other sub-indicators of democracy as the explanatory variable. It is observed from the table that

[8] The presence of democracy may not always ensure a socially optimal outcome. For instance, looking into the scenario in Ireland, Ray Davies (2008) noted that, '… the tripartite focus of community-based recycling organizations (CBROs) on economic development, environmental enhancement and social capacity building can be problematic rather than bringing enhanced status…. such problems emerge as dominant governing conditions are pursuing ecological modernization and social partnership as distinct rather than integrated pathways of development.'

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Dependent variable	EPI08SCR								
Independent variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Constant	1.9E+01 ***	4.9E+01 ***	1.9E+01 ***	2.1E+01 ***	5.1E+01 ***	2.0E+01 ***	5.1E+01 ***	2.0E+01 ***	4.9E+01 ***
	(2.9E+00)	(2.3E+00	(3.0E+00)	(2.8E+00)	(2.2E+00)	(2.8E+00)	(2.2E+00)	(2.7E+00	(2.2E+00)
DISCORE	8.5E-01 **	2.1E+00 ***							
	(3.3E-01)	(5.2E-01							
DICLSCR			6.4E-01 ***						
			(2.2E-01)						
DIEPSCR				4.7E-01 ***	9.6E-01 ***				
				(1.8E-01)	(2.7E-01)				
DIFGSCR						7.0E-01 ***	1.3E+00 **		
						(2.7E-01)	(6.0E-01)		
DIPPSCR								9.4E-01 ***	1.9E+00 ***
								(3.2E-01)	(4.9E-01)
HDI07SCR	6.7E+01 ***		6.7E+01 ***	6.9E+01 ***		7.0E+01 ***		6.9E+01 ***	
	(4.4E+00)		(4.5E+00)	(4.4E+00)		(4.3E+00)		(4.4E+00)	
PCGDP07	−2.5E-04 **		−2.4E-04 **	−1.8E-04 ***		−2.2E-04 ***		−2.2E-04 ***	
	(7.3E-05)		(7.4E-05)	(5.9E-05)		(6.8E-05)		(6.1E-05)	
LNCPI08	1.6E+00	9.1E+00 ***	2.1E+00		1.2E+01 ***		1.1E+01 ***		1.1E+01 ***
	(1.9E+00)	(2.2E+00)	(1.8E+00)		(1.8E+00)		(2.8E+00)		(2.1E+00)
No. of observations (included)	143	146	143	144	146	144	146	144	144
Adj. R^2	**0.804**	**0.469**	**0.805**	**0.798**	**0.457**	**0.801**	**0.437636**	**0.799**	**0.466**
D-W Stat	2.193	1.972	2.178	2.223	1.954	2.243	1.96961	2.251	2.035
F-Stat	146.389	65.093	147.368	189.151	61.966	187.466	57.42006	190.497	64.306

Table 3. Relationship between Environment and Democracy
Figures in parentheses show the White heteroscedasticity-consistent standard error for the estimate coefficient; ***, ** and * indicate that estimated coefficient is significant at 0.01, 0.05, and 0.10 level, respectively.

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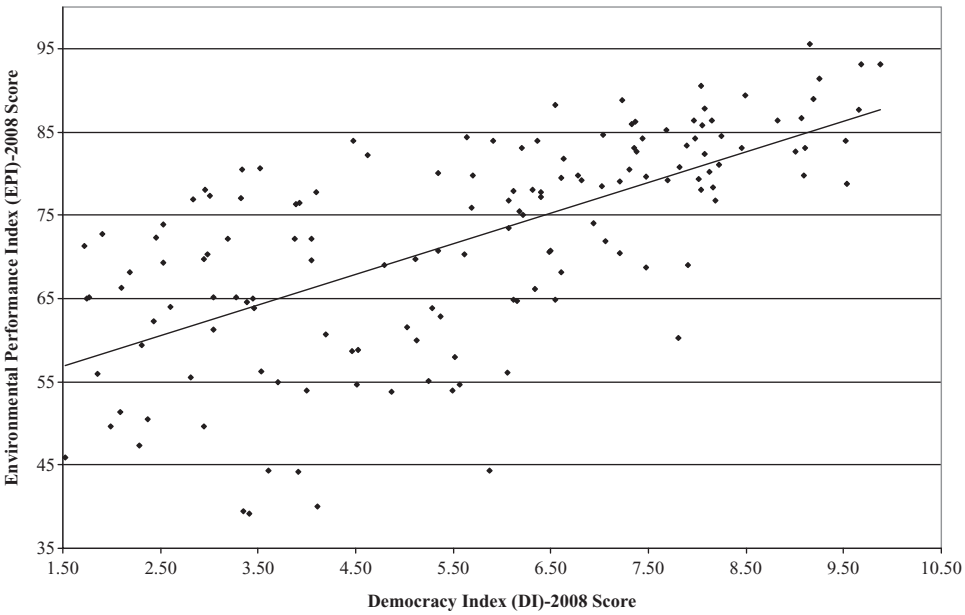

