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MEASURING HUMAN AND SUSTAINABLE DEVELOPMENT
An Integrated Approach for European Countries

Valeria Costantini, Salvatore Monni

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Measuring Human and Sustainable Development: an integrated approach for European Countries

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Abstract
During the last few years, sustainable development has represented one of the most important policy goals at global level and how to design specific policy actions, measuring performance and results continues to present a challenge. Scientific research has explored different analysis directions in order to identify a synthetic indicator to evaluate policy planning and achievements that goes beyond traditional income indicators such as Gross Domestic Product (GDP). In consideration of the social dimension of sustainable development, including health, education and employment, the Human Development Index (HDI) of the United Nations Development Programme represents a widely accepted methodology to be used as a starting point for building a more sustainable-oriented development index. The aim of this paper is to identify a numerical measure of what Amartya Sen defined as "sustainable human development" using a human development framework and adapt it taking into account more specific environmental aspects. For this purpose, building a complex Sustainable Human Development Index (SHDI) may be a difficult task because of data availability and the European countries – especially the European Union - could be a useful pilot area for testing the methodology. The most recent efforts of the EU to standardize statistical information at country level enable us to build more complex indicators, including those with economic, social and environmental dimensions. Long-term sustainability requires the maintenance of capital stock to guarantee constant or growing welfare levels. In a human development perspective, the sustainability condition has been directly analysed on the well-being side, assuming that a constant or growing SHDI could be the result of constant growing capital assets. An SHDI represents the core element of a comparative analysis to assess the effectiveness and the distributional effects of European policies, including environmental actions. Finally, a sensitivity analysis of the results will enable us to underline the key factors of effective sustainable human development and, at the same time test the real meaning of such a modified composite index compared with the existing GDP and HDI.

Key words: human development, sustainable development, sustainability indicators

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1. Introduction

The main objective of human development, as stated in the Human Development Report (HDR) 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. 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 last ten years due to an increasing focus 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 UN that reached the new and wider concept of Sustainable Human Development.

Human Development as a participatory and dynamic process is a definition that fits the description of Sustainable Development in the well-known Brundtland Report perfectly. 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" (WCED, 1987, p. 43). In the word "ability" there is the conceptual link to the human development approach.

The first international environmentally-oriented development strategy was formally expressed in the World Development Report (WDR) of the World Bank in 1992, *Development and Environment* and underlined a classical growth-oriented policy description. After this pioneering 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.

More generally speaking, links between poverty, natural environment and social capital have been analysed from a different perspective. In the 1992 WDR, poverty was interpreted as a major cause of environmental degradation while the protection of natural resources was still considered a constraint on economic growth and not an opportunity to achieve a higher level of well-being. From the mid-nineties onwards, a direction of integration through a new paradigm was adopted within the UNDP's Human Development Report (HDR, 1994, 1996; Anand and Sen, 1996; Sen, 2000). In this

paradigm, natural resources and environment were considered as a means of achieving well-being such as education or health. This approach to development does not oppose but rather complements the primary objective of monetary stability and economic growth recommended by the World Bank and looks at new growth factors such as social and natural capital, environmental protection, participation of local communities, governance, etc. (Dubois et al., 2002). Bilateral relationships among poverty and environment are useful for understanding the real meaning of a sustainable human development approach. It is true that poverty can be a cause of environmental degradation, especially in the fragile rural areas of the Least Developing Countries (LDCs) due to lack of investments and overexploitation of finite resources, but 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 (i.e., slums and shantytowns). In this context, policy options to interrupt this vicious circle can be geared both towards reducing poverty and improving living (environmental) conditions.[1]

The object of this work 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 Human Development Index (HDI) methodology in order to evaluate two different aspects: on the one hand, whether a Sustainable Human Development Index (SHDI) could be a feasible task and a more representative measure of effective capabilities and on the other hand, with regard to European countries, if a different development path exists from a sustainability point of view. Section 2 describes the main theoretical literature on the concept of human development and measurement. Section 3 analyses the main criticisms of lack of environmental factors in the HDI methodology, and the possibilities of integrating sustainable income in the HDI. Section 4 suggests some methodological issues for representing an empirical SHDI adapted to the European context, with specific reference to the green Net National Product (green NNP) developed in economic literature and the Genuine Saving (GS) indicator produced by the

[1] The debate on relationships between poverty and environment goes beyond the scope of this paper. For further details see Duraiappah (1998), Ekbom and Bojo (1999), Reardon and Vosti (1995).

World Bank, and other social aspects of development. Finally, section 5 underlines the main results of a descriptive analysis of sustainable human development and is focused on European countries.

2. From Income to Human Development approach: a literature review

The origin of criticism to 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 70s onwards, started to look for other kinds of indicators to explain economic development. We can probably regard the 70s as the decade of socio-economic indicators for measuring development. This was the time when we started to conceptualize such ideas as Basic Needs which were mainly geared towards human development.[2]

According to Amartya Sen another important step is to criticise the idea that development means growth. He underlined that the principal ethic theories of social assets, from Utilitarianism to liberalism and from rights theories to Rawls justice theory (Rawls, 1972) gave a partial answer to the problem of equity. These theories, in fact, have reduced the problem of equity to "equality of income" or "equality of well-being". Equality for one variable can be different in respect to another variable. Sen has substituted the traditional idea of utility with the idea of functioning and capabilities where "functions" are

[2] This approach is characterised by the need to give a clear explanation of the problem of the satisfaction of Basic Needs. It attempts to condition the choice of national policy actions in order to resolve this problem. The specific policies that directly face the problems of the Basic Needs of all populations, especially their poorest elements, can be illustrated in four points:
1) Increasing the poorest people's chance to produce income
2) Strengthening the production and the distribution of public services so they can effectively reach whoever is most in need
3) Improving the production of commodities or services that can directly satisfy the needs of all the members of the "household" found in the traditional sector
4) Increasing the participation of populations in the decision on the nature of their Basic Needs and how they can be met.

indicated as *attainments of different attributes* and capability as *the ability to attain* (Sen, 1985, 1987).

Furthermore, the Sen approach pointed out the importance of the sociological aspect in economic analysis: poverty can be defined as the lack of capability because *capabilities* are intensely relevant for well-being whereas income is simply a means of obtaining it.

Finally, according to the Sen approach, not only low income determines a lack of *capabilities and* therefore, simply concentrating on an increase in income to reduce poverty might be an inefficient policy. The relationship between income and *capabilities* changes according to the reference point for society, households and individuals.

By the mid-80s however, the subject of the socio-economic indicators became rather "unfashionable". There may be many reasons for this, ranging from the debt crisis to the rise of monetarism in the Western economies and their effects on policy changes, particularly in some of the relevant international organizations such as the International Monetary Found (IMF) and the World Bank. The increase in the literature in the 70s, however, resulted in the regular collection and publication of data on an array of socio-economic indicators and for a large number of countries, which has proved very useful. With the availability of cross national data a number of attempts were made to construct composite indices that aimed at reflecting the level of development more comprehensively than GDP per capita alone could do.

In 1980, the *World Development Report* started to integrate the measurement of poverty by means of indicators like nutrition, life expectancy, infant mortality and the schooling rate. The first Human Development Report of the UNDP, released in 1990, was the natural consequence of the debate and represents a milestone in the renaissance of the interest in how to measure the development level. It distilled various concepts raised in earlier development discussions into 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, pp. 10).

As a result of this definition, the Human Development Report in 1990 proposed a composite index that reflects three major dimensions of human development: the Human Development Index (HDI). The

HDI is a composite index of three dimensions, access to resources, knowledge and longevity, derived from human *capabilities* proposed by Sen that are regarded as the essential requirements for enlarging human choices (Desai, 1991). Even though there are other dimensions which could enhance well-being, the three dimensions in the HDI represent the minimum set of indicators for representing living standards at an aggregate level (Dasgupta and Weale, 1992).[3]

2.1 Criticism to Human Development Index

During the last decade, the literature has paid a great deal of attention to the HDI, both on the policy side and the methodology adopted. This second aspect presents some controversies as underlined by many scholars (Desai, 1991, 1995; Hicks, 1997; McGillivray, 1991; Noorbakhsh, 1998a, 1998b).

On the one hand, there are economists who believe that economic growth is the most important means for economic development and, consequently, growth is a guarantee for development economics. According to these authors, the benefits of growth would be shared among all people (*trickle-down* effect), and enhancing growth would create development and improve the quality of life. Therefore, it is not necessary to measure human and economic development separately because they are strictly correlated.

On the other hand, there are economists who focus more on human development and acknowledge that human development and economic growth are only partially related. However, they have highlighted some problems related to the methodology adopted.

First of all, using a value between 0 and 1 as the HDI, we have arbitrarily lost some degree of freedom (Streeten, 1981).

Secondly, when we have to choose the appropriate value of minimum and maximum, we have to choose between a linear and a non-linear scale. Another problem is therefore definition of the exact weight of the index component that should be based on a generally accepted function of welfare that does not yet exist.

