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Sustainable Human Development for European Countries

VALERIA COSTANTINI and SALVATORE MONNI
Valeria Costantini is a Research Fellow and Salvatore Monni is a Researcher at the Department of Economics, Roma Tre University, Italy

Abstract In recent years, sustainable development has represented one of the most important policy goals at the global level. How to design specific policy actions and how to measure performance and results continue to present a challenge. The aim of this paper is to identify a numerical measure of 'sustainable human development' by enlarging human development with more specific environmental aspects. The sustainability condition has been directly analysed on the well-being side. Building a complex Sustainable Human Development Index may be a hard task because of data availability. European countries represent a useful pilot area for testing the methodology. The key factors of effective sustainable human development are emphasized, comparing a Sustainable Human Development Index with existing traditional indicators such as the Gross Domestic Product and the Human Development Index.

Key words: Sustainable Development, Human Development Index

Introduction

The main objective of human development, as stated in the *Human Development Report* of the United Nations Development Programme (UNDP), is to create an enabling environment for people to enjoy long, healthy, and creative lives. In this context, income and economic growth are a means and not an end to development, and people's well-being depends on how income is used to achieve higher quality of life standards.

This first approach to human development has changed over the past 10 years and increasingly focuses on the environmental aspects of daily life. The Earth Summit in Rio de Janeiro in 1992 and the World Summit in Johannesburg in 2002 marked the development path of the United Nations that shaped the new and wider concept of sustainable human development.

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Human development as a participatory and dynamic process is a concept that perfectly matches the description of sustainable development in the well-known Brundtland Report. Sustainable development was defined as ''[…] development that meets the needs of the present without compromising the ability of future generations to meet their own needs'' (World Commission on Environment and Development, 1987, p. 43). In the word 'ability', there is the conceptual link to the human development approach. In the light of the pioneering Brundtland Report, UNDP has followed up this approach by widening the theoretical framework of human development and capabilities in order to represent a much more comprehensive development strategy.

In this paradigm, natural resources and environment were considered as a means of achieving well-being, such as education or health. Rather than opposing the primary objective of monetary stability and economic growth recommended by other international organizations (i.e. the World Bank), this approach to development complements it and looks at new growth factors such as social and natural capital, environmental protection, participation of local communities, governance, and so on (Dubois *et al*., 2002). The interrelated nature of poverty and environmental degradation is useful for understanding the real meaning of a sustainable human development approach. Although it is true that poverty can be a cause of environmental degradation due to lack of investment and overexploitation of finite resources, it is also true that poor people are often forced to live in places where the standard of living (including environmental conditions) is very low. In this context, policy options to break this vicious circle can be geared both towards reducing poverty and improving living (environmental) conditions.

The objective of this paper is to analyse the policy implications of a wider concept of human development, including environmental protection and long-term sustainability, by building a composite index on the basis of the Human Development Index (HDI) methodology in order to evaluate two different aspects: first, whether a Sustainable Human Development Index (SHDI) is a feasible task and a more representative measure of effective capabilities; and, the second, concerning European countries, if a different development path exists from a sustainability point of view. The following section describes the main theoretical literature on the concept of human development and analyses the main criticisms of lack of environmental factors in the HDI methodology. The third section suggests some methodological issues for representing an empirical SHDI adapted to the European context with specific reference to the Green Net National Product (GNNP) developed in the economic literature and other social and environmental aspects of development. The final section underlines the main results of a descriptive

analysis of sustainable human development focused on European countries.

Economic growth, natural resources, and human development: a sustainability approach

The origin of criticism of the use of the Gross Domestic Product (GDP) per capita for measuring the level of development in different countries can probably be traced back to the pioneering United Nations Reports in which specific recommendations were made against the use of this indicator as a measure of the level of living (Noorbakhsh, 1996). As a result, the academic world, especially from the 1970s onwards, started to look for other kinds of indicators to explain economic development. In 1980, the *World Development Report* started to integrate the measurement of poverty with indicators such as nutrition, life expectancy, infant mortality, and the schooling rate. The first UNDP (1990) *Human Development Report* was the natural consequence of the debate started in the 1970s by scholars like Streeten (1981) and Sen (1970, 1984, 1987). It represents a milestone in the debate on how to measure the development level. It took various concepts raised in earlier development discussions and placed them in a comprehensive framework of human development that was defined as ''a process of enlarging people's choices, the most critical ones are to lead a long and healthy life, to be educated and to enjoy a decent standard of living'' (UNDP, 1990, p. 10).

During the past decade, the literature has paid a great deal of attention to the measurement of human well-being (Dasgupta and Weale, 1992) and in particular to the HDI, with regard to policy and the methodology adopted (Desai, 1991, 1995; Hicks, 1997; Hopkins, 1991; McGillivray, 1991; Noorbakhsh, 1998a,b).

A lively debate on the HDI and how to improve it emerged in the years immediately following the 1990 report, and involved, above all, the meaning and interpretation of the index, the role of inequality, and computation issues. In recent years, new attention to the HDI has been based on a specific sustainability interpretation, with various critiques and proposals for implementing a 'green HDI' (Desai, 1995; Atkinson *et al*., 1997; Sagar and Najam, 1998; Hinterberger *et al*., 1999).

During the 1990s, the neoclassical vision of environment and natural resources as a means of achieving a higher income growth level was generally adopted while poverty has been analysed as one of the major causes of environmental degradation (World Bank, 1992). Such a framework was far removed from the Brundtland Report's definition of sustainable development where basic needs of poor people were placed at the centre of debate. The UNDP reports of 1994 and 1996 have implemented a widely held notion of human development including the

natural environment, and have shifted attention away from economic growth towards *capabilities* linked to the environment. If human development is to be considered from a sustainable perspective, an index with which to check whether current policies are consistent with a long-term sustainable path is required.

In the human development paradigm, environment and natural resources should constitute a means of achieving better standards of living just as income represents a means of increasing social expenditure and, in the end, well-being (Anand and Sen, 1996). If we consider the two development frameworks, human and sustainable development, full integration is a difficult task since, in the second framework, the utilitarian approach prevails throughout the whole literature. In a sustainable development approach, the utilitarian criterion of maximizing the total sum of welfare represents a widely used methodology to assess the possibility of future generations to maintain the same utility level in economic terms.

