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A new index of environmental quality

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Abstract

An optimal weighting scheme is proposed to construct a new index of environmental quality for different countries using an approach that relies on consistent tests for stochastic dominance efficiency. The test statistics and the estimators are computed using mixed integer programming methods. The variables that are considered include countries' greenhouse emissions, water pollution and forest benefits, as from the dataset of the World Bank. First, the stochastic efficient weighting for each set of variables is calculated to build three sub-indices (for greenhouse emissions, water pollution and land without forests) and then an overall risk index of environmental quality is constructed. One main result is that land without forest contributes the most (with around 70%), greenhouse emissions contribute with around 20% and water pollution contributes less (with around 10%). Finally, countries are ranked according to their index of environmental quality and their rankings are compared with those of the Kyoto Protocol.

JEL Classifications: C4, C5, C14, Q01, Q5, Q51

Key Words: Environmental Quality; Emissions; Water Pollution; Nonparametric Stochastic Dominance, Mixed Integer Programming.

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1 Introduction

Traditionally, wealth stock estimates have focused on produced capital, intangible capital (human capital, social capital) health and the quality of institutions. Recently, the concept of genuine saving has been introduced (Hamilton, 1994; Hamilton and Clemens, 1999; Arrow, Dasgupta and Mäler, 2003; Arrow, Dasgupta et al, 2004; Arrow, Dasgupta et al. 2010; Agliardi, 2011), which provides a broader indicator of sustainability, by evaluating changes in natural resources and environmental quality, in addition to the traditional measure of changes in produced assets, included in net saving, and human capital. In a recent work the World Bank (2006) has updated their previous empirical analysis (World Bank, 1997) in per capita terms in 120 countries for the year 2000, building on Hamilton and Clemens (1999), to estimate comprehensive investment, adding to net national saving the net additions to fossil fuels and minerals, forest cover, carbon in the atmosphere and public expenditures in education. It has been argued that growth in some countries is not sustainable because of depletion in stocks of natural resources and deterioration in the quality of environmental services (e.g. Millennium Ecosystems Assessment, 2005). And all this is exacerbated by high population growth rates.

Our paper complements the literature on genuine saving, since we aim at constructing a comprehensive measure of the main sub-components of wealth. In this paper we focus on one sub-component only, that is the environmental quality of a country. In particular, an optimal weighting scheme is proposed to construct a new index of environmental quality for different countries, using an approach that relies on consistent tests for stochastic dominance efficiency. Then, this index could be considered as a sub-index and added to other existing indices, for example, such as HDI and a natural resource index, to find with the same methodology the optimal composite index representing a most appropriate measure of wealth for a country. Our framework yields an empirically implementable measure that can be applied also to cross-country comparisons.

There are already some indicators and descriptive statistics in environmental accounts (see United Nations, 2003). The system of national accounts (SNA) includes stocks of natural resources, pollutant and material (energy) flow accounts at the industry level, expenditures incurred by industries, government and households to protect the environment. Assets are evaluated either as net present value or net price[1]. The environmental protection expenditure represents part of society's effort to reduce damages to environment and includes taxes or subsides and the activities of pollution-abatement by industries.

Several macroeconomic indicators measuring some aspects of the environmental quality of a country have been elaborated. The environmentally adjusted net domestic product (eaNDP) is obtained by combining the conventional NDP with monetary values of environmental degradation (Repetto et al. 1989). From national accounting matrix including environmental accounts (NAMEA) single indicators are obtained for different themes (e.g. acidification

[1]For early work on environmental accounting, see Repetto et al, 1989; UN 1993.

of the atmosphere, eutrofication of waters etc) by aggregating the emissions, using some common measurement unit and then comparing them with a national target level. The NAMEA, however, does not provide a single-valued indicator that aggregates across all themes. A single-valued indicator of total material requirements (TMR) can be derived from SNA, which sums all the material use in the economy by weights, to measure dematerialization. Many researchers have criticized eaNDP for mixing actual transactions with hypothetical values (monetary values) of environmental degradation; as a response, the indicators geNDP and SNI have been elaborated. Greened economy net domestic product (geNDP) estimates national income in a hypothetical future in which the economy must meet certain environmental standards and the impact is estimated by internalizing the costs of reducing environmental degradation (for a hypothetical model, see De Boer et al, 1994; the Swedish National Institute of Economic Research, 2000). Sustainable national income (SNI) estimates the maximum level of national income that would be obtained if the economy met all environmental standards using the current technology (see, for example, Verbrugger et al, 2000).

Although the above mentioned indicators and descriptive statistics have been provided in environmental accounts, there is no consensus over which indicators to use. Moreover, each indicator serves a somewhat different policy purpose. Finally, the above-mentioned indicators are often based on arbitrary weighting of the relevant variables. Thus, a construction of an index of environmental quality is all-important. In this paper we construct an aggregate index for the environmental quality of a country based on stochastic dominance (SD hereafter) analysis. Constructing an index based on SD analysis has advantages since the index will be efficient, in that it results from the least variable combination of risk factors that offers the maximum level of risk over time for each country or group of countries and relatively large data sets are available, so that nonparametric analysis can let the data "speak for themselves". The index is constructed in a way such that the weights given to each risk factors in each sub-index will make it stochastically dominate all other competitor indices.

The methodology employed in this paper is based on multi-variate (multidimensional) comparisons of country panel data over various years. In an important application to optimal portfolio construction in finance, Scaillet and Topaloglou (2010) use SD efficiency tests to compare a given portfolio with an optimal diversified portfolio constructed from a set of assets. In a related paper, Pinar, Stengos and Topaloglou (2010) use a similar approach to construct an optimal Human Development Index (HDI). The same methodology is applied in Agliardi et al (2011), where an optimal country risk index is constructed following SD analysis with differential component weights, yielding an optimal hybrid index for economic, political, and financial risk indices that do not rely on arbitrary weights as rating institutions do.

Our main result is the derivation of an optimal index for the environmental quality of a country based on SD analysis with differential component weights. This index will offer the maximum level of risk in a country for a given probability level and also be the least volatile over time among its set of competitors.

