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RECONSIDERING THE WELL-BEING: THE HAPPY PLANET INDEX AND THE ISSUE OF MISSING DATA

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WORKING PAPERS

2010/07

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Titolo: RECONSIDERING THE WELL-BEING: THE HAPPY PLANET INDEX AND THE ISSUE OF MISSING DATA

ISBN: 978 88 84 67 581 1

Prima Edizione: Aprile 2010

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09123 Cagliari
Tel./Fax 070 291201
www.cuec.it

Reconsidering the well-being: the Happy Planet Index and the issue of missing data

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Abstract

The main aim of this paper is to build up and to analyze a composite indicator, the Happy Planet Index (HPI), as an alternative measure to the Gross Domestic Product (GDP) in evaluating nations' well-being. HPI was firstly developed by the New Economic Foundation in July 2006 and it is the first well-being composite indicator that considers in its calculation a subjective measure of well-being: life satisfaction. This work updates the HPI for 178 countries using the most recent available datasets. Due to the lack of country data for some of the variables used to build up the HPI, it has been necessary to run some missing data estimation procedures. The results obtained show that no country manage to score high in terms of HPI because of countries' incapacity to maintain high living standards (expressed in terms of happy life years) and at the same time assure sustainability. Comparing HPI with GDP, no association between the resulting countries' classification was found, living proof that this indicator does not reflect the same reality that GDP illustrates.

Keywords: indicators, beyond GDP, HPI, happiness, life satisfaction
Jel Classification: E01, C43

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1 Introduction

It has become a widespread habit to measure a nation's well-being through a monetary measure which was developed as a universal metric for *living standards*: the Gross Domestic Product (GDP). It corresponds to the sum of the value of all the commodities and services that have been produced within a nation, independently from (i) who produces them, (ii) the resources that have been used, and (iii) the consequences that their production bring to the environment and to the society as a whole. GDP is, without question, a measure that, even with some approximation, allows us to evaluate world nations' wealth according to their economic performances. However, what is often outwardly deducted is that a positive GDP growth rate represents a signal of corresponding growth in well-being.

According to this paradigm, the main goal of policy makers is to increase the GDP in real terms. Too often, they act ignoring that GDP growth may bring a proportional increase of production and, therefore, may cause radical changes in the society and the overexploitation of environmental resources.

The main issue is that GDP does not account for those aspects of a country's life which are not dependent and connected to the monetary value of production. The *sustainable development*[1], is a difficult objective to pursue if the well-being is considered exclusively from a monetary point of view. That is, '*Does the economic growth, as measured by GDP, really contribute to the general well-being of populations*?' This important issue, which risked to be banished from the academic debate, is now taken into consideration from politicians and economists: severe critics have been addressed to the assumption that a maintenance of high growth rates let us achieve well-being.

A valuable exercise is to incorporate what GDP fails to measure, such as social and environmental costs, in an indicator that is able to represent nation's development, wealth and well-being. From this rationale arises the necessity to go 'Beyond GDP'. This has been the objective of an international conference *'Beyond GDP. Measuring progress, true wealth, and the well-being of nations'* that took place in Brussels in November 2007. More recently, *The Commission on the measurement of economic performance and social progress*[2] has produced a fundamental report

[1]The term was used for the first time by the Brundtland Commission, which originated what has become the most often quoted definition of sustainable development (UN, 1987).

[2]The Commission, chaired and coordinated respectively by Joseph E. Stiglitz, Amartya Sen and Jean-Paul Fitoussi, has been created on French government's initiative at the beginning of 2008.

(Stiglitz *et al.*, 2009) that goes in the direction of identifying the limits of GDP, considering additional information required for the production of a more comprehensive picture and to assess the feasibility of new measurement tools.

A lot of emphasis has been put on the so called *Economics of Happiness* (Bruni, 2004). These studies brought about an intense multidisciplinary debate focusing on the social discomfort that exists in high income societies (Oswald, 1997). The most efficient indicator to evidence this discomfort measures subjective well-being, which expresses the perception that individuals have of their life and their rate of satisfaction. This '*people's happiness indicator*' has been obtained through surveys conducted in the last decades in many countries; it is extensively used in theoretical and empirical studies, both in economics and in psychology. The indicator rarely increases in value in countries such as Japan and it even decreases in 'high per capita income' societies (e.g., in the USA). This phenomenon is often named as the '*paradox of happiness*' or the '*Easterlin paradox*'(Easterlin, 1974).

The purpose of this work is to reconstruct and analyze a composite indicator alternative to GDP as a measure of a country's wellness, the HPI (Happy Planet Index). This indicator, introduced in July 2006 by the New Economics Foundation (NEF) (Marks *et al.*, 2006) as an indicator of human well-being and environmental impact, is a measure of a country environmental efficiency in providing long-term well-being for all[3].

In Section 2 we will briefly concentrate on GDP, on the history of its international success, on its limits and on the different ways to assess well-being. In Section 3 the relationship between wealth, well-being and happiness is briefly discussed. Sections 4 and 5 are dedicated to the description of the HPI and the methodological steps that were necessary to calculate it. Section 6 contains some comparisons across countries for the calculated HPI and among the latter and the more common indicators, GDP and HDI.

2 GDP as a measure of a country's wealth

The first attempt to estimate national accounts is ascribable to Thomas Petty in 1665. His scope was to ascertain the taxable capacity of the United Kingdom (Cobb *et al.*, 1995). By the end of the nineteenth century, England's economic center of

[3]So, it brings back the economic vision to its most elementary basis: given an endowment of scarce resources, we have to produce an output that yields life satisfaction and guarantees the preservation of the same resources availability for future generations.

gravity had shifted significantly from manufacturing to trade and finance. Everything that could be traded is assumed to be part of national wealthiness simply because it has been produced and purchased. At the same time, this means that only transactions that imply money transfers can be taken into consideration for nation's wealth estimation. In doing that two actors of fundamental importance are not considered: families and environment. They are *invisible* to the national account systems because there isn't a system of prices associated with the services they provide[4]. In the Thirties of the Twentieth century, the Hoover administration in the United States assigned to Simon Kuznets the task to develop a uniform system of national accounts (Cobb *et al.*, 1995). The result was nothing but the prototype of what today is called GDP. Meanwhile, John Maynard Keynes gave a new and important contribution to the economic thought calling up a more active role of government in economics; obviously, this needed to be supported by the essential contribution of the data relative to the economic transactions of the country. It was by the end of the Second World War that GDP was finally established.

Soon after, the debate on GDP criticism arose, Kuznets, for example, tried to warn that the well-being of a nation could have been scarcely inferred from a measurement of national income defined as GDP (Kuznets, 1934). These were the main reasons:

- Interpreting GDP as a standard of living measure is based on the assumption that income is correlated with well-being at a national level. This implies that, *ceteris paribus*, economic growth determines a proportional increase in well-being.

- GDP doesn't account for income distribution within the population of a country. Countries with high poverty levels, but with a rich elite and high levels of exports, can have a GDP similar to the one of a country where income is more equally distributed among population[5].

- GDP considers all transactions as positive, so that damages caused by criminality, pollution, natural catastrophes all contribute to its growth. In this way

[4]In Adam Smith's times this could have been probably admissible because what was called 'market' occupied only a small part of social and environmental domain. Environment seemed to have an infinite capacity to produce resources and to absorb wastes, while the social structure was solid enough and founded on history not to be eroded by market growth.

[5]In fact, in 2005 although Botswana's and Croatia's GDP per capita is quite similar (around 13000 US $), Croatia has a life expectancy of 75 years while in Botswana is just of 48 years.

GDP does not dfferentiate between expenditures that improve the well-being and those which, instead, are necessary to correct and compensate the effect of undesired events, whose increase determine paradoxically an increase in GDP growth (Bottazzi, 2009).

- GDP considers only monetary transactions while the value of non market activities such as household work and volunteer contributions are excluded.

