Deliverable 1

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3. Introduction and Objective

Short Title: *Natural factors and carbon dioxide emissions*

This article examines what role natural factors play in explaining cross-country differences in carbon dioxide emissions. Natural factors mean here differences in the climatic conditions, the availability of renewable and fossil fuel resources and the transportation requirements of countries plays an important role in explaining cross-country differences in carbon dioxide emissions. Ideally, it is expected that cold countries to have better heating requirements and hot countries to have better cooling requirements. Naturally, big countries having higher transportation requirements to have higher emissions comparing to the smaller countries. Likewise, countries having access to their internal renewable energy resources have less emissions than countries that lack in such resources. Regression results show that natural factors contribute significantly to an explanation of cross-country differences in carbon footprint where income is kept the main variable. In further, major differences in natural conditions can cause to significant differences in predicted emission requirements for individual countries at approximately the same level of income. We shall be analyzing the relationship among the 4 Asian countries, which are Afghanistan (low-income), Vietnam (lower-middle-income), Thailand (middle-income), and Japan (high-income).

4. Proposed Model or Models

Variants of the following basic model were estimated:

$$\gamma = \alpha + \beta_1 x_1 + \beta_2 (x_1)^2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \varepsilon \qquad (1)$$

$\gamma = CO_2\ emissions\ per\ capita$
$x_1 = logged\ GDP\ per\ capita$
$x_3 = lowest\ average\ minimum\ temperature$
$x_4 = highest\ average\ maximum\ temperature$
$x_5 = logged\ \%\ of\ total\ land\ area\ impacted\ by\ human\ activities$
$x_6 = \%\ of\ renewable\ energy\ sources\ of\ total\ energy\ use$
$x_7 = logged\ combined\ oil\ and\ gas\ reserves$
$x_8 = time\ trend$
$\varepsilon = error\ term$

A fixed effects model could not be estimated as all of the explanatory variables apart from income do not vary over time and would have therefore been dropped. A random effects model avoids this problem, but a Hausman specification test rejected it. Variations of Eq. (1) were therefore estimated via ordinary least squares (OLS). It is unlikely that more complex estimation techniques would lead to drastically different results.

5. References

Neumayer, Eric, Can Natural Factors Explain Any Cross-Country Differences in Carbon Dioxide Emissions? (July 7, 2010). Energy Policy, Vol. 30, No. 1, pp. 7-12, 2002, Available at SSRN: https://ssrn.com/abstract=263505
https://www.sciencedirect.com/science/article/abs/pii/S0301421501000453
Belsley, D.A., Kuh, E., Welsch, R.E., 1980. Regression Diagnostics. Wiley, New York.
Benestad, O., 1994. Energy needs and CO2 emissions: constructing a formula for just distributions. Energy Policy 22 (4), 725–734.

CIESIN, 2001. Data on Land Area Impacted by Human Activities as a Percentage of Total Land Area. Center for International Earth Science Information Network, New York.