Income values entering the index represent another source of great debate especially because of unequal treatment and comparison in

[3] The methodology for building HDI has changed during the years in order to respond to some criticisms from many scholars. A chronological description of these changes has been described in Appendix I.

different countries. Hicks (1997) proposed estimating an Inequality-Adjusted HDI (IAHDI) in order to represent inequality issues in all three dimensions considered in the HDI - income, education, and health/longevity. The calculation of Gini coefficients for income distribution, educational distribution, and longevity distribution has been used to elaborate an IAHDI for 20 countries. Comparing country rankings by HDI and IAHDI, the author found that those countries with medium development presented wider (negative) changes in ranks underlining a positive correlation between inequality and the development process.[4]

Furthermore, there are some critical positions where statistical analyses suggest that the HDI generally reveals little more than any one of the pre-existing development indicators. The HDI's contribution to the assessment of inter-country development levels is therefore questioned (McGillivray, 1991).

At the same time, the main outcome of building an indicator such as HDI has been the representation of the capabilities concept that has changed the previous development framework based on basic needs. Sen is critical of the use of both wealth (income, or commodity possession) and utility as measures of well-being where such dimensions are shown to be deficient in dealing with achievements, freedoms and capabilities (Sen, 1970). The HDR takes a rather different view of what development is about and is broadly consistent with the capabilities approach advocated by Sen.

The path through which income growth effectively influences human development is what is important. Economic growth not only involves an increase in private income but can also contribute to generating resources for enhancing public services. Indeed, one of the most important factors that affect human development has been represented by the way national income is spent on public services. HDI, in conjunction with data on public social expenditures, represents a useful instrument for assessing the elasticity of the development process linked to public spending, as for example in the

[4] These results are consistent with previous results from Simon Kuznets (1955) where income growth and equity distribution are correlated with an inverted *U*-shaped curve (the Kuznets curve). During the first stages of development, economic growth corresponds to an increasing distributional inequality. After a threshold point, equity and income result positively correlated.

health sector where two-thirds of elasticity of life expectancy depend on public expenditure for health services (Anand and Ravallion, 1993; Ranis et al., 2000).

At the same time, quality of growth matters. If economic development goes hand in hand with increasing inequality in income distribution or with degrading environmental quality, then growing income produces a reduction in levels of well-being. The concept of human development therefore goes beyond the utilitarian approach (Desai, 1991). Insofar as growth of the GDP promotes better living conditions, its greatest achievement is the enlargement of individual capabilities and hence human development (Anand and Sen, 2000b).

3. Natural resources and Human Development: a sustainability approach

A lively debate on the Human Development Index and how to improve it first 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" (Atkinson et al., 1997; Dasgupta and Weale, 1992; Desai, 1995; Hinterberger et al., 1999; Sagar and Najam, 1998) or constructive framework with HDI compared to sustainability measures (Anand and Sen, 2000a; Dasgupta and Mäler, 2001; Jha and Murthy, 2003, 2004; Neumayer, 2001).

The World Development Report of the World Bank in 1992 (*Development and the Environment*) was the first international development approach based on environmental resources where a neoclassical position on income growth as an end of the development process remained the main task of World Bank policies. The vision of environment and natural resources as a means to achieving a higher income growth level was adopted for years while poverty has been analysed as one of the major causes of environmental degradation within least developing countries. Such a framework was far from the Brundtland Report sustainable development definition where basic needs of poor people were placed at the centre of debate. The UNDP reports of 1994 and 1996 have implemented a widely notion of human

development including natural environment, shifting attention from economic growth to *capabilities* linked with environment.

Therefore, in recent years, debates on how to measure the quality of life have been influenced by two different issues: 1) the constituents versus the determinants of well-being, and 2) the temporal horizon of the development path, current or sustainability-oriented (Dasgupta and Mäler, 2001).[5] Considering human development from a sustainable perspective, an index with which to check if current policies are consistent with a long run sustainable path would be required.

As we have seen, the most important deficiency in traditional development economics was considered to be the excessive concentration on "aggregate income and total supply of particular goods rather than on *entitlements* of people and the *capabilities* these entitlements generate" (Sen, 1984, p. 496). Such concerns resulted in the continuous search for alternative measures of human well-being (development), representing a wider range for human perspectives. The HDI developed by UNDP has been adopted as the main alternative to income aggregates, and nowadays it has been recognized as the best alternative development indicator.

3.1 The sustainable development approach

In this new development theory, environment and natural resources should constitute a means to achieving better standards of living just as income represents a means to increasing social expenditure and, in the end, well-being (Anand and Sen, 1996). Considering the two development frameworks, human and sustainable development, full integration is a difficult task since in the second one the utilitarian approach prevails within 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. Nonetheless, this neoclassical framework has been criticized by many authors because within the optimal control theory – by far the most frequent economic approach used to analyse intergenerational equity – an optimal growth

[5] In what follows we use the terms "quality of life" and "well-being" interchangeably.

path should not correspond to a sustainable path (Anand and Sen, 2000a; Asheim, 2002; Pezzey, 1992). Some requirements need to be added in order to have an optimal and sustainable solution since the equivalence of sustainability and optimality conditions depends on the social discount rate. Formally, if the social rate of return to investment in capital assets (including natural stock) is smaller than the rate of pure time discount, it is not worthwhile for the present generation to reduce its consumption and increase investment because the gain in well-being for future generations will not compensate for the sacrifice made by the present generation (Anand and Sen, 2000a). 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 at least as much capital stock as we have inherited from the past (Solow, 1992).

In order to sustain a constant or growing well-being level for future generations, the maximization of utility from the optimal control theory must be constrained by the imposition of a bound which could be a non-decreasing minimum level of consumption or utility or other quality of life indices such as the HDI.

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 run horizon.

Preserving productive capacity intact is not, however, an obligation to leave the world as we find it in every single detail. What needs to be conserved is a generalized capacity to create well-being, not any particular thing 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. 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).[6] This assumption does not preclude preserving specific resources where substitutes are not available or have an independent value such as clean air or fresh water. Preservation of the resource base does not imply that all exhaustible resources must be conserved (such as oil and other fossil fuels), but they have to be replaced by other sources of energy as renewables. For non-exhaustible resources such as forests or fishing stocks, substitution comes directly from their biological composition where the natural rate of re-generation must be conserved.

Furthermore, a Universalist approach such as human development cannot ignore the deprived people of today in an attempt to reduce deprivation in the future. The goal of sustainability would make no sense if the present life opportunities that are to be sustained in the future were indigence and poverty (Anand and Sen, 2000a).

Redistribution to the poor in order to improve their health and education is not only intrinsically important but is also instrumentally important in increasing their human capital and achieving more environmentally-oriented knowledge.

In terms of intergenerational justice, human development becomes a means in itself where 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. "Thus human development should be seen as a major contribution to the achievement of sustainability" (Anand and Sen, 1996, p. 14).

During recent years, numbers of indicators have been developed within the HDR context but no integration with environmental aspects appears in the latest editions. The current methodology on which HDI has been based includes qualitative and quantitative environmental information without complete integration within a complex index, while gender or poverty are factors affecting specific modified HDIs such as, for example, the Human Poverty Index (HPI) and the Gender-related Development Index (GDI) introduced in recent years (Anand and Sen, 1995).

[6] Weak sustainability perfectly matches the definition of *Hicksian* income, which corresponds to what can be spent while leaving the asset base intact to produce the same income level for the next period (Hicks, 1946). Following Hartwick's rule (Hartwick, 1977), the accumulation of reproducible capital investing the Hotelling rents from exhaustible resource deployment exactly replaces resource depletion and guarantees a constant capital stock.

In terms of sustainability, the real question that needs to be asked is: human development, but at what cost?

Some type of mechanism that accounts for over-exploitation of natural resources needs to be incorporated. In fact, the three dimensions of HD were represented with different methodologies during the past editions of HDRs and some indicators were changed in response to criticism emerging from academic debate. With regard to environmental quality and natural resources consumption, the HDR makes no attempt at a composite index.

As a measure of social well-being, the HDI is therefore mainly current (GDP, Life expectancy, literacy) and partially inter-temporal where literacy is a component of both current and future well-being giving a measurement of human capital accumulation. However, literacy is just one aspect of human capital accumulation and nothing describes natural capital. For this reason, the GDP and HDI are both not satisfactory.

A further step towards integration of environmental concerns into human development is the evolution of the sustainable human development approach. The demand of sustainability can be interpreted as a particular reflection of universality of claims applied to future generations compared with the present one. Obviously a Universalist approach cannot ignore the deprivation of poor people today, and, in this sense, natural environment should be interpreted as one of the main factors for enhancing human development and a means and not an end (Sen, 2000).[7] This approach is openly in contrast with the ecologist position where natural resources must be preserved for their existence and not for their usefulness to human beings.[8]

Some economic prosperity is a necessary condition for expenditure on welfare, and income growth could be a first sign of improvement in such well-being (Hopkins, 1991). However, in a sustainability context, if such income growth were the output of overexploitation of capital assets, including natural ones, that growth could not be sustained in

[7] In a sustainability context Universalism corresponds to intergenerational equity criteria, basically an elementary demand for impartiality applied within generations and between them (Anand and Sen, 1996, 2000).