The evident GDP limits and the necessity to understand complex realities pushed researchers to develop different measures for well-being. These measures can be classified into two broader categories: the first comprises the so called *corrective* measures of GDP, the second the *alternative* measures to GDP (Goossens, 2007). The measures that belong to this second category replace GDP with indicators that account for additional environmental and/or social information (e.g., health, education and equity). HDI or *Human Development Index* is the most known indicator that belongs to this category. It measures the average achievements of a country in three fundamental dimensions of human well-being (Watkins *et al.*, 2007):

- living standard, as measured by GDP per capita and adjusted for the local cost of living measured in Purchasing Power Parity dollars (PPP$);
- a long and healthy life, measured by life expectancy at birth;
- knowledge[6].

Nevertheless, HDI does not cover ecological sustainability, and it is being criticized for not appropriately considering people's perception of life that, as we will see later, is the key element of the indicator we want to present in this study: the Happy Planet Index.

3 Wealth, Well-being and Happiness

The notion of well-being is a broad concept that encompasses many elements, nevertheless, we are used to a notion that considers well-being just as a matter of monetary wealth.

According to Pigou's theorization, an income increase, or an improvement in monetary wealth, implies a proportional increase in people's happiness (Bruni and

[6] As measured by the adult literacy rate and the combined primary, secondary and tertiary gross enrollment ratio (Watkins et al., 2007).

Porta, 2004). This is nowadays the most common justification to the claim that GDP provides truthful indications of a community's happiness and well-being. The objective of income maximization is perceived although we all know that people's happiness does not depend exclusively on economic factors: indeed, it depends even from non-market factors. Modern economy is founded on the belief that richer people are healthier, live longer, record lower infant mortality rates, have a better access to goods and services and are more educated.

Contemporary economics, in its models and results, depends on a fundamental assumption: rationality. Economic agents are supposed to have coherent preferences towards alternative choices, so, they are supposed to be able to give a preference order to alternative choices without any contradiction (Samuelson, 1948). Consumer behavior is then exclusively deducted from the choice she makes rather than from the content of her preferences. The consumer, a rational agent, will make her choices maximizing her utility, which is a function of her preferences (under some constraints: e.g., income). The theory of revealed preferences, together with the assumption of rationality of individuals, confirms that choice is implicit in consumers' preferences (Pasinetti, 2005). Nobel Prize, Amarthya Sen affirms that a purely formal rationality describes the behavior of 'rational fools' (Sen, 1977) and that a detailed analysis on contents rather then a formal preference coherence is necessary. A more substantial definition of rationality puts emphasis on the real objective that each individual wish to reach: the well-being.

A lot of empirical proofs demonstrates that high levels of monetary wealth does not always guarantee high levels of well-being. This is true especially in high income countries where subjective well-being does not increase or even decreases, even though per capita income grew up in the last decades. This paradox is reinforced by the fact that income's inefficacy in securing happiness has not caused a drastic decrease in working hours. According to the American economist and demographer, Richard Easterlin (Easterlin, 1974), happiness paradoxes originate from the fact that people, in the attempt of maximizing their well-being, invest too many resources in increasing material consumption: that, dispite improving *happiness* and satisfaction levels, creates negative externalities in other life facets that strongly influence happiness (Kahneman, 2000).

3.1 Measuring happiness

The expression 'happiness of a population' defines an intangible and not directly observable concept, consequently it is possible to measure it through proxy variables

that are related with the concept of happiness. Among these proxies, those which have gained more importance in recent years arise from surveys conducted through questionnaires submitted to citizens to evaluate their happiness. Kahneman was one of the first supporters of this method to quantify the so called 'objective happiness', defined as '*the result of individual instantaneous utilities measurement in a certain amount of time*' (Kahneman, 2000). From this definition, we can consider happiness as something that we have inside ourselves and that could be evaluated through asking people how they judge their life as a whole. Questions on happiness' self perception can be asked in different ways: directly or indirectly; through more than one question and in different contexts (e.g., biographies, questionnaires or interviews). Many empirical studies have proved these measures as valid, reliable and highly correlated with objective indicators such as good mood frequency, probability of committing suicide and a long life (Veenhoven, 2007). On the other hand, while empirical literature makes an extensive use of subjective data on life satisfaction, doubts on their reliability emerge mainly in international comparisons.

4 Happy Planet Index: methodology and analysis

HPI has been originally proposed with the aim of obtaining a measure of ecological efficiency that a country could maintain while providing the well-being to its population. HPI makes no explicit use of income or income-adjusted measures; utilizes both objective and subjective data[7]. HPI is given by:

$$\text{Happy Planet Index} = \frac{\text{Life Satisfaction} \times \text{Life Expectancy}}{\text{Ecological Footprint}}$$

It represents the average number of *happy life years* produced by a certain society, nation or group of nations, per unit of 'planetary' resources consumed. HPI does not indicate the happiest country on the planet, or the best place to live. Nor it indicates the most developed country in the traditional sense, or the most environmentally friendly. Nevertheless, the HPI combines these notions, providing a method of comparing countries' progress towards long-term well-being without exceeding the limits of equitable resource consumption.

As this indicator encompasses three different variables, its calculation is sometimes difficult, especially due to the lack of data regarding both life satisfaction and

[7]Considering all the new alternative measures to GDP, those which make specific use of subjective data are very few. This fact have a strong relevance as individual's life quality perception is important at least as its objective welfare (Marks et al., 2006).

ecological footprints. This work has, therefore, the objective of presenting some methodological assumptions in order to overcome this problem.

4.1 Life Satisfaction

As well as the concept of happiness, the intangible concept of life satisfaction is measured through *ad hoc* surveys aimed to ask individuals to self assess their global life satisfaction. Data used in this application come from the *World Database of Happiness* that refers mainly to the life satisfaction and subjective happiness data results of *World Value Surveys* (WVS), a large scale survey carried out from 1995 to 2005. Sample units were asked to answer the following question: '*All things considered, how satisfied are you with your life as a whole these days?*'. Answers were given on a $0-10$ Likert-type scale ranging from *not at all* to *extremely* satisfied (Veenhoven, 2008).

4.2 Life Expectancy

Life expectancy at birth is an estimate based on social, environmental and economic conditions of a country; it is calculated using, for each country, the mortality rates for different age groups. It is, then, the average number of years that a newborn has the probability to live, given the current mortality rates. World Health Organization (WHO) country-level estimates have been used in this paper.

4.3 Ecological Footprint

The Ecological Footprint (EF) is a resource accounting tool which measures the extent to which the ecological demand of human activities stays within or exceeds the capacity of the biosphere to supply goods and services. The EF measures how much land area (i.e. '*how many planets*?') is required to keep a given population at a certain level of consumption, technological development and resource efficiency (Kitzes *et al.*, 2006). It is commonly expressed in global average hectares; a global hectare is an hectare normalized in order to have the average productivity of all the lands and water biologically productive in a given year. This measure is highly informative as human resource consumption exceeds Earth biocapacity. Biocapacity per capita is calculated dividing the total Earth's biocapacity, equal to 11.2 gha (global hectares), by its inhabitants (6.3 billions in 2003). This ratio gives the average per capita amount of biocapacity available in the planet, equal to 1.8 gha. The

main source for EF at country-level is the Global Footprint Network (Wackernagel *et al.*, 2005). As we can see from the examples in Table 1, high income countries have an EF higher than its biocapacity.

Table 1: Data on biocapacity and ecological footprint 2003

	Population (millions)	Ecological Footprint (gha per capita)	Biocapacity (gha per capita)
World	6,301.5	2.2	1.8
High income countries	955.6	6.4	3.3
Medium income countries	3,011.7	1.9	2.1
Low income countries	2,303.1	0.8	0.7
United States	294.0	9.6	4.7
France	60.1	5.6	3.0
Germany	82.5	4.5	1.7
Ireland	4.0	5.0	4.8
Italy	57.4	4.2	1.0
United Kingdom	59.5	5.6	1.6

Source: Global Footprint Network

5 Sources, missing data and HPI calculation

The main aim of the analysis presented here is to update the work made by the NEF in 2006 calculating the HPI at country level and trying to overcome the big drawback of HPI, which is surely the lack of data. The final dataset used for this research comprises 178 countries, some of which (like Afghanistan, Iraq, Liberia and Somalia) were not included in the NEF analysis. The index has been calculated using data from different sources. The estimation procedures that have been necessary to obtain an updated and complete dataset will be described in details in what follows by considering each of the sub-component of the HPI.

