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# Environmental Performance of Developing Countries: A Comparative Study

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## I. INTRODUCTION

The developing countries of the world enjoy cultural and economic diversity as well as diverse concerns and interests when dealing with environmental issues. The environmental concerns of the Euro Mediterranean countries may be drastically different from those of the Arab countries in the MENA region, due to variety of reasons including trade relationships, geographic proximity and Tran's boundary pollution issues. Pressure to improve environmental performance may be imposed from neighboring or distant developed countries, or trade partners. Import restrictions are commonly used to curb environmental damages or abide by environmental laws or improve environmental performance.

Measuring environmental performance is one of the more challenging tasks that researchers and scientists can embark on. The criteria used to measure performance can never be clearly defined and is very subjective. The environmental performance dimension is wide and could be defined alternatively at the individual level using health and well-being indicators in and out of the place of residence and work; at the household level using indoor and outdoor amenities; at the community level such as schools, clubs, hospitals, etc.; at the local level such as the municipality, village, and city; at the regional level such as the district which represents a collection of cities, villages and municipalities; at the national level, at the international level. Given the possible dimensions that a researcher can consider in measuring environmental performance, conducting a comparative study of environmental performance across countries is a

daunting and challenging task, if not impossible, in the absence of uniform measures of performance.

The need for designing environmental performance indicators that can be used for policy analysis and comparative studies has been increasing over time. There have been parallel efforts to develop such comparative measures. The Environmental Sustainability Index, the Ecological Footprint, the Carbon Footprint, the Water Footprint, and the Environmental Performance Index are examples of attempts to measure environmental bio-capacity and performance. The interesting feature of these indices is that they can be used to compare across countries, at a point in time, as there have been attempts to unify the methodology used in constructing them.

The objective of this paper is to study the state of the environmental performance of developing countries by conducting a comparative study across the countries to determine 1) whether variations exist in environmental performance using alternative measures of performance, 2) the extent of variation if they exist, and 3) the variables that can help explain the existing variations.

The paper is organized as follows: Section II addresses the first two objectives. It introduces a set of indicators that could be used to measure environmental performance. It then compares and assesses performance across developing countries in various regions of the world. Section III addresses the question of variation in performance and attempts to explain the variation. Section V concludes the paper with recommendations and suggestion for future efforts.

## II. ASSESSMENT OF ENVIRONMENTAL PERFORMANCE ACROSS COUNTRIES/REGIONS

The indicator of environmental awareness and commitment that we study is the one proposed by Djoundourian (2007, 2011). The indicator consists of the total number of international environmental agreements (IEAs) signed, ratified, partied, and entered into by force by the developing Countries of the World. Djoundourian considers that signing of regional and international environmental agreements represents an indicator of environmental commitment that can be used for comparative purposes. This indicator is compiled from the International Environmental Agreements Database Project. The term "international", in this database, is defined to mean intergovernmental as opposed to any other definition of the term. The term "agreement" is defined to mean a treaty, convention, or protocol between states with a clause indicating consent to be bound by the agreement in written form and governed by international law. The term "environmental" indicates any agreement that has a primary purpose of managing or preventing human impacts on natural resources, plant and animal species, water bodies, and other ecosystems (Ronald Mitchell and the IEA Database Project, 2002-2009). Table 1 presents the average number of IEAs signed (Signature), ratified, accessed or succeeded (Accession) and entered into force (Into Force) by developing countries in various geographic regions. A total number of 138 developing countries were included in the database spread over six geographic regions.

**Table 1: Mean and standard errors of IEAs for developing countries by region**

| **Regions** | **Signatures** | **Accession** | **Into Force** | **# of countries** |
|---|---|---|---|---|
| **Africa** | 24.24<br>(1.29) | 33.80<br>(1.42) | 14.71<br>(0.77) | 45 |
| **East Asia and Pacific** | 20.57<br>(2.21) | 34.05<br>(2.48) | 13.00<br>(1.29) | 21 |
| **Europe and Central Asia** | 34.32<br>(4.92) | 51.59<br>(5.43) | 29.91<br>(3.19) | 22 |
| **Latin America and Caribbean** | 34.34<br>(3.08) | 44.00<br>(2.67) | 19.52<br>(1.14) | 29 |
| **Middle East and North Africa** | 31.00<br>(4.97) | 42.77<br>(5.40) | 22.69<br>(3.35) | 13 |
| **South Asia** | 21.25<br>(3.84) | 33.00<br>(4.21) | 13.63<br>(2.62) | 8 |
| **All Developing** | 27.88<br>(1.33) | 39.62<br>(1.42) | 18.57<br>(0.87) | 138 |
| **F Statistic for equality of Means**<br>**(p-value)** | 3.94<br>(0.002311) | 5.32<br>(0.000174) | 12.40<br>(.0000000007) | |