[8] 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).

the long run, with consequent declining welfare levels for people and fewer available assets in the whole economic system (Dasgupta and Mäler, 2001). If countries in the past have not made adequate use of the opportunities their natural resources gave them to build up and maintain manufactured and human capital to compensate for resource depletion, in the long run the income flow will inevitably fall.

4. Building a Sustainable Human Development Index

There is some scepticism about using an integrated green HDI based 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 (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 an economic assessment of natural capital depletion could represent a measure of the effective available income for any specific year.

As for environmental degradation, it is difficult to assess the impact on human development due to pollution or 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 is the well-being level – 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 (the European Union, for instance) could represent a widely accepted methodology

(Hinterberger et al., 1999). Otherwise, minimum and maximum values could be represented by the amount assumed in a target year (Kyoto Protocol target for climate change, or 1990 for an index base year). Values going in the direction of such targets could be considered as an improvement in the human development process.

4.1 Proposals for integrating sustainability into human development

Even if some scholars do not present any integration exercises between environmental matters and HDI (Desai, 1995; Neumayer, 2001; Sagar and Najam, 1998), others claim full integration (Hinterberger et al., 1999; ISSI, 2002).

A comparison between human development achievements and sustainability issues without full integration represents the best way to proceed in a global context where well-being levels 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 country level. Integration of the HDI with environmental variables and other social aspects could enhance the composite development index explaining which policies were more effective in achieving higher living standards. Furthermore, considering different development paths of EU members and accession countries, sustainability can be an interesting point of view for dynamic analysis where available wealth after the development process might be substantially different from a sustainable path.

The Generalized Human Development Index described in Chakravarty (2003) for k attributes of well-being gives us the theoretical framework within which HDI could be extended with the environmental component. The properties suggested by the author guarantee that the HDI methodology including other factors (environment, natural resources or social stability) does not fail to attempt the original measurement goal.

In particular, four of the five properties described in Chakravarty (2003) help our analysis:

i) *Normalization*: $A(x_i, m_i, M_i) = 0$ if $x_i = m_i$
$= 1$ if $x_i = M_i$.

ii) *Monotonicity*: given m_i and M_i, an increase in x_i implies an increase in A.

iii) *Translation invariance*: $A(x_i, m_i, M_i) = A(x_i + c, m_i + c, M_i + c)$, where c is any scalar such that $m_i + c \geq 0$

iv) *Homogeneity*: for any $c > 0$, $A(x_i, m_i, M_i) = A(cx_i, cm_i, cM_i)$

Normalization means that indicator levels for attribute *i* are zero and one in extreme cases when the attribute assumes its minimum or maximum value. Under the monotonicity property, an increase in the attainment value of any factors increases the HDI. The third property, translation invariance, directly responds to some criticisms of HDI before 1994. From then on, HDI has been independent of the shifting values of single countries and if the actual value of the attribute as well as its lower and upper bounds are augmented by the same absolute amount, there is no change in the value of the indicator. Considering the *c* value for bounds only, the value of the indicator changes, but the relative ranking of all countries remains the same (origin independence). Finally, homogeneity requires insensitivity of the indicator to the unit of measurement of the attribute.

The functional form of the HDI for *k* attributes can be the following:

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

An arbitrary component $\left(x_i - m_i \right) / \left(M_i - m_i \right)$ in the generalized formulation in [1] satisfies all the four properties proposed in Chakravarty (2003). Therefore, the HDI becomes helpful in calculating the contributions made by individual factors to overall achievement, underlying the most effective development policies at country level comparing countries at similar development stages.[9]

[9] The achievement index in equation [1] presents the following analytical properties:

a) It is bounded between zero and one, where the lower (upper) bound is obtained in the case $x_i = m_i$ ($x_i = M_i$) for all *i*.

b) It is increasing at the individual factor level.

c) For any attribute, the achievement difference is greater at lower attainment levels, given that the values of other attributes remain fixed.

d) Since the HDI is a simple arithmetic average of attribute indicators, it is possible to identify the attributes which are more/less sensitive to the achievement.

Furthermore, the formulation in [1] describes perfect substitutability in the factors. The functional form adopted in [1] is typically linear, the marginal rate of substitution is constant and one attribute can be perfectly substituted for another. From a theoretical point of view, 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.

In order to integrate the traditional HDI with some environmental aspects and in an attempt to identify some information on the long term sustainability of the development path, we have tried to modify the HDI to take into account both natural environment and human capital formation in a context of an industrialized area such as European countries.

4.2 Greening the Income factor of HDI

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. Considering access to resources as a means of achieving higher well-being levels, the constituents of well-being must be a complete wealth measurement and not a flow measurement such as traditional income. Manufactured, human and natural capital should be maintained to guarantee sufficient stock assets and produce a constant or growing well-being.

In the theoretical literature, two definitions of sustainability seem to be prominent. The first notion, influenced by the Rawls' Maximin Criterion (Rawls, 1972) of intergenerational fairness, requires the aggregate consumption level (or social utility) to be maintained constant for the temporal (infinite) horizon (Farzin, 2004). This utility-constant criterion has been based on the definition of *Fisherian* income (Harris and Fraser, 2002). The other notion of sustainability is based on the *Hicksian* definition of income (Hicks, 1946), as the amount that can be consumed while keeping the value of total capital constant, including natural resources (wealth-constant criterion). Considering a theoretical notion of sustainable definition, *Fisherian* income seems to fit this definition perfectly, but most scholars have

adopted the *Hicksian* income within the optimal control theory in order to represent a sustainability path. The orderly formal model and social utility function used in the optimal control theory correspond to a wealth-constant criterion with a resulting green Net National Product as a measurement of sustainable consumption path.[10]

According to Solow, a green NNP 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 Sustainable Human Development Index could involve substituting a simple income indicator (GDP) with a green NNP and reducing traditional income measure with the amount of consumed natural capital stock.[11]

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

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

where $C + \dot{K}$ represent traditional NNP while other terms are adjustments for consumption and degradation of natural capital. In particular, the economic value of natural resources 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), while pollution (emissions e minus natural dissipation rate d) is evaluated by the marginal cost of abatement ($b = -1/e_a$).

At international level, the only practical measure available which corresponds to the theoretical green NNP model is the *Genuine Saving* (GS) index published within the World Development Report (World Bank, various years), expressed as:

$$GS = \dot{K} - (F_R - f_R)(R - g) - b(e - d) \qquad [3]$$

[10] For further details on formal optimal control model employed to obtain eq. [2] see Appendix I.

[11] In this context, using a neoclassical utilitarian approach as the green NNP is strictly functional to assess the effective income available as a means to achieve higher well-being level, as traditional income has been used in the human development concept.

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 (i.e. cost of climate change).[12]

The absence of an economic evaluation of environmental factors such as soil erosion or fisheries depletion for LDCs, and pollutant emissions such as SO_2 and NO_X for developed countries, gives a partially biased value to the green NNP. 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, while most pollution is emitted by industrialized countries.[13]

Taking 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. Adopting a human development perspective, such difficulties could be overcome by adding an environmental aspect to the existing economic and social aspects of the traditional HDI rather than by implementing a widely modified green NNP.

Unfortunately, no method that can specifically address the sustainability of the other HD components (longevity and education) is available and so the green NNP methodology calculated with World Bank data can only help to assess the sustainability of the income component of the HDI.

4.3 A Sustainable Human Development Index

In brief, the methodology for choosing SHDI components and normalization criteria has been adapted from many suggestions in the

[12] Energy and mineral resources considered in the WDR are oil, natural gas, coal, bauxite, copper, lead, iron, nickel, phosphates, tin, zinc, gold and silver. For methodological and empirical explanation of effective components of Genuine Saving index, see Hamilton and Clemens (1999).

[13] Considering highly developed countries such as the European Union and Accession Countries, population growth could represent a very marginal factor in achieving sustainability, while for LDCs it is a source of major concern. In this paper, an industrialized countries perspective has been adopted and problems linked to population trends can therefore be easily set aside. For details on the influence of population growth on sustainable income see Arrow et al. (2003).

literature (Dasgupta and Weale, 1992; Hinterberger et al., 1999; Jha and Murthy, 2004; Ranis et al., 2000; Sagar and Najam, 1998).