Then, countries are ranked according to their index of environmental quality and a comparison with alternative rankings (f.e. the ranking of the Kyoto Protocol, Annex I) can be performed. Finally, this methodology could be applied to find the optimal composite index representing a most appropriate measure of wealth for a country. One could find the weighting scheme of each sub-index (i.e. of environmental quality, of natural resources, and HDI) which corresponds to the overall riskiest case for the countries. As Hamilton and Clemens (1999) state, "thinking about sustainable development and its measurement leads naturally to a conception of the process of development as one of portfolio management". This implies that one has to consider not only assets and liabilities in the national balance sheet (i.e., natural resources, produced assets, human capital and pollution stocks) but also their appropriate weights. Our approach provides this portfolio analysis and can be seen as complementary to the seminal works on genuine saving and sustainable development by Dasgupta (2001), Arrow, Dasgupta et al (2003, 2004, 2010). The plan of the paper is as follows. Section 2 describes the SD methodology to construct the index, Section 3 discusses the data and the empirical results and finally Section 4 concludes.

2 The SD methodology

Let us consider a strictly stationary process $\{\boldsymbol{Y}_t; t \in \mathbb{Z}\}$ with values in $\mathbb{R}^n$. The observations consist in a realization of $\{\boldsymbol{Y}_t;\ t = 1, ..., T\}$. These data correspond to observed values of the n different constituent components of the given equally weighted environmental risk index ($\boldsymbol{\tau}$). We denote by $F(\boldsymbol{y})$, the continuous cdf of $\boldsymbol{Y} = (Y_1, ..., Y_n)'$ at point $\boldsymbol{y} = (y_1, ..., y_n)'$.

Let us consider a environmental composite risk index $\boldsymbol{\lambda} \in \mathbb{L}$, where $\mathbb{L} := \{\boldsymbol{\lambda} \in \mathbb{R}^n_+ : \boldsymbol{e}'\boldsymbol{\lambda} = 1\}$ with $\boldsymbol{e}$ for a vector made of ones. Let us denote by $G(z, \boldsymbol{\lambda}; F)$ the cdf of the composite index value $\boldsymbol{\lambda}'\boldsymbol{Y}$ at point z given by $G(z, \boldsymbol{\lambda}; F) := \int_{\mathbb{R}^n} \mathbb{I}\{\boldsymbol{\lambda}'\boldsymbol{u} \leq z\} dF(\boldsymbol{u})$.

Define for $z \in \mathbb{R}$:

$$\mathcal{J}_1(z, \boldsymbol{\lambda}; F) := G(z, \boldsymbol{\lambda}; F),$$
$$\mathcal{J}_2(z, \boldsymbol{\lambda}; F) := \int_{-\infty}^{z} G(u, \boldsymbol{\lambda}; F) du = \int_{-\infty}^{z} \mathcal{J}_1(u, \boldsymbol{\lambda}; F) du,$$
$$\mathcal{J}_3(z, \boldsymbol{\lambda}; F) := \int_{-\infty}^{z} \int_{-\infty}^{u} G(v, \boldsymbol{\lambda}; F) dv du = \int_{-\infty}^{z} \mathcal{J}_2(u, \boldsymbol{\lambda}; F) du,$$

and so on.

Following Davidson and Duclos (2000) we obtain:

$$\mathcal{J}_j(z, \boldsymbol{\lambda}; F) = \int_{\mathbb{R}^n} \frac{1}{(j-1)!} (z - \boldsymbol{\lambda}'\boldsymbol{u})^{j-1} \mathbb{I}\{\boldsymbol{\lambda}'\boldsymbol{u} \leq z\} dF(\boldsymbol{u}).$$

The general hypotheses for testing the stochastic dominance efficiency of order j of $\boldsymbol{\tau}$, hereafter SDE_j, can be written as:

$$\begin{aligned} H_0^j : &\mathcal{J}_j(z, \boldsymbol{\tau}; F) \leq \mathcal{J}_j(z, \boldsymbol{\lambda}; F) \quad \text{for all}\, z \in \mathbb{R}\, \text{and for all}\, \boldsymbol{\lambda} \in \mathbb{L}, \\ H_1^j : &\mathcal{J}_j(z, \boldsymbol{\tau}; F) > \mathcal{J}_j(z, \boldsymbol{\lambda}; F) \quad \text{for some}\, z \in \mathbb{R}\, \text{or for some}\, \boldsymbol{\lambda} \in \mathbb{L}. \end{aligned}$$

Under the null Hypothesis H_0^j there is no composite index λ constructed from the set of risk factors that dominates the index τ at order j. In this case, $\mathcal{J}_j(z, \tau; F)$ is always lower than $\mathcal{J}_j(z, \lambda; F)$ for all possible indices λ for any risk level z. Under the alternative hypothesis H_1^j, a composite index λ exists, such that for some risk level z, $\mathcal{J}_j(z, \tau; F)$ is larger than $\mathcal{J}_j(z, \lambda; F)$. Thus, when $j = 1$, the index τ is stochastically inefficient at first order if and only if some other index λ dominates it at some risk level z. Put in another way, the index τ is stochastically efficient at first order if and only if there is no index λ that dominates it at all risk levels. SD can be specified at first and second order when $j = 1$ and $j = 2$, respectively.

We say that the distribution of the composite index λ dominates the distribution of the fixed weight risk index τ stochastically at first order (SD1) if, for any risk level z, $G(z, \tau; F) \geq G(z, \lambda; F)$. If z denotes a risk level, then the previous inequality implies that the proportion of countries in the distribution λ with value of risk smaller than z is not larger than the proportion of such countries in τ. If the composite index λ dominates the index τ at first order, then there is always less risk in τ than in λ. We can test whether an equally weighted risk index is optimal, or whether we can construct a composite index $\boldsymbol{\lambda}$ from the set of the risk components in the respective index that dominates the index.

The general hypotheses for testing the optimality of equally weighted risk index $\boldsymbol{\tau}$ becomes:

$$\begin{aligned} H_0 : &G(z, \boldsymbol{\tau}; F) \leq G(z, \boldsymbol{\lambda}; F) \quad \text{for all}\, z \in \mathbb{R}\, \text{and for all}\, \boldsymbol{\lambda} \in \mathbb{L}, \\ H_1 : &G(z, \boldsymbol{\tau}; F) > G(z, \boldsymbol{\lambda}; F) \quad \text{for some}\, z \in \mathbb{R}\, \text{or for some}\, \boldsymbol{\lambda} \in \mathbb{L}. \end{aligned}$$

