Is there any Relationship between Environment, Human Development, Political and Governance Regimes? Evidences from a Cross-Country Analysis

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Abstract

The current study attempts to understand the relationships among Environmental Quality (EQ), Human Development (HD) and political and governance regime in a cross-country framework. The underlying hypothesis is that in addition to income, as reflected from the literature on Environmental Kuznets Curve (EKC) hypothesis, several other factors, including social and political ones, may influence environmental decision making, and thereby environmental sustainability, in a country. The EQ of the countries in the current study is denoted by their Environmental Performance Index (2008). Human development is represented by Human Development Index (2007) and Human Poverty Index (2006). 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 regression results confirm the closer association between the socio-economic and socio-political factors in a country and its environmental performance.

Keywords: environmental quality; human development; economic growth; democracy; corruption; environmental Kuznets curve.

JEL Classification Codes: D72, D73, O15, O4, P28, Q01, Q56

1. Introduction

The environmental sustainability of a country / region is generally influenced by a number of factors. The literature on environmental sustainability has focused on several routes through which 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 (as measured by per capita income) and its environmental quality, indicating that growing income level beyond a threshold might be associated with the demand for better environment and consequent adoption of superior governance (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 FDI flow in a country is directed more towards the pollution-intensive sectors and influencing the production pattern negatively. Third, the Natural Resource Curse Hypothesis (NRCH) proposes a negative relationship between natural resource endowment and growth scenario in a country.[1]

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

Second, despite growing income / HD, the PHH effect might get intensified in a country if the government is not sensitive to the requirement of the population. This might happen when the government for instance is autocratic and hence not concerned about facing the electorate in long run.

On the other hand, a similar scenario might occur if the environmental governance is susceptible to pressures from the local firms / MNCs involved in environmentally-sensitive business activities. In both these cases, the existing political

[1] Komarulzaman and Alisjahbana (2006) noted that countries like Iran, Venezuela etc. endowed with oil and gas generally experience a lower economic growth rate as compared to their natural resource poor counterparts like such as Japan, Singapore, South Korea etc.

economic and governance scenario and the presence of rent-seeking activities, may lead to environmental degradation.

Moreover, the influence on socio-economic and social-political factors on growth may get consolidated through NRCH route as well. The literature on NRCH suggests that 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 socio-political (e.g. corruption), economic (e.g. investment, openness, terms of trade), and socio-economic (e.g. schooling) indicators are included (Papyrakis and Gerlagh, 2003).

The current paper attempts to estimate the determinants of environmental performance in a country, by looking at the socio-economic (e.g. – economic growth, HD) and social-political (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. The relationship between EQ and Human Development (HD) is analyzed next. Human development, apart from augmenting demand for cleaner environment, may also increase the demand for political freedom. Therefore, the association between HD and political freedom and governance is explored next. To interpret the results in a better light, the relationship among corruption, income and democracy are explored next. The subsequent analysis focuses on the relationship between environmental performance of a country and democracy and corruption respectively. At the end, policy conclusions are drawn on the basis of the derived results.

2. Data

The idea in the present analysis is to identify the determinants of the environmental performance of the countries. In accordance with availability of latest data, 2007-08 has been taken as the period of analysis. In other words, a cross-section analysis has been attempted 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 168 countries, for whom data on the environmental, socio-economic and socio-political achievements in the recent period are obtainable, are considered for the analysis.

The data on Environmental Performance Index has been obtained from 'Environmental Performance Index 2008' by Esty et al (2008), published by Yale Center for Environmental Law and Policy. Higher EPI Score for a country implies better environmental quality. Switzerland is at the top position in the list with a score of 95.5, while Niger is placed at the bottom with a score of 39.1.

The data on Human Development (HD) has been taken from the 'Human Development Report' (2009), published by the UNDP. The HD parameters considered here for constructing the ranking include income, health profile and education achievements. It is observed from the report that Norway is at the top position with a score of 0.971, while Niger is at the bottom with a score of 0.340. The data on Human Poverty Index (HPI, HPI-1 and HPI-2) and income levels of a country (measured through PCGDP) is also obtained from the Human Development Report (2009).[2]

The data on political freedom of a country (i.e., democracy index) has been collected from the Economist Intelligence Unit's 'Index of Democracy 2008' report (EIU, 2008). Higher DI score obtained by a country implies that it is more democratic. Sweden tops the list with a score of 9.88, while North Korea with a score of 0.86 is located at the bottom. In order to segregate the various dimensions of political freedom in a country and their impact on environment, apart from the composite score on democratic achievements, several sub-indices 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 etc.

The effect of corruption in a country is measured through the 'Corruption Perceptions Index' for the year 2008, taken from 'Global Corruption Report 2009: Corruption and the Private Sector', published by Transparency International (2009). Higher score in the ranking denotes a less corrupt society. Denmark tops the list with a score of 9.3, while Myanmar is located at the other extreme with a score of 1.3.

[2] Interestingly, the HDI and HPI of the countries are often negatively related. For instance, Qatar is having a HDI score of 0.910 (highest 0.971, Norway), while it's HPI score is 5.0 (highest 59.8, Afghanistan). Similarly for Netherlands the HDI and HPI scores are 0.964 and 7.4 respectively. On the other hand, Afghanistan is characterized by low HDI and high HPI scores of 0.352 and 59.8 respectively.

The short forms of the variables used in the regression models of the analysis are presented below:

EPI08SCR	Environmental Performance Index 2008 Score
PCGDP07	Per Capita Gross Domestic Product 2007 (PPP USD)
HDI07SCR	Human Development Index 2007 Score
HPI07VAL	Human Poverty Index 2006 Value (%)
DISCORE	Democracy Index 2008 Score
DIEPSCR	*Democracy Index 2008 - Electoral Process and Pluralism Score (Sub-index)*
DIFGSCR	*Democracy Index 2008 - Functioning of Government Score (Sub-index)*
DIFGSCR	*Democracy Index 2008 - Functioning of Government Score (Sub-index)*
DIPPSCR	*Democracy Index 2008 - Political Participation Score (Sub-index)*
DIPCLSCR	*Democracy Index 2008 - Political Culture Score (Sub-index)*
DICLSCR	*Democracy Index 2008 - Civil Liberties Score (Sub-index)*
DEMSCR	Full Democracy (=1) and Otherwise (=0)
LNCPI08	Logarithm of Corruption Perceptions Index 2008 Score

3. Results

3.1 Environment and Income

The literature on the relationship between Per Capita Gross Domestic Product (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 indicator plane ('Environmental Kuznets Curve' (EKC)). The relationship implies that EQ worsens up to a certain PCI level, but improves afterwards with prosperity, as countries 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), Carbon monoxide (CO), etc. support EKC hypothesis; other pollutants exhibit either monotonicity or a N-shaped relationship (Dinda, 2004).

The Following model is estimated here:

$$EPI08SCR = \alpha + \beta_1 \text{ PCGDP07} + \beta_2 \text{ PCGDP07\^2} + \beta_3 \text{ PCGDP07\^3} + \beta_4 \text{ PCGDP07\^4} + \beta_5 \text{ HDI07SCR} + \beta_6 \text{ DISCORE} + \varepsilon$$

where α is a constant, βs are 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**. It is observed from the table that there is a significant relationship between the two series. In order to understand the non-linearity in the relationship, the higher order terms of income are also incorporated in the model and the significance of these terms in Model 1 and Model 2 confirm the presence of non-linearity in the relationship. It is observed that while the first order (PCGDP07) and cubic (PCGDP07^3) terms are positively related, the square (PCGDP07^2) and the quadruple (PCGDP07^4) terms are negatively related. In other words, it is found that EPI of the countries get influenced by growing income level, it increases initially with income, but decreases with further rise of the same. 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.[3]

Model 3 attempts to estimate the relationship between environment, income, HD and democracy index. It is observed from the regression results that while environmental performance of a country is positively related to its HD and democracy index, its relationship with respect to PCNSDP 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. Therefore, greater political freedom and higher human development level, in addition to income growth, are found to be conducive for better environment. The obtained result also suggests there is need for separately estimating the impact of HD and political freedom on EPI.