The Sustainable Human Development components for European countries must be different from a generalized Human Development Index whose target is mainly LDCs. We have therefore considered four components of development.

i) *Access to resources*. Instead of using simple GDP $PPP per capita, the green NNP methodology has been considered using the World Bank Genuine Saving data. For this reason, the aggregate current Gross National Income at $PPP (GNI) has been taken as the basis for calculating the green NNP. Three separate elements have been subtracted from the GNI: depreciation of natural capital, as the sum of total net rent from exploitation of exhaustible (energy and mineral resources) and renewable resources (forests), degradation of natural environment, as the total economic value of damage produced by CO_2-equivalent emissions and consumption of fixed economic capital. The final result is a modified income index that tries to take into account capital consumption that goes beyond the effective consumption possibilities of a nation every single year. Normalization criterion remains the same as for the original GDP component of the HDI.

ii) *Education*. Considering the high level of education for all countries considered, the only parameter that has been taken into account has been the tertiary gross enrolment ratio following HDI methodology. To explain our use of the tertiary gross enrolment ratio, it should also be remembered, as theorized by Amartya Sen, that individual capabilities differ at different times and in different places. Therefore, if in an underdeveloped country, it is important to read and to write in order to exercise one's freedom, in a richer country we have to consider reaching a high level of education as an essential component of the exercise of freedom.[14] Normalization criterion

[14] "[…] freedom depends on a person's ability to read and write. An illiterate person, for example, is not free to read newspapers and exchange ideas in written form. As thought is influenced by the ability to read and write, being illiterate conditions freedom of thought. Illiteracy is, therefore, lack of freedom". As illiteracy is not a common phenomenon in developed countries, it is clearly necessary to consider the standards in different countries. In a wealthy country where people suffer fewer privations, the tendency will be to use a different yardstick to assess whether or not a person has been deprived of freedom. Different layers of freedom

remains the same as for the original gross enrolment ratio of the HDI.

iii) *Social stability*. Here, the unemployment rate seems to give a more realistic representation of the social human condition index than life expectancy at birth since sanitary and health services within 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 go beyond income. Work allows them to make a productive contribution to society and to exercise their skills and creativity. It brings strong recognition that fosters self-respect and dignity. It gives them the opportunity to participate in the collective effort and interact socially (HDR, 1996). Finally, a high level of unemployment also means an increase in inequality between people that earn an income and those that do not. Minimum and maximum values for normalization process were the same for education, i.e. 0 and 100 percent rate.

iv) *Quality of natural environment*. This is the most innovative and difficult component considering that data availability is lower than other factors and the normalization criteria could be interpretable. In this paper some widely accepted environmental concerns have been considered: acidifying pollutants (NO_X, SH_2, NH_3) and ozone precursors (NMVOC, CO) summarized as Air pollution (total amount of emissions as tonnes per day per worker); organic water pollutant (BOD) emissions (kg per day per worker); and soil pollution as the total amount of fertilizers, herbicides and insecticides used on arable land (kg per hectare). Normalization criteria have been chosen taking minimum and maximum values into account and considering a variation range which could be feasible for the whole time period (1990-2000) analysed.[15]

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can in fact also be identified with regard to education. At more sophisticated levels, for example, an individual may wish to obtain an academic qualification and justly consider himself deprived of a freedom if this should be denied to him (Sen, 1999).

[15] For calculation purposes, as suggested in the technical notes of HDR 2003, when there is a single country with an absolute level consistently higher than other countries, the maximum value is substituted for the real value. In HDR 2003 such an accounting rule has been adopted for Luxembourg GDP level, higher than log(40.000), and assumed equal to the maximum level. The same rule has been adopted for this work, considering respectively air pollution emissions for Iceland

Finally, in the same way as for the HDI, the composite SHDI has been calculated as the simple average of the four development components: real access to resources, education, social stability and environmental quality.[16]

5. A Sustainable Human Development Index for European Countries

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

The second analysis has been based on historical trends of the indices to verify effective development path of 37 European countries and explain similarities within four country groups, Accession countries, European Union (15 members), other OECD European countries, and Transition economies. If we consider the SHDI data, there are many policy considerations about divergences among the four groups and convergences inside each group which allow some important issues to be underlined within a sustainable human development approach.

5.1 General assessment of SHDI methodology

A general assessment of the performance of a composite index in explaining more than consolidate methodologies, such as GDP or HDI, represents the very first step before proceeding with an analysis

equal to 30 tonnes, and soil pollution emissions for Spain equal to 6000 kg per hectare.

[16] The general formulation of SHDI calculated for European countries is described in Appendix II. All data used for the empirical analysis are from the Human Development Reports of UNDP (various years), the World Development Indicators data-book of the World Bank (last version 2003), the environmental dataset provided by the European Environmental Agency together with Eurostat, and the World Resource Institute online portal.

of policy actions at country level.

The three indexes, GDP, HDI, and SHDI have been compared in two reference periods, 1990 as the starting point and 2000 as the final date of analysis. For each year, every index has been used to obtain a separate ranking among the 37 available countries. Furthermore, an alternative ranking methodology has been tested using the so-called Borda rule.17 In order to evaluate if 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. The correlation matrix for different ranks was based on the Spearman correlation index (Tab. 1) while correlation matrix for absolute values adopted the Pearson correlation index (Tab. 2).

By analysing results, it appears that the HDI is highly correlated with the GDP index both for ranks and absolute values (0.938 and 0.960 for 1990 respectively), whereas the SHDI corresponds to a correlation level with GDP relatively lower than the HDI (0.427 and 0.473 for 1990 respectively). 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 ignored in the other two indexes. The alternative aggregation (Borda) rule, calculated for the HDI and SHDI, has not given very different results from the simple average adopted in the HDI methodology. The correlation between simple HDI and SHDI with GDP is quite similar to the correlation obtained using the correspondent Borda index, HDI-B and SHDI-B.

Furthermore, from an analysis of correlation between SHDI and each single component (EDU-S education for SHDI, SOC Social stability, GNNP access to resources, and ENV environmental quality),

[17] 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.

the SHDI seems to be highly dependent on the education factor, and secondly on the environmental index. Analysing the 2000 results, correlation with a single factor seems to change in favour of the access to resource factor meaning that the green NNP represents a major role in the SHDI value. This result confirms that a sustainable human development process is highly dependent on capital formation, investments in human capital and conservation of natural resources. In any case, the correlation values with each single component for the SHDI are lower than correlation between the HDI and its own factors, reinforcing the robustness of the methodological framework.

Table 1 - Correlation matrix, ranks 1990 and 2000

1990	HDI	SHDI	GDP	HDI-B	SHDI-B	EDU-S	SOC	GNNP
SHDI	0.528	-	-	-	-	-	-	-
GDP	0.938	0.427	-	-	-	-	-	-
HDI-B	0.986	0.540	0.923	-	-	-	-	-
SHDI-B	0.487	0.858	0.423	0.514	-	-	-	-
EDU-S	0.505	0.728	0.375	0.572	0.612	-	-	-
SOC	-0.019	0.233	-0.004	-0.020	0.548	-0.040	-	-
GNNP	0.928	0.387	0.986	0.901	0.374	0.309	-0.052	-
ENV	-0.466	0.173	-0.517	-0.476	0.212	-0.214	0.130	-0.507
2000								
SHDI	0.756	-	-	-	-	-	-	-
GDP	0.936	0.689	-	-	-	-	-	-
HDI-B	0.970	0.830	0.885	-	-	-	-	-
SHDI-B	0.835	0.909	0.813	0.856	-	-	-	-
EDU-S	0.484	0.760	0.349	0.630	0.584	-	-	-
SOC	0.674	0.472	0.742	0.587	0.693	0.127	-	-
GNNP	0.946	0.668	0.985	0.894	0.806	0.313	0.745	-
ENV	-0.123	0.189	-0.132	-0.105	0.197	-0.061	-0.238	-0.147

Finally, the correlation between the single components of HDI and SHDI respectively (calculated for 2000) reveals that in the first case the three indices (income, life expectancy and education) present high correlation values especially between income and the other two factors. The results for the SHDI are consistently different and the income index (green NNP) is correlated with the education and social stability indexes at lower levels than the HDI. Furthermore, the GNNP factor has a very low correlation with the environmental index

meaning that the two "sustainability" variables are not redundant.

Table 2 - Correlation matrix, values 1990 and 2000

1990	HDI	SHDI	GDP	HDI-B	SHDI-B	EDU-S	SOC	GNNP
SHDI	0.556		-	-	-	-	-	-
GDP	0.960	0.473	-	-	-	-	-	-
HDI-B	-0.958	-0.512	-0.919	-	-	-	-	-
SHDI-B	-0.551	-0.827	-0.480	0.527	-	-	-	-
EDU-S	0.491	0.712	0.368	-0.543	-0.594	-	-	-
SOC	0.042	0.334	0.071	-0.025	-0.583	0.060	-	-
GNNP	0.909	0.395	0.964	-0.864	-0.390	0.223	0.021	-
ENV	-0.315	0.465	-0.384	0.389	-0.217	-0.009	0.074	-0.382
2000								
SHDI	0.800	-	-	-	-	-	-	-
GDP	0.979	0.764	-	-	-	-	-	-
HDI-B	-0.953	-0.819	-0.903	-	-	-	-	-
SHDI-B	-0.862	-0.902	-0.850	0.868	-	-	-	-
EDU-S	0.503	0.774	0.413	-0.638	-0.598	-	-	-
SOC	0.505	0.536	0.550	-0.518	-0.636	0.251	-	-
GNNP	0.970	0.718	0.986	-0.889	-0.811	0.341	0.539	-
ENV	-0.058	0.318	-0.066	0.121	-0.158	0.015	-0.203	-0.090

In order to complete the evaluation from a methodological perspective, we have analyzed the historical trends of the HDI and the SHDI and their own components for three different country groups (Fig. 1 and Fig. 2): Accession countries (Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, the Slovak Republic, and Slovenia), the European Union (15 original countries), and Transition economies (Albania, Bulgaria, Croatia, Macedonia, Moldova, Romania, the Russian Federation and the Ukraine). For each group, the average value of the composite index was compared with the average values of each component (respectively, income INC, life expectancy HEA, and education EDU for HDI, and GNNP, EDU-S, SOC and ENV for SHDI). The three factors affecting HDI have similarities within all the three country groups where education represents the component with the highest absolute values, and life expectancy at birth and income indexes have the same values and trends (Fig. 1).