The empirical counterpart is simply obtained by integrating with respect to the empirical distribution $\hat{F}$ of F, which yields:

$$\mathcal{J}_j(z, \boldsymbol{\lambda}; \hat{F}) = \frac{1}{T} \sum_{t=1}^{T} \frac{1}{(j-1)!} (z - \boldsymbol{\lambda}' \mathbf{Y}_t)^{j-1} \mathbb{I}\{\boldsymbol{\lambda}' \mathbf{Y}_t \leq z\},$$

and can be rewritten more compactly for $j \geq 2$ as:

$$\mathcal{J}_j(z, \boldsymbol{\lambda}; \hat{F}) = \frac{1}{T} \sum_{t=1}^{T} \frac{1}{(j-1)!} (z - \boldsymbol{\lambda}' \mathbf{Y}_t)_+^{j-1}.$$

The test statistics and the asymptotic distribution of $\hat{F}$ are discussed in Scaillet and Topalaglou (2010). In particular, we follow Scaillet and Topalaglou

(2010) and consider the weighted Kolmogorov-Smirnov type test statistic

$$\hat{S}_j := \sqrt{T}\frac{1}{T}\sup_{z,\boldsymbol{\lambda}}\left[\mathcal{J}_j(z,\boldsymbol{\tau};\hat{F}) - \mathcal{J}_j(z,\boldsymbol{\lambda};\hat{F})\right],$$

and a test based on the decision rule:

$$\text{“ reject } \quad H_0^j \quad \text{if} \quad \hat{S}_j > c_j \text{ ”},$$

where c_j is some (appropriate) critical value.

The test statistic $\hat{S}_1$ for first order stochastic dominance efficiency is derived using the following mixed integer programming formulations:

$$\max_{\mathbf{z},\boldsymbol{\lambda}} \hat{S}_1 = \sqrt{T}\frac{1}{T}\sum_{t=1}^{T}(L_t - W_t) \tag{1a}$$

$$\text{s.t.} M(L_t - 1) \leq z - \boldsymbol{\tau}'\mathbf{Y}_t \leq ML_t, \qquad \forall t \tag{1b}$$

$$M(W_t - 1) \leq z - \boldsymbol{\lambda}'\mathbf{Y}_t \leq MW_t, \qquad \forall t \tag{1c}$$

$$\boldsymbol{e}'\boldsymbol{\lambda} = 1, \tag{1d}$$

$$\boldsymbol{\lambda} \geq 0, \tag{1e}$$

$$W_t \in \{0,1\},\ L_t \in \{0,1\}, \qquad \forall t \tag{1f}$$

with M being a large constant.

The model is a mixed integer program maximizing the distance between the sum over all scenarios of two binary variables, $\frac{1}{T}\sum_{t=1}^{T} L_t$ and $\frac{1}{T}\sum_{t=1}^{T} W_t$ which represent $G(z,\boldsymbol{\tau};\hat{F})$ and $G(z,\boldsymbol{\lambda};\hat{F})$, respectively (the empirical cdf of $\boldsymbol{\tau}$ and $\boldsymbol{\lambda}$ at risk level z). According to inequalities (1b), L_t equals 1 for each scenario $t \in T$ for which $z \geq \boldsymbol{\tau}'\mathbf{Y}_t$, and 0 otherwise. Analogously, inequalities (1c) ensure that W_t equals 1 for each scenario for which $z \geq \boldsymbol{\lambda}'\mathbf{Y}_t$. Equation (1d) defines the sum of all component weights to be unity, while inequality (1e) disallows for negative weights.

This formulation allows us to test the dominance of the equally weighted risk index ($\boldsymbol{\tau}$) over any potential linear combination $\boldsymbol{\lambda}$ of the risk factors that are in the respective index.

For more complex formulations we refer to Scaillet Topalaglou (2010) where tractable formulations and details on practical implementation are provided.

3 Empirical Analysis

3.1 Data and Descriptive Statistics

The data set used in this paper consists of annual data about greenhouse emissions, water pollution and forest cover for several countries to construct three sub-indices. The main source for our data is The World Bank, Policy and

Economics Environment Department[2]. Notice that not all countries have available data for all variables (for example, China has not released data for water pollution), which implies that only countries whose data are available for all sub-indices will be ranked in the overall index. A detailed description of all the variables used and the normalization procedure is in the Appendix.

This section presents our findings of the test for SD1 efficiency of each sub-index (i.e. greenhouse emissions, water pollution and forest cover). We find that arbitrary weights are not optimal. We compute the weighting scheme of each respective factor in each sub-index, which offers the riskiest environment for the various countries.

The variables used for emissions are: CO2, methane (CO2 equivalent), nitrous oxide (CO2 equivalent), other greenhouse gas emissions (CO2 equivalent), for a balanced data set for 133 countries for four time periods, that is, 1990, 1995, 2000, 2005.

We proceed to construct many other hybrid composites λ consisting of the four components of emissions listed above (CO2, methane, nitous oxide, other greenhouse gas emissions) that stochastically dominate the equally weighted risk outcome τ, in the first order sense (e.g. for which $G(z, \tau; F) > G(z, \lambda; F)$). There are 529 different such composite λ's. Table 1 summarizes the results, presenting the average weights of the 529 hybrid composites that dominate the equally weighted risk outcomes. The inefficiency of the equally weighted risk index indicates that it is suboptimal. Our findings show that CO2 is the main contributor to emissions with a 79.7% contribution followed by methane, nitrous oxide and other greenhouse gas emissions with 18%, 1.4% and 0.9% weights, respectively. By using the weighting scheme proposed in Table 1 for each component of greenhouse emissions, we obtain the "optimal" greenhouse emission for each country. Table A shows the rankings of the various countries in terms of greenhouse emissions.

Observe that our ranking differs from the ranking of the countries in the Kyoto Protocol. It is well known that the Kyoto Protocol establishes assigned amounts of emissions for various countries (see Annex 1 and Annex B), with the intention of reducing their average emissions during 2008-2012 to about 5 percent below 1990 levels. Under the Kyoto Protocol, only the Annex I countries have committed themselves to national or joint reduction targets that range from a joint reduction of 8% for the European Union (originally the 15 states that were EU members in 1997, when the Kyoto Protocol was adopted), of 7% for the United States, 6% for Japan, Canada, Hungary and Poland, 5% for Croatia, and 0% for New Zealand, Russia and Ukraine; moreover, a +1% was allowed to Norway, +8% for Australia and +10% for Iceland. The rankings we obtain in Table A remained substantially stable over the four time periods. Notice that the following countries have the highest values of the sub-index : US, China, Russian Federation, Japan, India, Germany, UK, Canada, Italy, Ukraine. This list does not overlap with the groups of countries adopted by the Kyoto Protocol

[2]The authors are indebted to Glenn-Marie Lange and her staff members at The World Bank for their help in providing most data.