In a wider context such as the *capability* approach, a justification for sustainability will therefore have to be found outside the welfarist framework of maximizing intergenerational utility in view of an ethical rule and a moral obligation to leave to the future a capital stock that is at least as large as the one inherited from the past (Solow, 1992). In an integrated sustainable human development approach, the maintenance of a constant or growing utility level could be interpreted as a functional condition (a means) for maintaining or enhancing a wider concept of well-being such as human development. The basic idea of expanding human capability for poor people, involving the assertion of unacceptability of discrimination, must apply to present and future generations, thus guaranteeing a minimum level of quality of life that should not decrease in a long-term horizon. In terms of intergenerational justice, human development becomes a means in itself in which improving health and education is also instrumental in achieving higher stocks of human capital, which will be the basis for higher well-being for future generations.

Preserving productive capacity intact is not, however, an obligation to leave the world exactly as we find it. What needs to be conserved is a generalized capacity to create well-being, not any particular item or resource. Since we do not know what the preferences of future generations will be, sustainability should only be set in terms of conserving the capacity to produce well-being (Anand and Sen, 2000a).[1] Some type of mechanism that accounts for over-exploitation of natural resources needs to be incorporated. The sustainable human development approach has evolved with the integration of environmental concerns in human development. By adopting a freedom-oriented point of view, sustainable development can be seen as development that promotes the *capabilities* of present people without compromising *capabilities* of future generations (Sen, 2000).

Building a SHDI

There is some scepticism about using an integrated green HDI based both on methodological and empirical problems. First, there is no direct relationship between resource exploitation and environmental degradation, on the one hand, and the level of human development on the other hand (Neumayer, 2001). Considering the wealth perspective described in Dasgupta and Mäler (2001), a possible response is that a higher consumption of natural resources compared with the same development level might mean that the (long-term) sustainability of the development process is less feasible due to excessive resource exploitation. In this sense, an integration of the income component of the HDI with economic assessment of natural capital depletion could represent a measure of the effective available income for any specific year. As far as environmental degradation is concerned, it is difficult to assess its impact on human development due to pollution and climate change. The main reason for including such (negative) attributes is again in terms of the sustainability of human development. In the long run, if a higher development level has been achieved with increasing pollution or climate change, the quality of life will be reduced by negative impacts (health disease or global warming effects).

Secondly, while the variables included in the HDI are all clear on where improvement is to be made — the longer people live, the better educated they are and the higher the level of well-being — this is more difficult for environmental variables. A possible response to this criticism could be the following. In order to evaluate which is the best value (minimum/maximum environmental standard) to be used in the normalization procedure, a target set by the international community (i.e. the European Union or the Kyoto Protocol target for climate change) could represent a widely accepted methodology. The ground covered towards reaching these targets could be considered as an improvement in the human development process.

Even if some scholars do not present any integration exercises between environmental issues and the HDI (Desai, 1995; Sagar and Najam, 1998; Neumayer, 2001), others claim partial (World Economic Forum, 2002) or full integration (Hinterberger *et al*., 1999). A comparison between human development achievements and sustainability issues without full integration probably represents the best way to proceed in a global context where levels of well-being assume different values. In a European context, where countries present very similar welfare levels, the HDI in the original formulation could only give partial information on real quality-of-life differences at a country level. Integration of the HDI with environmental variables and other social aspects could enhance the composite development index and explain which policies were more effective in achieving higher living standards. Furthermore, considering different development paths of European Union members and accession countries, the analysis of the environmental

performances in conjunction with the traditional human development aspects could be useful in the future for understanding if the expected increasing wealth after the enlargement process might be sustainable in the long run.

If we consider alternative synthetic indicators from the international literature such as the Environmental Sustainability Index (ESI) produced within the World Economic Forum (WEF) or the Index of Sustainable Economic Welfare proposed by Cobb and Daly (1989), reformulated by Cobb and Cobb (1994) and calculated for a few selected countries by the Friends of the Earth association, it is clear that the HDI methodology is easier to implement if the scope of the analysis is not only to build a ranking among countries for a specific year, but also to compare the historical trends of sustainable development within a complex area such as the European region. The ESI methodology requires a large number of indicators (68) in order to represent the environmental aspect of development, and omits some key information on the human dimension of development. The Index of Sustainable Economic Welfare methodology has been criticized for arbitrary variable definitions from one country to another, producing results that are not directly comparable (Neumayer, 2000). The HDI methodology, on the other hand, requires few variables and guarantees longer time series and a full comparison among countries.

The Generalized Human Development Index described in Chakravarty (2003) for k attributes of well-being gives us the theoretical framework within which the HDI could be extended with the environmental components. Four of the five properties suggested by the author (normalization, monotonicity, translation invariance, and homogeneity) guarantee that the HDI methodology including other factors (environment, natural resources, or social stability) does not fail to achieve the original measurement goal of an 'attainment index'.

The functional form of an attainment index as the generalized HDI for k attributes can be written as follows:

$$HDI = \sum_{i=1}^{k} [(x_i - m_i)/(M_i - m_i)]/k \qquad (1)$$

where x_i is the effective value, while m_i and M_i are the minimum and maximum values respectively. Equation (1) becomes helpful when calculating the contributions made by individual factors to overall achievement, and underlies the most effective development policies at country level when comparing countries at similar development stages.

Furthermore, the formulation in equation (1) assumes perfect substitutability in the factors where the marginal rate of substitution is constant and one attribute can be perfectly substituted by another. Such substitution regards not only the achieved values of chosen factors, but also the factors themselves. Changing factors (i.e. unemployment for highly industrialized countries instead of life expectancy) or adding other components (environmental and resource attributes) does not imply

changing the meaning or the interpretation of the HDI. The formulation of the HDI as the simple average of k equally weighted indices has been criticized because the absolute value of each component will affect the level of the HDI. The selected extreme values would therefore affect the value of the index and the ranking order (Noorbakhsh, 1998b). Since the HDI represents an attainment index, choosing the simple average reflects the idea that each aspect of human development could make a positive and equally important contribution to a higher level of quality of life (UNDP, 1991; Chakravarty, 2003).

Greening the income factor of the HDI

According to Anand and Sen (2000b), the income component remains a fundamental means for achieving higher standards of living. Considering the economic factor of the HDI, GDP per capita, from a sustainable development point of view, this does not take into account consumption (depletion and degradation) of natural resources. As far as access to resources is a means of achieving higher levels of well-being, such a dimension could be better represented with an income measure that considers natural capital depletion and degradation. Manufactured, human, and natural capital should be maintained to guarantee sufficient stock assets and produce constant or growing income flows (Dasgupta and Mäler, 2001). In the theoretical literature, the most widely used notion of sustainability is based on the Hicksian definition of income as the amount that can be consumed while keeping the value of total capital constant, including natural resources (Farzin, 2004).

