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Contents and Measures of Sustainable Progress: the Performance of Italy in a Selection of Synthetic Indices

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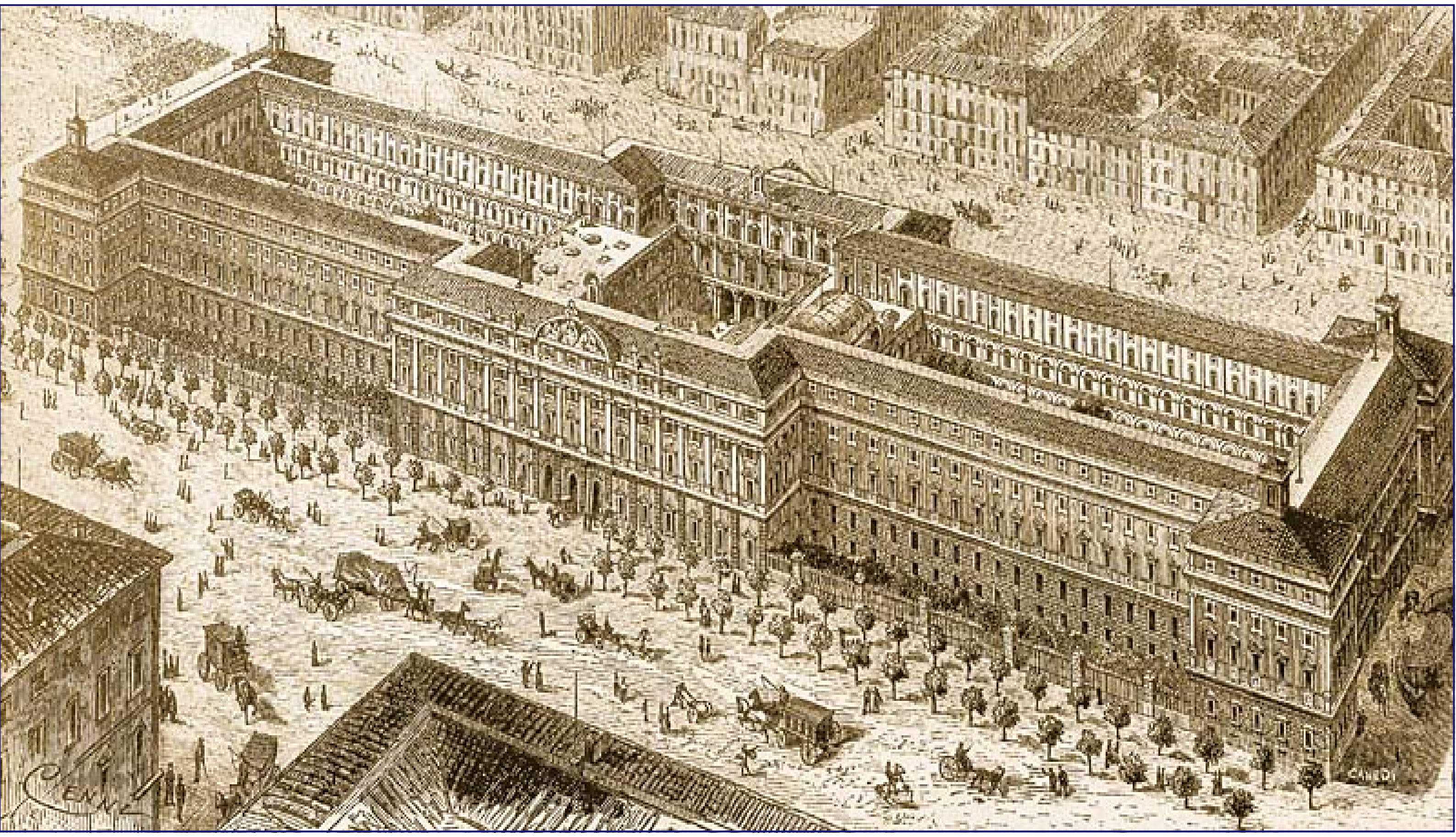

Working Papers

CONTENTS AND MEASURES OF SUSTAINABLE PROGRESS: THE PERFORMANCE OF ITALY IN A SELECTION OF SYNTHETIC INDICES

Priscilla Altili (*), Annalisa Cicerchia (**) e Pietro Zoppoli (***)

Abstract

Indicators are used in all steps of the policy cycle: to assess existing policies or to develop new strategies. They mark where a society stands, where it wants to go and how remote is it from where it wants to arrive. Indicators (and indices) are widely used tools to measure the progress of a nation, in its different aspects. The definition of a concept conditions strictly its measurement. Therefore, a definition the concept of progress will determine the appropriateness of the variables selected for its measurement. The first part of this paper explores why it is impossible, at the present time, to have a univocal definition and measurement of progress and, consequently, of sustainable development. The second part is devoted to the analysis of a set of synthetic indices – Human Development Index (HDI), Adjusted Net Saving (ANS), Environmental Sustainability Index (ESI) Ecological Footprint Index (EF) and Ecological Balance (EB) – that could offer a realistic frame for measuring the progress towards sustainability of nations, as well as a way of ranking their performances. In the third part of the study, based on the selected indices, a comparative analysis of a sample of countries is proposed, aimed at showing how the variables taken into account modify the countries performance in terms of measured progress and sustainability, and also comparing the resulting shifts in Italy's rank.

In brief, the main result of the paper is related to the Italian performance with respect to these indices. Italy shows shadows and light; in fact from the GDP point of view it ranks coherently with the other HIC nations. Italy, moreover, performs fairly in the indices focused on socio-economic results: HDI and ANS. When taking into consideration the natural resources consumption path (EF), the Italian performance is better than the HIC average. The Italian position worsens when other environmental-oriented indices are applied: EB and ESI. The environmental low rankings are linked with the biocapacity/natural assets of Italy, insufficient if compared with its natural resources consumption paths.

JEL Classification: O 1, Q 28, Q 56

Keywords: Sustainable Development; Adjusted Net Saving; Human Development Index; Environmental Sustainability Index; Ecological Footprint.

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1 INTRODUCTION

In the last decades, the relation between economic growth and the natural environment has been interpreted in many different ways. Simplifying, from the early fifties to the early seventies of the XX century, the environmental question was at first entirely neglected due to a general trust in industrialization, considered the panacea for all world evils, poverty above all. After the early Seventies, however, limits to growth have been perceived with increasing clarity and the not-so-latent conflict between the reasons of economic development and those of protection of the planet's equilibrium has been highlighted. A long period of multi-stakeholder elaboration of these issues, involving a number of multidisciplinary technical competences and political approaches and practices, supported and coordinated in the milieu of the United Nations, led, at the end of the eighties, to the notion of sustainable development: "*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). The concept of sustainable development has strategic, multidimensional and systemic aspects, with evident strong interrelations between the local and the global dimension. At the roots of sustainable development there is the assumption that:

1. a model of development that the planet can afford is theoretically and practically possible;
2. economic growth can be de-linked from the generation of unsustainable resource depleting and waste producing pressures. This process is named "decoupling".

Thus conceived, development becomes durable (and "*développement durable*" is the French rendering of sustainable development). Unsustainable development, on the contrary, is by definition only temporary, because it will be exhausted with the resources it is doomed to destroy without renewal or substitution. The adoption of sustainability as a global strategy, when in 1992 the Rio Declaration was signed by 179 countries, subsequently implemented by various supranational organizations, like the European Union (with its Strategy approved in May 2001), and the progressive involvement of many other actors – the NGOs, but also a growing number of enlightened private entrepreneurs – created a new demand for measurement, through synthetic indicators, the attainment of the sustainability goals. In other words, development is increasingly measured and assessed in terms of sustainability.