- in particular, China, the Russian Federation and India are stronger polluters in our rankings -, implying that further intents than environmental issues are in the Kyoto Protocol (e.g. redistributive). Iceland has a low value of the sub-index in our ranking, in keeping with the Kyoto Protocol, while Australia is ranked relatively high in our sub-index. Interesting information is provided by our ranking of developing countries, which may be taken into account in order to recognize the specific needs and concerns of them.

Then, we examine water pollution. The variables used for water pollution refer to yearly data from 1986 to 2006 in an unbalanced data set for 96 countries. They include organic water pollutant emissions (kg per day) expressed as percentage of organic water polluted by specific industries (i.e., chemical industry, clay and glass industry, food industry, metal industry, paper and pulp industry, wood industry, textile, other industries). We proceed to construct many other hybrid composites λ consisting of the eight components of water pollution listed above that stochastically dominate the equally weighted risk outcome τ, in the first order sense (e.g. for which $G(z, \tau; F) > G(z, \lambda; F)$). There are 844 different such composite λ's. Table 2 summarizes the results, presenting the average weights of the 844 hybrid composites that dominate the equally weighted risk outcomes.Our findings show that other industries and food industry contribute with 53.8% and 35.2% respectively (see Table 2). If other industries were removed, then food industry and textile industry would contribute with 75.2% and 21.1% respectively. By using the weighting scheme proposed in Table 2 for each component of water pollution, we obtain the "optimal" water pollution for each country. Table B shows the rankings of the various countries in terms of water pollution. Most industrialized countries and namely the United States, Japan, German, UK, France and Italy have a high value in the sub-index over the years, together with the Russian Federation, Ukraine and Indonesia, which maintain a relatively stable high value over these years. Unfortunately, some countries which are main contributors in the world scene, such as China and India, have not released data on water pollution, so we cannot have a complete picture.

Finally, we consider forest resources, to include the depuration activity, water filtration, erosion control etc. that forests provide. In order to be consistent with the other sub-indices, total values of forest cover (km sq.) are used in this sub-index. According to the World Bank definition, greenhouse (CO2) emissions measured in kilotons (kt) are those stemming from the burning of fossil fuels and the manufacture of cement. They include contributions to the carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring. CO2 is a stable gas which is not transformed chemically in the atmosphere. However, some CO2 is removed from the atmosphere by a natural process that includes the effect of vegetation, soils and oceans. Moreover, human activities such as reforestation, deforestation or land management may increase or decrease the amount of CO2 removed from the atmosphere[3]. Forests act as natural filters

[3] For example, the global natural CO2 removal rate for the set of countries that we examine has been estimated to be around 60 percent for the period 1990 to 2000, see IPCC, 2000. See

that remove CO2 from the atmosphere and as such their absence would affect negatively environmental quality. Since the other two indices are affecting the environment negatively, we use the land without forests (expressed in squared km. for each country) to evaluate the contribution of forests in the composite index. Clearly, higher land without forests concentrations imply lower CO2 removal rates. Now we have three sub-indices, that is, the greenhouse emissions, the water pollution and the land without forest. The normalization of each sub-index is achieved by dividing each country's value in each index by the highest total value in that index.

Table C is obtained combining the three sub-indices to find the optimal weighting scheme for each sub-index (Table 3) and provides the rankings of the various countries in terms of the composite index for years 1995, 2000 and 2005. Our findings suggest that land without forest contributes the most with around 70%, greenhouse emissions contribute with around 20% and water pollution contributes with around 10%. We can observe that the ranking remains less stable over the years. As argued above, higher land without forests concentrations imply lower CO2 removal rates, since forests act as natural filters that remove CO2 from the atmosphere. This explains the fact that land without forests contributes the most to the overall index as it is the overwhelming factor for the lack of CO2 removal. On average, the countries with higher values of the composite index are the Russian Federation and the United States, but also other countries, such as Iran, South Africa and Indonesia, are ranked as risky countries as far as the environmental quality is concerned.

4 Conclusion

In this paper we propose an optimal weighting scheme to construct a new index of environmental quality for different countries using an approach that relies on consistent tests for stochastic dominance efficiency. The test statistics and the estimators are computed using mixed integer programming methods. The variables that are considered include countries' greenhouse emissions, water pollution and forest benefits, as from the dataset of the World Bank. First, the stochastic efficient weighting for each set of variables is calculated to build three sub-indices (for greenhouse emissions, water pollution and land without forests) and then an overall risk index of environmental quality is constructed. One main result is that land without forest contributes the most (with around 70%), greenhouse emissions contribute with around 20% and water pollution contributes less (with around 10%). The results underscore the importance of forests to act as natural filters that remove CO2 from the atmosphere. We then proceed to rank countries according to their index of environmental quality and their rankings are compared with those of the Kyoto Protocol .

http://unfccc.int/ghg_emissions_data/predifined_qeuries/items/3814.php

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Appendix.

1) Emissions

Variables used: CO_2, Methane (kt of CO_2 equivalent), Nitrous oxide (thousand metric tons of CO_2 equivalent), other greenhouse gas emissions (thousand metric tons of CO_2 equivalent)

Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring.

Methane emissions are those stemming from human activities such as agriculture and from industrial methane production.

Nitrous oxide emissions are emissions from agricultural biomass burning, industrial activities, and livestock management.

Other greenhouse gas emissions are by-product emissions of hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride.

Data Set: Balanced data set for 133 countries for 1990, 1995, 2000, 2005

Findings: The results show that the CO_2 is the main contributor to emissions with a 79.7% contribution followed by methane, nitrous oxide and other greenhouse gas emissions with 18%, 1.4% and 0.9% weight respectively (see Table 1).

2) Water pollution

Variables used: Organic water pollutant (BOD) emissions (kg per day), % of organic water polluted by specific industry (Chemical industry, clay and glass industry, food industry, metal industry, paper and pulp industry, wood industry, textile, other industries). Other industries are treated as residual to capture remaining percent of the total water pollution.

Data Set: Unbalanced data set for 96 countries from 1986 to 2006 (yearly)

Findings: Other industries and food industry contribute with 53.8% and 35.2% respectively (see Table 2)

3) Land without forest (km. sq.)

Variables used: In order to be consistent with other sub-indices, total values are used in this sub-index. Since the other two indices are affecting the environment negatively, we use the land that has no forest in km. sq. for each country, to evaluate the contribution of forests (see Table 3 for the weigths in the composite index).