According to Solow, a GNNP could be considered as the return on wealth: ''properly defined and properly calculated, this year's net national product can always be regarded as this year's interest on society's total stock of capital'' (Solow, 1992, p. 17). Building a SHDI could involve substituting a simple income indicator (GDP) with a GNNP and reducing the traditional income measure with the amount of consumed natural capital stock.[2]

The formulation of a Hicksian income with consumption of natural capital can be expressed as follows:

$$GNNP = C + \dot{K} - (F_R - f_R)(R - g) - b(e - d) \qquad (2)$$

The components $C + \dot{K}$ represent consumption and capital accumulation, defining the traditional Net National Product. All the other terms are adjustments for consumption and degradation of natural capital. In particular, the economic value of natural resource consumption (resources extracted [R] minus natural growth rate [g] for renewables) is given by the resource rental rate (F_R) net of the marginal cost of extraction (f_R). The economic value of damage from pollution is evaluated by the marginal social cost of abatement (b) applied to the net emissions flow (emissions [e] minus natural dissipation rate [d]).

At an international level, the only practical measure available that corresponds to the theoretical GNNP model is the *Genuine Saving* (GS) index, developed in Hamilton (2000) and Hamilton and Clemens (1999), and published in the *World Development Report* (various years). Separate economic values for some typologies of natural resources exploited at national level are then available, such as energy and mineral resources, forests, and marginal economic damage linked to CO_2 emissions.[3]

The absence of an economic evaluation of environmental factors such as soil erosion or fisheries depletion for Least Developed Countries (LDCs), and pollutant emissions such as SO_2 and NO_X for developed countries, gives a partially biased value to the GNNP. The current formulation probably gives an over-estimated sustainability value for industrialized countries and an under-estimation of the sustainability level for LDCs considering that primary resources are exploited mainly in developing countries whereas most pollution is emitted by industrialized countries.

From a European perspective further results could be obtained by adding natural assets, but an economic assessment of natural resources depletion goes beyond the scope of this work. From a human development perspective, such difficulties could be overcome by adding an environmental factor to the existing economic and social aspects of the traditional HDI rather than by implementing a widely modified GNNP.

A Sustainable Human Development Index

The methodology for choosing SHDI components and normalization criteria has been adapted from many suggestions in the literature. It takes into account the original framework of HDI with three dimensions, access to resources, a long and healthy life, and an adequate knowledge, and adds a fourth environmental dimension (Sagar and Najam, 1998; Hinterberger *et al*., 1999; Jha and Murthy, 2004). The sustainable human development components within each dimension for European countries have been chosen to give a truer representation of the capabilities of these industrialized areas.

i. *Access to resources*. Instead of using simple GDP purchasing power parity ($PPP) per capita, the GNNP methodology has been considered using World Bank Genuine Saving data. The aggregate current Gross National Income at $PPP (GNI) has been taken as the basis for calculating the GNNP with three elements subtracted from the GNI: depreciation of natural capital (in terms of net rent from extracting energy and mineral resources and exploiting forests); degradation of natural environment (economic damage from CO_2 emissions); and consumption of fixed economic capital. The normalization criterion remains the same as for the original GDP component of the HDI used in the last reports, and the decreasing utility of income is figured as the logarithm of absolute value. Maximum and minimum values are the same as the HDI, 40000 and 100 $PPP per capita, respectively.

ii. *Education*. As stated in Sen (1988) individual capabilities can be prioritized differently in different places and different times. Therefore, if it is important to read and write in order to exercise one's freedom in an underdeveloped country, in a richer country we have to consider reaching a high level of education as an essential component of the exercise of freedom. The normalization criterion has been changed from the original gross enrolment ratio of the HDI, using a maximum value of 80%, due to the observed range of this variable. Most of the analysed countries show tertiary education that is somewhat lower than 100%, and such maximum value could bias results in terms of comparison among countries.[4]

iii. *Social stability*. Here, the unemployment rate[5] seems to give a more realistic representation of the social human condition index than life expectancy at birth, since sanitary and health services in Europe are fairly similar. Employment provides people with income that enables them to establish command over a range of goods and services needed to ensure a decent standard of living. Employment also means all ways of securing a livelihood, not just wage employment. People value their work for a number of reasons that extend beyond income. Work allows them to make a productive contribution to society and exercise their skills and creativity, bringing self-respect and dignity (*Human Development Report* 1996). The considerations that were relevant for education also apply to the unemployment index, where the maximum value for normalization is 25% and an unemployment rate that is higher than 10% represents a possible cause of social instability. The minimum value remains unchanged (0) considering that there are many countries with an unemployment rate of under 3%. A variation range from 0% to 25% gives more weight to this variable than using a normalization criterion, as with education in the HDI. Furthermore, considering that some East European countries have faced decreasing values of life expectancy at birth, the social stability index includes this variable (normalized as in the HDI), with a lower weight than unemployment (1/3 and 2/3, respectively). The choice of a weight system of this type depends on the small number of countries within the whole European context that have faced a decreasing trend in life expectancy at birth.

iv. *Quality of natural environment*. This is the most innovative and difficult component since data availability is lower than other factors and the normalization criteria is interpretable. In this paper some widely accepted environmental concerns have been considered: acidifying pollutants and ozone precursors summarized as air pollution; organic water pollutant emissions; and soil pollution as the total amount of fertilizers, herbicides and insecticides used on arable land. Furthermore, a fourth component based on energy consumption has been considered in order to include a resource depletion index that could obtain more information considering the

data gap in the GNNP components. Normalization criteria have been chosen that take minimum and maximum values into account and consider a variation range that could be feasible for the whole time period analysed (1992–2002). Alternative criteria for aggregation in a synthetic environmental index have been studied and the simple average compared with the geometric mean. The simple average has been applied for two main reasons: other environmental indexes such as the widely used ESI produced within the WEF (2002) have adopted this aggregation criterion and, secondly, because the geometric mean values that change suddenly from one year to another give the index a large variation range that is difficult to analyse considering that environmental data are not as robust as the other SHDI indicators. If the geometric mean was used, the environmental index would influence the SHDI trend too much and information on the other human development dimensions would be lost.