The interrelationship between EPI and PCGDP, as reflected from the regression analysis is reported in **Diagram 1**. An inverted and slanting S-shaped relationship between the two series is noticed from the diagram. The diagram suggests that the EPI

[3] For instance – for Kuwait, PCGDP07 is USD 47,812 and EPI08SCR is 64.5 and for United Arab Emirates – PCGDP07 is USD 54,626 and EPI08SCR is 64.0.

increases initially with income, but comes down after reaching a peak, which arguably is caused by intensification of economic activities. However, with further rise in income, EPI reaches a trough and starts increasing once again. Clearly the obtained results show a richer relationship pattern vis-à-vis the U-shaped contour proposed by EKC hypothesis.

3.2 Environment and Human Development

It is increasingly believed that environmental problems should no longer be viewed as the side effects of development process but rather be an integral part of it (Ginkel et al., 2001), which has been reflected in the Target 9 of the United Nations' Millennium Development Goals (MDGs). Melnick et al. (2005) argue that achieving environmental sustainability requires careful balancing of HD front as well while maintaining a stable environment that predictably and regularly provides resources and protects people from natural calamities. It is also held that socio-economic inequality leads to environmental inequality, which may consequently affect the overall extent of EQ (Boyce, 2003).

There have been several cross-country empirical analyses for estimating the relationship between variants of EPI and HD, and presence of non-linearity is generally reported. For instance, comparison of the Environmental Degradation Index (EDI) created by Jha and Bhanu Murthy (2001) for 174 countries with their HDI supported the existence of an inverted N-shaped global EKC rather than an inverted U-shaped one.

The Following models are estimated here:

$$EPI08SCR = \alpha + \beta_1 \,\text{HDI07SCR} + \beta_2 \,\text{HDI07SCR\^{}2} + \beta_3 \,\text{HDI07SCR\^{}3} + \beta_4 \,\text{DISCORE} + \varepsilon$$

and,

$$EPI08SCR = \alpha + \beta_1 \,\text{HPI07VAL} + \beta_2 \,\text{HPI07VAL\^{}2} + \beta_3 \,\text{HPI07VAL\^{}3} + \beta_4 \,\text{DISCORE} + \varepsilon$$

The regression models estimated by the current analysis are summarized in **Table 2**. It is observed from the first three reported models that there exists a significant non-linear relationship between EPI and HDI. In other words, enhancement in HD influences the EPI of a country significantly. 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. However the significance level of the higher order terms is found to be lower. The obtained result supports the non-linearity hypothesis in line with the literature. 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 growth in the latter. In other words, at a higher level of HDI, increase in HD leads to little improvement in EPI scores.

The relationship between EQ and Human Poverty Index (HPI) can be observed from model four as reported in **Table 2**. It is observed from the results that the first order and the cubic term of the HPI07VAL variable are positively related to EQ, while the square term is negatively related. The first order term is however not significant.[4] In other words like the HDI case, the HPI07VAL is also found to be having a non-linear relationship with EQ.

The fifth model looks into the relationship between EQ, HD and democracy. It is observed that both the variables are positively related to EQ, confirming that high order of human development as well as democracy level is conducive for better environmental achievement.

The relationship between EPI and HDI is reported in **Diagram 2**, which shows a slanting S-shaped of figure. In other words, like the case of income, the EKC hypothesis is not supported in case of EQ-HD interface as well.

Diagram 3 reports the non-linear relationship between EPI and HPI07VAL, in line with the regression results reported in **Table 2**. A slanting and inverted S-shaped curve emerges from the relationship between the two. As observed from the diagram, initially with rise in HPI, the EPI increases, but it decreases after a certain point. The decrease continues with growing level of HPI, but beyond a very high level of HPI, EPI increase once again.

The difference in the behavior of two indicators of HDI with respect to EPI can be explained by looking at the interrelation between the two series. It is observed from

[4] A regression with only HPI07VAL shows that its coefficient is having a negative sign and is found to be significant.

Diagram 4 that the line plotted in HDI-HPI plane in negatively sloped. The reason is that there are many countries with high HDI score but low HPI score and vice versa.[5]

3.3 Human Development and Democracy

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 HD level enhances citizen confidence and expectation from the policymakers and as a result their participation level in democratic process increases. On the other hand, a democratic government is always wary of the political business cycle in long run and hence attempts to enhance economic growth and HD level of the electorate in its own interest. However an autocratic regime may or may not share this motivation. The development process of Singapore (high HD) and Cambodia (moderate HD) may present the two extreme cases in this regard.

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 faces 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 weakened judicial system, which affects the growth process further.

The Following model is estimated here:

$$\text{HDI07SCR} = \alpha + \beta_1 \text{DISCORE} + \beta_2 \, PCGDP07 + \varepsilon$$

The regression analysis performed in the current framework on the relationship between HDI and democracy is reported in **Table 3**. It is observed from the table that human development is positively and linearly related to both democracy and income level of the countries, though the coefficient of the latter is found to be very small. In

[5] The point has been reported in Footnote 2.

[6] UNDP (2004) notes that the level of inequality in Latin American countries is higher than the corresponding world average.

other words, the countries characterized by higher levels of income and better democratic set up are prone to witness higher HD achievements.

The diagrammatic representation of the relationship between HD and democracy is noted in **Diagram 5**. The diagram represents the linear relationship between the two series. The positively sloped line indicates that with rise in democracy, the level of HDI also increases. Now, given the relationship between HDI and EPI established earlier, level of political freedom in a country (i.e. democracy index) should logically have a bearing on their environmental sustainability (i.e., EPI) as well, which is explored in subsequent analysis.

3.4 Human Development and Corruption

Before going into the relationship between environmental sustainability and corruption, an analysis of the relationship between Human Development and Corruption might provide interesting insights, given the influence of HD on EQ. Though corruption is a global phenomenon, its effect is found to be more prevalent in emerging economies, developing countries and least developed countries (Fokuoh Ampratwum, 2008).

The economic intuition suggests that with growing level of human development, the demand for better governance should increase and as a result, the rent-seeking activities may go down. However the real world situation is more complicated then the theorized version, given the fact that forces of corruption affects the development process of different countries in unique manner.

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, while 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 Selçuk (2006) as well, who reported that corruption reduces expenditures on HD front (i.e., education and health). UNDP (2003), focusing on the inter-linkage

between corruption and HD in Burkina Faso, also supported the interrelationship between the two.

The Following models are estimated here:

$$\text{HDI07SCR} = \alpha + \beta_1 \, LNCPI08 + \beta_2 \, LNCPI08\text{^}2 + \beta_3 \, PCGDP07 + \varepsilon$$

and,

$$\text{HPIVAL07} = \alpha + \beta_1 \, LNCPI08 + \beta_2 \, LNCPI08\text{^}2 + \beta_3 \, PCGDP07 + \varepsilon$$

The regression results of the current analysis are reported in **Table 4**. Models 1 and 2 look into the relationship between HDI and CPI. PCGDP07 is used as a control variable in our models. It is observed that while the first order term of LNCPI08 is having a positive coefficient, the second order term is having a negative coefficient. The income term, as expected, is having a positive coefficient, though the magnitude of the same is quite small. The obtained result suggests that with rise in HD level, CPI generally increases (i.e., society becomes less corrupt), but may decrease at the higher level of HDI.

Models 3 and 4 look into the relationship between HPI07VAL and CPI. It is observed that the result is opposite in nature to the HDI case, as revealed from the sign of the relevant coefficients. In other words, rising CPI is associated with a corresponding decline in HD level.

The relationship between HDI and corruption and HPI07VAL and corruption are noted in **Diagrams 6** and **7** respectively. In line with the regression results reported earlier, it is observed that while the former is having a positive slope, the latter is having a negative slope. Both the curves are found to be non-linear.

3.5 Corruption and Income

The interrelationship between corruption and income is a widely researched area. It is generally agreed that corruption creates a dampening effect on economic growth (Selçuk, 2006; Cooper et al, 2006; Mauro, 1996). Mo (2001) has reported that even a one percent increase in corruption level decreases GDP growth by almost three quarters of a

percent. Fokuoh Ampratwum (2008) notes the serious income implications of corruption in the emerging economies, developing countries and LDCs.