Life Expectancy

For this sub-component, no missing data estimation has been implemented. Two different data sources have been used: for 172 countries the data are those obtained from 2005 from United Nations' *Human Development Report* (Watkins *et al.*, 2007). For the remaining 6 countries data were obtained from *World Health Statistics* (WHO, 2008).

Table 2: Regression results for Ecological Footprint estimation

Constant	0.821
	(0.000)
GDP per capita (GDPpc)	0.00011
	(0.000)
Carbon dioxide emissions (CO2)	0.148
	(0.000)
Population density (DENS)	-0.001
	(0.002)
R^2	0.91

Linear regression on a 139 countries sample; p-values in parenthesis.

Ecological Footprint

The Ecological Footprint (EF) for 144 countries is the one reported by *World Wildlife Fund* (WWF) and Global Footprint Networks *Living Planet Report 2006*. For the other countries of the dataset, missing data were estimated through a linear regression model run on a 139 countries observations (Little and Rubin, 2002).

$$EF_i = \alpha + \beta_1(\text{GDP}_{\text{pc}})_i + \beta_2(\text{CO2})_i + \beta_3(\text{DENS})_i + \varepsilon_i$$

where:

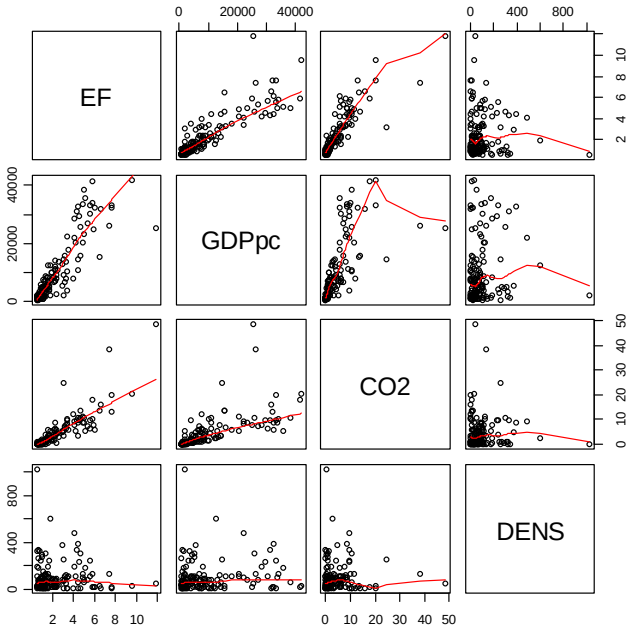
- $\text{i} = 1, \ldots, \text{N} = 139$;
- GDP_{pc} is GDP per capita expressed in dollars (PPP$) for 2005;
- CO2 represents the emissions of carbon dioxide (per capita tons);
- DENS is the population density (calculated as the ratio between number of inhabitants and the country surface).

The scatterplot matrix for the variables considered in the model are reported in Figure 1 and Table 2 reports the results obtained from the regression. Using the estimated regression coefficients, the EF has been calculated for the whole 178 countries dataset.

Life Satisfaction

The main source for the Life Satisfaction (LS) variable is the *World Database of Happiness* (Veenhoven, 2008). Unfortunately, the lack of data for many countries

Figure 1: Scatterplot Matrix for the EF estimation model



made possible to gather life satisfaction values only for 79 countries; for the others, it has been necessary to estimate. Countries to be included in the regression model where selected considering that the most of the missing data related to Africa, Asia and South America; for this reason neither European or OECD or high income countries were included in the regression model. 30 countries have been considered in the model[8]. For selecting the explanatory variables, we followed the methodological approach proposed by R. Costanza and P. Sutton. In their paper, the main assumption is that life satisfaction is influenced by natural, social and human capital of the considered country (Costanza *et al.*, 1997). The following variables were chosen:

- the *Ecosystem Services Product* (ESP). It is a measure of natural capital. For this variable a relation with life satisfaction has been assessed (Vemuri and Costanza, 2006). Data source is from Sutton and Costanza's work, these

[8] Algeria, Argentina, Armenia, Azerbaijan, Bangladesh, Brazil, Chile, China, Colombia, Dominican Republic, Egypt, El Salvador, Georgia, India, Indonesia, Iran, Jordan, Kyrgyzstan, Morocco, Nigeria, Pakistan, Peru, Philippines, South Africa, Tanzania, Uganda, Uruguay, Venezuela, Vietnam, Zimbabwe.

Table 3: Regression results for Life Satisfaction estimation

Life expectancy at birth	0.071
	(0.000)
Ecosystem Services Product (ESP)	2.991
	(0.035)
Voice and Accountability Index (VAI)	0.442
	(0.080)
R^2	0.98

Linear regression on a 30 countries sample; p-values in parenthesis.

authors calculated the index to consider the contribution of non-market resources to the well-being of the community (Costanza and Sutton, 2002). ESP is estimated using the International Geosphere-Biosphere Programme (IGBP) dataset and aggregating the values of ecosystem services per square kilometer. Multiplying the latter for the kind of Earth's surface of each country, a measure (expressed in US$) is obtained. It corresponds to the ecosystem services' value for each country. In this application the logarithm of ESP has been normalised in order to have an ESP index expressed in a $0-1$ scale;

- an indicator of government performance used as a proxy for social capital. It is calculated by World Bank in the *Governance Matters Report* (Kauffman *et al.*, 2008). This report calculates several indicators to analyse different dimensions of government's performance. For our estimation, **VAI** (*Voice and Accountability Index*) has been chosen. VAI data were available for 2007; this indicator measures citizens' perceptions of (i) their active participation in selecting government, (ii) expression, association and information freedom. Data are normalised in a $0-1$ scale;

- a proxy variable for the Human Capital (HC), **life expectancy** has been used. This is the variable used in the definition of Human Development Index (HDI) and it is also used in NEF's work as a predictor to estimate life satisfaction.

$$\mathrm{LS}_i = \beta_1(\text{Life expectancy})_i + \beta_2(ESP)_i + \beta_3(VAI)_i + \varepsilon_i$$

5.1 Calculating the HPI

HPI calculation required some adjustments in its components in order to ensure result's robustness and significance. Considering the evident difference in variable's distributions (see Figure 2), directly dividing HLY by EF would have led to the HPI being predominantly driven by EF[9]. With the basic calculation, the effect of EF becomes so overwhelming that countries with higher life expectancies actually have lower HPI scores; this can be demonstrated through the analysis of correlations. Correlations have been calculated using Bravais Pearson's linear correlation coefficient. Correlations coefficients reported in Table 4 show that if we calculate HPI as a simple ratio between HLY and EF, the effects of the latter could be overwhelming, while, if we apply the adjustments that will be described later, these unbalanced effects can be controlled. In fact, life satisfaction and life expectancy are positively correlated with adjusted HPI and EF has a negative influence on it but less than in the previous case.

Figure 2: Boxplot representation of variable's distributions

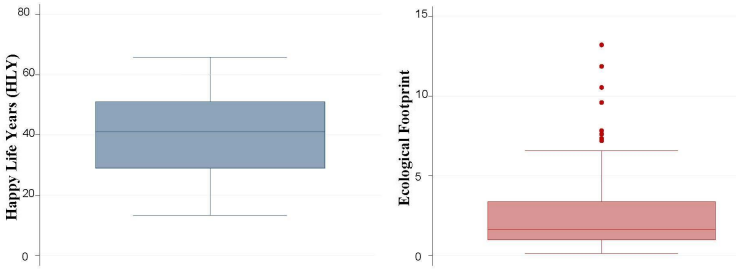


Table 4: Correlation table: differences between basic and adjusted HPI

	Life satisfaction	Life expectancy	Ecological footprint
Basic HPI	-0.11	-0.34	-0.66
Adjusted HPI	0.67	0.56	-0.19

[9]The latter varies between a maximum score of 13.20 gha for Qatar and a minimum of 0.13 gha for Afghanistan (a factor of 101), while HLY vary between Swiss 65 years and 13 years for Zimbabwe (a factor of 5). Doubling the EF value of Afghanistan has not the same implication of doubling its HLY, which are 14; it should be reminded that a footprint value of 0.26 is well under the EF average score of the considered countries (2.52 gha).