Finally, the composite SHDI has been calculated as the simple average of the four development components, education attainment (EDU), social stability (SOC), sustainable access to resources (GNNP), and environmental quality (ENV). This aggregative rule is simple to implement and it has the advantage of being directly interpreted by looking at specific trends of each indicator, as claimed in the HDI technical notes (UNDP, 2003) and in the Environmental Sustainability Index framework (WEF, 2002). Therefore, the final formulation of the SHDI is the following:[6]

$$SHDI = \frac{1}{4}\left[\underbrace{\left(\frac{x_1 - 0}{80 - 0}\right)}_{EDU} + \underbrace{\left(\frac{1}{3}x_2 + \frac{2}{3}x_3\right)}_{SOC} + \underbrace{\left(\frac{\log(x_4) - \log(100)}{\log(40000) - \log(100)}\right)}_{GNNP} + \underbrace{\left(\frac{x_5 + x_6 + x_7 + x_8}{4}\right)}_{ENV}\right] \tag{3}$$

where x_1 is the tertiary gross enrolment ratio, UNESCO definition; $x_2=(y_1-25)/(85-25)$, the Health Index (y_1=life expectancy at birth, number of years); $x_3=1-[(y_2-0)/(25-0)]$, the Employment Index (y_2=unemployment rate, percentage); x_4 is the GNNP current \$PPP per capita; $x_5=1-[(y_3-0)/(0.015-0)]$, the Air pollution index (y_3=tonnes per day per worker of NO_X, SO_2, NH_3, NMVOC, CO); $x_6=1-[(y_4-0)/(0.35-0)]$, the Water Pollution Index (y_4=BOD emissions, kg/day per worker); $x_7=1-[(y_5-0)/(1000-0)]$, the Soil Pollution from Agriculture Index (y_5=fertilizers, herbicides and insecticides used on arable land, kg per hectare); and $x_8=1-[(y_6-0)/(10-0)]$, the Energy Index (y_6=Tonnes of oil equivalent per capita consumed per year).

For calculation purposes, when there is a single country with an absolute level that is consistently higher than other countries, the maximum value is substituted for the real value (UNDP, 2003). In the *Human Development Report* 2003, this accounting rule has been adopted for Luxembourg's GDP per capita level that is higher than log(40000), and assumed equal to the maximum level. The same rule has been adopted for this study: the gross enrolment ratio for Finland amounts to 80%, air pollution emissions for Iceland amount to 0.015 tonnes/day per worker, BOD emissions for Moldova amount to 0.35 kg/day per worker, soil pollution emissions for Iceland, Spain, and Turkey amount to 1000 kg per hectare, and energy consumption for Iceland amounts to 10 tonnes of oil equivalent per capita. This accounting rule seems necessary when comparing countries with very low values with others with values well above the average. Such considerations imply that it is impossible to use a geometric mean because it gives a null value for all the quoted cases.[7]

A SHDI for European countries

The empirical analysis of a sustainable human development approach applied to European countries is structured in the light of two main objectives. The first one is to verify whether an SHDI represents a better measurement of development compared with the GDP and the HDI, and whether it is a robust composite index. For this purpose, a correlation matrix has been built both among the three indices and the SHDI, and among the SHDI and its own components, in order to test robustness and the meaning of such an index compared with the others. A further correlation with the ESI of the WEF gives some information on possible improvement of the environment component of the SHDI.

The second analysis has been based on historical trends of the indices to verify the effective development path of 37 European countries and explain similarities within four country groups, accession countries (Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, the Slovak Republic, and Slovenia), European Union (15 members), other OECD European countries (Iceland, Norway, Switzerland, and Turkey), and transition economies (Albania, Bulgaria, Croatia, Macedonia, Moldova, Romania, the Russian Federation, and Ukraine). If we consider the SHDI data, there are many policy considerations about divergences among the four groups and convergences within each group that allow some important issues to be underlined within a sustainable human development approach.

General assessment of the SHDI methodology

A general assessment of the ability of a composite index to represent more aspects than consolidate methodologies, such as the GDP or HDI, without including redundant variables, is undoubtedly the very first step to be

taken before proceeding with an analysis of policy actions implemented at country level.

The three indexes, GDP, HDI, and SHDI, have been compared in two reference periods with 1992 as the starting point and 2002 as the final date of analysis. For each year, every index has been used to obtain a separate ranking among the 37 countries. Furthermore, an alternative ranking methodology has been tested using the Borda rule.[8] In order to evaluate whether a composite index is a good one, there should be two fundamental conditions: (i) the components should not be highly correlated with each other, and (ii) the index itself should not be highly correlated with any of its single components. If these criteria are satisfied, the composite index is not redundant (Noorbakhsh, 1998b). For this purpose, a complex analysis was implemented to test both the robustness of the SHDI and to reply to criticisms of the HDI (and SHDI) being redundant compared with the GDP with a correlation matrix both for absolute values and ranks (Table 1).

From an analysis of results, it appears that the HDI is highly correlated with the GDP index both for ranks and absolute values, whereas the SHDI corresponds to a correlation level with a GDP relatively lower than the HDI. The SHDI seems to be useful for representing different conditions in terms of capabilities compared with the simple GDP and HDI, and describes some aspects that are ignored in the other two indexes. The alternative aggregation (Borda) rule, calculated for the HDI and SHDI (respectively, HDI-B and SHDI-B), has not given very different results from the simple average adopted in the HDI methodology. The correlation between the simple HDI and SHDI aned the GDP is quite similar to the correlation obtained using the correspondent Borda index, HDI-B and SHDI-B. An alternative weighting system suggested in Cherchye and Kuosmanen (2004) has been tested in order to build a Meta Index of Sustainable Human Development (M-SHDI), which has been based on the so-called 'benefit of the doubt' as an aggregation method. In their work, authors apply weights that maximize the index value for each country in response to the main criticism of the HDI methodology that specifies an *a priori* weight system.[9] Results in the correlation matrix show that the SHDI with a traditional HDI weight system seems highly correlated with M-SHDI, and we have therefore chosen to maintain a traditional HDI framework.