Figure 3. Environmental Performance Index (EPI) 2008 versus Democracy Index 2008

democracy scores of the countries and their environmental performance are generally positively related. In other words, the econometric finding of the current analysis is supporting the contention that enhancement in political freedom positively contributes to enhancing EPI. Similarly, HD and corruption index are found to be positively related to EPI, along the expected lines. However, the coefficient of the PCGDP term is found to have a negative coefficient, like the case observed in Table 2.

The visual representation of the regression results obtained in Table 3 is noted in Figure 3, which represents a linear relationship between EPI and DI. While the autocratic countries like North Korea, Chad and Turkmenistan are located at the southwest end of the figure, major liberal democracies like Sweden, Norway and Iceland are placed at the northeast corner of the same.

Environment and Corruption

The interrelationship between corruption and income is another widely researched area. It is generally agreed that corruption creates a dampening effect on economic growth (Akçay, 2002, 2006; Drury *et al.*, 2006; Mauro, 1995). Mo (2001) has reported that even a 1% increase in corruption level decreases GDP growth by almost 0.75%. Ampratwum (2008) reports the serious income implications of corruption in the emerging economies, developing countries and less developed countries.

The literature on environment and corruption is quite rich and like the case of environment and democracy, the findings are generally ambiguous. Though it could be theoretically argued that corruption may tend to compromise the environmental sustainability vis-à-vis the private/multinational business interest, the empirical findings do not always necessarily support this viewpoint. The ambiguity in empirical findings could be explained by the fact that selection of country/period has a major bearing over the findings.

The literature supporting a negative correlation between corruption and environmental performance is noted first. Welsch (2004) theorizes the link between the two by arguing that corruption reduces income of a country, and the lower income level may lead to higher pollution levels. A similar viewpoint has been expressed by other studies (Damania *et al.*, 2003; Lopez and Mitra, 2000). Looking at the social and economic costs of corruption, Dillion *et al.* (2006) noted that bribery and poor enforcement of laws tend to lower environmental sustainability

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of people and thereby their wellbeing.[9] Arguing along the same line Winbourne (2002) noted that corruption leads to activities like trafficking in wildlife and similar natural resources, leading to their depletion/extinction.[10] Similarly, Pellegrini and Gerlagh (2006) have argued that institutional improvements and reductions in corruption might induce higher economic growth rates and stricter environmental policies.

Apart from bribery of the administrative side, the nexus between business and enforcement agencies (police and judiciary) in a corrupt society might also lead to environmental degradation. For instance, Kotlobay (2002) noted that in Russia in 1999, among the 6383 forest-related illegal cases investigated; only 3113 cases were brought to court and in only 907 cases was any penal action taken.

The other end of the licensure argues that corruption may not be environmentally destructive in a general sense (Robbins, 2000). The empirical analysis of Morse (2006) looked into the corruption–environmental sustainability interface through empirical analysis of Environmental Sustainability Index (ESI) of 2002 (Economist, 2002) and its component variables and Corruption Perceptions Index (CPI) of 2002 (Transparency International). The study found both CPI and ESI to be statistically significantly related to income (proxied as per capita GDP) and argued that environmental sustainability declined with decreasing income whereas corruption worsened. The study further divided ESI into various sub-indicators representing pressure, state, impact and response and regressed them on 'residual CPI' after removing the income effect. The regression results indicated that for the most part the sub-indicators of ESI are not correlated with 'residual CPI'.