Measures of sustainable development and of progress towards it entails a accurate examination of the basic components of the concept and the construction of systemic relations between those components. We are going to show that the instruments applied until now refer to two basic typologies:

a. analytic and synthetic measures of the level of integration among economic, social and environmental components;

b. analytical-descriptive measures of the level of de-linking the process of economic growth from generation of unsustainable pressures on the environment.

The paper starts from the assumption that, at the present time, there is no univocal definition and measurement of progress and, consequently, of sustainable development. We analyze of a set of synthetic indices – Human Development Index (HDI), Adjusted Net Saving

(ANS), Environmental Sustainability Index (ESI). Ecological Footprint Index (EF) and Ecological Balance (EB) – that are likely to offer a realistic frame for measuring the progress towards sustainability of nations, ranking their performances.

In the third part of the study, based on the selected indices, a comparative analysis of Italy and other countries is proposed, aimed at showing how the variables taken into account modify their performance in terms of measured sustainability, with consequent shifts in Italy's rank.

2 THE NOTION OF SUSTAINABLE PROGRESS

Analytical and synthetic measures, like indicators and indices, are widely used tools to quantify the progress of a nation, in its different aspects. The definition of a concept conditions strictly its measurement. Therefore, the analytic contents of the progress concept will determine the appropriateness of the variables selected for its measurement.

The economic performance of a nation is generally measured through GDP, and that variable has become in practice the universal measure for progress. Nevertheless, considering the purpose of its construction, there is wide consensus on the fact that, while GDP does measure quite satisfactorily national income and output, it fails taking into proper account the social and environmental dimensions of progress. In his National income 1929-32[1] even Kutznets admits that «*the welfare of a nation can, therefore, scarcely be inferred from a measurement of a national income*».

In the 20th century, since the sixties many efforts have been aimed at developing appropriate indicators or indices for those aspects of progress which are not taken into account by GDP - e.g. well-being, living conditions, quality of life, happiness - with results that are still far from satisfactory. "*Several studies have been published over the last two decades on alternative measures of well-being/ quality of life/ sustainable development/ societal progress, all terms closely related to each other. Academic researchers, official statisticians and international organisations have proposed alternative measures, which can be classified according to different criteria. A consensus has not emerged yet on the best way to go*" (Giovannini, Hall, d'Ercole, 2007).

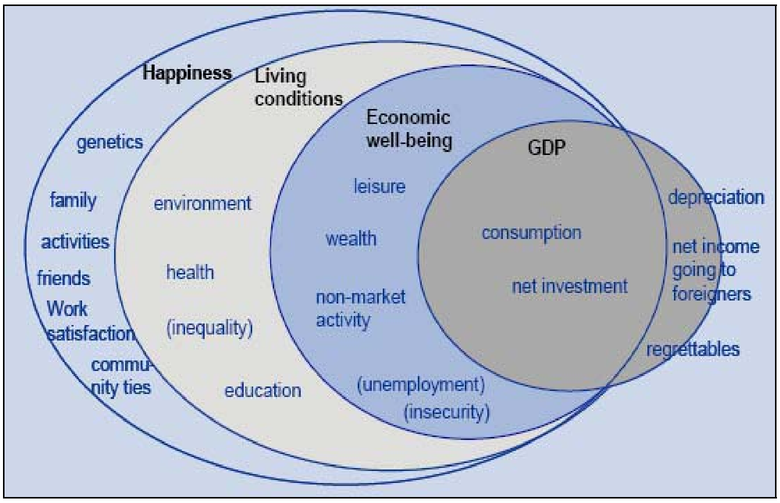
Taking up the scheme drawn up by Deutsche Bank Research (Figure 1) we find confirmation that "GDP is not an ideal yardstick for well-being" (Deutsche Bank Research, 2006).

Starting from the notorious Brundtland Report definition, the concept of sustainable development has acquired a plurality of interpretations. All the definitions have a common element, that is the analysis of some key factors, as the relationship between present and future generations, the environment subjective right to exist and the connection of economic growth, to social equity and environmental protection. Social equity, economic growth and environmental protection are considered the three pillars of sustainable development and the basis for its assessment. In the most recent interpretations of the idea of sustainability, the three elements form the so called triple bottom line (TBL): society depends on the economy and the economy, in turn, depends on the global ecosystem, which is the indispensible basis for the other two

[1] Kutznets S. (1934), "National Income, 1929-32", Letter from the Acting Secretary of Commerce transmitting in Response to Senate Resolution n.22. Report On National Income, US Government Printing Office, Washington, 4 January 1934, p. 7.

elements. The three components are not stable, but are in a sort of perpetual flow, because of the social, political, economic and environmental pressures, cycles and conflicts.

Fig. 1: Many different attempts to measure well-being



Source: Deutsche Bank Research, 2006.

The aim of quantifying sustainability is very ambitious and complex and can be achieved by including, in the methods of information collection and analysis (mainly indicators and revised forms of accounting), the three pillars, the inter-generational issues and the intra-generational relations among countries. Additional implications of the measurement of the three-component definition of sustainability are the need for inter-sectoriality, long term approach, the multiscaling, multiactor and multilevel nature of important processes, as well as the governance elements they imply.

3 INDICATORS OF SUSTAINABILITY

In very general terms, theories of sustainability split into two main groups: Weak Sustainability (WS) and Strong Sustainability (SS)[2]. The highest detectable difference between the two types is based on the possibility they assume to replace the natural capital, both as a productive input and as a direct supplier of utility, with human, produced and social capital. WS authors believe that it is possible to replace natural capital with the other form of capital; to be more precise the elasticity of substitution between natural and other forms of capital is equal or greater to one. Conversely, for the SS authors such replacement is unlikely, although some "moderate" SS approaches consider not all services provided by nature to be irreplaceable.

Further, the indices could be differentiated on the bases of the *numerario* used to measure the different phenomena. In fact, some of them translate all phenomena in an single *numerario* (eg. monetary indicators, physical indicators), others utilize different yardstick and, later, aggregate the various indicators through a subsequent second step.

Different indicators and indices relate to different definitions of sustainable development.

[2] Neumayer, 1999a.

Each of these signals to policy makers alternative actions to be taken to achieve the sustainability of the economic system. The starting point for almost all these indicators is that the current measures of national accounts are not able to assess the sustainability of nations. The perceived limits of GDP have prompted the search for measures of sustainability towards three directions:

- adjusting GDP: aims to correct the existing national accounts and, in particular, the GDP (e.g. ISEW, GPI, Green GDP, ANS);
- replacing GDP: aims to create altogether new indicators or indices with innovative assumptions (e.g. HDI, EF, ESI, HPI);
- supplementing GDP: aims to be complemented with additional environmental and/or social information (e.g. Namea, SDIs).

Besides this classification, as we said, the various indicators of sustainability can be divided into two main groups: WS-based indicators and SS-based indicators.

WS indicators use the existing systems of national accounts, suitably modified in order to effectively assess the sustainability of a country and usually they utilize money as numerario. Their measurements are based on the possibility of substitution between different types of capital, so that a loss of natural capital is accompanied by compensatory increases in the human capital. Between these measurement systems: Green GDP, the Adjusted Net Saving and the Index of Sustainable Economic Welfare (ISEW) are of particular interest.

The difficulty to identify a necessary and sufficient condition for ensuring the sustainability of an economic system, based on the total substitutability between natural capital and human capital and the limits of monetary measures have led many scholars to shift to physical measurements.

The assumption of SS is, in fact, non-substitutability between several forms of natural capital and other forms of capital, especially produced capital, both of material source or of knowledge gained. Models and policies consistent with the SS apply a minimum standard of security, which ensures the continued existence and functional integration of the minimum stock of the various renewable resources and ecosystems. Indicators and indices related to these models/policies are: the Net Primary Productivity (NPP), the Environmental Space (ES), the Material Intensity Per Service Unit (MIPS) and the Total Material Requirement (TMR).