Furthermore, if we consider the correlation between the SHDI and each single component (EDU-S education for SHDI, SOC for social stability, GNNP for access to resources, and ENV for environmental quality), the SHDI seems to be highly dependent on the education factor and the GNNP, and secondly on the social and environmental index. High correlation with the sustainable income component confirms that a sustainable human development process is highly dependent on capital formation, investments in human capital and conservation of natural resources. Furthermore, the GNNP factor has a very low correlation with

Table 1. Correlation matrix, ranks and values (2002)

	HDI	GDP	SHDI-1	SHDI-2	SHDI-3	ESI	HDI-B	SHDI1-B	SHDI2-B	M-SHDI	GNNP	EDU-S	SOC	ENV-1	ENV-2
Rank															
GDP	0.934														
SHDI-1	0.728	0.637													
SHDI-2	0.727	0.653	0.960												
SHDI-3	0.702	0.634	0.947	0.983											
ESI	0.422	0.320	0.305	0.346	0.319										
HDI-B	0.971	0.896	0.782	0.760	0.736	0.356									
SHDI1-B	0.793	0.775	0.852	0.911	0.926	0.326	0.814								
SHDI2-B	0.806	0.786	0.838	0.904	0.916	0.319	0.812	0.993							
M-SHDI	0.665	0.638	0.851	0.865	0.887	0.328	0.682	0.898	0.884						
GNNP	0.938	0.991	0.623	0.633	0.613	0.338	0.906	0.760	0.772	0.635					
EDU-S	0.386	0.242	0.688	0.692	0.661	0.187	0.478	0.499	0.463	0.363	0.209				
SOC	0.742	0.802	0.456	0.561	0.565	0.336	0.680	0.735	0.761	0.573	0.801	0.041			
ENV-1	−0.252	−0.264	0.136	0.155	0.219	0.003	−0.219	0.197	0.175	0.426	−0.287	−0.017	−0.191		
ENV-2	−0.220	−0.240	0.140	0.161	0.217	−0.017	−0.209	0.189	0.206	0.415	−0.262	−0.065	−0.149	0.962	
ENV-3	−0.065	−0.048	0.288	0.287	0.352	−0.011	−0.032	0.338	0.313	0.635	−0.077	0.058	−0.054	0.950	0.910
Absolute value															
GDP	0.980														
SHDI-1	0.786	0.754													
SHDI-2	0.754	0.723	0.954												
SHDI-3	0.764	0.738	0.933	0.968											
ESI	0.346	0.329	0.309	0.297	0.247										
HDI-B	−0.952	−0.906	−0.802	−0.778	−0.746	−0.371									
SHDI1-B	−0.810	−0.795	−0.875	−0.933	−0.928	−0.341	0.824								
SHDI2-B	−0.817	−0.799	−0.867	−0.930	−0.921	−0.333	0.826	0.993							
M-SHDI	0.708	0.707	0.884	0.882	0.883	0.269	−0.677	−0.887	−0.877						
GNNP	0.976	0.991	0.721	0.682	0.690	0.355	−0.901	−0.762	−0.769	0.685					
EDU-S	0.440	0.362	0.748	0.766	0.729	0.233	−0.546	−0.608	−0.588	0.474	0.299				
SOC	0.618	0.652	0.534	0.672	0.614	0.279	−0.624	−0.749	−0.759	0.579	0.645	0.220			
ENV-1	−0.216	−0.233	0.224	0.190	0.219	−0.125	0.244	−0.087	−0.081	0.435	−0.252	0.058	−0.247		
ENV-2	−0.182	−0.197	0.232	0.202	0.232	−0.128	0.223	−0.101	−0.105	0.452	−0.211	0.034	−0.221	0.994	
ENV-3	0.262	0.250	0.532	0.511	0.655	−0.044	−0.154	−0.479	−0.473	0.679	0.206	0.294	0.052	0.741	0.754

the environmental index meaning that the two 'sustainability' variables are not redundant. Considering alternative aggregation methods for the ENV index, correlation results are very similar in response to possible criticisms related to the aggregative rule of simple average and to some data gaps for environmental issues. In particular, there are three alternative indices for the environmental dimension, ENV-1, ENV-2, and ENV-3, and three correspondent SHDI indices (respectively, SHDI-1, SHDI-2, and SHDI-3). The ENV-1 index has been calculated using equation (3) with a data gap; the ENV-2 index has the same formulation as ENV-1 with replaced missing values with the average value of the regional area of each country (see note 7 for details); finally, the ENV-3 index has been calculated using the geometric mean of the four environmental indicators. Interesting results appear from the correlation among SHDI-3 and its own components where ENV-3 assumes a higher weight compared with the GNNP and EDU-S.[10] Final considerations on robustness compared with other sustainable indicators such as the ESI denote a low correlation between the SHDI and the ESI (similar values are for the HDI and the GDP). These results are probably linked to the absence in the SHDI of indicators for reduced environmental stresses that are considered in the ESI methodology. A more complete environmental index in the SHDI could be a future research task.

Other considerations about the SHDI regard the composition and meaning of the GNNP and the specific sustainability criterion adopted in this context. From a sustainability perspective, the fact that the GNNP has been calculated on the basis of a weak sustainability hypothesis with perfect substitution between capital assets has to be taken into account. These results cannot fully confirm that the development path is sustainable in the long run because it depends on how many natural resources have been depleted. Furthermore, data availability is not homogeneous for all countries, giving partially biased results. In order to maintain a GS methodology, the GNNP has been calculated including all GS components, taking into account the fact that the GNNP represents an overestimated value of sustainable income for most of the countries analysed. Countries with large energy resource exploitation have a lower GNNP in relative terms. The GS methodology does not take into account large exporting flows towards countries with scarce natural resources (mainly industrialized countries). Since international energy markets, especially the oil market, are influenced by few economic agents, producing high price volatility and a price level higher than the effective resource availability, it is clear that the calculated rent for energy depletion is much higher than the equilibrium level, penalizing exporting countries such as the Russian Federation. The correct solution to this problem would be to build an ''ecological balance of payments'', as suggested in Atkinson and Hamilton (2002), but finding this solution is a hard task that goes well beyond the scope of this study. An alternative solution to this gap could be to perceive the real per-

capita energy consumption within the complex environmental index of the SHDI, in order to correct in part the misleading results from GNNP values.

An empirical analysis of SHDI for European countries

A descriptive analysis of divergences from the HDI ranking and the SHDI could give an initial general assessment of SHDI values compared with results obtained by applying a traditional human development approach and a traditional economic growth approach. If we consider the four country groups — accession countries, the European Union, other OECD European countries, and transition economies — it is interesting to note similar features within each group.