Table 5: Goalposts scheme

	Life satisfaction	Life expectancy	Ecological footprint
Min	0	25	0
Max	10	85	15

The algorithm used by NEF, that is here reproduced, can be described as it follows: firstly, all the HPI's components are normalized. Indexes on a $0-1$ scale are obtained by a normalization. A minimum and a maximum "goalpost" are fixed for each variable (Table 5). The normalization for each variable is:

$$\text{Index } 0 \text{ - } 1 = \frac{\text{Observed value} - \text{MIN}}{\text{MAX} - \text{MIN}}$$

The result takes us to have indexed happy life years or HLI (Happy Life Index) and an index for ecological footprint, both characterized by a similar standard deviation (respectively 0.17 and 0.15) but with a different average (respectively 0.43 and 0.17). This difference cause the problem of ecological footprint overestimation on our indicator, as said previously. To correct for this effect, as in the reference paper, a constant is added to the ecological footprint index in order to have the same coefficient of variation for EF and HLI distribution. This constant was chosen as equal to 0.20 and does not imply any variation in countries' rankings. Finally, HLI has been divided by the "adjusted" EF index; this sprung values for HPI ranging between 0.34 and 2.24. Such results are not very appealing to work with; so HPI was normalized as well in order to have a $0-100$ range[10]. In Table 6 the steps for the HPI calculation are shown for some countries. To summarize:

1. all variables have been normalized to obtain $0-1$ indexes;
2. EF index has been adjusted with an additive arbitrary constant, to correct for EF effects' overestimation on HPI;
3. HPI has been calculated as a ratio of HLI (Indexed Happy Life Years) and the adjusted EF index;
4. HPI has been normalized to range between 0 and 100.

[10]In the reference paper, if a country has a life satisfaction score of 9, a life expectancy of 85 years and a footprint of 1.8 gha, scores a HPI equal to 100.

Table 6: HPI calculation for some countries

Country	Life Satisfaction	Life Expectancy	Ecological Footprint	HLY
France	6.53	80.20	5.63	52.37
Germany	7.17	79.10	4.55	56.71
Italy	6.89	80.30	4.15	55.33
United Kingdom	7.11	79.00	5.59	56.17
United States	7.41	77.90	9.59	57.72

Country	HLI	EF Index	Adjusted EF Index (+0.20)	HPI	HPI (0-100)
France	0.60	0.38	0.58	1.04	37.18
Germany	0.65	0.30	0.50	1.28	49.82
Italy	0.64	0.28	0.48	1.33	52.29
United Kingdom	0.64	0.37	0.57	1.12	41.01
United States	0.65	0.64	0.84	0.78	23.22

6 Some comparisons

In this section we provide some between-countries comparisons for HPI. For ease of explanation, HPI and its component values have been associated to the colors of the traffic lights: red will identify worst performances, while yellow and green will indicate countries with average and good performances, respectively. To make this association possible, the variables have been categorized:

- Life Satisfaction categories represent the bottom, middle and top third of the distribution.
- Life Expectancy categories are based on the UN's own categorization of low, medium and high HDI scores.
- Ecological Footprint categories are based on the definition of Earth's biocapacity, with the world's resources shared equally amongst its population: 1.8 gha. A Footprint of 1.8 represents one planet living.

In Figure 3, happy life years are represented *versus* ecological footprint for all the countries of the dataset, clustered by continent. Chart's area is colored according to the categorization described above. As it can be seen, there is no country placed in the green area (that expresses high levels of HLY and low scores of EF). Immediately below the green area, we have Colombia, Maldives and Chile which are countries with the highest HPI score and which are ranked in the top three position of HPI ranking. Most countries are placed in the yellow and red area illustrating how challenging is to deliver high levels of well-being in an ecologically efficient way. Among these we can make important distinctions. African countries have prevalently low EF scores and few HLY; European countries are mainly placed in the intermediate area showing that they can provide quite high levels of well-being (expressed in terms of HLY) in an ecological inefficient way. Very significant are outliers' performances: countries with the highest EF are United Arab Emirates and Qatar (respectively among 12 and 13 gha) against a modest value for HLY. Among the outliers, there are even the United States that maintain very high well-being levels by consuming an amount of resources that is 5 times what our planet can produce; finally, Luxembourg have a HLY score higher than the United States' one but with a resource consumption 6 times higher then our planet's biocapacity.

Concluding, we can say that, in absolute terms, no country in the world has achieved the objective of assuring high well-being standards accounting for environment importance and sustainability. The following part of this Section is dedi-

cated to the countries' evaluation in terms of HPI, to the interpretation of obtained rankings and, finally, to the comparison between these rankings and the classifications obtained for other indicators.

6.1 Rankings

The complete countries classification on the values of HPI is available in the Appendix. Here we report some remarks on special subsets of countries.

6.1.1 Best performers

In 2006 work by NEF (Marks *et al.*, 2006), the first positions of the HPI ranking were occupied by island countries (e.g., Vanuatu), many Caribbean and South America countries. Our updated index shows that the situation is not changed too much. Colombia was in the second position in NEF's classification, while here is in the first. The ranking of Maldives, Dominican Republic, Saint Vincent and the Grenadines and Saint Lucia confirms that islands perform quite well[11].

6.1.2 Worst performers

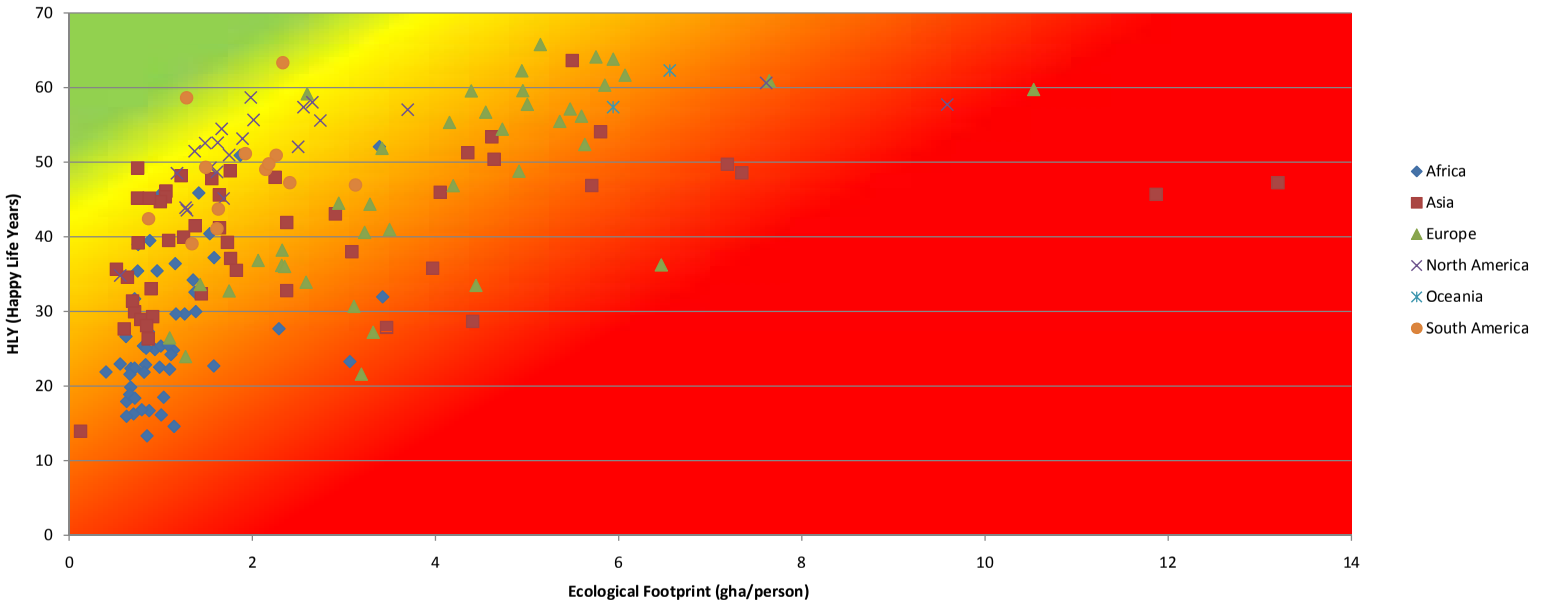
Worst performers are mainly the poorest African countries and Afghanistan. Among these, Qatar's 170th position has to be evidenced; besides its high levels of life satisfaction and longevity, it shows a too high EF score.