Among those various synthetic indices, we selected: Human Development Index (HDI); Adjusted Net Saving (ANS); Environmental Sustainability Index (ESI), Ecological Footprint Index (EF) and Ecological Balance (EB).

The aim of the indices selection is to rank the nation's performances using different approach to sustainability and comparing them with GDP. The selected indices focus on different dimensions of sustainability: some of them take mainly into account socio-economic aspects, the others, instead, are more environmental-oriented. In this way we should outline if using different indices the county's performance change and evaluate the presence of gap in the sustainability dimensions.

The choice of these indices to analyse the sustainability of nations, has been done for four main reasons: 1) these indices are coherent with WS and SS approach[3]; 2) they are calculated using data from the authoritative international institutions like IMF, the World Bank, the WWF's Living Planet Report and Yale University, and these data also are available for the 120 selected

[3] The WS-based indicators are HDI, ANS and ESI; the SS-based indicator are EF and EB.

countries; 3) finally, these indices are strictly related with the aim of this paper as it is a measurement of the other aspects of progress, like sustainability.

4 THE HUMAN DEVELOPMENT INDEX

The Human Development Index (HDI) was based on an idea of Amartya Sen and it was implemented, in 1990, by Mahbub ul Haq and Richard Jolly. "*The breakthrough for the HDI was the creation of a single statistic which was to serve as a frame of reference for social and economic development*" (UNDP, 2004).

HDI is a composite indices that offer a broad proxy of human development, it is used by United Nations Development Program (UNDP) in its annual Human Development Report, since 1990, to ranking the performances of the countries in this field. It is made up of three equally weighted components, and it doesn't take into account directly the environmental dimension of sustainability. It is generally considered and used to describe the national path towards sustainable development[4]. Some authors are trying to refine the HDI calculation, for example Dahme et al. (1998) and Neumayer (2001) have proposed to construct an extension to HDI, but this studies were not included in UNDP report.

Anyway, in this paper we choose to employ this Index as a yardstick for the national ranking for two (social and economic) of the three dimensions of sustainability. In particular, the HDI measures the average achievements in a country in three basic dimensions of human development: life expectancy index (LEI), education index (EI), GDP index (GDP).

Before the HDI itself is calculated, an index needs to be created for each of these three dimensions. The underlying indicators are chosen to calculate the dimension of the three indices mentioned above. LEI is measured as life expectancy at birth in a country; EI is constituted by the adult literacy and combined primary, secondary and tertiary gross enrolment, with two-thirds weight given to adult literacy and one-third weight to the other one; GDP is calculated using adjusted GDP per capita and PPP in US$ (UNDP, 2004).

Performance in each underlying indicators is expressed as a value between 0 and 1 by applying the following general formula:

$$X\_index = \frac{(actual\_value - \min imum\_value)}{(\max imum\_value - \min imum\_value)}$$

Where X is Income or Longevity or Education.

So, the HDI is calculated as a simple average of the three indices:

$$HDI = {}^{1}\!/_{3}(LEI) + {}^{1}\!/_{3}(EI) + {}^{1}\!/_{3}(GDP)$$

The validity of the HDI as an indicator has been criticized in many respects[5]. In particular, for the aims of this research, it is important underline that the three indicators within HDI are

[4] For example: Neumayer E. (2001), European Parliament (2007).

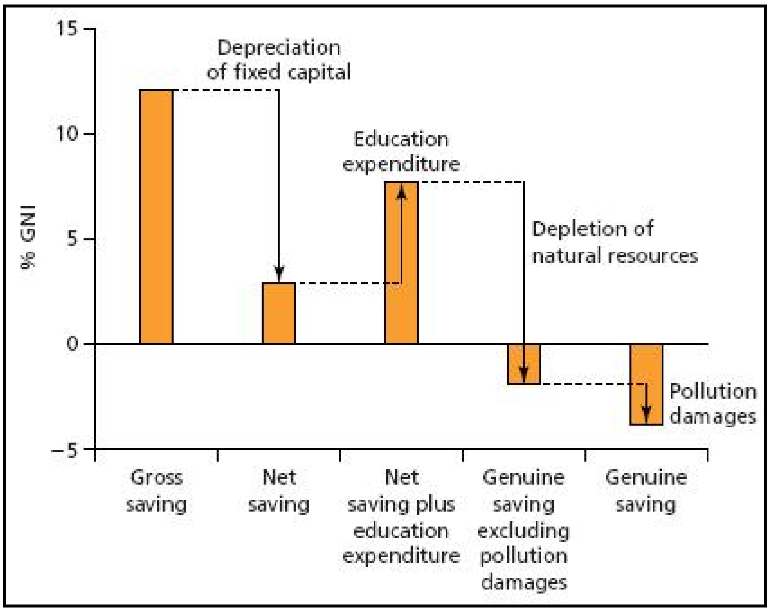
[5] McGillivray (1993), Hicks (1997), Noorbaksh (1998a, 1998b), Sagar and Najam (1998).

equally weighted, without adding new information with respect to the individual measures composing HDI. Moreover, HDI results for a country in a given year are difficult to read and manage, because they stem from a formula that used minimum and maximum values (goalposts), for each underlying indicator, achieved by the other countries, included in the dataset, in the same year. However, thanks to the yearly updating this problem is limited. Moreover the easily ranking mechanism allows a high comparability across different country.

5 THE ADJUSTED NET SAVING

"Adjusted Net Saving (ANS, also known as Genuine Saving - GS), is a sustainability indicator built on the concepts of green national accounts. ANS measure the true rate of savings in an economy after calculating investments in human capital, depletion of natural resources and damage caused by pollution" (The World Bank, 2002).

Fig. 2: How to calculate ANS (or GS)



Source: http://web.worldbank.org

While standard measures of "savings" and "investment" reflect changes in the value of a certain, limited set of assets, a more inclusive and realistic definition of what constitutes an asset can lead to a correspondingly more realistic picture of how a nation invests. In standard national accounting, only the formation of fixed, produced capital is counted as an investment in the future and thus as an increase in the value of the assets available to society. Likewise, standard calculation of net saving rates include only depreciation in the value of human-made capital as a decrease in the value of a nation's assets. The adjusted net savings framework takes the broader view that natural and human capital are assets upon which the productivity and therefore the well-being of a nation rest. Since depletion of a non-renewable resource (or over-exploitation of a renewable one) decreases the value of that resource stock as an asset, such activity represents a disinvestment in future productivity and well-being. In the same way, the creation of an educated populace and a skilled workforce - a nation's human capital - increases the value of that resource and might better be seen as an investment. In many cases, a nation which appears to be a net investor is, when natural and human capital are considered to be assets, actually decreasing the value of its collective assets with each year. Adjusted net savings, in such cases, become negative. Since all assets are finite in nature, this situation cannot persist; it is, in some sense, unsustainable.

The ANS represents a first-approximation numeric indicator of the degree to which a nation satisfies the Hartwick-Solow rule, often called "*weak sustainability*" (Barbier et al., 1994).

In short, the adjusted net savings rate was calculated as:

$$ANS = \frac{GDS - D_p + EDU - \sum R_{n,i} - CO_2 Damage - PM10 Damage}{GNI}$$

where ANS is Adjusted Net Saving, GDS is gross domestic savings, Dp is depreciation of physical capital, EDU is current expenditure on education, Rn,i is the rent from depletion of i-th natural capital (included energy, mineral and forest depletion), CO2 damage is damage from carbon dioxide emissions (currently estimated as US$20 per ton of carbon times the number of tons of carbon emitted), and GNI is gross national income at market prices. PM10 damage is based on the estimate of particulate matter less than 10 microns in diameter for all cities with a population of 100,000 or more and is measured using willingness-to-pay to avoid mortality due to particulate emissions (World Bank, 2007).