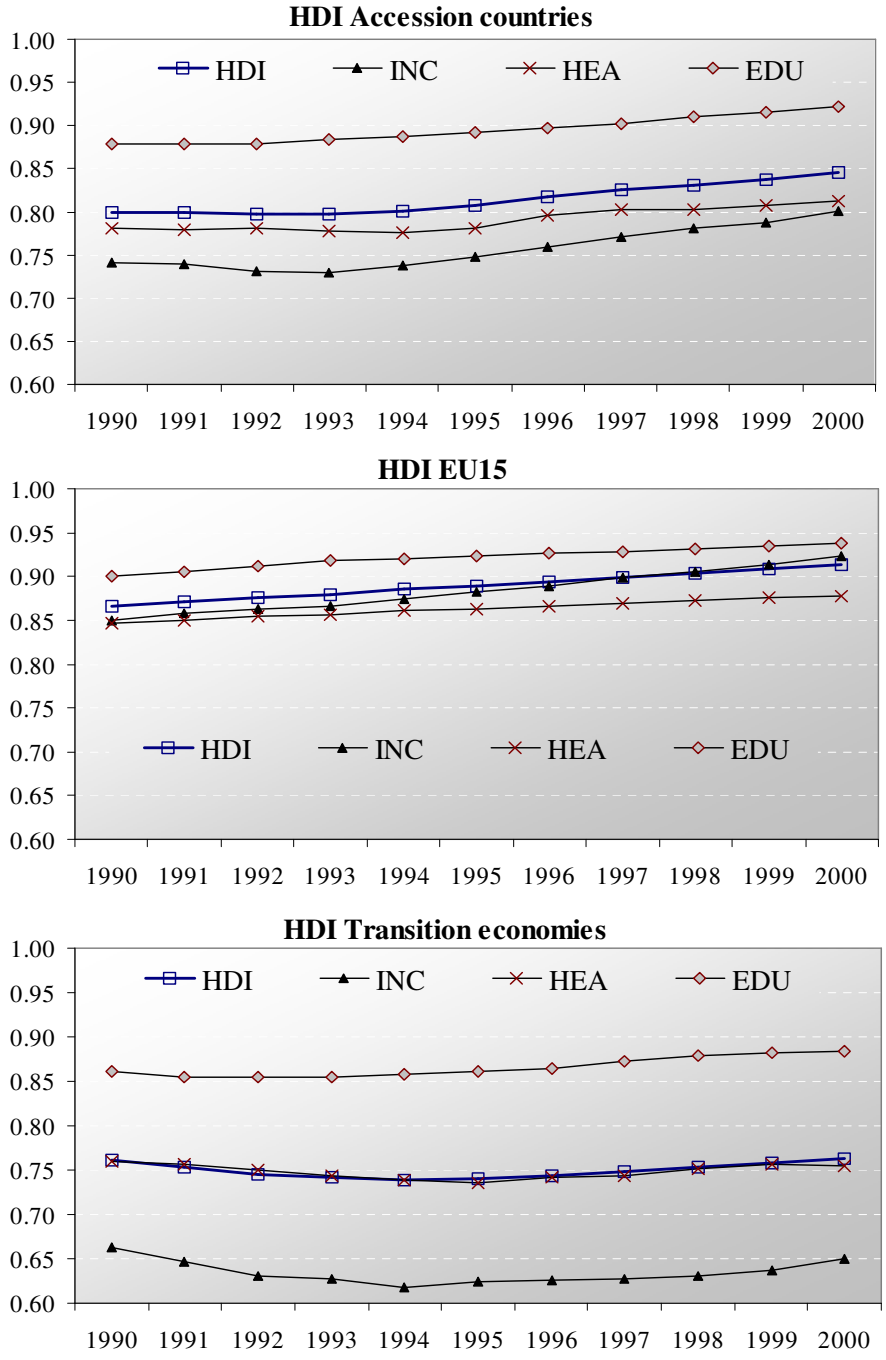

Figure 1 - HDI components, trend 1990-2000 for country groups

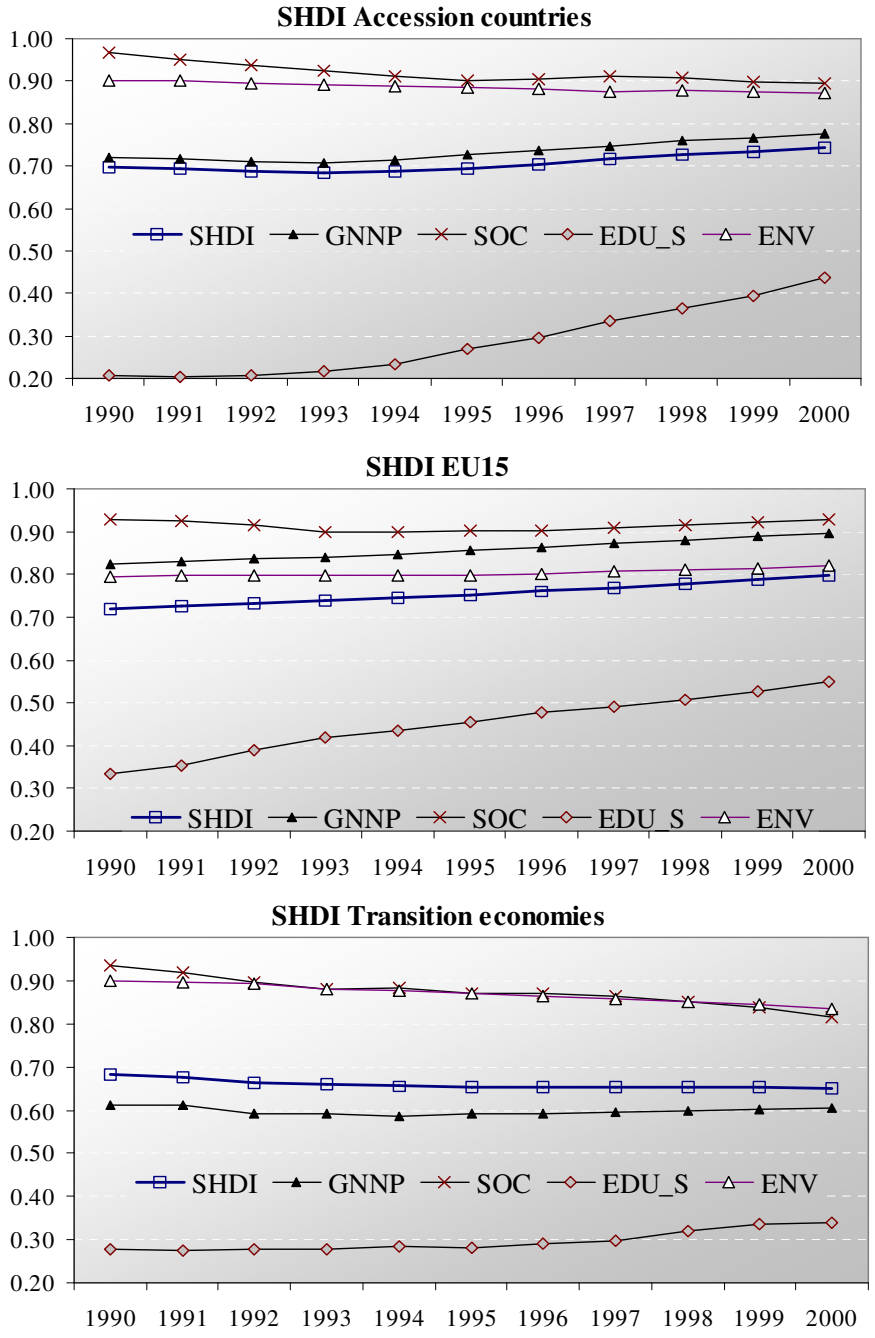

Figure 2 - SHDI components, trend 1990-2000 for country groups

The HEA index seems particularly redundant compared with HDI trends for all the groups considering that absolute values of life expectancy at birth are very similar for all analyzed countries with a small variation in range (from 66 years to 80 in 2000). Trends and values of the three factors only affect the HDI performance differently in Transition economies, explaining more than the simple GDP. On the contrary, values of HDI and single factors seem to have exactly the same level and trends in the European Union.

If we consider the SHDI values, country groups have specific peculiarities and the factors affect the SHDI values and trends in a very different way (Fig. 2). 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 SHDI 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, on the contrary, the only index which has a higher growth rate than the others is the tertiary gross enrolment ratio.

Other considerations on the SHDI as an alternative methodology to the HDI regard the composition and meaning of the green NNP as the specific sustainability criterion adopted in this context. From a sustainability perspective, the fact that the green NNP 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 optimal and sustainable in the long run because it depends on how many natural resources have been depleted (Tab. 3).