The following model is estimated here:

$$LNCPI08 = \alpha + \beta_1 PCGDP07 + \beta_2 PCGDP07\text{^}2 + \beta_3 HDI07SCR + \varepsilon$$

The empirical findings of the current analysis are reported in **Table 5**. It is observed from the table that there exist a non-linearity in the relationship between corruption and income level, while the coefficient of the first order term (PCGDP07) is positive and significant, the same for the second order term (PCGDP07ˆ2) is negative and significant. In other words, while the CPI score increases (i.e., corruption decreases) with income, at a higher level of income CPI decreases.

The relationship between CPI and PCGDP is shown with the help of **Diagram 8**. It is observed from the diagram that with rise in income, corruption level increases upto a point but comes down beyond that. The curvature is caused owing to Qatar, which is having a moderate CPI (6.5), despite having a high level of PCGDP.

3.6 Corruption and Democracy

Corruption is generally argued to be negatively associated with level of political freedom. Selçuk (2006) has argued that corruption distorts the two basic norms of democracy, namely equality and openness.

The empirical literature on interrelationship between the two is quite rich. For instance, the analysis of Selçuk (2006) could be noted which worked with the *Corruption Perception Index* (1999, 2000) published by Transparency International and the *Political Freedom Index* (1998) published by Freedom House. The empirical results supported the negative relationship between the two series. In other words, with advent of democracy, corruption is likely to go down.

The following model is estimated here:

$$LNCPI08 = \alpha + \beta_1 \text{ DISCORE} + \beta_2 \text{ DISCORE\^2} + \beta_3 \text{ DISCORE\^3} + \beta_4 HDI07SCR + \beta_5 PCGDP07 + \varepsilon$$

The regression results of the analysis are reported in **Table 6**. PCGDP and HDI are taken as the control variables. It is observed from the table that level of democracy is showing a non-linear relationship with corruption level. The coefficient of the first order term (DISCORE) is found to be positive in all three models. On the other hand, the coefficient of the second order term (DISCOREˆ2) is positive in the second model, but becomes negative in the third model with introduction of the third order term (DISCOREˆ3), which itself is positive and significant. On the whole greater political freedom is found to be conducive for better management of corruption.

The relationship between democracy and corruption is shown with the help of **Diagram 9**. It is observed from the diagram that with rise in democracy level, CPI is increasing at a decreasing rate upto a point, but beyond a point, the corruption level is found to be increasing at an increasing rate. The increase is caused owing to the presence of countries like Sweden, New Zealand, Denmark, Australia, all of which are characterized by both higher CPI and DI scores.

3.7 Environment and Democracy

Given the earlier evidence that environment and democracy are both influenced by several common factors like income and HD, there is a need now to evaluate the direct relationship between the two. It is observed from the international literature on environment and democracy that no evident conclusion on interrelationship between the two series can be drawn, as the evidence reported is ambiguous. One side of the literature reports 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 presence of democracy positively influence provision of environmental public goods as they relate to human health. It is observed that liberal democracies are more forthcoming in this arena as compared to 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 championed the environmental sustainability.

Jasanoff (1996) noted that the citizen involvement in ensuring better quality of environment is increasingly 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 at Europe (especially Germany) as well.[7] On the other hand, Chatrchyan (2004) noted that shallow democratization and stagnation may adversely affect environmental protection in post-communist countries.

The complex relationship between democracy, liberty and type of democracy has been explore by Bernauer and Vasiliki (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, 2004; Tucker, 2008). The cross-sectional empirical analysis of Congleton (1992) involving 118 countries shows 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, 2009b) 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.

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[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).

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 becomes a difficult proposition.

The other branch of empirical 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 etc.) as the dependent variables in the multiple regression analyses. The analysis showed that the statistically significant effect of democracy on the environment actually was negative for several categories, 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 network are more important than the effects of democracy.

The analysis of Cheng 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. While the study measures democracy by political rights and civil liberties; Carbon dioxide damage, CO_2 emissions, energy depletion, and net forest depletion are used as the dependent variables to show the environmental situations in a country. The results indicate that 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: while political democracy does decrease particulate emissions, but 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 result and the political freedom scenario in the communist countries is often cited. 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.

The following model is estimated here:

$$EPI08SCR = \alpha + \beta_1 \, Democracy + \beta_2 \, HDI07SCR + \varepsilon$$

where, in various versions of the model in place of democracy, DISCORE, DICLSCR, DIEPSCR, DIFGSCR, DIPPSCR are used as discussed earlier.

The regression results of the current analysis are reported in **Table 7**. It is observed from the table that democracy scores of the countries and their environment performance in general are positively related. Model 1 looks into the relationship between overall democracy score of a country and its environmental performance. The same hypothesis is tested in the subsequent models as well. In models 2, 3 and 5, more than one set of democracy parameters are considered. It is observed that the democracy indicators are having statistically significant coefficients with positive signs. Hence we observe that the econometric finding of the current analysis is supporting the contention that democratic set up is conducive for better environmental performance.

The visual representation of the regression results obtained in **Table 7** is noted in **Diagram 10**, which represents a linear relationship between EPI and DI. While the autocratic countries like North Korea, Chad and Turkmenistan are located at the south-west end of the diagram, major liberal democracies like Sweden, Norway and Iceland are placed at the north-east end of the same.

3.8 Environment and Corruption

The literature on environment and corruption is quite rich and like the case of environment and democracy, the literature is generally divided. 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 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, and the lower income level may lead to higher pollution levels. Similar viewpoint has been expressed by other studies as well (Lopez and Mitra 2000, Damania et al. 2003). 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 of people and thereby their wellbeing.[8] 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.[9] Similarly, Pellegrini (2006) has 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 judiciary might also lead to environmental degradation. For instance, Kotlobay (2002) noted that in Russia in 1999 6,383 forest-related illegal action cases were investigated; 3,113 cases were brought to court and finally in only 907 cases any penal action was taken.

The other side 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, 2002) and its component variables

[8] To support the argument, Dillion 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, as they were recipient of bribes from the former.

[9] 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).

and Corruption Perceptions Index (CPI, 2002). The study found both CPI and ESI to be statistically significantly related to income (proxied as GDP/capita) and argued that environmental sustainability declined with decreasing income while corruption worsened. The study further divided ESI (2002) into various sub-indicators representing pressure, state, impact and response and regressed them on 'residual CPI' (2002), 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.

The following model is estimated here:

$$EPI08SCR = \alpha + \beta_1 \text{ LNCPI08} + \beta_2 \text{ LNCPI08\^2} + \beta_3 \text{ LNCPI08\^3} + \beta_4 HDI07SCR + \varepsilon$$

The regression results are reported in **Table 8**. It is observed from various versions of the model that environmental performance of a country is positively related to the CPI score (i.e., if the society is less corrupt). It is observed that the higher order values of CPI are not having a significant relationship with EPI, indicating a linear relationship between the two. Interestingly, the HDI variable is not found to be having any significant relationship with EPI in presence of CPI indicators, so we dropped those models from the present paper.

The linear relationship between CPI and EPI is shown with the help of **Diagram 11**. While the countries like Iraq, Myanmar, Haiti and Afghanistan characterized by poorer environmental achievements and higher corruption are located in South-West of the diagram, the better performers on both counts (e.g., Denmark, New Zealand and Sweden) are placed in the North-East corner.

4 Conclusion

The Copenhagen Summit (2009) recently organized has shown the reluctance of the several developed as well as developing countries to go for further commitment with respect to 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 socio-economic and socio-political variables on their environmental performance through a cross-country analysis.

The literature on the linkage between environment-corruption and environment-democracy is quite rich. However, it is observed that a considerable section of the studies in this sphere are qualitative and case 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 on the macro perspective. On the other hand, several studies focusing on the macro variables (e.g. CPI, ESI) have been conducted with the 2002-03 period data, which misses out the dynamics in the post 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 analysis are summarized in the following. First, it is observed that EPI of the countries get influenced by growing income level. It increases initially with income, but decreases with further rise of the same. Hence, unlike the EKC hypothesis an inverted U-shaped curve is obtained. However, if other factors like HD achievement and democracy index are considered, the obtained regression results fall in line with the EKC hypothesis. Therefore, greater political freedom and higher human development level, in addition to income growth, are found to be conducive for better environment.