Normalization procedure:

- Highest total emission is used to normalize the carbon emissions, US 2005
- Highest total water pollution is used to normalize the water pollutions, US 2000
- Highest total water pollution excluding other industries is used to normalize the water pollution in second case, US 2000
- Highest total land without forest is used to normalize the land without forest in all countries, Russian Federation 2005

Table 1: Stochastic efficient weighting for greenhouse emissions					
Number of observations	Number of dominating weighting schemes	Carbon dioxide emissions	Methane emissions	Nitrous oxide emissions	Other greenhouse gas emissions
N	**n**	***Average of dominating weighting schemes***			
529	529	0.797	0.180	0.013	0.009

Table 2: Stochastic efficient weighting of industries for organic water pollution									
Number of observations	Number of dominating weighting schemes	Chemical industry	Clay and glass industry	Food industry	Metal industry	Paper and pulp industry	Wood industry	Textile industry	Other industries
N	**N**	***Average of dominating weighting schemes***							
848	844	0.012	0.005	0.352	0.002	0.009	0.002	0.080	0.538

Table 3: Stochastic efficient weighting of sub-indices (Greenhouse emissions, water pollution, land without forest)				
Number of observations	Number of dominating weighting schemes	Greenhouse emissions	Water pollution	Land without forest
N	**n**	***Average of dominating weighting schemes***		
165	158	0.207	0.076	0.717
Greenhouse emissions for each country are obtained by using the weighting scheme proposed in table 1 and then each country's emissions are normalized by the highest total greenhouse emissions. Water pollution for each country is obtained by using the weighting scheme in table 2 and then each country's water pollution is normalized by the highest total water pollution. Land without forest for each country is normalized by using the largest total land that has no forest.				

Table A. Greenhouse emissions rankings 1990, 1995, 2000 and 2005

Country	1990	Country	1995	Country	2000	Country	2005
United States	4034820.0	United States	4313929.9	United States	4730831.4	United States	4804426.3
China	2126766.2	China	2823965.5	China	2894891.7	China	4658434.9
Russian Federation	1979716.7	Russian Federation	1332662.3	Russian Federation	1240614.5	Russian Federation	1298231.3
Japan	929391.7	Japan	1003263.8	India	1078727.7	India	1255962.4
India	665515.4	India	854055.9	Japan	991021.3	Japan	999972.6
Ukraine	576627.7	Germany	733278.8	Germany	677559.8	Germany	656459.5
United Kingdom	467230.4	United Kingdom	459908.6	Canada	446688.7	Canada	465281.8
Canada	374132.0	Canada	389058.9	United Kingdom	442552.4	United Kingdom	441054.6
Italy	346628.6	Ukraine	361075.0	Italy	364437.3	Italy	380258.8
France	329219.7	Italy	356465.7	Korea, Rep. of	357684.3	Korea, Rep. of	374750.1
Mexico	302881.5	France	323288.7	Brazil	334108.4	Mexico	373750.8
Poland	293633.1	Korea, Rep. of	301568.4	Mexico	332145.2	Brazil	358597.2
South Africa	275356.7	Mexico	297474.0	South Africa	304491.3	Iran, Islamic Rep. of	357990.3
Australia	253555.7	South Africa	291474.8	France	300829.5	South Africa	336151.8
Kazakhstan	245033.2	Poland	291452.8	Iran, Islamic Rep. of	287780.4	France	321443.1
Brazil	220772.6	Brazil	276948.6	Australia	284345.9	Indonesia	312925.3
Korea, Rep. of	197594.8	Australia	266778.8	Ukraine	258051.8	Australia	312642.7
Korea, D.P.R. of	196859.7	Iran, Islamic Rep. of	239712.4	Poland	252683.9	Saudi Arabia	303857.0
Iran, Islamic Rep. of	191421.2	Indonesia	218654.2	Saudi Arabia	248588.5	Spain	289086.9
Spain	187436.6	Spain	210941.2	Indonesia	246625.4	Ukraine	273980.6
Saudi Arabia	178533.6	Korea, D.P.R. of	208455.0	Spain	241671.8	Poland	252960.7
Indonesia	152346.8	Saudi Arabia	196281.2	Turkey	177276.1	Thailand	229920.1
Netherlands, The	134485.0	Thailand	157978.2	Thailand	174722.8	Turkey	193829.9
Romania	134457.9	Turkey	145904.3	Netherlands, The	135693.4	Malaysia	150811.9
Czech Republic	133738.4	Netherlands, The	144311.0	Venezuela, R.B. de	133038.1	Kazakhstan	146300.0
Turkey	125551.9	Kazakhstan	140597.8	Argentina	129670.3	Argentina	144247.3
Uzbekistan	110099.9	Venezuela, R.B. de	115303.8	Egypt, Arab Rep.	118386.6	Venezuela, R.B. de	142822.8
Argentina	105322.1	Argentina	114060.4	United Arab Emirates	107121.2	Netherlands, The	140791.4
Venezuela, R.B. de	105051.5	Romania	107787.3	Kazakhstan	106490.9	Egypt, Arab Rep.	136397.2
Belarus	92205.2	Czech Republic	105979.7	Malaysia	105504.1	Pakistan	129710.0
Thailand	89015.6	Malaysia	101014.0	Pakistan	104586.7	Algeria	115087.7
Belgium	87667.7	Belgium	92317.4	Uzbekistan	103608.5	Nigeria	102565.7
Pakistan	70237.9	Uzbekistan	88641.6	Czech Republic	103175.4	Czech Republic	100602.3