ANS has some strengths: thanks to the work of WB, it is constructed on the basis of a dataset constantly updated with data largely derived from National Accounts. The theoretical and methodological assumptions have been refined over time. Another positive point of this Index is the use of a *numerario*, the cash-money, that allows you to have a single result for each country. The ANS can be used to guide or assess policy choices, for example encouraging countries that have abundant natural resources, that constitute the bulk of its trade balance, to invest the income in another form of capital.

Several critical comments were made on ANS; in particular this indicator has been criticized with reference to:

- the difficulty of empirically identifying the rate of depreciation of both human and environmental resources;

- the assumption that the rate of substitution between different types of capital is equal to one, which in practice does not always occur, since some stocks of natural capital replacement with manufactured capital is not feasible.

The methodology used to convert the natural and social resources in monetary terms has been criticized by various authors. Note that the assumptions provided for in ANS do not guarantee the sustainability of a country. In practice, ANS is a necessary, but not sufficient condition to that purpose. In other words, a country with a positive ANS cannot be said with certainty to be sustainable. Nonetheless, should ANS value be negative, then it would mean that country is certainly unsustainable. For example, all technological progress is captured in man-made capital and human-capital. Finally, the assumptions of weak sustainability need to hold, namely that either other forms of capital can substitute for the depletion of natural capital without limit or that natural capital is superabundant or that technical progress can always overcome any apparent resource constraint[6]. Within such a framework, it can be shown that the economy of a country cannot be weakly sustainable if its ANS rate is below zero[7]. The policy recommendation following from this result would be to keep GS above zero: invest into all forms of capital at least as much as there is depreciation of all forms of capital.

6 THE ENVIRONMENTAL SUSTAINABILITY INDEX

The Global Leaders for Tomorrow Environment Task Force, with the collaboration of the Yale Centre of Environmental Law and Policy and the Centre for International Earth Science Information Network of the Columbia University, produced the Environmental Sustainability Index (ESI).

Differently from other analytical measures and sets of indicators, ESI is a composite index, intended to measure all elements of sustainable development: environmental, social and economic.

Sustainability is measured through 21 indicators (I), each of which given an equal weight (w); each indicators is derived from the combination of variables, for a total of 76 reference data sets.

$$ESI = \sum_{i=1}^{21} wI_i$$

For each country, ESI examines five key components:

- environmental systems;
- reducing stresses;
- reducing human vulnerability;
- social and institutional capacity;
- global stewardship.

While the first three components are frequently found in traditional measures of sustainability, the innovation of ESI is the introduction of the social and institutional capacity and of stewardship, as essential factors for assessing the propensity for sustainability in national systems.

We shall now more closely see the logical construction of the two non-environmental components. Social and institutional capacity are measured by five sets of indicators: science and technology (technological achievement and innovation indices, mean years of education among the population); capacity of debate (presence of organizations for the conservation of nature, protection of civil liberties and presence of democratic institutions, percentage of ESI variables in publicly available sets of data); environmental governance (surveys of the World Environmental Foundation on environmental governance), percentage of land area under protected status, number of sector-based guidelines for environmental impact evaluation, accredited forest area according to the Forest Stewardship Council (FSC) as a percentage of total forest area, control of corruption, gasoline price distortions, subsidies for energy and

[6] Neumayer, 1999a, 2003.

[7] Pezzey and Toman, 2002a; Pezzey and Toman, 2002b.

material usage, subsidies for the commercial fishing sector – the two latter indicators have a negative sign); private sector responsiveness (number of ISO 14001 certified companies per million of dollar GDP, Dow Jones sustainability index, Innovest EcoValue rating of firms, number of firms member of the World Business Council for Sustainable Development, private sector environmental innovation); and eco-efficiency of the private sector (measured by total energy consumption per unit of GDP and by the production of renewal energy as a percent of total energy consumption).

Finally, environmental global stewardship is measured by three sets of indicators: participation in international collaborative efforts (in particular, participation in environmental intergovernmental organizations, attainment of CITES reporting requirements, participation in the Vienna Convention and the Montreal Protocol, participation in global environmental organizations and level of compliance with environmental agreements); greenhouse gas emissions, which are emitted locally but cause global effects (CO_2 emissions per capita and per unit of dollar GDP); reduction of cross-border environmental pressures, which may have an impact on countries other than those where emissions are produced (chlorofluorocarbons (CFC) per-capita consumption, SO_2 exports, total marine fish catch and per-capita seafood consumption, behaviours that add to the impoverishment of marine fish resources.

Obviously, many critical observations were made on ESI. Among others, Campbell[8] identifies four types of flaws in the construction of ESI, which nevertheless represents an important attempt to develop a synthetic instrument.

The limits Campbell singles out are the following:

- the subjective nature of the choice of the weightings for the components of ESI;
- a still insufficient level of technical robustness for monitoring trends in a reliable way;
- the possibility that diverging trends in the components of indicators may create confusion or cancel each other out;
- the complexity of the method, which still necessitates more explanations to avoid misunderstandings.

One of the most radical detractor of ESI is Mathis Wachernagel, who in 2001 underlined many shortcomings: a blurry conceptual definition, an inappropriate index architecture due to the vague theory behind the collection of components, the more social than environmental nature of the index, the mixing up of stock, flows and intentions, the unrealistic weights assigned to the indicators, the under-representation of externalities, the questionable proxy measures, and the poor confrontation capacity of ESI with other sustainability measures, such as MIPS (Material Input Per Service), TMR (Total Mass Requirements), GPI (Genuine Progress Indicator), NCA (National Capital Accounts), LPI (Living Planet Index), HANPP (Human Appropriation of Net Primary Productivity) and ES (Environmental Space). Most likely, Wachernagel's remarks have a dose of truthfulness. Undeniably, ESI is more a project for a composite index than a complete instrument and a perfectly functioning one. But blurriness may be progressively reduced and the instrument seems sufficiently flexible to allow further developments and specifications. In part, criticism is possible exactly because the construction process has been exposed with great transparency. It is possible, and legitimate, to doubt the appropriateness of certain choices when one inevitably enters the minefield – as it is inevitable for indicators and even more for indices – of the assignment of weights and the selection of

[8] Campbell, 2001.

proxies.

7 THE ECOLOGICAL FOOTPRINT

The Ecological Footprint (EF) was defined by W.E. Rees in 1992 and implemented as calculation method by M Wackernagel and W.E. Rees in 1994, to clarify the relationship between consumption, growth and pressure natural assets[9]. Form 2000, it is one of the indices included in the Living Planet Report.

"*The ecological footprint of a specified population is the area of land and water ecosystems required to produce the resources that the population consumes, and to assimilate the wastes that the population produces, wherever on Earth the relevant land and water may be located*" (Rees 2000).

The Ecological Footprint is a Strong Sustainability (SS) index and a land-based measure, because it translates the human consumption path in a single physical *numeraria* (eg. land). EF compares the resources required to sustain/produce the goods and services consumed by a given population settled in a country (or region, or city etc.), with the resources available in that country (or region, city etc.). Goods, services and energy consumption per capita are translated into the biological productive areas necessary to produce such amounts; in this way it is possible to measure the environmental burden of the consumers' life styles.

The EF is therefore a measure of environmental impact of consumption behaviours. To be produced, consumed and disposed at the end of its lifecycle, every good, process or service requires energy and material (including land intended as physical space): "*The footprint of a country includes all the cropland, grazing land, forest, and fishing grounds required to produce the food, fibre, and timber it consumes, to absorb the wastes emitted in generating the energy it uses, and to provide space for its infrastructure*" (Living Planet Report, 2006). The EF is a SS index, it uses a global budgeting approach: the capacity of production and absorption of the planet is the upper limit that consumers can use without progressively worsening ecosystem integrity. This value is compared with the global demand for renewable natural resources required to sustain the current level of consumption. EF is usually compared with the biologically productive area highlighted in the nation's bounders. In this way, it is possible to know if a nation is consuming according with its natural assets (or biocapacity).