Second, there is a behavioral difference in EPI's response to HDI and HPI, the two HD achievements considered here. We find that EPI 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 owing to higher human development scenario facilitates environmental governance. The coefficient of the democracy variable included in the analysis is also found to be positive and significant. However, a diametrically opposite scenario is noted for HPI.

Third, it is observed that HD is positively and linearly related to both democracy and income level, indicating that the countries characterized by higher levels of income and better democratic set up are prone to witness higher HD achievements.

Fourth, the regression results on the relationship between HD and corruption confirms presence of a non-linearity and suggests that with decline in corruption, HD level rises, but declines marginally for a few countries characterized by a less corrupt regime. An opposite picture is however noted for the relationship between HPI and corruption.

Fifth, it is observed that there exist a non-linearity in the relationship between corruption and income level. While corruption initially decreases with income, at a higher level of PCGDP, it marginally increases.

Sixth, non-linearity is also observed in the relationship between corruption and democracy. With rise in political freedom, corruption decreases, but initially at a slower rate. However beyond a particular level of political freedom, the increase in the same is found to be associated with higher reduction in corruption. On the whole greater political freedom is found to be conducive for better management of corruption.

Seventh, political freedom of the countries and their EQ in general are found to be positively and linearly related, supporting the standpoint that democratic set up is conducive for better environmental performance. This signifies the presence of a more responsive governance mechanism towards environmental assets in liberal democracies.

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 observed in the present set up. However, interestingly, other socio-economic factors like the HDI, do not play any role in determining the relationship here.

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Table 1: Relationship between Environmental Performance and Income Levels

Independent variables	**Dependent Variable: EPI08SCR**		
	Model 1	**Model 2**	**Model 3**
Constant	56.81 (39.62) ***	54.63 (33.62) ***	17.52 (5.51) ***
PCGDP07	$0.27 \text{ X } 10^{-2}$ (9.95) ***	$0.37 \text{ X } 10^{-2}$ (7.39) ***	$- 0.39 \text{ X } 10^{-3}$ (-3.29) ***
PCGDP07^2	-7.57E-08 (-7.13) ***	-1.58E-07 (-3.95) ***	2.78E-09 (2.00) **
PCGDP07^3	5.80E-13 (6.26) ***	2.62E-12 (2.51) **	
PCGDP07^4		-1.47E-17 (-1.89) *	
HDI07SCR			71.72 (14.37) ***
DISCORE			1.06 (3.63) ***
R-squared	0.60	0.62	0.81
Adjusted R-squared	**0.59**	**0.61**	**0.80**
Log likelihood	-504.71	-501.05	-450.66
Durbin-Watson statistics	2.17	2.21	2.17
Akaike information criterion	7.07	7.03	6.33
Schwarz criterion	7.15	7.13	6.43
F-statistic	**69.40**	**56.19**	**148.36**
Prob (F-statistic)	0.00	0.00	0.00
Method	Least Squares	Least Squares	Least Squares
Number of observations	166	166	166
Included observations	144	144	144

Note: Figure in the parenthesis shows White heteroskedasticity-consistent standard error for the estimated coefficient. *** denotes significance at 1 percent level, while * denotes significance at 10 percent level.

Table 2: Relationship between Environmental Performance and Human Development

Independent variables	**Dependent Variable: EPI08SCR**				
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Constant	26.11 (11.67) ***	14.14 (2.10) **	18.04 (3.68) ***	80.42 (40.34) ***	26.43 (11.63) ***
HDI07SCR	62.71 (21.55) ***	99.42 (4.74) ***	81.87 (7.46) ***		56.63 (13.03) ***
HDI07SCR^2		-26.72 (- 1.74) *			
HDI07SCR^3			-12.97 (- 1.77) *		
HPI07VAL				0.15 (0.46) ***	
HPI07VAL^2				- 0.03 (- 2.38) **	
HPI07VAL^3				0.40 X 10^{-3} (-2.15) **	
DISCORE					0.73 (2.22) **
R-squared	0.77	0.78	0.78	0.68	0.78
Adjusted R-squared	**0.77**	**0.77**	**0.77**	**0.67**	**0.78**
Log likelihood	-463.38	-462.15	-462.15	-444.48	-460.28
Durbin-Watson statistics	2.36	2.36	2.36	2.01	2.29
Akaike information criterion	6.46	6.46	6.46	6.84	6.43
Schwarz criterion	6.50	6.52	6.52	6.93	6.49
F-statistic	**485.01**	**246.18**	**246.20**	**90.34**	**254.52**
Prob (F-statistic)	0.00	0.00	0.00	0.00	0.00
Method	Least Squares	Least Squares	Least Squares	Least Squares	Least Squares
Number of observations	166	166	166	166	166
Included observations	144	144	144	131	144

Note: Figure in the parenthesis shows White heteroskedasticity-consistent standard error for the estimated coefficient. *** denotes significance at 1 percent level, while * denotes significance at 10 percent level.

Table 3: Relationship between Human Development and Democracy

Independent variables	**Dependent Variable: HDI07SCR**	
	Model 1	**Model 2**
Constant	0.46 (13.28) ***	0.49 (18.58) ***
DISCORE	0.05 (9.96) ***	0.02 (5.66) ***
PCGDP07		6.93E-06 (7.73) ***
R-squared	0.36	0.62
Adjusted R-squared	**0.36**	**0.62**
S.E. of regression	0.14	0.11
Sum squared residual	3.34	1.97
Log likelihood	85.65	127.35
Durbin-Watson statistics	2.01	2.12
Mean dependent variable	0.73	0.73
S.D. dependent variable	0.18	0.18
Akaike information criterion	-1.03	-1.54
Schwarz criterion	-0.99	-1.48
F-statistic	**91.23**	**131.57**
Prob (F-statistic)	0	0
Method	Least Squares	Least Squares
Number of observations	166	166
Included observations	163	162

Note: Figure in the parenthesis shows White heteroskedasticity-consistent standard error for the estimated coefficient. *** denotes significance at 1 percent level, while * denotes significance at 10 percent level.

Table 4: Relationship between Human Development and Corruption

Independent variables	Dependent Variable: HDI07SCR		Dependent Variable: HPI07VAL	
	Model 1	**Model 2**	**Model 1**	**Model 2**
Constant	0.48 (16.04) ***	0.36 (6.16) ***	33.90 (9.76) ***	51.38 (6.64) ***
LNCPI2008	0.14 (4.82) ***	0.34 (3.80) *	- 9.84 (-3.08) ***	- 41.52 (- 3.45) ***
LNCPI2008^2		- 0.08 (- 2.37) **		13.53 (3.02) ***
PCGDP07	5.28E-06 (4.30) ***	6.31E-06 (4.06) ***	- 0.19 X 10^{-3} (-2.06) **	- 0.37 X 10^{-3} (-3.10) ***
R-squared	0.61	0.62	0.25	0.29
Adjusted R-squared	**0.61**	**0.62**	**0.24**	**0.28**
Log likelihood	123.51	125.97	-575.78	-571.56
Durbin-Watson statistics	2.07	2.09	2.03	1.97
Akaike information criterion	-1.50	-1.52	7.93	7.88
Schwarz criterion	-1.44	-1.44	7.99	7.97
F-statistic	**124.16**	**86.43**	**23.95**	**19.62**
Prob (F-statistic)	0.00	0.00	0.00	0.00
Method	Least Squares	Least Squares	Least Squares	Least Squares
Number of observations	166	166	166	166
Included observations	161	161	146	146

Note: Figure in the parenthesis shows White heteroskedasticity-consistent standard error for the estimated coefficient. *** denotes significance at 1 percent level, while * denotes significance at 10 percent level.

Table 5: Relationship between Corruption and Income

Independent variables	Dependent Variable: LNCPI2008	
	Model 1	**Model 2**
Constant	0.31 (2.38) **	0.55 (3.23) ***
PCGDP07	0.15 X 10^{-4} (5.22) ***	0.36 X 10^{-4} (4.39) ***
PCGDP07^2		- 0.30 X 10^{-10} (- 3.09) ***
HDI07SCR	1.01 (4.71) ***	0.47 (1.49)
R-squared	0.63	0.66
Adjusted R-squared	**0.63**	**0.65**
Log likelihood	-35.40	-29.80
Durbin-Watson statistics	1.96	2.07
Akaike information criterion	0.48	0.42
Schwarz criterion	0.53	0.50
F-statistic	**136.10**	**100.42**
Prob (F-statistic)	0.00	0.00
Method	Least Squares	Least Squares
Number of observations	166	166
Included observations	161	161

Note: Figure in the parenthesis shows White heteroskedasticity-consistent standard error for the estimated coefficient. *** denotes significance at 1 percent level, while * denotes significance at 10 percent level.