6.1.3 OECD performances

From the analysis of the performances for OECD countries (see Appendix), it emerges that the EF values counterbalance the high country performances either in life satisfaction and in longevity (that for all these countries are high and above the world average). Within the OECD group the best performers are Mexico, Switzerland, Netherlands, Austria and Italy. Last ranks are unexpectedly assigned to countries that are usually considered as the best performers for living standards: Canada, Finland, United States and Luxembourg. As we can see from Table 8, they score well in terms of life expectancy and satisfaction but they are not capable to achieve these high scores in an environmentally efficient manner. As a consequence, these countries are not just found at the bottom of OECD classification but score very low positions in the general classification.

[11] For further deepening on NEF paper (Marks et al., 2006).

Figure 3: Missing the green target



	Blood red	Red	Yellow	Green
Life Satisfaction		<5.2	5.2-6.6	6.6>
Life Expectancy		<60	60-75	75>
Ecological Footprint	> 5 planets	>2 planets	1-2 planets	<1 planets

6.2 Maps

6.2.1 World

Figure 4 maps the Happy Planet Index geographic distribution. What appears more evident from the map is the prevalence of countries with low and very low HPI scores. This happens mainly in African, Asian and Eastern European countries but it occurs also in developed countries such as Canada and the United States (the Appendix reports the general classification for HPI). Nevertheless, countries that score medium/high HPI levels are prevalently emergent economies of South-Eastern Asia, the majority of Central and Southern American countries, some North African and Western Europe countries.

Before analyzing jointly HPI and other well-being indicators, it is useful to present also the map projections for GDP per capita and Human Development Index. These exhibit how the picture changes according to the measure adopted. Figure 5 clearly shows that countries with highest economic well-being are the European ones, together with Australia, Japan, Canada and United States. Nevertheless, according to the previous map the same countries were instead scoring low or even very low HPI values. It is also true, though, that many poor countries have also quite low HPI scores. It can be deducted that HPI assess countries' performances in a substantially different way than the GDP does and, consequently, classifications obtained may be very different.

For Human Development Index, the map projection is more similar to the one obtained from HPI than from GDP. Most developed countries according to HDI are Iceland, Norway, Switzerland and Ireland; according to HPI, their score are quite low. Switzerland, which is the country that among these scores the higher HPI, is at the 55th position of the general ranking.