Among the control variables, Democracy can be considered in the regression analysis, as both are found to be negatively related (Akçay, 2002; Mukherjee and Chakraborty, 2010). HD can also be included in the analysis as with growing level of human development, the demand for better governance should increase and as a result, the rent-seeking activities may go down (Mukherjee and Chakraborty, 2010; UNDP, 2003). Tran (2008) has argued in favour of a multi-equilibria (virtuous and vicious) relationship between HD and corruption. The virtuous equilibrium exists in rich countries, whereas the vicious equilibrium occurs in poor countries, thereby limiting their development potential further. He has argued that investment in human capabilities can play a crucial role in preventing corruption, especially after crossing a threshold level of HD. The idea is that if at a lower level of income, the corruption effect is rampant, then the very process of HD suffers, which may adversely influence governance and environmental sustainability as well. The adverse relationship between the two has been noted by Akçay (2006) as well, who reported that corruption reduces expenditures on the HD front (i.e. education and health).

In light of the discussion, the variants of the following model are estimated here:

$$EPI08SCR = \alpha + \beta_1 \mathrm{LNCPI08} + \beta_2 \mathrm{LNCPI08\hat{}2} + \beta_3 PCGDP07 + \beta_4 HDI07SCR + \beta_5 DISCORE + \varepsilon$$

The regression results are reported in Table 4. It is observed from models 1 and 4 that the environmental performance of a country is positively related to the CPI score. In other words, if the society is less corrupt, environmental sustainability improves. However, it could be noted from models 2 and 3 that if higher-order values of CPI are included in the analysis, the coefficient of the first-order term becomes negative while the same for the second-order term becomes positive. However, only in model 2 is the relationship between EPI and the second-order term of corruption found to be statistically significant, although the significance level is much lower. Model 3 on the other hand does not report a significant relationship of EPI with corruption index. Along expected lines, HD and democracy is found to be positively related to EPI, but PCGDP07 is found to be negatively related to it.

The linear relationship between CPI and EPI is shown with the help of Figure 4. While countries like Iraq, Myanmar, Haiti and Afghanistan, characterized by poorer environmental achievements and higher corruption are located in the southwest corner of the figure, the better performers on both counts (e.g. Denmark, New Zealand and Sweden) are placed in the northeast corner.

[9] To support the argument, Dillon *et al*. (2006) quoted the tussle between Kayu Lapis Industry logging company and the local community of Waisor in Indonesia during 2001. While illegal logging was going on, the local Police Mobile Brigade (Brimob) supported the company against the community, because they were receiving bribes from the former.

[10] The major channels in environmental corruption include bribery in environmental inspections and permitting system, overlooking of illicit consignments of endangered wildlife species, development of environmentally damaging policies and practices, unfair allocation of environmental resources etc. (Winbourne, 2002; Mastny and French, 2002).

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Dependent variable	EPI08SCR			
Independent variable	Model 1	Model 2	Model 3	Model 4
Constant	1.9E+01 ***	2.3E+01 ***	2.2E+01 ***	2.1E+01 ***
	(3.1E+00)	(3.5E+00)	(3.5E+00)	(2.9E+00)
LNCPI08	4.3E+00 **	−4.1E+00	−5.1E+00	9.0E-01 ***
	(1.8E+00)	(5.0E+00)	(4.8E+00)	(3.1E-01)
LNCPI08^2		3.5E+00 *	2.9E+00	
		(2.1E+00)	(1.9E+00)	
PCGDP07	−2.6E-04 ***	−3.2E-04 ***	−2.9E-04 ***	−3.2E-04 ***
	(8.6E-05)	(1.0E-04)	(8.5E-05)	(9.8E-05)
HDI07SCR	7.0E+01 ***	7.1E+01 ***	6.8E+01 ***	7.1E+01 ***
	(4.6E+00)	(4.7E+00)	(4.6E+00)	(4.5E+00)
DISCORE			7.9E-01 **	
			(3.1E-01)	
No. of observations (included)	143	143	143	143
Adj. R^2	**0.796**	**0.799**	**0.805**	**0.801**
D-W Stat	2.262	2.240	2.184	2.232
F-Stat	186.195	141.899	118.118	191.266

Table 4. Relationship between Environment and Corruption
Figures in parentheses show the White heteroscedasticity-consistent standard error for the estimate coefficient; ***, ** and * indicate that estimated coefficient is significant at 0.01, 0.05, and 0.10 level, respectively.