Table 6: Relationship between Corruption and Democracy

Independent variables	**Dependent Variable: LNCPI2008**		
	Model 1	**Model 2**	**Model 3**
Constant	0.25 (2.42) **	0.39 (2.52) **	- 0.14 (0.43)
DISCORE	0.09 (8.11) ***	0.03 (0.79)	0.37 (2.10) **
DISCOREˆ2		$0.54 \text{ X } 10^{-2}$ (1.22)	- 0.06 (-1.79) *
DISCOREˆ3			$0.39 \text{ X } 10^{-2}$ (2.01) **
HDI07SCR	0.37 (1.84)	0.38 (1.87) *	0.46 (2.18) **
PCGDP07	$0.14 \text{ X } 10^{-4}$ (6.08) ***	$0.13 \text{ X } 10^{-4}$ (5.29) ***	$0.12 \text{ X } 10^{-4}$ (4.66) ***
R-squared	0.75	0.75	0.76
Adjusted R-squared	**0.75**	**0.75**	**0.75**
Log likelihood	-4.32	-3.68	-1.64
Durbin-Watson statistics	2.11	2.14	2.13
Akaike information criterion	0.10	0.11	0.09
Schwarz criterion	0.18	0.20	0.21
F-statistic	**157.31**	**118.47**	**97.38**
Prob (F-statistic)	0.00	0.00	0.00
Method	Least Squares	Least Squares	Least Squares
Number of observations	166	166	166
Included observations	161	161	161

Note: Figure in the parenthesis shows White heteroskedasticity-consistent standard error for the estimated coefficient. *** denotes significance at 1 percent level, while * denotes significance at 10 percent level.

Table 7: Relationship between Environment and Democracy

Independent variables	**Dependent Variable: EPI08SCR**				
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Constant	26.43 (11.63) ***	26.12 (11.61) ***	26.79 (11.41) ***	26.68 (11.53) ***	25.58 (11.22) ***
DISCORE	0.73 (2.22) **				
DICLSCR		0.67 (2.78) ***			
DIEPSCR			0.45 (2.19) **		
DIFGSCR				0.37 (1.47)	
DIPPSCR					0.28 (0.79)
HDI07SCR	56.63 (13.03) ***	56.69 (14.68) ***	57.93 (14.79) ***	59.32 (14.68) ***	61.17 (16.37) ***
R-squared	0.78	0.79	0.78	0.78	0.77
Adjusted R-squared	**0.78**	**0.78**	**0.78**	**0.77**	**0.77**
Log likelihood	-460.28	-458.92	-459.87	-462.35	-463.07
Durbin-Watson statistics	2.30	2.28	2.28	2.34	2.35
Akaike information criterion	6.43	6.42	6.43	6.46	6.47
Schwarz criterion	6.50	6.48	6.49	6.53	6.54
F-statistic	**254.53**	**260.73**	**256.40**	**245.30**	**242.15**
Prob (F-statistic)	0.00	0.00	0.00	0.00	0.00
Method	Least Square	Least Square	Least Square	Least Square	Least Square
Number of observations	166	166	166	166	166
Included observations	144	144	144	144	144

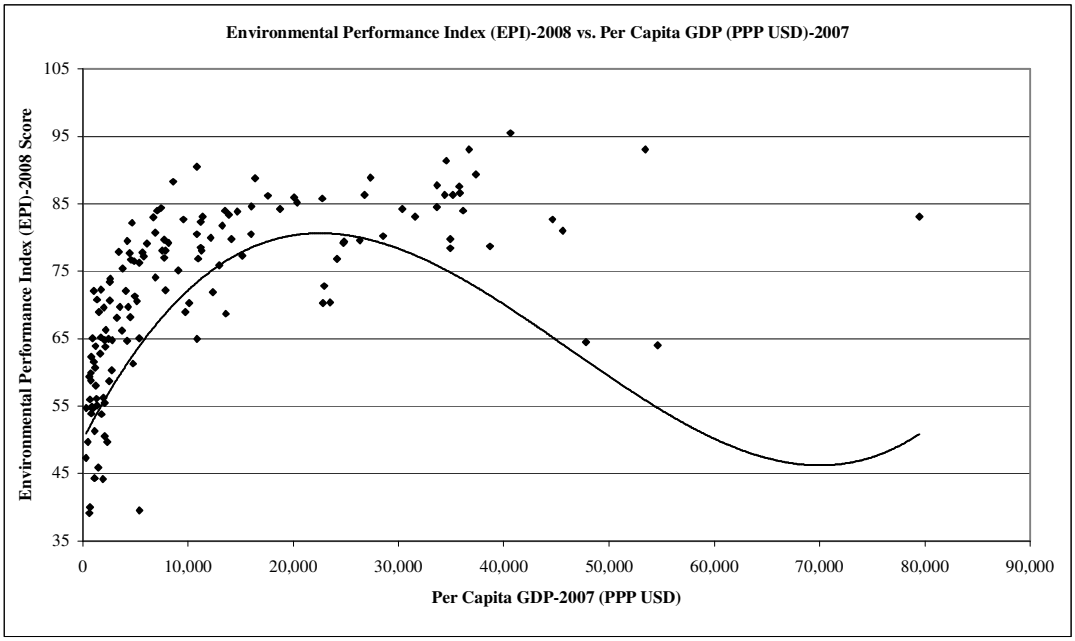
Note: Figure in the parenthesis shows White heteroskedasticity-consistent standard error for the estimated coefficient. *** denotes significance at 1 percent level, while * denotes significance at 10 percent level.

Table 8: Relationship between Environment and Corruption

Independent variables	**Dependent Variable: EPI08SCR**		
	Model 1	**Model 2**	**Model 3**
Constant	51.31 (23.31) ***	52.87 (11.06) ***	57.07 (7.30) ***
LNCPI08	16.49 (12.20) ***	13.73 (1.83) *	1.12 (0.05)
LNCPI08^2		1.04 (0.39)	11.98 (0.67)
LNCPI08^3			- 2.82 (- 0.62)
R-squared	0.42	0.42	0.42
Adjusted R-squared	**0.42**	**0.41**	**0.41**
S.E. of regression	9.75	9.78	9.80
Sum squared residual	13680.10	13669.09	13647.82
Log likelihood	-538.59	-538.53	-538.42
Durbin-Watson statistics	1.98	1.97	1.98
Mean dependent variable	72.02	72.02	72.02
S.D. dependent variable	12.77	12.77	12.77
Akaike information criterion	7.41	7.42	7.43
Schwarz criterion	7.45	7.48	7.51
F-statistic	**104.77**	**52.12**	**34.63**
Prob (F-statistic)	0.00	0.00	0.00
Method	Least Squares	Least Squares	Least Squares
Number of observations	167	167	167
Included observations	146	146	146