Figure 4: HPI in the world

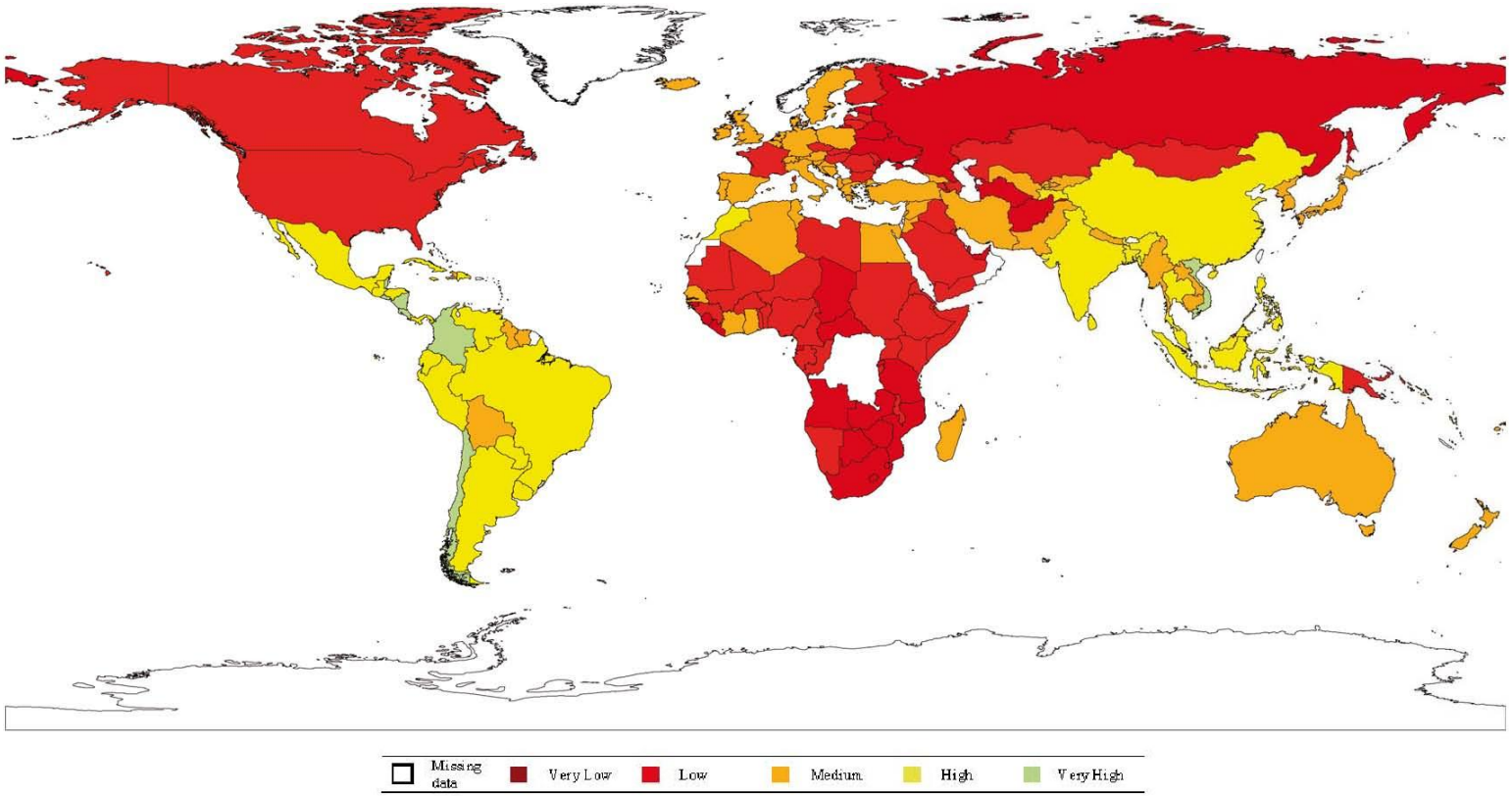


Figure 5: GDP per capita in the world

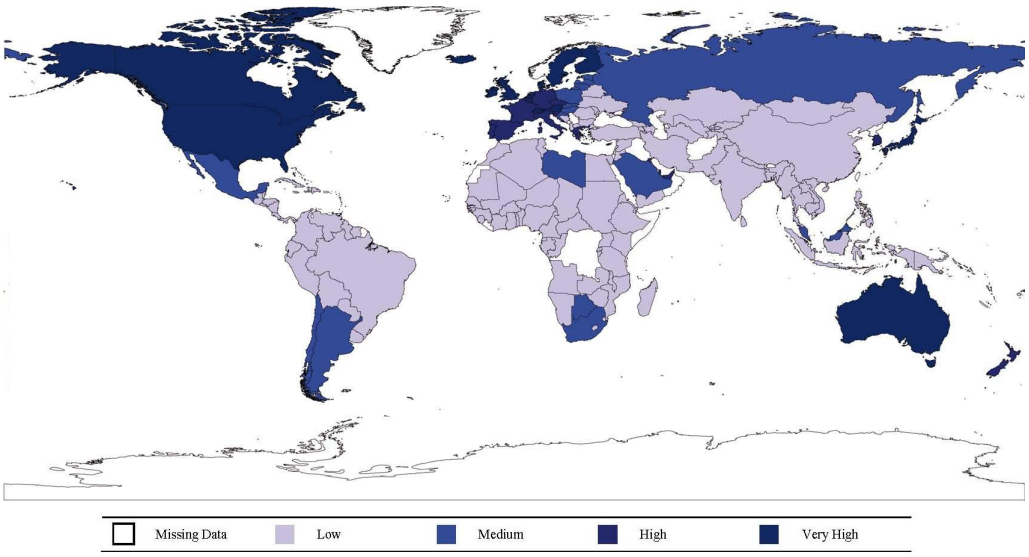
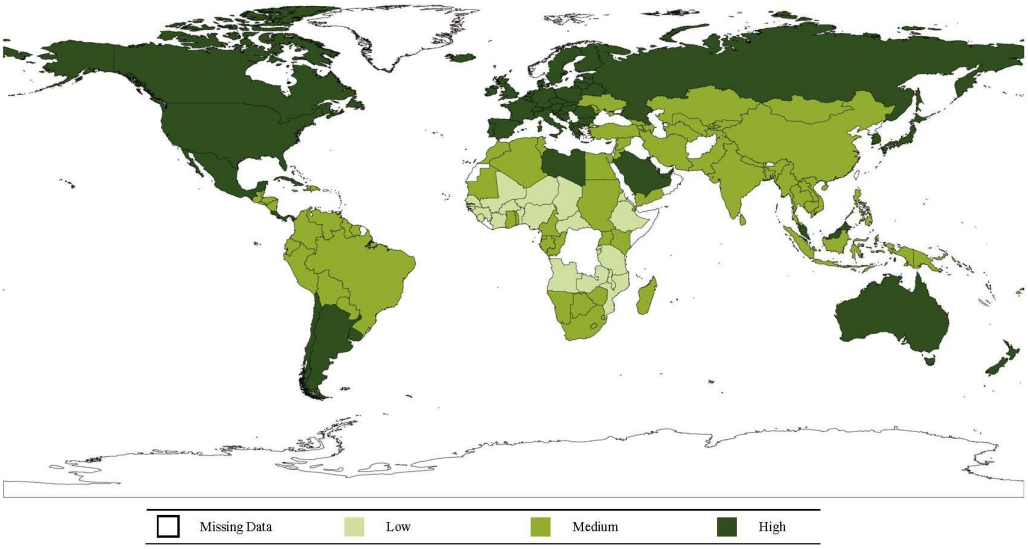


Figure 6: HDI in the world



6.3 HPI, HDI and GDP: comparisons between rankings

In this section we present a more formal comparison between HPI, HDI and GDP. In the Appendix, classifications are shown for all the analyzed countries together with a comparison between them so that for each country we can detect how many positions is loosing or gaining according to the classification we consider. This comparison has been simply made through differences between ranks:

$$\text{HPI compared to GDP} = \text{HPI rank} - \text{GDP rank}$$

$$\text{HPI compared to HDI} = \text{HPI rank} - \text{HDI rank}$$

The results are interpreted as follows:

Negative value: when the country is ranked higher in HPI classification than in the other indicator;

Null value: when the country is equally ranked in both classification we are comparing;

Positive value: when the rank associated with a certain country is higher for GDP or HDI classification than for the HPI ranking position.

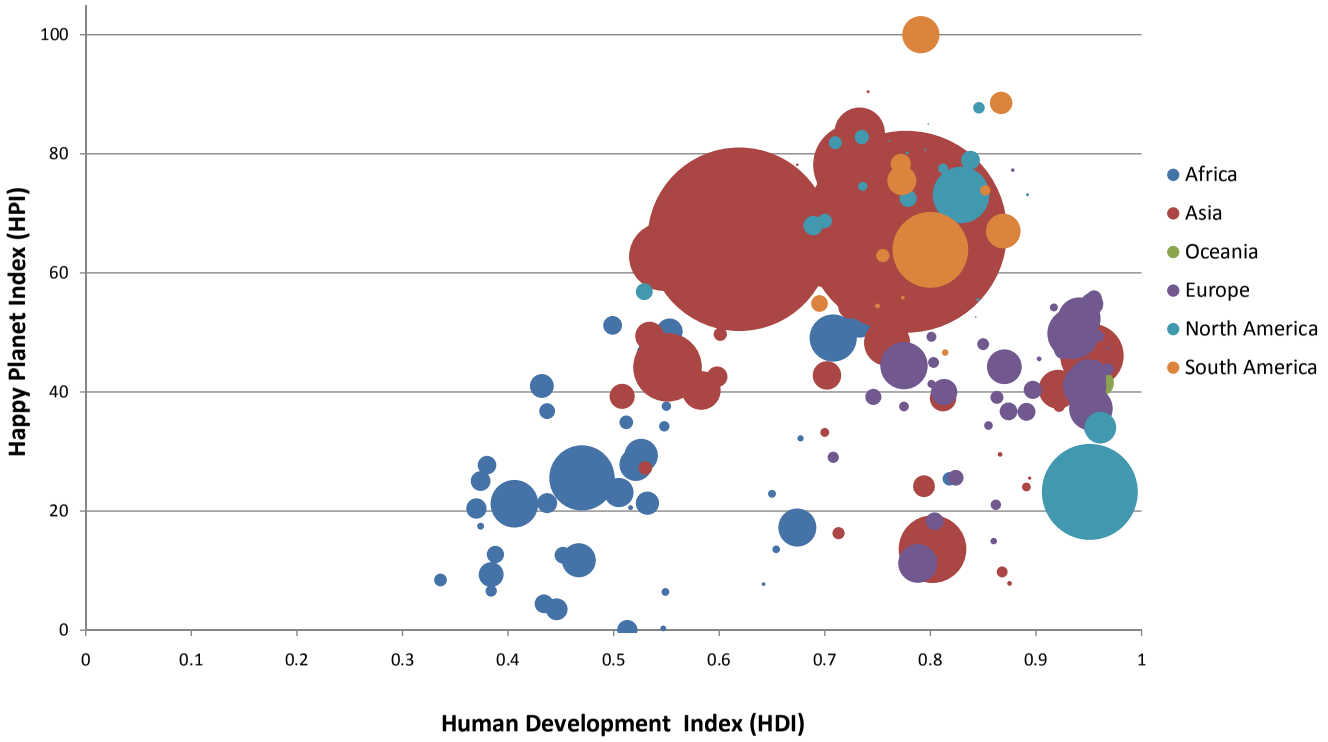
6.3.1 HPI vs HDI

In Figure 7 we represent the United Nation grouping for HDI scores (three clusters respectively for low, medium and high human development); there is concordance between the two rankings for those countries that register low scores for both HDI and HPI. For countries that, instead, HPI scores are high, the corresponding level of human development is medium. Finally, many countries with very high HDI scores perform poorly according to HPI.

To verify the concordance or discordance between the classifications, the Spearman's ρ_s coefficient has been calculated[12]; ρ_s coefficient shows a positive association between Happy Planet Index and HDI rankings (equal to 0.24).

[12]Numerous countries had the same modality for HDI scores; for this reason to each of them we have assigned a mid-rank.

Figure 7: HPI vs. HDI for world countries



Dot size represents population.

6.3.2 HPI vs GDP

Figure 8 shows a scatterplot that represents countries clustered according to their continent and differentiated for population density. The aim of this graphical representation is to show the relationship between the two variables: nevertheless, the relation pattern is not so clear. For levels of GDP per capita below the threshold of 10000$ PPP we have both low and high scores for HPI. For higher GDP per capita levels HPI scores are constant, while, over 30000$ they decrease.