Source: Data compiled by Author from IEA Database Projects

* Standard errors in parentheses

On average, a developing country has signed around 28 international agreements, accessed, ratified or succeeded around 40 agreements and has about 19 agreements already into force. The mean values for the indicators for the various regions indicate that there are variations in the values obtained. For instance, a developing country in Europe and Central Asia has signed around 34 international environmental agreements compared to 21 agreements for a developing country in East Asia and the Pacific. Obviously there are variations in the means of the three variables. The question that imposes itself at this juncture is the following: are the observed differences across regions significantly different? The joint hypothesis of equal means for the three indicators, across all regions, using analysis of variance (ANOVA) technique was rejected against the alternative that at least one of the means is different from the others. ANOVA basically compares the between group variation (groups here are the different regions) with within group variations in the observed values (within each region) and decides accordingly whether the observed differences across the groups are significant. The F-statistic for equality of means reported in the Table 1 are systematically higher than the critical value of F and the reported p-values indicate that the probability of rejecting a true hypothesis is less than 0.5% in all cases; that is, we can safely conclude that from the observed means of the IEAs signed, accessed or entered into force, at least one pair of means are statistically significantly different across regions.

## III. DETERMINANTS OF ENVIRONMENTAL PERFORMANCE

A question of interest to this study, as stated in the objectives, is accounting for variations in environmental performance if they existed. The previous section clearly identified differences in environmental performance of the developing countries. Environmental performance is expected to be a function of variety of factors including, but not limited to, income, state of knowledge, and existing environmental conditions. If prevailing environmental conditions are acceptable, then there is no need to expend any resource or effort for correction purposes. However, if the existing conditions are dire, then communities will choose the path of resistance. The driving force behind all environmental engagement is the expectation that involvement and activism pay off. The biggest evidence for the notion that activism pays off is the existence, strength, and resourcefulness of various interest groups such as the Green Peace that effectively lobby for the common good. Almost all NGOs develop because of a common ideology or interest or problem. Environmental performance of countries is expected to be influenced by the interest groups in the country. The effectiveness of these groups is determined by their willingness and ability to expend efforts to enhance environmental quality which will increase with income.

### a. *The Empirical Model*

In an attempt to explain the observed differences, the following behavioral model is proposed:

$$\text{Performance Indicator}_{ij} = \alpha + \beta_0 \text{Income}_i + \beta_1 \text{Income}_i^2 + \sum_k \gamma_k Z_{ki} + \varepsilon_i$$

Where Performance Indicator$_{ij}$ is the jth indicator of environmental performance (j=1, 2, and 3) for a given country i; Income is the indicator of economic well-being in location i; $Z_{ki}$ is a vector of socioeconomic characteristics that may help explain variations in environmental performance; $\varepsilon_i$ is the error term.

b. *Variable Description and Data Sources*

The dependent variable in the alternative models is defined as the indicator of environmental performance; the total number of IEA signatures (Indicator 1), IEA accessions and ratifications (Indicator 2), and IEA entry into force (Indicator 3) are obtained from the International Environmental Agreements Database Project.

The Income variable is the GNI per capita obtained from World Development Indicators published by the World Bank; the variable is adjusted for purchasing power parity and is used as the indicator of economic well-being. The expectation is that $\beta_0 > 0$ and $\beta_1 < 0$ indicating that environmental performance of countries would be increasing with income at a decreasing rate. This expected relationship is in line with the literature on environmental Kuznets curve where the expected relation between pollutants and income follows an inverted U-shape. At low incomes pollution increases and then as income gets higher and higher new technologies are instituted to cut down on pollution. Here we are arguing that as income increases, the efforts to combat pollution will increase and environmental performance will improve.

The vector Z is composed of socioeconomic and environmental variables that are expected to explain variations in the dependent variable; most variables are obtained from the World Development Indicators. Foreign direct investments (FDI), is used as a control variable for global openness and liberalization; this variable is expected to have a positive coefficient, $\gamma_{FDI}$

> 0. Countries that attract more FDI are expected to be relatively better international players than others. While it is possible to argue that many of the developing countries may be considered pollution havens and FDI flows into them for the purposes of avoiding stringent environmental regulation, the available data would not allow the testing of the pollution haven hypothesis. An export of goods and services as a percent of GDP (EXPORTS) is also used as a proxy variable for trade openness; this variable is expected to have a positive coefficient, $\gamma_{EXPORT} > 0$. A country's exports are determined by comparative advantage, of course, but we argue that the country's ability to export more has an impact on its environmental performance.

The regions of the world are captured in the model by five dummy variables: AFRICA, EAP (East Asia and Pacific), EUROPE (Europe, Eastern Europe and Central Asia), LAC (Latin America and the Caribbean), and MENA. These dummy variables take the value of 1 for all developing countries falling in a specific region and 0 otherwise. These variables are included to test whether these regions differ with respect to the environmental performance indicators from other developing countries in South Asia, the base category, after controlling for all the other variables that are believed to affect the indicators used. Based on the analysis in Section II, we do expect to observe few significant coefficients for regional dummies in some if not all of the specifications.