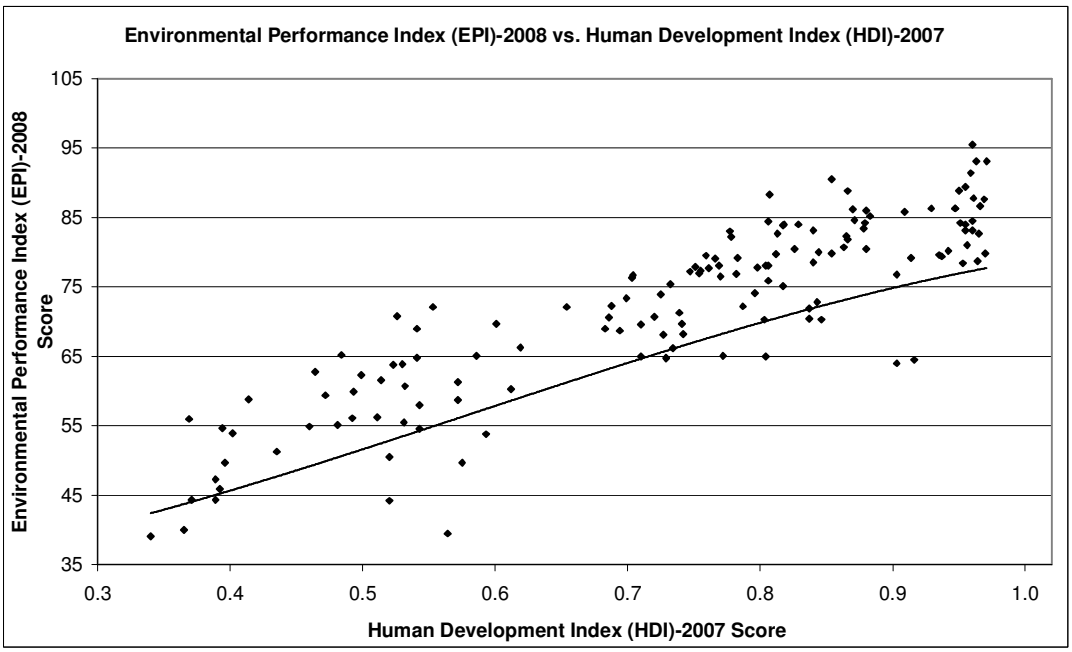
Note: Figure in the parenthesis shows White heteroskedasticity-consistent standard error for the estimated coefficient. *** denotes significance at 1 percent level, while * denotes significance at 10 percent level.

Diagram 1: Environmental Performance Index (EPI) – 2008 vs. Per Capita (PPP USD) - 2007



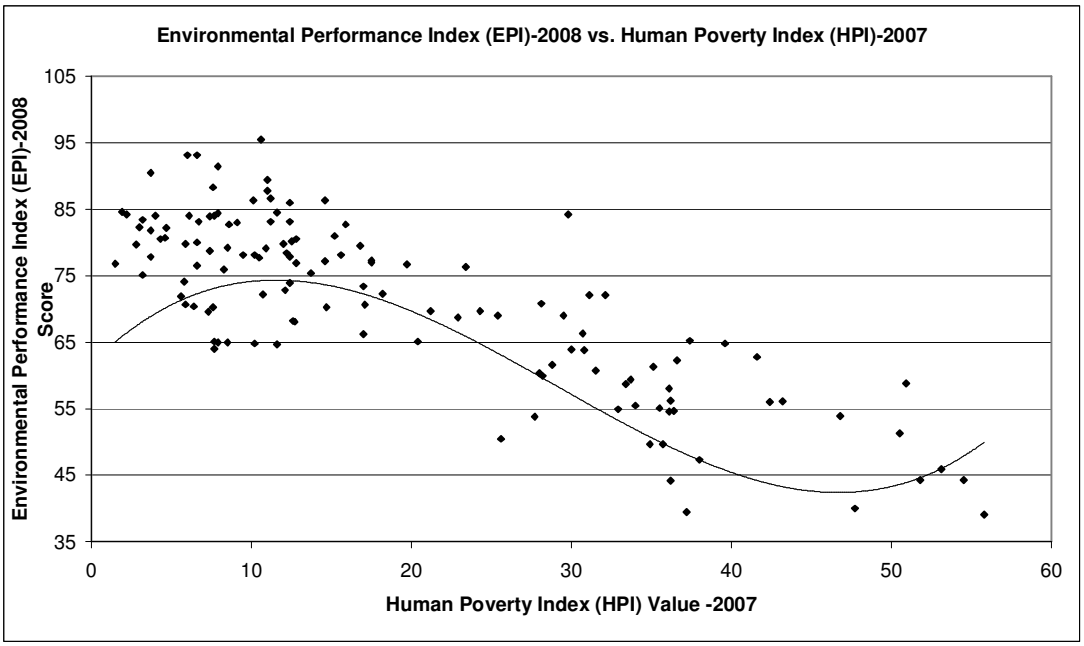
Source: Mukherjee and Chakraborty (2010)

Diagram 2: Environmental Performance Index (EPI) – 2008 vs. Human Development Index (HDI) – 2007



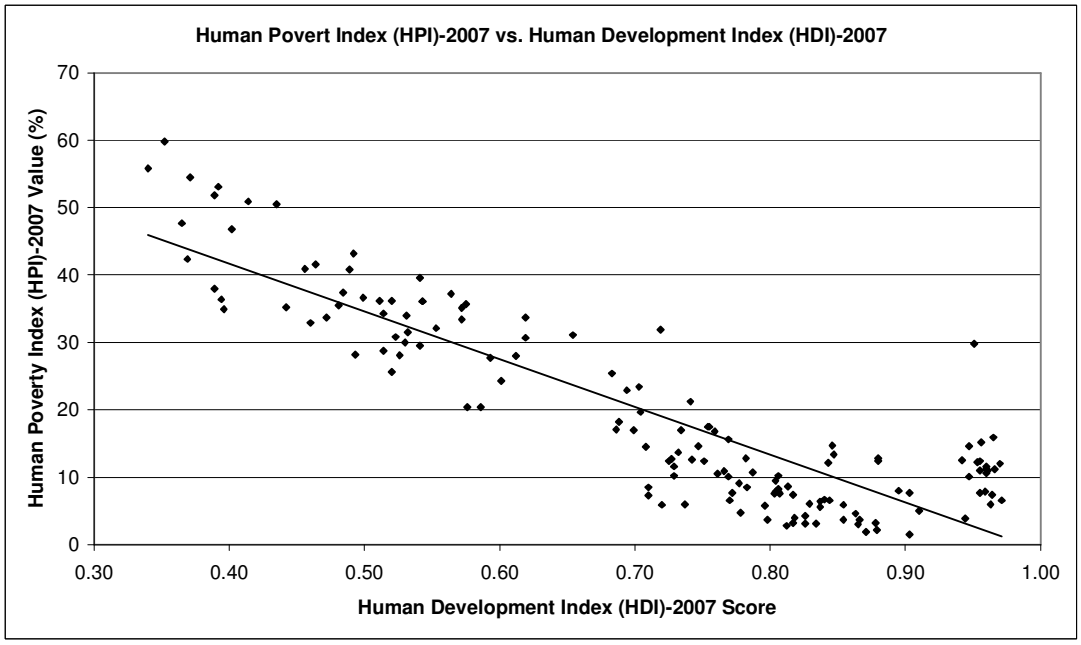
Source: Mukherjee and Chakraborty (2010)

Diagram 3: Environmental Performance Index (EPI) – 2008 vs. Human Poverty Index (HPI) - 2007



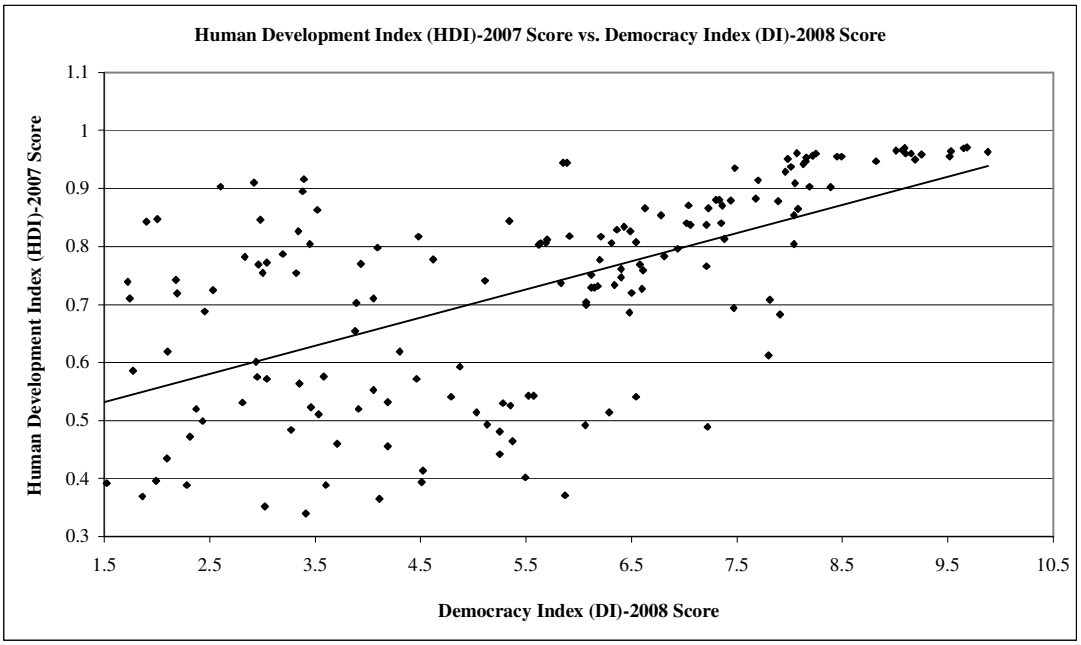
Source: Mukherjee and Chakraborty (2010)