It is now necessary to measure the level of concordance between the ranking results obtained for the two indicators: for this, Spearman's rank correlation coefficient and Spearman's ρ_s has been calculated. Even if the interpretation of this coefficient is not straightforward, it is possible to consider that a ρ_s coefficient equal to 0.12 shows that there is a poor association between the two classifications.

7 Final Remarks

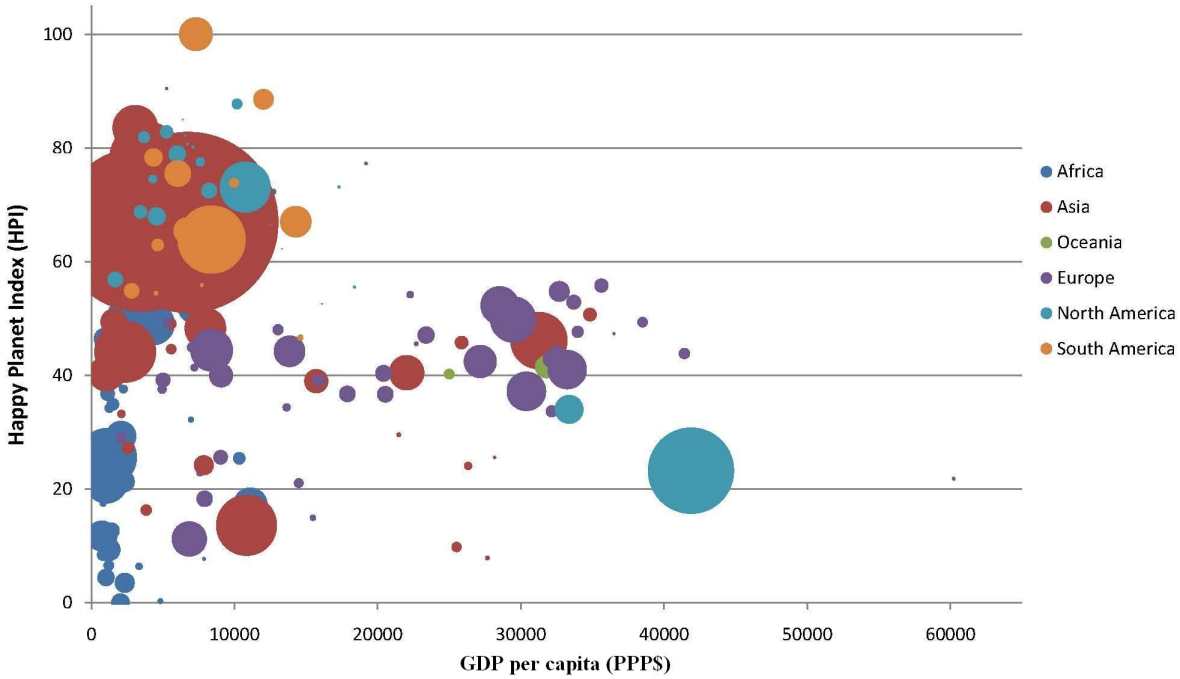
In this paper, through the reconstruction of the HPI, we attempt to underline the limits of GDP in determining a nation's well-being. Besides its accuracy in measuring the monetary domain and its ease of interpretation, GDP shows drawbacks in assessing the broadest significance of well-being. As we have seen, GDP does not consider relevant aspects as environment and its sustainability, the community and its happiness.

We have briefly presented an overview on the attempts to go beyond GDP brought by the studies on happiness; these represent a harsh critic to the claims of the so called 'more is better' economy, mainly thanks to the empirical evidence that demonstrate an increase in income does not always imply a proportional increase in well-being.

Starting from this theoretical framework, we focused our attention to the measurability of happiness through subjective evaluation on happiness or on life satisfaction. Even if this measurement method shows evident limits, there is a vast consensus on the fact that a subjective measure is capable to capture more information than an objective one.

HPI has been considered as a measure of well-being. Its main limit was that it was difficult to calculate for many countries because of the missing data; therefore, in this work a considerable effort was devoted to implement a method to obtain estimates for those missings. Furthermore, it has been necessary to adjust and normalize the data in order to get easy to interpret values of HPI characterized by a

Figure 8: HPI vs. GDP per capita for world countries



Dot size represents population.

correct balance of the component variables. The results obtained from our empirical analysis can be summarized as follows:

- no one country manages to reach the "green area", characterized by high well-being levels, expressed in terms of happy life years, and by a low footprint score; good performances are mainly overruled by countries' incapacity to maintain high living standards, and at the same time to ensure environment sustainability. This is particularly true for the high income and industrialized countries such as OECD ones.

- comparing our indicator with GDP, it has been demonstrated that there isn't any clear relation between them and, consequently, the association between the resulting countries' classifications is null. Analogous results have been obtained from the comparisons between HPI and Human Development Index.

From these results we can conclude that HPI is effectively a measure that does not reflect the same reality the GDP illustrates. Instead, it provides important information that shouldn't be ignored when analyzing well-being in its broader meaning. While GDP still represents a valid measure of monetary wealth, it is worth putting effort in producing more accurate data on the behavior of important variables such as life satisfaction.

A Ranking and analysis

Table 7: Rank analysis for HPI

Country	Rankings			Comparisons between ranks	
	HPI	GDP	HDI	HPI-GDP	HPI-HDI
Colombia	1	78	74	-77	-73
Maldives	2	98	100	-96	-98
Chile	3	54	38.5	-51	-35.5
Costa Rica	4	60	47.5	-56	-43.5
Dominica	5	89	67	-84	-62
Viet Nam	6	121	104	-115	-98
El Salvador	7	99	100	-92	-93
Saint Vincent and the Grenadines	8	88	92.5	-80	-84.5
Nicaragua	9	115	108.5	-106	-99.5
Saint Lucia	10	86	67	-76	-57
Belize	11	80	80	-69	-69
Kiribati	12	-	-	-	-
Cuba	13	93	50.5	-80	-37.5
Ecuador	14	109	87	-95	-73
Vanuatu	15	120	119	-105	-104
Indonesia	16	112	104	-96	-88
Sri Lanka	17	105	100	-88	-83
Philippines	18	100	87	-82	-69
Panama	19	76	61	-57	-42
Malta	20	36	34.5	-16	-14.5
Peru	21	92	87	-71	-66
Sao Tome and Principe	22	131	122.5	-109	-100.5
Jamaica	23	111	100	-88	-77
Uruguay	24	61	47.5	-37	-23.5
Barbados	25	39	31.5	-14	-6.5
Mexico	26	58	52	-32	-26
Dominican Republic	27	68	80	-41	-53
Mauritius	28	51	67	-23	-39
Samoa	29	90	74	-61	-45
Tonga	30	69	55	-39	-25
Cape Verde	31	94	100	-63	-69
Honduras	32	117	113	-85	-81
Morocco	33	107	122.5	-74	-89.5
Guatemala	34	106	116	-72	-82
Argentina	35	46	38.5	-11	-3.5
China	36	85	80	-49	-44
Antigua and Barbuda	37	52	55	-15	-18
India	38	116	126	-78	-88
Comoros	39	141	131	-102	-92
Venezuela	40	87	74	-47	-34
Brazil	41	66	67	-25	-26
Paraguay	42	104	92.5	-62	-50.5
Bangladesh	43	137	135	-94	-92
Grenada	44	74	80	-30	-36
Saint Kitts and Nevis	45	49	55	-4	-10
Thailand	46	64	80	-18	-34
Malaysia	47	56	61	-9	-14
Tajikistan	48	151	119	-103	-71
Tunisia	49	67	87	-18	-38
Solomon Islands	50	140	128	-90	-78
Kyrgyzstan	51	142	113	-91	-62
Haiti	52	145	141.5	-93	-89.5
Fiji	53	91	92.5	-38	-39.5
Suriname	54	75	87	-21	-33
Switzerland	55	6	5	49	50
Bahamas	56	37	47.5	19	8.5
Bolivia	57	122	113	-65	-56
Netherlands	58	12	10.8	46	47.2
Guyana	59	108	96	-49	-37
Syria	60	114	106	-54	-46
Slovenia	61	31	26	30	35
Austria	62	9	10.8	53	51.2
Seychelles	63	40	50.5	23	12.5
Italy	64	21	20	43	44
Algeria	65	81	104	-16	-39