The Ecological Debt or Biocapacity Reserve can be calculated as:

$$EB = \sum_i Bn - \sum_i EF$$

where EB is Ecological Balance - Debt or Biocapacity Reserve -, Bn is the Nation's Biocapacity and EF is Ecological Footprint.

We choose to ranking the nation using both EF and EB. The first one takes into consideration the consumption path, the latter measures the overshooting, in the case ecological debt, or biocapacity reserve, if the natural supply presents in country boundary is sufficient.

[9] For further elaboration on EF see: Van den Bergh J. and H. Verbruggen (1999) and Rees W.E. (2000).

The main advantages related to the EF are summarised in the following section.

The use of a single *numerario*, that avoid to turn to satellite accounts as in the case of supplementing GDP. Thanks to this choice, you can translate heterogeneous goods, which adopt different measuring criteria, in a uniform size, precisely "land", in order to overcome a limitation inherent to the physical analysis.

The method of calculation is relatively simple[10]. If it is estimated at national level, data are relatively available and reliable, using surveys of national statistical offices and FAO. This Index identifies clearly who is a debtor and a creditor. It is a communicative indicator, with a unique message and, finally, it adopts a Life Cycle Assessment methodology. The shortcomings of this indicator have been highlighted in many papers related to this issue.

EF is not dynamic. Ecosystems are complex adaptive systems characterized by non-linearity and by thresholds, while the EF is a static measure. EF does not provide information on the resilience (the ability of an ecosystem to absorb disturbance and reorganize itself) or as a system it is far from the threshold of support capabilities. Rees replied saying that the creation of a dynamic model has never been the goal of EF, because it "*is an ecological camera*". Each analysis provides a snapshot of the demands that population has on nature, a portrait of the current state of pressure, given the prevalent social and technology values.

EF ignores all environment harmful substances involved in the production process (with the exception of carbon dioxide) and it does not distinguish between sustainable and unsustainable use of land, but it assumes that current methods of production are all sustainable. Reasonably, however, not all processes are to be considered sustainable. Agricultural lands, for example, are degraded faster than they can replenish itself biologically.

Ayres, for example, states that, within a reasonable time frame, technologies to make possible the storage of CO2 in the depths of oceans or in fossil fuel reserves exhausted will be available. Van den Berg, moreover, notes that the land available for CO_2 absorption may not be sufficient and that the EF did not consider the use of few-emission fuels or energy efficiency as a possible alternative choices. Finally, the present method of calculation does not take into account the type of emission source of CO_2: for each energy unit produced, the amount of CO_2 released may vary significantly depending on the characteristics of the sources used.

All these points have in common the assumption that EF is calculated based on the present level of technology. In fact, Ayres, Van den Bergh and others authors argue that EF does not consider positive shock technology capable of overcoming the constraints of biocapacity. This will be true, however, only if the predictions of technological progress will occur.

A final consideration relates to international trade. According to commentators such as Van den Bergh and Verbruggen, EF approach is "prejudiced" on international trade, that is to say that "comparing the EF of a country with the biological availability found within its borders seems to affirm a desirability of self-sufficiency or autarchy. In practice, it is evident that for some countries, poorly endowed in natural resources it is essential to import the resources from the outside to maintain their consumption. It is useful also to calculate the national EF because political boundaries determine the arrangements for the management of natural resources and it

[10] A methodological critique is focused on the choice of conversion factors. These factors are used to convert consumption into world average ground, and they are fixed. They take into account only biophysical elements, such as, for example, the productivity of different types of land, linked to the intrinsic quality of the considered areas. The conversion factors ignored, in this way, economic considerations, such as the relative scarcity of good.

is through laws and habits of consumption of each population that the exploitation of ecosystems is made.

In conclusion, EF, as aggregate index, share costs and benefits associated with this type of indicators. The biggest advantage is that the EF calculation produces a single number, which can be used as a basis for making choices towards sustainability. At the same time, however, the main risk is likely to be just the excessive synthesis of the results. In other words, the ignorance of the methodological assumptions and of the provenance of data could lead to a distorted use of the results. Furthermore, EF is characterized as an indicator of sustainability, sharing with other strong indicators strengths and weaknesses. In fact, it will certainly ensure the sustainability of a system of consumption; in contrast, being very restrictive, because of preservation of the environmental system priority, it will limit the policy choices practicable.

8 RANKING THE SUSTAINABILITY OF NATIONS[11]

To analyze the results achieved by different countries for each of the indicators considered in this paper, a database was built with data produced from qualified sources12. While the geographic coverage of GDP is full, an homogeneous time series for the various sustainability indexes are not available. For this reason, we decided to refer to the year with highest data coverage, namely 2005, and to include only those countries for which data were available for all the four indices. In this way, 120 countries were selected and subsequently classified in the four World Bank categories of income:

- 34 Low Income Country (LIC);
- 37 Low Middle Income Country (LMIC);
- 21 Upper Middle Income Country (UMIC);
- 28 High Income Country (HIC).

Table 1 shows the ranking of the 120 selected countries for each indicator. The countries are ordered according to GDP at Purchasing Power Parity (PPP). Near the GDP and the income categories columns, there is the HDI that is used as a yardstick for the national ranking for the socio-economic dimension of sustainability. Then there are four sustainability indices: two (ANS, ESI) respect the principles of WS and the latter two (EF, EB) are SS-based indicator.

When applying HDI, all HIC and OECD members are on top of the list[13]. The HDI variation range among these 10 countries goes between 0.968, totalized by Norway, and 0.951 of United States. At the bottom, we find all LIC, they are all located in Sub-Saharan Africa[14], because this indicator measures the average achievements in life expectancy, education index and GDP, as mentioned above, that are lacking in this socio-economic dimensions.

[11] We would like to thank Marco Ventura (ISAE) for many helpful suggestions and comments on this section.

[12] Data sources: for the GDP at Purchasing Power Parity the source is the IMF, for Adjusted Net Saving (ANS) and Human Developed Index (HDI) the source is the World Bank, the source of Ecological Footprint (EF) is the WWF's Living Planet Report 2008, for the Environmental Sustainability Index (ESI) the source is Yale University.

[13] Norway, Canada, Australia, Ireland, Sweden, Netherlands, Switzerland, Japan, France and United States.

[14] Chad, Mali, Ethiopia, Guinea-Bissau, Burundi, Niger, Mozambique, Congo, Dem. Rep., Central African Republic and Sierra Leone.

Italy ranks 19th in both absolute terms and when compared to the HIC countries sub-group. This index is positive correlated with GDP PPP (Table 2), in fact those countries that show a higher income level should implement effective policies on health and education areas, so they take up the top position of the rank.

With regard to ANS, the first 10 countries ranked are two HIC and one LIC, while the other seven are all LMIC including the four at the top[15]. Among this countries, five are located in Asia, two in Africa, two in Europe and one in South America. Those countries perform better with respect to sustainability. Analysing the score of each indicator, that build up the ANS Index, it can find that they have different results with respect to the whole index. In details, the Environmental Depletion indicator shows the two biggest Asiatic countries (China and India) have such higher values than the others neighbours countries. The Education Expenditures indicator, instead, positions Namibia and Morocco at the top of ranking, meanwhile China and Philippine sit at the opposite extreme. Finally, analyzing the Net National Saving (Gross National Saving - depreciation of physical capita) it underlines a more homogeneous performance among these 10 countries.

The ten countries at the bottom of the ranking[16] are resource – namely oil – dependent. Similarly to the previous group, if you analyze the different components of the ANS index, these countries are not homogeneous among themselves. In particular, analysing the National Net Saving indicator, Azerbaijan, Congo Republic and Uzbekistan are placed at the top of the list with very positive values, while others countries occupy low positions as Mauritania and Lebanon. Anyhow, these countries have in common the similar performance of the Environmental Depletion indicator. These countries are among the most critical because the not only do not invest the revenues generated from the sale of natural resources in human resources, but those resources they sell are not renewable. According to WB income classification, among the least 10 countries, four belong to the LIC, four to the LMIC, one to the UMIC and one to the HIC.