Diagram 4: Human Development Index (HDI) - 2007 vs. Human Poverty Index (HPI) - 2007



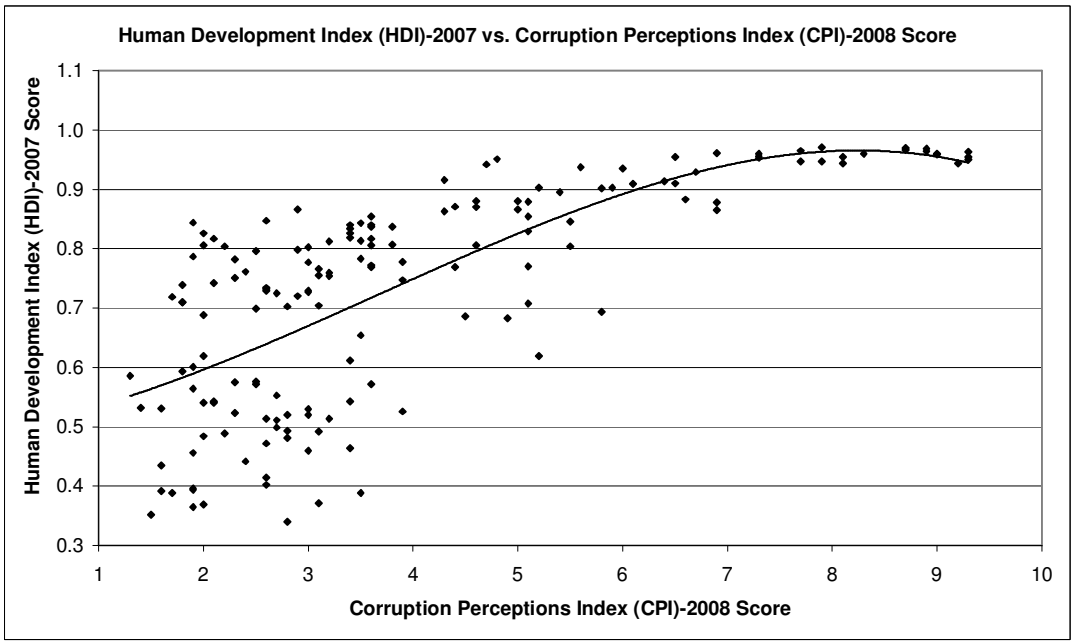
Source: Mukherjee and Chakraborty (2010)

Diagram 5: Human Development Index (HDI) – 2007 vs. Democracy Index – 2008



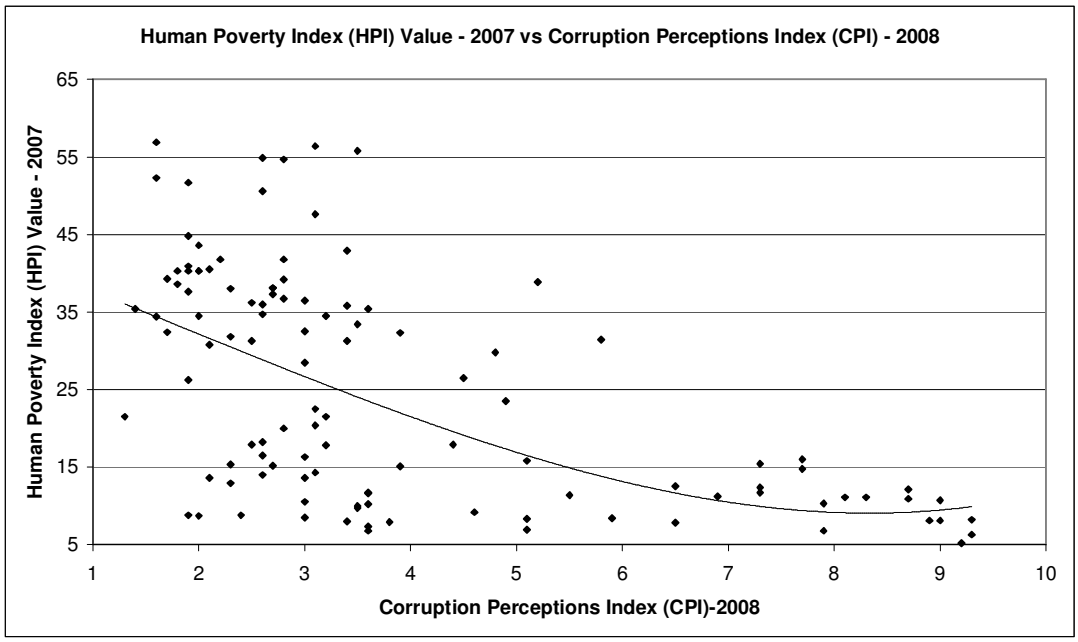
Source: Mukherjee and Chakraborty (2010)

Diagram 6: Human Development Index (HDI) – 2007 vs. Corruption Perception Index (CPI) - 2008



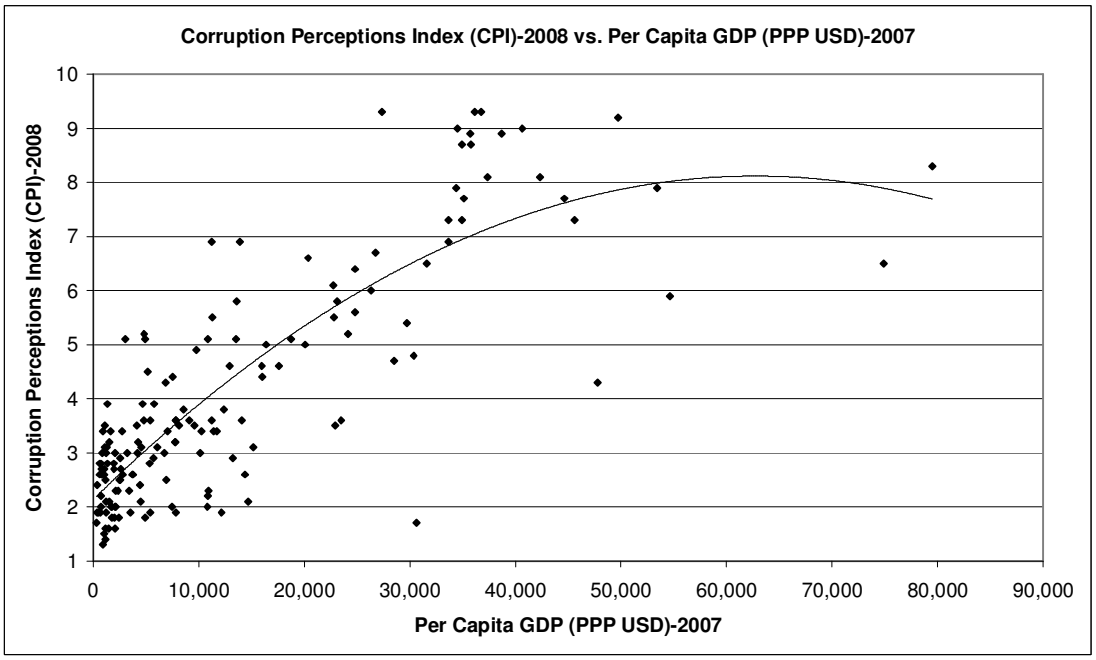
Source: Mukherjee and Chakraborty (2010)