Algeria	66287.1	Pakistan	84809.9	Algeria	97548.7	Uzbekistan	99055.8
Egypt, Arab Rep.	64903.5	Egypt, Arab Rep.	81446.5	Belgium	93842.5	United Arab Emirates	98284.8
Bulgaria	62942.9	Algeria	79150.2	Nigeria	77409.9	Vietnam	96395.3
Greece	59243.6	Greece	64408.5	Romania	74438.6	Belgium	87328.7
Colombia	54789.3	Iraq	63676.6	Greece	74413.1	Greece	80110.1
Hungary	53244.3	United Arab Emirates	63405.0	Philippines	71078.6	Iraq	79201.9
Austria	50108.8	Philippines	58505.8	Korea, D.P.R. of	63387.0	Romania	77517.1
Malaysia	49061.0	Colombia	57415.7	Iraq	61359.7	Kuwait	73600.8
Nigeria	47244.6	Belarus	55062.7	Kuwait	58639.3	Philippines	72519.1
United Arab Emirates	47105.1	Hungary	51284.3	Colombia	57016.0	Korea, D.P.R. of	68701.4
Slovak Republic	45250.8	Austria	49824.8	Vietnam	55915.1	Austria	59324.6
Iraq	43942.9	Bulgaria	47651.6	Syrian Arab Republic	51936.2	Syrian Arab Republic	59322.9
Philippines	42687.2	Denmark	45759.6	Portugal	51701.5	Colombia	58552.4
Sweden	42649.7	Sweden	44085.6	Chile	51338.3	Chile	55789.8
Azerbaijan	42348.4	Kuwait	43715.0	Austria	50610.4	Belarus	54368.2
Finland	41979.9	Portugal	43559.3	Belarus	50189.7	Portugal	53213.5
Denmark	41287.6	Israel	43422.8	Israel	50162.2	Hungary	49085.4
Singapore	37520.7	Finland	43069.7	Hungary	47792.5	Bangladesh	49081.9
Portugal	36717.0	Syrian Arab Republic	42325.7	Finland	42741.0	Singapore	47775.0
Switzerland	35129.2	Nigeria	40820.2	Singapore	42000.9	Israel	47397.1
Libya	33720.8	Libya	38712.3	Sweden	41236.0	Libya	46196.0
Kuwait	33684.7	Chile	37810.2	Libya	41178.5	Qatar	46186.5
Turkmenistan	31249.3	Singapore	37739.3	Bangladesh	39171.2	Finland	44548.0
Syrian Arab Republic	30972.1	Slovak Republic	35749.3	Denmark	38696.2	Sweden	42539.3
Chile	30454.9	Vietnam	34680.6	Bulgaria	35438.8	Norway	39186.0
Cuba	28508.2	Bangladesh	33777.2	Ireland	33374.6	Bulgaria	38612.9
Bangladesh	27350.1	Switzerland	32267.4	Norway	33256.9	Denmark	38233.2
Israel	26919.4	Turkmenistan	31088.0	Hong Kong SAR	32509.3	Morocco	37513.4
Vietnam	26767.3	Azerbaijan	28568.7	Turkmenistan	32385.1	Turkmenistan	37450.0
Norway	26435.4	Ireland	28525.3	Switzerland	31977.7	Ireland	35257.9
Ireland	26413.4	Norway	28196.2	New Zealand	31231.3	Switzerland	33803.3
New Zealand	24422.6	New Zealand	26553.9	Morocco	31037.7	Peru	33747.2
Estonia	22964.1	Morocco	26003.7	Slovak Republic	30121.2	Hong Kong SAR	32493.4
Hong Kong SAR	22242.3	Hong Kong SAR	25420.9	Qatar	28598.9	Slovak Republic	32191.1
Lithuania	21347.7	Qatar	25055.4	Peru	28014.1	New Zealand	31884.2
Croatia	20705.8	Peru	22584.3	Azerbaijan	26283.2	Azerbaijan	30157.2

Morocco	20567.3	Cuba	22103.6	Cuba	22574.1	Oman	27998.0
Peru	20148.1	Ecuador	20828.4	Trinidad and Tobago	20211.3	Trinidad and Tobago	25338.8
Tajikistan	19838.2	Trinidad and Tobago	17227.0	Ecuador	18940.8	Ecuador	23409.5
Moldova	19742.5	Croatia	15318.8	Bosnia and Herz.	18611.9	Myanmar	22863.7
Ecuador	15712.2	Estonia	14782.9	Oman	18327.1	Angola	22777.9
Slovenia	14874.1	Myanmar	14684.0	Myanmar	18033.9	Cuba	21742.1
Georgia	14862.7	Zimbabwe	13949.1	Dominican Republic	17077.7	Sudan	21653.2
Zimbabwe	14430.9	Dominican Republic	13890.0	Sudan	16927.6	Bosnia and Herz.	20928.6
Trinidad and Tobago	13962.2	Lithuania	13642.6	Croatia	16791.0	Croatia	19526.4
Latvia	12783.8	Tunisia	13371.3	Tunisia	16757.1	Tunisia	19042.3
Sudan	12096.0	Oman	13141.2	Bahrain	16091.0	Yemen, Rep. of	17681.2
Tunisia	11293.9	Bahrain	13064.8	Angola	14564.2	Jordan	17295.8
Kyrgyz Republic	10823.0	Sudan	11836.6	Yemen, Rep. of	13298.6	Dominican Republic	16952.0
Myanmar	10822.6	Slovenia	11462.9	Ethiopia	13175.6	Bahrain	16032.8
Ethiopia	10102.6	Angola	11429.3	Zimbabwe	13080.4	Estonia	14763.7
Qatar	9780.5	Jordan	11065.2	Estonia	12984.5	Bolivia	14378.1
Bahrain	9768.3	Lebanon	11019.1	Bolivia	12763.3	Lebanon	14162.9
Mongolia	9456.8	Bolivia	10636.1	Jordan	12647.9	Ethiopia	13785.4
Dominican Republic	8626.0	Yemen, Rep. of	10065.2	Lebanon	12405.4	Kenya	12626.2
Oman	8618.7	Ethiopia	9938.9	Kenya	11967.9	Slovenia	12194.8
Jordan	8494.1	Kenya	9797.8	Slovenia	11809.6	Lithuania	12096.0
Kenya	8414.9	Moldova	9599.4	Lithuania	10444.5	Tanzania	11565.1
Luxembourg	7934.3	Tanzania	8329.1	Congo, Rep.	10310.7	Guatemala	11405.3
Lebanon	7386.1	Jamaica	7971.5	Sri Lanka	9964.7	Sri Lanka	11162.8
Bolivia	7368.3	Mongolia	7952.9	Guatemala	9586.8	Congo, Rep.	10839.5
Tanzania	7027.1	Latvia	7918.2	Nepal	9152.9	Zimbabwe	10595.5
Nepal	6665.1	Nepal	7847.8	Tanzania	8949.9	Cote d'Ivoire	9421.5
Jamaica	6578.2	Uruguay	6869.4	Jamaica	8429.2	Nepal	9155.1
Albania	6394.9	Guatemala	6823.2	Cote d'Ivoire	8297.5	Luxembourg	9054.4
Congo, Rep.	6187.8	Congo, Rep.	6783.4	Mongolia	7853.1	Jamaica	8316.9
Angola	6047.4	Cote d'Ivoire	6781.0	Uruguay	7237.1	Mongolia	8182.6
Bosnia and Herz.	5946.0	Luxembourg	6691.6	Ghana	6653.7	Uruguay	8161.0
Uruguay	5917.1	Sri Lanka	6568.6	Luxembourg	6594.3	Ghana	7643.1
Cote d'Ivoire	5622.6	Ghana	5574.4	Paraguay	6286.1	Honduras	7086.8
Gabon	5433.2	Cameroon	5532.2	Cameroon	5589.6	Paraguay	6413.9
Brunei Darussalam	5411.2	Paraguay	5383.1	Brunei Darussalam	5575.3	Latvia	6055.6