Italy is ranked 42nd on the list, while it reaches the 18th place among the 28 High Income Countries. The Italian performance is very similar to that of countries like Germany, Spain, France and UK; the latter has different values on the Environmental Depletion indicator, that probably depend to the natural resources exploitation of the North Sea.

When ranking is produced through the application of the ESI, seven HIC and three UMIC[17] are found at the top of the list. In the HIC group there is a prevalence of the north and middle European countries, instead all UMIC are located in South America.

Going into details, these countries perform in similar way with respect to the different indicators that compose ESI, inside the five core components[18]:

- all the European countries carry out high performance in the ESI building block component “Social and Institutional Capacity”, that means promote institutions framework and social patterns, attitudes and networks that encourage effective responses to environmental

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[15] China, Bhutan, Namibia Morocco, Switzerland, Honduras, Korea Rep., Nepal, India, Philippines.

[16] Syrian Arab Republic, Trinidad and Tobago, Azerbaijan, Nigeria, Kazakhstan, Mauritania, Chad, Uzbekistan, Angola and Congo Republic.

[17] Finland, Norway, Uruguay, Sweden, Canada, Switzerland, Austria, Argentina, Brazil and New Zealand.

[18] The components summarize the indicator values in 5 thematic categories: Environmental Systems, Reducing Environmental Stresses, Reducing Human Vulnerability, Social and Institutional Capacity, Global Stewardship.

challenges. Moreover, these countries, apart from Finland, reveal lower performance in the component “Reducing Environmental Stresses”, that shows small level of measures engaged to reduce anthropogenic stress. Canada and New Zealand scores are polarized on three components: “Environmental Systems”, “Reducing Human Vulnerability” and “Social and Institutional Capacity”. They do not show great interest into cooperation with other countries to manage common environmental problems. The South American countries rise homogeneous performance for each of five blocks of indicators. When compared with each other they still show uniform results.

The bottom of the list is occupied by five LIC, three LMIC, one UMIC and one HIC[19] countries. These countries have unequal performance for the different indicators of the five blocks, whether individually taken or when they are compared with each other. Summarising some current characteristics, it shows that the worst performance focus on “Reducing Human Vulnerability” and “Global Stewardship”. That are exactly the components where the best ten countries have the greatest results. Finally, Italy ranks 56th, while, in the HIC sub-group of 28 countries, it is 22th. The Italian performance has two clear strengths: “Reducing Human Vulnerability” and “Social and Institutional Capacity”. These blocks of indicators are both related to health, governance and institutional skills. Italy has a bad score in he other three blocks of indicator, and in particular in the specific environmental one (“Environmental Systems”).

Table. 3: Ranking of the 120 selected countries for each indicator

Country Name	GDP PPP PC	Income group	HDI 2005	ANS 2005	ESI 2005	EF 2005	EB 2005
Norway	1	HIC	1	46	2	115	87
United States	2	HIC	10	76	40	120	120
Ireland	3	HIC	4	11	18	113	102
Switzerland	4	HIC	7	5	6	104	115
Canada	5	HIC	2	55	5	116	3
Netherlands	6	HIC	6	26	35	96	112
Austria	7	HIC	13	23	7	103	103
Denmark	8	HIC	12	25	24	119	106
Australia	9	HIC	3	68	11	118	6
Sweden	10	HIC	5	12	4	105	14
United Kingdom	11	HIC	16	57	53	108	114
Belgium	12	HIC	15	28	97	106	116
France	13	HIC	9	36	31	102	101
Finland	14	HIC	11	19	1	107	8
Germany	15	HIC	20	39	28	95	105
Japan	16	HIC	8	21	27	101	118
Italy	17	HIC	19	42	56	100	113
Spain	18	HIC	14	35	64	111	119
Greece	19	HIC	18	38	57	112	117
New Zealand	20	HIC	17	61	10	117	9
Slovenia	21	HIC	22	31	26	98	104
Korea, Rep.	22	HIC	21	7	106	92	109
Czech Republic	23	HIC	24	24	79	109	107

[19] Lebanon, Burundi, Pakistan, Iran, Islamic Republic, Tajikistan, China, Ethiopia, Trinidad and Tobago, Sudan and Uzbekistan.

Portugal	24	HIC	23	86	32	97	111
Hungary	25	HIC	25	40	46	90	84
Estonia	26	HIC	29	109	23	114	19
Slovak Republic	27	HIC	28	82	41	85	77
Trinidad and Tobago	28	HIC	39	112	118	63	60
Lithuania	29	UMIC	30	63	19	82	34
Poland	30	UMIC	27	53	88	94	100
Croatia	31	UMIC	31	30	16	83	89
Latvia	32	UMIC	32	47	13	88	18
Mexico	33	UMIC	36	72	82	87	99
Chile	34	UMIC	26	93	37	79	33
Russian Federation	35	UMIC	48	102	30	93	16
Malaysia	36	UMIC	40	67	33	70	46
Turkey	37	UMIC	51	49	78	75	91
Argentina	38	UMIC	34	78	8	72	10
Lebanon	39	UMIC	50	108	111	80	108
Venezuela, RB	40	UMIC	42	103	70	77	43
Uruguay	41	UMIC	33	81	3	110	12
Romania	42	UMIC	41	94	81	78	79
Bulgaria	43	UMIC	37	73	61	76	53
Iran, Islamic Rep.	44	LMIC	56	107	114	73	96
Kazakhstan	45	UMIC	49	115	66	86	36
Costa Rica	46	UMIC	35	20	15	68	73
Brazil	47	UMIC	47	79	9	69	13
South Africa	48	UMIC	82	87	80	60	51
Panama	49	UMIC	38	33	25	81	44
Macedonia, FYR	50	LMIC	44	27	77	99	110
Jamaica	51	UMIC	57	16	95	28	75
Thailand	52	LMIC	52	14	62	64	93
Colombia	53	LMIC	53	77	20	55	25
Ecuador	54	LMIC	45	101	45	66	59
Dominican Republic	55	LMIC	60	54	104	42	83
Peru	56	LMIC	55	92	12	44	23
Tunisia	57	LMIC	62	41	47	53	80
Algeria	58	LMIC	66	95	83	49	85
Ukraine	59	LMIC	54	52	94	74	64
Albania	60	LMIC	46	64	21	67	90
El Salvador	61	LMIC	65	84	103	46	88
Namibia	62	LMIC	84	3	29	91	11
Egypt, Arab Rep.	63	LMIC	75	98	101	50	97
Azerbaijan	64	LMIC	68	113	85	65	92
Jordan	65	LMIC	59	90	72	52	98
Guatemala	66	LMIC	80	74	100	43	63
Syrian Arab Republic	67	LMIC	70	111	102	59	94
China	68	LMIC	63	1	116	61	95
Paraguay	69	LMIC	64	37	14	84	7
Angola	70	LMIC	103	119	107	17	24
Armenia	71	LMIC	58	17	39	40	81