If we consider the SHDI values over the period 1992–2002, country groups have specific peculiarities and the factors influence the SHDI values and trends in a very different way (Fig. 1). The education index (EDU-S) explains most of the SHDI growth rate within accession countries and the European Union, whereas it has a quite similar trend for transition economies. The unemployment rate (SOC index) and the environmental quality (ENV index) both have a great effect in accession countries and transition economies, reducing the performance in terms of sustainable development. In the European Union, the tertiary gross enrolment ratio has a higher growth rate than the others.[11]

If we consider accession countries, for instance, the 2002 rank values seem to give better results in terms of sustainable development than the traditional GDP or HDI indices (Table 2). Most of the accession countries have a better ranking with the SHDI in 2002 than with the GDP or HDI, and in all cases the SHDI performance for this group is better than for transition economies and in some cases better than the Eureopan Union 15 and other OECD countries (Luxembourg, Spain, Iceland, and Turkey). Generally speaking, an improvement in sustainable human development is consistent with a better human development level (in rank values).

More specifically, the Nordic countries show excellent performance in the SHDIs. In fact, Sweden, Norway, and Finland occupy first, second, and third places, respectively, in the ranking, while the fourth is occupied by the United Kingdom. This outcome is explained mainly by the result of the education component, which in the three mentioned countries is higher than in the other countries by up to 0.9 points — with Finland occupying first place with a coefficient of 1.000. Sweden with 0.952 and Norway 0.926 are second and third in the ranking. It is very interesting to note that both Sweden and Finland stand in a substantially lower position in the GDP ranking compared with the SHDI and HDI.

This evidence proves yet again that human development does not necessarily mean economic growth. In the same way, Slovenia (+13) and the United Kingdom (+9) show good performance in the SHDI with

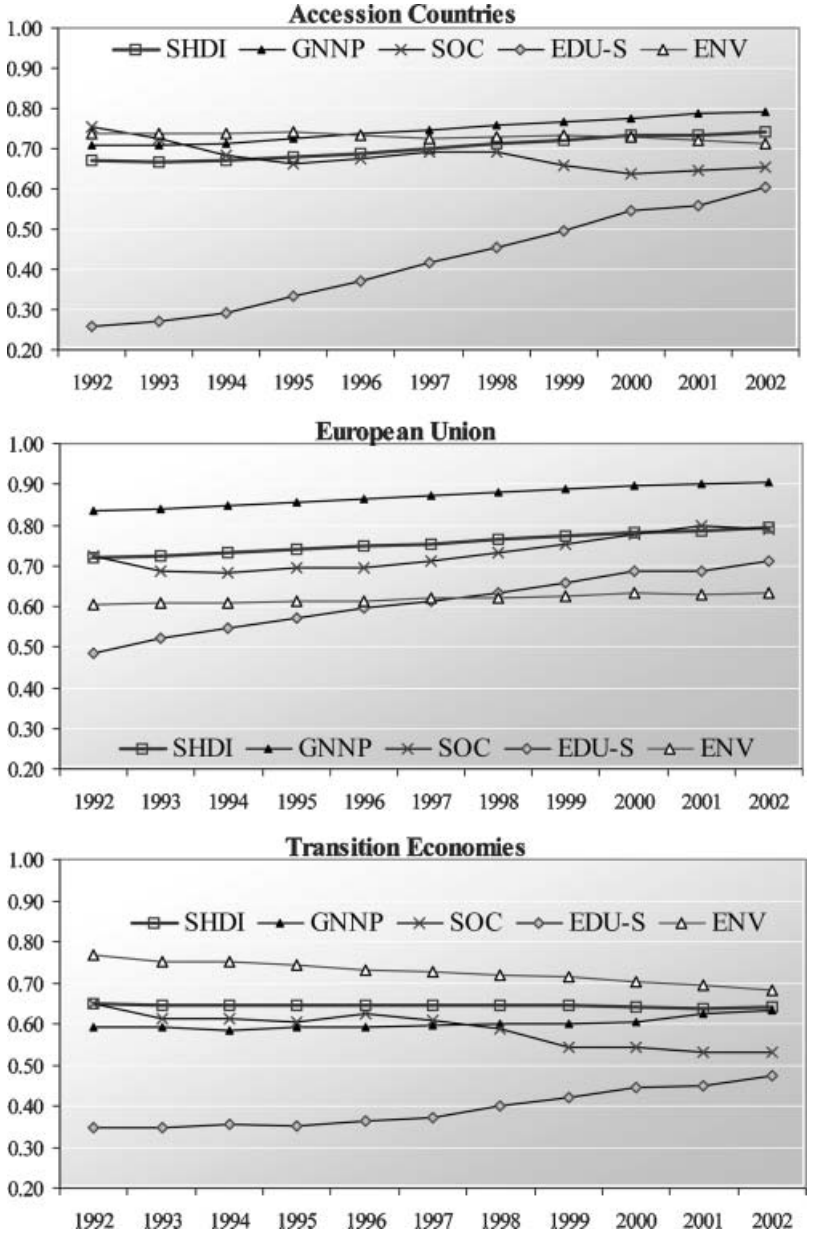

FIGURE 1. SHDI components, trend 1992–2002 for country groups. *Note*: Accession countries=Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovak Republic, and Slovenia; European Union=Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom; Transition economies=Albania, Bulgaria, Croatia, Macedonia, Moldova, Romania, Russian Federation, and Ukraine.