Guatemala	5178.1	Netherlands Antilles	5193.0	Cyprus	5520.5	Cyprus	6042.5
Netherlands Antilles	4966.3	Tajikistan	4957.5	Latvia	5277.9	Costa Rica	6006.0
Sri Lanka	4886.6	Botswana	4860.5	El Salvador	5126.5	Cameroon	5860.4
Ghana	4147.0	El Salvador	4784.3	Panama	5124.2	Cambodia	5693.9
Paraguay	4035.7	Brunei Darussalam	4754.7	Costa Rica	4898.1	Senegal	5681.1
Armenia	3875.4	Cyprus	4612.3	Honduras	4857.5	El Salvador	5616.3
Zambia	3777.8	Costa Rica	4531.6	Zambia	4587.5	Panama	5395.4
Cyprus	3761.4	Kyrgyz Republic	4498.0	Netherlands Antilles	4564.3	Tajikistan	5233.0
Congo, Dem. Rep. of	3732.7	Senegal	3992.7	Georgia	4377.7	Kyrgyz Republic	5112.3
Senegal	3614.6	Honduras	3978.9	Senegal	4368.4	Zambia	5050.5
Cameroon	3389.2	Gabon	3713.5	Kyrgyz Republic	4324.7	Brunei Darussalam	4904.9
Costa Rica	3068.0	Zambia	3625.8	Cambodia	4244.3	Georgia	4622.8
Panama	3064.1	Bosnia and Herz.	3603.4	Botswana	4197.1	Netherlands Antilles	4573.2
Honduras	3014.3	Cambodia	3505.3	Nicaragua	4190.5	Botswana	4441.9
Nicaragua	2998.4	Panama	3361.4	Tajikistan	3988.3	Moldova	4406.8
El Salvador	2604.9	Nicaragua	3211.9	Moldova	3314.3	Nicaragua	4353.2
Mozambique	2533.0	Armenia	3100.3	Armenia	3140.6	Albania	3986.4
Botswana	1752.2	Mozambique	2742.3	Albania	2853.3	Armenia	3883.3
Malta	1751.5	Congo, Dem. Rep. of	2595.2	Congo, Dem. Rep. of	2370.8	Mozambique	3709.1
Iceland	1725.4	Georgia	2406.6	Benin	2160.9	Benin	2975.9
Haiti	1340.1	Namibia	2179.1	Namibia	2120.3	Namibia	2944.0
Benin	1088.4	Malta	2165.1	Mozambique	2003.6	Congo, Dem. Rep. of	2877.7
Togo	964.2	Albania	2106.1	Haiti	1805.2	Haiti	2381.8
Namibia	838.6	Benin	1628.6	Iceland	1794.3	Malta	2167.9
Cambodia	359.2	Iceland	1614.2	Malta	1662.9	Gabon	1856.1
		Haiti	1356.4	Togo	1637.5	Iceland	1823.6
		Togo	1135.2	Gabon	1337.4	Togo	1648.2
		Eritrea	650.9	Eritrea	974.5	Eritrea	1048.4

Table B. Water pollution rankings 1995, 2000 and 2005 (8 industries, including other industries)

Country Name	1995	Country Name	2000	Country Name	2005
Japan	473382.47	United States	790548.91	United States	606289.79
United Kingdom	184772.38	Japan	445356.64	Russian Federation	385391.20
Italy	145789.78	Russian Federation	433085.02	Japan	384640.62
Poland	125128.31	Germany	355343.17	Germany	338243.92
Korea, Rep.	106026.23	United Kingdom	194414.25	France	182800.62
Spain	93064.86	France	191156.46	United Kingdom	160172.76
Canada	77986.09	Ukraine	166748.35	Indonesia	158779.69
South Africa	58568.84	Indonesia	151851.73	Italy	147412.22
Czech Republic	51174.39	Italy	149490.89	Ukraine	143538.27
Netherlands	39927.59	Spain	105145.39	Spain	110582.70
Argentina	39910.59	Poland	103928.68	Korea, Rep.	108069.75
Turkey	34579.32	Korea, Rep.	98056.08	Poland	107732.16
Sweden	33517.21	Canada	91891.12	Vietnam	97423.62
Bangladesh	30950.97	Thailand	90993.02	Malaysia	62012.20
Hungary	29568.32	Malaysia	56736.71	South Africa	52969.60
Belgium	28537.15	South Africa	51669.48	Czech Republic	48467.59
Austria	28135.52	Vietnam	48071.11	Iran, Islamic Rep.	41718.73
Denmark	27241.80	Czech Republic	42488.00	Hungary	36652.27
Iran, Islamic Rep.	25038.12	Netherlands	42359.69	Netherlands	36472.97
Finland	18982.60	Argentina	42021.70	Sweden	31921.99
Norway	15744.27	Turkey	39807.52	Portugal	29116.98
Slovak Republic	14162.21	Sweden	36456.75	Philippines	28968.05
New Zealand	13224.18	Hungary	34527.71	Austria	26596.06
Israel	13021.49	Iran, Islamic Rep.	31609.26	Belgium	26426.46
Greece	10509.90	Portugal	28541.30	Bulgaria	24477.37