Bolivia	72	LMIC	72	110	17	62	1
Bhutan	73	LMIC	88	2	38	21	37
Georgia	74	LMIC	61	50	48	26	38
Morocco	75	LMIC	83	4	93	30	74
Congo Rep.	76	LMIC	85	120	34	2	2
Honduras	77	LMIC	76	6	75	54	52
Sri Lanka	78	LMIC	69	15	68	23	82
Indonesia	79	LMIC	71	83	65	20	41
Philippines	80	LMIC	67	10	110	13	68
Mongolia	81	LMIC	43	22	59	89	4
Moldova	82	LMIC	74	32	49	33	55
Nicaragua	83	LMIC	78	60	54	58	32
Pakistan	84	LIC	90	45	113	11	72
Vietnam	85	LIC	73	34	109	34	76
India	86	LMIC	87	9	87	15	78
Uzbekistan	87	LIC	77	118	120	56	86
Cameroon	88	LMIC	98	97	43	35	27
Nigeria	89	LIC	101	114	84	37	70
Mauritania	90	LIC	91	116	108	57	15
Sudan	91	LMIC	97	105	119	71	42
Kyrgyz Republic	92	LIC	79	48	69	29	39
Lao PDR	93	LIC	86	70	44	24	30
Cote d'Ivoire	94	LIC	108	91	76	14	29
Chad	95	LIC	111	117	90	51	31
Senegal	96	LIC	99	18	51	39	49
Tajikistan	97	LIC	81	69	115	5	61
Cambodia	98	LIC	89	56	58	19	58
Kenya	99	LIC	93	59	86	25	50
Benin	100	LIC	105	71	74	22	40
Ghana	101	LIC	94	43	42	41	66
Zambia	102	LIC	107	104	50	7	26
Gambia, The	103	LIC	104	51	60	32	56
Bangladesh	104	LIC	96	13	99	3	67
Tanzania	105	LIC	100	89	52	31	54
Nepal	106	LIC	95	8	73	6	71
Mali	107	LIC	112	65	36	47	35
Guinea	108	LIC	110	99	71	36	28
Madagascar	109	LIC	92	62	55	27	20
Rwanda	110	LIC	109	29	91	9	65
Togo	111	LIC	102	80	96	10	45
Mozambique	112	LIC	117	100	92	18	22
Malawi	113	LIC	106	44	63	1	57
Central African Republic	114	LIC	119	58	22	45	5
Ethiopia	115	LIC	113	85	117	38	69
Niger	116	LIC	116	88	89	48	48
Sierra Leone	117	LIC	120	75	105	8	47
Guinea-Bissau	118	LIC	114	66	67	16	21
Burundi	119	LIC	115	106	112	12	62

Congo Dem. Rep.	120	LIC	118	96	98	4	17

Source: Elaboration on IMF WB, Yale University and WWF data (2008).

Ecological Footprint, as we said above, takes into account the human consumption burden on the natural capital. The ranking for Ecological Footprint per capita favours countries located in Africa (7) and in Asia (3), these countries are all part of LIC group, excluding Congo Rep. that is incorporated in the LMIC[20]. In details, focusing on EF six key components[21], seven countries show higher values in the "Cropland" component, that may be related to their low stage of economic development, fixed at a subsistence level. Other three countries underline high scores into "Forest" component, which is their wealth. Moreover, this group has in common the very low percentage of "Carbon uptake land" upon the whole amount.

The end-of-list countries are all HIC and they are mainly located in Europe[22]. In particular, eight countries show higher values in the "Carbon uptake land" component, instead "Grazing land" and "Fishing ground" components are respectively predominant in Australia and Norway.

From this ranking it is clear that the Ecological Footprint per capita of the population of each country is connected with the consumption structure and, ultimately, with the level of income. For this reason, it ranks all developed countries among the countries with the highest EF, that is the richer. On the contrary, among the most sustainable countries EF puts the developing, but they have very low living standards. Finally, Italy position for EF is 100th. Analyzing the EF six key components, Italy shows values in line with the EU27 average, except for "Carbon uptake land" and "Built-up land" components, that differ slightly in the opposite direction with respect to the average.

If, besides the consumption profile (EF), the allocation of productive area within each country (EB) is taken into account, national ranking changes significantly: the top sustainable 10 countries are in that case: four LMIC countries, four HIC, one LIC and one UMIC[23].

This result is directly related to the natural resources endowment available in the country. For this reason, countries with large ecological reserves show very positive values, even if they have a high level of EF per capita; how it is, for example, the case of Australia and New Zealand which have a value of EF more than 7,5 gha per capita and a ecological reserve more than 6,0 gha per capita. Analysing the countries with the higher ecological deficit, the list includes all HIC countries[24]. Among these countries, excluding the United States, which have a natural resources endowment of 5 gha per capita, no one goes over 1.7 gha per capita of resource endowment. All these countries have a high degree of openness (trade dependence index), just to compensate for scarcity of natural resources within its borders.

An implicit information gives by the EB indicator is that Australia and New Zealand, that are rich of natural resources have a sustainable consumption, while others, as Japan an Holland, with scarce resources endowment, are taken on a path of unsustainable consumption, despite the latter two have a lower Ecological Footprints than the first two countries. Italy, in this case,

[20] Malawi, Congo Rep., Bangladesh, Congo, Dem. Rep., Tajikistan, Nepal, Zambia, Sierra Leone, Rwanda e Togo.

[21] The six Footprint land uses are the five land types (Cropland, Grazing land, Forest, Fishing ground, Built-up land) and carbon uptake land.

[22] United States, Denmark, Australia, New Zealand, Canada, Norway, Estonia, Ireland, Greece and Spain.

[23] Bolivia, Congo Republic, Canada, Mongolia, Central African Republic, Australia, Paraguay, Finland, New Zealand and Argentina.

[24] United States, Spain, Japan, Greece, Belgium, Switzerland, United Kingdom, Italy, Netherlands and Portugal.

decreases its performance due to the reduced availability of biologically productive areas.

Tab. 4: Correlation matrix among indices, values 2005.

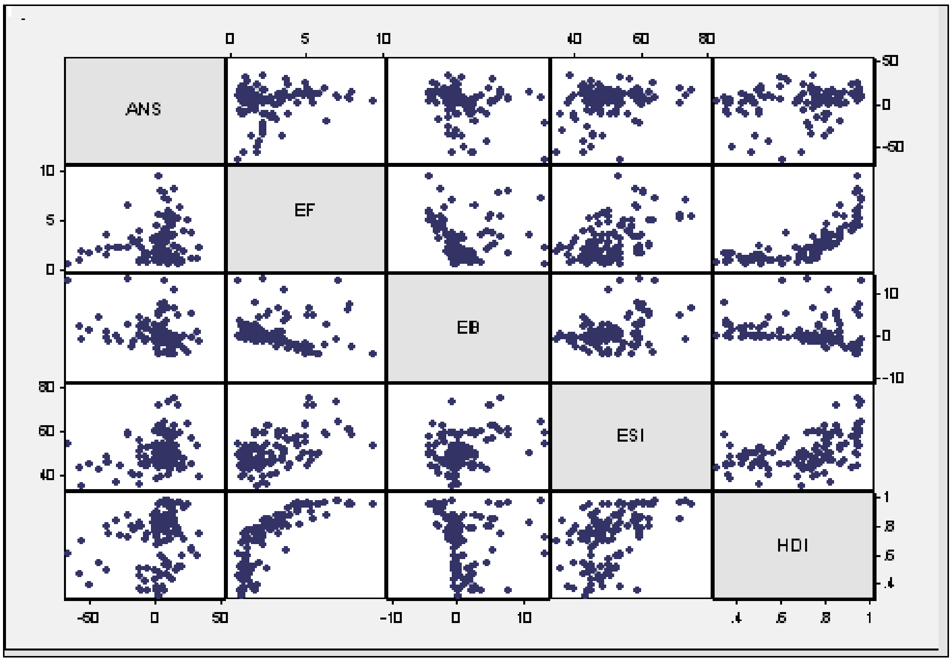
	GDP PPP PC	ANS	EF	EB	ESI	HDI
GDP PPP PC	1.0000					
ANS	0.2387** 0.0086	1.0000				
EF	0.8900** 0.0000	0.1794 * 0.0499	1.0000			
EB	-0.2025* 0.0265	-0.2499** 0.0059	-0.0654 0.4776	1.0000		
ESI	0.5259** 0.0000	0.2717** 0.0027	0.5261** 0.0000	0.3638** 0.0000	1.0000	
HDI	0.7791** 0.0000	0.2489** 0.0061	0.7591** 0.0000	-0.1706 0.0625	0.4608** 0.0000	1.0000

Source: Elaboration on data collected from variety of sources.
* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

Table 2 shows the correlation coefficient between the selected indices. GDP shows a significant correlation with all the indices, as well as positive with the exception of EB. The HDI and EF have highest coefficients of correlation, because both are strongly linked to the ability to spend. In addition, all the indices are significant correlated with each other, except for EB, which is not correlated with HDI nor with EF.