If we consider single environmental factors affecting the green NNP values, it is clear that some countries are performing in a sustainable direction such as Poland and Romania, where both energy depletion and CO_2 damage seem to be consistently lower in 2000. On the contrary, many EU countries (France, Germany, Italy, the Netherlands and the United Kingdom), Norway, Turkey and the Russian Federation are depleting a lot of energy resources and producing higher CO_2 emissions. This means that even if the green NNP is increasing during the period, as for all quoted countries excluding the Russian Federation, this result mainly depends on income growth but natural resources depletion continues to be consistent.

Table 3 - Green NNP components, 1990 and 2000 (cur. mil. $PPP)

	Country	Energy Depletion		Mineral Depletion		Forest Depletion		CO2 Damage	
		1990	2000	1990	2000	1990	2000	1990	2000
Acc	Cyprus	-	-	-	-	-	-	28	60
	Czech R.	213	280	-	-	-	-	2338	1899
	Estonia	303	68	-	-	-	-	406	379
	Hungary	1074	837	90	-	-	-	806	970
	Latvia	0	0	-	-	-	-	229	196
	Lithuania	27	150	-	-	-	-	321	336
	Malta	-	-	-	-	-	-	10	42
	Poland	9031	1903	2150	381	-	-	6450	3431
	Slovak R.	47	61	-	-	-	-	901	975
	Slovenia	32	33	-	-	-	-	41	218
EU15	Austria	141	221	-	-	-	-	282	419
	Belgium	-	-	-	-	-	-	362	727
	Denmark	296	1227	-	-	-	-	197	329
	Finland	-	-	85	-	-	-	170	422
	France	-	-	-	-	-	-	1011	3218
	Germany	2853	2133	-	-	1427	-	2853	6678
	Greece	343	178	114	178	-	-	458	918
	Ireland	40	-	120	99	-	-	120	406
	Italy	984	1427	-	-	-	-	1969	3473
	Luxemb.	0	0	-	-	-	-	42	63
	Netherl.	1057	2177	-	-	-	-	528	1373
	Portugal	-	-	105	130	-	-	316	653
	Spain	498	-	-	-	-	-	995	2517
	Sweden	-	432	432	216	-	-	144	300
	Un. K.	7522	19012	-	-	-	-	2821	3674
OECD	Iceland	-	-	-	-	-	-	10	17
	Norway	4122	12967	88	-	-	-	88	133
	Switzer.	-	-	-	-	-	-	165	232
	Turkey	1208	1698	242	402	-	-	1208	3069
Trans	Albania	610	182	134	10	75	-	142	35
	Bulgaria	334	149	239	298	-	-	907	1305
	Croatia	488	513	-	-	-	-	175	304
	Maced.	-	-	-	-	-	-	259	322
	Moldova	-	-	-	-	-	-	221	282
	Romania	5953	5344	372	127	-	-	2357	1910
	Rus. Fed.	266624	409698	3190	4107	-	-	29625	51129
	Ukraine	23897	20317	-	-	-	-	10657	17556

In order to complete the general analysis on SHDI methodology, a comparison between standard deviation of the three indices (GDP, HDI, SHDI) and standard deviation of single factors affecting SHDI seems useful to underline which factors appear more differentiated on average (Fig. 3).

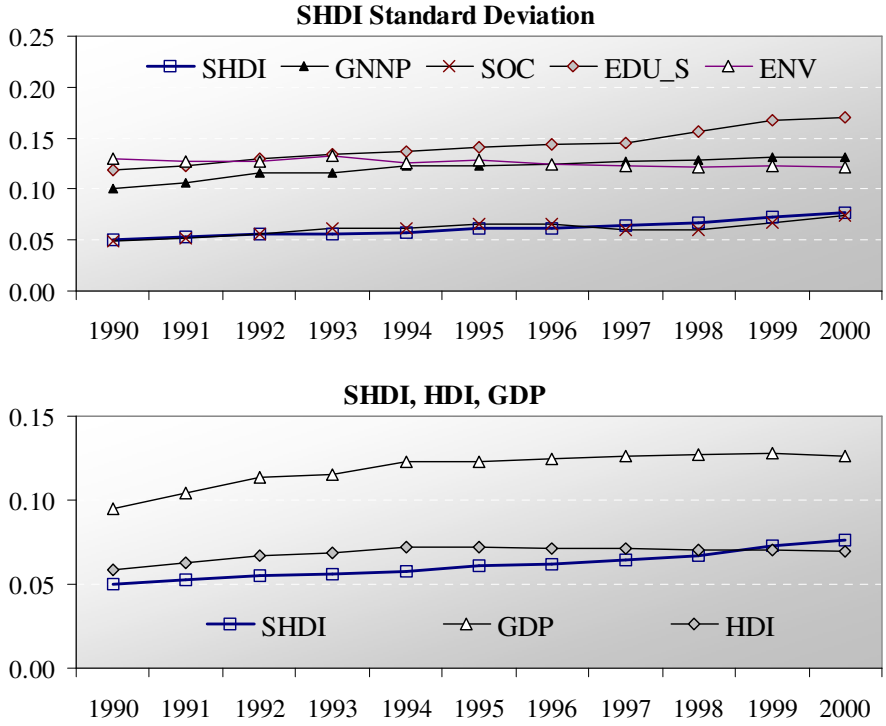

Figure 3 – Standard Deviation, trend 1990-2000

Values of standard deviation calculated for GDP and HDI indices show quite similar movements for the whole period with a constant trend in recent years. On the contrary, SHDI reveals increasing values of standard deviation especially in the last period. If we look at standard deviation calculated for each single factor, the education and social stability indices seem to have major effects on this trend and increase more than the others. Such results suggest that by introducing alternative components to the original HDI it will be possible to identify some differences within a regional area that otherwise appears quite homogeneous as described in the following section.

5.2 An empirical analysis of SHDI for European countries

A descriptive analysis of divergences from HDI ranking and SHDI could give an initial general assessment of SHDI meaning compared with a traditional human development approach, and with 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 notice some similar features within each group.

When analysing data, we pointed out that SHDI reveal more information about disparities among European countries than GDP and HDI. This is due to the fact that, as explained in the previous methodological paragraph, the GDP, child mortality and the primary education rate - the components of the United Nations Index - are fairly similar in different European countries. In contrast, unemployment and the environmental index, two relevant SHDI components, are very dissimilar in those countries.

If we consider Accession countries for instance, 2000 rank values seem to give better results in terms of sustainable development than the traditional GDP or HDI indices. Only three out of ten Accession countries have a worse rank with SHDI in 2000 while in most of the cases SHDI performance is better than for Transition economies and in some cases better than EU 15 and other OECD (Luxembourg, Spain and Iceland). Generally speaking, an improvement in sustainable human development is consistent with a better human development level (in rank values), apart from Cyprus and Slovak Republic where the HDI decreases and the SHDI increases (Tab. 4).

More specifically, the Scandinavian countries show excellent performance in the SHDIs. In fact, Finland, Sweden and Norway occupy first, second and fourth places respectively in the ranking while the third is occupied by Belgium. This outcome is explained mainly by the result of the Education component which in the three Scandinavian countries is higher than in the other countries by up to 0.7 points with Finland occupying first place with a coefficient of 0.796. Sweden and Norway (0.700) are second in the ranking with one point less than Finland. It is very interesting to note that both Sweden and Finland stand in a substantially lower position in the GDP ranking comparing with the SHDI and HDI.

Table 4 - Compared ranks for different indices, 1990 and 2000

Rank	Countries	SHDI value 2000	Δ rank GDP 2000	Δ rank HDI 2000	Δ rank SHDI 1990
1	Finland	*0.849*	11	5	0
2	Sweden	*0.847*	13	1	7
3	Belgium	*0.833*	6	4	0
4	Norway	*0.823*	-2	-3	8
5	Austria	*0.818*	2	0	1
6	Denmark	*0.817*	-2	5	7
7	Germany	*0.815*	3	6	-2
8	United Kingdom	*0.815*	6	7	9
9	Switzerland	*0.805*	-3	-5	-5
10	Slovenia	*0.804*	11	8	11
11	Netherlands	*0.804*	-3	-2	4
12	Italy	*0.799*	1	0	-4
13	Ireland	*0.794*	-10	1	15
14	Greece	*0.793*	6	3	-4
15	Estonia	*0.790*	10	11	-4
16	France	*0.788*	-5	-8	-2
17	Portugal	*0.787*	1	4	5
18	Poland	*0.754*	8	5	12
19	Russian Fed.	*0.751*	11	13	-17
20	Hungary	*0.750*	3	4	7
21	Lithuania	*0.743*	7	6	-14
22	Malta	*0.738*	-5	-2	4
23	Latvia	*0.736*	6	6	-4
24	Cyprus	*0.722*	-5	-5	1
25	Spain	*0.721*	-9	-9	8
26	Czech Republic	*0.718*	-4	-4	-3
27	Luxembourg	*0.695*	-26	-17	5
28	Slovak Republic	*0.687*	-4	-3	1
29	Croatia	*0.682*	-2	-1	-5
30	Romania	*0.672*	4	3	1
31	Iceland	*0.669*	-26	-29	5
32	Ukraine	*0.661*	3	2	-16
33	Bulgaria	*0.661*	-1	-2	-15
34	Turkey	*0.607*	-1	2	3
35	Macedonia	*0.596*	-4	-5	-1
36	Albania	*0.593*	0	-1	-1
37	Moldova	*0.577*	0	0	-17

This evidence proves yet again that human development does not necessarily mean economic growth. In the same way, Slovenia (+11) and the United Kingdom (+6) show good performance in the SHDI with respect to their GDP ranking. This result depends mainly on the social component of the SHDI (unemployment).