Table 2. Compared ranks for different indices

Rank	Country	SHDI value 2002	Δrank GDP 2002	Δrank HDI 2002	Δrank SHDI 1992	Δrank SHDI–SHDI-3 2002
1	Sweden	0.845	14	1	10	0
2	Norway	0.843	1	−1	0	0
3	Finland	0.834	11	0	0	3
4	United Kingdom	0.829	9	9	8	0
5	Austria	0.825	3	2	−4	2
6	Denmark	0.824	−2	6	1	−3
7	Slovenia	0.807	13	11	12	−2
8	Belgium	0.806	1	0	−4	5
9	Germany	0.802	1	5	−1	2
10	Portugal	0.799	8	10	3	−2
11	The Netherlands	0.794	−4	−1	−5	−1
12	Italy	0.793	0	3	−2	0
13	France	0.792	−2	−4	−8	1
14	Ireland	0.791	−12	−8	6	1
15	Switzerland	0.780	−10	−10	−6	−6
16	Greece	0.778	1	1	−1	1
17	Latvia	0.769	12	12	4	4
18	Estonia	0.767	7	8	4	−2
19	Poland	0.755	7	4	12	6
20	Hungary	0.748	3	4	8	−2
21	Spain	0.731	−5	−5	8	11
22	Lithuania	0.729	6	5	−5	−2
23	Malta	0.726	−2	−2	−5	0
24	Russian Federation	0.721	6	8	−8	−5
25	Czech Republic	0.715	−3	−3	0	−3
26	Cyprus	0.700	−7	−7	−3	0
27	Slovak Republic	0.682	−3	−2	3	4
28	Croatia	0.677	−1	0	−1	1
29	Bulgaria	0.675	2	1	−3	4
30	Romania	0.672	2	3	2	−3
31	Ukraine	0.660	4	3	−17	−7
32	Iceland	0.660	−26	−28	3	−4
33	Luxembourg	0.656	−32	−22	0	−3
34	Turkey	0.613	0	2	2	1
35	Albania	0.592	1	0	2	2
36	Macedonia	0.580	−3	−5	−2	−2
37	Moldova	0.556	0	0	−13	−1

respect to their GDP ranking. This result depends mainly on the social component of the SHDI (unemployment).

Austria, which once occupied first place in the 1992 ranking, is replaced by Sweden and now occupies fifth place in the 2002 ranking. The former communist countries such as Ukraine (−17), Moldova (−13), the Russian Federation (−8), Lithuania (−5), and Bulgaria (−3) show a declining performance. This is due to the economic recession experienced by transition economies during the 1990s, which caused a great drop in employment and a worsening of environment conditions, as revealed by our SHDI.

Table 3. SHDI components, 1992–2002

Country	1992					2002				
	SHDI	GNNP	EDU-S	SOC	ENV	SHDI	GNNP	EDU-S	SOC	ENV
Accession countries										
Cyprus	0.670	0.773	0.154	0.906	0.658	0.700	0.852	0.320	0.858	0.566
Czech Republic	0.658	0.725	0.182	0.860	0.685	0.715	0.812	0.421	0.750	0.737
Estonia	0.679	0.673	0.308	0.812	0.778	0.767	0.763	0.799	0.584	0.772
Hungary	0.646	0.705	0.189	0.647	0.738	0.748	0.791	0.551	0.772	0.749
Latvia	0.683	0.661	0.304	0.849	0.772	0.769	0.734	0.857	0.578	0.654
Lithuania	0.696	0.698	0.353	0.825	0.772	0.729	0.751	0.806	0.564	0.718
Malta	0.688	0.774	0.231	0.842	0.753	0.726	0.850	0.306	0.790	0.736
Poland	0.641	0.648	0.298	0.568	0.701	0.755	0.754	0.744	0.407	0.728
Slovak Republic	0.641	0.699	0.201	0.623	0.743	0.682	0.784	0.401	0.439	0.743
Slovenia	0.687	0.743	0.352	0.628	0.765	0.807	0.846	0.826	0.792	0.729
European Union (15 members)										
Austria	0.762	0.858	0.505	0.852	0.725	0.825	0.917	0.603	0.869	0.744
Belgium	0.750	0.857	0.580	0.773	0.580	0.806	0.915	0.748	0.780	0.594
Denmark	0.744	0.859	0.536	0.705	0.655	0.824	0.926	0.782	0.839	0.707
Finland	0.752	0.810	0.735	0.632	0.605	0.834	0.899	1.000	0.721	0.585
France	0.749	0.854	0.577	0.690	0.656	0.792	0.912	0.670	0.730	0.667
Germany	0.741	0.860	0.483	0.770	0.662	0.802	0.907	0.712	0.730	0.713
Greece	0.713	0.786	0.475	0.750	0.586	0.778	0.858	0.854	0.705	0.557
Ireland	0.684	0.788	0.434	0.546	0.506	0.791	0.929	0.624	0.843	0.571
Italy	0.728	0.848	0.455	0.647	0.690	0.793	0.904	0.664	0.723	0.746
Luxembourg	0.621	0.934	0.089	0.895	0.374	0.656	1.000	0.144	0.889	0.411
Netherlands	0.745	0.850	0.557	0.813	0.525	0.794	0.915	0.712	0.878	0.564
Portugal	0.724	0.772	0.382	0.828	0.779	0.799	0.838	0.663	0.814	0.766
Spain	0.643	0.802	0.510	0.472	0.431	0.731	0.869	0.736	0.659	0.475
Sweden	0.728	0.829	0.471	0.809	0.685	0.845	0.901	0.952	0.835	0.715
United Kingdom	0.725	0.833	0.486	0.692	0.624	0.829	0.911	0.795	0.822	0.657
OECD										
Iceland	0.590	0.851	0.339	0.848	0.088	0.660	0.923	0.682	0.885	0.021
Norway	0.758	0.874	0.630	0.799	0.557	0.843	0.947	0.926	0.861	0.553
Switzerland	0.731	0.890	0.361	0.886	0.701	0.780	0.937	0.555	0.895	0.705
Turkey	0.588	0.630	0.190	0.680	0.506	0.613	0.677	0.310	0.634	0.480
Transition economies										
Albania	0.571	0.438	0.092	0.645	0.806	0.592	0.631	0.203	0.334	0.646
Bulgaria	0.656	0.629	0.393	0.515	0.744	0.675	0.689	0.471	0.409	0.610
Croatia	0.652	0.652	0.321	0.516	0.784	0.677	0.749	0.455	0.532	0.712
Macedonia	0.608	0.650	0.210	0.261	0.827	0.580	0.673	0.338	0.269	0.680
Moldova	0.660	0.471	0.418	0.886	0.760	0.556	0.443	0.359	0.705	0.644
Romania	0.639	0.608	0.202	0.697	0.805	0.672	0.671	0.380	0.740	0.730
Russian Federation	0.701	0.644	0.584	0.766	0.689	0.721	0.640	0.872	0.656	0.689
Ukraine	0.716	0.636	0.544	0.900	0.715	0.660	0.575	0.725	0.611	0.740

At the same time, the Czech Republic remains unchanged and, in particular, Poland and Hungary performed better, registering +12 and +8, respectively, due to the improvement of the SHDI educational and environmental components. Countries in this group do not have good performance for both social stability and environmental quality, and most of them present a decreasing value of SHDI at absolute and rank level. These results confirm that the simple HDI methodology alone cannot describe complex economic and social phenomena as in the past 15 years in transition economies (Table 3).