Diagram 7: Human Poverty Index (HPI) – 2007 vs. Corruption Index (CPI) – 2008



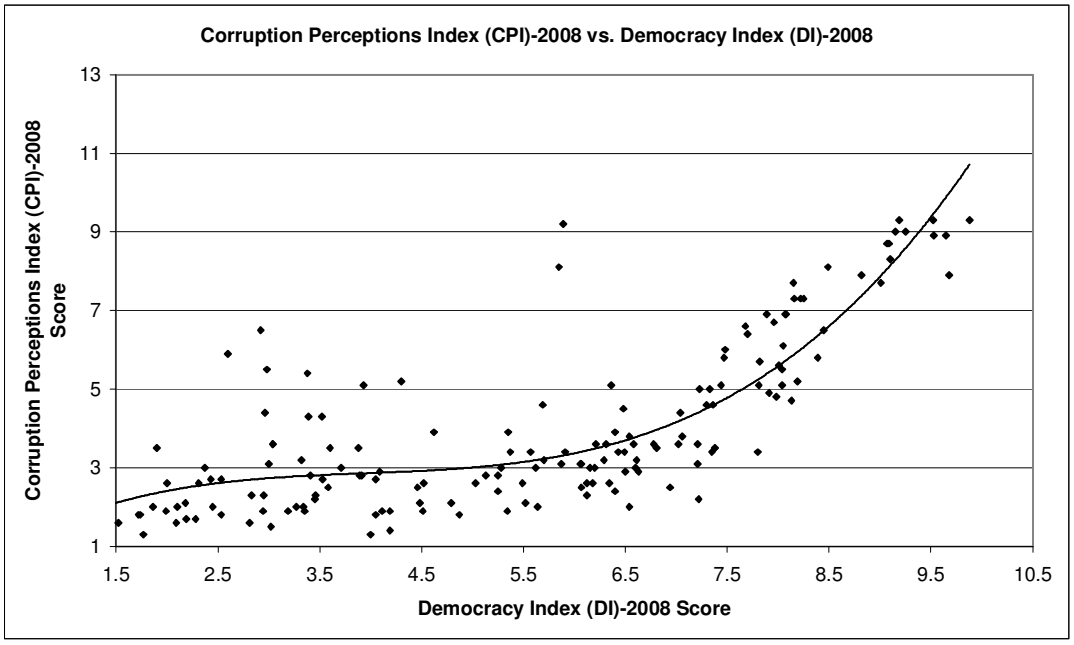
Source: Mukherjee and Chakraborty (2010)

Diagram 8: Per Capita GDP – 2007 vs. Corruption Index (CPI) – 2008



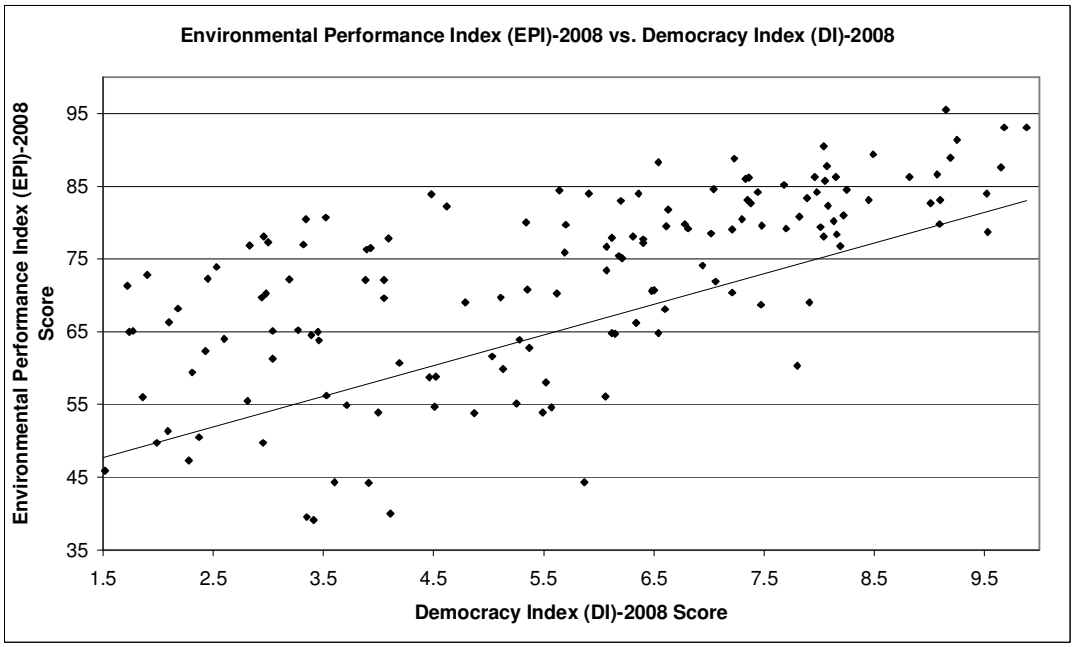
Source: Mukherjee and Chakraborty (2010)

Diagram 9: Corruption Perceptions Index (CPI) - 2008 vs. Democracy Index (DI) – 2008



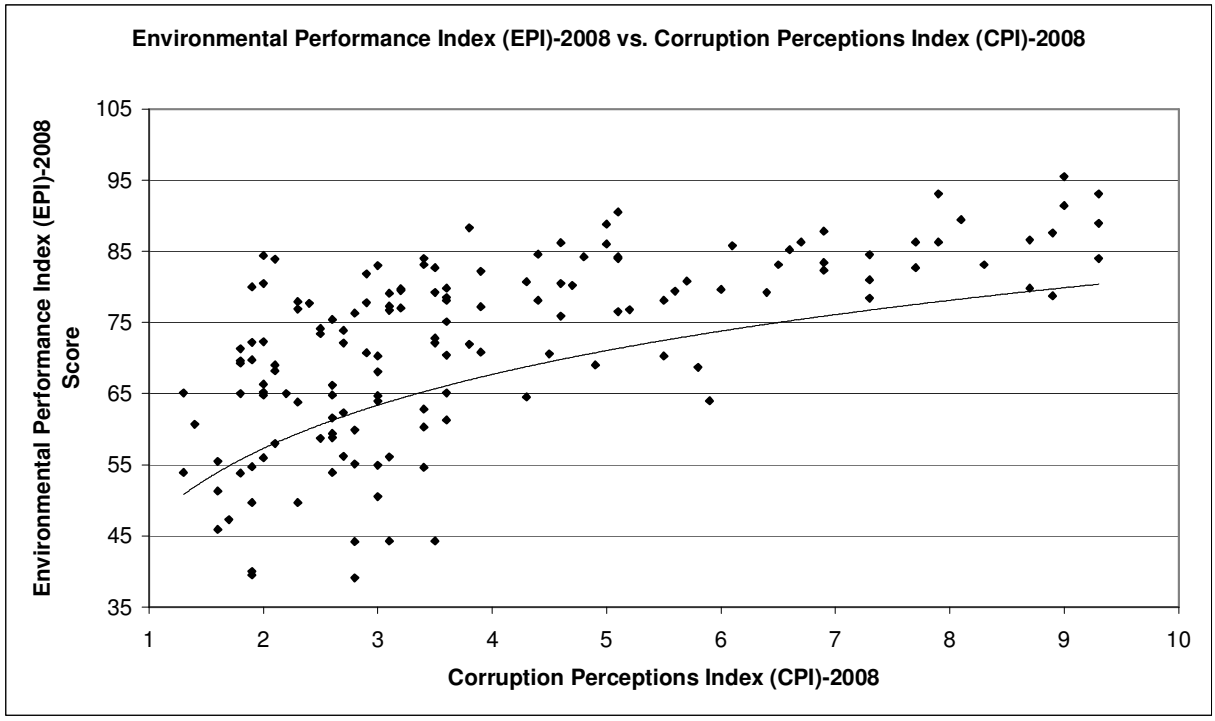
Source: Mukherjee and Chakraborty (2010)

Diagram 10: Environmental Performance Index (EPI) – 2008 vs. Democracy Index - 2008



Source: Mukherjee and Chakraborty (2010)

Diagram 11: Environmental Performance Index (EPI) – 2008 vs. Corruption Perceptions Index - 2008



Source: Mukherjee and Chakraborty (2010)