Finland occupied first place in the 1990 ranking and still occupies the same place in the 2000 ranking. In contrast, the Russian Federation, second in the 1990 ranking, drops to 19th place in today's ranking. This is due to the economic recession experienced by transition economies during the 90's which caused a great drop in employment and a worsening of environment conditions, as revealed by our SHDI. The other former communist countries such as Lithuania (-14), Ukraine (-16), Moldova (-17), and Bulgaria (-15), have the same performance as Russia. At the same time, the Czech Republic (-4) and in particular, Poland and Hungary performed better, registering +8 and +3 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 that are involving transition economies (Tab. 5 and Tab. 6).

If we consider the European Union, countries such as Spain (-9) and France (-5) are penalized by a worsening of the environmental component and an increase in unemployment. In particular, Spain is the last in the environmental ranking due to high intensity of fertilizers and pesticides. Ireland, the Celtic tiger, loses 10 places in the SHDI ranking compared with the GDP, mainly due to a lower educational level. However, the SHDI performance of Ireland in the last 10 years increased by 15 places due to an improvement in GNNP growth and good employment performance.

Germany and the United Kingdom (0.815), or the Netherlands (0.804) and Italy (0.799), which occupy the same position in the SDHI ranking, show very different performance within the single components. Whereas German SHDI value is explained by a very high environmental and employment component and low education and GNNP component, the UK has a very high employment component but a low environmental level. The same phenomenon is

shown by a comparison between Italy and the Netherlands: the former has good performance in the environmental component and the latter has a very low unemployment rate. With regard to Italy and Germany, it is very important to underline that they have high performance in the environmental component.[18]

Moldova, Albania and Macedonia represent the worse performances in SHDI with values below 0.6. This is due to a low coefficient in all the components (education, GNNP, unemployment, environment). Finally, we would like to underline that the seemingly bad performances of Iceland and Luxembourg are not significant because of the small dimensions of the countries and their low population.

[18] Environmental data for some non-EU countries are very incomplete and the only factor affecting the environmental index is the consumption of fertilizers and pesticides, producing a biased high environmental performance.

Table 5 – SHDI components, 1990

	Countries	*SHDI*	EDU_S	SOC	GNNP	ENV
Acc	Cyprus	*0.686*	0.128	0.982	0.753	0.882
	Czech Rep.	*0.694*	0.160	0.993	0.737	0.887
	Estonia	*0.733*	0.260	0.994	0.692	0.987
	Hungary	*0.685*	0.140	0.983	0.720	0.896
	Latvia	*0.701*	0.250	0.977	0.726	0.849
	Lithuania	*0.741*	0.338	0.962	0.739	0.923
	Malta	*0.686*	0.130	0.961	0.749	0.904
	Poland	*0.672*	0.217	0.935	0.639	0.896
	Slovak Rep.	*0.683*	0.186	0.917	0.728	0.899
	Slovenia	*0.698*	0.245	0.953	0.712	0.884
EU15	Austria	*0.743*	0.352	0.968	0.843	0.808
	Belgium	*0.762*	0.402	0.928	0.843	0.874
	Denmark	*0.730*	0.365	0.917	0.847	0.790
	Finland	*0.776*	0.489	0.968	0.823	0.824
	France	*0.729*	0.397	0.908	0.842	0.769
	Germany	*0.756*	0.339	0.935	0.840	0.909
	Greece	*0.735*	0.361	0.930	0.772	0.875
	Ireland	*0.683*	0.293	0.870	0.771	0.799
	Italy	*0.737*	0.321	0.886	0.836	0.906
	Luxembourg	*0.640*	0.055	0.984	0.913	0.608
	Netherlands	*0.729*	0.398	0.926	0.835	0.756
	Portugal	*0.694*	0.232	0.953	0.753	0.840
	Spain	*0.640*	0.367	0.840	0.787	0.565
	Sweden	*0.736*	0.320	0.982	0.827	0.816
	United K.	*0.710*	0.302	0.932	0.826	0.781
OECD	Iceland	*0.595*	0.249	0.982	0.853	0.296
	Norway	*0.730*	0.423	0.949	0.847	0.700
	Switzerland	*0.759*	0.257	0.995	0.887	0.898
	Turkey	*0.571*	0.131	0.920	0.616	0.618
Trans	Albania	*0.598*	0.069	0.905	0.504	0.913
	Bulgaria	*0.704*	0.311	0.983	0.645	0.878
	Croatia	*0.692*	0.239	0.918	0.708	0.904
	Macedonia	*0.619*	0.168	0.764	0.651	0.893
	Moldova	*0.700*	0.355	0.993	0.550	0.903
	Romania	*0.645*	0.097	0.936	0.634	0.914
	Russian Fed.	*0.773*	0.521	0.981	0.667	0.925
	Ukraine	*0.717*	0.467	0.996	0.536	0.869

Table 6 – SHDI components, 2000

	Countries	***SHDI***	**EDU_S**	**SOC**	**GNNP**	**ENV**
Acc	Cyprus	*0.722*	0.220	0.963	0.838	0.866
	Czech Rep.	*0.718*	0.298	0.912	0.797	0.867
	Estonia	*0.790*	0.576	0.852	0.735	0.996
	Hungary	*0.750*	0.400	0.935	0.773	0.893
	Latvia	*0.736*	0.631	0.916	0.704	0.694
	Lithuania	*0.743*	0.525	0.845	0.722	0.881
	Malta	*0.738*	0.258	0.947	0.846	0.902
	Poland	*0.754*	0.555	0.833	0.743	0.885
	Slovak Rep.	*0.687*	0.303	0.811	0.766	0.867
	Slovenia	*0.804*	0.606	0.925	0.831	0.855
EU15	Austria	*0.818*	0.577	0.944	0.909	0.841
	Belgium	*0.833*	0.610	0.930	0.908	0.882
	Denmark	*0.817*	0.589	0.946	0.915	0.818
	Finland	*0.849*	0.796	0.902	0.890	0.806
	France	*0.788*	0.536	0.900	0.902	0.815
	Germany	*0.815*	0.533	0.919	0.900	0.909
	Greece	*0.793*	0.577	0.887	0.839	0.870
	Ireland	*0.794*	0.475	0.953	0.906	0.840
	Italy	*0.799*	0.499	0.892	0.895	0.910
	Luxembourg	*0.695*	0.093	0.976	1.000	0.711
	Netherlands	*0.804*	0.550	0.957	0.909	0.800
	Portugal	*0.787*	0.502	0.962	0.830	0.853
	Spain	*0.721*	0.594	0.859	0.859	0.573
	Sweden	*0.847*	0.700	0.949	0.891	0.847
	United K.	*0.815*	0.595	0.947	0.898	0.819
OECD	Iceland	*0.669*	0.487	0.965	0.916	0.307
	Norway	*0.823*	0.700	0.966	0.930	0.695
	Switzerland	*0.805*	0.421	0.973	0.931	0.896
	Turkey	*0.607*	0.217	0.917	0.678	0.615
Trans	Albania	*0.593*	0.151	0.816	0.603	0.801
	Bulgaria	*0.661*	0.408	0.812	0.662	0.760
	Croatia	*0.682*	0.320	0.794	0.728	0.886
	Macedonia	*0.596*	0.245	0.579	0.675	0.884
	Moldova	*0.577*	0.279	0.886	0.415	0.726
	Romania	*0.672*	0.273	0.892	0.646	0.877
	Russian Fed.	*0.751*	0.641	0.886	0.579	0.899
	Ukraine	*0.661*	0.408	0.849	0.538	0.851

6. 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 Human Development Index methodology called the Sustainable Human Development Index.

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

First, the nature of SHDI as a composite index represents a limit itself and loses important information as described above in this work.

Secondly, the data used in the SHDI only partially represents a capability approach due to lack of available information. For instance, the environmental index explains only few aspects, which affect individual functioning. A wider assessment of damage to resources due to polluting emissions is a very difficult task that goes beyond the scope of our work.

Thirdly, policy considerations on the influence of public expenditures on environmental protection or social stability have not been carried out due to lack of information. Such analysis, developed by scholars for health and education, could be a further research task to underline policy efficacy in order to achieve environmental and social goals.

Nonetheless, some interesting results emerged from the empirical analysis. On the methodology side, introducing the environmental factor and the Green NNP 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, an enlarged 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 Scandinavian countries. In a highly industrialized area, this index

helped to represent individual freedom with more efficacy than 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, that consumes large portion of exhaustible resources (mainly oil and natural gas), remains in the highest part of SHDI ranking due to investment in education, suggesting a development approach geared towards long-term sustainability. On the contrary, transition economies such as Russian Federation have high resource consumption and a relatively low increase in human capital, loosing positions in the ranking during the analyzed decade.