If we consider the European Union, countries like Spain (−5) and France (−4) are penalized by a worsening of the environmental component and an increase in unemployment. In particular, Spain is last in the environmental ranking due to high intensity of fertilizers and pesticides. Ireland, the Celtic tiger, loses eight places in the SHDI ranking compared with the GDP, mainly due to a lower educational level. However, the SHDI performance of Ireland in the past 10 years increased by six places due to an improvement in GNNP growth and good employment performance.

Germany (0.812), The Netherlands (0.794), and Italy (0.799), which occupy approximately the same position in the SDHI ranking, show very different performance within the single components. Whereas the German SHDI value is explained by a very high environmental and employment component, Italy shows good performance in the environmental component and The Netherlands has a very low unemployment rate.

Moldova, Macedonia, and Albania represent the worst performances in the SHDI, with values below 0.6. This is due to a low coefficient in all components. Finally, we would like to stress that the seemingly bad performances of Iceland and Luxembourg partially depend on the specific geographic characteristics of these countries (i.e. size and low populations).

Conclusions

The object of this work has been to analyse the policy implications of an integrated concept of sustainable human development including environmental protection and long-term sustainability. For this purpose, we have implemented a composite index based on the HDI methodology called the SHDI.

It has been pointed out in this work that a wider framework for measurement of development produces very interesting results but could be affected by some methodological and empirical problems.

Nonetheless, some interesting results emerged from the empirical analysis. On the methodology side, the introduction of the environmental factor and the GNNP was intended to integrate the human development concept with a sustainability criterion. Furthermore, the unemployment

factor and the tertiary education level could help to assess whether or not a person has been deprived of freedom following Sen's capability approach.

On the descriptive side, a wider measure of development allowed differences among countries that seemed important to be emphasized. Different performance in the SHDI values highlighted hidden problems and limits affecting policy actions in rich areas such as European countries.

One of the most interesting results is the role of tertiary education, as in Nordic countries. In a highly industrialized area, this index helped to represent individual freedom with more efficacy than a simple literacy rate. Furthermore, linking data on the formation of human capital with consumption of environmental resources allowed an assessment to be made as to whether consumption of natural capital has been replaced with adequate investments in other capital assets. Norway, which consumes a large portion of exhaustible resources (oil and natural gas), remains in the highest part of the SHDI ranking due to investment in education, suggesting a development approach that is geared towards long-term sustainability. On the contrary, transition economies such as the Russian Federation have a high consumption of natural resources and a relatively low increase in human capital, with lower rank orders in the SHDI 2002 compared with 1992 values. However, more attention must be paid to the policy implication of depleting natural resources for export revenues. Accession countries with a less sustainable development path should not be left on their own in their struggle to become sustainable. Unsustainable resource exploitations in less developed countries are often encouraged by Western countries who want to import resources as cheaply as possible (as is probably the case with the Russian Federation).

From a sustainability point of view, it may be helpful to identify how many resources European Union 15 members should set aside and transfer (i.e. Structural Funds, Cohesion Fund, etc.) to accession countries in order to achieve the same level of sustainable human development. As proposed by some scholars for state aid for sustainable development of LDCs, the same aid flow will be necessary from the European Union to accession countries in order to reach higher well-being without depleting too much. It has to be remembered that some of the major concerns for the European Union regard the security of energy supply, and transition economies play a fundamental role in the geopolitical equilibrium of oil and gas markets.

Implementing policy actions oriented to a wide sustainability concept requires a large amount of economic resources, knowledge, and technological skills. Industrialized countries — as stated in the United Nations Millennium Development Goals — should help developing countries to build a ''global partnership for development''.

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Notes

1 This approach corresponds to the widely known 'weak sustainability criterion' where all the capital assets considered, including manufacturing, social, human, and natural assets, can be substituted in the production function, and the sustainability constraint is represented in the optimal control problem as non-declining general capital stock (Solow, 1986).

2 In this context, the use of a neoclassical utilitarian approach such as the GNNP is strictly functional and is used to assess the effective income available as a means to achieving higher well-being in the same way, as traditional income has been used in the human development approach.

3 For methodological and empirical explanation of effective components of the GS index, see Hamilton and Clemens (1999).

4 In this work, we assume that educational attainments are directly reflected by the HDI value, in order to maintain UNDP methodology. For an alternative HDI with diminishing returns for education see Noorbakhsh (1998a).

5 The employment rate might be a more appropriate indicator than unemployment but, unfortunately, no homogeneous data are available for all countries for the entire analysed time period, reducing the usefulness of the SHDI to make policy considerations for historical trends.

6 All data used for the empirical analysis are from the Human Development Reports of the UNDP (various years), the World Development Indicators data-book of the World Bank (last version 2003), and the environmental dataset provided by the European Environmental Agency together with Eurostat.

7 In particular, y_5 was not considered at all in the calculation of the x_7 index for Luxembourg, whereas herbicides do not affect soil pollution in Bulgaria, Iceland, and Moldova. The Environmental Index for Estonia does not include the water pollution factor (x_6), and the Air Pollution Index (x_5) was not available for Albania, Malta, Moldova, Russian Federation, and Switzerland. An alternative SHDI-2 has been calculated replacing missing data with the average value of the regional area of each country (i.e. Baltic Republics for Estonia, Eureopan Union 15 for Iceland, Luxembourg, and Switzerland, Accession countries for Bulgaria and Malta, and Transition economies for Albania, Moldova, and Russian Federation). Results have been compared with the original SHDI.

8 The Borda rule provides a ranking order on the basis of the sum of rankings for each component. Countries are ranked according to each single component, and then the resulting ranks are added. Finally, countries are ranked on the basis of their composite scores.

9 For methodological specification of a Meta Index based on the 'benefit of the doubt' approach, see Cherchye and Kuosmanen (2004).

10 The Borda rule has been applied to all of the three alternative SHDIs. Table 1 presents results for SHDI-1B and SHDI-2B. The results for SHDI-3B are not reported in Table 1 because they are very similar to the other indices. All details are available from the authors upon request.

11 Evaluation of the SHDI trends has been based on the formulation of SHDI-1 (as equation (3)). The other indices with a modified ENV factor do not show large differences considering the average values for country groups.

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