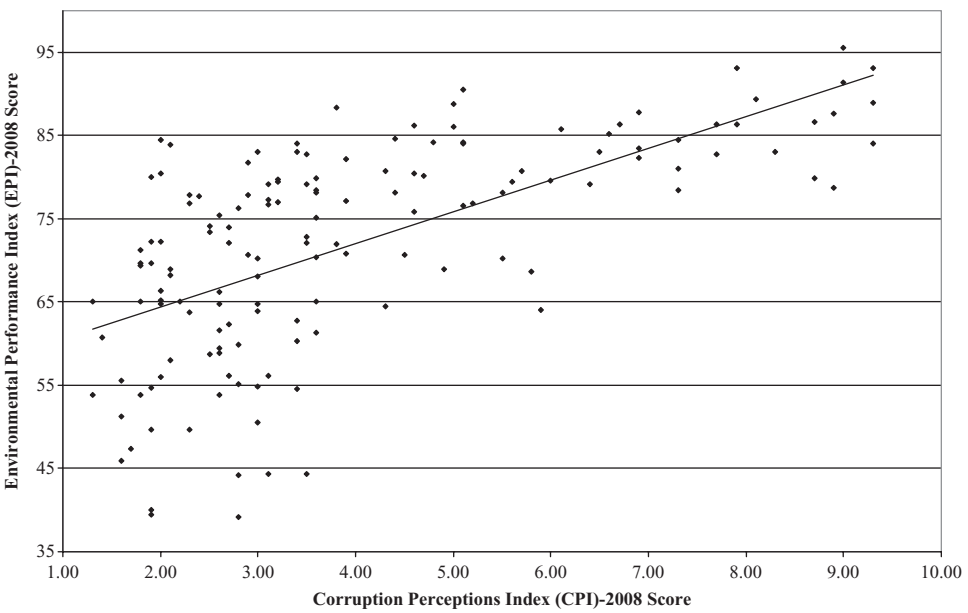

Figure 4. Environmental Performance Index (EPI) 2008 versus Corruption Perception Index (CPI) 2008

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Observations and Policy Implications

The recently organized Copenhagen Summit (2009) has shown the reluctance of several developed as well as developing countries to go for further commitment with respect to the Kyoto Protocol to prevent climate changes and global warming. Given the fact that income indicators alone may not explain the behaviour of the countries with respect to their current level of environmental governance as well as future commitment in multilateral environmental agreements, the current study intends to analyze the influence of the socioeconomic and sociopolitical variables, such as human development, corruption and democracy, on their environmental sustainability through a cross-country analysis.

The existing literature on the link between environment–corruption and environment–democracy is abundant. However, a considerable proportion of these studies on this front are qualitative and case-study-based in nature. A major section of the empirical studies conducted so far have undertaken the analysis with sub-categories of environmental performance (e.g. forest, water, air quality etc.), thereby not focusing explicitly on the overall environmental sustainability of a country. Although the sectoral perspective is quite important in understanding environmental repercussions in a country, its overall environmental sustainability might be more responsive towards the socioeconomic and sociopolitical characteristics. On the other hand, several studies focusing on the macrovariables (e.g. CPI, ESI) have been conducted with the 2002–03 period data, which miss out the dynamics in the period following the United Nations Climate Change Conference in Bali (2007). The current study is therefore an attempt to understand the scenario in the recent period with a cross-sectional data analysis during 2007–08.

The major findings of the present analysis and the policy observations are summarized in the following. It is observed that the environmental sustainability of countries is influenced by growing income level. The sustainability generally increases initially with income, but decreases with further rise of the same. Hence, unlike the proposed EKC hypothesis, an inverted U-shaped curve depicts the relationship between PCGDP and EPI. The absence of the EKC phenomenon could be explained by the selection of the composite EPI over individual categories like air pollution, water pollution or degradation of forests. In other words, the overall environmental sustainability and income level might exhibit a more complex relationship. Interestingly, if other factors like HD achievement and democracy index are considered in the analysis, the obtained regression results might fall in line with the EKC hypothesis. The results suggest that greater political freedom and higher human development level, in addition to income growth, are found to be conducive for better environmental sustainability. The obtained result provides some insight into why income alone may not explain a country's position at the domestic and international forums.[11]

The regression results also suggest that environmental sustainability of the countries generally goes up with HDI, but may marginally come down at a higher HDI level. This corroborates the general expectation that better confidence among the citizens owing to higher human development scenario not only in terms of incomes, but also through educational and health attainments facilitates environmental governance. The coefficients of the democracy and corruption variables included in the analysis are also found to be positive and significantly related to EPI. The cross-effects of HD–democracy and HD–corruption are significant here because investment by a country in HD achievements fuels demands for a responsive and transparent regime, both of which are instrumental in fueling further demand for environmental sustainability. Interestingly, the coefficient of the income term (PCGDP07) turns negative. This might be termed counterintuitive because income is one of the three constituents of the composite HD index. However, a closer look at the HD scale reveals that countries with higher income levels may not necessarily secure a higher HD score.[12] In other words, educational or health achievement might offer a better explanatory power for determining sustainability quest for a country. In addition, in the presence of a wider set of control variables, the EKC hypothesis might hold good.