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 (this could be the case for minerals, fossil fuels and forests, i.e. Russian Federation).

From a sustainability point of view, it may be helpful to identify how many resources original EU 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 EU to accession countries to reach the same well-being without depleting too much. It has to be reminded that some of the major security concerns for EU regard 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”.

The achievement of an adequate sustainability level with a positive capital accumulation is a very difficult task in the first stages of industrialization process. The satisfaction of basic human needs is a

necessary condition for such an objective; consideration of environmental protection is a secondary (or luxury) good.

At the same time capital accumulation is a means to reaching and maintaining higher welfare levels. While Transition economies must promote environmental protection as soon as possible, European Union could help this process through a coordinated know-how and technological transfer to avoid the great degradation and depletion of natural resources.

Achieving a higher standard of living and maintaining natural capital could be complementary rather than competing objectives, mutually reinforcing an upward spiral of development.

Limits and results of this work represent an incentive to further research to implement an enlarged development concept, improving both theoretical and measurement frameworks.

Appendix I: Methodological issues for Human Development Index

The methodology for building HDI has changed over the years in response to criticism from many scholars. Some components have remained the same as the 1990 report while others have changed substantially including the income factor. Furthermore, general issues such as normalization criteria have been modified for theoretical and empirical reasons.

i) The dimension of longevity is directly measured by life expectancy. "The importance of life expectancy lies in the common belief that a long life is valuable in itself and in the fact that various indirect benefits are closely associated with higher life expectancy" (UNDP, 1990, pp. 10).

ii) The dimension of education was measured by a weighted sum of adult literacy rate plus the mean years of schooling between 1990 and 1994. That was:

$$E = a_1 \text{ Literacy} + a_2 \text{ Mean years of schooling}$$

The selected weights were: $a_1 = 2/3$ and $a_2 = 1/3$.

In 1995 the mean years of schooling was replaced by the combined first, second and third level gross enrolment ratio.[19] However, the weight of this new variable in constructing educational attainment was the same as the one used for the dropped variable.

iii) The dimension of command over resource was originally represented by the real per capita income, at Purchasing Power Parity (PPP$), of countries adjusted with reference to the average of poverty-line income in several developed countries (y^*).[20]

In the 1990 report, income above y^* did not contribute to the HDI since a cap on the poverty line was introduced for countries with

[19] Gross enrolment ratio has been defined as "enrolment in a specific level of education, regardless of age, expressed as a percentage of the official school-age population corresponding to the same level of education in a given school-year" (UNESCO, Education and Literacy Indicators, 2001).

[20] "The third component of human development, the dimension of command over resource needed for a decent living, is perhaps the most difficult to measure simply. It requires data on access to land credit income and other resources. But given the scarce data on many of these variables, we must for the time being make the best use of an income indicator" Anand and Sen (2000b).

income that was higher than y^*. From the 1991 report, income above y^* was considered to have some effects for people's wider choice. This was reflected by using the Atkinson formulation for the utility of income $W(y)$:

$$W(y) = \frac{1}{1-\varepsilon} \times y^{1-\varepsilon} \qquad [1]$$

Parameter ε measures the extent of diminishing returns and reflects the deviation of the elasticity of the income utility from unity.

In this formulation, for $\varepsilon = 0$ the full income value is taken, while for $\varepsilon \rightarrow 1$ $W(y)$ becomes log$y$. The higher income is in respect to y^*, and the more rapidly income utility decreases (UNDP, 1991).
These assumptions can be formalized as:

$\varepsilon = 0$ for $y \leq y^*$ $W(y) = y$
$\varepsilon = 1/2$ for $y^* \leq y \leq 2y^*$ $W(y) = y^* + 2(y\text{-}y^*)^{½}$
$\varepsilon = a/(a+1)$ for $ay^* \leq y \leq (a+1)y^*$ $W(y) = y^* + a(y^*)^{1/a} + (a+1)\ (y - ay^*)^{1/(a+1)}$
$\varepsilon \rightarrow 1$ $W(y) = \log y$

Since the 1994 report this threshold value was replaced by the current average global value of real GDP per capita in PPP$.[21] Finally, in the 2000 report a "GDP index" was adopted without any evaluation of distances from the poverty line and considering income as a generic access to resources with a decreasing value in terms of utility. The

[21] In the 1990 report income above y^* with no contribution to the HDI as a cap at the poverty line was introduced for countries with income higher than y^*. Income for countries above the poverty line was therefore reduced to the poverty line income. Moreover, the logarithm of income was used for calculating the HDI. The combination of introducing a cap and taking the logarithm of income was to reflect, rather sharply, the diminishing marginal contribution of income to human development (Human Development Report 1991). In practice, this resulted in the HDI having three components for those countries with income equal or below y^* while it had only two components (plus a constant) for countries with an income component for the latter group of countries that remained the same. Subsequent reports accepted that income above y^* will have some effects on the HDI. This modification was to take into consideration the wider "people's choice" rendered through higher income.

income index has been formally represented as:

$$\text{GDP index} = \frac{\log(x) - \log(100)}{\log(40.000) - \log(100)} \qquad [2]$$

where log(100) and log(40.000) represent respectively the minimum and maximum reference value, for normalization purpose.
For the calculation of the index, fixed minimum and maximum values have already been established for each of these indicators and each component can be computed according to the general normalization formula:[22]

$$\text{Component (i)} = \frac{\text{actual } X_i \text{ value} - \text{minimum } X_i \text{ value}}{\text{maximum } X_i \text{ value} - \text{minimum } X_i \text{ value}} \qquad [3]$$

The HDI overall index will be obtained from the average of these three components and the HDI will have a value between 0 and 1. From 1990 to 1993, the minimum value of each dimension - longevity, educational attainment and income – were set at the level of the poorest-performing country, and the maximum at that of the best-performing country. The HDI for any country was thus its position between the best and the worst countries but maximum and minimum values changed each year following the performance of the countries at the extreme end of the scale. This scaling could produce a frustrating outcome since a country might improve its performance on life expectancy or educational attainment but see its HDI score drop because the top or bottom countries had done even better: indeed, "a moving of the goal posts" (HDR 1994). This is shown in the values between 1990 and 1993. In 1994 the value was changed, so that, from that year onwards, the minimum adult literacy rate is 0%, the maximum is 100% and the literacy component of knowledge for a country where the literacy rate is 75% would be 0.75. Similarly, the minimum for life expectancy is 25 years and the maximum 85 years and finally, as far as income per capita is concerned, the minimum is $100(PPP) and the maximum is $40.000(PPP).

Since 1994, the HDI for country *i* was computed from the following formula:

[22] See technical note on UNDP (1997).

$$HDI_i = \frac{1}{3}\sum_{j=1}^{3}\left(\frac{X_{ij} - \min F_j}{\max F_j - \min F_j}\right) \qquad [4]$$

where X_{ij} is the actual value of component j for country i and min F_j and max F_j are the minimum and maximum values, fixed for the four constituent indicators. The UNDP argues that these fixed normative values have been selected as the extreme values observed or expected over a long period. Nonetheless, the HDI is sensitive to these values and choosing normative values for other dimensions might be a hard task.

Appendix II: Sustainable Human Development Index (SHDI) Components

Final formulation of SHDI adopted in this paper can be synthesized in the following general equation:

$$SHDI = \frac{1}{4}\left[\left(\frac{x_1 - 0}{100 - 0}\right) + \left(\frac{(100 - x_2) - 0}{100 - 0}\right) + \left(\frac{\log(x_3) - \log(100)}{\log(40.000) - \log(100)}\right) + \left(\frac{x_4 + x_5 + x_6}{3}\right)\right]$$

where

x_1 = Tertiary gross enrolment ratio, UNESCO definition

x_2 = Total unemployment rate

x_3 = Green NNP current $PPP per capita

$x_4 = 1 - \left(\frac{y_1 - 0}{0{,}03 - 0}\right)$ = Air pollution index (y_1 = tonnes per day per worker of NO_X, SH_2, NH_3, NMVOC, CO)

$x_5 = 1 - \left(\frac{y_2 - 0}{0{,}55 - 0}\right)$ = Water pollution index (y_2 = BOD emissions kg per day per worker)

$x_6 = 1 - \left(\frac{y_3 - 0}{6.000 - 0}\right)$ = Soil pollution from agriculture index (y_3 = fertilizers, herbicides and insecticides used on arable land, kg per hectare)

Empirical analysis using SHDI values must take into account the fact that some environmental variables and factors of the green NNP are only available for certain countries and not for all the considered period. In particular, y_3 was not considered at all in the calculation of the x_6 index for Luxembourg whereas herbicides do not affect soil pollution in Bulgaria, Iceland, and Moldova and insecticides were not considered for Iceland, Moldova. The environmental index for Estonia does not include the water pollution factor (x_5), and the Air Pollution index (x_4) was not available for Albania, Belgium, Croatia, Cyprus, Estonia, Germany, Greece, Hungary, Lithuania, Macedonia, Malta, Moldova, Slovak, Spain, Switzerland, and Turkey.

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