Two environmental variables are included in the model to control for prevailing environmental conditions in the country, with the expectation that in the presence of environmental degradation, there will be increased willingness to improve the situation through remediation efforts such as committing to improvements through signing or accessing IEAs or seeking better values for the EPI. The percentage forest land (FOREST), as a % of land area, and the emissions of carbon dioxide ($CO_2$), in metric tons per capita, are used as two such indicators

of environmental quality. Environmental preservation is expected to be higher when a country has scarce resource base indicated by low percentages in forest area. With reduction in forest areas, the protectionist movement is expected to rise. As such, this variable is expected to have a negative coefficient, $\gamma_{FOREST} < 0$. The $CO_2$ emissions are those stemming from the burning of fossil fuels and the manufacture of cement. Increased values of $CO_2$ indicate deterioration in environmental quality and as such create a movement towards remediation effort. The expected sign of the coefficient of $CO_2$ is positive, $\gamma_{CO2} > 0$.

Total population (POP) is included as a control variable. Larger population is expected to exert pressure on the environment. The last set of variables on the list of explanatory variables includes the total number of all registered non-profit organizations (NGO) in a country, including environmental NGOs and the total number of terrestrial protected areas (PROTECT) in the country. Terrestrial protected areas are those officially documented by national authorities. NGO is obtained from the World Association of NGO (WANGO) website. Theoretically, NGOs are expected to exert pressure on governments to take action and correct a wrong. While not all NGOs are successful, there are many local and global NGOs (Greenpeace, Red Cross, for example) that have impacted the course of events. While it would have been better to include only environmental NGOs, data are not readily available for the variable. The expected sign for the coefficient of NGO is positive for all indicators, $\gamma_{NGO} > 0$. PROTECT is obtained from the World Bank Indicators Database and the expected sign of its coefficient is positive also, $\gamma_{PROTECT} > 0$.

c. *Estimation results and discussion*

We estimate the specified model using weighted least squares with linear functional specification and correction for heteroskedasticity. Table 2 presents the estimation results for the first set of indicators of environmental performance, the IEAs.

Table 2: Regression Results for International Environmental Agreements (IEAs)

| Coefficient | Signatures | Accession | Entry to Force |
|---|---|---|---|
| Intercept | + | + | + |
| MENA | +** | +* | +* |
| EUROPE | - | + | +* |
| INCOME | +* | +* | + |
| $INCOME^2$ | - | + | + |
| EDU | + | + | +*** |
| EXPORT | - | - | + |
| FDI | - | +* | +* |
| FOREST | + | + | - |
| $CO_2$ | - | -* | -* |
| POP | +*** | + | + |
| NGO | +* | +* | +* |
| PROTECT | + | +* | +* |
| $R^2$ | 0.64 | 0.69 | 0.71 |
| N | 89 | 89 | 89 |

All models use the same right hand side variables with the same specification. All variables are linear except for income which also appears in quadratic form and for population which is presented in logarithm to the base 10. The explanatory power of the various models captured by the coefficient of determination, $R^2$, do not differ significantly, they range between 0.64 and 0.71, and are better than expected. Around 64% of the observed variation in total number of IEA signatures across the developing countries can be explained by the variables on the right hand side of our model. The MENA coefficient in all three models is positive and significant at the 1% level indicating that a developing country in the MENA region has on average more IEAs signed, accessed, ratified or entered into force. This is in line with the data provided in Table 1 above. The same cannot be said about the EUROPE dummy coefficient, as this coefficient is only significant in one of the three models. The INCOME variable has systematically positive coefficient in all three models and is highly significant in two of the cases indicating that total number IEAs increase with national income, all else held equal. This result was expected as there have been many documented evidence of the relationship suggesting that "economic growth is essential for environmental stewardship" (World Bank, 1992) and "in the end the best – and probably the only – way to attain a decent environment in most countries is to become rich" Beckerman (1992). The square of the INCOME variable is not significant in any of the models. The coefficient of EDU has the expected positive sign but is only marginally significant at the 10% level of significance in one model. The FDI coefficient is positive and highly significant in two models supporting may be the notion that openness and international presence make countries more cooperative with IEAs.

The coefficient of $CO_2$, the variable reflecting state of the environment in the models, is negative and highly significant. We expected a positive relationship with this variable based on

the notion that if pollution is severe then there would be a movement to correct the wrong. However, higher values for $CO_2$ are indicative of both higher production levels (industrial and manufacturing) and higher consumption level (electricity and cars) and may well be a poor proxy for the state of environment. The variable NGO, on the other hand, performs as expected with positive and highly significant coefficients in all three models. Total number of protected areas also performs as expected with positive and significant coefficients in two models.

## IV. CONCLUSION AND SHORTCOMINGS

The paper compared environmental performance across developing countries in various regions of the world and concluded that there were significant variations. It then addressed the question of variation in performance and attempted to explain it.

There are few issues of concern that we would like to bring out. While the indicators that were introduced may be correlated to actual environmental performance, they suffer from many problems including the notion that signing an agreement does not necessarily mean actually executing the articles of the agreement. Presently, almost 200 countries have accessed or ratified the Montreal Protocol; does this mean that the Montreal Protocol's objectives have been reached? The answer is probably not.

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