Azerbaijan	8901.24	Belgium	28359.52	Chile	22142.61
Ireland	8752.88	Austria	27249.66	Denmark	19392.44
Slovenia	7534.55	Denmark	24882.61	Finland	18343.31
Latvia	7113.84	Bulgaria	22910.15	Colombia	17785.91
Ecuador	6487.27	Colombia	19220.03	New Zealand	17138.23
Estonia	5970.74	Finland	18679.48	Slovak Republic	15453.88
Kyrgyz Republic	4273.07	Norway	16257.32	Singapore	14183.82
Tajikistan	3861.69	Slovak Republic	15954.45	Morocco	13259.50
Paraguay	3309.54	New Zealand	15326.62	Madagascar	11535.69
Ethiopia	3189.32	Morocco	14554.63	Croatia	11009.95
Jordan	3093.79	Israel	13621.25	Lithuania	10863.34
Bolivia	2196.23	Ireland	13234.25	Ecuador	10811.02
Malta	1068.21	Singapore	12979.15	Ireland	9858.66
Oman	775.35	Malawi	10872.87	Slovenia	8688.21
Uganda	737.63	Croatia	10845.17	Moldova	7664.08
Luxembourg	612.32	Lithuania	10239.72	Latvia	6860.80
Eritrea	583.69	Slovenia	8467.20	Jordan	6015.48
Cambodia	152.28	Ecuador	7448.07	Ethiopia	4798.00
Bahamas, The	124.06	Moldova	6856.14	Estonia	4319.79
Haiti	24.05	Latvia	6371.72	Azerbaijan	4261.44
Aruba	14.21	Estonia	4664.10	Panama	3820.94
		Azerbaijan	4648.99	Kyrgyz Republic	2690.21
		Ethiopia	4004.52	Cyprus	2021.31
		Jordan	3750.26	Malta	1368.44
		Kyrgyz Republic	3654.61	Lesotho	1295.71
		Panama	2589.93	Botswana	1259.28
		Bolivia	2224.44	Oman	1256.50
		Tajikistan	2014.54	Luxembourg	731.97

Syrian Arab Republic	1830.66	Albania	654.67
Cyprus	1760.25	Eritrea	636.87
Senegal	1734.50	Qatar	369.90
Trinidad and Tobago	1482.50	Mauritius	163.50
Malta	1335.45	Yemen, Rep.	145.28
Oman	1186.77		
Botswana	1104.55		
Luxembourg	831.67		
Eritrea	603.75		
Uganda	513.25		
Albania	382.74		
Qatar	362.97		
Kazakhstan	307.54		
Bahamas, The	166.07		
Mauritius	163.99		
Yemen, Rep.	161.25		
Tonga	65.31		

Table C. Overall rankings 1995, 2000 and 2005

Country Name	1995	Country Name	2000	Country Name	2005
Canada	0.53714	Russian Federation	0.78297	Russian Federation	0.78445
Argentina	0.21286	United States	0.75818	United States	0.75516
Iran, Islamic Rep.	0.14230	Canada	0.54003	Iran, Islamic Rep.	0.14789
South Africa	0.11135	Kazakhstan	0.23509	South Africa	0.11310
Ethiopia	0.07452	Argentina	0.21424	Indonesia	0.09834
Japan	0.06735	Iran, Islamic Rep.	0.14456	Ethiopia	0.07595
Turkey	0.06533	South Africa	0.11170	Japan	0.06459
United Kingdom	0.04392	Indonesia	0.08718	Germany	0.05897
Spain	0.04212	Ethiopia	0.07529	Ukraine	0.05790
Bolivia	0.04106	Turkey	0.06667	France	0.05321
Italy	0.03743	Japan	0.06601	Colombia	0.04647
Poland	0.03486	Germany	0.06039	Yemen, Rep.	0.04594
Oman	0.02734	Ukraine	0.05797	Spain	0.04342
Norway	0.02002	France	0.05275	United Kingdom	0.04224
Korea, Rep.	0.01922	Colombia	0.04625	Botswana	0.03890
New Zealand	0.01779	Yemen, Rep.	0.04575	Italy	0.03759
Paraguay	0.01716	United Kingdom	0.04338	Morocco	0.03682
Kyrgyz Republic	0.01617	Spain	0.04248	Poland	0.03265
Sweden	0.01467	Bolivia	0.04232	Oman	0.02800
Ecuador	0.01393	Thailand	0.04161	Chile	0.02557
Bangladesh	0.01287	Botswana	0.03837	Philippines	0.02358
Tajikistan	0.01208	Italy	0.03743	Vietnam	0.02269
Greece	0.01125	Morocco	0.03661	Korea, Rep.	0.02233
Czech Republic	0.01050	Poland	0.03247	Malaysia	0.01869
Netherlands	0.01002	Oman	0.02758	New Zealand	0.01785

Finland	0.00945	Korea, Rep.	0.02143	Kyrgyz Republic	0.01613
Hungary	0.00926	Vietnam	0.02060	Ecuador	0.01588
Jordan	0.00813	Norway	0.02018	Sweden	0.01446
Azerbaijan	0.00788	New Zealand	0.01784	Czech Republic	0.01017
Eritrea	0.00740	Syrian Arab Republic	0.01781	Netherlands	0.00976
Ireland	0.00699	Kyrgyz Republic	0.01614	Finland	0.00935
Austria	0.00682	Malaysia	0.01598	Hungary	0.00925
Denmark	0.00605	Ecuador	0.01474	Bulgaria	0.00865
Cambodia	0.00483	Sweden	0.01459	Jordan	0.00848
Slovak Republic	0.00446	Tajikistan	0.01198	Portugal	0.00780
Israel	0.00399	Czech Republic	0.01012	Azerbaijan	0.00776
Latvia	0.00347	Netherlands	0.00972	Eritrea	0.00745
Estonia	0.00258	Finland	0.00930	Ireland	0.00719
Haiti	0.00234	Senegal	0.00919	Austria	0.00714
Slovenia	0.00141	Hungary	0.00919	Belgium	0.00659
Malta	0.00015	Bulgaria	0.00886	Denmark	0.00546
		Jordan	0.00821	Lithuania	0.00445
		Portugal	0.00789	Slovak Republic	0.00434
		Azerbaijan	0.00760	Croatia	0.00398
		Eritrea	0.00743	Latvia	0.00331
		Ireland	0.00726	Panama	0.00306
		Belgium	0.00693	Moldova	0.00298
		Austria	0.00680	Singapore	0.00254
		Denmark	0.00566	Estonia	0.00246
		Lithuania	0.00443	Albania	0.00187
		Israel	0.00430	Slovenia	0.00143
		Slovak Republic	0.00427	Cyprus	0.00097
		Croatia	0.00404	Luxembourg	0.00056

Latvia	0.00329	Malta	0.00016
Panama	0.00300		
Moldova	0.00291		
Estonia	0.00242		
Singapore	0.00225		
Albania	0.00184		
Slovenia	0.00143		
Trinidad and Tobago	0.00116		
Cyprus	0.00094		
Luxembourg	0.00046		
Malta	0.00014		