Table 7 – continue from previous page

Table 7 – continue from previous page

Country	Rankings			Comparisons between ranks	
	HPI	GDP	HDI	HPI-GDP	HPI-HDI
Senegal	66	144	151.5	-78	-85.5
Hong Kong, China (SAR)	67	7	20	60	47
Ghana	68	125	135	-57	-67
Germany	69	20	20	49	49
Laos	70	138	128	-68	-58
Nepal	71	147	141.5	-76	-70.5
Ireland	72	4	5	68	67
Albania	73	97	67	-24	6
Jordan	74	96	87	-22	-13
Egypt	75	110	108.5	-35	-33.5
Iran (Islamic Republic of)	76	70	92.5	6	-16.5
Croatia	77	50	47.5	27	29.5
Denmark	78	8	10.8	70	67.2
Iceland	79	5	1.5	74	77.5
Georgia	80	118	96	-38	-16
Greece	81	29	23.5	52	57.5
Trinidad and Tobago	82	44	61	38	21
Madagascar	83	166	141.5	-83	-58.5
Japan	84	17	10.8	67	73.2
Israel	85	26	23.5	59	61.5
Cyprus	86	30	28.5	56	57.5
Bosnia and Herzegovina	87	82	67	5	20
Lebanon	88	95	87	-7	1
Turkey	89	65	80	24	9
Poland	90	47	38.5	43	51.5
Pakistan	91	126	135	-35	-44
Sweden	92	13	5	79	87
Norway	93	3	1.5	90	91.5
Belgium	94	15	10.8	79	83.2
Uzbekistan	95	136	113	-41	-18
Cambodia	96	123	128	-27	-32
Spain	97	24	10.8	73	86.2
Korea (Democratic People's Republic of)	98	-	-	-	-
Australia	99	16	5	83	94
Macedonia	100	79	67	21	33
United Kingdom	101	11	10.8	90	90.2
Côte d'Ivoire	102	146	162	-44	-60
Korea (Republic of)	103	32	26	71	77
Portugal	104	35	28.5	69	75.5
Myanmar	105	163	130	-58	-25
New Zealand	106	28	20	78	86
Romania	107	62	61	45	46
Yemen	108	165	148.5	-57	-40.5
Azerbaijan	109	101	96	8	13
Slovakia	110	41	43.5	69	66.5
Saudi Arabia	111	42	61	69	50
Gambia	112	143	151.5	-31	-39.5
Singapore	113	19	26	94	87
Mauritania	114	130	135	-16	-21
Armenia	115	102	80	13	35
France	116	18	10.8	98	105.2
Benin	117	158	159.5	-41	-42.5
Hungary	118	38	38.5	80	79.5
Czech Republic	119	34	31.5	85	87.5
Togo	120	148	148.5	-28	-28.5
Latvia	121	48	43.5	73	77.5
Congo	122	152	135	-30	-13
Canada	123	10	5	113	118
Finland	124	14	10.8	110	113.2
Mongolia	125	133	113	-8	12
Gabon	126	83	117	43	9
Iraq	127	-	-	-	-
Bahrain	128	33	38.5	95	89.5
Sudan	129	135	141.5	-6	-12.5
Moldova	130	134	108.5	-4	21.5
Somalia	131	-	-	-	-
Kenya	132	154	145.5	-22	-13.5
Mali	133	162	167.5	-29	-34.5
Guinea	134	128	156	6	-22
Papua New Guinea	135	124	141.5	11	-6.5
Eritrea	136	160	153	-24	-17

Table 7 – continue from previous page

Table 7 – continue from previous page

Country	Rankings			Comparisons between ranks	
	HPI	GDP	HDI	HPI-GDP	HPI-HDI
Bulgaria	137	63	55	74	82
Nigeria	138	159	154.5	-21	-16.5
Brunei Darussalam	139	22	31.5	117	107.5
Libya	140	59	55	81	85
Niger	141	169	170	-28	-29
Kazakhstan	142	73	74	69	68
Kuwait	143	25	31.5	118	111.5
United States of America	144	2	10.8	142	133.2
Uganda	145	149	148.5	-4	-3.5
Namibia	146	77	122.5	69	23.5
Luxembourg	147	1	20	146	127
Malawi	148	172	159.5	-24	-11.5
Cameroon	149	129	141.5	20	7.5
Ethiopia	150	161	163.5	-11	-13.5
Burundi	151	171	163.5	-20	-12.5
Lithuania	152	45	43.5	107	108.5
Djibouti	153	132	145.5	21	7.5
Burkina Faso	154	156	170	-2	-16
Belarus	155	71	67	84	88
Guinea-Bissau	156	167	170	-11	-14
South Africa	157	55	119	102	38
Turkmenistan	158	113	108.5	45	49.5
Estonia	159	43	43.5	116	115.5
Russia	160	57	67	103	93
Botswana	161	53	122.5	108	38.5
Liberia	162	-	-	-	-
Chad	163	150	165	13	-2
Rwanda	164	157	157.5	7	6.5
Tanzania (United Republic of)	165	170	154.5	-5	10.5
Ukraine	166	84	74	82	92
United Arab Emirates	167	27	38.5	140	128.5
Mozambique	168	153	167.5	15	0.5
Sierra Leone	169	168	172	1	-3
Qatar	170	23	34.5	147	135.5
Equatorial Guinea	171	72	125	99	46
Central African Republic	172	155	166.5	17	5.5
Lesotho	173	119	135	54	38
Afghanistan	174	-	-	-	-
Zambia	175	164	161.5	11	13.5
Angola	176	127	157.5	49	18.5
Swaziland	177	103	135	74	42
Zimbabwe	178	139	148.5	39	29.5

HDI ranking was obtained considering countries with the same rank.

Table 8: OECD ranking according to HPI

Rank	Country	Life Satisfaction	Life Expectancy	Ecological Footprint	HPI
1	Mexico	7.59	75.60	2.56	73.09
2	Switzerland	8.09	81.30	5.15	55.78
3	Netherland	7.52	79.20	4.39	54.76
4	Austria	7.84	79.40	4.94	52.85
5	Italy	6.89	80.30	4.15	52.29
6	Germany	7.17	79.10	4.55	49.82
7	Ireland	7.60	78.40	4.95	49.35
8	Denmark	8.23	77.90	5.75	47.66
9	Iceland	7.83	81.50	5.94	47.32
10	Greece	7.32	78.90	5.00	47.08
11	Japan	6.23	82.30	4.35	46.10
12	Turkey	5.16	71.40	2.06	44.42
13	Poland	5.90	75.20	3.29	44.22
14	Sweden	7.66	80.50	6.07	43.89
15	Norway	7.56	79.80	5.85	43.82
16	Belgium	7.25	78.80	5.47	42.81
17	Spain	6.89	80.50	5.36	42.43
18	Australia	7.70	80.90	6.56	41.48
19	United Kingdom	7.11	79.00	5.59	41.01
20	South Korea	5.90	77.90	4.05	40.46
21	Portugal	6.03	77.70	4.19	40.35
22	New Zealand	7.19	79.80	5.94	40.21
23	Slovakia	5.47	74.20	3.23	39.09
24	France	6.53	80.20	5.63	37.18
25	Hungary	5.62	72.90	3.50	36.73
26	Czech Republic	6.43	75.90	4.91	36.66
27	Canada	7.55	80.30	7.61	34.01
28	Finland	7.72	78.90	7.64	33.67
29	United States	7.41	77.90	9.59	23.22
30	Luxembourg	7.62	78.40	10.53	21.82

Values in bold were obtained through estimates.

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Finito di stampare nel mese di Maggio 2010
Presso **studiografico&stampadigitale Copy Right**
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ISBN 978-88-84-67-581-1