It is also observed from the empirical results that political freedom of the countries and their environmental sustainability are positively and linearly related, supporting the standpoint that democratic set up is conducive for

[11] The decision of the USA (high on the income scale and a successful democracy) not to ratify the Kyoto Protocol may by cited in this regard.
[12] For instance, Botswana with a PCGDP of US$ 12,387 had an HD rank of 124, while Albania with a PCGDP of US$ 5316 had an HD rank of 68 during 2007–08.

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better environmental performance. This signifies the presence of a more responsive governance mechanism towards environmental assets in liberal democracies. The underlying logic behind the result is that an autocratic regime never expects re-election and functions with a shorter time span in mind. Therefore long-term environmental sustainability never enters its objective function. Moreover, the urge to earn a support group with sufficient lobbying power is more prominent in a non-democratic regime and the adoption of weaker environmental standard to woo the industry can be one such policy tool. Moreover, non-democratic regimes often result in excessive control over resource rents by political elites (Dietz *et al*., 2007), which may lead to lower incentives for others to ensure sustainability. The income term is again found to be negatively related with EPI and statistically significant, even when various democracy-related indices are used as the explanatory variable. The result indicates that political rights in addition to income play a major role in determining the environmental sustainability of a country.

Finally, it is observed that environmental performance of a country is positively related to its ability to control corruption. A linear relationship between the two series is generally observed in the present set up, though a non-linearity assumption is supported in one variant of the model. The coefficient of PCGDP07 remains negative in this case as well.

The empirical findings of the current study provide a set of important policy considerations. First, the limitation of considering income as the only explanatory variable for understanding environmental orientation and sustainability across countries becomes obvious. Therefore, the propensity of the countries to make commitments at the multilateral forums needs to be analyzed on a wider canvas, i.e. in the light of their socioeconomic and sociopolitical scenario. Second, there seems to be an urgent need to analyze the potential risk of corruption in the presence of non-liberal political regimes for any environmental and natural resources-related initiatives. For instance, if the recent trend of FDI inflow in the agricultural sector in several developing countries and less developed countries spread over Asia, Africa and Latin America is considered, there is a potential concern for resource over-exploitation in the recipient economies. Given the fact that often the strategy of the multinational corporations investing in these countries is to maximize per acre productivity of the crops rather than maximizing the welfare of the local population, chances of depletion of groundwater and degradation of soil quality cannot be ruled out. It is observed from the data provided by Economist Intelligence Unit (DI) and Transparency International (CPI) that many of these host countries are marked by a non-liberal political set-up and susceptible to various rent-seeking activities. Moreover, human development achievement in all of them is not equally praiseworthy, which implies a civil society protest against realized misuse of resources might not be there to the desired extent. Therefore it is extremely important for the host governments to formulate an effective strategy to address these concerns.

Rapid modification of the political regime or rectifying the corruption level in the society is a difficult proposition for a developing country or less developed country in the short term, which as per the findings of the paper have negative consequences for its environmental sustainability as well. However, the positive relationship between HD level and environmental sustainability is the saving grace and the Millennium Development Goals (MDG) provide an important opportunity for this group of countries in this regard. For instance, the Goal 2 of MDG talks about achieving universal primary education, Goal 4 intends to reduce Child Mortality Rate, Goal 5 targets to improve maternal health and Goal 6 combats HIV/AIDS, malaria and other diseases, which are to be achieved by 2015. However, a number of developing countries and less-developed countries are falling short of their targets (Government of Kenya, 2005; Vivek and Dar, 2006). A renewed focus on the quoted goals would facilitate HD enhancements, and the HD augmentation process would be instrumental in controlling corruption and bringing pressure on the prevalent political regime to provide responsive governance. The cumulative effect of HD augmentation and enhanced transparency would be instrumental in securing Goal 7 of MDG, namely, ensuring environmental sustainability. Therefore UN Members in general and developing countries and less-developed countries in particular must ensure that they are able to fulfill the MDG targets by the stipulated deadline.

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