The following scatter plot matrix (Fig. 3), that shows the correlations between all the selected indices.

Fig. 3: The scatter plot correlations between the selected indices



Source: Elaboration on data collected from variety of sources.

9 CONCLUSION

The search for synthetic measures of a complex and multidimensional process such as sustainable development represents an extraordinary challenge for the scientific community. In fact, at the present time, there isn't an universal agreed idea of what means sustainability, and in particular progress.

In economic literature, for every definitions there is a different indicator and/or index, with its pro and con. Each of them tools point out to the policies-makers different and alternative actions to address the society into a sustainable path.

The Italian performance monitoring with these indices shows light and shadow. In fact, Italy, a High Income Country, ranks coherently with the other HIC nations for GDP; Italy performs fairly in the indices focused on socio-economic results: HDI and ANS. When taking into consideration the natural resources consumption path (EF), the Italian performance is better than the HIC average. The Italian position worsens when other environmental-oriented indices are applied: EB and ESI. The environmental low rankings are linked with the biocapacity/natural assets of Italy, insufficient if compared with its natural resources consumption paths.

The gathering of components, generally considered separately, such as social equity, environmental management and economic activity, makes the task of rapidly developing entirely satisfactory and convincing indices more complicated, but at the same time enriches thought. It is necessary to decide if develop indicators and indices coherent with WS or SS approach. The sustainability goals are easier to achieve with the WS approach than the SS one, but it actually doesn't give the certainty to walk along the sustainability path.

The comparative analysis proposed shows how the variables taken into account modify the countries performance in terms of measured progress and sustainability. This allow us to claim that the index choose influence in decisive way the performance of a nation; so the first step for a good valuation of the nation's sustainability is the creation of a common and shared framework.

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Fig. 4. Country by income classification: Adjusted Net Savings

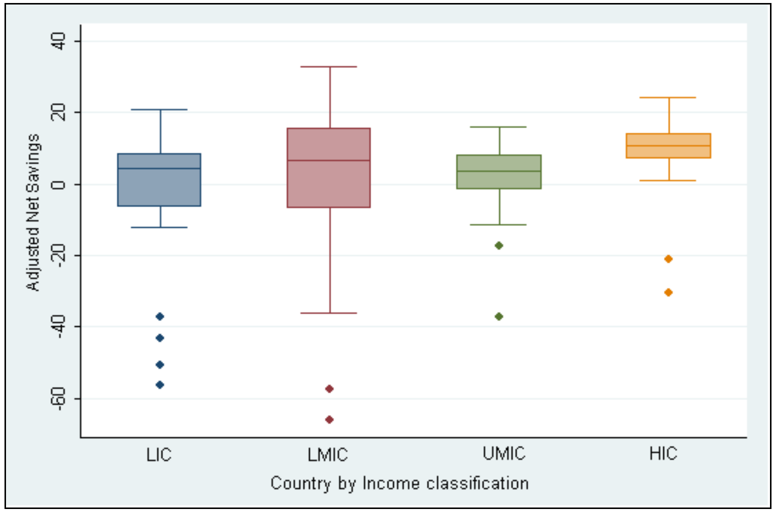


Fig. 6 Country by income classification: Environmental Sustainability Index

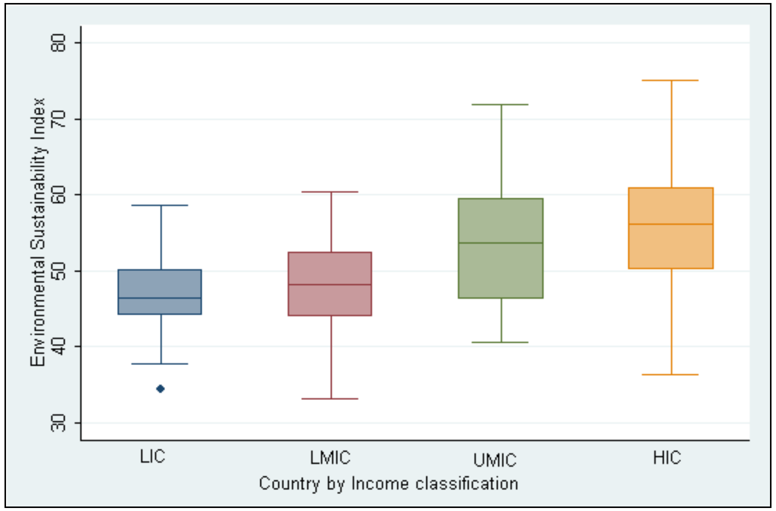


Fig. 5: Country by income classification: Ecological Debt/Blocapacity Reserve

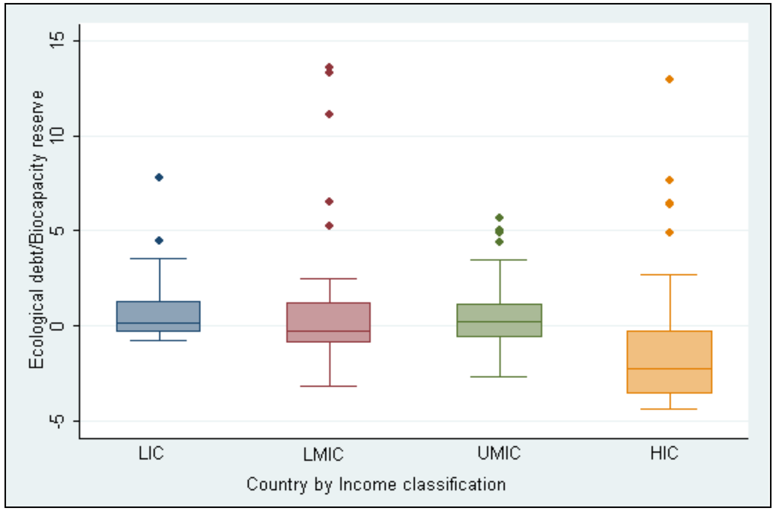
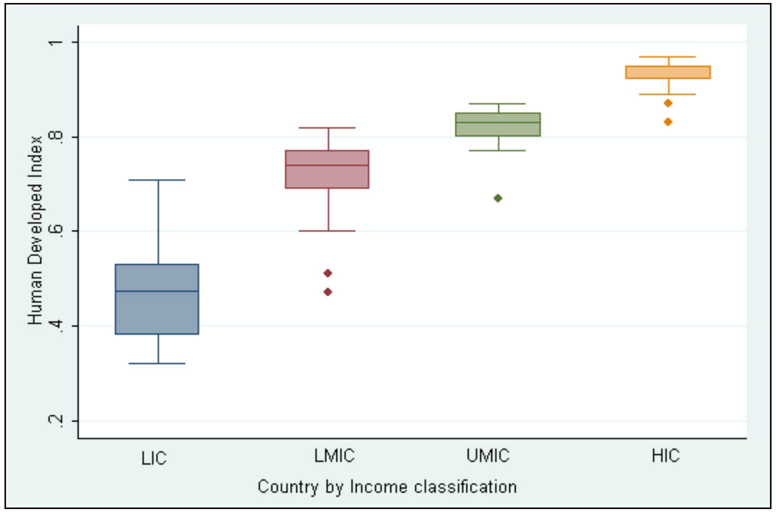


Fig. 7: Country by income classification: Human Developed Index



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